RADIO BOOKS

Tape and Wire Recording. A selection of articles reprinted from the pages of *The Radio Constructor*, covering both the theory and practical applications. A really useful book on this latest development of the hobby. 3/– *post* 3d.

Receivers, Preselectors and Converters. Practical articles, again reprinted from past issues of *The Radio Constructor*, which will prove of interest to many radio enthusiasts. 2/6 *post* 3d.

TV Fault Finding. Profusely illustrated with photographs taken from a televisor screen depicting the faults under discussion, and containing a wealth of technical information, with circuits, enabling those faults to be eradicated. 5/– *post* 4d.

F.M. Tuner Units for Fringe and Local Area Reception. Including optional Tuning Indicator and circuit of Osram 912 Amplifier. 2/– *post* 2d.

Radio Amateur Operator's Handbook. An indispensable aid to the amateur transmitter and listener, containing all details of information which are constantly required. Prefix Lists, Zone Boundaries, Call Areas, Codes, and Mileage Tables, together with Maps and much other useful operating data. **1956 edition** 3/– *post* 3d.

Inexpensive Car Radio. In which two versions, one constructed from surplus and one from new components, are described. 1/6 *post* 2d.

Radio Control for Model Ships, Boats and Aircraft, by F. C. Judd, G2BCX. A comprehensive work on this fascinating subject.

Standard edition, **8/6** *post* 5d.

Cloth bound edition, **11/6** *post* 7d.

All available from your local bookseller, or from

DATA PUBLICATIONS LTD

57 MAIDA VALE LONDON W9

Telegrams **Databux London** *Telephone* **CUNningham 6141** *(2 lines)*

Printed in Great Britain for the Proprietors and Publishers Data Publications Ltd., 57 Maida Vale, London, W.9, *by* A. Quick & Co. Ltd., Oxford House, Clacton-on-Sea, England. *Is obtainable abroad through the following:* Collets Subscription Service, Continental Publishers & Distributors Ltd., William Dawson & Sons Ltd. *Australia and New Zealand:* Gordon & Gotch Ltd. *South Africa:* Central News Agency. *U.S.A.:* Gilfer Associates. *Holland:* "Radio Electronica." *Registered for transmission by Magazine Post to Canada (including Newfoundland).*

CHALLENGER FM TUNER, Part 2

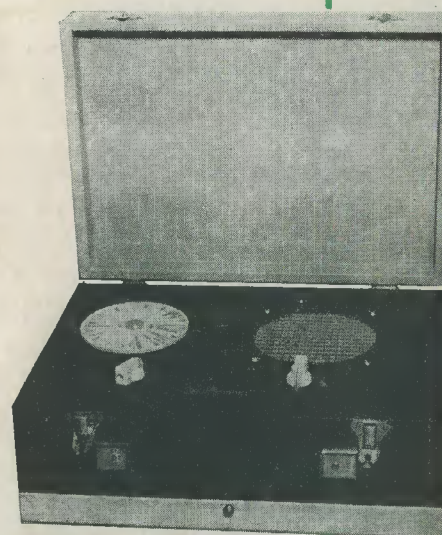
VOLUME 9
NUMBER 12
JULY 1956

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

BUILDING THE HIWAYMAN PORTABLE

by **P. VERNON**



Also in this issue

ACCURATE LOW VALUE CAPACITY METER
EFFECTS WITH A TAPE RECORDER, Part 2
TELEVISION for the HOME CONSTRUCTOR, Part I
PORTABLE RADIO-TELEPHONE
USING VHF ACORNS · DESIGN CHARTS, No. 7
and all the usual features

DATA Publications 1/9

THE MODERN BOOK CO

The Radio Amateur's Handbook. By A.R.R.L. **30s. 0d.** *Postage 1s. 3d.*

The 3rd Audio Anthology. Published by Radio Magazines Inc. **20s. 0d.** *Postage 1s.*

Radio Handbook. By W. I. Orr. **60s. 0d.** *Postage 1s.*

Sweep and Marker Generators for Television and Radio. By R. G. Middleton. **20s. 0d.** *Postage 1s.*

Basic Audio Course. By D. C. Hoefler. **22s. 0d.** *Postage 1s.*

The Practical Electrician's Pocket Book 1956. **5s. 0d.** *Postage 6d.*

Making and Using a Telescope. By H. P. Wilkins and P. Moore. **12s. 6d.** *Postage 6d.*

T.V. Fault Finding Data Book No. 5. **5s. 0d.** *Postage 4d.*

The Services Textbook of Radio. Vol. 3. "Electronics." **12s. 6d.** *Postage 9d.*

A Beginner's Guide to Radio. By F. J. Camm. **7s. 6d.** *Postage 6d.*

Audio Handbook No. 5. The Quest for Quality. By N. H. Crowhurst. **6s. 0d.** *Postage 4d.*

Audio Handbook No. 4. Public Address. By N. H. Crowhurst. **4s. 6d.** *Postage 4d.*

The Oscilloscope at Work. By A. Haas and R. W. Hallows. **15s. 0d.** *Postage 6d.*

Radio Valve Data. Compiled by the *Wireless World.* **3s. 6d.** *Postage 6d.*

We have the Finest Selection of British and American Radio Books in the country

Complete list on application

19-23 PRAED STREET (Dept RC) LONDON W2

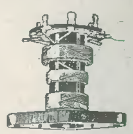
Telephone PADdington 4185

BAND III CONVERTER COIL KITS

Mk. 1, a two-valve converter for use with TRF or Superhet TV receivers. Complete set of coils, with wiring diagram and alignment instructions, **15/–**

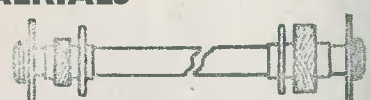
Mk. 2, a two-valve cascode converter (see October issue). Set of coils, complete with wiring diagram and alignment instructions, **17/6**

SUPER INDUCTOR COILS · MINIATURE DUST CORE TYPES



Selective crystal diode coil type HAX, 3/– (MW); HAX L, 3/6 (LW). Dual wave TRF coils, with adjustable iron dust cores, type A/HF, 7/- matched pair. Type S.S.O. supersonic oscillator coil for tape recorders (*Radio Constructor*, April, 1956). Provides 6.3V 0.3A for pre-amp. heater plus record/erase bias, price **15/–** each

TELETRON FERRITE ROD AERIALS



Wound on high permeability Ferroxcube rod. No external aerial required. Full sensitivity. Reduces static and whistles. Extremely selective. Simply fitted as replacement for Ae coil or frame aerial. Ideal for battery portable receivers.

Medium wave type FRM, 4" × $\frac{5}{16}$" **8/9**

Dual wave type FRD, 8" × $\frac{5}{16}$" **12/9**

THE TELETRON COMPANY LIMITED

266 Nightingale Road · London N9

HOW 2527

Trade enquiries to sole distributor **S. Mozer 95 Kendal Ave N18** *Telephone EDMonton 7707*

MODEL 7 50 RANGE *Universal* AVOMETER

Fifty ranges...

in one instrument

THE wide scope of this multi-range AC/DC measuring instrument, coupled with its unfailing reliability, simplicity of use and high degree of accuracy, renders it invaluable wherever electrical equipment has to be maintained in constant, trouble-free operation.

CURRENT AC/DC
0 to 10 amps.

VOLTAGE AC/DC
0 to 1,000 volts.

RESISTANCE
Up to 40 megohms.

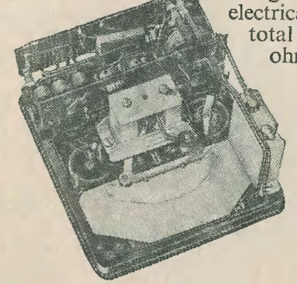
CAPACITY
·01 to 20 mFds.

AUDIO-FREQUENCY POWER OUTPUT
0—2 watts.

DECIBELS
—25Db. to +16Db.

Various accessories are available for extending the wide range of measurements.

It provides 50 ranges of readings on a 5-inch hand calibrated scale fitted with an anti-parallax mirror. Accuracy is within the limits laid down in Section 6 of B.S.S. 89/1954 for 5-inch scale industrial portable instruments. Range selection is effected by means of two electrically interlocked rotary switches. The total resistance of the meter is 500,000 ohms.



The instrument is self-contained, compact and portable, simple to operate, and is protected by an automatic cut-out against damage through inadvertent overload.

Power and Power Factor can be measured in A.C. circuits by means of an external accessory, the Universal AvoMeter Power Factor & Wattage Unit.

Size 8" × 7½" × 4½"
Weight 6¾ lbs.
(including leads)

List Price
£19 : 10s.

Illustrated Brochure available on request.

---you can depend on AVO

Sole Proprietors and Manufacturers:—
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.
AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1. *Telephone: VICtoria 3404 (9 lines)*

A7/9

The AMATEUR'S PARADISE

LANES (RADIO) LTD

11 GARDNER STREET

Telephone BRIGHTON 20773

LANES POWER PACK

220/230/250 Input A.C. 250V @ 60 m/A Output D.C. Filament 6·3V @ 3 amps.

SUITABLE FOR DRIVING AUXILIARY FM AND TUNING UNITS ETC.

£3.10.0 POST FREE

★ *ALL LEADING COMPONENTS IN STOCK* ★

LANE 4-WATT AMPLIFIERS

Illustrated in March issue

Independent treble, middle and bass controls. Valves 6BR7, 6BW6, 6X4. Output 4 watts matched to 2-3 ohms. Mains input tapped 200-250V a.c. **£6.12.6**

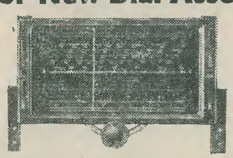
Why be swamped by BBC?

In areas with high signal strength the new B.B.C. high-powered Band I transmitter is likely to render the contrast control of your receiver almost inoperative. The OSMOR Variable Attenuator will reduce the signal to the required level. Easily fitted—just plug in. Reduction ratios variable 2-1 to 10-1. 15/-.

Band I Filter rejects B.B.C. from I.T.A. aerial, improves picture, 10/- including instructions.

Osmor New Dial Assembly

Calibrated specially for Osmor coils and Coilpacks



Type 5 Price 24/6 Scale length 7"

This is a really attractive horizontal 3-colour slide rule, precision built assembly. Complete with 6-band Perspex scale 9" x 4¾", for chassis mounting. L, M and S wave bands with station names; S.W.1, S.W.2 and trawler bands. The vernier drive has a ratio of 18-1 search and 50-1 reverse. Positions for two dial bulbs.

ESCUTCHEON for above, bronze finish metal, 4/–

ITA band III Converter Kit

Complete with all components, including **power unit** for construction of an efficient Band III Converter, Nothing else to buy. Circuit, wiring diagram, chassis templates and complete instructions, **£6.19.0**

OSMOR RADIO PRODUCTS LTD

418 BRIGHTON ROAD SOUTH CROYDON SURREY *Telephone* CROydon 5148-9

HANNEY *of* BATH

OFFERS

ALL COMPONENTS FOR

Mullard

3 VALVE 3 WATT AMPLIFIER
510 HIGH QUALITY AMPLIFIER
TYPES 'A' & 'B' PRE-AMPS
FM TUNER UNIT

Osram

912 + H.Q. AMPLIFIER
PASSIVE UNIT
PRE-AMPLIFIER
FM TUNER UNIT

Send stamp for lists

L. F. HANNEY

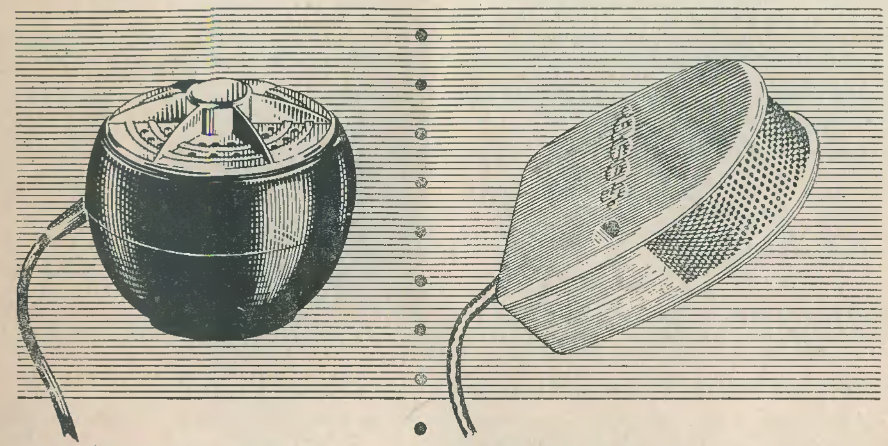
77 LOWER BRISTOL ROAD BATH

Telephone 3811

IF YOU WANT A GOOD **Microphone**

WITHOUT HAVING TO PAY TOO MUCH FOR IT

What about one of these?



MIC 33

A crystal microphone that fits the hand perfectly. For the high quality public address and tape recording field, incorporating a specially designed acoustic filter giving a flat response from 30 to 7,000 c/s.

RETAIL PRICE £2.10.0

MIC 35

A general purpose hand microphone of robust construction and convenient "handling" qualities with substantially flat response from 50 to 5,000 c/s. Suitable for recording apparatus, Public Address equipment, etc.

RETAIL PRICE £1.5.0

ACOS *always well ahead*

ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

COSMOCORD LTD · Eleanor Cross Road · Waltham Cross · Herts

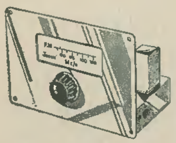
Telephone Waltham Cross 5206

HOME RADIO OF MITCHAM

187 LONDON ROAD MITCHAM SURREY. *Telephone* MIT 3282

FOR LOW PRICED HIGH FIDELITY EQUIPMENT

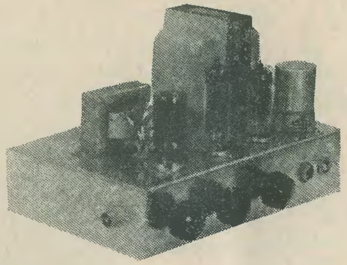
F.M. TUNERS



JASON.—As illustrated. Complete kit **£7.5.0.** Full constructional details, price 2/–.

ARGONAUT. — All parts in stock. Full details. 2/–.

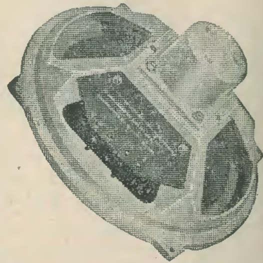
AMPLIFIERS



MULLARD.—3 valve 3 watt with independent Bass and Treble controls. Circuit diagram and price list free on request.

MULLARD.—"Five/Ten" full constructional details in Mullard book, price 2/6

SPEAKERS



HF1012 10in. die-cast unit. 10 watts Universal speech coil. Response 30–14,000 cycles. Acclaimed by the technical press, **£4.19.9.**

LORENZ tweeter unit, 39/6.

Full particulars and detailed price lists are available on all these units. We are also demonstrating daily.

HOLIDAYS AHEAD! Build the "Hiwayman" 4-valve All-Dry battery portable NOW! Full constructional details and price list 1/6. See page 771 this issue.

Components for

The "HIWAYMAN"

SEND S.A.E. FOR COMPLETE PRICE LIST OF SPECIFIED COMPONENTS EVERY PART IN STOCK

EASY PLANS AND WIRING INSTRUCTIONS **1/9** Post Free

RADIO EXPERIMENTAL PRODUCTS LTD

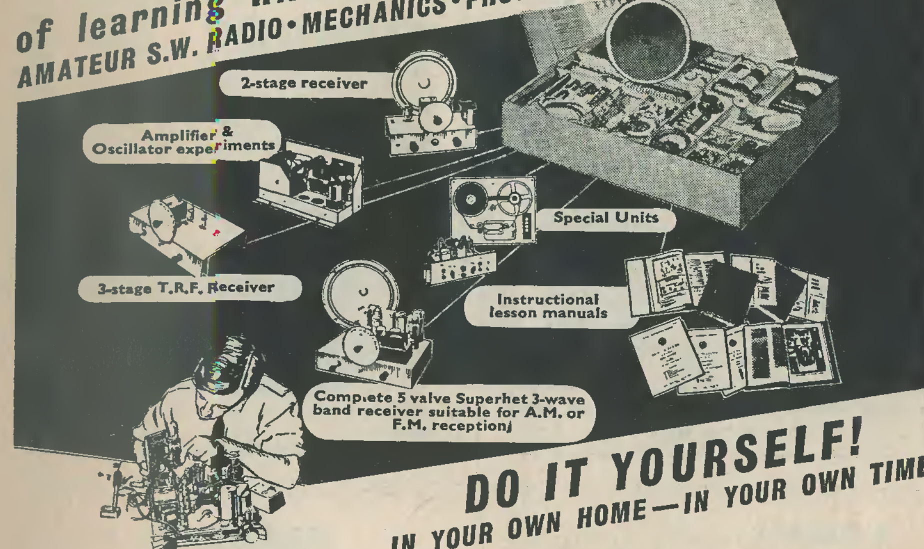
33 MUCH PARK STREET COVENTRY

Telephone 62572

NEW! THE PRACTICAL WAY

of learning RADIO • TELEVISION • ELECTRONICS

AMATEUR S.W. RADIO • MECHANICS • PHOTOGRAPHY • CARPENTRY • ETC • ETC



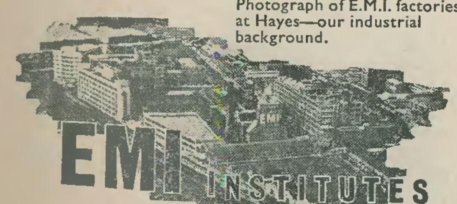
DO IT YOURSELF!

IN YOUR OWN HOME—IN YOUR OWN TIME

An entirely new series of courses designed to teach Radio, Television and Electronics more quickly and thoroughly than any other method. Specially prepared sets of radio parts are supplied and with these we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio receivers etc.

Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business—these Practical Courses are ideal and may be yours at very moderate cost.

With these outfits, which you receive upon enrolment and which remain your property, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to designing, testing and servicing of complete Radio and Television Receivers.



Photograph of E.M.I. factories at Hayes—our industrial background.

EMI INSTITUTES

An Educational Organisation associated with the E.M.I. group of Companies including 'HIS MASTER'S VOICE', COLUMBIA, etc.

OTHER COURSES WITH PRACTICAL EQUIPMENT INCLUDE: RADIO (Elementary and Advanced) TELEVISION • MECHANICS • ELECTRICITY CHEMISTRY • PHOTOGRAPHY • CARPENTRY.

Also Draughtsmanship • Commercial Art • Amateur S.W. Radio • Languages • Simple Electrical Repairs in the Home • Painting and Decorating Etc. • Etc.

With these outfits, you are given instructions that teach you the basic principles in the subject concerned.

NEW TELEVISION COURSE including a complete set of equipment dealing with the design, construction and servicing of a high quality television receiver.

COURSES (with equipment) also available in many other Engineering subjects.

COURSES FROM 15/- PER MONTH

To E.M.I. INSTITUTES,
Dept. 179, 43 Grove Park Rd, London, W.4

NAME ....

ADDRESS ....

....

SUBJECT(S) OF INTEREST..........

July (We shall not worry you with personal visits) I.C.76

Smith's of EDGWARE ROAD

Component Specialists Since Broadcasting Started

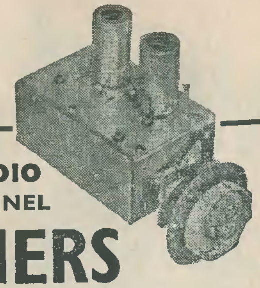
Manufacture a full range of 4-sided Blank Chassis of **16 Gauge** half-hard aluminium.

Size (in)	Price	Size (in)	Price
6 x 4 x 2	... 4/6	10 x 8 x 3	... 8/6
7 x 5 x 2	... 5/–	13 x 8 x $2\frac{1}{2}$	... 8/9
$8\frac{1}{2}$ x $5\frac{1}{2}$ x 2	... 5/6	12 x 9 x $2\frac{1}{2}$	... 8/11
10 x 4 x $2\frac{1}{2}$	... 6/–	14 x 7 x 3	... 9/–
9 x 7 x 2	... 6/6	13 x 10 x $2\frac{1}{2}$	... 9/9
12 x 4 x $2\frac{1}{2}$	... 6/6	14 x 10 x $2\frac{1}{2}$	... 10/–
9 x 8 x $2\frac{1}{2}$	... 7/3	12 x 10 x 3	... 10/3
10 x 8 x $2\frac{1}{2}$	... 7/6	15 x 10 x $2\frac{1}{2}$	... 10/6
12 x 5 x 3	... 7/9	17 x 10 x $2\frac{1}{2}$	... 11/3
12 x 7 x $2\frac{1}{2}$	... 7/11	17 x 9 x 3	... 11/9
11 x 8 x $2\frac{1}{2}$	... 8/–	17 x 10 x 3	... 12/6

Other sizes *pro rata* plus 2/6
Keep this List for reference

H. L. SMITH & CO. LTD
287/9 EDGWARE ROAD LONDON W2
Telephone Paddington 5891

Come and see us at stand No. 213 at the Radio Show.



VALRADIO 13 CHANNEL

TUNERS

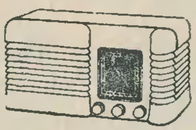
NOW AVAILABLE TO THE HOME TV CONSTRUCTOR

Adapt your set to receive the Commercial TV programmes. Valradio tuners are suitable for home constructed receivers including "The Wireless World," "Magnaview," etc. I.F. outputs, 9-14 mcs; 16-20 mcs; 19-24 mcs; and 34-40 mcs.
Complete with fitting instructions ... **£6**
Bracket for fixing tuner to cabinet ... **4/-**

Valradio

Valradio Limited Browells Lane Feltham Middx. *Telephone* **Feltham 4242**

A REALLY SELECTIVE 5-VALVE SUPERHET



139/6
Plus 2/8 for Post & Packing

Once again our "know-how" shows you the easy way to surprise your friends with this Superb Superhet. Make it yourself—no radio knowledge necessary. Easy to read step-by-step instructions and diagrams. We guarantee it to work. Only tools needed are pliers, screwdriver and soldering iron.

IDEAL FOR BEGINNERS . . .

. . . Let us show you how simple a 3-Valve T.R.F. Receiver can be to make our way and how amazed you will be. It's the Easy to Follow instructions that take the headaches out of construction. Hundreds already working over the country . . . 109/6 plus 2/8 post and packing.

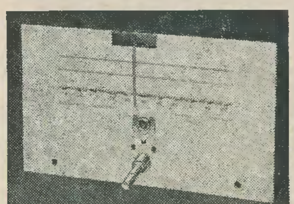
★ **A PROFESSIONAL JOB MADE SIMPLE There's nothing to lose—Our MONEY BACK guarantee covers you**

Complete parts available for the above receivers in cream or brown cabinets. . . Write to-day and get started on the fascinating hobby of Electronics.

EASY INSTRUCTIONS WITH OUR "KNOW-HOW" DIAGRAMS 1/- POST FREE SEND TO-DAY

NORMAN H. FIELD Electronics
(Dept. RC) **68 Hurst Street Birmingham 5**
BIRMINGHAM'S LARGEST CONSTRUCTORS' STORE

JACKSON



S.L.16 DRIVE — **RETAIL PRICE 11/6**
A general purpose slide rule drive for F.M./V.H.F. units, short-wave converters, etc. Printed in three colours on aluminium, with a 0-100 scale, and provision is made for individual calibrations. Travel of pointer $4\frac{3}{8}$". Scale plate 7" x $4\frac{1}{4}$". Scale aperture $5\frac{1}{2}$" x $1\frac{1}{2}$".

S.L.15 DRIVE — **RETAIL PRICE 25/6**
A complete kit of parts for the construction of the Jackson S.L.15 drive, calibrated for the F.M./V.H.F. band.

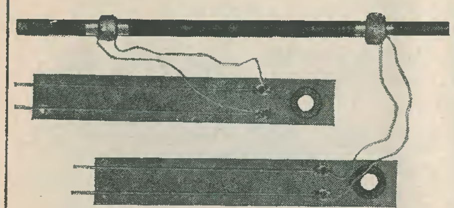
IT'S RELIABLE IF IT'S MADE BY JACKSONS

Write for our illustrated Price List

JACKSON BROS. (London) **LTD**
KINGSWAY . WADDON . SURREY
Telephone CROYDON 2754-5

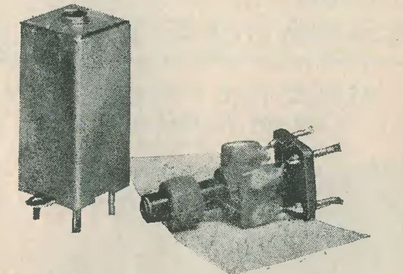
Repanco Components
specified for
THE "HIWAYMAN"

DUAL RANGE
FERRITE ROD AERIAL
TYPE FR. 1.



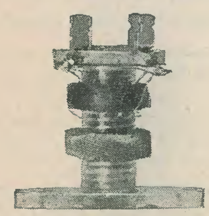
12/6

MINIATURE INTERMEDIATE
FREQUENCY TRANSFORMERS
TYPE M.SE



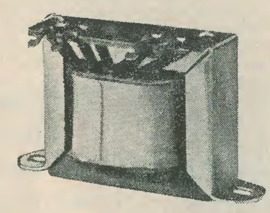
12/6 PAIR

OSCILLATOR COILS
TYPE RO1. Long wave
TYPE RO2. Medium wave



3/3

MIDGET OUTPUT
TRANSFORMER
TYPE MOT1



6/9

PUNCHED ALUMINIUM
CHASSIS WITH
CONDENSER BRACKET **4/-**

TWO WAVEBAND
TWO COLOUR
ENGRAVED DIAL **5/-**

Available component stockists — Trade supplied

REPANCO LTD

116—117 MUCH PARK ST. COVENTRY *Telephone* **62572**

The
Radio Constructor
incorporating THE RADIO AMATEUR

CONTENTS FOR JULY

VOL. 9, NO. 12
JULY 1956
ANNUAL SUBSCRIPTION 21/-

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9

Telephone
CUNNINGHAM 6141 (2 lines)

Telegrams
DATABUX, LONDON

Editor
C. W. C. OVERLAND, G2ATV

Advertising Manager
F. A. BALDWIN, AMIPRE

NOTICES

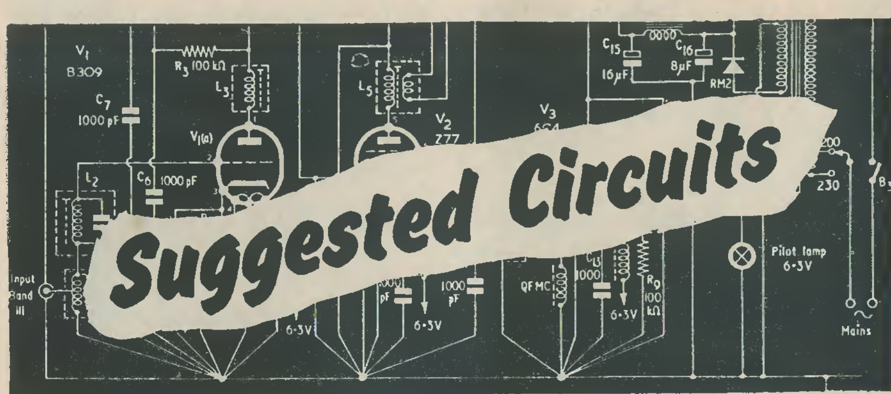
THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

QUERIES. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR 57 Maida Vale London W9



The circuits presented in this series have been designed by G. A. FRENCH, *specially for the enthusiast who needs only the circuit and essential relevant data*

No. 68. AN ACCURATE CAPACITY METER FOR LOW-VALUE CONDENSERS

NOW THAT F.M. AND BAND III TELEVISION receivers have become commonplace equipment in this country, an additional complication has been added to the work undertaken by service engineers and amateur constructors. The complication is due to the fact that the circuitry needed for Band II and Band III reception involves the use of components which are not normally encountered in conventional radio and amplifier practice. This point is especially applicable to fixed condensers, these components frequently having values as low as 1 or 2pF when employed in v.h.f. equipment. The capacity of condensers with values as small as this cannot be measured on most existing bridges, with the result that v.h.f. servicing and construction is liable to become a matter of guesswork when components of this nature are encountered.

To offer a solution to this problem, the Suggested Circuit in this issue depicts a simple test device for checking condensers having very small values of capacity. The circuit can be built with readily obtainable components, and it employs a laboratory technique which obviates any necessity to guard against long-term drift. All that is needed is a low short-term drift; and even this has to be maintained only over the period during which a reading is being taken.

The Circuit

The circuit of the meter is shown on the opposite page. It consists essentially of two r.f. oscillators, both of which are capable of being tuned by means of varying capacities in parallel with their tuned coils. The two oscillator circuits are screened from each other to prevent "pulling." This screening does not need to be extensive, however, and, under certain conditions could be dispensed with. The question of screening is discussed in greater detail later.

Readings are taken from the instrument when the two oscillators function at the same frequency. This state of affairs is indicated by beating the two oscillator outputs together with the aid of a detector, zero beat indicating oscillator synchronisation. In this circuit a leaky-grid detector is employed, and it is assumed that sufficient coupling to its grid is obtained by running a probe wire near the coils or wiring of the two oscillators. Although the coupling from the oscillators to this probe wire is capacitive, a further series condenser (C_9) is still inserted at the grid of the detector. This condenser obviates the possibility of the probe wire passing hum picked up from heater circuits, etc., to the detector.

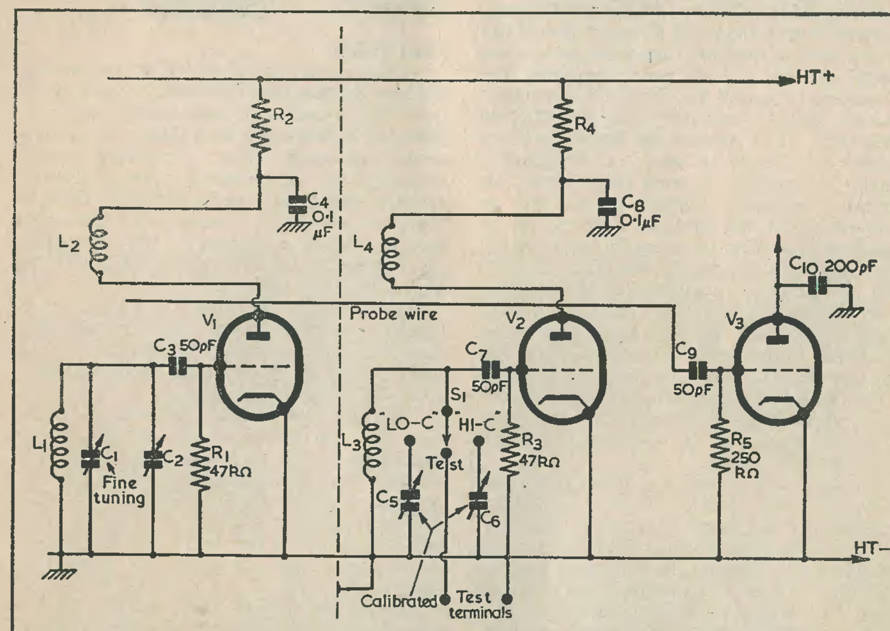
The detector should be capable of operating a pair of phones directly. Alternatively, it may be coupled to an a.f. amplifier stage which will then drive a loudspeaker. It is feasible that, with some versions, there may be sufficient a.f. amplitude at the anode of the detector to drive a loudspeaker directly, without the aid of an additional a.f. stage.

Operation

The operation of the meter is quite straightforward. After the equipment has been switched on and allowed to warm up, switch S_1 is thrown to the "Test" position. The unknown condenser is then connected across the test terminals. Condensers C_1 and/or C_2 are then adjusted to give zero beat in the phones (or speaker). C_1 and C_2 are then left alone, and S_1 is thrown to the "Lo-C," or "Hi-C," position as applicable. C_5, or C_6 (whichever has been switched in by S_1) is then adjusted for a similar zero beat, whereupon the basic technique ensures that the value of the unknown condenser is compared with that of C_5 or C_6. Drift or inaccuracies in any other circuits or components is, in consequence, ignored completely, with the result that a very high degree of accuracy can be obtained. Since the time factor between comparisons can be reduced to that needed to adjust S_1 from one position to the next, the effect of any drift in the device is reduced to negligible proportions. The second advantage is the fact that, apart from the comparison condensers C_5 and C_6, no other components need be classed as being "critical" at all.

Components

With the exception of the tuning condensers and coils, all components have their recommended values designated in the diagram. So far as valves are concerned, any



A capacity meter for low-value condensers

the value of the unknown condenser may be read from its scale. In cases of test condensers with very low values, it might be advisable to check readings by adjusting S_1 between the "Test" and "Lo-C" positions several times before finalising the settings of the tuning condensers. However, this course should only be necessary if short-term drift in the meter is excessive, such as might happen immediately after switching on.

As will be realised, this method of operation has two considerable advantages. Firstly, triode valve capable of reliable oscillation at short-wave frequencies may be employed for V_1 and V_2, whilst any conventional low-mu triode can be used in the V_3 position. It would be unwise to combine V_1 and V_2 in a single double-triode, although it should be quite permissible to so combine V_3 and one of the oscillator valves.

The main requirements of the oscillator coils L_1, L_2 and L_3, L_4 are that they should have low self-capacity and are capable of functioning over a wide range of tuning capacity. An excellent choice here would be commercial short-wave superhet oscillator coils designed to work over the conventional 6–18 Mc/s range when connected up to a 500pF tuning condenser. The best type of coils to employ would be those having air-cored spaced windings, with the feedback coil interwound in the bottom few turns of the tuned winding. Such coils are readily available in the home-constructor market. The coil L_1 should have a slightly lower inductance than that of L_3 in order to ensure that the frequency of the latter is always capable of being reached by tuning the former. Assuming identical coils for the two oscillators, the lower inductance for L_1 may be achieved by soldering a tap into the tuned coil, approximately half a turn from its top connection.

Although the capacity meter is at its most useful when reading very low values of capacity, there is no reason why its range should not be extended to measure capacities up to some 600pF or so. This point explains the presence of C_2 and C_6, both of these condensers having relatively high maximum capacities. For measuring low-value condensers C_5 should be used. C_5 requires a maximum capacity of some 15 to 20pF. Its minimum capacity should be as low as possible, this being ensured, if necessary, by judiciously bending its vanes outwards in the appropriate directions at the minimum setting. If difficulty is experienced in obtaining a sufficiently low minimum capacity for C_5, it will be necessary to keep a known low-value condenser permanently connected across the test terminals to allow for this, the test condenser being then connected in parallel with it. It should be remembered that the range of the meter will be decreased by this additional condenser.

Condensers C_2 and C_6 have maximum values slightly greater than the highest capacity it is intended to measure. Coils of the type just mentioned should continue to oscillate with parallel capaciites as high as 700pF, and such a tuning capacity could be given by connecting the two sections of a twin-gang 350pF tuning condenser in parallel. The amplitude of oscillation will, of course, decrease as tuning capacity increases.

The condensers C_1 and C_2 are merely provided to tune the coil L_1 and do not, of course, require any calibration. C_1, whose maximum capacity may be some 20 to 40pF or so, is intended to operate as a "band-spread" or "fine tuning" condenser, and it could be deleted if C_2 were provided with an efficient high ratio slow-motion drive.

The switch S_1 plays an important part in the circuit. A reliable component with well spaced out contacts is needed here. If there is reason to believe that capacity between adjacent fixed contacts in the switch is rather high, the condensers C_5 and C_6 should always be kept at the minimum capacity position if they are not being used. (A more elegant solution would consist of employing a switch with an earthing bar, this short-circuiting to chassis any fixed contacts not selected. However, switches of this type are rather difficult to obtain through normal channels.)

Final Points

As was mentioned above, a screen between the two oscillators is desirable but not essential. If the two coils were spaced apart by some six inches or so with their axes at right angles to each other, screening would probably not be required. An alternative arrangement could consist of having one coil mounted above the chassis, and the other below. Where screening is not employed, the wiring of the two oscillators should be kept well separated.

The switch S_1 and coil L_3, L_4 should be mounted as close to the test terminals as is possible. All wiring in the test circuit and to C_5 should be made with a view to keeping stray capacities to a minimum.

The capacitive coupling between the probe wire and the wiring of the two oscillators should be as low as is consistent with good results. Too tight a coupling could give rise to false readings due to harmonics of either oscillator beating together. If either oscillator "squegs" at the high-frequency end of its tuning range, its grid leak should be reduced in value.

Finally, calibration of C_5 and C_6 may be effected by measuring a number of condensers of known capacity. Graphs may then be drawn, from which suitable condenser scales can be made up.

THE TRANSISTORETTE

Osmor Radio Products Ltd., of 418 Brighton Road, South Croydon, Surrey, inform us that, as they have received several good reports on the performance of the "Transistorette," they are making available a set of punched chassis to the drawings given in this magazine. The price will be 12s. 6d. for the set.

IN YOUR WORKSHOP

This month J.R.D. continues with his description of the "Challenger," a high-performance f.m. tuner designed especially with the home-constructor in mind

READERS MAY REMEMBER THAT, LAST month, I altered the nature of my monthly contribution somewhat by devoting it to the initial discussion of an f.m. tuner which had aroused the interest of readers. I would now like to continue with the description of this unit, concentrating this month on constructional details.

The Chassis

The first thing which has to be made for the "Challenger" is the chassis, and the dimensions of this are given in Fig. 2. The chassis may be made of aluminium of any reasonable thickness.

The dimensions shown in Fig. 2 are those before bending. The four side aprons should be bent upwards, towards the reader. The two short half-inch aprons are intended only for strengthening the chassis across its width. It would be advisable to bend up the two long aprons first, after which the two short half-inch aprons may be bent with the aid of a conventional vice fitted with short bending clamps. Many constructors will, of course, prefer to drill out the chassis after bending.

Three holes in the rear apron are given centre position dimensions only. These holes are intended for the power lead grommet (hole "X"); the aerial input socket (hole "Y"); and the audio output socket (hole "Z"). Further dimensions are not given for these holes as the constructor is free to employ whatever types of socket or grommet he desires. However, care should be taken to ensure that the sockets chosen do not project too far back into the chassis, where they might make the process of wiring more difficult.

All the holes marked "A" in Fig. 2 should be drilled out 6BA clearance; whilst those marked "B" are intended to be 4BA clearance (the same applies to subsequent diagrams). Part of the front of the chassis is cut away to allow clearance for the tuning drive mechanism.

Two brackets are also required, these being needed for the tuning condenser and for its drive. The first of these is shown in Fig. 3. The half-inch section of this bracket should be bent up through 90 degrees. As this bracket has to hold the tuning condenser, it is rather important to see that it is not made of too flimsy a material. Aluminium of 16 s.w.g. would, in practice, be a good choice. The second bracket, intended for the tuning condenser drive, is illustrated in Fig. 4. After bending, the two sections of this second bracket should be at 90 degrees to each other.

Mounting the Components

To assist in understanding the layout given in the wiring diagrams, Fig. 5 shows the top layout of the principal components in the tuner unit. After the chassis has been prepared, the valveholders, tuning condenser,

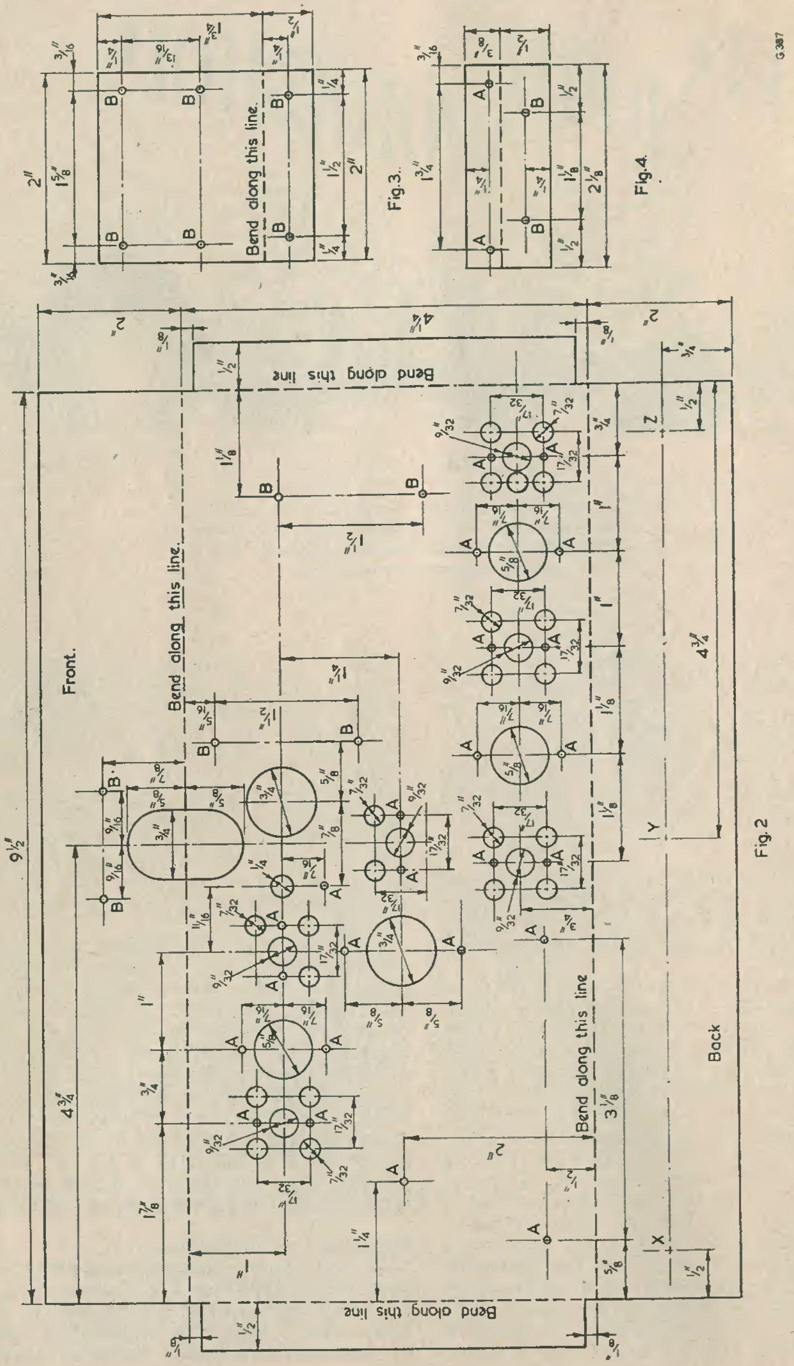


Fig. 2. Drilling dimensions for the "Challenger" chassis. Fig. 3. The bracket employed for mounting the tuning condenser. Fig. 4. The bracket which secures the tuning drive to the front panel

tag-strips and coils may be mounted. The dial and drive are not fitted at this stage. Two three-inch lengths of 14 to 16 s.w.g. tinned copper wire should be soldered to the frame and the rear fixed vanes of the tuning condenser before it is mounted, as these points become inaccessible later. (Wire of this thickness is only necessary for the tuning condenser circuits. Thinner wire may be employed elsewhere, if desired.)

Fig. 6 gives a detailed view of the underside of the chassis and should be studied with some care, since it shows the manner in which the valveholders are mounted, together with the tag positioning of the various coils. (The relative layout of each valveholder is shown by indicating its pin No. 1.) The way in which the two tuning condenser leads are taken through the chassis is also shown in this diagram. These leads are not connected yet.

Note that a small clamp holds the three-way power cable under the chassis after it has passed through its grommet. The heater choke, L_4, is also mounted at this stage; as are the individual heater decoupling condensers. In this and succeeding wiring diagrams, it may be necessary to show rather long component leads for reasons of clarity. In practice all components should be mounted very close to their appropriate tags. This applies especially to decoupling components.

The r.f. and oscillator stages may now be wired up, this process being carried out as shown in Fig. 8. All component leads shown in this diagram *must* be kept short.

The tuning condenser wiring deserves especial mention at this point. It was recommended, previously, that fairly thick tinned copper wire should be used for the tuning

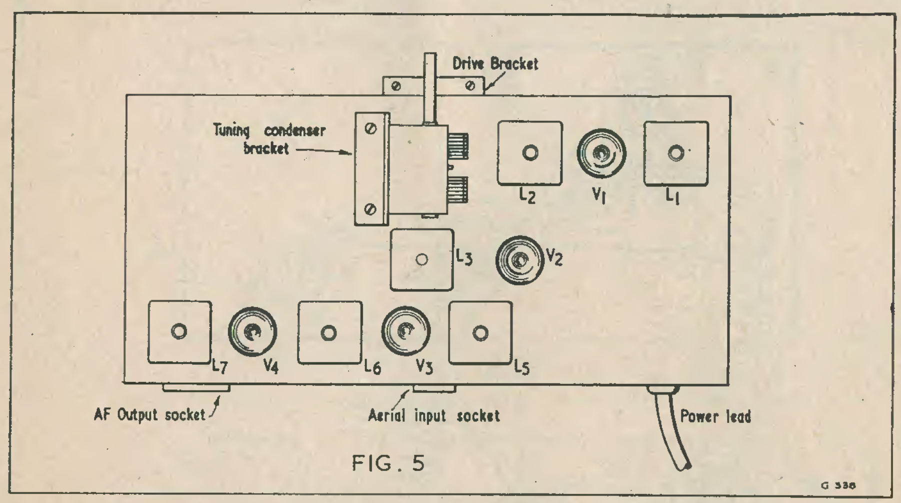


Fig. 5. Above-chassis layout, showing the positions of the principal components

It will be noted, from Fig. 6, that two of the five-way tag-strips employed in the tuner unit have been "cut down" to make them three-way. The process of cutting down the tag-strips can be carried out quite easily with the aid of a pair of nippers. One of the cut-down tag-strips is secured under a mounting bolt of the oscillator coil, L_3. Since this bolt is inserted into the bakelite of the coil-former and cannot consequently be fastened as tightly as it could be with a nut, the particular tag of the tag-strip concerned is not employed for earthing purposes.

The Power Wiring

The wiring may now be commenced. The heater and h.t. wiring is illustrated in Fig. 7.

condenser connections. This is done in order to reduce losses in the variable tuned circuits. However, the relatively thick wire employed should be handled with care during wiring since, otherwise, undue strain may be placed on the tuning condenser tags. The lead from the tuning condenser frame connects to the chassis solder tag immediately adjacent to the grommet through which the wire passes, after which it travels direct to the centre spigot of V_2 valveholder. Another piece of heavy tinned copper wire then connects the chassis solder tag to tag 3 of L_2. The lead from the rear fixed vanes of the tuning condenser travels through the large chassis hole under the tuning condenser direct to tag 1 of L_3.

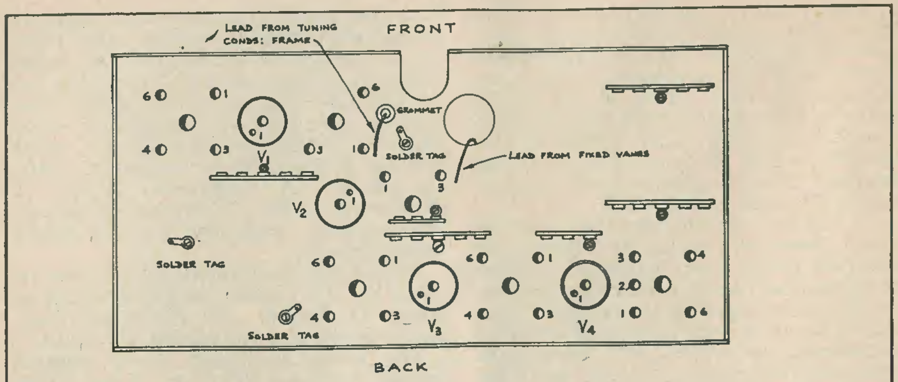


FIG. 6.

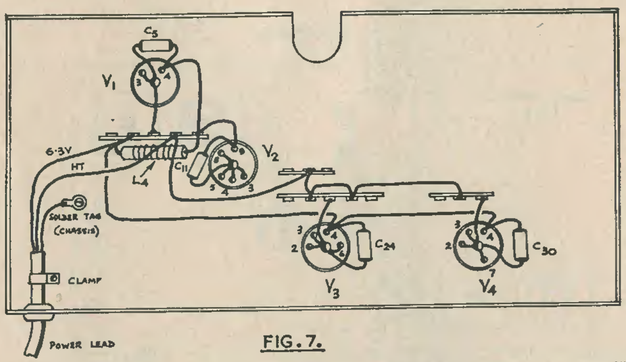


FIG. 7.

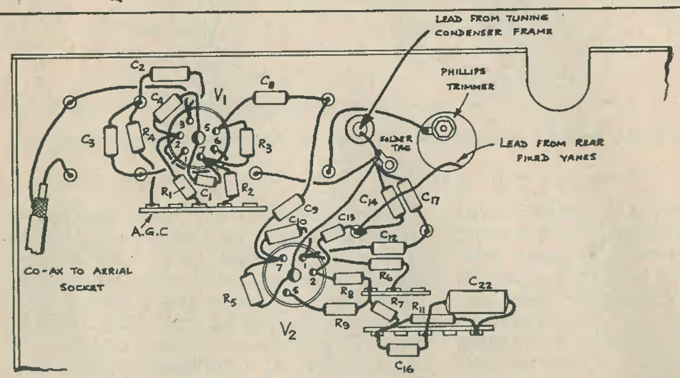


FIG. 8.

G359

Fig. 6. Under-chassis layout, illustrating in particular the relative positioning of valveholder and coil tags. Fig. 7. The initial h.t. and heater wiring. Fig. 8. Wiring up the r.f. and oscillator circuits

The fact that thick wire is used for these connections is not shown in Fig. 8.

Fig. 8 also illustrates the positioning of the Philips trimmer in the large hole in the chassis under the tuning condenser. The stem at the lower end of this trimmer is soldered direct to the tag of the front fixed vanes of the tuning condenser, this being the only mounting method required. The process of soldering the trimmer to the condenser tag is quite simple, the best method consisting of applying the soldering iron bit to the condenser tag above the chassis. The lead from the trimmer to tag 1 of L_2 should be of the same relatively heavy gauge wire which is employed for the other tuning condenser connections.

In Fig. 8, C_{10} is shown as a conventional condenser. It is possible, however, to use a "twisted pair" here instead, the procedure required being illustrated in Fig. 9. As may be seen, all that is done is to twist one lead half a dozen times around the sleeving of the other. After this, a soldering iron is run very quickly over the turns of bare wire in order to solder them together without melting or damaging the sleeving. The "condenser" thus formed is quite adequate in practice for oscillator coupling. If any polystyrene varnish is available, this may be painted over the "twisted pair."

The I.F. Strip

The i.f. strip can now be wired up. This is carried out as shown in Fig. 10. Again, all component leads *must* be kept short.

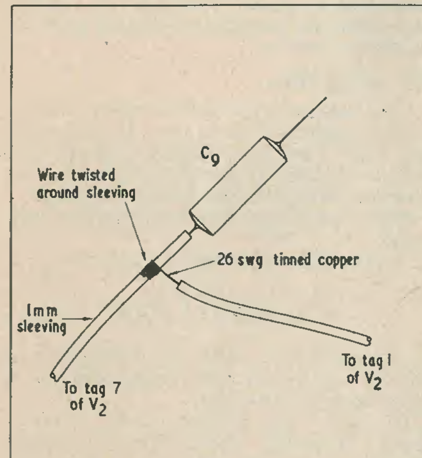


FIG. 9.

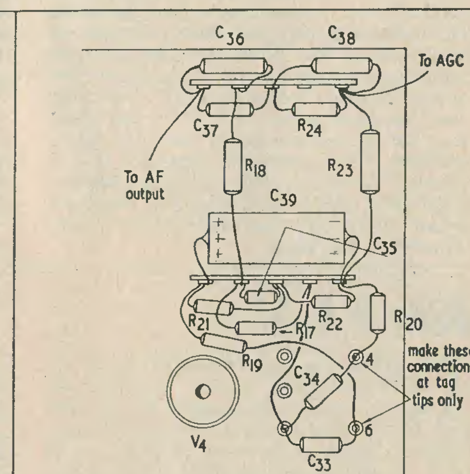


FIG. 11.

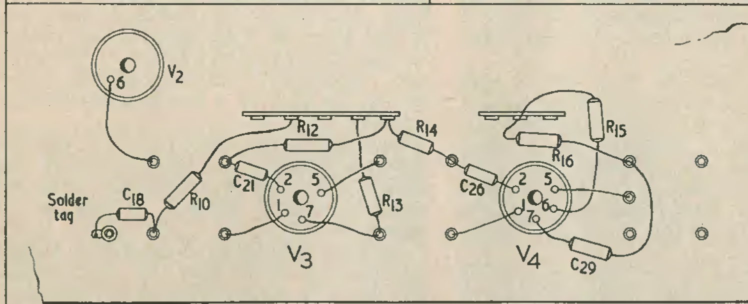


FIG. 10.

G340

Fig. 9. How a "twisted pair" may be made, to replace C_{10}. Fig. 10. The wiring of the i.f. strip. Fig. 11. Wiring and component layout of the discriminator stage

Fig. 10 does not include condensers C_{23} and C_{28}, as these would complicate the drawing. C_{23} should be connected between tags 7 and 3 of V_3 valveholder; and C_{28} between tags 6 and 3 of V_4 valveholder. It is important to ensure that the "outside foil" connections of these condensers (at the end of the condenser marked with two concentric bands) are taken to the earth tags. When fitted, C_{23} and C_{28} lie directly across and just touching the centre spigots of their respective valveholders. In this position they then provide a measure of additional screening between the grid and anode tags.

The Discriminator

Next comes the discriminator wiring. This is illustrated in Fig. 11. Once more, it is important to ensure that short leads are used, especially when connecting to the tags of the discriminator transformer itself. It must be mentioned at this point that the soldered connections to tags 4 and 6 of the discriminator must be made only at their tips. Soldering these tags closer to the body of the coil might cause the germanium diodes inside the can to overheat, with consequent damage. If it is intended, later, to replace R_{19} with a resistor which gives greater a.m. rejection, this component need only be soldered in "temporarily" at this stage.

The two tags on C_{39} may possibly not be long enough to reach the tag-strip comfortably, whereupon it will be necessary to extend them slightly with short lengths of wire.

The lead in Fig. 11 which is marked "to a.g.c." connects to the a.g.c. point, previously wired, in Fig. 8. This a.g.c. lead travels along the front angle of the underside of the chassis, leaving it at right angles to connect to the appropriate tags at either end. If a reasonably thick wire is used here, it should not need to be cleated at any point along its length.

The connection marked "to a.f. output" is a single lead which connects to the "live" terminal of whatever output socket has been fitted by the constructor. Unless the tuner is to be used close to mains fields this lead should not need to be screened. The chassis connection to the a.f. output socket may be taken from any convenient adjacent point on the chassis itself.

The Tuning Drive

The chassis wiring is now complete, and the tuning condenser drive may be mounted. The fully clockwise position of the dial pointer should, preferably, correspond to minimum capacity in the tuning condenser.

Alignment instructions will be given next month.

HI-FLY

by F. NEVILLE HART

THE CLAIM IN A RECENT ADVERTISEMENT OF Hi-Fi equipment, stating "Capture the beyond-aural range sounds in the very high frequencies of the sound sprectrum," brings to mind an amusing story of an *In Town Tonight* broadcast some years ago.

When the writer was doing material for the B.B.C. Variety Department, he met an inventor, who said he was about to market a most unusual fly catcher, which he called "The Flute."

He claimed that flies, when mating, call to one another on a "super-aural frequency" of a very high order. So he designed this contraption which consisted of a reed, vibrating at this high, inaudible note. The reed itself was encased in an upright metal tube and both were connected to a dry h.t. battery. The whole stood in a small trough of water.

The theory was that the fly, on hearing the attractive note, was supposed to alight on the metal tube, no doubt expecting to find a "winged syren" or beau, as the case might be, then become electrocuted and fall into the water!

The writer was so staggered by the wonderful arrangement that word was passed to the late Bill Hanson, then in charge of *In Town Tonight*, and the inventor was invited to describe the instrument in a Saturday night broadcast.

To make the feature more amusing, Heath Robinson, whose famous cartoons of crazy inventions have never been surpassed, was interviewed at the same time, and he declared that it quite equalled his best. The script was slightly spoiled, for at that time the B.B.C. was having one of its prudish fits, and all mention of "mating" and "sex-appeal" was blue pencilled, and we had to stick to a purely technical description.

However, a few days later the inventor took the "Flute" into the kitchens of the Savoy Hotel, and in the evening, when all the cooking had finished, it was set in operation.

All night long the inventor and his friends sat watching, in the hope that unsuspecting flies would be fatally attracted by the seductive call.

Unfortunately the party met bitter disappointment for, when the cold light of dawn came, not one fly had been trapped.

Perhaps, since no human ear could hear it, the frequency was too super super aural for the flies as well!

TELEVISION for the HOME CONSTRUCTOR

PART 1.

by R. G. YOUNG and S. WELBURN

This month our regular writer on television topics joins forces with another author, R. G. Young, in producing the first article in a new series—this series being devoted to home-constructor television in all its aspects

LAST MONTH MARKED THE END OF THE Band III series of articles published in this magazine and intended especially for the television amateur. This month we commence a new series, this being devoted to the wider aspects of home-constructor television. This change does not signify, incidentally, that Band III subjects will now disappear from these columns altogether; it merely denotes that greater attention will be paid to matters which fall outside what could be called purely Band III territory.

As a first contribution to this new series, the writers have great pleasure in discussing a technique which is only infrequently employed by the home-constructor. The development work was undertaken by Mr. R. G. Young, who is the co-author of this particular contribution. The article itself describes the design and operation of a simple line flywheel synchronisation unit.

Flywheel Sync.

As is well known, one of the most annoying features of fringe area television reception is the occasional periods in which loss of line synchronisation occurs. This loss of synchronisation is usually caused by one of two factors. Firstly, it may be caused by normal fading; this reducing the amplitude of the transmitted sync pulses until they become ineffective in reliably triggering the line timebase. Secondly, the loss of synchronisation may be caused by bursts of interference; these triggering the line timebase at a moment preceding the arrival of the transmitted sync pulse, whereupon a number of the subsequent lines of the picture are liable to be badly misplaced.

The obvious solution to this problem consists of fitting a flywheel synchronisation circuit to the receiver. Many commercial manufacturers employ such circuits in their "fringe" models as a matter of course, but the use of flywheel synchronisation by amateur constructors is not very widespread. This is rather a pity as the advantages to be gained are quite considerable. Also, given an intelligent approach, the additional circuitry required is neither very expensive nor very complicated.

This article describes one of the simpler types of flywheel synchronisation arrangement, and gives details of a typical practicable instance in which it has been used.

Some readers may, perhaps, be a little hazy concerning the working of flywheel sync circuits. It would be to advantage, therefore, to devote a few explanatory paragraphs at this stage to the theoretical aspects of the circuit.

With normal sync circuits, every line of the television picture is kept in its position by means of the transmitted line sync pulses. These pulses initiate the flyback period, after which the line timebase commences to scan the next line in the picture. As the flyback period always occupies the same amount of time, it can be seen that each subsequent line of the picture takes up its proper position on the screen. To obtain proper synchronisation, using sync pulses, it is necessary to set the "line hold" control such that the line timebase oscillator runs at a slightly lower frequency than the synchronised frequency. Thus, when the sync pulse arrives, the oscillator is itself almost on the point of going into the flyback period. The sync pulse knocks the oscillator "over the edge," as it were, just shortly before it would have done had it been left on its own.

If, however, the sync pulse did *not* arrive, or had insufficient amplitude, the flyback period would occur at the moment chosen by the timebase in its free-running state. In consequence, the next line would be scanned incorrectly. So also, probably, would a number of succeeding lines until the line timebase oscillator got into step again.

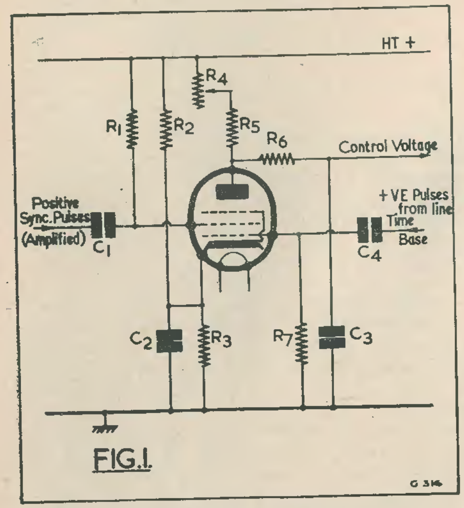


Fig. 1. *A simple coincidence detector*

The reverse happens when an interference pulse triggers the line timebase. In this case the timebase is triggered *before* the arrival of the transmitted sync pulse. The result, however, is the same: one, or more, of the subsequent lines is misplaced until the line timebase oscillator settles down to its correct frequency again.

When a flywheel synchronisation circuit is employed, the transmitted pulses are not used to trigger the line timebase in the same manner as they do with direct sync arrangements. Instead, the frequency at which the transmitted pulses occur is *compared* with the frequency at which the timebase is running. If these two frequencies happen to differ from each other a control voltage is set up, this being applied to the timebase oscillator in such a manner that it either reduces or increases the timebase frequency, as the case may be. The control voltage is delayed in time by means of an R.C. filter, with the result that the circuit responds relatively slowly to changes in control voltage. Hence the "flywheel" effect, and hence the fact that the timebase oscillator maintains its correct speed over a period of time, even when the sync pulses are absent or there are heavy interference pulses.

The Coincidence Detector

One of the simplest methods of comparing the frequencies of the two pulse sources just mentioned, and of obtaining a control voltage therefrom, is by means of a coincidence detector.

A typical example of such a detector is shown, in simplified form, in Fig. 1. In this diagram a conventional pentode is employed, the two pulse waveforms whose frequencies are to be compared being applied to its control grid and screen grid respectively. Fig. 2 (*a*) illustrates the positive-going part of a differentiated transmitted line sync pulse, as obtained from the sync separator of the receiver. It is assumed, in this case, that this pulse has sufficient power to effectively modulate the screen-grid of the coincidence detector of Fig. 1. Fig. 2 (*b*) illustrates a positive pulse obtained from the line timebase during the flyback period, and which is to be applied to the control grid of the detector of Fig. 1. An excellent place to obtain this pulse would be at the line output anode itself; in which case it could consist of a scaled-down version of the positive pulse appearing at this anode during the flyback period.

The cathode of the coincidence detector in Fig. 1 has a high positive potential, due to R_2 and R_3. In consequence, the valve normally passes little or no anode current during the period when its grid is at chassis potential. Also, due to the fact that a relatively high-value resistor, R_1, is connected in series with the h.t. feed to the screen-grid, the anode current passed by the valve is still not very high even when the control grid has a potential which is close, or equal, to that at the cathode. If, however, a pulse is applied to the screen-grid which makes it go positive at the same time that the control grid goes positive, then the valve passes a relatively heavy anode current.

The best relative position, for accurate scanning, between the two pulses of Figs. 2 (*a*) and (*b*) is shown in Fig. 2 (*c*). As may be seen, the flyback pulse occurs just slightly after the appearance of the transmitted sync pulse, this being just what is required in practice for good synchronisation. The shaded portion in Fig. 2 (*c*) illustrates the amount by which these two pulses coincide. Remembering the operation of the coincidence detector of Fig. 1, it will be readily seen that the area of this shaded portion will be proportional to the anode current of the detector which occurs when both pulses coincide.

Let us now see what happens if the line timebase oscillator suddenly commences to run at too high a frequency. When this happens, the positive pulse from the timebase will appear earlier than it did in Fig. 2 (*c*), giving the effect illustrated in Fig. 2 (*d*). As will at once be obvious, the area of the shaded portion now becomes larger. In consequence, the current passed by the anode of the detector becomes larger also. To take the reverse instance: when the line timebase commences to run at too low a frequency we get the effect shown in Fig. 2 (*e*). This time the shaded area has become smaller and, as a result, the anode current passed by the detector becomes smaller as well.

The varying anode currents passed by the coincidence detector for the pulse relationships shown in Figs. 2 (*c*), (*d*) and (*e*), are not steady. They consist, themselves, of pulses of varying amplitude. If, however, these pulses are applied across a resistor so that a proportionately varying voltage is built up, and this voltage is subsequently "smoothed," we have immediately available a steady voltage capable of controlling the frequency of the timebase. In Fig. 1, the anode voltage is built up across the resistors R_4 and R_5 in series. This voltage is then applied to the R.C. circuit R_6, C_3. The values of R_6 and C_3 are such that a steady voltage appears across C_3. R_6 and C_3 also provide the time delay needed to give the arrangement its "flywheel" action. R_4 is made variable in order to adjust the amplitude of the control voltage and it can, in fact, become the "line hold" control of the televisor.

Control Circuits

The arrangements required at the timebase oscillator for flywheel sync are quite simple. One of the most easily controlled types of circuit is the blocking oscillator, as shown in Fig. 3. It is possible to control the frequency of this oscillator by returning its grid leak to a positive potential. If this potential increases, so also does the frequency of the oscillator.

In Fig. 2 (*d*) we saw that, when the line timebase oscillator ran at too high a speed, the current passed by the coincidence detector increased. In consequence the control voltage obtained from its anode decreased. If, therefore, we connect the grid leak of the oscillator of Fig. 3 to the "control voltage" given in Fig. 1 we have a workable flywheel

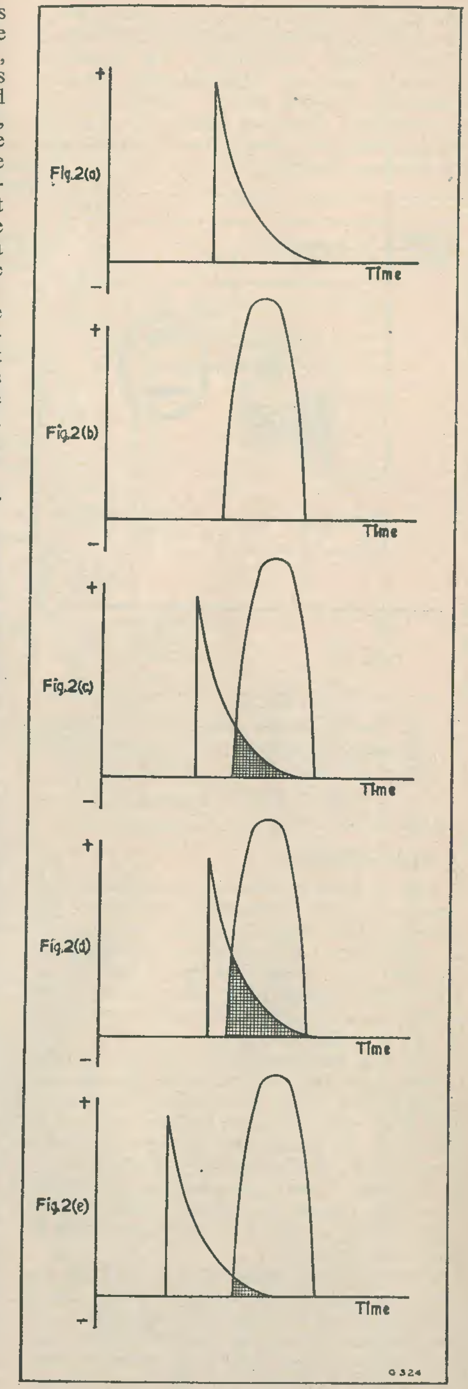


Fig. 2 (*a*). *The leading part of a differentiated positive-going sync pulse. Fig.* 2 (*b*). *A positive pulse obtained from the line timebase. Fig.* 2 (*c*). *An ideal relationship in time between the two pulses. Fig.* 2 (*d*). *What happens when the line timebase runs at too high a frequency. Fig.* 2 (*e*). *The relationship for too low a line timebase frequency* knocks the oscillator "over the edge," as it were, just shortly before it would have done had it been left on its own.

If, however, the sync pulse did *not* arrive, or had insufficient amplitude, the flyback period would occur at the moment chosen by the timebase in its free-running state. In consequence, the next line would be scanned incorrectly. So also, probably, would a number of succeeding lines until the line timebase oscillator got into step again.

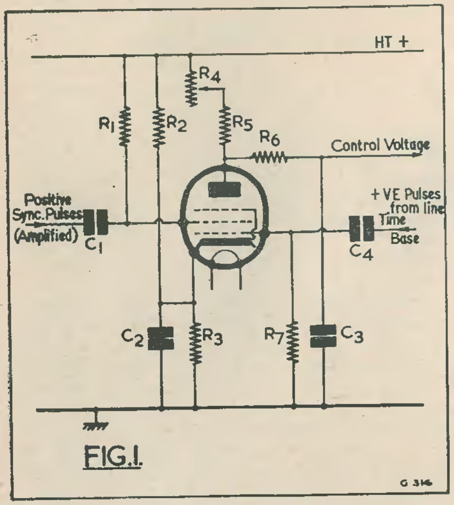


Fig. 1. A simple coincidence detector

The reverse happens when an interference pulse triggers the line timebase. In this case the timebase is triggered *before* the arrival of the transmitted sync pulse. The result, however, is the same: one, or more, of the subsequent lines is misplaced until the line timebase oscillator settles down to its correct frequency again.

When a flywheel synchronisation circuit is employed, the transmitted pulses are not used to trigger the line timebase in the same manner as they do with direct sync arrangements. Instead, the frequency at which the transmitted pulses occur is *compared* with the frequency at which the timebase is running. If these two frequencies happen to differ from each other a control voltage is set up, this being applied to the timebase oscillator in such a manner that it either reduces or increases the timebase frequency, as the case may be. The control voltage is delayed in time by means of an R.C. filter, with the result that the circuit responds relatively slowly to changes in control voltage. Hence the "flywheel" effect, and hence the fact that the timebase oscillator maintains its correct speed over a period of time, even when the sync pulses are absent or there are heavy interference pulses.

The Coincidence Detector

One of the simplest methods of comparing the frequencies of the two pulse sources just mentioned, and of obtaining a control voltage therefrom, is by means of a coincidence detector.

A typical example of such a detector is shown, in simplified form, in Fig. 1. In this diagram a conventional pentode is employed, the two pulse waveforms whose frequencies are to be compared being applied to its control grid and screen grid respectively. Fig. 2 (*a*) illustrates the positive-going part of a differentiated transmitted line sync pulse, as obtained from the sync separator of the receiver. It is assumed, in this case, that this pulse has sufficient power to effectively modulate the screen-grid of the coincidence detector of Fig. 1. Fig. 2 (*b*) illustrates a positive pulse obtained from the line timebase during the flyback period, and which is to be applied to the control grid of the detector of Fig. 1. An excellent place to obtain this pulse would be at the line output anode itself; in which case it could consist of a scaled-down version of the positive pulse appearing at this anode during the flyback period.

The cathode of the coincidence detector in Fig. 1 has a high positive potential, due to R_2 and R_3. In consequence, the valve normally passes little or no anode current during the period when its grid is at chassis potential. Also, due to the fact that a relatively high-value resistor, R_1, is connected in series with the h.t. feed to the screen-grid, the anode current passed by the valve is still not very high even when the control grid has a potential which is close, or equal, to that at the cathode. If, however, a pulse is applied to the screen-grid which makes it go positive at the same time that the control grid goes positive, then the valve passes a relatively heavy anode current.

The best relative position, for accurate scanning, between the two pulses of Figs. 2 (*a*) and (*b*) is shown in Fig. 2 (*c*). As may be seen, the flyback pulse occurs just slightly after the appearance of the transmitted sync pulse, this being just what is required in practice for good synchronisation. The shaded portion in Fig. 2 (*c*) illustrates the amount by which these two pulses coincide. Remembering the operation of the coincidence detector of Fig. 1, it will be readily seen that the area of this shaded portion will be proportional to the anode current of the detector which occurs when both pulses coincide.

Let us now see what happens if the line timebase oscillator suddenly commences to run at too high a frequency. When this happens, the positive pulse from the timebase will appear earlier than it did in Fig. 2 (*c*), giving the effect illustrated in Fig. 2 (*d*). As will at once be obvious, the area of the shaded portion now becomes larger. In consequence, the current passed by the anode of the detector becomes larger also. To take the reverse instance: when the line timebase commences to run at too low a frequency we get the effect shown in Fig. 2 (*e*). This time the shaded area has become smaller and, as a result, the anode current passed by the detector becomes smaller as well.

The varying anode currents passed by the coincidence detector for the pulse relationships shown in Figs. 2 (*c*), (*d*) and (*e*), are not steady. They consist, themselves, of pulses of varying amplitude. If, however, these pulses are applied across a resistor so that a proportionately varying voltage is built up, and this voltage is subsequently "smoothed," we have immediately available a steady voltage capable of controlling the frequency of the timebase. In Fig. 1, the anode voltage is built up across the resistors R_4 and R_5 in series. This voltage is then applied to the R.C. circuit R_6, C_3. The values of R_6 and C_3 are such that a steady voltage appears across C_3. R_6 and C_3 also provide the time delay needed to give the arrangement its "flywheel" action. R_4 is made variable in order to adjust the amplitude of the control voltage and it can, in fact, become the "line hold" control of the televisor.

Control Circuits

The arrangements required at the timebase oscillator for flywheel sync are quite simple. One of the most easily controlled types of circuit is the blocking oscillator, as shown in Fig. 3. It is possible to control the frequency of this oscillator by returning its grid leak to a positive potential. If this potential increases, so also does the frequency of the oscillator.

In Fig. 2 (*d*) we saw that, when the line timebase oscillator ran at too high a speed, the current passed by the coincidence detector increased. In consequence the control voltage obtained from its anode decreased. If, therefore, we connect the grid leak of the oscillator of Fig. 3 to the "control voltage" given in Fig. 1 we have a workable flywheel

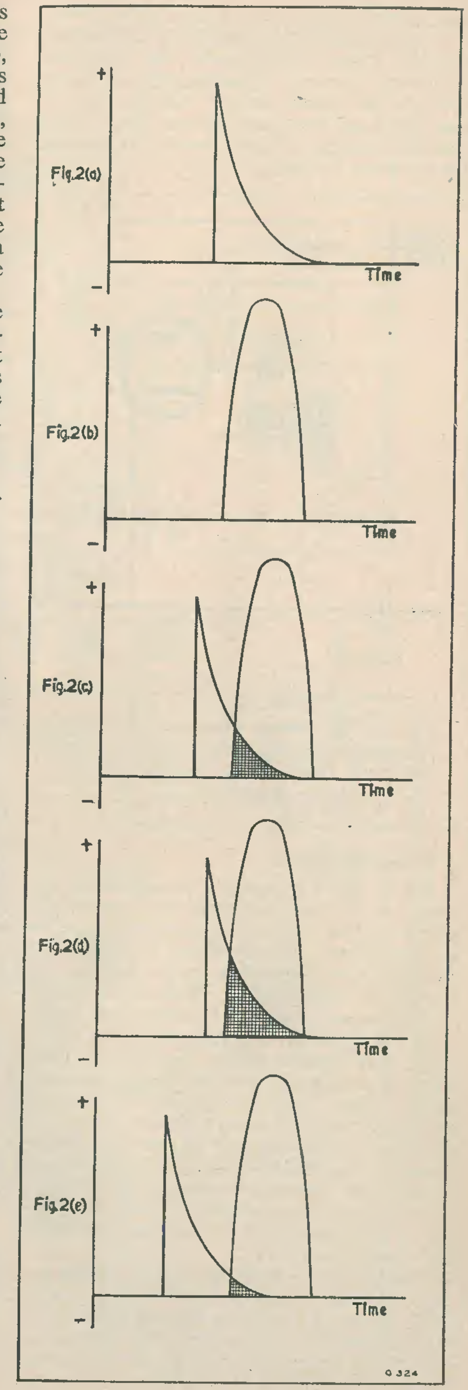


Fig. 2 (a). The leading part of a differentiated positive-going sync pulse. Fig. 2 (b). A positive pulse obtained from the line timebase. Fig. 2 (c). An ideal relationship in time between the two pulses. Fig. 2 (d). What happens when the line timebase runs at too high a frequency. Fig. 2 (e). The relationship for too low a line timebase frequency sync circuit. What now occurs is that, when the timebase frequency increases the control voltage drops, whereupon the timebase frequency becomes automatically lowered towards its original value. Alternatively, if the timebase frequency drops the control voltage becomes raised, thereby increasing the timebase frequency.

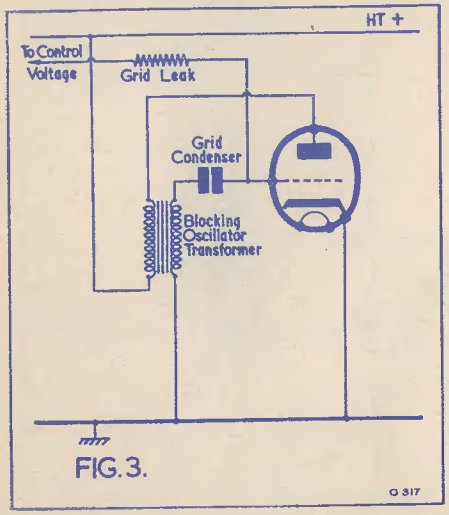


FIG. 3.

Fig. 3. A simple blocking oscillator. Frequency control is achieved by returning the grid leak to a varying positive potential

A Practical Circuit

Fig. 4 shows a practical circuit which has been used very successfully by one of the writers. This diagram consists, in essence, of a conventional line timebase to which the flywheel sync circuit has been added in the form of an external unit. This unit is shown within the area enclosed by the dotted line.

In Fig. 4 the video signal, as applied to the c.r.t., has positive-going line sync pulses. These appear, at the anode of V_1, as negative-going pulses. Since their polarity is incorrect and they may not have sufficient power to modulate the screen-grid of the coincidence detector, V_4, phase inversion at some power is required. This is provided by V_3, which is a 6AM6 triode-connected. The positive pulses at the anode of V_3 are then applied to the screen-grid of V_4.

Positive pulses from the line timebase are also required. These are obtained in Fig. 4 from the anode of the line output valve itself. Unfortunately, however, the pulses present at this point have a very high positive peak potential with respect to chassis (possibly up to 5 kV) and considerable care has to be taken to prevent such high potentials reaching the coincidence detector. In this instance the pulses are applied to the fixed potentiometer given by R_{26}, R_{25} and R_{22} in series (condenser C_{13} merely isolates the h.t. voltage appearing at the line output anode), the reduced voltage appearing across R_{22} being finally applied to the grid of V_4. If taps had been available into the line output transformer anode winding, a more elegant method of obtaining the positive pulses would have consisted of connecting the control grid of V_4, via a suitable fixed potentiometer, to one of these taps. However, this was not possible in the particular case bing described, and the arrangement used functioned satisfactorily in practice. When the method of connection shown in Fig. 4 is employed, it is most important to ensure that R_{25} and R_{26} have the wattage indicated in the diagram, and that they are kept well clear of metal parts. Otherwise flashover, with consequent damage, may occur.

Resistor R_{20} is inserted in series with the pulse drive to the control grid of V_3 in order to limit any positive grid current that may flow. This resistor tends to form a low-pass circuit with the capacity existing between grid and cathode of V_4, but the consequent integrating effect is largely overcome with the aid of the small-value condenser C_{11}. C_{11} helps to ensure that the original sharp front of the pulse appears on the control grid.

The varying voltage at the anode of V_4 is "smoothed" by C_{10} and C_{12}. In the prototype C_{12} was a paper condenser; but there is no reason why a modern electrolytic condenser with a low leakage current should not function equally well in its place. The positive control voltage appearing at the anode of V_4 is next applied direct to the-grid leak, R_{19}, of the line blocking oscillator, V_5. The flywheel sync loop is thereby set up.

Although, in theory, the control given by a flywheel sync circuit gives perfect locking over the whole of the transmitted picture, in practice this does not always occur. It is usually desirable to employ some additional stabilising device to ensure that the long-term frequency stability of the arrangement is held during the period of slight drift which occurs in the first hour or so of running and during changes in mains voltage. One method of obtaining this stabilisation consists of injecting a small proportion of the transmitted sync pulses into the oscillator section. This process is carried out, in Fig. 4, by applying the transmitted sync pulses to the blocking oscillator via R_{16} and C_8. The pulses given by this arrangement are too weak to trigger the time-

Fig. 4. The practical circuit described in the text.

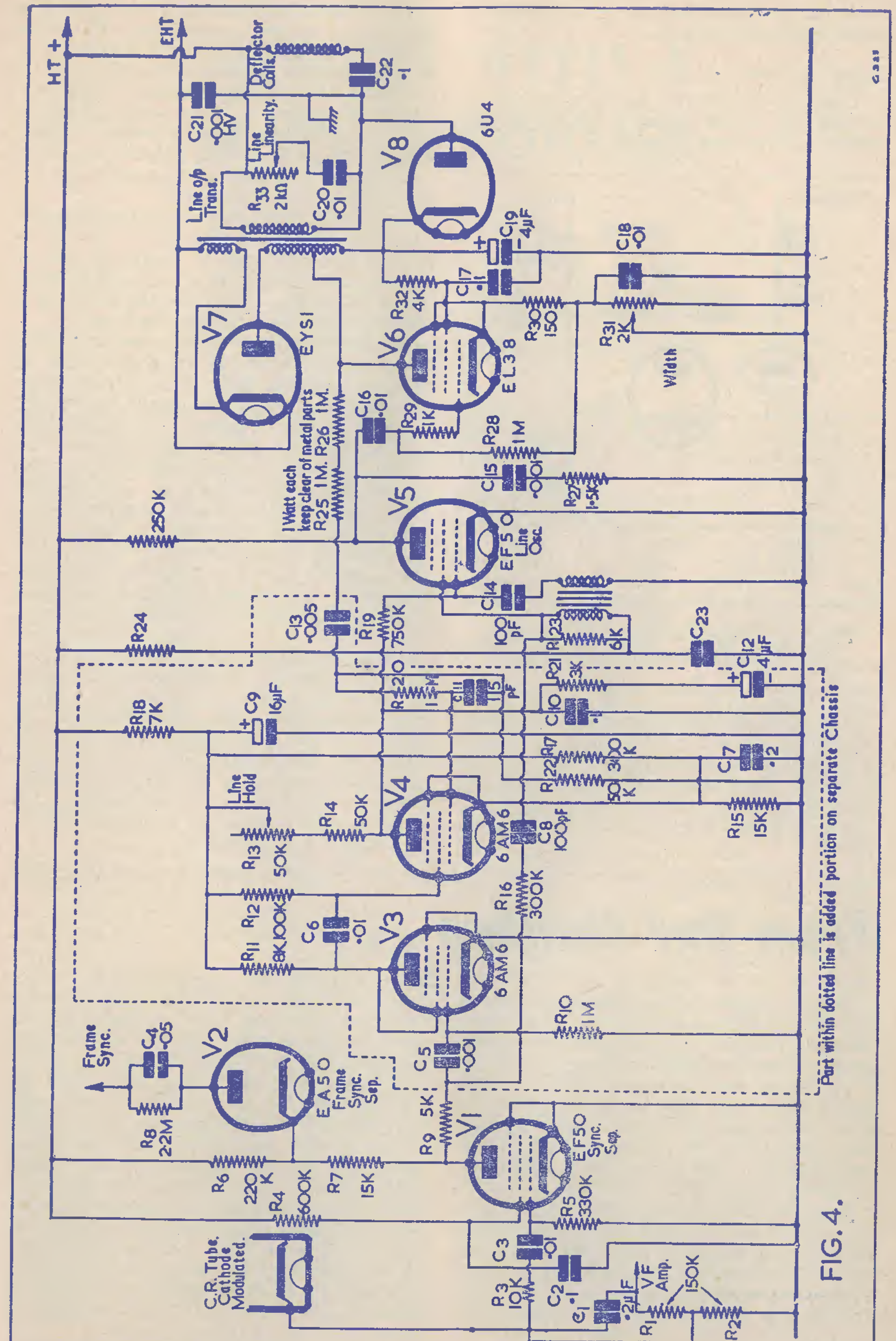


FIG. 4.

base, but are sufficiently large to provide a useful reference frequency.

Practical Points

There are one or two further points concerning the circuit shown in Fig. 4 which deserve a little extra comment.

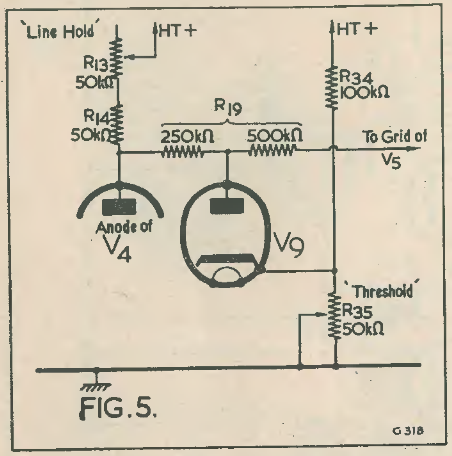


Fig. 5. A circuit for restricting the range of the flywheel sync control voltage

The valves employed in the additional unit, V_3 and V_4, are not at all "critical." 6AM6's were used in the prototype because they were to hand. Later tests showed that almost any medium to low-mu triode would cope in the V_3 position, and most r.f. pentodes in the V_4 position.

The value of the blocking oscillator grid leak, R_{19}, is of some importance. The value shown for this resistor in Fig. 4, 750 kΩ, was suitable in the prototype but may need alteration for different versions. The best approach consists of temporarily replacing R_{19} by a 2MΩ variable resistor when initially setting up. This resistor may then be replaced by a fixed component when the correct value has been found.

Resistor R_{16} may also have to be altered in value for different versions. If this component has too low a resistance, direct synchronisation may occur; and the flywheel action will be lost. The value shown in Fig. 4 should cope for most cases, however.

In some instances it may be found that the flywheel sync circuit has too wide a range of control and that some time elapses, after switching on, before the receiver falls into synchronisation. Should it occur, this trouble may be cleared by restricting the range of control; a suitable circuit for carrying this out being shown in Fig. 5. The principle employed is very simple. What occurs is that when the control voltage at the anode of the coincidence detector becomes higher than that tapped off by R_{35}, the diode conducts; whereupon this higher voltage is prevented from being applied to the blocking oscillator. The latter then runs at nearly normal speed until the coincidence of its pulses with those in the transmitted carrier cause the whole circuit to lock into synchronisation. When synchronisation occurs, the voltage at the anode of the coincidence detector drops below that tapped off by R_{35}, and the diode ceases to conduct or to have any further effect on the working of the circuit. The diode may be replaced by a suitable rectifier or Westector, if desired.

From Our Mailbag . . .

DEAR SIR,

I wish to correct the information given by Mr. F. C. Judd regarding the relationship between recorder tape speeds and musical pitch in the June issue.

He states that the speeds of 6in, 7.5in and 12in per sec. give respectively, keys of C, F and B flat. This is incorrect, for if the tape speed is doubled, from 6in to 12in/sec. the pitch will rise exactly an octave, or C to C not C to B flat.

Also, the ratio 7.5/6 (or 1.25/1) is exactly a major third in "just intonation" which corresponds to the inverval C to E, not C to F. (For the "equal temperament" system to which pianos etc., are tuned to-day, the ratio is actually 1.2599/1 not 1.25/1. This slight difference in pitch is quite noticeable to a sensitive ear).

In order to obtain the musical ratios stated by Mr. Judd, i.e., C. F and B flat, the three speeds (taking 7.5in/sec. as standard) should be 5.62, 7.5 and 10in/sec.

I would add, from experience, that the pulleys must be very accurate in diameter (to within a few thousandths of an inch) if the correct musical intervals are to be obtained. In the "equal tempered" scale the octave is divided into twelve equal semi-tones. The ratio of frequencies between each semi-tone is therefore $^{12}\sqrt{2}$ or 1.0595/1. Thus the correct ratio for any interval can be worked out, for example C to A flat is an interval of 8 semitones, the ratio is therefore $^{12}\sqrt{2^8}$ or $^{3}\sqrt{2^2}$=1.5874/1.—NORMAN WATSON (*Leigh, Lancs*).

EFFECTS WITH A TAPE RECORDER

PART 2. *by* **F. C. JUDD**

General effects and sounds. Echo effects. Splicing and editing. Multiple recording.

WITH SUITABLE EQUIPMENT (SEE PART 1) multiple recording becomes a fairly simple problem. The writer's electric guitars have lent themselves well in this respect, as no microphones are used and the instruments are coupled directly to the recording amplifier. Because of this, room echo and microphone distortion are eliminated. The system may, of course, be used with non-electrical instruments and voices, in which case a microphone must be used.

Successful multiple recording and the production of effects can be increased by the number of recording heads, the flexibility and number of amplifier channels and tape speeds. The technique to be described, however, will be confined to the use of one additional recording head and a two-stage amplifier. (See circuit of Fig. 2, part 1).

As an example, take a recording of piano, and two voices by the same singer. The first recording, of piano and one voice, is made at normal level and the tape run back to the start of the recording. The second recording head is connected via the auxiliary amplifier to a low gain stage for the singer's next part. Erase and recording head bias units are switched off, and for the purpose of monitoring and rehearsal the main recording head is also switched off. A headphone monitoring position must be available from the output of the recording amplifier. The tape may now be run through and checked for the new recording level and balance with the singer's second voice part. The singer may also make use of one or two dummy runs for practice. When satisfactory, the live recording may be completed by switching on bias and recording head.

It will be seen from the diagram of Fig. 1 that the first recording is picked up by head No. 2, mixed with the second voice through the recording amplifier and the whole recording completed a little further along the tape. It will be appreciated that head No. 2 and the auxiliary amplifier must be capable of delivering good quality reproduction to the network. Make the initial recording with as little distortion as possible, and preferably at a lower level than normal. Special care to be taken to avoid picking up hum from stray fields, and careful screening of all jacks and sockets, switching and leads, is essential if good quality recordings are to be made.

Flexibility is the keynote of successful multiple recording, and this simply means extra switching and jack facilities so that amplifiers and recording heads may be interconnected ad lib. All the writer's equipment is interconnected by means of standard telephone jacks and sockets for amplifier connections and co-axial connectors for recording heads. Three or four tape speeds are also desirable.

Perhaps a brief account of how this equipment is used may be helpful; for example, a recording to give the effect of two or three pianos and two guitars plus echo chamber, etc. Three microphones were installed inside the piano, two of the crystal variety having a good overall frequency range and a third with a very limited bass response. A two-way foot-operated volume control was used to fade in either of the two crystal microphones or the one with the low bass response. The latter microphone was coupled to a pre-amplifier with plenty of treble boost so that the piano was made to record with a very high pitched sharp tone. At the same time, the pre-amplifier was being rapidly cut on and off with a free-running multi-vibrator to give a fast tremolo effect. Thus, by operating the foot control, highly contrasting tones could be obtained ad lib from one instrument.

By using different recording speeds, high speed arpeggio runs were superimposed on the original recording together with a bass-guitar background obtained by using an electric guitar playing the bass and chord sequence of the melody. A change over from one instrument to another is very effective and easily made by splicing separate recordings. The tempo, however, must be constant and should be taken from the original recording.

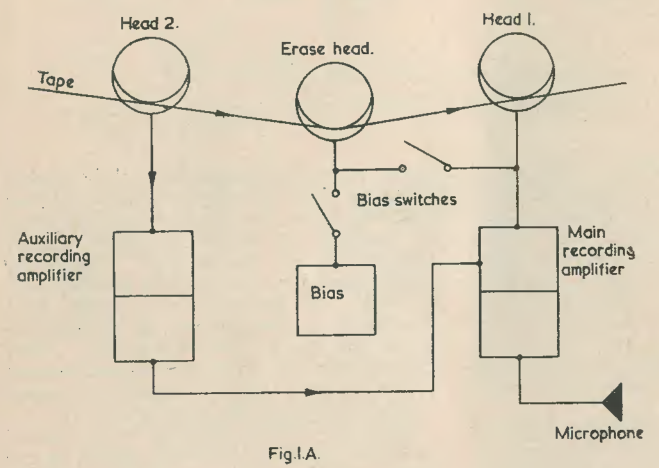


Fig. 1a. System used by the writer for multiple recording

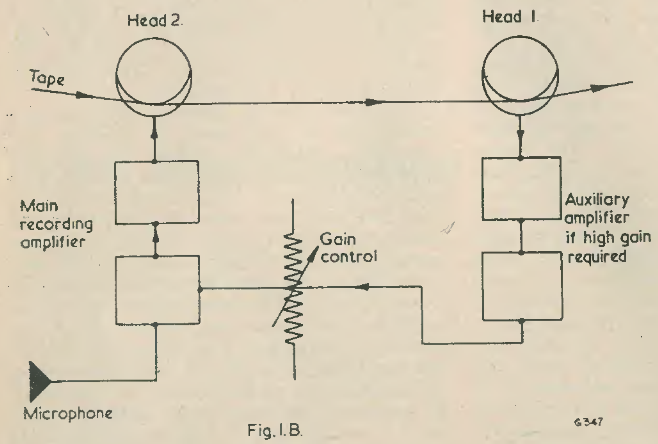


Fig. 1b. If the amplified, delayed output of Head 1 is fed back in parallel with the input to Head 2, an echo will be superimposed on the recording. Various results may be obtained by variation of gain and the distance between the two heads

Echo Chamber Effects

With the aid of a second recording head and an auxiliary amplifier (the normal recording amplifier will do if the first stages have enough gain), echo chamber effects may be obtained and the results are quite amusing if the echo is allowed to build up from a single word or a sound. For example, if the head 1 is connected into the amplifier network as shown in Fig. 1*b*, and the gain control set to allow for full tape modulation, it is only necessary to say "Hello" into the microphone. The sound will carry on all the way along the tape until it becomes distorted. If the gain is high the word will build up into a tremendous noise; if the gain is gradually reduced as soon as the echo starts to build up the sound will gradually die away. By carefully controlling the gain from head 1 all sorts of echo effects may be obtained. The diagram explains the interconnections between the heads and the amplifier, and it will be seen that the whole effect is obtained because of delayed feedback via the head 1, the amplifier and the tape; the echo recording being completed by Head 2.

Splicing and Editing

The recording and editing of complete plays and musical items may be carried out with very limited equipment. A good splicing block is essential as it is very important that the tape is joined perfectly in line. A commercially made splicing block (the Bib) is available and this is recommended. Splicing should always be made with a diagonal cut and with the overlay on the outside of the tape when it runs from left to right, and on the inside when it runs from right to left. Temporary splices may be made with adhesive tape (cellotape) but this method of jointing is not recommended for permanent use. After a while the adhesive presses out from under the tape and spreads along adjacent layers. The result is tape sticking on guides and heads. The most successful method is that of cutting on the diagonal and overlapping as above and making the joint with E.M.I. jointing compound. Strong, noiseless joints may be made by this method.

BOOK REVIEWS

GERMANIUM DIODES. By Dr. S. D. Boon. 85 pages, 72 diagrams and charts. Published by Philips Technical Library. Obtainable in England from The Cleaver-Hume Press Ltd., 31 Wright's Lane, London, W.8. Price 9s. 6d. postage 6½d. inland, 3½d. overseas.

Although this is but a small book in card covers, it contains a considerable amount of information and many graphs concerning germanium diode types OA71, 72, 73 and 74. The book is of Dutch origin, but the diodes are the same types as those obtainable from Mullard, Ltd., in this country.

Three short chapters describe briefly the underlying principles of the device and some manufacturing processes, the characteristics, and general properties of diodes. Further chapters deal more extensively with applications such as rectification or demodulation. There is one chapter devoted to brief descriptions of several other applications such as rectifiers for high and low impedance sources, measuring instruments, video detectors, d.c. restorers, f.m. limiters, mixers, ratio detectors, pulse-shapers, interference suppressors, etc.

A fair amount of space is given up to very useful graphs concerning the diodes mentioned above, and there is an Appendix which deals with diodes for special applications, i.e., types OA81, 85 and 86.

Presented in the usual high standard of the Philips Technical Library, this book provides all the information likely to be needed on the diode types around which it is written.

MK BUIZEN HANDBOEK. 334 pages. Produced by U.M. De Muiderkring, Bussum, Holland. Price 15s. 0d. postage 9d. Sole Agents; The Modern Book Co., 19–23 Praed Street, London, W.2.

Not the least attractive feature of this rather unique valve data book is the manner in which the information for each valve type is presented in diagram form instead of the more usual tabulated data. The brilliantly-coloured edges to the pages in the eight sections into which the information is divided are not only nice to look at, but facilitate reference to the data one is seeking.

The Introduction, printed in nine languages, reveals that a fair amount of thought has gone into the compilation of all the valve data.

The method adopted to present information is to show a typical circuit diagram for each valve type. On this diagram there are symbols, consisting of small circles, triangles and rectangles, in which are shown the usual values of currents and voltages, while associated components are given typical practical values. A base diagram is also shown.

The eight sections deal with (1) diodes (rectifiers and detectors), (2) triodes (double-triodes and double-diode-triodes), (3) tetrodes and pentodes (including double-diode-pentodes), (4) output valves (triodes, tetrodes and pentodes), (5) frequency changers (hexodes, heptodes, octodes, and mixer valves containing triode oscillator sections), (6) combination valves (triode-pentodes, etc., for r.f., i.f., and a.f. use), (7) thyratrons, crystal diodes and transistors, and (8) cathode ray tubes (magic-eye indicators, and c.r. tubes for television and oscilloscopes). Each section gives details of alternative or near-equivalent types.

A good index enables one to ascertain quickly details of a particular valve, its service or CV No., and so on. This very useful book covers a considerable number of current American, British and Continental valve types. Although it is priced somewhat higher than most books of its type, the additional cost seems justified in many ways.

One criticism can be made: The difference between International Octal and Mazda Octal bases is not mentioned.

AN INTRODUCTION TO AMATEUR TELEVISION TRANSMISSION. By M. W. S. Barlow, G3CVO/T. 30 pages, 34 diagrams and illustrations. Published by the author, and obtainable from him at 10 Baddow Place Avenue, Gt. Baddow, Essex. Price 3s. 6d., post free.

Michael Barlow needs no introduction as an authority on amateur television transmission, and this booklet he has produced reveals the great strides that he and other enthusiasts have made in their particular field of activity.

The booklet consists of reprints of articles that have appeared from time to time in the R.S.G.B. *Bulletin*. The circuit diagrams show that considerable simplification of circuitry has been achieved, which brings a complicated technique within the understanding of those who may not be familiar with the complex technical problems of picture transmission.

Although this absorbing line of development may be beyond the financial resources and technical ability of many amateurs, Barlow's record does at least show that it is a subject that can interest professional and amateur worker alike. On reading this booklet through, one is left with nothing but profound admiration for the results achieved, and the enormous amount of work that has been devoted to the project.

W. E. Thompson

A PORTABLE RADIO-TELEPHONE

by A. C. GEE G2UK

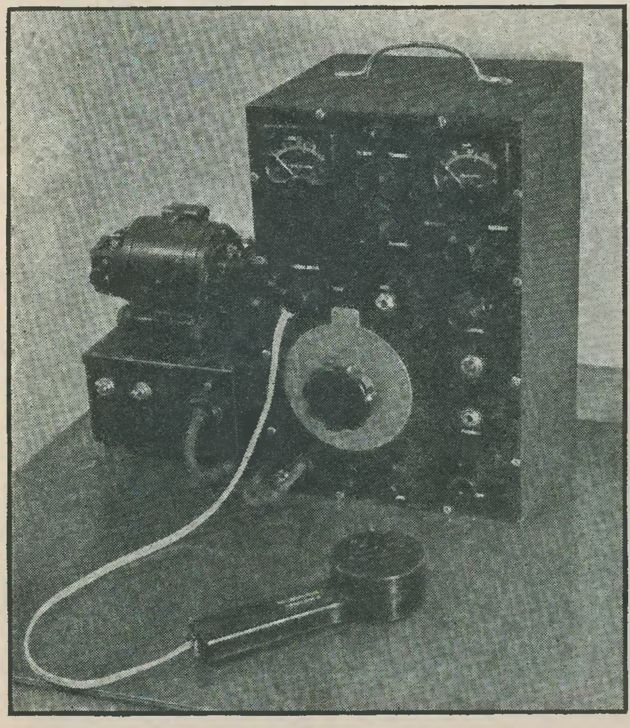
THE 160 METRE AMATEUR BAND HAS MUCH to recommend it as a "local net" frequency, whether as part of an R.A.E.N. organisation or solely for keeping in touch with one's local colleagues. The simplicity of equipment for this purpose gives it a big lead over that needed for the higher frequencies.

The equipment described here was designed with a number of such uses in mind, As it was intended for R.A.E.N. service, operation from accumulators was essential. This feature also meant that the equipment could be used as a portable from the car or aboard a motorboat. Such use would undoubtedly mean that a variety of aerials might have to be used, so provision was made for this contingency. Long range was not required, neither was the ability to work weak stations through QRM, so a simple t.r.f. receiver appeared to be all that was required. The final circuit decided on was, therefore, a single tube crystal oscillator modulated by a three-stage modulator for the transmitting section, using an aerial coupling system which would resonate a wide variety of aerials, and a three-valve "straight" receiver.

Economy of battery consumption was desirable, and it was felt that operation from a 12-volt d.c. supply was likely to be the most useful. Accordingly, the valves and pilot light have been so chosen that they can be wired in series-parallel, h.t. only being supplied from a small rotary converter. Total d.c. consumption has thus been reduced to 1.5 amps with filament only on, 4.5 amps in the "receive" condition, 6 amps at "monitor" and 5.5 amps at "transmit." These ratings are all well within the capacity of a normal size 12-volt car battery.

Mullard miniature valves are used throughout, the transmitter line-up consisting of an EL41 as crystal oscillator, modulated by a second EL41, which in turn is driven by an EL91 and an EF40 as pre-amplifier for a carbon microphone. The receiver uses an EF91 as r.f. stage, an EF92 as detector and an EL91 as audio amplifier.

The various controls on the front panel are as follows: Two knobs between the meters are for the oscillator anode tuning and aerial tuning variable capacitors. Above them is the aerial socket. Beneath the right hand meter is the second/monitor/receive switch, and immediately underneath is the crystal selection switch control. On the left, just above the receiver tuning dial, is the knob controlling the potentiometer P, which determines the depth of modulation. The left of the two lower knobs is the receiver volume control, and that at the right controls the reaction. The microphone lead is connected directly to the appropriate terminals on the microphone transformer, passing through the panel via a rubber grommet.



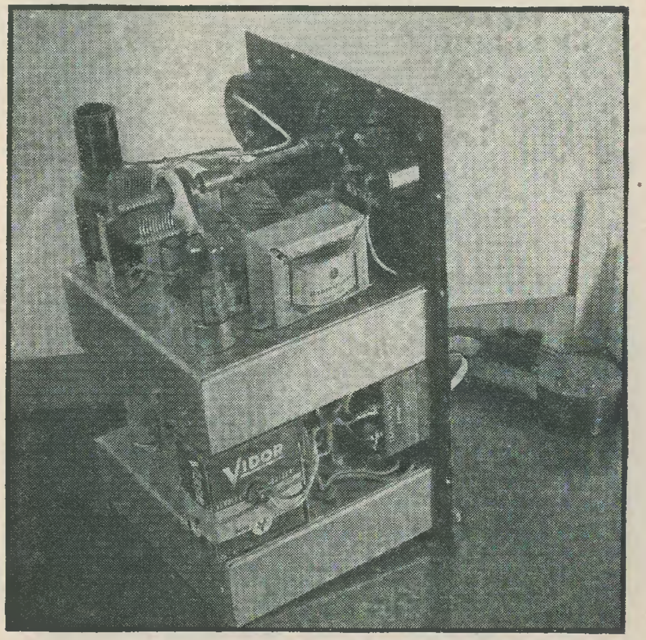
The complete radio telephone, with rotary generator power supply

The general construction and layout can be seen from the photos, and a detailed description seems unnecessary, as the location of the various components is not critical. In the model built by the author, a war surplus microphone type No. 4A is used. This is a carbon type and thus must be used with a small energising battery. After some experimenting, 1.5 volts was found to be all that was required, so a Vidor type No. L5040 battery was fitted as shown. A switch is provided in the handle of the microphone so that the battery can be permanently fitted at the back of the equipment and forgotten. It will run for months without requiring renewal. The microphone transformer used is also war surplus, type Trans Mic No. 2 ZA 6904, but any similar type will do just as well.

Provision for two crystals is made, a switch being available for changing from one to the other. If desired, it should be quite possible to make room for a third.

In order to simplify going from "receive" to "transmit," a fairly elaborate switching system is provided, which will shift the aerial from the receiver to the transmitter, and transfer the h.t. from the receiver to the transmitter. An intermediate position of this switch will enable the receiver to be used at the same time as the transmitter, thus enabling the latter to be monitored. In this position the h.t. is applied to both receiver and transmitter and the aerial removed from the receiver. This monitoring facility is very useful for checking the modulation.

The complete unit is housed in a cabinet 8in wide, 7in deep, and 12in high, supplied by Philpotts Metal Works Ltd., Loughborough. Two aluminium chassis 6½in by 7in by 2in deep are also required. The layout of the front panel is clearly shown in the photographs and the lettering is done with "Panel Signs" transfers supplied by Data Publications Ltd., which much enhance the appearance of the completed transmitter/receiver.



The transmitter-receiver removed from its case

The Receiver

A perusal of the appropriate circuit diagram will show that the receiver is, as already stated, a straightforward t.r.f., detector and audio amplifier line-up. Maxi-Q coils are used, Range 3 covering the frequency band required. In the author's model the octal plug-in types are used, and the figures shown in the circuit diagram indicate the appropriate pin connections. The blue colour coded coil is required for the r.f. tuning circuit, and the green type for the detector and reaction circuits. The two-gang variable capacitor of 370pF maximum capacity is a J.B. Miniature type. The l.f. choke in the anode of the audio amplifier valve is a midget 10H, 40mA type. The two variable potentiometers are also of the midget type. The tuning dial is an Eddystone type 843 Vernier Slow Motion dial, which is coupled to the variable capacitor by a small Eddystone flexible coupler. The r.f.c. in the detector anode circuit is an Eddystone type 1066. The values of the other components are shown in the circuit diagram. Layout follows the usual practice. A small metal screen should be placed between the r.f. stage and the detector stage components, beneath the chassis, but no above chassis screening is necessary, as all valves and both coils are covered by cans.

The EL91 and the EF92 both take a filament current of 0.2 amps, so that they can be wired in series. The EF91 has a filament current of 0.3 amps and this should be wired in series with a 6.3 volt 0.3 amp pilot lamp. Both sets of filaments are then wired in parallel to the filament supply, so that the 12-volt battery supply can be used for filament heating.

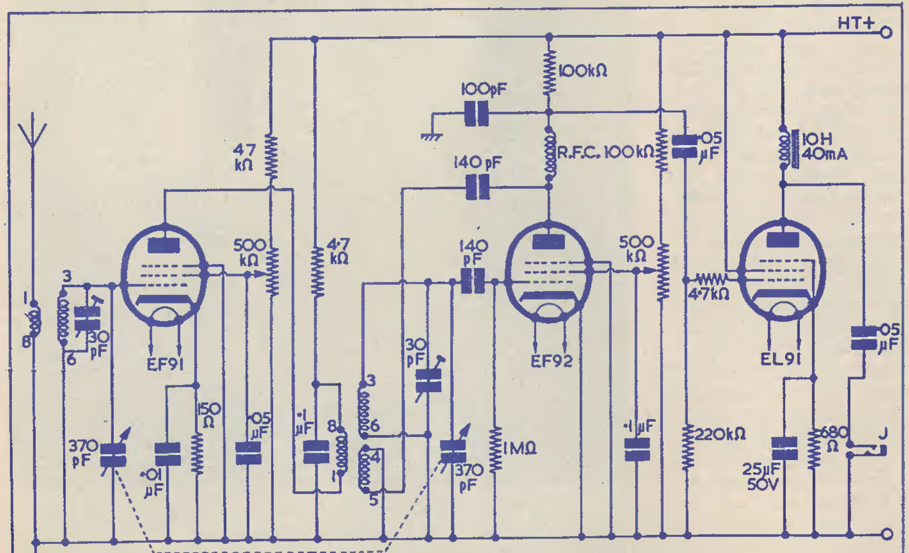


FIG.1. Circuit of RECEIVING SECTION

G 313

The Transmitter

The transmitting section is also quite straightforward. The microphone transformer is fixed to the panel below the transmitting section chassis, the microphone battery being carried in a small clip-holder made up from strip aluminium. A metal screen divides the modulator section components from those of the oscillator on the underside of the chassis, but no above-chassis screening is needed. The oscillator anode coil L_1 is wound on a 1½in diameter former. Approximately 45 turns of enamelled wire of 22 or 24 s.w.g. tuned with a 250pF variable capacitor should tune to the 160 metres band.

Whilst this transmitter was built primarily for use as a local radio telephone, it can, of course, be used for c.w. and with a good aerial normal long-distance c.w. communication can be effectively carried out if the oscillator is keyed. Provision is, therefore, made for keying in the cathode circuit; a key click filter being wired in around the key jack J, which is of the closed circuit type. The modulation choke is a small receiver type of 10H, 90mA rating.

It is advisable to screen the lead from the potentiometer P to the grid of the EF91, and the 4.7kΩ resistor should be soldered right up close to the grid pin.

The EF40 and the EL91 both have a filament current of 0.2 amps, so they can be connected in series, leaving the two EL41's to be wired in series, thus enabling the 12-volt battery supply to be used for filament heating.

Aerial Arrangements

The only other point which needs mentioning is the aerial arrangement. In the writer's equipment, what amounts to a loading coil is mounted on top of the anode coil as shown in the photos. This consists of about 100 turns of 34 s.w.g. enamelled wire on a 1in former, series tuned by a 500pF variable capacitor. With this, any length aerial from a 12ft whip to a fifty to sixty foot length of wire can be resonated. It is advisable to spend a little time experimenting with the number of turns on L_2 and the distance of the two coils from each other, using the length of aerial which will most frequently be used. The arrangement shown is that most convenient in the writer's case, but other readers may find a more conventional link coupling to a centre loaded whip or antenna tuning unit more convenient, in which case, of course, all that is required is a two-turn coupling link over the end of L_1.

Send/Receive Switch Connections

A three-wafer, three-position switch is required for the transmit/monitor/receive switching mechanism. The aerial section has the first and second contacts joined and taken to the transmitting unit aerial connection. The third contact is connected to the receiver aerial.

The second switch section has the first and second contacts joined and connected to the transmitter h.t. connection; the third contact is left blank. The third switch section has the first contact not connected, with the second and third strapped and connected to the receiver h.t.

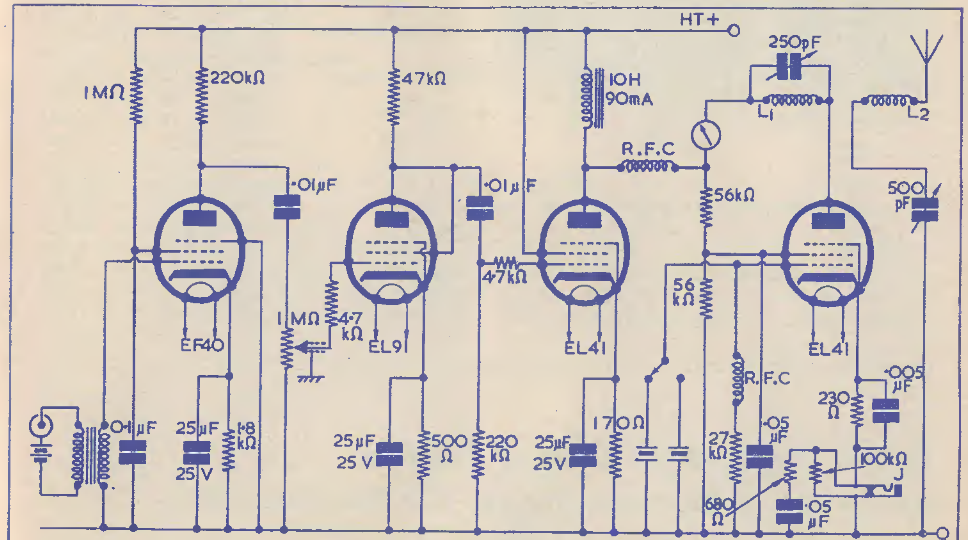


FIG.2. Circuit of TRANSMITTING SECTION

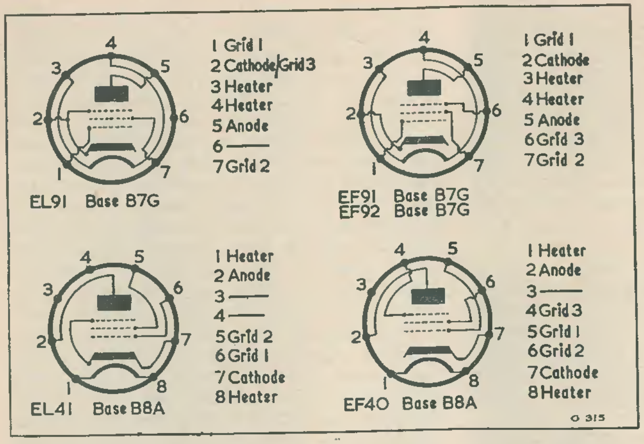
G 314

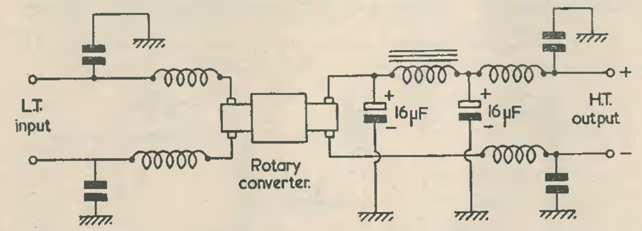
Power Supply

As previously stated, the equipment is intended for operation from a 12-volt d.c. supply. The filaments are wired up in series/parallel so that they can be connected directly to the battery. The h.t. requirements are supplied by a small rotary converter. That used by the writer is a Type ZA 1517 (HT 31 Watt No. 1 Rec.). Input 11.5V, output 250V, 125mA. It is mounted on top of a small metal box 5in × 5½in × 3in deep, which houses the smoothing components. It is worth while taking some trouble over this smoothing, for if well done, no hash whatsover will be audible in the receiver. As can be seen from the circuit diagram, chokes and capacitors are provided in each l.t. lead and also in each h.t. lead, together with, in the latter case, a pair of 16μF electrolytic capacitors—a single double-section type being used in the design shown, together with a smoothing choke. The smoothing choke, together with the chokes and capacitors in the leads, were obtained from a type 104 Power Unit (10K/238). These are, of course, designed specifically for this purpose. Similar components from any other small surplus rotary would do just as well. The general arrangement of these components and the rotary itself is well shown in one of the illustrations. Two double-pole on/off toggle switches are provided, one acting as "main" switch to rotary and filaments, the other switching on the rotary itself.

With an h.t. supply of 250 volts, the equipment draws about 25mA in the oscillator anode circuit, thus giving quite a reasonable input for "top band" use.

The two meters shown are surplus voltmeters reading 0–20 volts d.c. and 0–40 volts





Smoothing arrangement for rotary converter.

respectively. That on the left reads accumulator voltage, being wired in parallel with the filament leads. The other was modified by removing the internal resistor and replacing with a shunt across the terminals; the shunt being wound up from a short length of resistance wire, the exact length of which was chosen by experiment, so that the meter reads mA instead of volts. The original "volts" marking on the dial was blacked out with Indian ink and the new "volts" and "mA" signs put on the meter glass with "Panel Signs" transfers (Set No. 3).

This small portable radiotelephone has been extensively used by the writer for a year or more, and has given the greatest satisfaction in all respects. It has been operated portable from a car and also aboard a Broads motor cruiser, when good contacts on both phone and c.w. were achieved. It is regularly used for local "top band" schedules, running off a 75 amp hour accumulator which is trickle charged, the whole thus making an ideal emergency communications unit.

British Standard for Code of Practice on the use of Electronic Valves (C.P.1005—Part 3:1956)

Part 3 of British Standard Code of Practice CP.1005, "The use of Electronic Valves" covers requirements for photo-cells, transmitting valves and cold-cathode gas-filled valves.

The new part should be read in conjunction with the recommendations for all electronic valves contained in Part 1 of the Code of Practice which was published in 1954 together with Part 2.

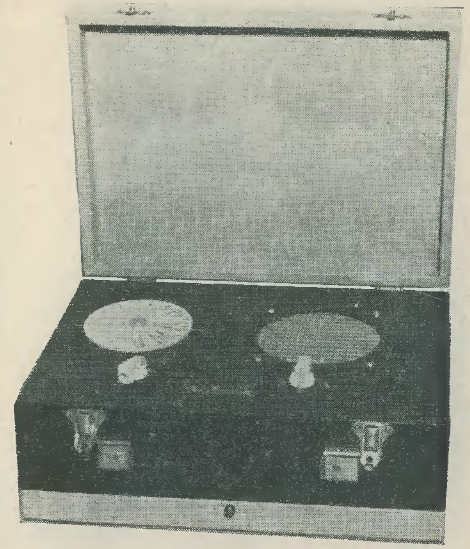
Part 3 gives information, additional to that in Part 1, on photo-cells, transmitting valves and cold-cathode gas filled valves; and on the more common aspects of the use of electronic valves, such as: ratings, mountings and temperature.

Specific aspects of the subject of which the following are examples, are also dealt with: modulation-frequency response and relative spectral-reponse for photo-cells; means of ventilation and cooling for transmitting valves; and ionization and de-ionization in cold-cathode gas-filled valves.

Reference is made in the document to the possibility of danger arising from X-radiation from valves operating at high voltages.

Copies of the standard may be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. Price 3s. each.

Building The HIWAYMAN PORTABLE



PART 1

by **P. VERNON**

MANY READERS AT THIS TIME OF THE YEAR must have felt the need for a fully portable receiver which they may carry around with them on country walks or other family outings. Others again may require a set capable of being transported to any part of the house or garden without the necessity of having to plug in to a mains socket. It is rather pleasant to be able to have a picnic lunch in some secluded glade complete with the latest Test commentary to round off the pleasure of the occasion!

A modern portable receiver must be fully mobile in every sense of the word. It must, of necessity, possess a self-contained power supply, an efficient aerial (not a "throw-out" type), a selective and a high gain circuit, together with adequate audio output and, to round off the list, light weight and portability.

All of the above conditions have been complied with in the design and construction of the receiver about to be described.

"The Hiwayman" has been designed by Radio Experimental Products Ltd., and the receiver is available in kit form right down to the last nut and bolt. It is also available from many radio dealers and some of our regular advertisers. Wiring plans—reproduced here—and instructions are also available, either separately or with the kit as supplied.

Specifically designed to meet the need for a really efficient portable receiver, especially for the home constructor, at a reasonable price, it is a first-class performer and, contained within an attractively styled carrying case—as the front cover illustration shows—it is a worthy addition to the range of home constructor equipment offered in kit form that is now available to the home hobbyist.

Circuit

This is shown in Fig. 1, where it will be seen that the well-known range of B7G-based valves are used. The frequency changer is the 1R5, i.f. stage 1T4, detector and first audio 1S5 and the output stage a 3V4.

L_1 and L_2, the medium and long wave aerial windings respectively, are mounted on a Ferrite rod and supplied as a complete assembly. The wavechange switches A, B, C and D are, of course, ganged. C_1 and C_2 are the mixer/oscillator ganged tuning condenser. The mixer grid has a.v.c. applied via R_1, decoupled by C_8.

The i.f. stage is conventional and is followed by the detector/first audio valve. Via R_4, a.v.c. is applied to the i.f. stage. R_6 is the volume control.

The output stage is simple and will produce more than sufficient audio, without distortion, for the average person. Coupling into the output stage is via C_{12}, the purpose of C_{11} being to filter out any residual r.f. that may still be present and to ensure that this unwanted part of the signal is not passed on to the 3V4. R_{10} is the grid bias resistor and R_{11} the grid leak.

The l.t.—and h.t.—on/off switches are combined with R_6, the audio gain control.

From Fig. 1 and the above short description, it will be noted that the whole aim of the design has been to produce an efficient but, at the same time, a simple receiver capable of being built by the average home constructor in a few hours and with the minimum of trouble.

Constructional Details

Before dealing with these in detail, it would be as well to consider several points which are of some importance if the best possible final results are to be achieved.

When handling the Ferrite rod aerial, great care should be taken at all times—one sharp tap is sufficient to fracture and break the rod.

Component wiring should be kept as short as possible and all components should be neatly placed, as shown in the various drawings featured herewith.

The construction of this receiver is divided into four parts, the last part also including the alignment instructions. It is assumed in the following that the kit of parts has been obtained from a dealer and the reader is ready to assemble and construct the receiver.

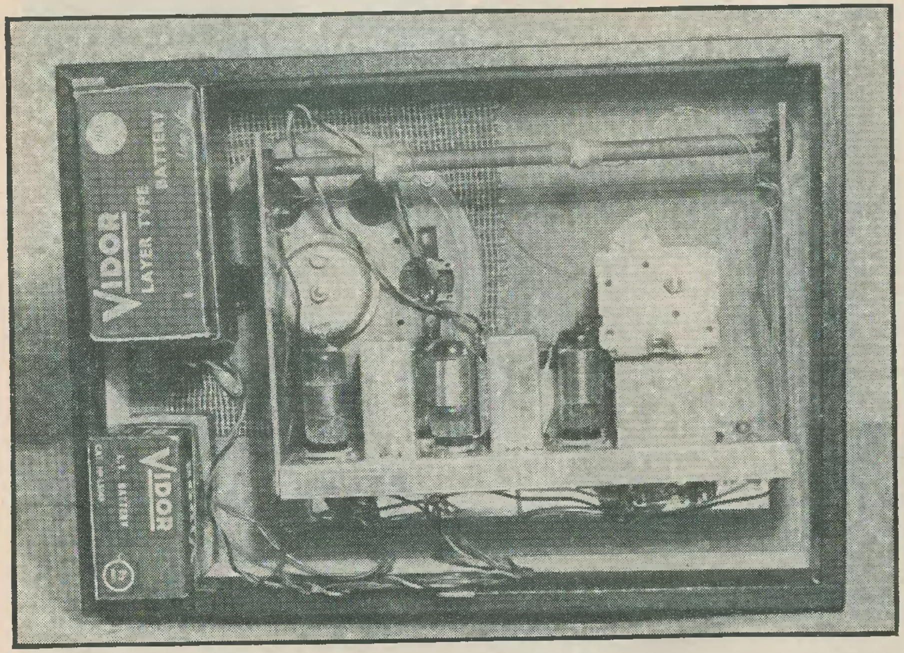
Stage 1

Mount all components as shown in Figs. 3 and 5, ensuring that all nuts and screws are tightly fitted.

Mount potentiometer R_6 on the right-hand side of the chassis.

Fit the four valveholders, taking care that pins 1 and 7 are correctly positioned, and at the same time fitting 6BA solder tags under the valveholder screws.

Insert the three grommets G_1, G_2 and G_3. Next fit the 5-way tag strip. Mount the output transformer T_1 on the top of the chassis.



View showing layout of chassis, etc., in cabinet

It is advisable for the home constructor to use resin cored solder throughout and to ensure that all soldered joints are carefully made. Most manufacturers of kits have found by experience in the past that some 90% of the failures of equipment built at home are caused through badly made joints —and very dry ones at that!

Fit two ¾in 4BA screws through the chassis for the trimmer block and secure in position with *two* nuts on *each*. Join the four tags of the trimmer block marked "60" together and leave about 2in of wire free. Having done this, secure the trimmer block to the two screws with 4BA nuts and one solder tag as shown in Fig. 3. The side of the trimmer

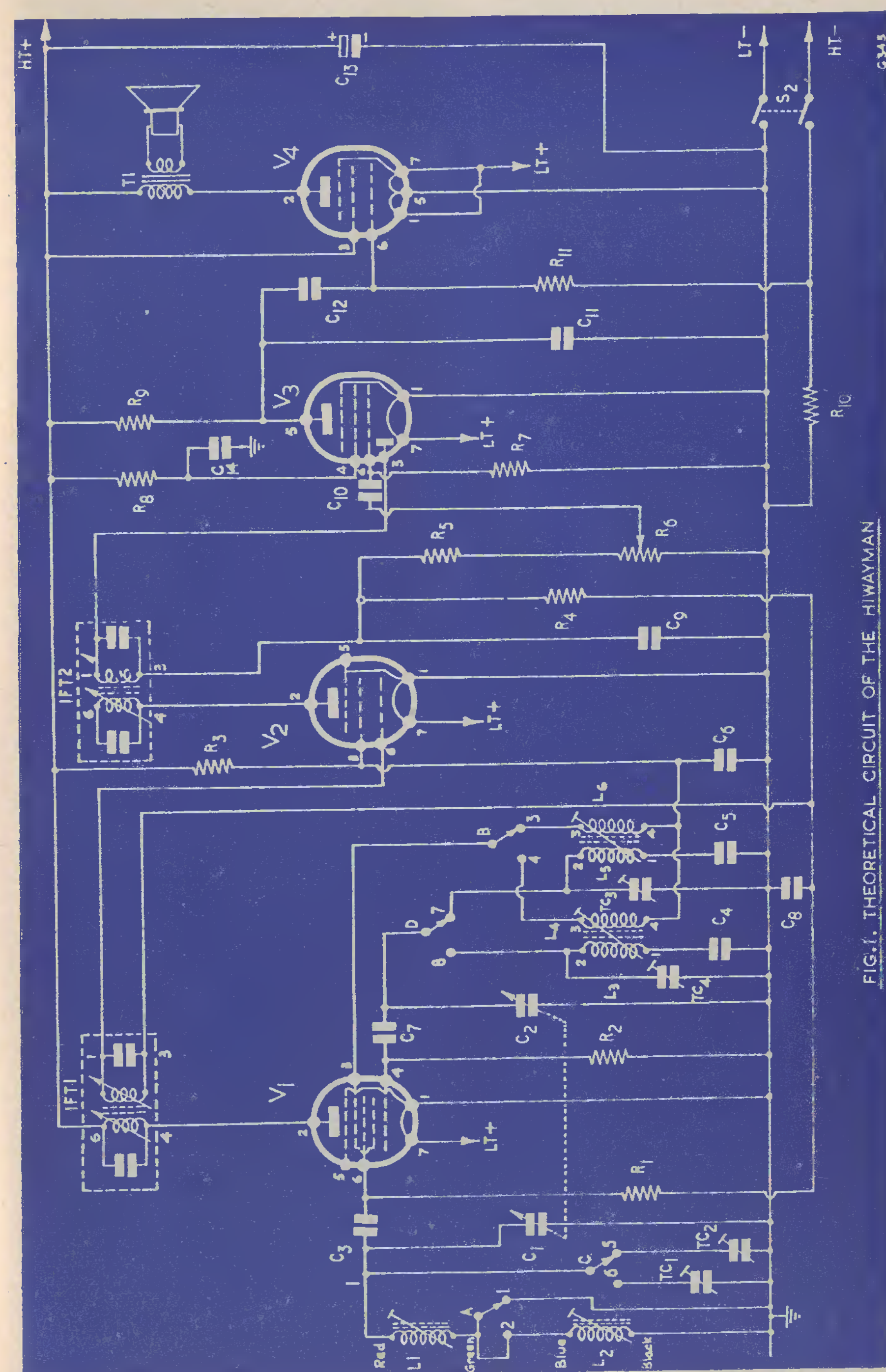


FIG. 1. THEORETICAL CIRCUIT OF THE HIWAYMAN

block marked "60" should be nearest to the edge of the chassis.

Mount the two i.f. transformers (the pin numbers are clearly marked on the bases [see Fig. 1 for these connections]) and, at the same time, fit 6BA solder tags as shown in Fig. 3.

Fix the Medium Wave coil (red) on left-hand side and the Long Wave coil (blue) on the right-hand side, the slots to be oriented as shown in Fig. 2.

Next fit the gang condenser C_1–C_2 to the bracket as shown in Fig. 2, with $\frac{1}{4}$-in 4BA screws, and follow this by fixing the bracket to the chassis with 6BA nuts and screws.

Position and secure the wavechange switch S_1.

Wiring Instructions

Connect pin 7 of V_1 to pin 7 of V_2 and thence to tag 4 of the tag strip. From the same tag, connect to pins 1 and 7 of V_4 and to pin 7 of V_3.

Solder the metal centres of V_1, V_2 and V_3 to pins 1 of their corresponding valveholders and from thence to the earthed solder tags fitted under the valveholder screws. Wire the centre of V_4 likewise to pin 5 and to the solder tag of V_4. Connect tag 4 of S_1 to tag 3 of the Long Wave coil.

Connect tag 6 of S_1 to TC_1 and tag 5 of S_1 to TC_2. Wire pole C of S_1 to C_1 (rear section of ganged condenser), via grommet G_1. Pole D of S_1 is next wired to C_2 (front section of ganged condenser), via grommet G_2.

Next, tag 2 of the Medium Wave coil should be wired to TC_3 and pole A of S_1 to tag 2 of S_1. Follow this by soldering tag 2 of the Long Wave coil to TC_4 via a length of wire. Continue by connecting pin 2 of V_1 to tag 4 of IFT_1. Pin 6 of V_2 now goes to tag 1 of IFT_1.

Connect R_1 between pin 6 of V_1 and tag 1 of the tag strip. Solder C_8 between tag 1 of the tag strip and tag 3 of the same strip. Connect pin 2 of V_2 to tag 4 of IFT_2.

Wire R4 between tag 3 of IFT_2 and tag 3 of IFT_1, and connect C_9 between tag 3 of IFT_2 and the metal centre of V_3. Connect R_5 between tag 3 of IFT_2 and pin 2 of V_3. R_7 is now wired from pin 6 of V_3 to the solder tag on V_3. R_8 is next connected between pin 4 of V_3 and tag 6 of IFT_2.

C_{14} is next fitted between pin 4 of V_3 and the solder tag on the near side of V_4. The next step is to connect R_3 from tag 6 of IFT_1 to pin 3 of V_2. Follow this by soldering pin 2 of V_3 to the right-hand tag of R_6. Next, connect the left-hand tag of R_6 to the solder tag of V_4 and follow this by connecting the loose lead from the trimmer block direct to the solder tag under the fixing nut.

Solder pin 3 of V_3 to tag 1 of IFT_2.

This now completes stage 1 in the construction of the receiver. Below are listed the component parts for this stage.

COMPONENTS

Stage 1

Resistors—all $\frac{1}{4}$ watt

R_1	470kΩ
R_3	12kΩ
R_4	2.2MΩ
R_5	100kΩ
R_6	1MΩ pot with D.P. switch
R_7	4.7MΩ
R_8	4.7MΩ

Condensers

C_8	0.1μF, 250V wkg
C_9	100pF, SM or Ceramic
C_{14}	0.1μF, 250V wkg

Repanco punched chassis
Repanco I.F. Transformers type MSE
Repanco Miniature O.P. Transformer
Repanco oscillator coils types RO_1 and RO_2
4-pole, 2-way switch
B7G Valveholders
Twin-gang 500pF variable condenser, Jackson type "L,' (C_1 and C_2)
4-bank trimmers, Cyldon (TC_1, TC_2, TC_3 and TC_4)
Nuts, Screws, Solder tags, etc.

Stage 2—Wiring Instructions

Having carefully checked the wiring of stage 1, we now proceed to wire up stage 2 as follows, carefully comparing the instructions given below with Fig. 4.

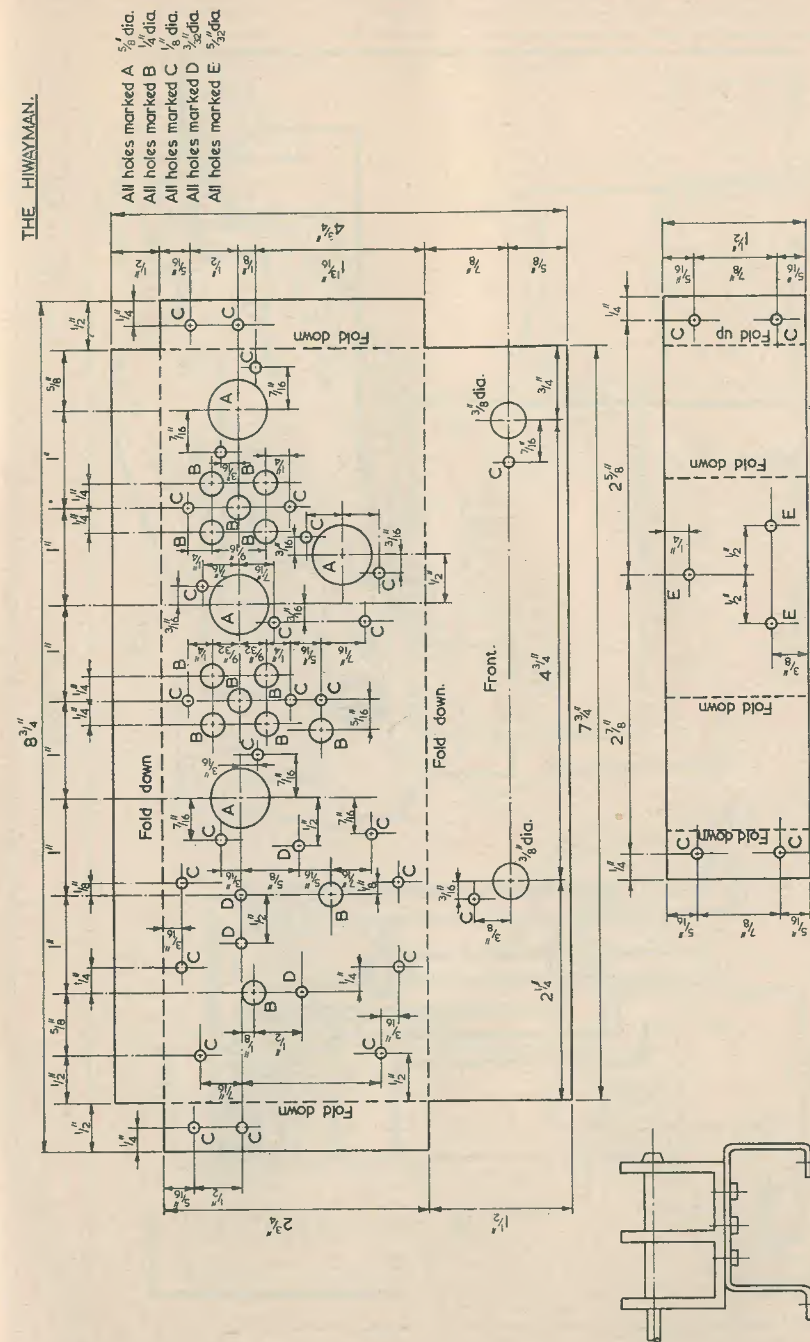
Solder tag 3 of the Medium Wave coil to tag 3 of S_1, and pin 3 of V_1 to pole B of S_1. Connect C_7 between pole D of S_1 and pin 4 of V_1; follow this by wiring C_3 between pole C of S_1 and pin 6 of V_1.

Carefully solder R2 between pin 4 of V_1 and pin 1 of V_1. Next, wire into position C_5 between tag 1 of the Medium Wave coil and the earthed tag of the trimmer block (see Fig. 4).

Insert and solder C_4 from tag 1 of the Long Wave coil to the earthed tag of the trimmer block. Connect tag 2 of the Medium Wave coil to tag 7 of S_1. Wire tag 2 of the Long Wave coil to tag 8 of S_1 and follow this by connecting tags 6 of IFT_1 and IFT_2 together.

Solder tag 6 of IFT_1 direct to tag 2 of the tag strip, tag 3 of IFT_1 then being connected to tag 1 of the tag strip. Wire C_6 from pin 3 of V_2 to the earthed tag of IFT_1, R_9 now being connected from tag 6 of IFT_2 to pin 5 of V_3.

Between pin 5 of V_3 and pin 6 of V_4 solder C_{12} into position, following this by wiring C_{11} between pin 5 of V_3 and the earthed solder tag of the same valve. Connect pin 3 of V_4 direct to tag 2 of the tag strip, following



Side view of condenser on bracket.

Fig. 2. Chassis and bracket drilling details.

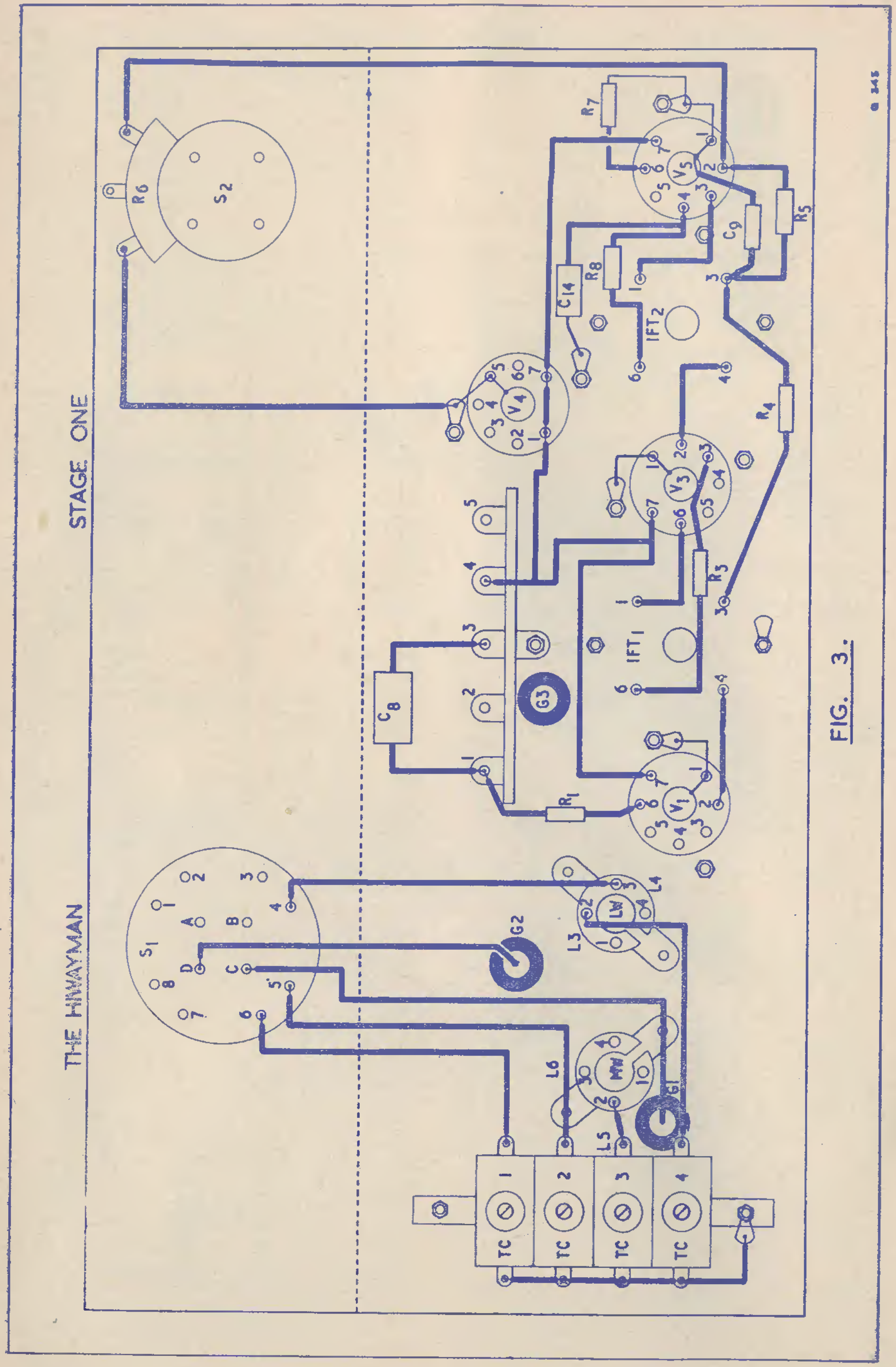


FIG. 3.

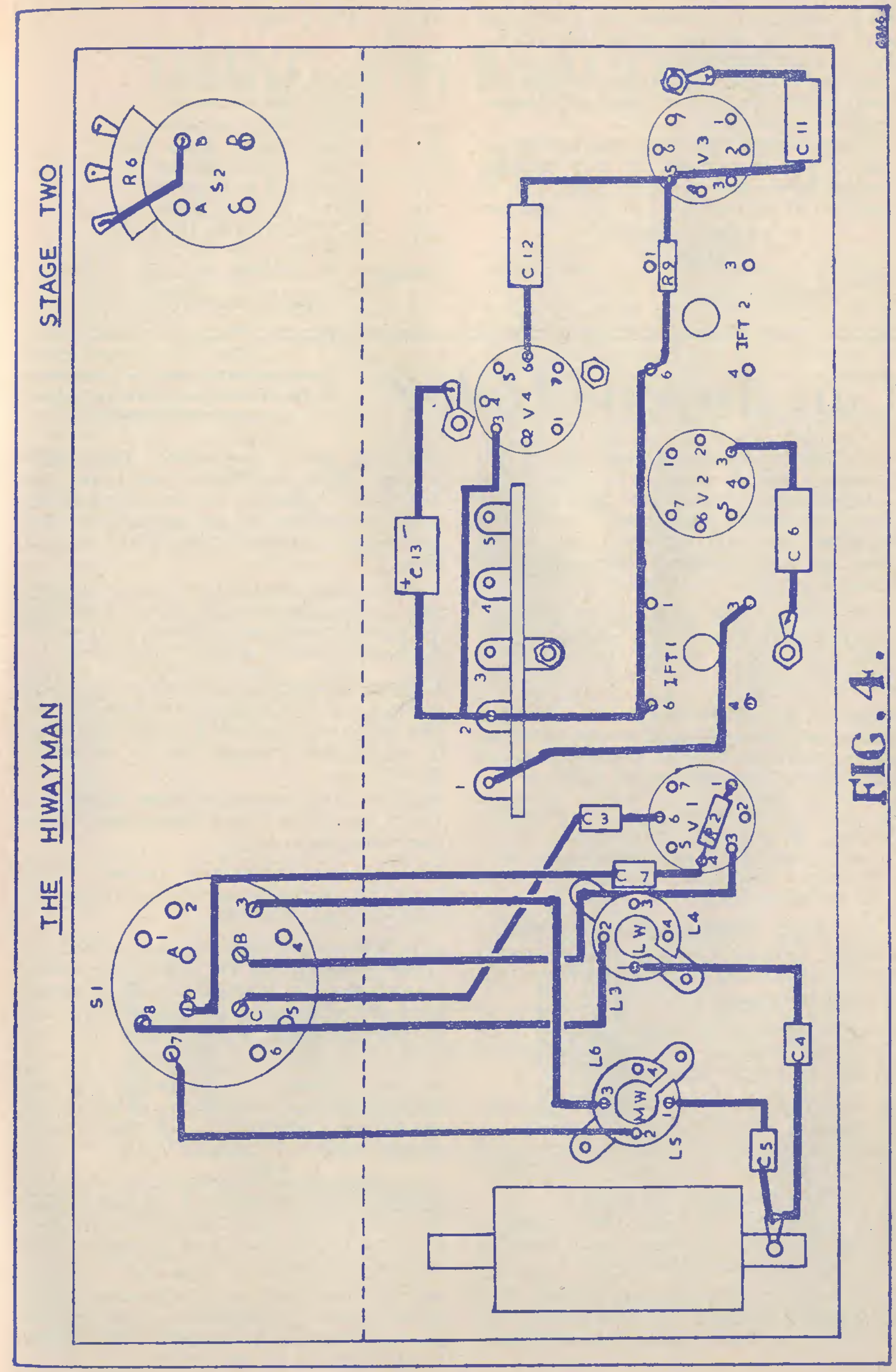


FIG. 4.

this by inserting C_{13} between tag 2 of the tag strip and the earthed solder tag of V_4. (NOTE. The positive end of C_{13} should be connected to the tag strip—see Fig. 4.) Lastly, solder the left-hand tag of R_6 (potentiometer) to pole B of S_2.

This completes the wiring instructions for stage 2 and this should be very carefully checked before proceeding to stage 3, to be described in the next issue of this magazine.

COMPONENTS
Stage 2

Resistors

R_2	100kΩ ¼ watt
R_9	1MΩ ¼ watt

Condensers

C_3	100pF, SM or ceramic
C_4	150pF, SM or ceramic
C_5	500pF, SM or ceramic
C_6	0.1μF, Tubular, 250V wkg
C_7	100pF, SM or ceramic
C_{11}	200pF, SM or ceramic
C_{12}	0.01μF, Tubular, 250V wkg
C_{13}	2μF, Electrolytic, 150V wkg

Insulated wire and sleeving, etc.

(to be continued)

Can Anyone Help?

Requests for information are inserted in this section free of charge; subject to space being available

W. J. TEMPLE, 56 Oakfield Road, Altrincham, Cheshire, asks if anyone can give him a source of supply for a ½-watt neon indicator lamp, candelabra base (screw) used in a Supreme Tube and Battery Tester, model 504A, made by Supreme Instruments Corporation, Greenwood, Mississippi, U.S.A.

B. N. WADE, 408 High Road, Chilwell, Nottingham, wishes to buy or borrow the circuit and details of the Murphy V150 12in t.v. receiver.

J. BAILEY, 38 Consfield Avenue, New Malden, Surrey, wishes to obtain, on sale or loan, the circuit of the Puratone television model T-14 on the Raymond chassis F60.

G. A. MACLAUCHLAN, c/o 14 Mannfield Avenue, Bonnybridge, Stirlingshire, would be very grateful for any information on a transformer coded AC1724-10K/975, from a 62 Indicator Unit.

J. E. BROWN, c/o Brookhouse Farm, Doxey, Stafford, requires a service sheet or circuit details, which he is willing to purchase, of a Baird portable a.c. t.v. receiver.

CPL. J. CHINNOCK, R.A.M.C. Billet, Porton Camp, nr. Salisbury, is in need of the circuit of the Test Set 31, ref. 10SB/57.

G. NORTON, 14 The Flats, Wilsthorpe, Bridlington, asks if anyone can supply any details of the circuit, modifications etc., of the Amplifying Unit type 445, serial 1OU/16575.

J. R. BLACKBURN, 58 Pen y Dre, Rhiwbina, Cardiff, asks if anyone can supply servicing data for a Ferguson 272RG.

W. HURFORD, 120 North End House, West Kensington, London, W.14, wishes to buy the circuit and data of a polyphonic electronic organ.

BRIAN V. TEECE, "Tryphena," Pen-y-Maes Avenue, Rhyl, N. Wales, would like any information regarding the conversion of any ex-WD apparatus to use as radio, t.v. or oscilloscopes, especially the RDF1 and 62 Units.

G. F. WALKER, 19 Burleigh Avenue, Wallington, Surrey, wishes to purchase or borrow the circuit of the Stromberg-Carlson "Command" Receiver type CCT-46104, 1.5–3.0 Mc/s.

T. PARR, 28 West Lane, Middlesbrough, will willingly pay for the circuit and details of the Philco t.v. receiver model BT.1753C, especially on the valve line-up and on the width controls.

ALEC M. JONES, Ashville College, Harrogate, Yorks, wishes to obtain the circuit of the Beethoven Major SG4.

C. HARRISON, 9 Sheldon Avenue, Vicars Cross, Chester, requires information on the ex-Govt. receiver R1448.

L. G. HUTTON, 29 Elmstead Avenue, Marston Green, Birmingham 33, will gladly reward anyone who can supply information, circuit data and, if possible, modifications for the Stromberg-Carlson aircraft radio Tx type CCT.52211, frequency 7–9.1 Mc/s.

M. H. HAGUE, 36 Gladstone Terrace, Grantham, Lincs, wishes to buy or borrow the circuit and information on the Kolster Brandes 12-in T.V. model E.V.30B.

J. A. CUSDIN, Hillcrest Nurseries, Polegate, Sussex, desires the circuit of the Invicta T.V. model 815, particularly details of the line sync separator (EF6), frame sync separator (EF6) and h.t. rail voltage.

W. R. WILLIAMS, 31 Alexandra Street, Ebbw Vale, Mon, urgently needs service data for the Alba D.C.56 receiver (SP20, VP20, SP20, PEN3520 and Barretter).

USING V.H.F. ACORNS

by **F. G. RAYER**

ACORN VALVES ARE AVAILABLE FROM many surplus stockists at very low prices indeed. This, combined with their small size, high efficiency, and particular suitability for H.F. operation, makes them exceedingly useful for a number of purposes. The 955 triode and 954 pentode are most suitable, and have 6.3V, 0.15 amp heaters. They can thus be operated from a 6.3V heater transformer, in parallel with other 6.3V valves, or in series, for 0.15 amp circuits, as in normal a.d./d.c. procedure.

Pin connections for the 955 are shown in Fig. 1, the valve being viewed from the top, or larger end. Stray capacities are exceedingly low, and the central position of the cathode pin also helps in reducing induced hum to a very low level, even on high frequencies. The 955 has a maximum anode voltage of 180V, maximum anode current of 7mA, and amplification factor of about 25. Primarily intended for detector or oscillator positions, it can be pressed into service in 1st a.f. stages, in small sets, or may be employed in b.f.o. stages, or as detector or oscillator in small S.W., V.H.F., or all-wave receivers.

The valves can be fitted into ring type holders, but these are not easy to obtain (Paxolin holders may be obtained from R.C.S. Products Ltd.—*Ed.*). It would be feasible to make such holders, or an alternative is to use small wire clips, taken to the pins, the valve being supported in the wiring. These methods avoid soldering.

It is also practicable to solder the valves directly to the circuit wiring, but care is *essential* or the glass seal will be broken by the heat. To solder the valves successfully, a really hot iron is necessary. An electric iron that has been allowed to reach full temperature is suitable. Connecting leads should not be stouter than 20 s.w.g. and a small loop should be clipped to the *extreme end* of the valve pin. Thin cored solder of the kind intended for radio connections (i.e., relatively low-melting point) can then be applied to the end of the pin, simultaneously with the heated iron, and removed *immediately* the joint is made. It should not be necessary to keep the iron in contact with the valve pin for longer than one second. Long application will render the valve useless for the reason above. If the pin is held between joint and valve by

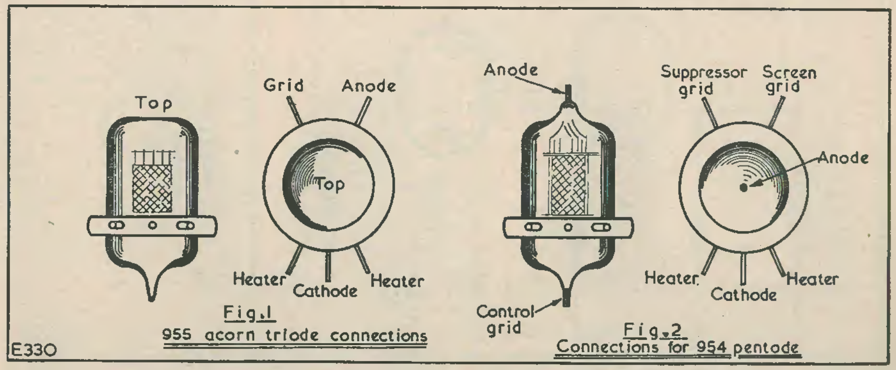


Fig.1 955 acorn triode connections

Fig.2 Connections for 954 pentode

The 954 pin connections are given in Fig. 2. This valve has maximum anode and screen grid ratings of 250V, 2mA, and 100V, 0.7mA, respectively. A negative control grid voltage of −3V is usual.

thin-nosed pliers, this will help to keep heat travelling to the seal. Once leads have been soldered on, they can be suitably cut and shaped, and no further soldering at the valve pins is required.

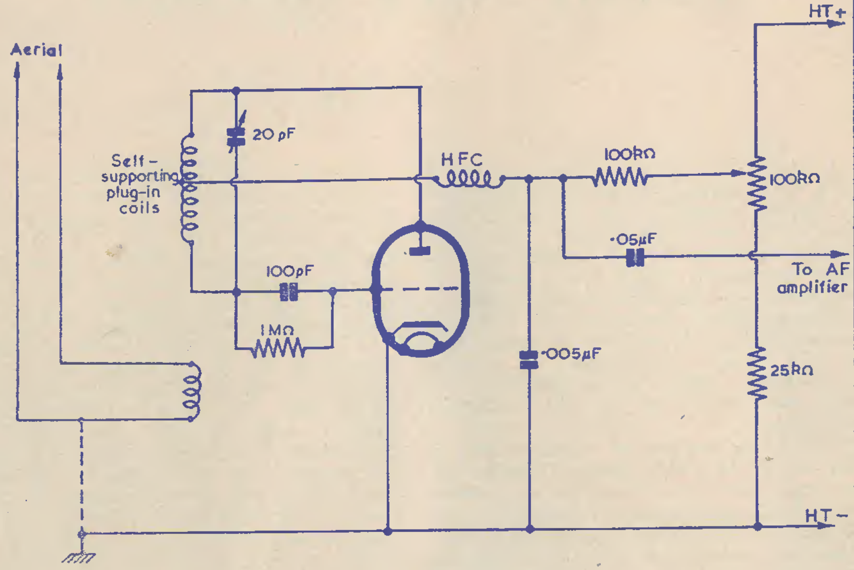


Fig.3
2–15 metre set with 955 triode

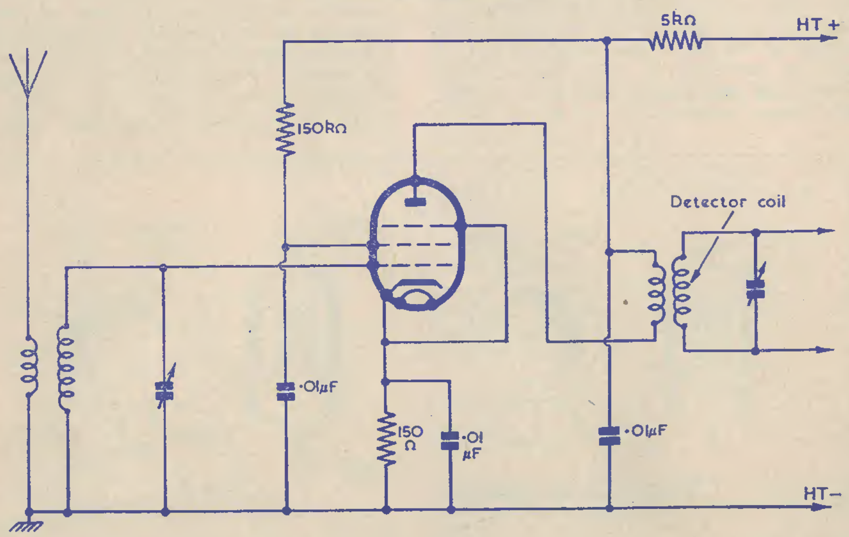


Fig.4
954 in RFstage

E331

Circuits

Though the valves will operate well down to half a metre or so, this naturally does not mean they are unsuitable for normal frequencies. They can be used successfully upon *any* frequency, provided the power to be handled is small.

A simple v.h.f. detector is shown in Fig. 3. A dipole is most suitable, but a short wire aerial of unspecified length, with earth connection as indicated by the dotted line, can be used. Exact frequencies tuned will naturally depend greatly on stray capacity, but the following coils will be approximately correct for the bands given:—

2–3½ metres, 6 turns 14 s.w.g. ⅜in diameter.
3–5 metres, 9 turns 14 s.w.g. ⅜in diameter.
5–10 metres, 12 turns 14 s.w.g. ⅝in diameter.
10–15 metres, 16 turns 14 s.w.g. ⅝in diameter.

A tuning condenser with low minimum is required, and very short direct wiring. The 100kΩ potentiometer is for regeneration control.

The use of an r.f. stage reduces radiation of interference, and maximum efficiency arises when this stage is also tuned. A suitable circuit is shown in Fig. 4. With home-wound coils, separate tuning condensers are best, to avoid ganging difficulties and possible inefficiency from lack of alignment.

the triode, or pentode type wired as triode, or operated as a pentode, this being unimportant.

L_1 is the b.f.o. coil, and can consist of one winding from an i.f. transformer of the same frequency as found in the i.f. amplifier—usually 465 kc/s. The cathode tap will require to be only about 3 turns from the earthed end, and can be made by winding on a few extra turns of thin insulated wire. If oscillation does not arise, the winding must be reversed. With some i.f. coils a tapping can be made on the existing winding, though this is not always easy.

For a note of 1,000 cycles, the b.f.o. is tuned above or below the i.f. to this extent. C_1 may be the usual i.f. coil trimmer, fixed if the component used has an adjustable core. C_2 can be a small variable condenser, panel operated through an extension spindle, of about 25 or 50pF maximum capacity. Once C_1 is suitably adjusted, the note can be modified by operating C_2.

Very tight coupling is not helpful, and may increase background noise, so that the coupling capacity to the detector diode needs to be very small. A 0-8pF air-spaced Philips concentric pre-set is suitable, here. If the note is unsatisfactory, the stage is oscillating too strongly. The number of coil turns between cathode and earth may be reduced, or the 50kΩ resistor increased in value, to correct this.

Standard type S.W. coils can also be used, for wavelengths down to 10 metres. In this case, it is best to use a conventional detector circuit for these frequencies, not the super-regenerative type shown in Fig. 3. The circuit in Fig. 4. is also satisfactory in all-wave sets. The valve is not very suitable for later circuit positions, such as in an i.f. stage, because of the ease with which it may be overloaded.

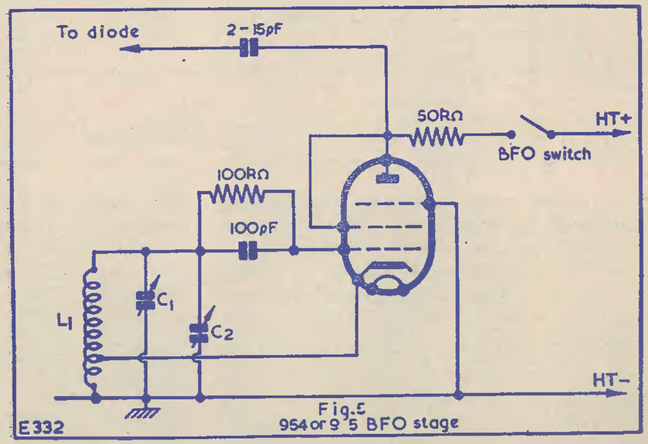


Fig.5
954 or 955 BFO stage

A B.F.O. Stage

The small size of an acorn, and its low current consumption, makes it suitable for inclusion in an existing receiver, for such purposes as a beat frequency oscillator. Here, the valve and all components may be included in a small i.f. transformer can, and a circuit is shown in Fig. 5. This can use

Complete Circuit

A circuit particularly suitable for 10–100 metres is shown in Fig. 6. It may operate phones direct, or an output stage can be added, for speaker reception. As with the other circuits, an h.t. line voltage of about 150 to 250V is satisfactory. If the circuit is used as it stands, battery operation is possible, though these valves are not primarily intended for the purpose, so that a 6V accumulator is desirable for filaments, the total of 0.45 amp being a little heavy for dry cells, except for intermittent use. In such cases, a 120V h.t. battery is satisfactory. For mains operation, a small mains transformer, with half-wave rectifier, will be suitable.

the tuning condensers, or inserted in pin connectors fitted thereto. If the set is to be used on M.W. and L.W., then the by-pass condensers should be increased from 0.01μF to 0.1μF. The variable screen grid control for the first stage is optional. For speaker reception with only the three valves, it is highly desirable to replace the a.f. stage by a type more suitable for the purpose in

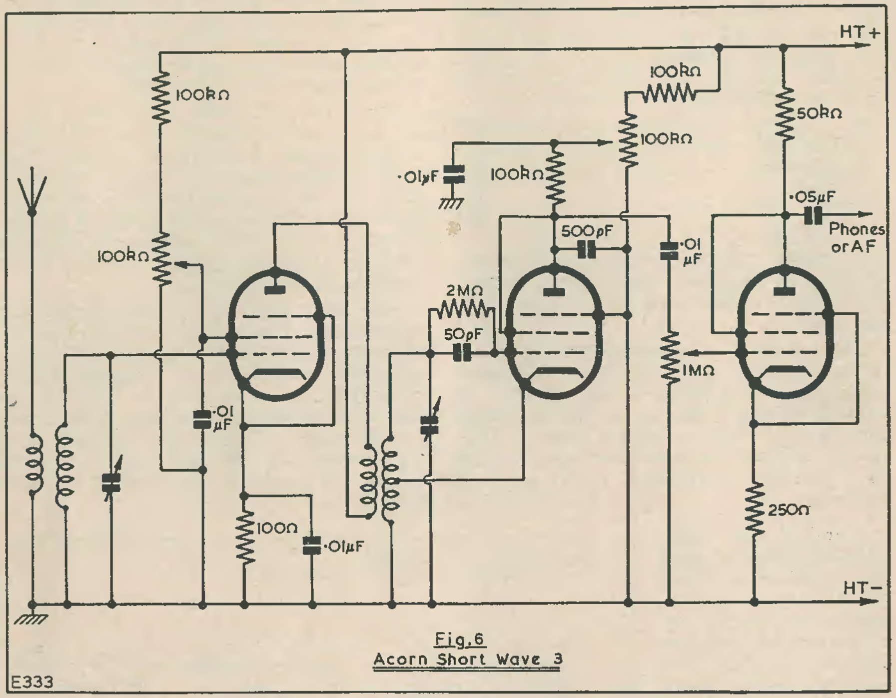


Fig. 6
Acorn Short Wave 3

For short wave purposes, 160pF tuning condensers are satisfactory. With this value, the following coils can be wound:—

9–17m. 4 turns. Cathode tap at ⅓ turn.
16–31m. 7 turns. Cathode tap at ½ turn.
30–61m. 16 turns. Cathode tap at ¾ turn.
60–105m. 31 turns. Cathode tap at 1 turn.

These are all on 1¼in dia. formers, with 24 s.w.g. wire except for the smallest coil, which is of 20 s.w.g., and occupies ¾in winding length, the other coils occupying 1½in. The r.f. stage tuned winding will be exactly similar, but with no cathode tap. For aerial and anode coupling, 2, 4, 6, and 12 turns respectively can be used on the coils, interwound with 32 s.w.g. silk-covered wire at the earthed end of the tuned section.

For v.h.f. purposes, tuning values of 15 to 25pF will be more satisfactory, with small self-supporting coils soldered directly to view, such as a 6V6, with 240 ohm bias resistor, 50μF bias condenser, and output transformer for 5,000 ohms at 50mA. This will give sufficient volume from the more powerful stations.

In service types, the 954 is designated the VR95 and VT120, the 955 being the VR59 and VT121. The 957 triode requires special mention, as it has a 1.25V, 0.05 amp directly heated filament, and would be at once damaged if used in error in a 6.3V, 0.15 amp heater circuit.

In a circuit with plug-in coils and r.f. stage, it is usually convenient to have a vertical screen between stages, and the r.f. valve can be arranged with its grid pin projecting through a hole in this, when high stability can be expected. On wavelengths below 15 metres, a condenser of about 0.005μF may be wired from each heater circuit to chassis, to by-pass r.f.

RIGHT—*From the Start*

PART 7. INTERFERENCE

by **A. P. BLACKBURN**

Anyone who has gone "station hunting" on their radio receiver will be familiar with interference between stations. Those annoying strains of music breaking into the programme are one of the thorns in the side of the perfect radio communication. Although familiarity with the effect may now have made it seem a matter of common sense, the reasons for it are seldom suspected.

In the last article, we saw that a particular signal could be selected by a tuned circuit. The question of how well that tuned circuit rejects all the unwanted signals was not touched upon.

This is a very important question, particularly nowadays, when all wavebands are so crowded. As always, before we come to the point, another aspect must be introduced first.

Sidebands

The first question is: why should two stations interfere? If station A has a frequency of 200 kc/s, and station B a frequency of 202 kc/s, why should one of them not be completely rejected by a tuned circuit tuned to the other? The reason is twofold.

First, a modulated signal of frequency, say, 200 kc/s, has other frequencies associated with it which are dependent upon the modulation, and second, the amount of acceptance or rejection of a tuned circuit depends upon how close in frequency the wanted and unwanted signals are.

To deal with the first point first, a modulated signal contains "sidebands," the frequency of which depend upon the modulating frequency. For example, if our 200 kc/s carrier were modulated with a steady 500 c/s tone, two other "signals" would appear, 500 c/s either side of the carrier, their amplitude depending upon the depth of modulation, i.e. how much the carrier amplitude was varied by the modulation. The three frequencies would, therefore, be 200 kc/s minus 500 c/s, or 199.5 kc/s, the carrier at 200 kc/s, and 200 kc/s plus 500 c/s (or 200.5 kc/s). The first of these (199.5 kc/s) is called the "lower sideband" and the last (200.5 kc/s) the "upper sideband." Fig. 1A illustrates this diagrammatically.

Now, a complex musical sound, such as an orchestra with many instruments producing many frequencies simultaneously, will give rise to a large set of sidebands. The highest frequency present in the sound will produce the pair of sidebands displaced furthest from the carrier frequency. Fig. 1B illustrates a possible siebeband group for such a sound.

Audible sounds may have frequencies up to 16 kc/s or so. To transmit such a sound, a pair of sidebands 16 kc/s either side of the carrier will be produced. This means that no other station can operate nearer than 16 kc/s to the first station without danger of interference. If the second station also has sidebands of up to 16 kc/s, it cannot operate closer than 32 kc/s to the first station.

In practice, broadcast stations limit the highest frequency they transmit to somewhere in the region of 8 kc/s.

Selectivity

The second point concerns the operation of the tuned circuit. What we want of it is to accept the signal with all the sidebands and no other signal. Unfortunately, the natural law of things has not made tuned circuits very efficient in this respect. Fig. 2 shows a signal and sidebands and the shape of the ideal tuning "response." The term "response" here means what happens to the output of the tuned circuit at various frequencies. The response just fits nicely to the sidebands and lets them all through, but immediately outside this range, nothing is passed through the circuit. Also, within the response area all frequencies receive equal treatment; that is, all are passed with their original amplitude.

Fig. 3, however, shows the sad state of affairs that really exists. Curve a is a highly "selective" tuned circuit which just passes the outer sidebands and increasingly favours those nearer the centre or carrier frequency.

This means that the higher sidebands, and therefore the higher frequencies, will suffer some attenuation relative to the lower sidebands nearer the carrier. Curve b shows a relatively unselective circuit. Here the higher sidebands are not attenuated so much as before, but any unwanted signal occurring at A or B will also be passed through. The sharpness of this type of response curve shows the "selectivity" of the circuit.

This then is the choice. With a single tuned circuit, if high selectivity is used as in Fig. 3 curve a, the high frequencies in the modulation will suffer (the upper octave on a piano, for example, would be lost); and if a low selectivity circuit is used, there is a danger of interference from other transmitters.

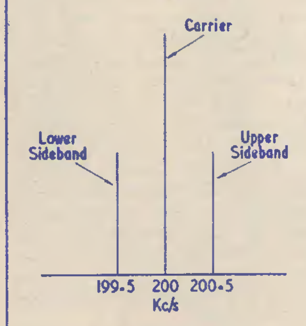


FIG. 1a.

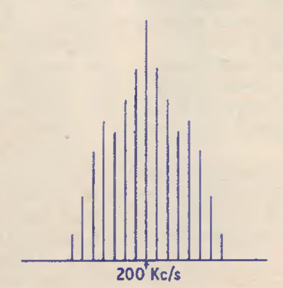


FIG. 1b.

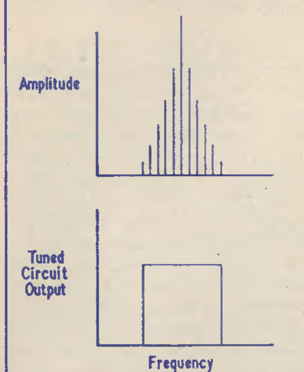


FIG. 2.

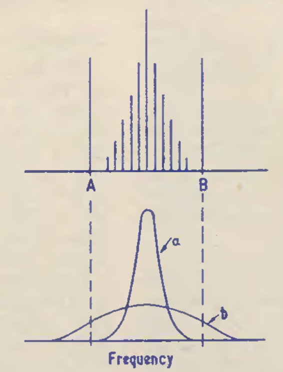


FIG. 3.

Q

In most receivers an attempt is made to compromise between these two extreme conditions. The crystal receiver described in an earlier article had one tuned circuit. The selectivity of the set would not be particularly good, because of the loading of the tuned circuit by the aerial and crystal. A similar circuit is reproduced for reference in Fig. 4. The loading has been minimised in this circuit by tapping the aerial and crystal down the coil.

What we now have to see is upon what features of the circuit does the selectivity depend. It depends upon the coil and the tuning capacitor, their relative values and their quality. Undoubtedly, the most important item is the coil.

A factor of quality is usually used so that coils may be compared from the standpoint of selectivity. This factor is called the "Q" of the coil, and is defined in the following way.

A typical selectivity curve is shown in Fig. 5. $f0$ represents the resonant frequency of the circuit, that is, the frequency where the output of the circuit is greatest. If the frequency is now raised or lowered, the output will drop. It will drop to 0.707 of its maximum value at two frequencies, $f1$ and $f2$ either side of $f0$. The Q is then given by the expression:

$$Q = \frac{f0}{f2 - f1}$$

To take an example, if $f0$ were 1 Mc/s, $f1$ 0.995 Mc/s and $f2$ 1.005,

$$Q = \frac{1}{1.005 - 0.995}$$

$$= 100.$$

This is a fairly high-Q circuit. What this signifies is that the response of the circuit is 0.7 times that at resonance when a signal 5 kc/s away from the resonant frequency is applied to it. The higher the Q value, of course, the better the selectivity obtainable.

Now to examine the coil itself a little closer. The wire with which it is wound must obviously have some resistance. The resonant L and C circuit operates by storing energy in the coil, passing it to the capacitor, which in turn passes it back to the coil and so on, back and forth. The frequency with which the energy is transferred is the resonant frequency of the coil. Every time the energy passes from coil to capacitor, current flows around the circuit, and some energy will be lost in the resistance of the coil. If there were no losses, such as resistance, anywhere in the tuned circuit the energy would oscillate back and forth for ever, once it had been excited.

The operation is very much like a pendulum. If it is swung in air it will continue to oscillate for a considerable time, but due to air resistance and so forth it will finally come to rest. If the pendulum were now placed in treacle, it would come to rest very much sooner. The former case is analogous to a high-Q circuit and the later to a low-Q circuit.

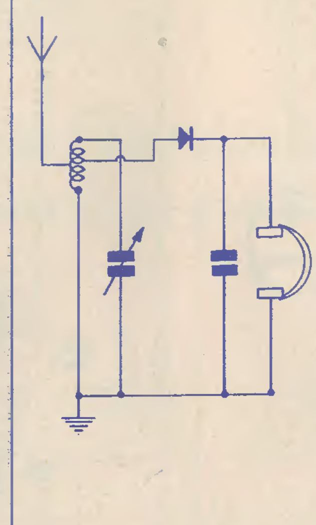


FIG. 4.

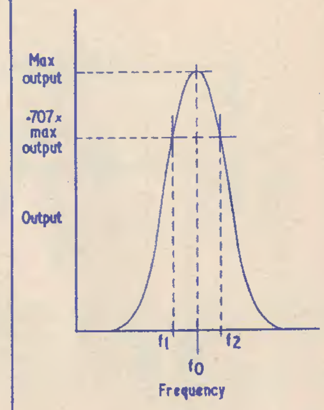


FIG. 5.

It is clearly desirable to keep the resistance of the coil in the tuned circuit to a minimum. It is not the resistance alone which decides the Q of a coil, however. The inductance comes into it also, as can be seen from the expression for the Q of a coil:

$$Q = \frac{2\pi f L}{R}, \text{ where } f \text{ is the frequency, L is the inductance, R is the resistance.}$$

So much for the tuned circuit on its own. Unfortunately, it is not much use on its own; other things have to be connected to it. These limit the useful Q of the circuit. In Fig. 4, for example, the aerial and crystal are connected, and these introduce extra losses into the circuit. The actual Q is always less, therefore, than the theoretical value of the circuit on its own.

Reaction

A single tuned circuit will not normally give sufficient selectivity because of its low Q value, when connected into a receiver. A very successful and simple method of apparently increasing the Q and therefore the selectivity is the use of reaction.

This system uses the principle of feeding back a little energy into the tuned circuit to make up for the losses, and is called "reaction"; or in more highbrow circles "regeneration." A circuit which uses this is shown in Fig. 6.

Basically, the circuit is a leaky grid detector fed from the tuned circuit L_2C_1. The aerial is coupled into L_2 by the coil L_1. So far this is a normal detector. We saw when dealing with detectors that some r.f. "ripple" is still left on the audio after detection. This will, therefore, appear in the anode circuit of the valve and the coil L_3 will couple some of it back into the tuned circuit. The variable capacitor C_3 controls how much is fed back, and therefore controls the selectivity. This scheme has the advantage that it improves the selectivity at the same time as it improves the sensitivity of the receiver. If too much energy is fed back into the tuned circuit, oscillation will occur. This is the condition that occurs when sufficient energy is fed back to cancel the losses in the circuit completely. To revert to the pendulum for a moment, oscillation is analogous to giving the pendulum a little tap every now and again, so that it will swing for as long as you care to tap it.

If reaction has to be applied too close to the point of oscillation, it becomes very difficult to control, so it is still desirable to have a fairly good tuned circuit even with reaction.

amplification afforded by the value; and the Q of the whole circuit is now the product of the Q of L_2C_1 and the Q of L_4C_3. If L_2C_1 had a Q of 80 and that of L_4C_3 were 100, the overall Q would be 8,000.

There is, of course, no reason why the

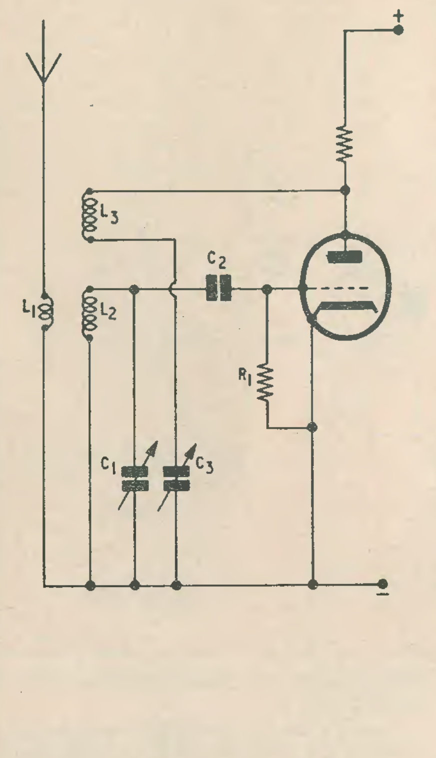


FIG. 6.

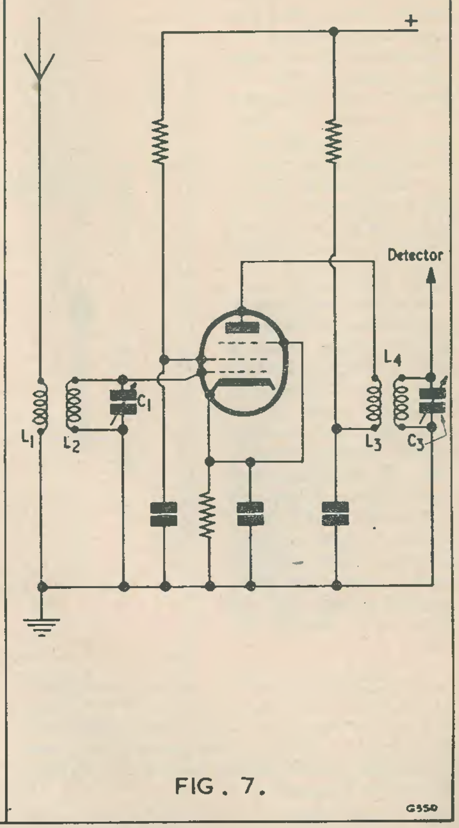


FIG. 7.

Tuned Stages

Selectivity and sensitivity may be increased still further by using more than one tuned circuit. It is virtually impossible to obtain any marked improvement by merely coupling two tuned circuits together, so an r.f. (radio frequency) amplifier is used, as shown in Fig. 7.

Once again the aerial is coupled to a tuned circuit $L_2 C_1$ by the coil L_1. The pentode valve amplifies the signal and couples it via L_3 into the tuned circuit L_4C_3. The resultant selectivity and sensitivity are very much increased by the use of an r.f. stage. The sensitivity increase is due, of course, to circuit connected to L_4C_3 should not have reaction applied as well. With such a circuit we are getting to the stage where the high frequencies in the modulation will suffer due to the high selectivity. In some high grade receivers where both selectivity and sensitivity are of prime importance, two r.f. stages are used, but there are many practical difficulties associated with such a scheme and very careful design is essential.

The Straight Receiver

There are two types of receiver in common use today—the straight and the superhet. The straight is what we have been leading up to so far, the superhet will come later.

A typical straight receiver may consist of a detector alone, or a detector and output stage, and very frequently an r.f. stage, detector and output stage.

The latter two types make very satisfactory receivers. The sensitivity of a receiver with only a detector and output stage is limited, but is quite suitable for listening to the three B.B.C. medium wave stations. If reaction is used, the selectivity is adequate.

Generally, a fairly good aerial must be used, but this depends to some extent upon location.

With an r.f. stage added, the sensitivity is sufficient usually for Continental stations, once again with the proviso of a good aerial. Selectivity, particularly if reaction is used, can be good, and a long aerial will not have as much effect upon the selectivity as in the case of the detector and output stage receiver.

The quality of reproduction in either case will not be particularly good, especially if reaction is used, because of the narrowness of the tuning response.

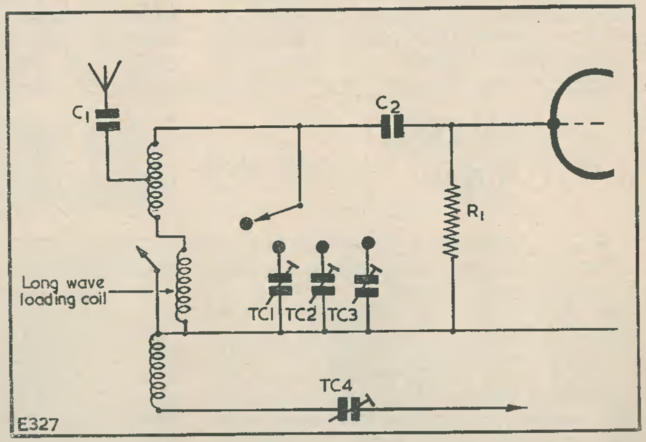
Long Waveband Addition for the High-Q Pre-set Push-Pull Two

by **J. E. BLOOMER**

I CONSTRUCTED THIS RECEIVER FROM THE article by Mr. J. W. Bagnall in the December issue of this magazine, and must congratulate the designer on a really remarkable little set.

The coil was home-wound on a Neosid former with 36/47 Litz wire and a "Q" of about 400 was obtained, which accounts for the wonderful performance. There was one snag, however, when using the set in the Midlands Area, and this was that the Light Programme on Medium Waves tended to fade badly and was a very unreliable signal.

Consequently, I decided to incorporate a loading coil to bring the Light Programme in on the Long Waveband, which is a very good signal here. The diagram shows how this was done with the minimum of trouble and expense.



All that is needed is a single-pole make and break switch and a coil covering the Long Waveband. The end of the Medium Wave coil is broken where it joins the reaction winding, and the two ends are joined to the switch which is shunted by the Long Wave coil.

It is not essential to have a high-Q loading coil, and any long wave coil can be used for the purpose.

The operation of the switch will bring the coil into circuit on either of the trimmers 1 and 2.

I now have my trimmers set for the Long Wave Light programme, Medium Wave Midland programme, and thirdly Luxembourg. All these stations come in at great volume, and the quality amazes all who listen to it.

Radio Miscellany

The number of readers who have written on points in connection with small wind-driven generators came as quite a shock, but I have finally got round to answering them all individually. Unfortunately, as far as I know, there have been no constructional articles dealing with any specific design as all the mechanical components are not normally available. It is a case of improvising with whatever bits and pieces can be scrounged or otherwise acquired. Even if suitable parts were ordinarily available the price would be almost prohibitive. All the amateur-built wind-generators I have seen, or heard described, have been contrived from ex-car or motor-cycle generators picked up from the breaker's yard at bargain prices, plus sundry bits of ironmongery to provide the motive power. The wind-wheel can easily be cut from sheet metal, as can the "tail" required to keep it heading into the breeze.

CENTRE TAP	*talks about*	WIND-DRIVEN GENERATORS YOUR PERSONALITY RADIO TERMS FLOCK SPRAYING

The arm and mast can readily be made up from light tubular metal, but to bring the drive down from the wind-wheel to the generator requires a considerable amount of mechanical ingenuity and skill. It would, of course, be a comparatively simple job by means of pulleys and an endless belt if it were not for the fact that the head has to revolve with the wind. True, the generator could be mounted on a platform designed to rotate with the mast, but this would involve virtually frictionless bearings requiring all-weather protection.

Fortunately, the drive required by a small generator is light and much can be achieved by flexible cable, sheathed and regularly greased; but, again, extensive weather protection is essential. The construction of such an arrangement calls for more than average mechanical knowledge and workshop facilities.

The design of a wind-driven generator thus boils down to individual experiment according to the material available, but if any reader has discovered a *simple* method of getting round the difficulties with parts the average man might obtain with reasonable luck, I shall be pleased to hear from him.

Personality

A popular weekly recently contained an article analysing the personalities of followers of six major hobby interests. Working on the premise that our characters guide us to the hobby, we are apparently easily "typed." As I read it I began to wonder about my fellow hobbyists, not only those I meet but also the occasional correspondent. The rough and ready division—the musical (high-fi fans, etc.) and the scientific (experimental and constructional) seemed at first to be irreconcilable.

The music lover is described as sensitive, highly strung, easily carried away by emotion and of variable moods. The scientific types, however, are better adjusted than average, emotionally stable, and are rarely bothered with personality conflicts.

It all sounded very reasonable, but what about the high-fi enthusiast-cum-constructor? I began to wonder whether they all had split personalities, and if you, too, have doubts on this point set your minds at rest. The investigators found that a strong interest in music coupled with a mechanical or scientific hobby indicates that the individual is likely to prove well balanced.

Philatelists were found to be the best adjusted and happiest of fellows, so if you collect stamps as well as possess a leaning for music and radio construction your wife (or girl friend) is a lucky woman. Personally, I haven't collected stamps since my school-days although I was once a keen collector of QSL's, but that wore off years ago. I got hot under the collar when I didn't get a 100% response, so even at my best I wasn't out of the top drawer—and I must have deteriorated since then, as nowadays I don't collect anything much at all.

The Name's the Same

The London *Evening News* has for a long time held quite a reputation for its coverage of news of the amateur radio movement. Perhaps it has not been so noticeable in recent months simply because there has been a dearth of "hot" news in that line, but at all times the reportage (despite the garbled accounts on technical items which one often finds in the popular Press) has been accurate. Amateurs must therefore have been surprised to read that following the visit of B. & K. Russian amateurs were now using the "QC" call (a mistake for CQ, appearing three times) instead of the mysterious WSEM which they have been using for a number of years now.

No one seems to have discovered what the letters WSEM stand for—indeed I have still not heard a plausible guess!

Incidentally, the same paper recently carried a story of G2WJ's colour t.v. transmissions. A reference in the headline re "T.V. Hams" mentioned that the term Ham was nowadays discouraged. Indeed, an appeal was included for suggestions for a better term—apparently without response. The word Ham implies clumsiness, awkward amateurness, bad-acting, ham-fistedness or worse. Years ago I campaigned for its discontinuance, a campaign in which I was vigorously supported by Dr. Arthur Gee, G2UK, then Editor of the *Short Wave News*. Our campaigning had some good effect and the term was largely dropped.

There is, of course, no harm in speaking amongst ourselves or even of one another as Hams, but the term is given quite another connotation when disparagingly used to describe the follower of a scientific hobby by outsiders. Amateur radio has already lost enough of its prestige without being further cheapened by a name which infers a slight.

Flock Spraying

My appeal for the experiences of readers who have sprayed the insides of radio and speaker cabinets with flock as a means of damping out resonances, brought in several interesting letters. They are unanimously agreed that it has proved effective in cases where the volume level is limited to a few watts, such as in the normal domestic receiver. Even a thick spraying is inadequate for levels of about six watts upwards.

Mr. P. Imhof of Chingford Road, Walthamstow, E.17, in writing and confirming this opinion mentions a helpful 84-page book on various types of spraying published by Leonard Brooks Ltd., of 25 Harold Road, Romford, Essex. It costs 3s. 6d. post free.

Mr. Imhof also praises the efforts of *The Radio Constructor* Staff and reports that he built an amplifier recently described in our pages. It is used to drive a Goodmans Audium 60 and the performance is equal to the costlier commercial amplifiers. His good wishes to the staff have been passed on to those concerned. It is nice to know your work is appreciated, and it provides the incentive to put just that extra bit into it that keeps your magazine lively and as fresh as a new coat of paint.

Hints on the use of Perspex

by J. A. CUSDIN

Where the decorative appearance of any piece of home constructed "gear," whether electronic or otherwise, warrants the rather high expenditure entailed in the use of Perspex, then it is worth the energy of proper finishing. Those amateurs who have no experience of this material may be interested to learn that in addition to the well-known colourless form it is also available in many colours, including delicate pastel shades, and in sheets of varying thicknesses.

It is easily worked with light hand tools, the normal way of cutting a straight edge being with a metalworker's hacksaw or the now popular miniature version, but taking care to use a blade with the least number of teeth per inch. The rough edge so left is cleaned up with first a fine file, and then with the finest grade of emery or glass paper. This leaves the edge with a very smooth but matt surface which may be objectionable, in which case the original highly polished surface is regained by repeatedly polishing with ordinary metal polish used in the customary manner, i.e. apply with rag and rub vigorously whilst the polish is still wet, allow to dry and then rub off. This will also remove surface scratches if not too deep.

In both the cutting and the polishing operations care must be exercised that excessive heat is not generated, as this can start melting the Perspex.

The small pieces left over are very useful for insulators for power and audio frequency circuits and even for the lower radio frequencies; but it definitely is no use in v.h.f. applications where losses could not be tolerated, in spite of the outward similarity between colourless Perspex and Polystyrene.

Technical Forum

T.V. SNOW

The rather unusual title this month may come as a surprise in the middle of the summer holiday season, when it is to be hoped that fine weather has put snow very much out of mind. But when applied to a television picture this term, which originated in America, is used to describe the scintillating noise pattern which is frequently seen to mar t.v. pictures. With the increasing number of t.v. sets in use, the service areas of both the B.B.C. and I.T.A. transmitters have been stretched to their utmost, with a result that many sets are expected to operate on a very low signal level for at least one of the two signals. Under these conditions the general background noise becomes apparent on the picture as the signal-to-noise ratio is low. This noise appears as a very fine discontinuous pattern on the screen, and gives the impression that the scene is being enacted in a very fine snowstorm. This unwanted interference is usually generated within the set, and is equivalent to the hiss which is heard

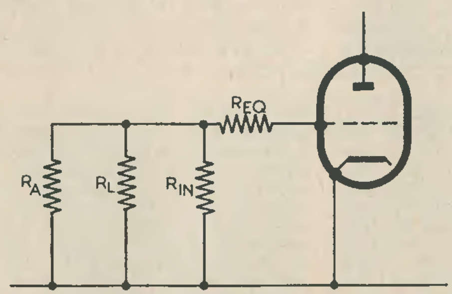


Fig.1
Diagram showing the resistive components which appear in the grid circuit
E341

from a sensitive radio receiver when it is operated at maximum gain. The trouble is yet more pronounced in a colour television receiver when noise appears as a speckled pattern of coloured dots, for which the word "confetti" has been chosen in America.

The noise generated within the circuit of a television receiver may be divided into two categories, Shot noise and Johnson noise. The former starts within the valves and is due to the high velocity electrons which form the anode current actually striking the surface of the anode. This may be likened to the noise produced by allowing sand to fall upon a tin plate. The magnitude of this noise naturally depends upon the current I_a which is flowing in the valve and is given by the equation:

$$i = \sqrt{2eIaBk^2}$$

where $e = 1.59 \times 10^{-19}$ being the charge in coulombs of an electron

B = bandwidth over which the noise is effective in cycles per second

k = a constant whose value depends upon the proportion of the total available cathode emission which reaches the anode. k^2 is usually about 0.05.

The second type of noise with which we are concerned is Johnson noise, which is present in all resistors. It is sometimes known as thermal agitation noise because it is due to the random movement of electrons in the resistive elements. Its magnitude depends upon the value of the resistance and the temperature of it, and is given by the formula:

$$e = \sqrt{4KTBR}$$

where K is a constant and equals 1.38×10^{-23}

T is the temperature (absolute scale) and R is the resistance in ohms.

It will be seen that both noise formulae take into account the bandwidth of the receiver. This is because the noise is distributed over an infinitely wide band so that the more narrow the pass band of the set is made, the less the noise which will be accepted.

Now let us consider which are the resistors in a t.v. set which can cause the noise. Under the worst conditions the noise level will be in the region of a few microvolts, so we are only concerned with that which appears in the grid circuit of the first valve. In other parts of the circuit the signal level is sufficiently large to completely swamp locally generated noise. Figure 1 shows the resistors which appear in the grid circuit of the first valve, but as they are not all actual resistors they require some explanation. The aerial circuit has a fixed resistance, usually about 80 ohms, which after

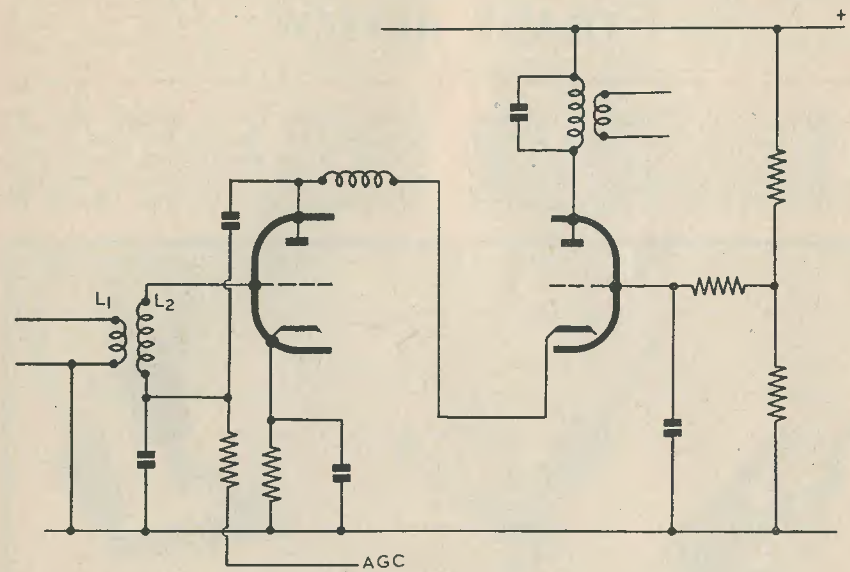


Fig.2
A typical low noise cascade circuit
E342

being transformed up by the aerial coil provides a grid circuit resistance R_A. The tuned input circuit itself has certain losses which are represented by R_L. R_{IN} equals the input resistance of the valve and arises largely because of the transit time effect. This resistance varies as the inverse of the square of the frequency, thus the higher the frequency the less the value becomes. The only remaining noise component is R_{EQ}, and this has been added to take into account the shot noise discussed earlier. R_{EQ} is often referred to as the "equivalent" noise resistance of the valve and it is the value of a resistor which, if connected in the grid circuit, would provide a noise level at the anode which is equal to the shot noise. The values of R_{IN} and R_{EQ} depend upon the type of valve chosen; lately it has become common practice to employ a triode in the first stage of a t.v. set because it enables the best results to be obtained over a large number of channels. The values for R_A and R_L depend upon circuit and coil design and require very careful attention.

Summary

Before concluding this short discussion upon the factors which govern the generation of noise, it is worth while considering the practical application of the information given above. These may be summarised as follows:

1. Choose a suitable valve for the first stage. The chief requirements are a low noise level and high mutual conductance. Double triode valves such as the PCC84 and 6BQ7 are frequently used nowadays in the cascode type of circuit such as indicated in Fig. 2.

2. The design of the aerial transformer requires careful consideration. For example, if the turns ration of L_1 and L_2 (Fig. 2) is made too large the reflected resistance R_A will be high and consequently the noise will be increased. Also, because of mismatching the signal level will be decreased. On the other hand, if the turns ration is made too low, the

sensitivity of the receiver will be adversely affected.

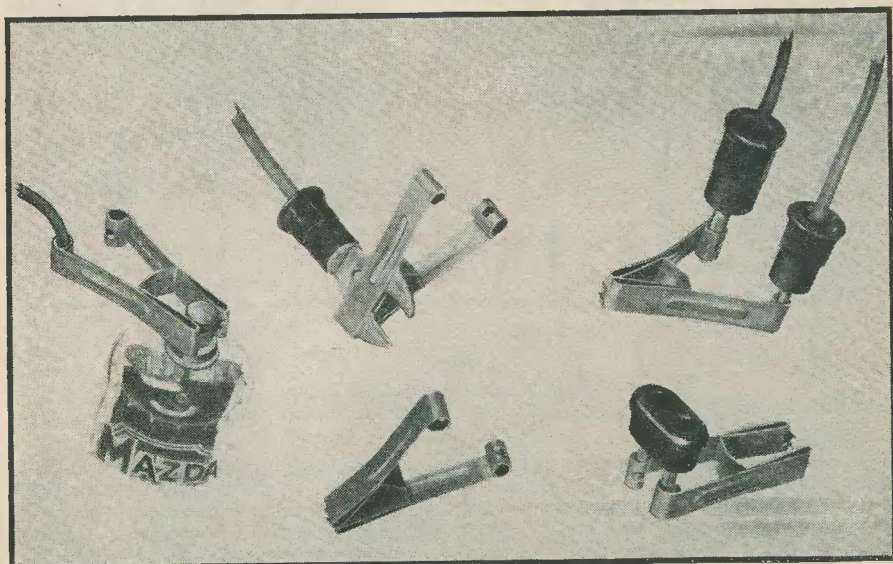
3. Input circuit losses must be reduced to a minimum to keep the value of R_L down.

4. Noise is generated by all stages in a receiver, but by virtue of the low signal level only that in the first stage is generally troublesome. However, in a receiver which has a sensitivity control varying the gain of the first stage, it is advisable to work with the gain set as high as possible and the contrast control down to avoid trouble with second stage noise. In observing this the signal level at the second stage is kept reasonably high, thus providing a good signal-to-noise ratio.

5. If a receiver is operated at the limit of its sensitivity but still gives a weak noisy picture, a pre-amplifier may improve matters. The required improvement will only be obtained, however, if the noise factor of the pre-amplifier is better than that of the receiver. This point is frequently overlooked and accounts for the disappointing results which are occasionally reported in the use of pre-amplifiers. In the next issue we hope to describe the method usually used to measure receiver noise, as only by the direct comparison of figures can the performance of one set be assessed against that of another.

TRADE REVIEW

The latest TC.431 Ediswan Clix Crocodile Clip offers something new in such components. Brass-plated for easy soldering, it is made of single-piece spring steel for strength, adaptability and maximum electrical contact. The Clip has been designed so that plugs and pins both English (3mm) and Continental (4mm) can be plugged into the respective rings, leaving the jaws free for clipping. In the double-folds, spade plugs can be slipped in easily when required; again leaving the jaws free. Behind the teeth, wide jaws allow clipping over the valve caps.



NEXT MONTH: Miniature Crystal Frequency Standard

by W. E. Thompson, *A.M.I.P.R.E.*

DESIGN CHARTS FOR CONSTRUCTORS

No. 7 INDUCTANCE-CAPACITY-WAVELENGTH CHARTS MEDIUM AND I.F. RANGES

by HUGH GUY

Continuing with the series of four design charts for interpreting wavelength in terms of the required values of inductance and capacitance and vice versa, we come this month to two charts which can conveniently be covered in the one issue. They are charts dealing with the Medium Waveband, from 150 to 700 metres, and the I.F. band, from 450 to 1,500 metres.

All the charts in this series operate on the same principle, and this was covered in full detail in last month's issue. It will suffice here, therefore, to give examples on the use of the charts only, and to assist in this respect on each chart dashed lines appear outlining the steps involved in getting from a value of wavelength to the appropriate values of inductance and capacitance.

(4) To determine the value of capacitance with which a known value of inductance will tune to a specified wavelength.

The first use and last two uses are almost identical in operation, while the second is merely the reverse of the first.

Now a word about the individual charts.

Medium Wave Chart

The capacity range covers values from 30pF to 2,000pF on the inner scale and 300pF to 0.02μF (i.e. 20,000pF) on the outer scale. The inductance scale reads from 100μH to 1mH (i.e. 1,000μH) on the inner scale and 10μH to 100μH on the outer scale. Note that the inner scales should be read in conjunction with one another, and similarly the outer scales.

Design Chart Coverage

Chart	Waveband Coverage Metres	Frequency Coverage
Short Waves	1 — 20 m	300 — 15 Mc/s
	10 — 200 m	30 — 1.5 Mc/s
Medium Waves	150 — 700 m	2 Mc/s — 428.6 kc/s
I.F. Band	450 — 1500 m	666.7 — 200 kc/s
Long Waves	450 — 6000 m	666.7 — 50 kc/s

Each and every chart has four uses:

(1) To determine suitable values of inductance and capacitance for a specified wavelength.

(2) To determine the wavelength to which a tuned circuit comprising known values of inductance and capacitance will tune.

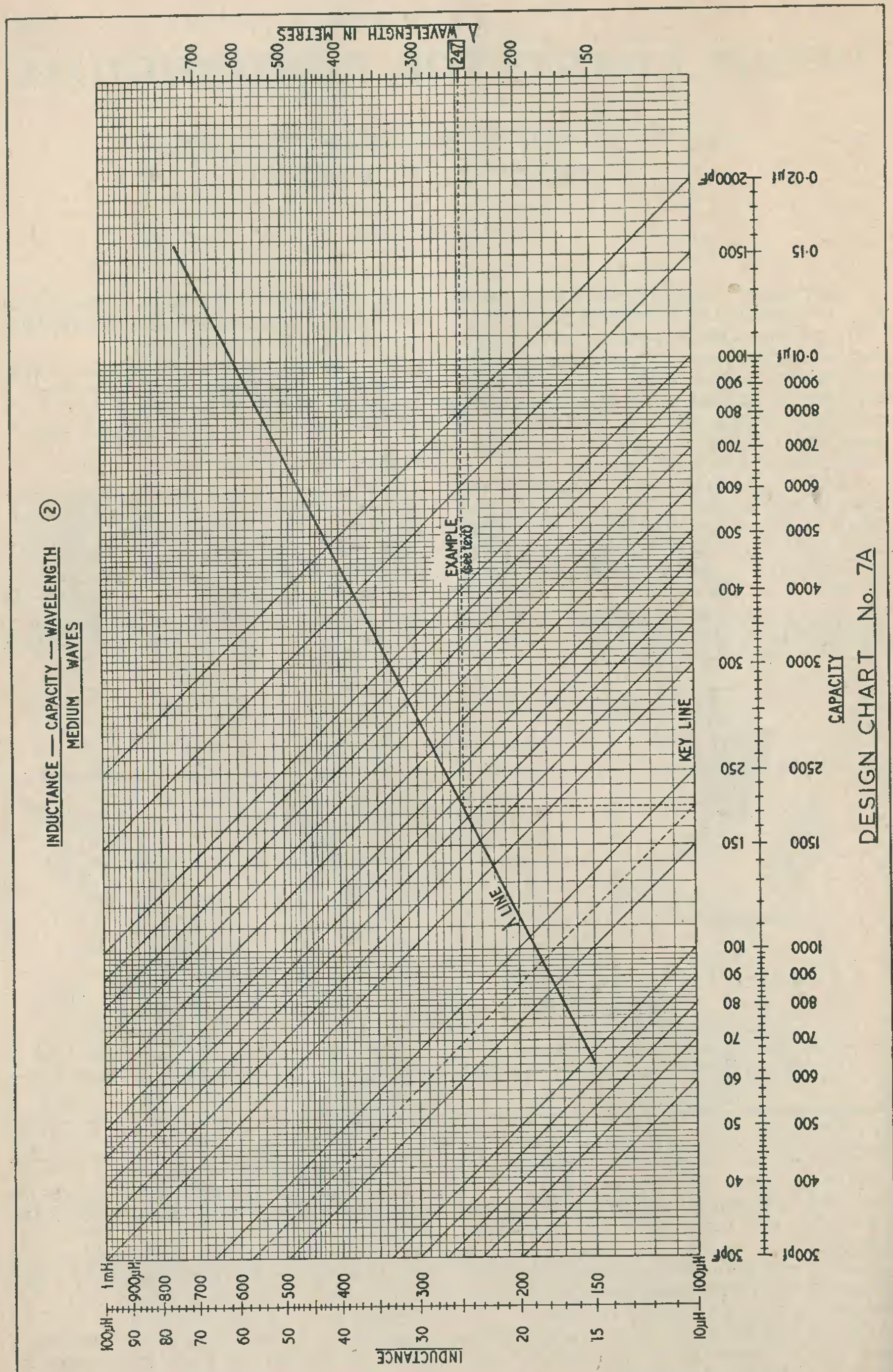
(3) To determine the value of inductance with which a known value of capacitance will tune to a specified wavelength.

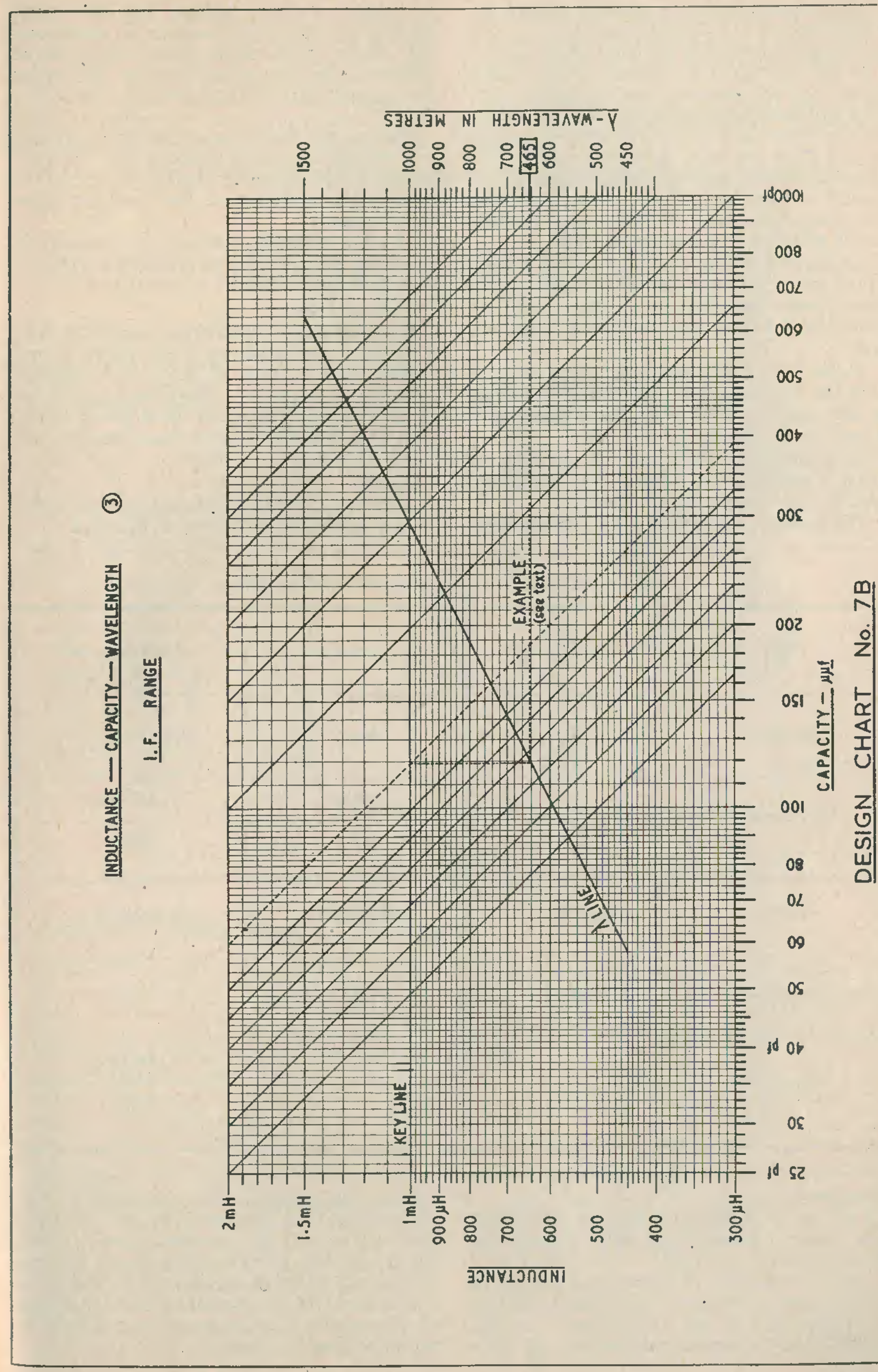
The "Key Line" on this chart occurs at the bottom of the graph, coincident with 10 and 100μH.

The example in dashed outline will now be used to illustrate the operation of the chart.

Example 1

Determine suitable component values for a circuit to tune to the Light Programme on 247 metres.


INDUCTANCE — CAPACITY — WAVELENGTH ②
MEDIUM WAVES
λ WAVELENGTH IN METRES
EXAMPLE (see text)
KEY LINE
λ LINE
CAPACITY
INDUCTANCE
DESIGN CHART No. 7A


INDUCTANCE — CAPACITY — WAVELENGTH ③
I.F. RANGE
λ - WAVELENGTH IN METRES
EXAMPLE (see text)
KEY LINE
λ LINE
CAPACITY – μμf
INDUCTANCE
DESIGN CHART No. 7B

The intersection of the value of wavelength corresponding to 247 metres with the "λ Line" is dropped vertically to the "Key Line." Through this point a diagonal line is drawn parallel to the printed diagonal lines. Any values of inductance and capacitance crossing on this line will give the required componet values. For example, actually on the "Key Line" itself we see that 100μH and 173pF could be used; alternatively, at the same point the outer scales show that 10μH and 1730pF, would produce the same wavelength.

Similarly it is seen that 300μH and 57.5pF would also produce the same result. This then covers the first use. The third and fourth uses follow quite naturally from this point.

If the value of capacitance being used to tune the wavelength to 247 metres was fixed at, say, 100pF, then the required inductance is seen to be 173μH.

If instead an inductance was available of value, say, 250μH, then the necessary capacitance value is seen to be 69pF.

The second use is given in the next example.

ing diagonal line, making the task easy. Invariably, however, this does not occur and the reader may either draw the required diagonal line lightly in pencil, or interpolate the appropriate intersection at the "Key Line."

Having got this far, a vertical line is drawn (or visually traced) to intersect the "λ Line," the point of intersection being referred to the wavelength scale where the resulting value may be read.

In this example, which is not shown in print on the chart, the wavelength is found to be 325 metres, an error of less than 1%.

I.F. Band Chart

Since the use of this chart is exactly the same as that of the Medium Wave chart, it will suffice here merely to use the "dashed" example as a guide. This chart covers the range 450 to 1,500 metres, all of which will be included in next month's chart covering the Long Waves.

Example

Determine suitable component values for an intermediate frequency of 465 kc/s.

INDUCTANCE AND CAPACITANCE CONVERSION

Unit	microfarads		millimicrofarads		picofarads or micro-microfarads
Symbol	μF		mμF		pFs or μμFs
Quantity	1	=	1000	=	1,000,000
	0.001	=	1	=	1000
Unit	Henrys		millihenrys		microhenrys
Symbol	H		mH		μH
Quantity	1	=	1000	=	1,000,000
	0.001	=	1	=	1000

Example 2

Determine the wavelength to which an inductance of value 300μH and a capacitance of value 100pF will tune.

The intersection of these two values is located, and a diagonal line traced through this point back to the "Key Line." In this example the two values intersect on an exist-

For convenience, the wavelength corresponding to a frequency of 465 kc/s has been marked on the wavelength scale. This value and any other frequency can be converted to a value of wavelength by using the conversion chart published in the April issue of *The Radio Constructor* where it will be found as Design Chart No. 6.

The "λ Line" intersection of 465 kc/s is referred to the "Key Line" and the usual diagonal line traced, either drawing it in, or by using a straight-edge as a reference.

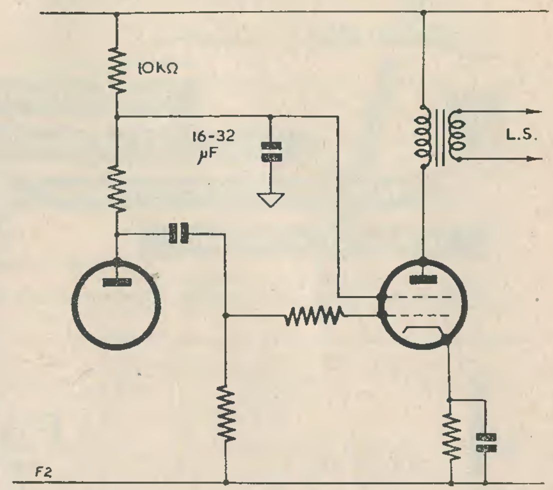
The alternative methods of using the chart follow the same practice as previously outlined, and after a little use the reader will rapidly become familiar with the routine involved, something which unavoidably appears cumbersome when written down at great length.

Next month's article completes this short series of Inductance-Capacity-Wavelength charts.

Hints and Tips

Reducing Hum in Midget Sets

In midget sets there is often a considerable background hum produced by the output stage. This may easily be checked by shorting the grid of the output valve to chassis. If the hum is still there, it is almost certainly being fed into the screen grid (g_2), which in this case is acting as a control grid. The source of this hum is the h.t. line, and the hum may, of course, be removed by decoupling. However, the most economical method is to take this feed from the decoupling circuit of the previous stage. The circuit diagram gives typical values.

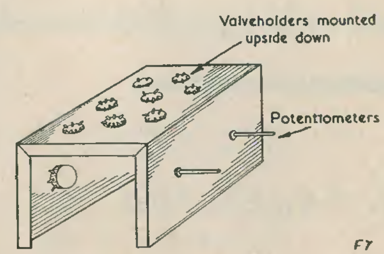


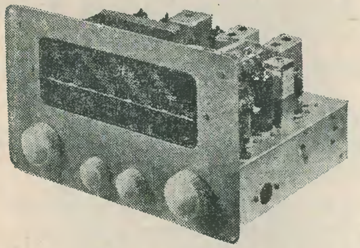
A Useful "Breadboard" Chassis

The illustration shows a method of making quick tests on circuits. A number of valveholders of various types are mounted upside down, so that all wiring is easily accessible. The heater circuits and various earthing points are wired carefully and the chassis is then ready for a "hook-up." The following valveholders could be usefully mounted:—two octal holders with pins 7 and 8 connected to the heater circuit; two octal holders with pins 2 and 7 connected to heaters and pin 1 earthed; two B7G holders with pins 3 and 4 connected to heater circuit and pin 6 earthed; and two B9A holders with pins 4 and 5 connected together to one side of the heater circuit and pin 9 to the other side.

The chassis should be made of tinplate so that wires may be soldered directly to it.

A few tag panels should be mounted at convenient points, and potentiometers may be fitted to the sides. A convenient size is 7in square for the top and 4½in for the height.





BUILD THE
Jason "ARGONAUT"
A.M.-F.M. TUNER-RECEIVER

Following the success of our F.M. Tuner Kit, we now introduce this super-sensitive M.W.-F.M. Tuner-Receiver. The switching and wiring are simple, but performance has not been sacrificed. There is space on the chassis for power pack and output stage. The building instructions are appearing in the March and April issues of this magazine, and will be available as a reprint.

Dial assembly, with chassis, flywheel tuning, Jackson Bros. 4-gang condenser, 500pF+500pF, and 15pF+15pF, glass scale calibrated in station names on both bands, and hammer finish front panel, **price £3 . 18 . 0**

All coils, including ratio detector, M.W. coils and 2 twin-i.f.t.'s (472 kc/s and 10.7 Mc/s), **price £2 . 17 . 9**
Approximate total cost to build, as a receiver and with power supply, **£16 . 0 . 0**

Send S.A.E. for complete component price list

THE JASON MOTOR & ELECTRONIC CO
328 CRICKLEWOOD LANE LONDON NW2
Telephone SPEedwell 7050

THE ARGONAUT . . .
AM—FM MW—VHF TUNER RECEIVER

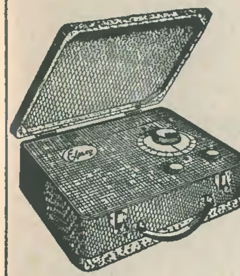
First published in the March and April 1956 issues of this magazine, this high quality tuner-receiver has aroused considerable interest. In this reprint the text has been revised and enlarged, and additional diagrams, including a map of present and projected coverage areas, have been included as a result of suggestions by readers.

28 pp. plus stiff card cover — *2s. postage 2d*

DATA PUBLICATIONS LTD
57 MAIDA VALE · LONDON · W9

Telephone CUNningham 6141/2
Telegrams Databux, London

The "CRISPIAN" BATTERY PORTABLE



A 4-valve truly portable battery set with very many good features as follows:

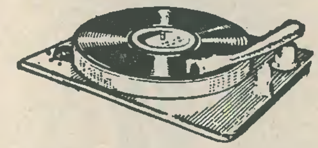
- **Ferrite rod aerials**
- **Low consumption valves**
- **Superhet circuit with A.V.C.**
- **Ready built and aligned chassis if required**
- **Beautiful two-tone cabinet covered with I.C.I. Rexine and Tygan**

Guaranteed results on long and medium waves anywhere

All parts, including speaker and cabinet, are available separately or if all ordered together the price is **£7 . 15 . 0** complete, post and insurance 3/6

Ready built chassis 30/– extra. Instruction booklet free with parts or available separately price 1/6

RECORD PLAYER for £4.10.0



3-SPEED INDUCTION MOTOR

3-speed motor with metal turntable and rubber mat. Latest rim drive with speed selection by knob at the side.

HI-FI PICK-UP

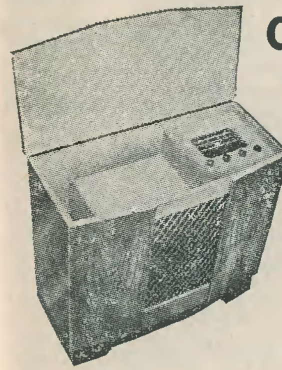
Using famous Cosmocord Hi-G turnover crystal. Separate sapphire for each speed. Neat bakelite case with simple adjuster for weight compensation.

SPECIAL SNIP OFFER THIS MONTH

The two units for **£4 . 10 . 0**, or 30/– deposit and four payments of 18/–, post and insurance 5/–. **Or fitted upon base, as illustrated, £5 . 10 . 0**, plus 7/6 post and insurance.

FOUR MODELS of Auto-changers also in stock. Prices from **£7 . 15 . 0**

Cabinets For All

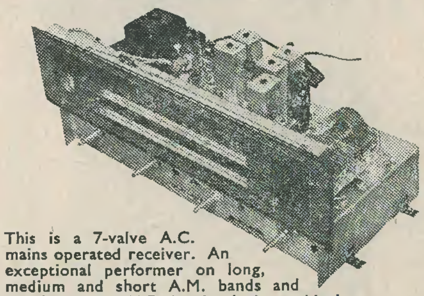


WE CARRY A VERY VARIED STOCK

PLEASE CALL

This is the "Empress," undoubtedly a beautiful piece of furniture, elegantly veneered in figured walnut and in white sycamore. The radio section is raised to convenient level but is not drilled or cut. The lower deck acts as the motor board, again is uncut. It measures 16" x 14" and has a clearance of 5" from the lid. There is a compartment for the storage of recordings. Overall dimensions of this essentially modern cabinet are 3ft wide, 2ft 8in high and 1ft 4½in deep. Price **£14 . 14 . 0**, carriage and insurance 20/–

A.M./F.M. RADIOGRAM CHASSIS



This is a 7-valve A.C. mains operated receiver. An exceptional performer on long, medium and short A.M. bands and on the new V.H.F. band. It is an ideal unit for a quality radiogram.

Special features include magic eye tuning indicator, extra long scale and pointer travel—latest circuitry employing full A.V.C. feed-back, etc.

Undoubtedly one of the finest AM/FM chassis available to-day. Chassis size 17¼" x 6½" x 7½". Price **£23 . 17 . 6**, carriage, packing and insurance 20/– extra.

Also in stock AM/FM chassis by Dulci, Armstrong and other famous makers.

ELECTRONIC PRECISION EQUIPMENT LTD
Post Orders should be addressed to Dept. 34, 123 Terminus Road, Eastbourne
Personal shoppers, however, please call at

42-46 Windmill Hill	152-3 Fleet Street	29 Stroud Green Road	249 High Rd., Kilburn
Ruislip, Middx.	E.C.4	Finsbury Park, N.4	*Telephone*
Telephone RUIslip 5780	*Telephone* FLEet 2833	*Telephone* ARChway 1049. Half-day Thurs.	MAIda Vale 4291
Half-day Wednesday	Half-day Saturday		Half-day Thursday

G2AK THIS MONTH'S BARGAINS G2AK

THERE IS NO EXCUSE NOW or not being on phone or for not having a nice clean signal

CRYSTAL HAND MICROPHONES

As illustrated, in silver hammer case with polished grille, handle and 4 feet screened lead. Only **21/–** p. p.

COPPER WIRE: 14G, H/D 140ft, **15/–**; 70ft, **7/6**, post and packing **2/–**. Other lengths pro rata.

KNOB AND DIAL with engraved scale 2" dia. New and boxed. White figures on black, complete with cursor, **1/9** each, post 6d. Ideal for portables and mobiles.

For the New MOBILE 12V miniature rotary transformers. Output 360/310V, 30mA c.s. or 70mA, I.C.A.S. Only 4½" x 2½" overall. ONLY **17/6** each, or **30/–** for 2, post and packing **1/6**

POWER UNITS in black metal case. With input and output sockets. For 200/260V 50c input. Output 200/250V 60/80mA fully smoothed and fused. Also gives 31V 0.3A d.c. and 6.3V 3A a.c. fitted with 6X5 rectifier. **50/–** each, carriage paid.

FISK SOLARISCOPES. Complete with charts, give world time, light and dark paths. Invaluable to the DX man. List 21/–. **Our price 7/6 post free**

PANL HOME CRACKLE. Black, 3/– tin, postage and packing 8d.

TWIN FEEDER: 300 ohm, twin ribbon feeder, similar K25, **6d.** per yard. K35B Telcon (round), **1/6** per yard. Post on above feeder and cable, 1/6 any length

CERAMIC FORMERS, 2⅞" x 1¼". Ideal for V.F.O. or turrets, **1/9** each or **17/6** doz.

CERAMIC SWITCHES. 2 bank, 2 pole, 4-way each bank, **5/–** each, post and packing **9d.**

PI CIRCUIT OUTPUT TUNING CONDENSERS. Made by E. F. Johnson Co., U.S.A. Max. cap. 500pF 1,500V rating. Ceramic insulation, size 5" long x 2 3/16" wide x 2 3/16" high, excluding spindle projection. **Our price only 15/– post free**

RACK MOUNTING PANELS: 19" x 5¼", 7", 8¾" or 10½", black crackle finish, **5/9, 6/6, 7/6, 9/–** respectively, postage and packing **2/–**

ABSORPTION WAVEMETERS: 3.00 to 35.00Mc/s in 3 switched bands. 3.5, 7, 14, 21 and 28Mc/s. Ham bands marked on scale. Complete with indicator bulb. A **must** for any Ham Shack. **Only 15/–** each, post and packing **1/–**

Special Offers

CONDENSERS 8µF, 600V trop, 750V normal. New ex-W.D. stock, **5/6** each, p. & p. **2/–**

SHADED POLE MOTORS. Heavy duty type. Totally enclosed. Made for professional tape deck. **Very limited quantity.** Only **35/–** each, p. and p. **2/–**

Carriage paid on all orders over £1 except where stated

Please include small amount for orders under £1

CHAS. H. YOUNG LTD

ALL CALLERS TO **110 DALE END, BIRMINGHAM**
PLEASE PRINT YOUR NAME AND ADDRESS

MAIL ORDERS TO **Dept. 'R,' 102 HOLLOWAY HEAD, BIRMINGHAM** Midland 3254 Central 1635

VALVES NEW TESTED AND GUARANTEED

1R5	7/6	6J5GT	6/6	AZ31	10/6	EF37A	14/6
1S5	7/6	6K7G	6/–	BL63	10/6	EF39	5/6
1T4	7/6	6K8	8/6	DF91	7/6	EV55	9/6
3S4	7/6	6K8G	8/–	DK91	7/6	EF80	10/–
3V4	7/6	6K8GT	8/6	DAF91	7/6	EF85	10/6
5U4G	8/6	6L6G	9/6	DL92	7/6	EF91	7/6
5Z4G	8/6	6Q7GT	8/6	DL94	7/6	EF92	4/9
6AG5	6/9	6SN7GT	8/6	DK92	7/6	EK32	8/6
6AM6	7/6	6SL7GT	8/–	DK96	9/–	EL32	7/6
6AL5	6/6	6SS7	6/6	EA50	1/6	EL84	11/–
6AT6	8/–	6V6G	7/6	EB34	5/6	EM34	12/6
6BE6	8/–	6V6GT	7/6	EB91	6/6	EY51	11/6
6BW6	8/–	6X4	8/–	EBC33	8/6	EZ35	8/–
6B8	7/6	6X5GT	7/6	EBF80	10/6	KT33C	9/6
6B8G	7/6	12AT7	9/–	ECC81	10/6	KT66	11/6
6BA6	8/6	12AU7	9/–	ECH35	9/6	PL81	10/6
6BR7	8/6	12AX7	8/6	ECH81	10/6	PL82	10/6
6SA7	8/–	35L6GT	9/–	ECH42	11/6	PY781	10/6
6F6G	8/–	58	7/6	ECL80	10/6	UCH42	11/6
6G6G	4/9	807	6/9	EF22	7/6	PCC84	11/6
6J5G	5/6	5763	8/6	EF36	7/6	X65	10/6

Matched Pairs. EL84, **23/–**; 6V6G and GT, **17/–**; 6BW6, **18/–**; KT33C, **19/6**; 807, **14/6** per pair

Volume Controls. All values, long spindle. L/S **3/–**, SP **4/–**, DP **4/6**, ext. spkr. control, **3/–**

W.W. Pots. Preset **3/–**; 3W, long spindle **5/6**, SP **6/6**

P.M. Speakers, 3 ohm. 5" **16/6**, 6½" **17/6**, 8" **21/–**, 10" **25/–**, 12" **27/6**

★ **C.R.T. Isolation Transformers** with 25% boost. Low capacity, a.c. mains 200-240V. For 2V, 4V, 6.3V and 13V tubes. All **12/6** each

Coaxial Cable. 75 ohm ¼" stranded, **8d.** yd; semi-air spaced, **9d.** yd; screened cable single and twin, **9d.** yd

Coaxial Plugs and Sockets, 1/– each

Valveholders. 4, 5, 7 pin English and U.S.A. B7G, B9A 1.0 Mc, B8G, **9d.** each; B7G, B9A with screening can, **1/6**

2-Gang Condensers, .0005 small size, **6/6**

I.F. Transformers, 465 kc, small size, **9/6** pair

Capacitors, small mica, 5% 1pF to 100pF, **8d.**; 120pF to 1,000pF, **9d.**

Ceramic Capacitors, close tol. 500V for V.H.F., **9d.**

Paper Capacitors, tubular, .01, 1,000V, **1/–**; 0.1 to 0.5 500V, **10d.**

Paper Blocks, 4 mfd, 1,000V wkg, **2/3**; 2 mfd, 350V, **2/–**; 4 mfd, 350V, **2/6**

Recording Tape. 1,200ft on standard plastic spools, **17/6**

Resistors, ¼ and ½W, insulated, **4d.** and **6d.**; 1W, **8d.**; 6W W.W., **1/–**; 10W, **2/–**

Electrolytics. Wire ends. 25/25V, **1/6**; 50/50V, **2/–**; 12/50V, **9d.**; 8/450V, **2/–**; 16/450V, **2/9**; 32/450V, **4/–**; 8+16/450V, **4/6**; can types: 16/450V, **3/6**; 32/500V, **6/6**; 32+450V, **6/6**; 20+20/450V, **4/6**; 64+120/264V, **7/6**

Wavechange Switches, midget: 1P 12W, 2P 6W 3P 4W, 4P 3W, 4P 2W, long spindles, **4/6**

Toggle Switches. QMB, s.p.s.t., **2/–**; s.p.d.t., **3/3**; d.p.s.t., **3/6**; d.p.d.t., **4/–**

Chokes, 80mA 15H, **5/6**

Solder, Multicore, 4d. yd

★

Band III Converter Kits for all I.T.A. Transmitters. Complete kit of parts, including ready wound coils, two EF80 valves, drilled chassis and wiring diagram. For a.c. mains 200-250V. **£3 10s. 0d.,** p. and p. 1/6

As above less power pack components. Power required, 200V 20mA, 6.3V 0.6A. **£2 5s. 0d.,** p. and p. 1/–

Teletron Band III Coil Set. Mk I **15/–**; Mk II **17/6**; Osmor Coil Set **17/6**

Aerials. Band I from **13/6**; Band II **17/6**; Band III **6/6**

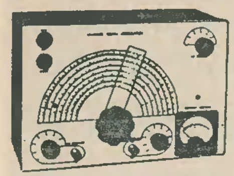
Spares for Philips Radio and TV Receivers and most other makes supplied

P. and P. 6d. Over £1 post paid except where stated

R. COOPER G8BX

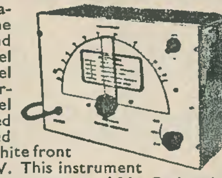
32 SOUTH END CROYDON SURREY CROYDON 9186

COMPLETELY BUILT SIGNAL GENERATOR



Coverage 120 Kc/s-320 Kc/s, 300 Kc/s-900 Kc/s, 900 Kc/s-2.75 Mc/s, 2.75 Mc/s-8.5 Mc/s, 8 Mc/s-28 Mc/s, 16 Mc/s-56 Mc/s, 24 Mc/s-84 Mc/s. Metal case 10" x 6½" x 4¼". Size of scale 6½" x 3½". 2 valves and rectifier. AC mains 230-250V. Internal modulation of 400 c.p.s. to a depth of 30 per cent, modulated or unmodulated RF output continuously variable 100 milli-volts. CW and mod. switch, variable AF output and moving coil output meter. Black crackle-finished case and white panel. Accuracy ±2%. **£4 19 6 or 34/–** deposit and 3 monthly payments **25/–**. P. and p. 4/6 extra

PATTERN GENERATOR



40-70 Mc/s direct calibration, checks frame and line timebase, frequency and linearity, vision channel alignment, sound channel and sound rejection circuits and vision channel band width. Silver-plated coils, black crackle-finished case 10" x 6¾" x 4¾" and white front panel. AC mains 200/250V. This instrument will align any TV receiver, accuracy ±1%. Cash price, **£3 19 6** or **29/–** deposit and 3 monthly payments of **£1**. P. and p. 4/6 extra

←Both generators guaranteed for 12 months↑

BAND III CONVERTER KIT comprising 5 channel tuner, mains transformer, metal rectifier, electrolytic, 2 valves, 12AT7 and EF80, and all necessary components for a.c. mains operation. Complete with conversion data. **£2 . 5 . 0** *Post and Packing 2/6*

Three-speed automatic changer B.S.R. Monarch, current model. Will take 7", 10" or 12" records mixed. Turnover crystal head. **Brand new.** A.C. mains, 200/250. **£7 15 0,** p. and p. 3/–

16" TUBE
BY FAMOUS MANUFACTURER

BRAND NEW **£9.19.6**

guaranteed 3 months, EHT 14kV, heater 6.3V at 0.6A. p. and p. and insurance, 22/6 H.P. terms arranged.

LINE EHT TRANSFORMER with built-in line and width controls, scan coil and frame output transformer, **£2 19 6,** p. and p. 3/–. Focus unit to suit, **15/–**

Line and EHT Transformer, 9kV. Ferrocart core. EY51 heater winding, complete with scan coils and frame output transformer and line and width control. P. and p. 3/–, **35/–**

As above but complete with line and frame blocking transformers, 4 henry 250mA choke, 100 mfd and 150 mfd 350 wkg 380mA AC ripple. P. and p. 3/–. **£2 9 6**

Standard Wave-change Switches. 4-pole 3-way, 5-pole 3-way, 3-pole 3-way, **1/9** each. 9-pole 3-way **3/6**. Miniature type, long spindle 4-pole 3-way and 4-pole 2-way, **2/6** each. 2-pole 11-way twin wafer, **5/–**: 1-pole 12-way, **5/–**. P. and p. 3d.

USED Metal Rectifier, 250V 150mA, **6/6**

Combined 12" Mask and Escutcheon Perspex. New aspect, edged in brown. Fits on front of cabinet, **12/6.** As above for 15" tubes, **17/6**

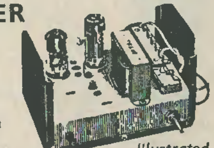
Polishing Attachment for electric drills. ¼" spindle, chromium-plated 5" brush, 3 polishing cloths and one sheepskin mop mounted on a 3" rubber cup. Post and pkg. 1/6. **12/6.** Spare sheepskin mops, **2/6** each

Line or Frame Oscillator Blocking Transformers, 4/6 each. **Smoothing Choke,** 250mA, 5 henry, **8/6**; 250mA, 10 henry, **10/6: Wide Angle PM Focus Unit** vernier adj., state tube, **15/–. PM Focus Unit** for Mullard tubes with vernier adjustment, **15/–**

Ion Traps for Mullard or English Electric tubes, **5/–,** post paid

COMMERCIAL TELEVISION CONVERTER

SUITABLE ANY T.V.
NO ALTERATIONS TO SET



Illustrated with cover removed

Complete with built-in power supply, 230-250V A.C. mains. Crackle finish case 5¾" x 3½" x 4¾" high. Incorporating gain control and band switch. **£3 · 19 · 6** Plus p/p 2/6

Less power supply **£2 . 19 . 6** plus p. & p. 2/6

3-speed TRANSCRIPTION MOTOR
By Famous Manufacturer

Complete kit of parts comprising accurately balanced precision made heavy turntable with rubber mat, large constant speed condenser starting motor, base plate. Can be assembled in half an hour. AC mains 200/250V. Fully guaranteed. Parts sold separately. **£6 19 6,** post paid

TV Coils, moulded former, iron cored, wound for rewinding purposes only. Ali-can 1⅜" x ⅞", 1/– each: 2 iron cores Ali-can, 2⅜" x ⅞", **1/6** each. Suitable for Band III Converters.

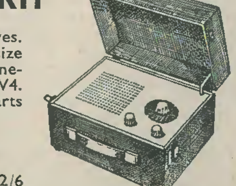
Dubilier, 0.001 10kV working, **3/6**

1,200ft High Impedance Recording Tape on aluminium spool. **12/6,** post paid

Valveholders, moulded octal Mazda and loctal, **7d.** each. Paxolin, octal Mazda and loctal, **4d.** each. Moulded B7G, B8A and B9A, **7d.** each. B7G and B9A moulded with screening can, **1/6** each

16 x 24, 350 wkg	4/–
40mfd, 450 wkg	3/6
16 x 8mfd, 500 wkg	4/6
16 x 16mfd, 450 wkg	3/9
16mfd, 500 wkg	3/3
8mfd, 500V wkg, wire ends	2/6
8mfd, 350V wkg, tag ends	1/6
100+150mfd, 350V wkg 280mA, AC ripple	4/6
100+200mfd, 265 wkg	7/6
16+16mfd, 350 wkg	3/3
50mfd, 180 wkg	1/9
65mfd, 220 wkg	1/6
60+100mfd, 280 wkg	7/6

4 VALVE ALL-DRY SUPERHET PORTABLE KIT



Medium and long waves. In grey leatherette, size 9" x 7" x 6". Valve line-up 1T4, 1R5, 1S5, 3V4. Complete kit of parts (less batteries)

£6.6.0

Plus post and packing 2/6

R.&TV COMPONENTS (ACTON) LTD

23 HIGH STREET ACTON LONDON W3

Where cost and packing charge is not stated, please add 1/6 up to 10/–, 2/– up to £1 and 2/6 up to £2. All enquiries SAE. Lists 5d. each

TRANSISTORS Offered at less than half-price

This JUNCTION TRANSISTOR type P.N.P. is designed for

A.F. Application up to 800 kc/s, and is suitable for use in Radio Control, Signal Tracers, Local Station Receivers, Oscillators, Transistors Voltmeters and Experimental work etc.

10/– EACH

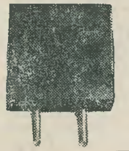
(Complete with Technical Data and Circuits)

ELECTRICAL DATA

Maximum Collector Voltage — 5 volts
Peak collector voltage — 5 volts
Maximum Collector Currents — 10 mA
Maximum emitter current — 10 mA
Maximum power dissipation 25 mW

QUARTZ CRYSTALS

Type FT243. Fundamental frequencies, 2-pin, ½" spcing.
120 TYPES 5,675 kc/s to 8,650 kc/s in steps of 25 kc/s.
80 TYPES 5,706 kc/s to 8,340 kc/s in steps of 33,333 kc/s.
All Brand New 10/– each
Special price for complete sets of 80 or 120
Above are ideal for regrinding



Type FT241A. 54th Harmonic.
2-pin ½" spacing
80 Types, 20 Mc/s to 27.9 Mc/s
(In steps of 100 kc/s)
Brand New and Guaranteed, 7/6 each
(Complete sets of 80 available)
FT241A 200 kc/s, **10/–**. 2-pin holders for all types, **1/3**

SPECIAL REDUCTION FOR SETS OF VALVES

	Set
1A7GT, 1N5GT, 1H5GT, 1A5GT (or 1Q5GT or 3Q5GT) ...	37/6
10 EF50 (ex-Brand New Units) 5/– each ...	45/–
10 EF50 (Red Sylvania ex-new units) 6/– each	55/–
6K8G, 6K7G, 6Q7G, 5Z4G, 6V6G ...	35/–
1R5, 1S5, 1T4, 1S4 or (3S4 or 3V4) ...	27/6
DK96, DF96, DA96, DL96 ...	32/6
6K8G, 6K7G, GQ7G, 25A6G, 25Z5 (or 25Z6G)	37/6
12K8GT, 12K7GT, 12Q7GT, 35Z4GT, 35L6GT (or 50L6GT) ...	37/6
12SA7GT, 12SK7GT, 12SQ7GT, 35Z4GT, 35L6GT or 50L6GT ...	35/–

CATHODE RAY TUBES

VCR138A (with screen) ...	35/–
VCR139A 2½" C/R Tube. Brand new in original cartons (carr. free) ...	£1.15.0
VCR97 Guaranteed full TV picture (carr. 2/–) ...	£2.0.0
VCR517C Guaranteed full TV picture ...	£1.15.0
MU-METAL SCREENS for VCR97 or 517. P.P. 1/6 ...	10/–
6" ENLARGER for VCR97 or 517. P.P. 1/6	17/6
VCR97 Slight cut-off. Carr. 2/– ...	15/–
3BP1 Brand new ...	£1.10.0

PIRANI HIGH VACUUM TEST EQUIPMENT

Manufactured by Pye Radio Ltd. for Atomic Research Station. Comprising: Pirani control unit, Pirani bridge unit, gauge head with calibrator and Pye scale lamp-galvonometer. All items brand new in original packing. **£33.10.0** COMPLETE
Spare Pirani heads (Edwards M6) ... **15/–**

WE HAVE OVER 50,000 B.V.A. AND AMERICAN VALVES IN STOCK AT VERY LOW PRICES.

MINIATURE TRANSMITTING STRIP TYPE 81

Size 7½" x 6" x 3". Complete with valves type CV415, CV309, 2-6AM6, 2-7D9 and Quartz Crystal 4,860 kc/s, **£4.10.0** complete

MINIATURE I.F. STRIP TYPE 373 9-72 MEG.

Brand new miniature i.f. strip size 10¾" x 2¼" x 3" high. Valve line-up: 2-EF92, 3-EF91 and EB91. With circuit. Price (less valves) **7/6**, P.P 1/6
This i.f. strip is part of above equipment.

CRYSTAL MICROPHONE INSERTS

Ex-Units 5/– post free. Brand new and boxed **8/6** post free. Ideal for tape recording and amplifiers. No matching transformer required.

T/R 1196 RECEIVER

Complete with 6 valves, 2 EF36, 2 EF39, 1 EK32, 1 EBC23. 465 I.F.T. ideal for conversion. In absolute new condition. **27/6** p.p. 2/6, with circuit.

T/R 1196 TRANSMITTER

Transmitter section comprising EL32, EF50, VT501, Relay, etc., **12/6**, p.p. 2/6. **COMPLETE TRANSMITTER-RECEIVER** with 24V power-pack in original transit case, **57/6**, p.p. 5/–

RF26 F.M. CONVERTER UNIT 88/100 Mc/s

This well-known RF26 Unit is now adaptable for F.M. reception using 2 i.f. stages and separate local oscillator and tuned by a Muirhead graduated vernier drive. Can be converted at low cost of **92/6**. Send 1/6 for 8-page descriptive booklet containing full wiring instructions, circuits and layout diagrams.

BAND III CONVERTER UNIT

Complete kit of parts. Including 2 EF80 and chassis and wiring diagram. Voltage required 200V at 30mA, 6.3V .6A, **48/6**, plus 2/– P.P. Or assembled and tested, **67/7**, plus 2/– P.P. Power supply components, **22/–**. The Unit, complete with power supply, tested and ready to plug in, **97/6**

TRANSMITTER-RECEIVER 38 WALKIE TALKIE SETS

Special offer of above set, complete with 5 valves, 4 ARP12 and ATP4, with circuit. Range 7.4 to 9 Mc/s. These sets are not guaranteed but are serviceable. **25/–**. Junction box 2/6 extra

PYE 45 Mc/s STRIP TYPE 3583 UNITS

Size 15" x 8" x 2". Complete with 45 Mc/s. Pye Strip, 12 valves: 10 EF50, EB34 and EA50, volume controls and hosts of resistors and condensers. New condition. Modification data supplied. Price **69/6**, carriage paid.

INDICATOR UNIT TYPE 182A

Unit contains VCR517 Cathode Ray 6" Tube, complete with mu-metal screen, 3 EF50, 4SP61 and 1 5U4G valves, 9 wirewound volume controls and quantity of resistors and condensers. Offered BRAND NEW (less relay) at **67/6**, plus 7/6 carr. *Radio Constructor* 'scope circuit included.

HENRY'S 5 HARROW ROAD PADDINGTON W2

Telephone PADdington 1008/9 & 0401

SEND 3d. FOR 28-PAGE CATALOGUE

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, including address, minimum charge 2/–. Trade advertisements will be accepted at 9d. per word, minimum charge 6/–. If a Box Number is required, anadditional charge of 1/– will be made. Terms: Cash with order. All copy must be in hand by the 8th of the month for insertion in the following month's issue.

PRIVATE

FOR SALE Scophony Baird tape recorder, mike, 5 tapes, excellent condition, perfect, £30, or near offer. SCR522 transmitter/receiver, unused, ideal for 2 metres, less power pack, offers. F. W. Hardstone, 43 Shrubbery Road, Streatham, London, S.W.16.

OFFERS FOR 120 watt, 12 volt petrol charging generator. Handy, small, lightweight job. White canvas tent, 6ft high, 8ft by 10ft. "East Keal," Romany Road, Oulton Broad, Lowestoft, Suffolk.

SELLING OUT. 1155, power pack, 30 modern valves, meters (inc. repairable Universal Avominor); Q-Max punches, phones, magazines, resistors, capacitors, etc. The lot £15. Buyer collects. Wilson, 40 Mount Pleasant, Alperton, Wembley.

FOR SALE Cossor combined radio and television with almost new tube. Wants a new transformer, £15. A. Lawrence, *Telephone* BIShopsgate 7836 (London).

FOR SALE Radio experimenter selling complete workshop, separately or one lot. Includes scope, bridge, audio oscillator, VTVM valves, condensers, resistors, transformers, meters, etc. Suit serviceman setting up business cheaply or keen experimenter. Selected items, 5in American CRT's, £1; coil winder, £5. Consider exchanges, photographic equipment. Box No. E117.

AMATEUR SELLING UP. PM speakers (new), 5in, 7/6; 6½in, 9/6; 8in, 11/6; 10in, 15/–. Indicators complete 182A, 35/–; 6E with VCR97, 40/–; APN4 with 5CP1 and 26 valves, 65/–; RF25 units, 6/–. Block condensers, 10uF, 400V, 3/–. 0.25uF, 2kV, 9d. 0.1uF, 2.5kV, 2/6. J50 rectifiers, 2/6, VCR138, 15/–. VCR97, 10/–. Odd CRT's, 5/–. Mains and O/P transformers, chokes, valves, very cheap. Call after 6 p.m. 30 Parkhill Road, East Croydon, Surrey.

AMATEUR CLEARING. SAE for lists. Hubbard, 5 Davenant Road, London, N.19.

FOR SALE Felstead electronic invertor, d.c. to a.c. 78 watts output, suitable radio or radiogram, almost new, £9. Adams, 124 Forster Street, Nottingham.

FOR SALE Trawler CNY2, combined receiver/transmitter/loud hailer, operates 12–24V d.c., 100/110V a.c., 200/250V a.c. Offers? Holder, Green Trees, Forest Road, East Horsley, Surrey.

FOR SALE G.E.C. Miniscope, £11 10s. 0d. Axiom 150 Mk1, with bass reflex to Goodmans spec., £12, carriage extra. 1132A receiver, £2, carriage extra. All hardly used. Other receivers, meters, components, etc. SAE for list. Moran, "Penryn," Moorgreen Road, West End, Southampton.

FOR SALE two sets CR100 valves, 12s. 6d. each. U52, 5U4G, 5s. AC2PEN, TH4B, ACTP, 4s. each. VP2, VP1, AC/HL/DD, 3s. 6d. each. Box No. E116.

FOR SALE Mullard amplifier and Garrad 3-speed record changer, unused, £14. Box No. E118.

FOR SALE 90 Mc/s receiver, 50s. 8-valve set with crystals, 50s. (S.E.9.) *Telephone* FOO 3994.

FREE VALVES. A new EF50, 6J6, SP61, 6AG5, EB34 with each order for 5s. parcel of brand new equipment, assorted pots, valve holders, coils, switches, resistors, etc. State valve preferred. Bates, 1 Queens Circus, Cheltenham, Glos.

(continued on page 807)

The Walk-around Shop

Offers many lines of interest to Radio Constructors

Make a Miniature Pocket Radio. Incorporating high "Q" technique using the new Ferrite rod. Made possible by simple conversion of an ex-Govt. hearing aid. **£2 6 0** post paid, with circuit diagram and full instructions. Batteries extra: 1.5V l.t. (type D18), **8d.**; 30V h.t. (type B119), 4/3

Vibrator Packs (Mallory). 12V input 150V 40mA, size 5½" x 5½" x 3", **17/6** each; 12V input 275V 80mA, size 5½" x 5½" x 3", **25/–** each; 6V input 275V 80mA, size 4½" x 6" x 4½" with harness, **35/–** each. All plus 2/6 p.p.

Line Testing Meter Unit. With one 0-30mA and one 0-100V 2½" panel mounting meters. P.O. switch, 3 panel mounting fuse holders in strong polished wooden case with lined lid and handle. Size 8" wide x 5¾" x 5¾" Price **15/–** each plus 2/6 p.p.

Command Receivers: BC-453-B 190-500 kc/s, **£2 17 6** each; **BC-454-B** 3-6 Mc/s, **£1 5 0** each; **BC-455-B** 6-9.1 Mc/s, **£1 5 0** each. All fully valved —less dynamotors (not new), all plus 3/– p.p.

Miniature I.F. Strips, size 10¾" x 2¼" x 3". Frequency 9.72 Mc/s, line-up 2 EF92's and 1 EF91 i.f. amps., EB91 Det/AGC, EF91 AGC amp. and EF91 Limiter. Circuit supplied. Price, less valves, **8/–** each, post paid

A.R.88. Ceramic wafered Range Switch Assembly. New and boxed. Price **17/6**, post and packing 2/–

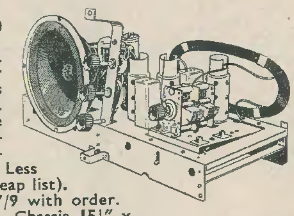
R.F. Units. R.F.24 20-30 Mc/s, switched tuning, valved, **9/6** each; **R.F.25** 40-50 Mc/s, switched tuning, valved, **9/6** each; **R.F.26** 50-65 Mc/s, variable tuning, valved (new), **25/–** each. Packing and postage 2/– each

Command Transmitters. BC-458-A 5.3-7 Mc/s, **BC-459-A** 7-9.1 Mc/s, fully valved—less dynamotors (not new), **£2** each, plus 3/– p.p.

Orders and Enquiries to Dept. "R" please

PROOPS BROS. LTD. *Open all day Saturday*
52 Tottenham Court Road W1
Hours 9-6 pm *Thursday to 1 pm* *LANgham 0141*

RADIO CHASSIS 39/6



3 w/band & gram. Extra speaker sockets, 5 valves international octal. Built-in portable aerial, 4 knob control. A.C. or universal optional. Less valves (see our cheap list). **8" P.M. speaker 7/9** with order. Set of knobs **2/–**. Chassis **15½"** x 7" x 9" (when speaker is fitted). Carr. 4/6.

12" T.V. CHASSIS 97/6

Easily adapted to Band 3 (I.T.V.). Drawing **2/6** or FREE with order. Complete chassis by famous manfr. R.F. E.H.T. unit included. Owing to this chassis being in 3 separate units (power, t/base and s/vision interconnected), it is easily fitted to table or console model. This chassis is less valves and tube. Ins. and carr: London 5/–, state B.B.C. channel—Provinces 10/–

RADIOGRAM CHASSIS, 29/9. Including 8" speaker, dial and knobs. 5 valve s/het. 3 w/band. A.C. mains. Complete. Guar. tested. Less valves. Ins. and carr. 4/6

POWER TRANSFORMERS, 15/9. 325-0-325V mains. 6V at 5A, 4V at 5A, 4V at 5A. Extra isolated winding for 2 or 4V tubes. Also similar trans. with 6V at 5A, 6V at 5A, 22V at 1½A. Both are 250 mA. Plus post 2/–

MAINS TRANSFORMERS, 5/9. Heaters 6V and 5V, 350-0-350V, primary 200-250V. Post 2/–

MAINS POWER PACK UNIT, 29/9. 5kV E.H.T. 325V, 250mA. Smoothed h.t. heaters, 6V at 5A, 4V at 5A, 4V at 5A. Carr. 4/6.

DUKE & CO
621 ROMFORD ROAD LONDON E12
Send 2½d. stamp for FREE Catalogue *Telephone GRA 6677*

SMALL ADVERTISEMENTS

(*continued from page 805*)

PRIVATE

FOR SALE Avominor, 22 ranges, a.c./d.c. In perfect condition, £5. Lomas, 68 Knott Lane, Hyde, Cheshire.

FOR SALE Bridge (CR50) Grayshaw's, five months old, as new, £5 10s. 0d. Kirkham, 2 Elizabeth Road, Boston, Lincs.

FOR SALE Eddystone coils, 706/LB, 706/Y, 706/R, 706/P, base 707, condenser 586, 30s. complete. 157 Wanstead Park Road, Ilford, Essex.

FOR SALE Avo signal generator, battery model, 50 kc/s–70 Mc/s, condition as new, £20. Piper, 58 Southville Road, Aberavon, Glam.

FOR SALE Tested valves. 78, 2X2, PP4A, 3s. 6AK5, MSPEN, MSP4, 6A7 and 6J5, 3s. 6d. MX40, KT66, 80, AZ1, VR150/30, CL33, 4s. each. Other types, SAE. 24 Cornwallis Avenue, London, S.E.9.

WILL ENGINEER assist with "Magnaview," sound and vision, working but not satisfactory. Specified parts, Sutton Coldfield transmission. Well recompensed for good job. Box No. E119.

TRADE

FOR SALE Brand new 5-element channel 8 and 9 aerials with mast, etc., to fix to existing aerial, 39/6. (list 52/6). Indoor model, universal fixing, 30s. Special price for dozen or over. Send P.O. 1s. for our illustrated lists of aerial parts, data, etc. Amazing value. Full guarantee. Skyline Works, Burnsall Road, Coventry. *Telephone* 60418.

VALVES PY82, PY81, PY80, PL82, 9s. each. L77, 6AK5, EB91, 6s. each. 6H6M, 3s. 12H6M, 4s. 6SK7, 5s. Multicore, 16 s.w.g., 3d. yard.

TV AERIALS 10 element Yagi, 65/–; 8, 55/–; 6, 45/–; 5, 40/–, etc. 70 different types and all fittings available. SAE List. BCM/SILEC, London, W.C.1.

TAPE RECORDINGS transferred to disc. 78's and L.P.'s. Queensway Recording Studios, 123 Queensway, London W.2. *Telephone* BAY 4992.

I.P.R.E. PUBLICATIONS. 5,500 alignment peaks for superhets, 5/9. Sample copy *The Practical Radio Engineer*, 2/–. Membership examination particulars, 1/–. Syllabus of TV and Radio Courses free and post free. Secretary, I.P.R.E., 20 Fairfield Road, London, N.8.

GOVERNMENT SURPLUS ILLUSTRATED CATALOGUE No. 12, containing over 400 items of electrical, mechanical and radio equipment for experiments, etc., price 1/6 post free. Arthur Sallis, 93 North Road, Brighton, Sussex.

JOIN THE INTERNATIONAL S.W. LEAGUE. Free Services to members including Q.S.L. Bureau, Translation, Technical and Identification Depts.—both Broadcast and Fixed Stations, DX Certificates, contests and activities for the SWL and Transmitting members. Monthly magazine, "MONITOR," containing articles of general interest to Broadcast and Amateur SWL's, Transmitter page and League affairs, etc. League supplies such as badges, headed notepaper and envelopes, QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership, including monthly magazine, etc., 15/– per annum. Secretary, ISWL, 86 Barrenger Road, London, N.10.

BUILD YOUR OWN TV and learn about its operation, maintenance and servicing. Qualified engineer-tutor available whilst you are learning and building. Free brochure from E.M.I. Institutes, Department R.C. 58, London, W.4 (associated with H.M.V.).

BLUEPRINTS. High Gain 10 metre converter, with a de luxe circuit comprising EF91 r.f. stage, ECC91 double triode mixer and oscillator, EF92 i.f. amplifier, with stabilised voltage supply via 7475, 1/8 post free with full instructions. Data Publications, Ltd., 57 Maida Vale, London, W.9.

(*continued on page 808*)

CRACKLE

Panl air-drying crackle has been used for many years by constructors, and most radio component dealers stock this popular finish as a regular line. Under air-drying conditions Panl is slow in hardening, but the hardening time can be considerably speeded up with the aid of an ordinary domestic gas oven. We feel this information will be of interest to manufacturers for prototype and test instrument finishing.

The work should be left to crackle according to the instructions printed on the label, OR place in the gas oven with the gas turned as low as possible and the door *left wide open*. When the crackle is complete and surface dry, proceed as follows:

Bake at 90 deg. F. approx. (Regulo 3) for one hour, or 150 deg. F. approx. (Regulo 5) for half-hour, with the oven door closed. (The times and temperatures are not critical.) Allow to cool, when the surface will be rock hard and ready for working on.

Panl is available in black in 1/8th pint cans at 3/-. Other sizes to special order. Trade and wholesalers' terms available.

If unable to obtain locally send 3/6 to

G. A. MILLER 8 Kenton Park Crescent Kenton Middlesex

PANL

WORLD RADIO HANDBOOK

1956 Edition 10/6 Post 6d

Complete Guide to World Radio and TV stations

DATA PUBLICATIONS LTD

57 MAIDA VALE LONDON W9

H.A.C. SHORT-WAVE EQUIPMENT

Suppliers for over 18 years of Radio S.W. Receivers of Quality

One-valve Kit, price 25/-. Two-valve Kit, price 50/-. Improved designs with Denco coils. All kits complete with all components, accessories and full instructions. Before ordering, call and inspect a demonstration receiver, or send stamped addressed envelope for descriptive catalogue.

H.A.C. SHORT-WAVE PRODUCTS (DEPT. R)
11 OLD BOND STREET LONDON W1

GUARANTEED VALVES — Over 3,000 in Stock

6AM6, 6C4, EF92, 6AL5, EAC91, 6J6 ... ... 5/-
12AT7, 12AX7, 6AK5, 6F33, EC91, EL91, 6SN7, 6SL7, 6SK7, 6SJ7, R10, 6BA6, 6F17, 6CH6, 6BW6 ... 7/6
12AU7, 2D21 ... ... 9/-

A. A. W. SKILLMAN
74 FRANCHISE STREET WEYMOUTH

BRASS, COPPER, DURAL ALUMINIUM, BRONZE

ROD, BAR, SHEET, TUBE, STRIP, WIRE

3,000 STANDARD STOCK SIZES

No Quantity too Small *List on application*

H. ROLLET & CO. LTD

6 Chesham Place SW1 *Telephone* SLOane 3463

also at Liverpool Birmingham Manchester Leeds

SMALL ADVERTISEMENTS

(continued from page 807

TRADE

OSMOR—for efficient coils, coilpacks, etc. Send 5d. stamp for FREE circuits and lists. Dept. R.C.C., Osmor Radio Products Ltd. 418 Brighton Road, South Croydon, Surrey. *Telephone* Croydon 5148/9.

MULLARD 3 valve, 3 watt, high fidelity audio amplifier, featured in April issue, full sized blue print, 2/8 post paid. Data Publications, Ltd., 57 Maida Vale, London, W.9.

COILS, COILS, COILS. We can supply coils for all frequencies, r.f. chokes, etc. Send SAE for circuits and data. The Teletron Co., 266 Nightingale Road, London, N.9.

TELEVISION INTERFERENCE. Receiver filters: High-Pass E.5037, 30/-; Low-Pass E.5031, 30/-; Composite Band I/III, 49/6. Transmitter filter: E.5034 80dB 1kW, £6. Labgear (Cambridge) Ltd., Willow Place, Cambridge.

FREE: Brochure giving details in Home Study Training In Radio, Television, and all branches of Electronics. Courses for the hobby enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds, R.T.E.B., and other Professional examinations. Train with the college operated by Britain's largest Electronics organisation. Moderate fees. Write to E.M.I. Institutes, Dept. RC28, London, W.4.

SITUATIONS VACANT

PRACTICAL ENGINEER with workshop experience required for the construction and service of specialised sound equipment. Apply Stagesound (London) Ltd., 16 Gerrard Street, W.1.

RADIO CONTROL

FOR MODEL SHIPS, BOATS AND AIRCRAFT

by F. C. JUDD, G2BCX

To operate a model ship or aircraft is a most interesting hobby. But how much more fascinating it would be if one could emulate the skipper or pilot and remain in control after the model has been set off on its course. This, thanks to radio control, can now be done, and enthusiasm for it is steadily mounting. **Radio Control for Model Ships, Boats and Aircraft** has become a recognised handbook in this field.

144 pages *135 diagrams and illustrations*

Standard Edition, art board cover, 8s. 6d. *postage 5d.*

Cloth bound, with gold lettering, 11s. 6d. *postage 7d.*

DATA PUBLICATIONS LTD
57 MAIDA VALE LONDON W9

CONSTRUCTORS *build these at low cost !*

PERSONAL PORTABLE RADIO **30/-** *Post Free*

This little set was designed to give you a real personal portable radio that you can enjoy anywhere without disturbing others. Ideal for the holiday, hiking, fishing, camping, cycling, etc. Use it at home, at the office, in bed, or just anywhere.

Send 2/- for layout, wiring diagram and components price list.

PRESELECTOR

Component parts for this unit, specially designed to suit the ALL-WAVE RADIO, are available as follows:

Panel and Chassis	3/6
Coil Holder	9d.
Coil to cover reqd. range 10–23, 20–43, 40–100 and MW range each	3/6
954 Valve	3/-
Valveholder	2/-
0.00016μF Condenser	4/-
RF Choke	2/-
Variable potentiometer	3/-
Suitable resistors	2/6
Suitable condensers	2/6

POWER UNIT TYPE PU1

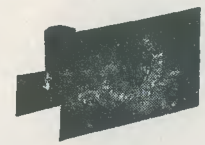
An ideal power supply for both these receivers and the Preselector. Also for inclusion in Test Equipment. 120V at 25mA, 6.3V at 1.5A.

32/6

ALL-WAVE RADIO

30/-

Ideal for the beginner or for those requiring a simple standby receiver.



This 1 valve S.W. receiver can be built for 30/- from our list of components, which can be purchased separately. It includes valve and 1 coil covering 20–40 metres. Provision is made to increase to 2 or 3 valves if required, and all components are colour-coded so that the beginner can build this set quite easily. *Send 2/- for specification, wiring diagram, layout and price list.*

R.C.S. PRODUCTS (RADIO) LTD
11 OLIVER ROAD *(Mail order only)* **LONDON E17**

YOU CAN RELY ON US

We specialise ONLY in radio and electronic components, a comprehensive stock of which are held by us, to supply Government, educational and commercial laboratories. Can we be of some help to you, the experimenter and constructor? ?

QUALITY AMPLIFIER KITS

IN STOCK **ALL SPECIFIED PARTS FOR**

MULLARD 3 WATT QUALITY AMPLIFIER
INCLUDING WYNALL TRANSFORMERS
MULLARD 510, F.M. UNIT, PRE-AMP
20 WATT AMPLIFIER
OSRAM 912, PASSIVE UNIT, PRE-AMP, F.M. UNIT

TRANSFORMERS FROM STOCK—
WYNALL, PARTRIDGE, GILSON, W.B., ELLISON

Detailed Price List Available on Request *New Catalogue No. 14 on Request*

Next to South Ealing Tube Station 65 Bus

82 SOUTH EALING ROAD
LONDON W5 *Telephone* **EAL 5737**

RADIO SERVICING CO