The Wireless World

COVERING EVERY WIRELESS INTEREST

JUNE, 1941

BROADCAST RECEIVER MAINTENANCE: WARTIME MAKESHIFTS
SILVERED MICA CONDENSERS

for SERVICE and the SERVICES

Every U.I.C. Condenser is subject to the most thorough mechanical and electrical inspection, and is tested for:

- **CAPACITY**: Tolerance can be made as close as ± 0.5%
- **LOSS FACTOR**: Average 0.05% (maximum 0.2%) at 1,000 Kc/s.
- **TEST VOLTAGE**: As specified, but normally 1,000 v. D.C.

Constant production check measurements are made on the effect of repeated cycles of HEAT & HUMIDITY on DIELECTRIC STRENGTH—INSULATION RESISTANCE—NOISE, etc.

Approved as satisfying all current official specifications.

Send for interesting Technical Brochure.

CONTRACTORS TO GOVERNMENT DEPTS.
On A.I.D. APPROVED LIST.

UNITED INSULATOR CO LTD

The Pioneers of Low Loss Ceramics

12-16 LAYSTALL STREET, LONDON, E.C.1

Tel: TERMINUS 4118-9

Grams: CALANEL, SMITH, LONDON
FROM years of intensive research in the design and manufacture of electrical testing equipment has grown the range of world-famous "AVO" Instruments. To-day, wherever rapid precision testing is demanded, there will be found the meters that matter—"AVO" Meters.

46 range Model 7
Universal AvoMeter

40-range Model 40
Universal AvoMeter

"Avo" Valve Tester with Universal Panel

All-Wave "Avo" Oscillator

"Avo" Test Bridge

Universal AvoMinor

D.C. AvoMinor

OTHER "AVO" INSTRUMENTS
(Not Illustrated)

"Avo" Bonding Meter.
"Avo" Milliohm meter.

Write for literature fully descriptive of any "Avo" Instrument in which you are interested.

In spite of greatly increased production, most of our output of "AVO" Instruments is being taken by the Services. Delay in delivery of Trade orders is consequently inevitable, but we shall continue to do our best to fulfil your requirements as promptly as possible.

Sole Proprietors and Manufacturers:
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT Co. Ltd.
Phone: Victoria 3404-7.
RAF wants Radio Enthusiasts

SKILLED & SEMI-SKILLED TRADESMEN —

the R.A.F. needs your knowledge and ability. You can be enrolled as:—

Wireless Mechanics - (18 to 50)
Radio Mechanics - (18 to 50)
Electricians - (18 to 38)

UNTRAINED MEN WHO ARE KEEN ON RADIO—

the R.A.F. will quickly train you and add to your knowledge. Recruits are now wanted for training as:—

Radio/Wireless Mechanics (18 to 32)

(THese ARE ALL GROUND DUTIES)

Men are wanted NOW to maintain and operate the wireless installations without which the grand work of the R.A.F. would not be possible. These jobs are interesting, the pay and conditions are good, and you have the satisfaction of doing work of first-rate importance.

Please send me details of Wireless Trades in the R.A.F.

NAME

ADDRESS

To Air Ministry Information Bureau, Kingsway, London, W.C.2.

speed up and simplify assembly and cut down costs. They are available in a wide range of standard types, but our Development Department is at the service of Manufacturers whose particular needs call for special designs.
New and Improved TAYLOR VALVE TESTERS

The Taylor range of Valve Testers, all of proved performance, now incorporate a circuit which enables accurate measurements of mutual conductance to be made on at least 99% of British and American receiving valves.

By means of the illustrated directions provided with every instrument, it is also possible for the user to work out the correct switch setting for any new type of receiving valve which may be produced.

NOTE THE SCOPE OF THIS—

TAYLOR MODEL 45

MUTUAL CONDUCTANCE. Measures mutual conductance of at least 99% of British and American receiving valves.

17 VALVEHOLDERS. The 17 different types fitted, include the new American Bantam, Lokstat, Mazda Octal and Midget Deal-Aid types.

TESTS EVERY VALVE under correct working condition.

MULTI-ELECTRODE VALVES. Each section can be tested independently.

CATHODE LEAKAGE. Calibrated scale shows leakage as high as 10 megohms.

“GOOD,” “BAD,” “REPLACE.” The Taylor 45-in. square type moving coil meter has a scale of indicating the slope of valves.

FILAMENT CONTINUITY AND SHORTS. These are indicated by a lamp mounted on the panel.

NOTE: MODEL 47 also includes provision for the measurement of D.C. volts, amps, and ohms.

MODEL 45 £14.3.6

Portable Model £14.19.0 (No purchase tax payable on any of these models.)

Every Taylor Valve Tester is supplied complete with a grid connecting lead—comprehensive book of instructions and an up-to-date Valve Manual. Fully descriptive Brochures are available on request.

BRITISH MADE AND GUARANTEED 6 MONTHS.

TAYLOR

Electrical Instruments Ltd.,
419-422, Montrose Avenue,
SLOUGH, Bucks.
Phone: Slough 12381.
PREMIER RADIO

PLEASE NOTE—ALL KITS ARE NOW SUBJECT TO PURCHASE TAX.

PREMIER SMOOTHING CHOKE

<table>
<thead>
<tr>
<th>Type</th>
<th>Current</th>
<th>Henrys</th>
<th>Res. Prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 40-500</td>
<td>40 MA</td>
<td>20-34 H</td>
<td>500 ohms</td>
</tr>
<tr>
<td>C 60-100</td>
<td>60 MA</td>
<td>25-34 H</td>
<td>500 ohms</td>
</tr>
<tr>
<td>C 60-200</td>
<td>60 MA</td>
<td>25-34 H</td>
<td>500 ohms</td>
</tr>
<tr>
<td>C 60-300</td>
<td>60 MA</td>
<td>25-34 H</td>
<td>500 ohms</td>
</tr>
<tr>
<td>C 100-400</td>
<td>100 MA</td>
<td>25-34 H</td>
<td>500 ohms</td>
</tr>
<tr>
<td>C 150-185</td>
<td>150 MA</td>
<td>25-34 H</td>
<td>185 ohms</td>
</tr>
<tr>
<td>C 200-145</td>
<td>200 MA</td>
<td>25-34 H</td>
<td>145 ohms</td>
</tr>
<tr>
<td>C 250-220</td>
<td>250 MA</td>
<td>25-34 H</td>
<td>120 ohms</td>
</tr>
</tbody>
</table>

PREMIER PICK-UPS

Heads (will fit any tone arm) 8-9
Premier Pick-ups with Volume Control Tone Arm 17-6

ANOTHER SPECIAL OFFER
Rothertorn Brush Fiozo Crystal Pick-ups. Standard S.B. Model with arm.... 34-9

PREMIER 1941 HIGH FIDELITY AMPLIFIER KITS

Each Kit is complete with ready drilled chassis, selected components, specially matched valves and full diagrams and instructions.

- Kit of Completely Wired and Assembled Parts Ready to Go.
- 4-watt A.C. Amplifier £2 14 0 £3 11 6
- 6-watt A.C. £4 16 6 £7 13 6
- 8-watt A.C. £6 17 0 £7 9 0
- Black Craddock Cabinet £17 6 extra.

MAINS TRANSFORMERS

Wire-ends, All L.T. Windings Centre-Tapped

SP 350 250-0-250 v. 60 ma, 4 v. 1-2 a.
SP 300 200-0-200 v. 60 ma, 4 v. 2-3 a.
SP 250 180-0-180 v. 60 ma, 4 v. 2-3 a.
SP 200 150-0-150 v. 60 ma, 4 v. 2-3 a.
SP 150 100-0-100 v. 60 ma, 4 v. 2-3 a.
SP 100 0-0-100 v. 60 ma, 4 v. 2-3 a.
SP 50 0-0-50 v. 60 ma, 4 v. 2-3 a.
SP 40 0-0-40 v. 60 ma, 4 v. 2-3 a.
SP 30 0-0-30 v. 60 ma, 4 v. 2-3 a.
SP 20 0-0-20 v. 60 ma, 4 v. 2-3 a.

Auto Transformers, Step up or down. 100-150 to 200, 230 to 250, 250 v. A.C., 60 watts, 114; 125 watts, 15-26; 200 watts, 22-4.

L.T. Transformers, all C.T.

2 v. 2-3 a.... 11 4
3 v. 2-3 a.... 11 4
5 v. 2-3 a.... 11 4

Push-Pull Driver Transformers, 3:1 6/6 Universal Output Transformers, 11 Ratios, or Push-pull 6/6 MATCHMAKER UNIVERSAL OUTPUT TRANSFORMERS

Will match any output values to any speaker impedence.

11 ratios from 11 to 80: 1 5-7 watts, 16/10; 10-15 watts, 21/10; 20-30 watts, 36/10.

Faxon Valve Holders, chassis mounting, 4 or 5 pin, 4d. each. 7 pin, 4d. each.

Valve Screens, for American type valves. Small size, 1/2. Medium size, 1/2.

PREMIER MICROPHONES

Transverse Current Mike. High grade large output unit. Response 45-7,000 cycles. Low hiss level, 2/12.

ALL ENQUIRIES MUST BE ACCOMPANIED BY 2d STAMP.

PREMIER RADIO CO.

ALL POST ORDERS TO: JUBILEE WORKS, 167, LOWER CLAPTON ROAD, LONDON, E5 (Anthem 6725). CALLERS TO: Jubilee Works, 167, Fleet Street, E.C.4 (Central 2833) or 50 High Street, Clapham, S.W.4

"LEARNING MORSE"

- Premier Morse Practice Key on Bakelite Base and Brass Movement...
- General Purpose Morse Key...
- Bakelite Buzzers...
- 3 Henry Chokes...
- Complete KIT of Parts for Valve Oscillator, as described in W.W. "Learning Morse" 25-6

NEW PREMIER S.W. A.C. RECEIVER

In response to many requests we have now produced an A.C. version of our popular Premier Short Wave SGI Kit. Circuit: Pentode H.F. Stage, Pentode Detector, Beam Power Output, and F.M. Rectifier. 200-250 v. A.C. Operation. Built-in Power Pack. Hum-free operation. For use with Phones or P.M. Speaker.

- Complete Kit of Parts with Drilled Chassis, all components. Plug-in Coils covering 13-170 metres, 4 valves and full instructions and circuit... 6-14-6

PREMIER SHORT-WAVE KITS FOR OVERSEAS NEWS

Incorporating the Premier 3-Band S.W. Coil, 11-86 Metres without coil changing. Each Kit is complete with all components, diagrams, and 2 volt valves, 3-Band S.W. 1-Valve Kit, 18-7.

- 3-Band S.W. 2-Valve Kit, 27-6

DE LUXE S.W. KITS

Complete Kit, including all Valves, coils, wiring diagrams and lucid instructions for type, 2- and working. Each Kit supplied with a steel Chassis, Panel and plug-in coils to tune from 13 to 170 metres.

1-Y.S.W. Receiver or Adaptor Kit 24-6
2-Y. S.W. Superhet Converver Kit 28-6
5-Y. S.W. Receiver Kit 35-6

SHORT-WAVE CONDENSERS

Trollful insulation. Certified superior to ceramic, All-brass construction. Easily ganged.

- 15 mfd. 2-4 100 mfd. 3-7
- 20 mfd. 2-4 160 mfd. 3-7
- 40 mfd. 2-6 250 mfd. 4-6

SHORT-WAVE GEAR

Short-Wave Coils, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 2- each, with circuit.

- 4-pin or 6-pin Coil Formers. Plain or Threaded, 1/2 each.
- Bakelite Dielectric Variable Condensers, .0005 ml. Suitable Tuning or Rejection 1-6 each.
- Short-Wave H.F. Chokes. 10-100 m., 10-100 m., each. High grade Pie-Wound U.S.A. type, 1-2 each.
- Lissol Dual Range Screwed Coils, Medium and Long Waves, 1-2 each.

PREMIER REPLACEMENT VALVES

4 volt A.C. Types, 5-pin, A.C./M.O., A.C./I.
A.C./F., A.G.H., A.C./F.K. All 5/6 each.

Premier I.F. Trans. 450-470 kc. Air cores, 5/6 each. Without or with top grid connection.

Bifilar Couplings, (in bore, 11/4, each.
Valve Screens for International and U.S.A. types, 1/2 each.

Super Potentiometers. All resistances, 2/4, with switch, 3/3.

Beehive Stand Offs, 2/4in., 7d. each.
Mains Noise Suppressors, comprising double wound Choke and Condens., 6/6 each.
Microphone Cable. Weatherproof. Shielded and Rubber covered, 1 yard.

ELECTROLYTIC CONDENSERS.

Cardboard cases. 500 v. working, 4 mfd. and 8 mfd., 2 each. 6-8, 4m., 45-113, 6-8, 4, 4-4, 4, 3, 3, 10, 16-11, 16-6, 22, 25 mfd. 32 volt. 10 mfd. 12 volt. 16 volt. 15 mfd. 160 volt. 13, 4 mfd. 500 volts, 48, 1-1 Mains Buffer, 1/2.


All orders under 5/6d. post extra.

www.americanradiohistory.com
Proven for long life and reliability under war conditions (in all services, on land, sea and in the air).

Size only 5\(\times\)4\(\frac{1}{2}\)\(\times\)5\(\frac{1}{2}\) high and weighing only 6 lbs. approx.

Write for details: — MASTERADIO LTD.

---

**WHARFEDALE GOLDEN CHASSIS**

As supplied to the B.B.C.

Supplies of this first-class Loud Speaker are still available.

Delivery 2/3 weeks.

**PRICES:**

<table>
<thead>
<tr>
<th>Type</th>
<th>Less With Transformer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis only</td>
<td>60/- 75/-</td>
</tr>
<tr>
<td>Cabinet Model</td>
<td>97/6 112/6</td>
</tr>
</tbody>
</table>

---

**M.R. SUPPLIES**

continued to offer from stock the following FIRST-CLASS BROADCAST & RADIO AND ELECTRONIC TECHNICAL EQUIPMENT. We still maintain our long-standing reputation for prompt delivery and service.

**PHOTO-SWITCH Cables.** Great opportunity which cannot recur. Brand new 40 Cables. Latex or Cable is available. For use in direct-wire and wireless-station, 100,000 miles per hour. For use in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in tube circuits, include in text
Condensers and Dials

Owing to heavy Government demand we have considerably increased our range of Micro-Variable Condensers and Precision Dials. All have features not found in competitive makes. In the case of the Condensers—heavy all brass construction, ball-bearing spindle (electrically shorted) Ceramic (RMX) insulation, smooth operation with freedom from end or side play.

The Dials are noted for their fine appearance, accurate workmanship, and non-reflecting satin finish, graduations being deeply engraved and clear and easy to read. In addition a range of Knobs both skirt and otherwise to match these Dials are available. Full description of these instruments are available on receipt of a stamped addressed envelope.

STANDARD (VCX) SERIES CONDENSERS

VCX

The VCX series condenser can be mounted by means of the three holes where both rotor and stator are required to be insulated from panel.

MIDGET (MCX) SERIES CONDENSERS

MCX

Special condensers can be made with intermediate capacities. The ganging feature may also be omitted with a consequent saving in length. Such alterations, however, can only be considered where the quantity justifies the resetting of machines to make the special parts required.

PRECISION DIALS AND KNOBS

Our range of specialised short wave and communication equipment is the most comprehensive manufactured in this country.

Every necessary component for the construction of short and ultra-short wave Transmitters, Receivers, Oscillators and other scientific instruments are available. Your enquiries are solicited. Where the material is for use on Government Contract, delivery dates can be given if the priority and service is mentioned at the time of writing.

RAYMART

44 & 48, HOLLOWAY HEAD, BIRMINGHAM, 1. Phone: MIDLAND 3254
THE OUTSTANDING properties of Frequentite—Low Loss and High Mechanical Strength—led to a demand which even before the war severely taxed our productive capacity. The needs of the fighting services have inevitably led to restriction in supplies for general industry, but we can now meet all requirements promptly. Extensions to our plant, the employment of specialised new equipment, and progressive improvements in our manufacturing technique made during the past seven years, now enable manufacturers to obtain bulk supplies of the most intricate designs. Please write for Catalogue No. SP.10.

STEATITE & PORCELAIN PRODUCTS LTD.
Head Office and Works: STOURPORT-ON-SEVERN, WORCS. Telephone: Stourport 111. Telegrams: Steatoin, Stourport.
The Wireless World
31st Year of Publication
Covering Every Wireless Interest
JUNE, 1941

<table>
<thead>
<tr>
<th>Editorial</th>
<th>147</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making the Most of Short Waves</td>
<td>148</td>
</tr>
<tr>
<td>By L. A. Moxon, B.Sc., A.C.G.I.</td>
<td></td>
</tr>
<tr>
<td>Short-Wave Receiving Conditions</td>
<td>151</td>
</tr>
<tr>
<td>Makeshifts. By W. H. Cazaly</td>
<td>152</td>
</tr>
<tr>
<td>Noise in FM Receivers</td>
<td>156</td>
</tr>
<tr>
<td>Reducing Loading on Short Waves</td>
<td>159</td>
</tr>
<tr>
<td>Frequency Measurement</td>
<td>160</td>
</tr>
<tr>
<td>The Psychological Pause</td>
<td>162</td>
</tr>
<tr>
<td>The World of Wireless</td>
<td>163</td>
</tr>
<tr>
<td>News in English From Abroad</td>
<td>164</td>
</tr>
<tr>
<td>Letters to the Editor</td>
<td>166</td>
</tr>
<tr>
<td>Random Radiations. By &quot;Dialist&quot;</td>
<td>168</td>
</tr>
<tr>
<td>Recent Inventions</td>
<td>170</td>
</tr>
</tbody>
</table>

Branch Offices:

**Coventry:**
8-10, Corporation Street,
Telephone: Coventry 5200,
Telegram: "Autocor, Coventry."

**Birmingham:**
Guildhall Buildings,
Navigation Street, 2,
Telephone: Midland 2971 (4 lines),
Telegram: "Autopress, Birmingham."

**Manchester:**
260, Deansgate, 3,
Telephone: Blockfriars 4557 (4 lines),
Telegram: "Hifpo, Manchester."

**Glasgow:**
26a, Renfield Street, C.2,
Telephone: Central 4857,
Telegram: "Hifpo, Glasgow."

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

---

Address your staff through a **CELESTION LOUDSPEAKER**

— with a volume sufficient to overcome local noise.

The same speaker will carry music to your staff—true music, not just a volume of sound.

The Celestion method of suspension enables the sound to be directed wherever you want it.

**Celestion Limited, Kingston-upon-Thames, Surrey**

Acoustical Engineers

Telephone: K1Ngston 5656-7-8.

---

6 WATTS INPUT CADMIUM PLATED AND SPRAYED BATTLESHIP GREY

---

www.americanradiohistory.com
SELECTIVITY

SIMMONDS DOUBLE CRYSTAL FILTER

The paramount importance of high selectivity has long been recognised by radio engineers, but it is only comparatively recently that bandpass filters employing quartz crystal resonators have been made commercially available. After considerable research work our radio laboratory has evolved a new type of crystal bandpass filter employing a pair of quartz crystals, which will be found invaluable in many branches of radio tele-communication. Standard filters are available for frequencies within the range of 440-480 Kcs., having bandwidths of 300 cycles or 3 Kcs. Filters for other frequencies can be made to order. Simmonds crystal filters have an outstanding performance, including a very sharp cut-off and readily adjustable characteristics which make them very suitable for use in the Intermediate Frequency stages of super-heterodyne receivers.

SIMMONDS AEROCESORIES LTD
GREAT WEST ROAD, LONDON.
Presentation of Broadcast News

Is a Change of Technique Overdue?

WHAT most technical wireless people call the "programme side" of broadcasting is little concern of ours. In conformity with the clearly expressed wishes of the vast majority of our readers, we confine ourselves to the other side of wireless—to the means rather than the end. But, although we leave the details of programme organisation and make-up severely alone, it is our duty to keep a watchful eye on the broader and more fundamental issues, especially when it seems that our medium of communication is not being used to best advantage.

Now the dissemination of news is the most important function of broadcasting at the present time, and it has long been our opinion, confirmed by careful observation of the reactions of listeners of different types, that there is room for improvement in the technique of news presentation. In the first month of the war, when the Press of this country showed signs of resenting B.B.C. competition, we urged that there was no real foundation for antagonism, and that Press and broadcasting should be complementary channels of distribution, only needing to find the right techniques for changing conditions. We said "the trouble at present is that broadcasting is too much like the newspapers, and the newspapers are too much like broadcasting."

No Basic Change

That trouble still persists after nearly two years of war. One often reads long passages in the morning papers that contain not only the substance but very often the exact phrasing of something that has been heard during the previous evening's news bulletin. The make-up and style of the broadcast bulletins has undergone little fundamental change since 1939—or, for that matter, since 1922.

As compared with the Press, broadcasting enjoys the advantages of extreme speed and living actuality. It suffers under the handicaps of being unable (in the present absence of a television service) to employ such graphical aids as pictures, maps and diagrams to explain and amplify the news; in addition, the listener, unlike the reader of the printed page, cannot absorb information at his own pace. Consequently, news bulletins must be read at a compromise speed—too slow for some listeners and too fast for others.

These inherent advantages and disadvantages should obviously be taken into account in devising an improved technique of news presentation, and as a first step we suggest a sharp line of demarcation should be drawn between real news on the one hand, and commentary, exposition or speculation on the other. News proper might be broadcast in almost telegraphic phrasing, with the utmost economy in words. Change of speed in reading is a dramatic trick that is perhaps not to our national taste, but, skilfully done, it makes for easy assimilation of facts by the listener. The telegraphic trick of repeating numbers and extremely significant words or phrases might be helpful; the time spent in repetition would be more than offset by savings effected elsewhere. The interlarding of bulletins with "geography lessons" and passages from reference books annoys the well-informed listener, and belongs more properly to a commentary. Intuition, skill and a sympathetic outlook are needed for the arrangement of the items of a bulletin in their proper order, and pains should be taken to see that the burning question of the hour (in the estimation of the average intelligent listener) is dealt with first—even if there is "nothing to report."

New-style Newspapers, Too?

Although there has been little change in the Press so far as the fundamentals of news presentation are concerned, there seems to be a growing realisation of the fact that its function is changing. The newspaper cannot compete with broadcasting in speed of reporting events, but it has advantages in explaining and commenting on the news. This, we think, is now being realised by the Press, and we look forward to the time when the two channels of news distribution will be more nearly complementary.
Making the Most of

Short Waves

Improving the All-wave Receiver

By L. A. MOXON, B.Sc.,
A.C.G.I.

URING recent years, SW broadcasting has made rapid strides. Great improvements have been made on both the transmitting and receiving sides. The number of stations operating has greatly increased; the use of beam aerials and higher powers has made better signals available; and the development of the "all-wave" superhet has extended the circle of SW listeners far beyond the select few.

There remains, however, a long way to go. Short waves still fall far short of the standard of reliability desirable, or even that to which we are accustomed on medium waves. An American station which provides excellent entertainment one evening may the next be submerged by noise, distorted by selective feeding, jammed by morse interference, or perhaps not audible at all. The reasons for this are various. In the first place, of course, we have to rely entirely on the various reflecting layers for long-distance reception, and these layers, though extremely useful, are very capricious servants. They sometimes go more or less completely on strike; at others they pass the signal on to us in a distorted, badly fading or noise-ridden condition.

It is unfortunate that the receiver tends to introduce further elements of unreliability. It adds more noise, which may entirely swamp the signal. Second-channel and other forms of interference are added by the frequency changer. It is possible for the AVC circuits to operate in such a way as to render distortion produced in transit more obtrusive, or even to produce similar distortion in a synthetic manner. In addition, the simpler receivers provide little encouragement to the listener wanting to tune in a short-wave signal, and he may be compelled to exercise great skill and patience.

All these deficiencies in the receiver present serious problems to the designer, and it is the purpose here to show how they can be overcome or minimised. The value of an RF stage for improving the ratio of signal to noise, and reducing second-channel interference is well known, and some design considerations for making the best use of it will be outlined. Band-spreading will be considered in some detail as it is essential to a solution of the tuning problem; the latter also demands a very high degree of "staying put" on the part of the oscillator circuits, and the very accurate scale calibration that this makes possible. The uses of double frequency changing will be discussed, and finally a number of minor design points which repay attention will be considered.

Importance of an RF Stage

Engineers, yielding to public demand, have evolved what might almost be called a standard receiver; the familiar three waveband, four-valve superhet with frequency changer, an IF stage operating at about 465 kilocycles, double-diode triode for detection, AVC and AF amplification, and a high-slope output pentode. This design can give quite good results, but requires elaboration if a maximum of shortwave reliability is to be approached. Probably the first essential is to increase the signal-to-noise ratio by addition of an RF stage.

There are two main sources of noise in receivers, the tuned circuits and the valves. Assuming adequate gain from the first valve, only this and the preceding circuits need be considered, since other sources of noise will have much less amplification following them. In any con-
Making the Most of Short Waves—
signal has collected from the RF
valve. The RMS addition of the
two components gives an increase of
3 db. in total noise, and this is only
just appreciable. It may be possible
to get greater gain, but noise level
sets a limit to the amount of sensi-
tivity which can be usefully em-
ployed. This limit can be achieved in
practice (with or without an RF
stage) by making the FC, IF, AF
and output stages as efficient as pos-
sible. Unnecessary RF gain is
harmful for the following reason.

Over a range of a few hundred
kc/s on either side of the frequency
to which the set is tuned, little
attenuation can be expected from the
signal circuits, and all stations within
this range will reach the frequency
changer. If two signals which happen to be spaced by a frequency
equal to the IF of the receiver are
present in sufficient strength, they
will beat together to produce an
appreciable IF component, which
may cause interference with all weak
stations over quite a wide tuning
range. The RF stage amplifies not

only the wanted, but both the un-
wanted stations, and the interference
tends to be increased in proportion
though some help is afforded by the
selectivity of the usual extra circuit.
Those who like "gadgets" may find
a variable gain control useful.
Otherwise slightly more than the
"just adequate" gain is quite a
good compromise. Some increase in
gain may be permitted on the longer
SW bands in view of the greater
signal selectivity, but it is desirable
to avoid extreme variations over the
frequency range. This argument
does not apply to receivers with
double frequency changing and a
high value of first intermediate fre-
quency.

Battery valves have much lower
values of both G and I than mains
valves, and are about the same from
the noise point of view. On account

of the low slopes, it appears essential
to use tuned anode couplings in order
to get adequate gain. With mains
valves some form of transformer or
tapped coil coupling is usually more
satisfactory.

The additional tuned circuit that
an RF stage brings with it is some
help with image rejection. In an

average design, with an IF of 465
kc/s, it contributes some 12 db. to a
total of 20 db. rejection at 15 mega-
cycles. This is not a very satis-
factory improvement, and in one
receiver* a further 10 db. was ob-
tained by using a band-pass inter-
valve coupling.

Image Rejection

In a later receiver a total of 40 or
50 db. rejection was obtained by
means of a simple image rejector of
which Fig. 1 shows the principle.
This circuit, used as an anode
coupling impedance, would give
maximum gain at the resonance of
LC. At some lower frequency the
circuit LC, looking like an induc-
tance, forms a series resonance with
Cs and produces a very low imped-
ance. This can be utilised for image
rejection by suitable choice of Cs.
The practical application of the cir-
cuit is illustrated by Fig. 2. Its
working is somewhat modified by
the capacity Cr consisting of various
strays—the interelectrode capacities
of the RF and FC valves, the self-
capacity of the HT feed choke,
wiring, and possibly switch capaci-
ties. These must be kept as low as
possible, since their effect is to reduce

the effective impedance, and therefore
by the factor

\[ \frac{C_s}{C_s + C_p} \]

An average value for Cs may be
about 25 \(\mu F\), and \(C_p\) can be kept
down to about 30 \(\mu F\). At 16 metres
a coupling impedance of more than

1,000 ohms is unlikely, but this is
adequate if a high-slope valve is
used. From 25 metres upwards the
gain may then be excessive unless
Rs or C is increased.

Fig. 3 shows the measured selec-
tivity of the image rejector at
15 Mc/s compared with the esti-
imated performance of a simple cir-
cuit with similar losses. The tapping-
down effect of \(C_v\) helps to keep the
losses low and improves the suppres-
sion of double beats as well as
images.

It will be appreciated that the
oscillator must be tuned to a lower
frequency than the signal. In theory,
Making the Most of Short Waves—

Cs could be replaced by an inductance and the oscillator tuned high, but in practice difficulties arise over stray capacities.

This circuit was developed for use with a band-spread receiver using switched inductances pre-set to each of the short-wave broadcast bands (the Murphy A92). The value required for Cs depends on C, C2 and the IF. It was not found to be very critical, but had to be changed for each band, with the exception of 25 and 31 metres, which were able to share one value.

Most short-wave broadcasting stations lie within seven narrow bands, all less than 300 kc/s in width and centred around 6.1, 7.25, 9.6, 11.8, 15.22, 17.8 and 21.6 megacycles respectively. It is standard practice to cover the entire frequency range, or at least up to 18 Mc/s, by capac-

desired frequency. There are many possible means to this end, as illustrated in Fig. 4. Referring to this family tree, the left-hand side requires little discussion; slow-motion drives and mechanical or optical condenser at specified points. This may consist of a notched disc with a spring-controlled arm locating in the notches and giving a definite “feel” to the correct setting. An auxiliary means of tuning with its

![Wireless World](https://www.americanradiohistory.com/)

**Fig. 4.** "Family tree" depicting the various methods of band spreading.

(Left) Components associated with the double frequency-changing system of the Murphy Model A36 receiver.

Magnifying scales are very useful devices, but the very high mechanical standard required by the ideal is not readily achieved in mass production. Some American communications receivers employ very successful precision drives and geared-up scales which enable the receiver to be tuned accurately to any desired frequency within a wide range. For broadcast reception there is some advantage in being able to switch rapidly from one band to the next without tuning through a lot of intervening noises, and this is most readily achieved by electrical band-spread methods.

One interesting method is to provide means of arresting the tuning own scale must be employed to cover the bands thus selected. This method was employed some years ago on the Murphy A36 receiver, which employed double-frequency changing. SW signals were converted to an intermediate frequency in the medium-wave band, and tuned-in as medium-wave signals. The medium-wave tuner, therefore, provided the auxiliary means. An alternative would be to vary the oscillator inductance about 8 per cent. by means of an iron dust core or piece of non-ferrous metal moving inside it. A small auxiliary tuning condenser can be used, but is not satisfactory over a wide tuning range. A given spread at 6 Mc/s, compared with 18 Mc/s, would require 27 times as much charge of capacity, so that full cover of the former would severely cramp the latter. The inductance method possesses the same fault, but only to the extent of 3 to 1, which is tolerable. The double-frequency changing method described has the advantage of a constant band-spread scale calibration in terms of frequency differences. That is to say, a difference of 100 kc/s on the band-spread scale remains 100 kc/s whatever the
band selected by the main tuning control.

All systems which cover a wide frequency range by variable capacity share one disadvantage: that of tuning drift on the higher frequency bands, especially during the warming-up process. This is discussed in the next instalment. No wide-range inductance tuning devices are available, and the only alternative seems to be the use of separate oscillator inductances for each band, selected by a switch. This is no longer the formidable problem it would have been some years ago, thanks to the development of iron-dust cores which enable compact and easily adjustable coils to be constructed. In this way it is possible to produce really stable circuits, and there are two alternative methods of band-spreading, with a possible third. These will be described and discussed in a concluding instalment.

(To be concluded.)

Short-wave Receiving Conditions

PROSPECTS FOR JUNE

(Communicated by the Engineering Department of Cable and Wireless, Ltd.)

A LTHOUGH somewhat more settled than during the preceding month, short-wave receiving conditions during April were, nevertheless, not as favourable as those during the corresponding month of 1940.

Ionosphere storms occurred on fifteen days of the month as follows: On four consecutive days commencing April 10th and 18th and, in addition, on the 3rd and 7th (first week) and on the 24th, 25th, 26th, 28th and 29th (last week). In this connection readers of these reports may recall that, in the April issue of this journal, published on March 20th (see page 118), the possibility of a relatively high disturbance factor was suggested for a few days in the vicinity of April 9th and 17th, and, in addition, at the beginning and end of the month.

Sudden ionosphere disturbances of the Dellingter type occurred as follows, these and other times given in this report being G.M.T. on the 24-hour clock notation: (A) April 19th at 0109, (B) April 20th at 0409.

The effects of (A) and (B) were in each case confined mainly to easterly and southerly routes, and were in evidence for a period of about fifteen minutes; those on April 19th were, however, the more pronounced.

Particulars of the broadcast bands which, it is considered, should prove most reliable during June under normal conditions of propagation at the times stated for five selected routes are given below: these may serve as a guide when considering the possibilities of reception from places not too remote from those specified.

Attention is drawn to the fact that a number of factors, for example, (a) transmitting power, (b) efficiency of aerials at both the transmitting and receiving end, and (c) ionosphere abnormalities, may often result in better reception being obtained on wavebands other than those quoted. Moreover, transmission on each of the stated wavebands may not necessarily be available.

Tokio: Midt, 19 or 25 m; 0400, 19 m; 0700, 16 or 19 m; 1000, 16 m; 1300 and 1500, 16 or 19 m; 1800, 19 or 25 m; 2000, 19, 25 or 31 m.

Whereas in winter difficulties may be encountered for several hours on this route, in summer, and in particular during the month of June, favourable conditions persist throughout most, if not all, of the 24 hours. Echo effects may be prevalent during the period 1900 to 2100.

Montreal: Midt, 25 or 31 m; 0400, 31 m; 0900, 19 or 25 m; 1100, 1500 and 1900, 16 or 19 m; 2200, 19 or 25 m.

Under normal propagation conditions the most favourable period for reception should be between 1200 and midnight. The most difficult period is likely to be for a few hours in the vicinity of 0700.

Singapore: 0100, 19, 25 or 31 m; 0500 and 1900, 16 m; 1500, 16 or 19 m; 1900, 19 or 25 m; 2200, 25 or 31 m.

The period from 0100 to 0500 is expected to be a difficult one; in addition, the route may on occasions be subject to echo effects for one or two hours around 0700 due to signals traversing the major arc of the Great Circle (i.e., via Southern Australia and West Indies).

Salisbury, Rhodesia: Midt, 25 or 31 m; 0300, 31 or 41 m; 0600, 16 or 19 m; 1000 and 1400, 16 m; 1700, 16 or 19 m; 2000, 19 or 25 m.

Conditions should be favourable for reception throughout most of the 24 hours; signals may, however, be subject to echo effects around 0400 and to weakness for a short period around 1100.

Rio de Janeiro: 0100, 25 or 31 m; 0500, 31 m; 1000 and 1500, 16 m; 1800, 16 or 19 m; 2200, 19, 25 or 31 m.

Signals may be subject to weakness between 0500 and 1000 and to echo effects for one or two hours around 2000.

In temperate latitudes in the Northern Hemisphere, the highest values of critical frequency (F layer) usually occur during winter day and the lowest during winter night; the values for summer, both day and night, are normally between these two extremes.

As a result of the smaller range of critical frequencies encountered in summer, the usefulness of a frequency band employed for inter-communication within the Northern Hemisphere at this season may extend over several hours in fact, under favourable conditions satisfactory long-distance communication (for example, with the Far East) may often be carried out for over 24 consecutive hours without the necessity of a change of frequency.

The E layer, in contrast to the F layer, has its maximum critical frequency in summer at about local noon; in consequence, under certain conditions of layer height it may frequently become the controlling factor in "skip-distance" calculations, particularly during late forenoon and early afternoon.

At the time of writing this report it would seem that conditions during June, and particularly during the latter part thereof, are likely to be more stable than of late.

Maintaining a Service

A LTHOUGH some journals, especially those from the Western Hemisphere, at times fail to reach this country owing to enemy action, every effort is made to obtain duplicate copies or, if this is not possible, photostat reproductions of the journals, in order that the Abstracts and References section of The Wireless Engineer may be a complete bibliography of articles on wireless and allied subjects published in the world's journals.

In this section of our sister journal the space devoted to abstracts from journals published in enemy countries is considerable. This fact has greatly enhanced the value of the section.

In addition to some 280 abstracts and references, the May issue contains articles on the Rhoarbis transmitting aerial and receiver aerial coupling circuits.

Published on the first of the month, The Wireless Engineer is obtainable to order through newsagents, or direct from our publishers at Dorset House, Stamford Street, London, S.E.1, at 2s. 6d., including postage.
Makeshifts — Wartime Measures to Meet a Shortage of Servicing Components

By W. H. CAZALY

It must be made quite clear at the outset that the advice that follows on alterations to the circuits and components of probably very well designed receivers is necessarily of a generalised nature, and that the results that may follow upon such alterations cannot be forecast with certainty. There is far more than meets the eye in even an apparently simple design of commercial broadcast receiver, and improvement seldom accrues from incautious and unintelligent “monkeying” with the products of experienced circuit engineers. On the other hand, we are faced now days with exceptional conditions, and if a receiver is put out of commission through a lack of some component that is unprociable, it is worth while making some attempt to get it going again, even if the attempt is not very successful. After all, the patient can only be killed once! And the maintenance of domestic radio reception in these days is of such importance—it may even be a matter of life or death—that liberties with the circuits may be permitted that would be rightly frowned upon in less unsettled times. It must be borne in mind that many of the factors involved in successful emergency adaptations will be peculiar to the particular cases the reader has to deal with and cannot be foreseen by the author. If some suggested alteration does not work, it may be either because the components involved are unsuitable for change, or because all the factors operating have not been taken into account. The only thing to do is to have a shot at it, anyway. With this warning, one can now proceed.

Valve Types

A shortage of replacement valves is likely to cause the greatest difficulties. Receivers may have to be adapted to work either with valves of characteristics different from the originals or without certain valves. As used in the stages of a typical superheterodyne receiver, valves fall into functional categories that will be dealt with in turn.

If a signal-frequency RF valve breaks down, reception is still possible without further alteration if the aerial is connected directly to the grid of the frequency-changer, via a very small pre-set condenser, which should be added to suit the aerial used. A certain all-round reduction of goodness of performance may be noticed; the signal/noise ratio may be higher than previously, especially on short waves, and AVC may not operate quite so efficiently. Local station reception will be hardly affected.

If a spare valve of a different make is available with characteristics similar to those of the original, probably no alteration at all will be necessary. If, however, the replacement valve is not of the variable mu type—it may be an old tetrode—it will be better to use it in the IF stage, and to place the IF valve thus released in the RF stage. The AVC feed to the new IF valve should be disconnected and the grid returned to the chassis or to some point of negative potential if it is of the type that requires negative bias to keep it stable. If the new valve is not metallised, possible instability from this source may be avoided by covering the glass envelope with ‘silver’ foil (in one continuous piece) and earthing this foil to the chassis.

It is possible to make use of a frequency-changer as an amplifier, employing only the signal amplifying portion and earthing the oscillator grid, while the oscillator anode is taken to a suitable point at HT and earthed by a condenser. This is shown in Fig. 1.

The frequency-changer offers more serious problems. It cannot be dispensed with, and of whatever type the replacement is, it must make the best use it can of the existing oscillator circuits. The values of inductance and tracking capacities of this circuit will have been taken care of by the designers, and it is inadvisable to attempt any alterations in this direction. All that can be done is to connect the existing oscillator assembly leads to the appropriate pins of the replacement valve. This subject is rather too involved for adequate treatment here, but it is hoped to return to it in a later article.

Dispensing with the IF Amplifier

Should an IF valve break down, the choice of a replacement—if one is available—should be governed by the considerations outlined for the case of an RF valve. If no RF valve of any kind is available, the IF amplifier must be dispensed with and the output of the frequency-changer fed direct to the diode rectifier. Local station reception at least will still be possible, but considerable loss of volume and selectivity may make the set almost useless for anything more. The arrangement is shown in Fig. 2. If the lack of a suitable IF amplifier is likely to be prolonged or permanent, it may be best to dispense with AVC and replace the diode rectifier by a leaky grid detector—utilising, perhaps, the existing triode portion of the DDT. This is a more sensitive type of detector than is the plain diode. To increase signal strength, it may be worth while to attempt to use fixed reaction on the IF coil. For this, some thirty or forty turns should be wound on the IF coil former about half an inch away from the secondary; if the winding is put on as if it were a continuation of the secondary, reaction will be in the wrong sense. This reaction winding can be energised from the anode of the leaky grid detector through a pre-set condenser. A little experimenting with the number of turns will be necessary, and when stable reaction—not oscillation—is obtained, it should be left fixed (not too near the point of oscillation, or quality will suffer badly) and the transformer tuned to the IF. Band-pass response will be poor, but this transformer tuned to the IF. Band-pass response will be poor, but this trick may add a little much-needed strength to the signal. The AVC line should be taken direct to

Fig. 1.—A frequency-changer valve may often be used as an IF amplifier if the oscillator grid and anode are given fixed working potentials as shown.

Fig. 2.— If no RF valve of any kind is available, the IF amplifier must be dispensed with and the output of the frequency-changer fed direct to the diode rectifier.

JUNE, 1941.
Wireless World

some earthy point—depending on whether the frequency-changer does or does not require a steady initial bias. It may be worth while, in this connection, to take this AVC line to a potentiometer across some source of considerable bias and use it as a RF manual volume control.

The above outline partly covers, evidently, the procedure possible to adopt if the double-diode-triode breaks down and cannot be replaced. Since the another value calculated from the formula

\[ \text{Bias voltage required} \]

Total anode current taken with new valve

Current is expressed as a fraction of an ampere.

When changing from triode to pentode output, of course, an extra lead to HT will have to be provided for the pentode screening grid. Quality will be appreciably improved by fit-

signal strength in a superhet is normally considerable by the time it reaches the rectifier circuit, it may be well to try anode-bend rectification, since this deals with signals of considerable strength without the distortion—within limits—that might easily arise with leaky grid detection. AVC must be dispensed with. "Power grid detection" may also be utilised, but this is likely to put an excessive load on the HT battery in a battery receiver, since the current taken with the high anode voltage required and no bias may be several mA. This high anode current will preclude the use of resistance-capacity coupling to the output stage and a transformer will have to be used—not more than 1:1.5 step-up—so that it may be inconvenient.

Replacing Battery Valves

The output stage of a battery receiver presents straightforward problems. A pentode and a triode output valve may be exchanged, if due attention is paid to matters of bias. The comparative inefficiency of the triode may to a certain extent be offset by turning up the volume control. If bias is obtained "automatically" by the potential developed across a resistance in the HT negative lead, this resistance may have to be changed for

![Fig. 2.—An unused IF stage is shown in dotted line. The connection from the first IFT secondary, A-B, should be as short and direct as possible to avoid coupling with other parts of the circuit; it may even have to be of screened wire. Re-adjustment of the first IFT trimmers will probably be necessary.](image)

![Fig. 3.—Alterations consequent on the fitting of a replacement output valve taking a considerably lower anode current than the original. The value of the bias resistance \( R \) will be \( \frac{E \times 1000}{I_1} \), where \( E \) is rated bias voltage and \( I \) total anode current in mA. The added "bleeder" resistance \( R_1 \) will be \( \frac{250 \times 1000}{I_1 \times 12} \) ohms, where \( I_1 \) is total anode current of original valve and \( I_2 \) is that of substitute valve, both in mA.](image)

JUNE, 1941.
Makethis—ample for continuous passing of the current. It should not be forgotten that even a general-purpose triode, passing only about 5 mA with 250 volts on its anode, can give an output that is enough for many domestic purposes. If such a triode replaces a pentode that took 40 mA, the ‘bleeder’ will have to carry 35 mA at 250 volts—i.e., be 7,000 ohms rated at 8 watts minimum.

If one of the pentodes in a mains push-pull output stage goes out of commission, probably it will still be possible to use the remaining valve as a straight output pentode, but a ‘bleeder’ will be necessary to pass current equal to that passed by the defunct valve, and also it will be necessary to examine the bias resistance circuit. If bias was originally obtained through a resistance common to both cathodes, the resistance should be doubled in value (so that the original bias is developed across it with the anode current of only one output valve passing through it). Another trouble may arise from an increase of hum after the change has been made. The only remedy for this lies in an increase of the smoothing in the power supply, preferably by the use of an extra condenser in parallel with the existing smoothing condenser.

The rectifier presents a very awkward problem if it cannot be replaced by the usual diode type. If by a lucky chance the receiver happens to be of the AC/DC variety and is being used on DC mains, the rectifier can be cut out altogether, as shown in Fig. 4. But, in this case, certain precautions must be taken. The mains plug must be plugged in “the right way round,” because the smoothing condensers will be polarised and will blow up if the mains supply connection is reversed.

The best thing to do is to fit a non-reversible plug and socket, so that, in the course of domestic upheavals consequent upon dusting and such-like non-technical interference, the lay person cannot reconnect the set wrongly. Moreover, in case the receiver should be taken to a district supplied from AC mains, connection to which of the altered circuit will have disastrous results, a note about the alterations should be stuck to the back of the set in a conspicuous place.

 Mention must be made of the possibility of using valves with different heater voltages and currents. Thus, 4-volt AC valves might be replaced by the 6.3-volt variety or vice versa. The safest and best way of doing this is to provide a separate filament or heater transformer for the new valve or valves, the design of which can be readily worked out from the Wireless World Data Charts, based, perhaps, on laminations from a good-sized unwanted choke or AF transformer. In such a case the load provided on the heater windings of the existing mains transformer by the valves that have been replaced must be simulated by a resistance, in order to prevent undue rise of heater voltage which would damage the original valves still remaining. Thus, if two 4-volt AC valves taking 1 A each were taken off the 4-volt heater circuit, their heaters would have to be replaced by a resistance of 2 ohms capable of passing 2 A. Or, if one 0.3-volt valve were taken out, the load its heater represents (at 0.3 A) would have to be replaced by 21 ohms. A small heater transformer is not very difficult to make, and care only has to be taken over insulation and layer-winding of the primary. The connections are shown in Fig. 5.

Extra L.T. Winding

Another possibility is that of making a small low-voltage auto-transformer fed from the original heater circuit. Yet another way, if room can be found for it on the original transformer, is to put on an extra winding; the extra load will probably not make much difference to the heating of the transformer. It involves finding the number of turns used in the original heater winding, by counting them or by calculating from the ratio of input primary volts to the output volts of this heater winding (ascertained preferably by an AC meter), the turns on the primary and so the turns ratio needed for the new secondary. Results should always be checked up by an AC meter, as incorrect heater current will seriously shorten the life of a valve.

The volume control is another component that may be difficult to replace.

If only one of a lesser resistance value is obtainable, it may be possible to use it in series with a resistance that will make up the total to the value of the original. Control will only be partial and, if the slider of the new component is insulated from chassis, the series resistance may be put either at the ‘live’ end—if loud volume is seldom wanted—or at the earthy end, if the set is normally used at average or considerable volume. If the new component is of higher value, it can be put in parallel with a fixed resistance, so that the combination will make up the original load on the diode, as can be calculated from the formula: \[ R_1 = \frac{R \times R_2}{R_2 - R} \] where \( R \) is the value of the original volume control. \( R_1 \) is that of the fixed resistance, and \( R_2 \) that of the new volume control.

If no replacement volume control at all is procurable, it is possible to use a step control, with a switch and a string of resistances. Even a 3-way switch will provide a useful measure of control, by providing high, medium and low levels, the medium being fixed at the most favoured level. Another way of controlling sound output if the earlier stages of a receiver are already taken care of by AVC is to provide attenuation in the speech coil circuit, as shown in Fig. 6.
Larger condensers, of the electrolytic type up to many μF, may be scarce. In the smoothing circuits of the power supply, their lack is serious and not too easy to remedy. In Fig. 5 is shown a typical power supply unit; C1 is essential, and in the majority of domestic radio receivers, 3 μF is the least value it should be. It can be made up from smaller condensers connected in parallel, each being rated at 500 volts peak, or from larger condensers in series of lower peak rating—but in the latter case a 100-mA fuse should be included as shown, because if one of the series condensers short-circuits, the other will soon follow suit, and such a short-circuit, unless the receiver were switched off at once, might damage both the rectifier and the transformer. In any case, short-circuiting one of the condensers would double the value of this reservoir condenser, raising the anode voltage and causing a heavy current to pass through the rectifier that might soon damage it. The main smoothing condenser C2 can only be of less capacity if additional inductance is provided in series with the existing choke or field winding, otherwise intolerable hum is likely to result. The extra choke L (if needed for any reason) should be of low DC resistance—not more than 200 ohms—and about 10 or 15 henrys inductance when passing the total anode current; C2 might then be of 4 instead of 8 μF capacity. Smoothing is also possible by using a choke-capacity tuned filter which is tuned to the fundamental 100 c/s of the rectified supply.

Fig. 6.—Volume control at the loudspeaker. R1 should be about equal to the speech coil impedance—anything from 2 to 200. R2 should be about 5 times this value. The two components should be ganged.

ripple; it will not be sufficient alone but may be enough with the existing field or choke smoothing and enables a smaller extra choke to be used.

Large-capacity low-voltage electrolytics used to by-pass cathode resistors present very awkward problems for replacement. Leaving them out will very seriously affect quality. If nothing can be found to make up even half their value, the drastic step may have to be taken of replacing automatic by battery bias even in mains receivers, which may be done as shown in Fig. 7. This gives a general idea of how battery bias can be used in a mains receiver. No cathode bias resistors are used in the circuits of any of the valves, all cathodes being returned direct to chassis. CB is a 27V battery, the tap A supplying delay to the AVC diode and bias to the RF valves (usually about 3 volts) and B applying normal bias to the output pentode.

Fig. 7. The bias batteries should be positioned as far away as possible from any parts of the receiver that get warm, should be of the best quality obtainable, and should be checked (preferably under an artificial load) every month or so, or at the least sign of distortion in quality; if they fail for any reason, the valves will pass very heavy anode current that may damage both themselves and the power supply unit.

In battery receivers, decoupling and voltage dropping through resistances feeding screening grids can be obviated by taking extra leads from these screening grids to suitable voltage taps on the HT battery. A small amount of decoupling, with small condensers and resistances, may in some cases still be necessary.

The foregoing covers many of the things that can be done without any profound knowledge of receiver design. It is very far, of course, from being a complete and exhaustive treatise on the subject; its purpose is merely to enable the man with a little knowledge and a lot of common sense to preserve, if not unimpaired, at least in working order, a domestic service that has now become a national necessity.

"Wireless Servicing Manual"
New Edition Now Available

IN publishing a new edition of this well-known book on wireless servicing, opportunity has been taken to carry out a certain amount of revision including extensive alterations in the section devoted to valve base connections which has been brought completely up to date. An entirely new chapter has been added dealing with automatic frequency control, a feature which is to be found in several modern receivers.

For those who are entirely unfamiliar with the book it may be said that, as its name implies, it consists of a very complete treatise on the servicing of wireless receivers. In the first place it deals very thoroughly with all types of testing apparatus, including cathode-ray gear, and advice is given on the most suitable type of equipment to obtain, both commercial and home-constructed instruments being dealt with, constructional details being given in the latter case. More important still are the chapters that deal with the most efficient method of using the equipment.

Later in the book, actual fault tracing is described in detail, obscure troubles as well as the better-known ones being dealt with. Short-wave receivers are considered in a separate chapter. Apart from actual fault tracing special interest attaches to the chapters which deal with aerial and earth installations and with the fitting of extension loudspeakers.

In the appendices will be found a collection of tabulated data, including the ever-useful copper wire tables and colour codes as well as valve base connections. Details for constructing a capacity and resistance bridge and a valve testing bridge will also be found in this section of the book.

This book is published from the offices of The Wireless World by our publishers, Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1, at a cost of 6s., or by post 6s. 6d.
Noise in FM Receivers

Further Light on the Behaviour of Discriminator and Limiter Circuits

The problems of noise in frequency-modulated systems have been carried a stage further towards solution by a very methodical series of investigations with the cathode ray oscillograph on the life history of a noise pulse in its passage through the receiver.

It has been shown that when a noise pulse of very short duration is applied to the input of a receiver, the output is in the form of a train of waves having a frequency the same as that at the centre of the IF passband, and a duration equal to the reciprocal of the cut-off frequency. With the usual FM band width of 200 kc/s the cut-off frequency would be 100 kc/s and the duration of the pulse 10 microseconds. Thus, with an intermediate frequency of 5 Mc/s, there would be 50 cycles in the wave-train.

The shape of the envelope of this wave-train is determined by the shape of the selectivity curve and a double-peaked curve results in the formation of the wave-train was considerably modified by the signal strength, and this was found to be due to the effect of grid current in altering the tuning of one or more of the RF circuits. The limiter grid circuit was, of course, the worst offender, and some idea of the magnitude of the detuning effect which may be met with is given by the curves in Fig. 2.

The trouble may be minimised in several ways. A larger tuning capacity giving a lower L/C ratio may be used, or the circuit response may be broadened by damping. Another useful expedient is to ensure that both primary and secondary of the RF transformers have circuits of equal Q, and that less than critical coupling is employed.

The oscillograms shown so far were taken with noise only and they are not valid for signal-to-noise ratios of more than 1/10. For higher signal-noise ratios, the noise output is a function of the interaction between the signal carrier and the noise wave-train after passage through the RF circuits. The result may be amplitude or frequency modulation, or a combination of both, depending on the phase of the noise and carrier waves.

1 "Impulse Noise in FM Reception," by V. D. Landon, Electronics, Feb., 1941.

(Left) Fig. 1. Oscillograms of noise wave-train (A to D) and output from discriminator (E to I). The lack of balance in the last oscillogram is equivalent to 10 μμF across 100,000 ohms on one side of the output circuit.

(Right) Fig. 2. Illustrating the detuning effect of grid current at high noise amplitudes. The more marked valleys between lobes in G, H and I indicate that mistuning is less with a lower L/C ratio (larger tuning capacity, C).
Noise in FM Receivers

To investigate the matter more closely, special equipment was built to ensure constant phase relationship between the signal carrier and noise impulse generators. A 10,000 c/s oscillator was used as the master driver, and its output was divided, one section being multiplied to a frequency of 5 Mc/s, and the other passed to a circuit designed to produce narrow uni-directional pulses at 10,000 per second. Finally the output from both branches was brought together and applied to the input of an IF amplifier with 200 kc/s band width and a mean frequency of 5 Mc/s. The phase between the signal and noise impulse was varied by altering the tuning of one circuit in the frequency multiplier.

The results of combining two elements in different phases are shown by the oscillograms of Fig. 3. At 0 deg. and 180 deg., amplitude modulation is at maximum and frequency modulation is at minimum, while at 90 deg. and 270 deg. the conditions are reversed. At intermediate phases both modulations are present. The effectiveness of amplitude limiting stages as noise suppressors is called into question when it is revealed by these oscillographic records that frequency as well as amplitude modulation may result from noise impulse, and the action of the limiter stage was accordingly further investigated.

In Fig. 4 the wave-trains resulting from the injection of a noise impulse are shown for various signal-noise ratios, and phase relationships. The amplifier gains have been adjusted to show the action both above and below the threshold of the limiter stage. In the plate voltage limiter a low anode voltage is used, and the RF swing at the anode is limited to something less than the DC anode volts. The grid leak limiter depends for its action on the self-biasing action of the valve caused by the flow of grid current in the leak as the signal is increased. Values of 10,000 ohms and 20 μF were used in the limiter grid circuit to give as short a time constant as possible.

It will be seen that from the point of view of amplitude modulation the grid leak limiter is not as good as the plate voltage limiter. The grid condenser does not charge up quickly enough to follow the rising front of the impulse. Also, when the response starts there is a tendency for the valve to over-bias, and the carrier is attenuated for a short time after the pulse has ceased, until the mean grid voltage is restored.

By themselves the oscillograms of Fig. 4 do not tell the whole story. The curves of Fig. 3 show that amplitude modulation does not come through the discriminator when the noise pulse and the carrier are synchronised.
Noise in FM Receivers—
limiter may actually increase the noise
due to its detuning effect on the preced-
ing RF circuit. Fortunately it is in
that of simple amplitude limitation. If
the curves of Fig. 6 with and without
limiter are compared it will be ob-
served that one effect of the limiter is
to equalize the area enclosed by the
impulse curve above and below zero
line; without the limiter the impulse
is definitely asymmetrical. Analysis
of the frequency distribution and total
energy constant of the spectra pro-
duced by various types of impulse
shows that less noise is likely to result
from the symmetrical type of curve.
Fig. 3 indicated that a reasonably sym-
metrical discriminator output was ob-
tained without a limiter stage, when
the carrier was accurately tuned to the
centre of the pass band, so that the
chief function of the limiter is the re-
duction of noise arriving when the
instantaneous frequency of the carrier
is off centre, e.g., when peak modulation
causes mistuning. The grid leak
limiter, in spite of its failure to remove
amplitude modulation, provokes the
least detuning due to grid current, and
in practice is probably the best type to
use.
The limiter stage is justified by con-
siderations other than that of noise
reduction, and its usefulness in limit-
ing distortion due to lack of flatness in
the top of the IF amplifier response

(Above) Fig. 5.
Noise wave-train
and discriminator
output with car-
rier tuned to edge
of pass band.
(Right) Fig. 6.
 Illustrating noise
 reduction by plate
and grid leak lim-
iters with carrier
off tune. Carrier
tuned to edge of
pass band; sig-
nal-noise ratio, 2.

The discriminator output is shown for both
plate and grid leak limi-
ters, and it will be
noticed that the perfor-
ance of the grid leak
limiter is at least
as good as that of
the plate limiter
in spite of the
disturbed wave-
train which the
former type of
limiter produces
(Fig. 4).
It would seem, therefore, that
the effectiveness of the limiter is
dependent on some factor other than

JUNE, 1941.
Reducing Loading on Short Waves

Offsetting the Effect of Cathode Lead Inductance

When valves are used at high frequencies the input impedance decreases as the operating frequency increases. This loss in the input circuit of the valve is the result of the increase of the input conductance due largely to the cathode lead inductance, because the cathode lead inductance is common to the anode and control grid return circuits.

It is now generally recognised that the inductance of the cathode lead of an amplifier or converter valve, which is common to both anode and control grid circuits, represents a degenerative coupling between these circuits. This degeneration exhibits itself in ordinary circuits in which loading effects due to the cathode lead inductance are eliminated or substantially reduced is described below with reference to the diagrams.

In the schematic arrangement of a typical amplifier stage shown in Fig. 1, the valve is provided with a cathode, preferably indirectly heated, control grid G1, screen grid G0, suppressor grid G2, and anode. The input circuit is connected between control grid and the cathode, the cathode being coupled to the secondary of the input circuit by condenser C1. The output circuit is connected between anode and the usual voltage supply source, the by-passing condensers C3 and C2 being used between anode screen and cathode. The common cathode lead inductance is represented by an inductance L and may be either due to the length of the internal cathode tube lead, or to the length of connecting wire, or to both.

Split Cathode Connection

The degenerative effect due to L may be overcome by means of the circuit arrangement and valve shown in Fig. 2. Here the cathode is provided with two separate leads, the inductances of which are represented by L1 and L2. In this arrangement two leads are provided, one for the anode and screen-grid return, and the other for the control grid return. If the mutual inductance between these two leads is negligible, the common cathode impedance is substantially eliminated, and the input loading due to this cause will be practically non-existent. However, if valves provided with two cathode leads are used in practical amplifier or converter stages, the input loading would not necessarily be greatly reduced. The reason is that if the impedance of the path through the HT supply is small as compared with the impedance of the path through L2, as it may be in an actual circuit, most of the AC anode and screen grid return current will flow through the supply path, and hence through the grid return lead. If it does so, then the object of having two leads is not fully realised, for the first cathode lead again constitutes a common inductance. However, this difficulty is removed by the insertion of choke coils or resistances as indicated at Z1, Z2, Z3 and Z4. In this way AC anode currents are prevented from flowing through the HT supply path to the cathode lead L1 and are forced to flow through the separate return lead L2. The impedances Z3 and Z4 can be used alone or the impedances Z1 and Z2 used alone. These additional circuit elements present a high impedance to currents of the operating radio frequencies and preferably, though not necessarily, a low impedance to the DC return currents.

The operation of the valve can be still further improved by mounting the by-passing condenser C (Fig. 2) inside the valve and connecting it directly to the cathode.

Circuit Values

In one successful example, in which the screen grid lead was by-passed to the control grid-cathode return lead, the impedance Z3 was a 64,000 ohm resistance and impedance Z4 a 5,000 ohm resistance; the by-pass condensers were all of 0.002 mfd. With this arrangement an input conductance of about 130 micromhos at 60 Mc/s was
Reducing loading on Short Waves—measured as compared to 500 micromhos in a conventional valve for the same value of anode current. The improvement was, therefore, in the ratio of 4 to 1.

Carrying the above further, the cathode may be provided with as many leads as there are electrodes in addition to the cathode. These leads can then be each separately connected by means of by-pass condensers to one of the other electrodes using suitable chokes or resistances to keep the radio frequency currents out of common paths due to common leads.

The AC screen grid current in the above arrangement still flows through the first or control grid cathode lead, and since the ratio of the screen grid to cathode current was about 1 to 5 in the valve tested, the degenerative effect of the screen grid current gave rise to an input conductance of about 100 micromhos. This would leave roughly 30 micromhos for the input conductance of the valve if the degenerative effect of the screen grid current could be eliminated. The overall improvement might then be of the order of 16 to 1.

Special Construction

A valve incorporating this improvement is shown in Fig. 3, provided with two cathode leads and a by-pass condenser connected inside the envelope directly between the screen grid and cathode. This by-pass condenser, by obviating the effect of the screen grid impedance, eliminates the degenerative effect of the screen grid current and ensures better shielding at high frequencies. The condensers can be of two types; namely, commercial condensers mounted on the tube structure, or built-up condensers which make use of mica spacers at each end of the mount.

The degenerative effect of the AC screen grid current can be still further reduced by using valves designed to have a low screen grid current. It is now generally known that such valves also have the virtues of reduced fluctuation noise and increased efficiency.

This development is reported from the Laboratories of the Radio Corporation of America.

Frequency Measurement

THE G.P.O. CHECKING STATION

It is the responsibility of the General Post Office, as the Department entrusted with the control of all wireless communications in this country, to see that transmitters operating under its licence adhere as closely as the existing state of technical development permits to their allotted frequencies. The matter first became of great importance when the value of short waves for world-wide communication became evident in about 1924. Soon after that date the G.P.O. set up a frequency standard, with the necessary associated apparatus, for the accurate measurement of the frequency of signals received from stations under its control. This apparatus was installed at the Post Office Research Station, Dollis Hill, on the outskirts of London.

Dollis Hill proved to be an inconvenient site for routine measurements and still more for the important subsidiary work of investigating interference, and so the frequency measuring station was transferred to Colney Heath, near St. Albans. The accuracy attained at the new site ultimately it was decided to equip a new station, transferring operations to a new site in clear open country, where reception conditions are good, particularly from the point of view of freedom from all kinds of interference.

The latest checking station is described by C. F. Booth and G. Gregory in the October, 1939, issue of The Post Office Electrical Engineers’ Journal. It is pointed out that, in addition to its primary function of measuring the frequency of transmitters under G.P.O. control within the range of 15-30,000 kc/s, a station like this must be laid out for the investigation of jamming, the measurement of incoming signals from overseas, observation on the choice of frequencies for new services, and at the same time to keep a watch on the activities of British amateur transmitters. In addition, it must perform special interception work where required. The station must also be prepared to measure, on request, the frequencies of stations under the control of other administrations.

The specification for the equipment of the new station was a stringent one. The stability over a period of weeks of the frequency standard was to be within ± 1 part in a million, with a short-period stability of ± 1 part in 10 million. These requirements were satisfied by a Marconi-Ekco type 482-C cry.

JUNE, 1941.
Wireless World

Frequency Measurement—

The frequency standard, which, in addition to generating the fundamental frequency, provides a number of harmonics and includes two interpolating oscillators, a crystal-controlled clock, and facilities for listening. The complete measuring equipment was built up around this unit, and the arrangement of apparatus for collecting and “presenting” the signals for frequency measurement is shown in the key of the accompanying photograph. The receivers used are a Marconi-Ekco RG37 and an American HRO “communication” set.

Means are available for checking the station’s sub-standard frequency unit from the Rugby time signals, and regular checks are also made against the primary standard frequency generator at Dollis Hill.

Three main methods of measuring the frequency of received signals are in use. The first, that of normal interpolation, operates over the range 14.5 to 30,000 kc/s and is used when the highest accuracy is not essential.

The second method, used between 1,000 and 30,000 kc/s, depends on inter-modulation, a harmonic from the 1,000-kc/s multivibrator being modulated by the output of the interpolating oscillator in such a way that the sum or difference frequency produced coincides with the frequency of the signal under observation. The accuracy over the greater part of the range is of a very high order; errors are greatest towards the long-wave end of the range, so this method is mainly used for routine short-wave measurements.

Graphical Records

To increase the accuracy of measurement on long and medium waves a third method, that of audio-frequency interpolation, is used. In addition, the principle of allowing the signal to beat directly with a harmonic of one of the multivibrators and recording the beats against time as shown by the crystal clock, may also be employed, with the limitation that the signal must be of a frequency within about ± 30 c/s of a multivibrator harmonic. One pen of the recorder is actuated by the resultant slow beats and the other pen marks an impulse each second from the clock.

One of the many checks made on the accuracy of the station’s apparatus consists of carrying out simultaneous comparisons between the sub-standard frequency generator at that station and the standard at Dollis Hill. Simultaneous measurements of the same transmitter are made at the two stations and very good agreement is reached. In the case of observations of the N.P.L. standard frequency transmissions, it is stated that the frequencies as determined at the two stations seldom differ by more than a few parts in 10 million.

JUNE, 1941.
The Psychological Pause

A Phase in the Learning of Morse

As readers of a previous article may remember, it can be taken as a fairly well-established fact that there are two stages in learning Morse, just as in learning to skate or to ride a bicycle, to quote two parallels only. The first stage is the conscious assimilation of the alphabet, so that when dash-dot is heard, N is thought of: the second stage is the driving of this into the subconscious mind, so that when dash-dot is heard it is impossible not to think of N.

Again, it can be accepted that teaching methods should differ from one stage to the other: slowly sent letters with slow dashes and dots during the short first stage; quickly sent ones with long pauses between letter and letter, these slowly decreasing as the learner gains speed during the second stage. Incidentally, it may be worth mentioning that my own experience indicates that if anyone feels like learning non-wireless systems of Morse signaling, and if these systems work at low speeds, tape, for example, it is best for this study to be done either during the first stage or else left until the end of the second stage is near: i.e., when the learner is at about six words a minute or at about 20, respectively. If he tries to learn tape with a friend as a relaxation when they are doing about twelve words on buzzer, it will merely tend to delay the progress of the second stage.)

Now during this second stage a "pause" almost invariably occurs, a horrid period that may last for days or even weeks, during which the learner makes no progress, curses the shade of Samuel Morse, bites pieces off the end of his pencil, swears that he will never manage it—even chucks up the whole thing in despair. This "pause" often happens at about 14 words a minute or at about 18: some particularly unfortunate people may get it twice. Some, on the other hand, never meet with it at all: they are usually, but by no means invariably, of the stolid, easy-going type; and if one of such favoured persons wants to learn how really unpopular he can make himself, he need only remark happily to some fellow-learner whom he has caught up and passed that he "really can't see what all the trouble is about. Why, I just do a bit better every week, and if you chaps would only—" The rest is likely to be a strangled silence.

Despite this scepticism, the pause is a very real one, and there is little doubt that it is due to a quarrel between the conscious and subconscious minds (to put it most unscientifically). The besotted conscious worries: "I can't get it. . . . What was that letter? . . . Oh, I am making a mess of it. . . . This will never do, it's worse than last time"; and the squashed subconscious cannot make its own gentle: "Let me alone, I'm getting it all right. . . . Oh, do let me alone!"

Helping the Subconscious Mind

Now there are several dodges that can be tried, all with the object of distracting momentarily the conscious interferer, and it is especially worth noting that if this can be done once— if, that is to say, one transmission of a goodish length can be taken reasonably well at an "impossible" speed, it is almost certain that the sticking point will be passed, for good and all! Next time that this speed is heard the subconscious will be able to assert itself: "I did it yesterday—I told you I could do it," and the conscious will ungraciously subside with a grumbled: "Well, perhaps you're right, go ahead, but don't worry me" (which is, of course, exactly what is needed.

One such dodge, mentioned with due reserve, is to get slightly drunk. Another, more generally applicable, is to recite mentally (or better still audibly) some passage of poetry or the Bible or the multiplication table or anything else favoured while a transmission is being taken: in this case, for obvious reasons, it should be a test in code, not in plain English. Another, ridiculously simple and often ridiculously effective, is to do with the left hand something demanding a certain degree of attention while the right hand writes down the text—for example, to balance a pencil across the forefinger or to keep a pencil standing upright on end by checking it as it falls with the circle formed by forefinger and thumb. Such devices have the advantage that the transmission can be in plain language or code as desired, but may distract the eye too much and make writing too difficult. Others which may be tried, and which need no visual attention, are buttoning and unbuttoning one's coat, turning a coin over and over in the left hand, and such like: the trouble is that, as a rule, these do not demand sufficient attention to keep the conscious mind from interfering. What is "sufficient" here, however, obviously varies from one person to another and even for the same person from day to day: sometimes the subconscious has already so nearly asserted itself that very little is needed for it to take full charge, and here very simple devices will suffice. It is a matter for the learner himself to try; and it is amusing to note that the fact that he is thus observing himself may in itself supply the needed extra attention.

Another possibility, often recommended by teachers although as a rule with no idea why desirable, is that of forcing oneself to copy one letter behind in code, or several letters behind in plain language, so that no letter is written down until well after it has been sent. Here the conscious mind is kept busy remembering the letter or letters: it is particularly effective when the transmission is taken on a typewriter (a thing that all beginners should learn to do), and above all if the learner is only a fair typist, something about midway between the "three pecks and a damn" class and the machine-gun expert. Yet another is to form the letters with excessive attention, almost drawing them rather than writing; or to make them extremely small and yet legible —I have as a souvenir of the last war a full-length Army test message taken down, quite legibly, on a scrap of paper the size of a Coronation stamp by a learner whom (he said) this dodge saved from "drink and despondency."

It is a matter for personal experiment. In any case, let it yet again be emphasised that if only the pause-speed can be once passed it is extremely rare for any further trouble to recur at this speed, so that a little experimentation may save the learner "weeks of orrid doubt" and "faith and 'ope and cursing and despair" (to quote Kipling from memory).

R. R.-H.

JUNE, 1941.
THE WORLD OF WIRELESS

CENSUS OF SERVICE ENGINEERS

Forces Will Take 87 per Cent.

THE publication of the Revised Schedule of Reserved Occupations and Protected Work, in which it will be remembered service-men continue to be reserved from 35 years of age, was thought an opportune moment to reveal the result of the second Service Questionnaire issued by our contemporary, The Wireless & Electrical Trader.

When the first census was undertaken by The Trader soon after the war began, it was estimated that with the reservation age at 30, as it then was, 66.5 per cent. of the pre-war service engineers were liable for military service. The latest census, which is based on 416 replies covering 875 engineers, reveals that the percentage of the originally employed service personnel which will be left in the retail side of the wireless industry is 13. The details of the other 87 per cent. are:

<table>
<thead>
<tr>
<th>Already called up</th>
<th>per cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>Already volunteered</td>
<td>21</td>
</tr>
<tr>
<td>Liabilities for call up</td>
<td>12</td>
</tr>
</tbody>
</table>

The census also shows how the remaining engineers are likely to be supplemented. The Trader states that this is taking place in two ways—by the employment of “improvers” of all ages and by the return of managers and owners of retail businesses to the service bench.

Unless the Schedule is modified in the very near future the following is an analysis of servicing personnel (based on the number of pre-war engineers) likely to remain available in the retail side of the industry:

- Fully-trained engineers (reserved): 13 per cent.
- Owners and managers: 20 per cent.
- Improvers (reserved): 18 per cent.

It is stressed, however, that this does not mean that the personnel available is equivalent to 70.5 per cent. of the original staffs, for it must be remembered that the majority are not up to the technical standard of the pre-war engineers.

FREE EUROPEAN AMATEURS

Hospitality from the R.S.G.B.

In extending greetings and good wishes to the large number of European amateur wireless men at present in this country, the Radio Society of Great Britain, through The T. & R. Bulletin, offers to publish notes from any representative group. Poles and Czechs, Free French and Belgians, Norwegians, Danes and Dutch are among those at present in these islands. They no longer have a journal of their own, and the offer of space in the Society’s journal will doubtless be much appreciated. It will serve not only as a connecting link between exiled amateurs of the same nationality, but will also give an opportunity for them to get into personal touch with British amateurs with whom they worked in peace-time.

CARAVAN RECEIVERS

Interpreting the Regulation

It is understood that whilst the Home Office regulation of last summer, prohibiting the use of a receiver in road vehicles, has not been altered the police have been given wider discretion regarding the application of the regulation to caravans.

It will be remembered that soon after the announcement banning car radio it was made clear that the order would not apply to caravans off the highway which were habitually used as residences, having no motive power and the wheels removed. The police are now to use their discretion regarding the use of receivers in caravans even if they have motive power. They must, however, be off the highway.

It should be remembered that when on the road the receiver must be rendered unusable by the removal of valves and the disconnection of batteries.

BONDS OF FRIENDSHIP

At the present time, when the ties between Great Britain and America are binding the two countries closer together, the following cablegram from Mr. Sarnoff, president of the R.C.A., to Mr. Donisthorpe, at the Tenth Annual General Meeting of the Radio Industries Club, is of special interest.

“Each year, since Marconi’s first wireless message from England to America forty years ago, radio has strengthened bonds of friendship between our countries, to-day it carries cordial and affectionate greetings to British Radio Industries Club and best wishes for success of Annual General Meeting this year, next year and many years to come.—David Sarnoff.”

U.S. AMATEURS’ TEST

A MATEUR radio operators in the U.S.A. recently took part in what is probably the greatest radio practice drill ever undertaken—the originiation and relaying of 3,700 separate messages between as many local chapters of the American Red Cross and the headquarters in Washington, D.C., St. Louis, and San Francisco.

The test, which was sponsored by the American Radio Relay League, was designed to test the ability of radio amateurs to serve the Red Cross in any national emergency. The 3.5 and 7 Mc/s amateur bands, which offer

JUNE, 1947.
The World of Wireless—

reliable domestic communication day and night, carried most of the traffic which consisted of 15-word messages.

**EXPORT PROHIBITION**

UNDER a Board of Trade Order (S.R. & O., 1941, No. 492), which came into force on April 24th, receiving valves and electric insulated (other than paper-insulated) wire and cable, are among articles which may not be exported to any destination without an export licence. The Order also prohibits the exportation without licence to certain specified destinations of paper-insulated electric wire and cable, insulating materials containing mica and certain mica manufactures.

**U.S. TELEVISION**

ACCORDING to our American contemporary, Broadcasting, it is expected that television stations in the States will very soon be granted facilities by the Federal Communications Commission for “full-time commercial operation.” It will be remembered that the F.C.C.’s authorisation of “limited commercial operation” was rescinded in March, 1940, following a dispute between the Commission and the parties concerned. The standard of transmission favoured is 525 lines, 30 frames interlaced, as recommended by the National Television System Committee. The proposed 30 hours per week operation is likely to be reduced to 15 hours.

**FROM ALL QUARTERS**

**New Summer Time**

In this and the succeeding two issues of The Wireless World the use of the designation BST will denote two hours ahead of GMT.

**Amateur Radio Conference**

ARRANGEMENTS are being made by The North Manchester Radio and Television Society for the holding of a Conference of radio amateurs at which various matters will be discussed, including “The Future of Amateur Radio,” “The Shortage of Radio Components,” and “The Radio and its Possible Uses in Home Defence.” Invitations have been sent to various allied Forces in this country to send representatives. All interested are invited to attend the Conference.

**NEWS IN ENGLISH FROM ABROAD**

**REGULAR SHORT-WAVE TRANSMISSIONS**

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>America</td>
<td>WNYB (Round Brook)</td>
<td>17,789</td>
<td>16.87</td>
<td>40%, 60.</td>
</tr>
<tr>
<td></td>
<td>WBOS (Milwaukee)</td>
<td>9,570</td>
<td>31.35</td>
<td>11.45.</td>
</tr>
<tr>
<td></td>
<td>WCAE (Philadelphia)</td>
<td>15,270</td>
<td>10.65</td>
<td>12.30 a.m., 7.45.</td>
</tr>
<tr>
<td></td>
<td>WBUX (Wayne)</td>
<td>9,639</td>
<td>31.09</td>
<td>9.55%, 11.45%.</td>
</tr>
<tr>
<td></td>
<td>WCRX</td>
<td>11,839</td>
<td>23.36</td>
<td>7.30%.</td>
</tr>
<tr>
<td></td>
<td>WCRX</td>
<td>17,830</td>
<td>16.83</td>
<td>20%, 30%, 40%, 14.5%, 5.30%.</td>
</tr>
<tr>
<td></td>
<td>WGEA (Sheenacottary)</td>
<td>9,530</td>
<td>31.48</td>
<td>8.90%, 10.55%.</td>
</tr>
<tr>
<td></td>
<td>WGEA (Sheenacottary)</td>
<td>15,330</td>
<td>10.57</td>
<td>10, 20%, 6.0, 7.45.</td>
</tr>
<tr>
<td></td>
<td>WPIT (Pittsburgh)</td>
<td>15,210</td>
<td>19.72</td>
<td>6.0.</td>
</tr>
<tr>
<td></td>
<td>WRUL (Boston)</td>
<td>11,790</td>
<td>25.45</td>
<td>8.15%, 9.30%.</td>
</tr>
<tr>
<td></td>
<td>WRUL</td>
<td>15,359</td>
<td>10.55</td>
<td>8.15%, 9.30%.</td>
</tr>
<tr>
<td>Australia</td>
<td>VLAQ (Sydney)</td>
<td>9,015</td>
<td>31.30</td>
<td>9.0 a.m., 9.0.</td>
</tr>
<tr>
<td></td>
<td>VLOQ</td>
<td>11,870</td>
<td>25.27</td>
<td>9.0 a.m., 3.45, 7.55.</td>
</tr>
<tr>
<td></td>
<td>VLOQ</td>
<td>11,860</td>
<td>25.25</td>
<td>3.15, 9.0, 12.30 mtdt.</td>
</tr>
<tr>
<td></td>
<td>VLOQ</td>
<td>17,800</td>
<td>10.55</td>
<td>8.0 a.m.</td>
</tr>
<tr>
<td>China</td>
<td>XVC (Chungking)</td>
<td>7,508</td>
<td>39.90</td>
<td>12.30 1.10, 10.30, 11.30.</td>
</tr>
<tr>
<td>Egypt</td>
<td>SUX (Cairo)</td>
<td>7,800</td>
<td>38.14</td>
<td>7.30, 11.10.</td>
</tr>
<tr>
<td>Finland</td>
<td>OFB (Lahti)</td>
<td>6,120</td>
<td>40.02</td>
<td>8.15, 11.15.</td>
</tr>
<tr>
<td></td>
<td>OFD</td>
<td>9,500</td>
<td>31.38</td>
<td>1.15 a.m., 8.15, 11.15.</td>
</tr>
<tr>
<td></td>
<td>OFE</td>
<td>11,780</td>
<td>25.47</td>
<td>1.15 a.m., 9.40 a.m., 8.15, 11.15.</td>
</tr>
<tr>
<td></td>
<td>OIE</td>
<td>15,190</td>
<td>19.75</td>
<td>1.15 a.m., 8.15, 11.15.</td>
</tr>
<tr>
<td>French Equatorial Africa</td>
<td>Brazzaville</td>
<td>11,970</td>
<td>25.06</td>
<td>9.45.</td>
</tr>
<tr>
<td>India</td>
<td>VUD2 (Delhi)</td>
<td>9,500</td>
<td>31.38</td>
<td>10.0 a.m., 2.30, 5.30.</td>
</tr>
<tr>
<td></td>
<td>VUD</td>
<td>11,830</td>
<td>25.36</td>
<td>10.0 a.m., 2.30, 5.30, 7.15.</td>
</tr>
<tr>
<td></td>
<td>VUD3</td>
<td>15,290</td>
<td>19.62</td>
<td>10.0 a.m.</td>
</tr>
<tr>
<td>Iran</td>
<td>EQB (Teheran)</td>
<td>6,155</td>
<td>48.74</td>
<td>8.30.</td>
</tr>
</tbody>
</table>

**USSR**

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (BST)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>JALC (Tokio)</td>
<td>9,500</td>
<td>31.57</td>
<td>11.20.</td>
</tr>
<tr>
<td></td>
<td>JZI</td>
<td>9,635</td>
<td>31.46</td>
<td>7.0.</td>
</tr>
<tr>
<td></td>
<td>JZJ</td>
<td>11,800</td>
<td>25.42</td>
<td>7.0.</td>
</tr>
<tr>
<td>Manchukuo</td>
<td>MCTK (Harbin)</td>
<td>11,775</td>
<td>24.48</td>
<td>9.0 a.m., 11.5.</td>
</tr>
<tr>
<td>Sweden</td>
<td>SDB (Motala)</td>
<td>6,005</td>
<td>49.46</td>
<td>11.20.</td>
</tr>
<tr>
<td>Thailand</td>
<td>HSPP (Bangkok)</td>
<td>11,715</td>
<td>25.61</td>
<td>1.45.</td>
</tr>
<tr>
<td></td>
<td>HSPPJ</td>
<td>10,020</td>
<td>15.77</td>
<td>1.45.</td>
</tr>
<tr>
<td>Turkey</td>
<td>TAP (Ankara)</td>
<td>9,405</td>
<td>31.70</td>
<td>8.15.</td>
</tr>
<tr>
<td></td>
<td>TAQ</td>
<td>15,190</td>
<td>19.74</td>
<td>1.15.</td>
</tr>
<tr>
<td></td>
<td>41</td>
<td>—</td>
<td>—</td>
<td>12.0 mtdt.</td>
</tr>
<tr>
<td></td>
<td>31</td>
<td>—</td>
<td>—</td>
<td>6.0, 6.25, 10.0.</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>—</td>
<td>—</td>
<td>1.0, 6.0, 6.30.</td>
</tr>
<tr>
<td></td>
<td>19</td>
<td>—</td>
<td>—</td>
<td>10.0, 19.0.</td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>—</td>
<td>—</td>
<td>18.25 a.m., 1.0.</td>
</tr>
<tr>
<td>Vatican City</td>
<td>HVJ</td>
<td>6,190</td>
<td>48.47</td>
<td>9.15.</td>
</tr>
</tbody>
</table>

**LONG- AND MEDIUM-WAVE TRANSMISSIONS**

<table>
<thead>
<tr>
<th>Country</th>
<th>Station</th>
<th>kc/s</th>
<th>Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egypt</td>
<td>Cairo</td>
<td>1,348</td>
<td>222.6</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>7.50, 11.10.</td>
<td></td>
</tr>
<tr>
<td>Ireland</td>
<td>Radio Eireann</td>
<td>505</td>
<td>531</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>2.40, 7.40, 11.54, 11.10.</td>
<td></td>
</tr>
<tr>
<td>U.S.S.R.</td>
<td>Moscow</td>
<td>172</td>
<td>1,744</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>12.0 mtdt.</td>
<td></td>
</tr>
</tbody>
</table>

It should be noted that the times are two hours ahead of GMT, and are p.m. unless otherwise stated. The times of the transmission of news in English in The B.R.G. Short-wave Service are given on the preceding page.

* Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

**JUNE, 1941.**
The "Fluxite Quins" at work

Cried Ol, from the gutter, "Hold tight! Till I've soldered this aerial right. I can see now quite plain Why it's broken again.
Pass me down, lads, the tin of FLUXITE!"

See that FLUXITE is always by you—in the house—garage—workshop—wherever speedy soldering is needed. Used for 30 years in Government works and by leading engineers and manufacturers. Of ironmongers—in tins, 4d., 8d., 1/4 and 2/8.

Ask to see the FLUXITE SMALL-SPACE SOLDERING S.T.—compact but substantial—complete with full instructions, 7/6.

Write for Free Book on the art of "soft" soldering and ask for Leaflet on CASE-HARDENING STEEL and TEMPERING TOOLS with FLUXITE

TO CYCLISTS! Your wheels will NOT keep round and true unless the spokes are tied with fine wire at the crossings AND SOLDERED. This makes a much stronger wheel. It's simple—with FLUXITE—but IMPORTANT.

THE FLUXITE GUN
is always ready to put Fluxite on the soldering job instantly. A little pressure places the right quantity on the right spot and one charging lasts for ages. Price 1/6, or filled 2/6.

FLUXITE LTD.
(Dept. W W.)
BERMONDESEY STREET, S.E.I

ALL MECHANICS WILL HAVE

FLUXITE
IT SIMPLIFIES ALL SOLDERING.
LETTERS to the EDITOR

The Editor Does Not Necessarily Endorse the Opinions of His Correspondents

Post-war Amateur Transmission

IN discussing the outlook for amateur transmitters after the war, all your contributors and correspondents take the gloomy view that the G.P.O. will refuse to restore the privileges (or should it be "rights"?) enjoyed previously by the amateur.

Why should the G.P.O. do any such thing? The frequency bands occupied by amateurs are allotted by international agreement, and presumably can only be diverted to other uses by similar agreement. So long as these hands are occupied by amateurs in other countries, the G.P.O. could not usefully employ them for its own purposes, and so the motive of self-interest would not arise—except, perhaps, with regard to the ultra-short waves.

C. T. C.

WHY be almost apologetic for saying that a transmitting amateur without a knowledge of morse "seems all wrong." There is a great deal more than "mere conservatism" (I again quote from your April Editorial) behind that point of view. A "phone only" transmitter will get very poor value from the few watts allowed by his licence and would be quite unable to observe the common amenities of non-interference with morse transmitters.

RADIOPHARE.

IT seems that the majority of British amateurs believe that a more difficult code test would be beneficial to the amateur movement. I do not know how the R.S.G.B. feel about this, but it is interesting to note that the Society's American counterpart, the American Radio Relay League, is reported (by Radio News, February, 1941, issue) to have approached the Federal Communications Commission with the view to "the lowering of standards of admission to the ranks of the licensed amateur."

Radio News continues: "It is said the A.R.R.L. believes there should be more amateurs and accordingly has asked the F.C.C. to make the entrance examinations leading to a licence a little easier. Code restrictions will be lowered instead of raised, and it may become a possibility that amateurs will be licensed with considerably less than 13 w.p.m. code speed requirements and lighter technical requirements. The exact code speed prerequisite . . . is supposed to be in the neighbourhood of 4 to 5 w.p.m."—E. A. S. Jones, (ex 2FOA). Gibraltar.

[The two cases seem hardly comparable. The U.S.A., in process of re-arming, naturally wishes to have a large body of amateurs from which to draw recruits for the wireless branches of its fighting services. In this country, so far as the present discussion is concerned, we are thinking solely of the post-war position.—Ed.]

"Mystery" Record Players: G.P.O. Ruling

It is considered that the publication of the article on "Mystery" Record Players in the April Wireless World might encourage some of your readers to construct similar apparatus, and you will appreciate that if such a device were connected to an efficient aerial it would radiate appreciably. Its possession and use would then be regarded by the G.P.O. as infringement of the Defence Regulations (S.R.O., 1939, Nos. 1687 and/or 1688). The P.M.G. has no objection to the use of this class of apparatus provided signals are of such low a field strength that no radiations can be detected outside the premises in which the device is housed.

E. F. H. Gould,
For Engineer-in-Chief, G.P.O. (Radio Branch).

The Cathode Follower

I SHOULD like to suggest that the formula given for the impedance of a cathode follower in the article "Photographing Transients," by Dr. T. H. Turney, in your issue for April, 1941, page 99, is inaccurate.

\[
Z_C = \frac{1}{\frac{1}{R_A} + \frac{1}{g_m + s}}
\]

The fundamental formula for the output impedance of a cathode follower (diagram (a)) is

\[
Z_C = \frac{1}{\frac{1}{R_A} + \frac{1}{g_m + s}}
\]

BOOKS ON WIRELESS

issued in conjunction with "The Wireless World"

<table>
<thead>
<tr>
<th>Title</th>
<th>Net Price</th>
<th>By Post Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;RECEIVING LABORATORY HANDBOOK,&quot; by M. G. Scroggie, B.Sc., A.M.I.E.E. (Second edition ready shortly)</td>
<td>10/-</td>
<td>11/1</td>
</tr>
<tr>
<td>&quot;TELEVISION RECEIVING EQUIPMENT,&quot; by W. T. Cocking, A.M.I.E.E.</td>
<td>8/-</td>
<td>9/-</td>
</tr>
<tr>
<td>&quot;RADIO INTERFERENCE SUPPRESSION,&quot; by Gordon W. Ingram, B.Sc.</td>
<td>5/-</td>
<td>5/4</td>
</tr>
<tr>
<td>&quot;LEARNING MORSE,&quot; Sixth Edition</td>
<td>6d.</td>
<td>7d.</td>
</tr>
<tr>
<td>&quot;RADIO DESIGNER'S HANDBOOK,&quot; Edited by F. Langford Smith, B.Sc., B.E. (Reprint in preparation)</td>
<td>8/-</td>
<td>9/1</td>
</tr>
<tr>
<td>&quot;THE WORLD WIDE&quot; LARGE CIRCLE PROJECTION MAP</td>
<td>2/-</td>
<td>2/-</td>
</tr>
</tbody>
</table>

Obtainable from Leading Booksellers and Railway Bookstalls or by post (remittance with order) from

ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1

JUNE, 1941.
Wireless World

Balanced Smoothing

In the normal vibrator system the battery circuit, although of low impedance, is not symmetrical to earth, and the small intermittent field which is established is sufficient to cause trouble where the receiver sensitivity is high. The methods of overcoming this difficulty which Masteradio have adopted is first to prevent the greater part of the contact pulse from reaching the battery leads by connecting a large reservoir condenser of the order of 1,000 mfd., across the LT supply inside the vibrator screening, and, secondly, to use a balanced smoothing circuit in the external battery leads. With this method the battery may be earthed on either side or left unearthen altogether without evoking any interference. A modified form of this smoothing circuit has been developed in which a part of the unwanted ripple can be used for the balancing of residual hum in the filament circuits of sets using directly heated valves, and also for reducing the ripple in the rectified HT supply leads, thus enabling less expensive smoothing to be used.

Another improvement has been effected in units of the self-rectifying type by shunting the contacts with a resistance-capacity circuit, the time constant of which bears a definite relationship to the duration of the spark. In this way the transients occurring at the corners of the square waveform are removed and there are fewer high-frequency components to filter in other parts of the circuit. The current rating of the vibrator can be exceeded by a considerable margin without deterioration of the contacts when this circuit is employed.

We were given the opportunity of handling a National H.R.O. receiver deriving its HT supply through the new circuit, and were unable to find any part of the wavelength spectrum where vibrator noise was more than a whisper. Tests with an oscilloscope also demonstrated convincingly the smoothing out of unwanted ripple components.
Tell-tale Lamps

How many of us have run down accumulators and shortened the lives of H.T.B.'s by leaving battery wireless sets switched on when we imagined that they were off? It's so easy to do it with two designs of receiver. The first is the one whose volume control does not actuate the battery switch when turned counter-clockwise as far as it will go. I have one of that kind; the volume control is just a plain rheostat and the wave-change switch has four positions: SHORT, MEDIUM, LONG and OFF. The set, however, becomes silent when the V.C. is at its minimum position, though both H.T. and L.T. current are still flowing fairly. The other design that may catch you out is the one whose wave-change switch has a GRAM position. You turn the knob absent-mindedly when you've finished listening, and don't notice that its indicator registers GRAM. Again the loudspeaker's voice is stilled; again the load on the batteries continues unchecked and unsuspected. With battery sets of either of these kinds the only sure way is to fit a tell-tale in the shape of a small 0-6 amp. filament lamp placed in a conspicuous position so that it is bound to catch your eye. The lamp is, of course, wired in parallel with the valve filaments. The tiny extra load makes little difference to the life per charge of the L.T.B. and the lamp genuinely earns its keep by acting as a safeguard.

The Americans, MW and SW

How have the medium-wave Americans been coming in during the winter months? I'd like to know, if any readers care to write, for I haven't been able to try for them much myself. For various reasons I can't rig up a decent medium-wave aerial, and the little set I have here needs the best of aerials if it is to be of any use as a distance-spanner on the MW band. Only on rare occasions have I been able to hear anything of 'broadcast band' Americans. I imagine, though, that if I heard them at all with this supremely inefficient gear, others with good apparatus may have had fine reception. On the short waves I'm rather luckier, for the set isn't too bad on them, and the rather comic aerial seems to suit its SW circuits fairly well. My best results have been on the 19-metre and 25-metre bands; but that may well be because my Heath Robinson outfit isn't happy on other short-wave bands. Perhaps a little later on I'll be able to manage a better set and a less comic aerial.

Too Difficult!

When you've been used to doing your short-wave DX-ing with a communication receiver and then have to take to an 'all-wave' set of the domestic kind in its stead, you realise what a tricky piece of apparatus the latter is to work. To the man used to what is commonly called a broadcast receiver the C-R, with its many knobs, dials and switches, looks rather frightening; he probably feels when he tries one for the first time that it will take him a long while to become familiar with its working. Actually, for all its complicated appearance, the bigger set is by far the easier to use. There is, of course, an art in handling a C-R so as to get the very best results out of it. When, for example, selectivity, RF (or IF) amplification and AF amplification are all variable, the C-R artist can work wonders by giving each control exactly its right setting. But apart from such skilled achievements, the C-R is less difficult to use than the 'simple set' for short-wave reception just because of its better tuning arrangements. Bandspreading combined with smooth, backlash-free slow-motion gears and large dials with clear graduations, make it so easy to find exact resonance, or to alter the tuning by the few kilocycles that separate one station from its next door neighbours on either side. But when, say, the entire 19-metre band with its score of stations occupies only a fraction of an inch on the dial and the coarse and rather jerky gears move a pointer half as thick as a poker, I, at any rate, find the tuning-in of all but the noisier short-wave stations a difficult and fiddling business. With a C-R you can always return quickly to a station if you leave it for a while to search elsewhere; with the other kind it is often a very different business.

The Debate Continues

What is the highest frequency in use on the other side of the Atlantic that is picked up in this country with any kind of regularity? The question arose just before I sat down with this note, when a fellow enthusiast and I were discussing a problem. Neither of us could remember just what had happened 'below ten' in 1932 and 1933. I seemed to recollect reports of reception of U.S.A. police and other transmissions on frequencies as high as 60 megacycles; he maintained stoutly that nothing with a carrier above 40 megacycles had been heard. Neither of us can get hold of his text books or his pre-war records, so there the matter has to rest, unless some reader will kindly help. And here's a further question awaiting an answer: What is the smallest skip-distance recorded for 50-megacycle transmissions? In other words, what is the shortest range outside its normal quasi-vertical area at which such an U.S.W. signal has reappeared by means of its sky wave? I maintained that in certain circumstances a 50-megacycle transmission, though unreceivable at 100 miles, might be picked up at seven or eight hundred. My adversary contended that the skip distance would always be far greater; he maintained, in fact, that the signal would in all probability never reappear, that it wouldn't be receivable anywhere outside the limits of its direct-wave area. I seem to remember reading much the same thing about far lower frequencies in the now discredited text books of years ago!

S.B.S.T.

For the radio long-distance enthusiast this time business is getting a bit too complicated. Even before the war countries adopting some kind of summer time didn't all start it or end it on the same date. And countries near the equator didn't have a rule have special summer time at all. When on the night scheduled for its opening here you had wrestled with the problem whether putting the clocks forward an hour or back an hour was the correct thing to do and had acted accordingly, you looked ruefully at that neat world time-chart that had been so useful during the darker months and perhaps tried to work out what hour it then was in Nebraska or Japan. Another time-chart might eventually be compiled as you were able to ferret out information whether this country or that did or did not adopt a summer time and, if it did, when the change was. In the course of a few days 6 p.m. in London might be noon in New York, then 1 p.m., then noon again. And now comes S.B.S.T. to present the D-Xer with maddening perplexities. To the best of my belief London's 6 p.m. is, at the moment of writing, June, 1941.
Random Radiations
New York's noon. But what it is now, or will be when this appears in
print, in Moscow or Vladivostock, are mysteries too deep for my poor
harassed brain to fathom.

Unfinished Argument
The other day I ran across an officer
who in times of peace is one of our
keenest amateur transmitters. We
hadn't met before, but when he told
me his call sign I realised that he
wasn't exactly a stranger, for I re-
called many occasions in the days
before the war when I'd listened to
him working this station or that.
Curiously enough, I'd a clear recol-
clection of a Sunday morning argument
on the subject of receiving aerials be-
tween him and another enthusiast, to
which I had listened with the greatest
interest. When I reminded him, he
also remembered it. The two, who
lived many miles apart, had arranged
to meet and thrash out the subject
at close quarters instead of through
the ether. Unfortunately, the out-
break of the war knocked that idea
on the head and the argument on which
I had eavesdropped so long ago still
awaits its continuation.

Things to Come
Like myself, this erstwhile keen
amateur has had very little oppor-
tunity for more than a year and a half
of indulging in our own particular
kind of wireless. As we discussed past
adventures on the short waves I could
see that his fingers were as eager to
get back to the controls of his trans-
mitter as mine are to rest again on
the knobs and switches of my big com-
munication receiver. Even when on
leave I have not been able to put it
into action. All my radio gear had to
be stowed away when the war came
and brought an influx of evacuees.
One of them now sleeps in what was
once my wireless den. May it not be
long before that room returns to its
rightful uses? But I shall have a rare
job in unpacking and sorting out the
wireless gadgets that now repose in
packing cases in a dry cellar. I've for-
gotten now which case contains what,
and though everything was carefully
stowed I'm sure that I shall be looking
here, there and everywhere for various
bits and pieces. And, of course, the
thing that one wants most urgently
is dead certain to be at the very
bottom of the last case in which one
rummages. But that unpacking will
be a time of such joy that little
bothers of that kind won't matter very
much.

JUNE, 1941.
RECENT INVENTIONS

A Monthly Selection of the More Interesting Radio Developments

RADIO NAVIGATION SYSTEMS

The pilot of an aeroplane navigates his craft over an area of country in which a number of beacon stations O, Fig. 1, are arranged to radiate a network of beams B. The plane is fitted with a receiver, the tuning of which is continuously and automatically varied over a wide band of frequencies. As a result it picks up, simultaneously, the signals from all the beacon stations within range, each being indicated in a manner that distinguishes it from the others.

The received signals, after rectification and amplification, are applied to a cathode-ray receiver, Fig. 2, where they appear as traces T of different amplitudes and positions on a calibrated fluorescent screen. The screen is associated with a chart of the locality, which is mounted on rollers R, Rt and is so arranged that by following the co-ordinate lines 1, 2 enclosing, say, the amplitude peak Kt corresponding to the North-South beam, and the co-ordinate lines 3, 4 enclosing the peak K2 corresponding to the East-West beam, the geographical position of the actual transmitter K can be identified. In the drawing a map of France is shown.

M. Wallace. Convention date (France) 21st February, 1938. No. 545393.

CATHODE-RAY TUBES

The object of the invention is to reduce the risk of high-voltage leakage from the anode of a cathode-ray tube to any of the other electrodes such as the grid or cathode, or even to the focusing or deflection electrodes, via the glass surface of the bulb. For this purpose the anode is mounted independently at one end of a tubular glass support, the other end of the support being sealed to the glass bulb of the tube at a considerable distance away from any of the other electrodes.

Since the glass support must be sealed to the metal of the anode at one of its ends, and to the glass wall of the tube at its other end, it is most conveniently made for assembly in three sections. The two end sections are each made of the particular type of glass best suited to the kind of seal required, whilst the middle section is of glass capable of being welded to both end-sections.

A. F. Pearce. Application date, 18th April, 1939. No. 527980.

SECOND-CHANNEL INTERFERENCE

The drawing shows an aerial input coupling designed to minimise second-channel interference in a superhet set. The aerial primary coil L is coupled to a secondary coil L1 forming part of the first tuned input stage, both coils being in series with a fixed condenser C. The secondary L1 is also in series with a coil L2; the circuit as a whole is tuned by a variable condenser Cr and is connected across the input terminals T of the first amplifier valve.

If the signal range is 150 to 300 kilocycles, and the intermediate frequency is 450 kc/s, the local oscillator will operate over a range of from 600 to 750 kc/s and second-channel interference is liable to occur between 1050 and 1200 kc/s.

To eliminate such image frequencies, the coupling between the coils L and L1 is adjusted so that, within this range, frequencies will scarcely be affected and will pass through to the amplifier.


RADIO RELAY STATIONS

The figure shows a short-wave installation for relaying simultaneously in different directions, so that a signal, introduced, for instance, at any one point, can be reproduced throughout a whole chain of such stations. The system is primarily designed for working on a common carrier wave, the signal being preferably superposed as a frequency modulation. It can also be used, among other things, to stabilise the frequency of a network of short-wave radio stations.

Half-wave resonators for S-W relay stations.

Two pairs of V-shaped aerials A, B, of opposite directivity as indicated by the two arrows, are so coupled together that there is little or no reaction between the input and output circuits of the common amplifier V. The coupling circuits comprise two half-wave tubes or coaxial resonators 1, 2 and 3, 4, which are equivalent electrically to a transformer having a single primary winding and a single secondary winding, with uniformly distributed capacity and inductance. Screening is effected by tubes S, Sr.

In operation a signal arriving, say, from the left, is collected by the pair of aerials A, and half the energy is led by the leads L, L1 to the input of the amplifier V. The output from the amplifier is fed by the leads O, O1 to the "primaries" 2, 4. These, in turn, energise the "secondaries" 1, 2 of the two pairs of aerials A, B and so re-radiate the amplified signal simultaneously in opposite directions.


The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

JUNE, 1941.
ELECTRADIX RADIOS

HEADPHONES
L.R. Double Headphones
Field Signallers, 120 ohm Phones. All leather headbands with slide adjustment chin strap and 4ft. cord. Com- 
fortable ... 5/-
L.R. Single Phone & Cord ... 2/-

MORSE INKERS
Captured Contraband, new Tape Strip Recorders ; portable or Table, Dot-dash, Cheap. Wheatstone Strip Hand Perforators, 15/- Paper Tape for Morse, green or white. Brass Tape Reels in mahogany case, 4/6.

The ROLLS-ROYCE of BUZZERS is the CAMBRIDGE-TOWNSEND. Tiny and Shriit. 10/-

Perfect for Waveometers, ideal for signals. High note Model "T" Diaphragm blade. Platinum Contacts. The smallest Buzzzz possible ... 10/-

VARIABLE CONDENSERS
.0005 mfd. Tekado, 1/6.; .00075 Polar Comp. 2.; 5/ W. Forino, 2/6.; B.J. Midget, .0001, 2/6.; 3-gang variable, .0005, 3/6.

RHEOSTATS
10-watt Small Rotary
Back of panel, one hole, front knob, 4 ohms, 25 amps, 2/6.; 6 ohms, 1.7 amps, 2/6.; 10 ohms, 1 amp, 2.6.; 20 ohms, 1 amp, 2.6.; 30 ohms, 3 amp, 2.6.; 30,000 ohms Volume Controls, 1/6.

RESISTORS
on mica, 8 ohms, 13 amps, 9d.

RECORD CUTTER NEEDLES
Real Diamond, 7/6.; Rotary Needle Sharpner, 1/6.; Wood Needles, round or triangle, 1/-dix.

CAMERASCOPES
True Twin Camerascopes, 2 lens viewers, short focus, stereoscopic. 1/6 post free.

RELAY FOR RADIO WORK
A 2 ma. Table Relay. Compact vertical type, enclosed. Screened 2,000 ohm coils. Platinum contacts. Single pole change-over. 1 amp. contacts. Wood base. Metal case. Size 21 in. diam. 31 in. high. Price ... ... ... 8/6
No. 6 Telephone Relay. Single pole change over. Double wound for 2 volts or 6 volts 25 ma. 7/6.

ALUMINIUM FOIL
12in. by 12in., 9d. sheet.

LOUD SPEAKERS (state wants).

OZONIZERS
SWEET AIR IN ANY ROOM, with a Leidex Norton Ozonizer. A.C. mains only. Can be hung on the wall: 10 watts, 1 tube, 20/-; 25 watts, 2 tube, 25/-

DYNAMO BARGAINS
110-volt, .8 amp. D.C. ball bearing, semi-enclosed, 1,850 revs., 15 lb. 6in. x 5in. Cheap. Only 15/6 Post Free.
200 volts 3/8 amp. ... ... ... 19/6 Post free
200 volts 1 1/2 amp. ... ... ... 27/6

MOTOR DRIVES
GEARS
Skew drive Gear Boxes for Cine, or Boat, 1/2 or 1 h.p., 10/- Ditto on C.I. Pedestal, with flywheel, 15/- Small 2 to 1 Gear Boxes, 1/2 h.p., 4/6.

DYNAMOS
Double Current, Govt., cost £15, two commutators, D.C., 12 volts, 15 amp., and H.T. 100 volts, 100 ma., 5 1/2 in., dia., 15 1/2 in., long, 17 lbs. 4,000 revs., ball bearings, 25/- We have some surplus mounted sets, 15/-

SMALL A.C. MAINS MOTORS
Enclosed, self-start on load, 220 volt, 1/2 hp. Type 40, 1,500 revs., 18/6 Split phase, 110/220, 2,500 revs., 45/-

D.C. MAINS MOTORS
1/4 h.p. Type 60, 220 volt, 150 revs. 18/6 Ditto, 1/4 h.p., G.E.C., 100 volt, 120 revs., 2,000 revs., 16/- Ditto, 1/4 h.p., Croydon 110 and 230 volt, twin, 1,700 watt, 35/-, M.G. for A.C., 220 volt to 100 volt, 1 amp, D.C., 7/6, 100 volt, 15/-.

STEREO MACHINES
All fully guaranteed.

MICRO-MOTORs
A.C. split phase synchronous motors, squirell cage rotor, 1/4 in. dia. Dog clutch drive to reduction gear from 2,000 revs. to 58 r.p.m. Voltage 15 to 20 volt, cycles reversible, double shaft, enclosed, laminated, new, Suit model drives, remote control switching, tuning drive, etc., 8/- Post free.

ALTERNATORS

VERTICAL MOTOR - ALTERNATORS

PHASE ALTERNATORS
G.E.C. 333 cycles 3 ph, 1 1/2 volt 1 amp, fitted road test instrument. Suit excision horizontal, 6/10.

A.C. HAND ALTERNATOR
Permanent steel magnets, wound armature driven by gearing and handle. Outrider of 80 volts 20 ma A.C. For Medical Treatment, A.C. experiments, etc. Sia, 7/-, Carriage, 1/4.

VIBRATOR H.T. KITS
Homemade L.T. Battery-operated Supersede H.T. Batteries. The Vibrator converts D.C. to A.C. by vibrating uniformly. Any voltage to 100 watts obtained by transformers and rectified for radio H.T.

WE OFFER
American Vibrators totally enclosed, slightly dented covers. 4-pin non-sync. at the low price of 10/-

SWITCHES, METERS, ETC.
A Special Design in Auto-Switches
with time-lag tripping on 2 to 3 amps. Safety thermo switch with quick-break auto overload trip, for back of panel with front knob, compact, 4in. x 2in. x 1 1/2 in. deep. Any voltage up to 1,000 v.

Worth a guinea only 5/6

Magnetically tripped Switches that operate instantaneously
Circuit Breakers of first-class make, in place of fuses. Operate instantly on an overload. Fireproof construction and bakelite or metal cover. Made in single, double, and triple pole. Prices are low, and type marked with a star have thermal trip delay.

SINGLE POLE HEAVY IRON CASE
240 volt, 10 amp. Illustration shows S.P. with cover removed.

Rating 6 amps. Type Price
6 ... S 1/1G ... 11/5
10 ... S 1/17 ... 15/6
15 ... S 1/11 ... 18/-

SINGLE POLE HEAVY IRON CASE
240 volt, 10 amp. Illustration shows S.P. with cover removed.

HOT WIRE METERS
For Radio or Low-Frequency
1 amp, 2 1/4 in. dial, front panel, 100 ma. to 1 amp., 10/-, 200 ma. to 1 amp., 7/6, 500 ma. to 2 amps, 7/6. To 2 1/2 amp., 15/- High voltage model in square ebonite case, 13 amps, 15/6. Special Saddle Meters with cut-out switch, 15/6. High-grade magnet dipped H.W. Meters, 100 to 500 ma., 41/2 in. dial, Marconi type 25/- 200 ma. to 1 1/2 amp., 1/2 P., brass case, 27/6, 2 amp and 3 amp, ditto, 21/6, 6 in., and 8in. H.W. Meters to 10 amps, 20 amp. and 50 amp, 40/-

PM METERS

LAb. GALVANOMETERS
Vertical Ballistic with mirror on coil, quite new, by Tinsley, with Mirror Galvanometer, 90 galvanometers, 90 galvanomes, by Gabbrell Paul and Naider, £13/10/- and £14 each. Universal Multiplying Galvanometers, Shunts, 35/-, Silvertown, Siemens and Fuller horizontal 35/- Galvanometers, 7/-, Vertical Telegraph type, Central Zero Scale, 4/6. Multiplex Vibrators, 45/- Wheatstone Bridges.

HORIZONTAL BRASS-CASED GALVANOMETERS, 7/6.

CELL TESTERS, Megger 3-0-3 mov. vol coil, aluminum case, 25/-

If you have Resistance to measure you will find this Standard Resistance Box guaranteed to standard, 1,000 ohms, 4,300 ohms, 8,000 ohms, 12,400 ohms. Cheap.

MEGGERS AND OHMMETERS
Evershed B r i d g e with decalcm box, 10,000 ohms. Megger 100 volts, 250 volts and 500 volts, and small MEG, for D.C. mains. N.C.S. Ohmer 500 volts to 20 meg. Ev. Edg. Metrall, 250 volts, 0 to 10,000 ohms. Dorothy Portable Test Set, Bridge type, .001 ohm to 1 meg.

Add postage for all mail orders.

2d. stamped envelope must be enclosed for post replies.

218, UPPER THAMES STREET, LONDON, E.C.4
Telephone Central 461/1

Advertisements 11

JUNE, 1941.
Wireless World

JUNE, 1941

ADVERTISERS may have letters, other than circulars, addressed to numbers at this office. The words Box 1000, c/o "Wireless World," must be paid for and a further 1/- added for registration and forwarding replies.


CLASSIFIED ADVERTISEMENTS. The charge is 6/- for each paragraph of 2 lines or less, and 3/- for every additional line thereafter, or part thereof, to 20 words a line. Each paragraph is charged separately.

ADVERTISEMENTS for the July issue are accepted up to Friday, June 8th, at the Head Office, Dorset House, Stamford Street, London, S.E.1, or one day earlier at provincial Offices.

THE PROPRIETORS retain the right to refuse or withdraw advertisements at their discretion. They are not responsible for printing any advertisements although every care is taken to avoid mistakes. Cheques and postal orders should be made payable to J. & J. Sons Ltd., and crossed. Notes are legal tender and cannot be traced if lost in transit.

NEW RECEIVERS AND AMPLIFIERS

HAYE Your Amp, or Receiver Built to Your Specs.—high fidelity equip. a specialty. Estimators and advice free.—S.A.R. Supplies, 20, Norwood Rd., S.E.23. (5350)

MACCULLOCH Silver 15-17 Olympic Autotriode, twin, new, price £3 15 0, Cash on delivery, £3 13 5, £4 11 9. 23/4" Console and U shaped. (4847)

£15 10 0 Only, usual price £23—Wireless World

2 R.F. Receiver, with push-pull quality amplifier,choice of 10 valves, including tuning control stage, 8 watts audio output, ideal for quality reproduction from radio and gramophone.—Limited number.—Bakers Selhurst Radio, 72, Selhurst Rd., South Croydon. (5950)

RECEIVERS & AMPLIFIERS—SECOND-HAND, ETC.

PARTRIDGE 30-watt Amplifier, complete, supply for first stage, diode warming inaudible hum level, 19 lbs. use.—Mr. C. S. Advertiser, 117, Eaton Rd., Newcastle, Staffs. (5044)

SCOTT 15, with Summer Change, Operato Amplifier, in magnificient cabinet. £15; Marcon 15A, £12 15 0; Phillips, £15 15 0.—A. G. Spint, 44, Wilmorton Rd., Birmingham. (5641)

SUGDEN Defiant, also Magnavox 66; full particulars, 2 1/2 lb., by post.—H. E. Lewis, 6, Arden St., Leeds. (5552)

NATIONAL Standard HRO, complete, coils, speaker, etc., £4 15 0.—S. E. H. Association, 39, Oakwood Rd., Bournville. (5953)

WANTED, several HRO receivers, in good condition, also Hifonizers.—Write Box 2078, c/o The Wireless World.

COMMUNICATION Receiver, A.C. mains; excellent price paid in first class condition.—Details, Channery Prec.Inst. Service, Middle Clacton, Essex. (5951)

HIGH Class Chassis or auto change radiograms wanted for spot cash. High price paid. Mid-week, 51, L.H.V., R.D.6., etc.—W. H. Wright, 30, Wolverhampton. (5960)

PUBLIC ADDRESS

LET Us Estimate for Your P. A. work; wide experience in office, factory, dance-band and air-raid alarm systems, etc.; estimates and advice free. Prices.—S.A.R. Supplies, 20, Norwood Rd., S.E.23. (5851)

NEW MAINS EQUIPMENT

VOXTEK Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B. Why not you? Immerse, but unequalled.


SHORT-WAVE EQUIPMENT

RAIMANET, limited, communications equipment. National distributors, 49, Holloway Head, Birmingham. (5955)

Bakers Brand New Special Speaker Bargains

Every Music Lover Interested in Realistic Reproduction should write for free descriptive leaflet now.

£5 10 0
total price. £6 — Brand new permanent magnet infinite baffle speaker, complete with beautifully finished cabinet in polished walnut.

£2 10 0
total price. £3 — Brand new super-quality triple cone speaker, permanent magnet motor; exceptional bargain; limited number. Details and Bargains On Application Now.

Bakers Triple Cone Conversion Will Immeasurably Improve Reproduction of Your Present Speaker.

For a few shillings extra we can give you a speaker, scheduled for the scrap heap into one worth pennies—W. E. Darby, Grass Prec.1.F.E.E. 1. Write for details.

Bakers SELHURST RADIO, 72, Selhurst Rd., South Croydon. (5942)

SECOND-HAND LOUDSPEAKERS

MAUNIVOX 66 Speaker, perfect £6.—Advertiser, 117, Claydon Rd., Newcastle, Staffs. (5954)

A CABINET for Every Radio Purpose

SURPLUS Cabinets (Unofficially) from Noted Makers.

We have hundreds in stock (no catalogues); send measurements of chassis, etc., and say what kind of cabinet required; stamp for reply.

INSPECTION Invited.

H. T. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 6692. (5931)

BOOKS

THE SUPERHETERODYNE RECEIVER

by Alfred T. Witts. A reliable and comprehensive guide to the superheterodyne receiver, incorporating all recent developments, provides the essential working knowledge required by every keen amateur, radio student and service engineer. Recognised everywhere as the standard work. "Gives all the information necessary for a complete understanding of the Superheterodyne Receiver," says PRACTICAL WIRELESS. Fourth Edition. 4 1/2 net.

INTRODUCING RADIO RECEIVER SERVICING

by E. M. Squire. One of the best books available on this subject. A concise introduction to the general operation of a radio receiver, which will be especially valuable to students, radio service engineers, testers and dealers, enabling all to attain a working knowledge of receivers and servicing equipment in a minimum of time, and without unnecessary theoretical frills. 5 1/2 net.

Write for 4-page illustrated leaflet of books on Radio and Television.

PITMAN

Parkway, Kingsway, W.C.2

CLASSIFIED ADVERTISEMENTS intended for the JULY issue can be accepted up to Tuesday, June 10th.
buying sound equipment?

If you are buying Sound Equipment and P.A. Gear you will find an investigation of the R.S. Amplifiers range interesting and well worth your while. We do not claim to build "the best in the world"—perfection, we hope, is unattainable else we should not strive. But we do sincerely believe that what we make is as good as it can be made and perhaps better than most. Below are listed briefly a few items from our standard catalogue which will gladly be sent on request. If you have any special needs tell us and we’ll be happy to co-operate.

AMPLIFIERS


"Porta Thirty."—30 watts output. Two speakers (this equipment can be used with up to five speakers). AC 200-230 volts. Complete with "mike", stand and cables. A scene of perfection in portable amplification.

CHASSIS

Five types of chassis are available: 50 watt, 30 watt, 15 watt, and a 12-watt Battery Unit.


R&S Amplifiers LTD

THREE & FOUR HIGHFIELD ROAD SHEPPERTON - MIDDLESEX

Phone: Walton-on-Thames 1017

WWW.AMERICANRADIOHISTORY.COM
You just plug in with Solon Electric Soldering

With the Solon you can work wherever there's a lamp holder—and do better work! Solon Electric Soldering is easy, neat, strong and clean. No stopping to heat up—a constant heat maintained at point. 15 hours soldering uses only 1 unit.

Made for following standard voltages—200-120, 220-230.

Handyman model supplied completed with Resin-Core Solder, Flex and Lamp Adaptor.

Solon Resin-Core Solder 5¢ per reel.

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.
(Dept. 21-E), Engineering Sales Dept., Milton Court, Westcott, Dorking, Surrey.

ACOUSTICAL MANF. CO.
Specialists in Amplifiers, Transformers, and all Sound Equipment having to do with Radio and Television.

For the RADIO SERVICE MAN, DEALER and OWNER

The man who enrolls for an I.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday, radio service work. We train them to be successful!

INTERNATIONAL CORRESPONDENCE SCHOOLS


Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Elementary Radio Television
If you wish to pass a Radio examination, indicate it below.

Inst. of Wireless Technology
P.M.G. Certificate for Wireless Operators
 Provisional Certificate in Radio Telephony and Television for Aircraft
City and Guilds Telecommunications

Name..............................................Age....................
Address..............................................(Use pen for stamp on unsold envelope)

ACOUSTICAL MANF. CO.

Specialists in Amplifiers, Transformers, and all Sound Equipment having to do with Radio and Television.

For the RADIO SERVICE MAN, DEALER and OWNER

The man who enrolls for an I.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday, radio service work. We train them to be successful!

INTERNATIONAL CORRESPONDENCE SCHOOLS


Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Elementary Radio Television
If you wish to pass a Radio examination, indicate it below.

Inst. of Wireless Technology
P.M.G. Certificate for Wireless Operators
 Provisional Certificate in Radio Telephony and Television for Aircraft
City and Guilds Telecommunications

Name..............................................Age....................
Address..............................................(Use pen for stamp on unsold envelope)

ACOUSTICAL MANF. CO.

Specialists in Amplifiers, Transformers, and all Sound Equipment having to do with Radio and Television.

For the RADIO SERVICE MAN, DEALER and OWNER

The man who enrolls for an I.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday, radio service work. We train them to be successful!

INTERNATIONAL CORRESPONDENCE SCHOOLS


Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Elementary Radio Television
If you wish to pass a Radio examination, indicate it below.

Inst. of Wireless Technology
P.M.G. Certificate for Wireless Operators
 Provisional Certificate in Radio Telephony and Television for Aircraft
City and Guilds Telecommunications

Name..............................................Age....................
Address..............................................(Use pen for stamp on unsold envelope)

ACOUSTICAL MANF. CO.

Specialists in Amplifiers, Transformers, and all Sound Equipment having to do with Radio and Television.

For the RADIO SERVICE MAN, DEALER and OWNER

The man who enrolls for an I.C.S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, everyday, radio service work. We train them to be successful!

INTERNATIONAL CORRESPONDENCE SCHOOLS


Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Elementary Radio Television
If you wish to pass a Radio examination, indicate it below.

Inst. of Wireless Technology
P.M.G. Certificate for Wireless Operators
 Provisional Certificate in Radio Telephony and Television for Aircraft
City and Guilds Telecommunications

Name..............................................Age....................
Address..............................................(Use pen for stamp on unsold envelope)
WIRELESS WORLD

SITUATIONS VACANT

WIRELESS Technical Instructors Required in Army Units.

EMOLUMENTS—Pay $8/9 per day (7 days a week); extra rates for various accommodations, or if it cannot be provided; allowances at authorized rates; officers and other eligible, gain substantial experience on the fine work, and position, subject to allotment from pay.

CANDIDATES Should Preferably be Under 35 and over 24, and

(A) Hold one of the following qualifications:

- Graduate of the Institute of Electrical Engineering.
- Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.
- Certificate of City and Guilds of London Institute for Radio service work.

(B) Be able to pass an examination on the following:

- Simple algebra, including quadratic equations; simple trigonometrical ratios and identities; vectors.
- Properties of electrical currents; heating of conductors; magnetic effects in radio receivers; electrolytic capacitors; Meters; Induction; effect of rotating a coil in a magnetic field.
- Mutual and self induction and inductance; effect of inductance on growth and delay of current.
- Capacitance, charge, and discharge of condensers; thermal expansion; surface resistance and repair.

PTIMAN'S, 39, Parker St., Kingsway, W.C.2.

GET THEM FROM

JOINING THE R.A.F.

ARMY—NAVY—MERCANTILE MARINE OR TAKING MORSE CODE TRAINING.

MORSE CODE TRAINING

There are courses for beginners and operators. A Candler trained operator now serving in the R.A.F. says—

"I should like to thank both yourself and the company for the great work which I have obtained through your Junior Code Course. The experience which I gained from that has kept me 'miles in front' of others who relied on obsolete means of learning code."

Fill in the Coupon and learn more about this highly efficient Candler method of Code training in your own home. JUNIOR Scientific Code Course for beginners. It teaches all the necessary code fundamentals scientifically, and brings you closer to perfection. Send 6d. (net) for a Junior Code Book and 3d. (net) Postage. THE TECNICAL INSTITUTE OF GREAT BRITAIN, 62, Temple Bar, House, London, S.W.1. 10352

TELEGRAPH WRITING COURSE for W/T operators who want to become expert in using a typewriter for recording messages.

Courses supplied on Open or Monthly Payment terms.

Please send me a Free Copy of Candler's "Book of Facts.

NAME.

ADDRESS.


Candler System Co., Asheville, North Carolina, U.S.A.

HUGE TELEVISION PURCHASE!

CHASSIS, COMPONENTS, CABINETS, C.R. TUBES, ETC.

We have just completed the purchase of the stock of the pioneer Television manufacturer. Chassis, components, cabinets, accessories of every description. These have been bought at prices at trade, at a clearance at ridiculous prices. Inspection invited. Here are only a few items.

POWER PACK AND AMPLIFIER

Size 161 in. x 131 in. x 4 in. Planned as the main unit for Television receivers costing many pounds. Includes heavy main transformer 350-0-350, 120 m.s., with 4 vacuum 5 amp. taps. High voltage transformer for supplying C.R. Tube. Various condensers including 16 x 16 mfd. 550 volt working, 1-16 mfd. 450 volt working, 50 x 20 x 2 mfd. 81. Electrolytic storage condensers for chokes; resistors; trimmers; bias electrolitics; mica and tubular condensers; large signal wave coils, etc. The quality of the workmanship and components is of the highest class. Also smaller units for replacing or filling the same functions but made for a different television set.

TIME BASE CHASSIS

For 8in. Cathode Ray Tube. Well-made cadmium-plated chassis, size 1711 x 411 in. x 2in., containing complete set of components. Various types ranging from 15,000 ohms to 1 megohm, five variable resistors, resistors 0 to 20,000 ohms, approximately 14 various tubular and electrolytic condensers, also sundry focus and scanning coils and chokes. Complete Service manual available, price 6d. each.

TUBE SUPPLY UNITS

For high voltage 16116 tubes. Approx. 6,000 units. Complete sets with sockets, sockets and test condensers with porcelain insulators, transformer, etc. The condensers are shielded in metal cases. (81. condenser supplied separately at 20/- and the transformer at 15/-.

Mains Transformers

These are one of the best jobs we have seen. Originally Made for Television Power Packs where accuracy and robustness are essential. Weight 121b., size 51in. x 41in. overall, 250-0-250 volts, 120 m.s. Four tappings each giving 4 volts 5 amps. Brand new.

CABINETS

Cabinets of every description available, Table type, Consoles, and large pedestal lift-up lid. All in condition. Beautiful examples of the cabinet-maker's art. House to house. Let us know your needs, or better still, come and inspect.

C.R. TUBES

The consignment includes 8in., 10in., and 15in. MACKAY T.T.N. and MACKAY T.T.S. tubes which are not available to-day through ordinary channels. Brand new in original cartons, as fast as new. Send us your requirements and we will quote by return. We know what the prices must be collected by purchaser.

Most lines advertised last month still available.

LONDON CENTRAL RADIO STORES
23, Lisle Street, London, W.C.2

GERRARD 2069

www.americanradiohistory.com
CHEERFULNESS

When cheerfulness is in danger of disturbance, light a 'Player,' and with a few 'puffs' put trouble in its proper place. The friendly Sailor, as always, stands for cheery contentment and a guarantee that quality and purity remain unchanged.

KEEP THAT HAPPY EXPRESSION

Player's Please

Send 3d. to Dept. W.W. for a copy of "The All-Metal Way!"
PRE-EMINENT IN PEACE
INDISPENSABLE IN WAR

Advertisement of
THE TELEGRAPH CONDENSER CO., LTD.