WIRELESS EXPORT DRIVE: BRITAIN DELIVERS THE GOODS
CERAMIC COIL FORMERS

...FOR GREATER RADIO EFFICIENCY

Outstanding advantages:
CERAMIC MATERIAL PROVIDES FOR
GREATER ACCURACY OF WORKING.
GREATER FLEXIBILITY IN DESIGN.
VERY SMALL LOSS FACTOR.
UNAFFECTED BY TEMPERATURE AND
HUMIDITY.
COMPLETE STABILITY.
MORE ECONOMICAL TO PRODUCE.

Write for details.

CONTRACTORS TO G.P.O. AND GOVERNMENT DEPARTMENTS.
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.
The world-wide use of "AVO" Instruments is striking testimony to their outstanding versatility, precision and reliability. In every sphere of electrical test work—laboratory, shop or out on a job—they are appreciated for their dependable accuracy, which is often used as a standard by which other instruments are judged. There is an "AVO" Instrument for every essential electrical test.

OTHER "AVO" INSTRUMENTS (not illustrated).
- High Resistance AvoMinor
- "Avo" Low Resistance Ohmmeter
- The "Avo" Bonding Meter
- The "Avo" MilliOhmmeter
- The Avedapter
- 9-pin AvoCupler

Sole Proprietors and Manufacturers:
THE AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT Co., Ltd., Winder House, Douglas St., London, S.W.1

Write for fully descriptive literature dealing with any instrument in which you are interested, and for current prices.
Just to remind you
of the fact that
Heedless of the interruptions by
Nocturnal aerial visitors
McClure’s are making
Chassis and Radio Apparatus which
Contribute more and more to
Listeners’ desire for
Unfailing Quality in both
Reproduction and Workmanship and
Ensure the utmost enjoyment from
broadcast entertainment

Write to:
JOHN MCCLURe LTD.
ERSKINE ROAD, LONDON, N.W.3. GULiver 5981
EVACUATION ADDRESS as from Dec. 2nd
CROXSON’S WORKS, HIGH WYCOMBE, BUCKS
Phone : High Wycombe 1370

NOISE SILENCER Applications

Westinghouse Metal Rectifiers may be used for the reduction of static interference, their operation in such circuits being entirely automatic, and dependent solely upon the property that their resistance decreases as the current passing increases. The rectifiers are connected to give a non-linear characteristic in both directions, the circuit being arranged that the normal maximum audio voltage across them does not raise the operating point on to the straight portion of the rectifier characteristic curve. Noise peaks cause the rectifiers to work on the straight portion and act as a short-circuit across the output for the duration of the peak.

(A) This is the most simple circuit and uses “H” type units.

(B) A more elaborate circuit using two W.6 Westectors and allowing the “cut-off” point to be varied to suit different conditions.

(C) A circuit using two W.X.6 Westectors for use in an early low-frequency stage.

WESTINGHOUSE METAL RECTIFIERS

COUPON

To Westinghouse Brake & Signal Co., Ltd., Pew Hill House, Chippingham, Wilts.

W.W. 1240
**Every day sees another assembly problem Solved**

Wireless World

Advertisements - 3

**Simmonds Speed Nuts**

Patents applied for

SIMMONDS AEROACCESSORIES LTD

GREAT WEST ROAD, LONDON

Blind assemblies, difficult spacing jobs, these tricky knob to shaft assemblies, and concealed parts in sheet metal assemblies—problems like these which have hitherto presented great difficulties to the designer are easily solved by the Speed Nut System.

Above are shown only a few of the thousands of successful applications which have been designed by our Engineers in collaboration with the Manufacturer.

We welcome enquiries from Designers and Manufacturers and our Development Department will be pleased to collaborate and work out the most effective types to solve your assembly problems.

Move with the times—investigate the Speed Nut System now.
Here's the family's Ideal Wartime Gift—

Music While They Work

& Shelter

Cabinet Models from 2½. Nothing can form a more useful or practical gift for the family these harassing days than the means of conveniently enjoying bright and cheery radio entertainment. A famous Stentorian Extension Speaker will make your radio instantly available at any part of the home. The womenfolk can listen-in whilst they work or take it into their refuge room when the need occurs. And you will readily appreciate the brilliant reproduction—it does justice to the finest receiver. Thousands of listeners are getting the fullest enjoyment from radio by this means. Why not YOU?

To avoid possible disappointment you are urged to place your order immediately with your local dealer.

Just Released!!!

A NEW 74 RANGE UNIVERSAL TAYLOR METER

Sensitivity 20,000 ohms per volt on BOTH A.C. and D.C.

Taylor Model 81C

There is no other multi-range meter in existence which has the same sensitivity on BOTH A.C. and D.C.

£16-16-0

(No purchase tax payable)

Supplied complete with instruction book and 3 test leads.

IMPORTANT FEATURES TO NOTE:—

- Meter, the movement having a sensitivity of 50 microamps, full scale on both A.C. and D.C.
- SCALES: 6 scales, the outer being 3½ long.
- RANGES:
  - D.C. Volts 0.0 to 0.2, 0.2 to 2.0, 2.0 to 20.0, 20.0 to 200.0, 0.2 to 2.0, 2.0 to 20.0, D.C. Current 0-50 microamp, to 0-20 amp. A.C. Current 0-50 microamp, to 0-5 amp. Ohms 0-1,000, 0-10,000, 0-100,000, 0-1 m, 0-10 m, 0-100 m, 0-1 k, 0-10 k, 0-100 k, 0-1 M, 0-10 M.
- Decibels (to 60).

The Taylor S.R.48 Resistor Kit offers you the right replacement in a form equally handy for toolbag, workshop or counter display. Remember, too, that Erie ½ watt and 1 watt standard carbon resistors will carry a load of ½ watt and 2 watts respectively, allowing for a 50% overload, and in consequence this kit will cover all your requirements over the ½ watt to 2 watt range. The Erie S.R.48 Resistor Kit contains 48 standard carbon resistors, 24 each ½ watt, and 1 watt in an assortment of most used values.

The Erie S.R.48 Resistor Kit contains 48 standard carbon resistors, 24 each ½ watt, and 1 watt in an assortment of most used values.

List Price £6.00

ERIE REPLACEMENT VOLUME CONTROLS

ERIE Replacement Volume Controls are the only fitting companions for Erie Resistors.

STANDARD CONTROLS.

Without Switch - 2/- With S.P. Switch - 2/- With D.P. Switch - 3/6

Non-standard Spindles 2/- per control extra.

Centre tap controls, dual and gang controls have been withdrawn temporarily.

ALSO Vitreous Wirewound Power Resistors.

Send for complete Price List.

ERIE RESISTOR LTD.

Carlisle Road, The Hyde, Hendon, N.W.4.
Telephone—Galefield 8011.
We have sufficient stocks of all taxable radio goods [with very few exceptions], for a reasonable period. When these are sold out, tax will become operative. Purchase now and save money.

**SHORT-WAVE GEAR**


*4-pin or 6-pin Coil Formers. Plain or Threaded. 1/2 each.*

*Utility Micro Cursor Dials, Direct and 100 : 1 Ratio. 4/3.*

*New Premier 2-Gang S.W. Condenser, 2 x 0.0015 mf. with integral slow motion, 7A, Bakelite Dyelectric Variable Condensers. 0.005 mf. Suitable Tuning or Reaction, 1/4 each. Short-Wave H.P. Chokes, 10-1000 m., 10/4 each. High grade Pie Wound U.S.A. type, 1/4 each.*

*Lissen Dual Range Screened Coils. Medium and Long Waves, 2/9 each.*

**“LEARNING MORSE”**

*Premier Morse Practice Key on Bakelite Base and Brass Movement ... 3/3*

*General Purpose Morse Key ... 5/10*

*Heavy Duty TX Key on Cast Base ... 10/10*

*Bakelite Buzzers ... 2/7*

*3 Henry Chokes ... 7/6*

*Complete Kit of Parts for Valve Oscillator as described in W.W. “Learning Morse” 25/-.*

**SHORT-WAVE CONDENSERS**

*Trollop Insulation. Certified superior to ceramic. All-brass, brass. Easily ganged. 15 m.mfd. ... 1/9 25 m.mfd. ... 2/- 40 m.mfd. ... 2/- 250 m.mfd. ... 2/11 25 m.mfd. ... 1/9 100 m.mfd. ... 2/6 510 m.mfd. ... 1/3 1000 m.mfd. ... 2/3 1500 m.mfd. ... 2/6 2500 m.mfd. ... 2/11*

**MAINS TRANSFORMERS**

*Wire-ends. All L.T. Windings Centre-Tapped S.P.361 300-350 v. 150 m.a. 4 v. 2-3 a. 15/- S.P.368 350-350 v. 100 m.a. 5 v. 2 a. (not C.T.) 6,2 v. 2 a. ... 14/6 S.P.358 350-350 v. 100 m.a. 4 v. 2-3 a. 14/- S.P.351 350-350 v. 100 m.a. 4 v. 1-2 a. 4 v. 2-3 a. 3-4 a. 18/- S.P.352 350-350 v. 150 m.a. 5 v. 2 a. 6,3 m. 2 a. ... 15/9 MATCHMAKER UNIVERSAL* OUTPUT TRANSFORMERS Will match any output valves to any speaker impedance. 11 ratios from 13 : 1 to 90 : 1. 5-7 watts, 1519. 10-15 watts, 28/6. 20-30 watts, 35/-.

**PREMIER MICROPHONES**

*Transverse Current Mike, High grade large output unit. Response 45-7500 cycles. Low noise level, 21/5.*

**PREMIER SHORT-WAVE KITS**

*for OVERSEAS NEWS Incorporating the Premier 3-band S.W. Coll, 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, 14/9. 3-band S.W. 2 Valve Kit, 22/4.*

**DE LUXE S.W. KITS**

*Complete to the last detail, including all Valves and coils, wiring diagrams and lucid instructions for building and working. Each Kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres. 1 Valve Short-Wave Receiver or Adaptor Kit ... 20/- 1 Valve Short-Wave Superhet Converter Kit ... 23/- 1 Valve Short-Wave A.C. Superhet Converter Kit ... 26/- 2 Valve Short-Wave Receiver Kit ... 29/- 3 Valve Short-Wave Grid and Pentode Kit ... 68/-*

**AMERICAN VALVES**

*We hold stocks of all types at competitive prices.*

**REPLACEMENT VALVES**


**NEW PREMIER S.W. 4 VALVE A.C. RECEIVER KIT**


**MOVING COIL SPEAKERS**

*All complete with transformer. Rolls 65 in. 15/-; 6 in. P.M. 14/- ; 10 in. P.M. 22/-.*

**ENERGISED MODELS**

*Plessy 8 in. 175 ohm field. 7/6 ; G.12 energised, 1.250 or 2.500 field, 43/- ; 10 in. B.T.H. 1.600 ohm field, less transformer, 11/6.*

**PREMIER 1940 HIGH FIDELITY AMPLIFIER KITS**

*Each Kit is complete with ready drilled chassis, selected components, specially matched valves and full diagrams and instructions. Completely Kit of Parts Wired and wired with Valves Tested 4-watt A.C. Amplifier ... 2 14 0 3 11 6 4-watt A.C./D.C. ... 3 0 0 3 17 6 6-watt A.C. ... 6 16 6 7 13 6 8-10-watt A.C./D.C. ... 11 11 7 9 0 10-watt A.C. ... 7 19 8 9 0 Black Crackle Steel Cabinet, 17/6 extra.*

**PREMIER BATTERY CHARGERS FOR A.C. MAINS**

*Westinghouse Rectification complete and ready for use To Charge: 6 volts a 1 amp. 22/6 2 volts a 1 amp. 11/9 12 volts a 1 amp. 24/6 6 volts a 2 amps. 6/2 6 volts a 2 amps. 37/6*

**REPLACEMENT VALVES**


**ANOTHER SPECIAL OFFER**


**PRIME PICK-UP HEADS**

*Will fit any tone-arm ... 7/6 Premier Pick-up with Volume Control ... 12/4 Premium Pick-up with Volume Control, all A.C., 24/6.*
9 REASONS WHICH PROVE
Ambassador is this year's radio!

- Six Valves (International Octal Base).
- Six Wave Bands 10 to 565 metres continuously.
- Push Pull Output—8 Watts.
- Large Energised Speaker.
- High L to C Ratio equivalent to the use of H.F. Amplification.
- Rotating Dial only. One Band visible at a time.
- Operates on either A.C. or D.C. Mains.
- Costs only £16 8s. 0d. including Tax.

GOOD as other Ambassadors have been, this new model beats them for tone, reception, soundness of design, and for a new low level price. For it's an out and out winner. Look at the abbreviated list of its features and look at its price...what greater value is there in Radio to-day? Yes, this is an Ambassador year. Please write for full details.

Ambassador
OUT VALUES THEM ALL

Write for details to the Manufacturers: R. N. FITTON LIMITED, BRIGHOUSE, YORKS, ENGLAND. Cable Export Enquiries to Ambassador, Brighouse, England.

---

M.R. SUPPLIES
announce a further selection of their bargains in High-class RADIO AND ELECTRICAL EQUIPMENT. As always, satisfaction is assured.

HIGH IMPEDANCE MOTORS, 15/50 v., A.C. operation. Fixed model imported from U.S.A.—Spindle 60 r.p.m., reversible, with automatic 5-pole make switch. High torque, suitable for many other purposes. 5/-.

PANEL METERS, of guaranteed accuracy, A.C. or D.C. 6½, flush panel mounted, finished black. Amps.: 0/10, 0/30, 0/100, 0/300, 1/600. Milliamperes: 50/6000, 10/300, etc. £3 9s. Volt : 0/10, 0/6. Get those good instruments while supplies are available!

PHOTO-ELECTRIC CELLS. Bond new, guaranteed, Citizen C.E.U. professional cells of standard rating, suitable for cameras, laboratories, etc. (those would now cost over £0. each to import). Each is 3/6.

ROTHERHAM-BRUSH D.104 MICROPHONE INSERT. The heart of the famous Colliery 104 Microphone only require housing, but can be used just as supplied. Very useful for the radio enthusiast. £3.6.6.

BRUSH PIEZO-CRYSTAL ELEMENTS. 2½in. dia., fitted stylium. For successful conversion of cards, phonograph gramophone, etc. £1.11.

L.T. RECEIVERS. Great news, supplies again in stock! Permanent metal type of both types. D.C. delivery 19/14 to 1½ up, 10/- Also Heavy Duty model, D.C. delivery 19/14. 2½ to 6 up, 20/-.

STEP-DOWN TRANSFORMERS, suitable for above rectifiers and for low-voltage heater lighting, etc. All types: 200/250 v., Secondary, 7½/15 v., 2 amp., 10/11. Sec. 22 v., 3 amp., 22½. Also special new model for use with above heavy duty rectifiers, tapped for 6 volt and 12 volt charging. 32½.

ELECTRO-MAGNETIC COUNTERS, various res. coil, mostly 500 ohms, counting up to 9999. 0/6.

MINIATURE P.M. COIL UNITS. £5 din. Imp. 12 sw. Perfect mini microphones or extension speakers, ideal for shelter or intercoms, free frequency response, high d-c nominals. 10/6.

MINIATURE Nickle ALLOY TRANSFORMERS to suit above units. £0.11.

MINI-DUAL MICROPHONE TRANSFORMERS (as reviewed in “W.W.” October). Tapped for mini or carbon mike, fully screened, first-class response, 19/6.

MAINS TRANSFORMERS (Good, Telephones, etc.). 200/250 v., Secondary, 300/0/300 v., 150 m.a. 5/3 v. 2 amp., 5/6 v. 3 amp., 10/-.

FLUID REBOSANTS, fully enclosed with bashed cable entries. Smooth action, very well made. 10 ohm 3 amp., 20 ohm 1 amp., 150 ohm 1 amp., 290 ohm 2 amp., and 400 ohm 7 amp., other 10/-.

ELECTRIC MOTORS (Asea and Century). 110 v., D.C., 1,500 r.p.m., one-quarter H.P., special offer to clear last few. 30/-6. Also small induction motors 1/30th H.P., 120/150 v., 2,200 r.p.m. Red-cast metal, 27/6. Also special high torque reduction gear motors, 200/250 v., A.C., geared to 6 or 3 r.p.m. (two models), either 25/-. Hoover, 1/6th H.P. 200/250 v., A.C., 1,450 r.p.m., 57/-6. Century, 1/4th H.P., 200/250 v., A.C., 1,400 r.p.m., 75/-, and others from time to time.

SMALL TAPPING MACHINES. Only a few of each, all perfect. Import 50 v., D.C., Output 200/250 v., A.C., 120 watts, 70/-6. Import 120/0/120 v., A.C., 150 watts, 87/10/6. Import 200/250 v., A.C., Output 200/250 v., A.C., 90 watts, with choke and filter, 90/-6.

AUTOMOTIVE VIBRATOR PACKS. Import 6 volt D.C., Output 215 to 1,000 v., D.C. 15/6.

ELECTRO-MAGNETIC COUNTERS, various res. coil, mostly 500 ohms, counting up to 9999, 5/6.

5-guinea D.104 Microphone, only requires housing, but can be used just as supplied. Very useful for the radio enthusiast. £3.6.6.

LARGE ELECTRIC WALL CLOCKS. Great opportunity for factories, offices, hotels, etc. Siemens finest models at bargain prices. 10½in. dia., chromium, with matt silvered dial, black numerals, 45/-; 13½in. dia., chromium, as above, 65/-; also new 21½in. model silvered in ivory or brass-bronze, white dial with black chapter, handsome modern clock, 45/-; Part packing and carriage 1½ an extra in each case. IMPORTANT—Please note that all above have central second hand and mouthed second minutes, making them ideal for lab. work.

MINIATURE FUEL-BUTTON SWITCHES, complete 2-pol., 2.5 v., £.1; 5 v., £.3.5; 9 v., £.6.5.

MINIATURE THERMOSTATS. 3½in. dia., fully adjustable, £1.11.

MINIATURE FUSE-BLICKER (as reviewed in “W.W.”). 3½in. dia., with non-penetrating base connections British and American Valves. £1.11.

MINIATURE P.M. COIL UNITS. £5 din. Imp. 12 sw. Perfect mini microphones or extension speakers, ideal for shelter or intercoms, free frequency response, high d-c nominals. 10/6.

TAPED FOR MI-SPHERE ELEMENTS. Tapped for m/coil or carbon mike, fully screened, finest response, 19/6.

5½in. dia., 200/250 v., A.C., geared to 6 or 3 r.p.m. (two models), either 25/-. Stirling, ⅛th H.P. 200/250 v., A.C., 1,450 r.p.m., 57/-6. Century, ¼th H.P., 200/250 v., A.C., 1,400 r.p.m., 75/-, and others from time to time.

TAPPED FOR MI-SPHERE ELEMENTS. Tapped for m/coil or carbon mike, fully screened, finest response, 19/6.

ELECTRIC TRANSFORMERS, direct from the Publishers for 1941. Size 3½ by 2½ inches, 192 pages. Bound leather cloth, back loop with承认.

PRICE 2/- net

By post, including purchase tax, 2/7

From bookstalls and stationers or direct from the Publishers

---

Wireless World

DECEMBER, 1940
LOW LOSS • HIGH SURFACE RESISTIVITY • COMPLETE STABILITY • These outstanding properties of “Frequentite” have led to its adoption by all leading radio manufacturers. “Frequentite” is suitable for every type of component however intricate the design. Full details will be sent on application—ask for Catalogue S.P.10.

STEATITE & PORCELAIN PRODUCTS LTD.

Head Office and Works:

Telephone: STOURPORT 333
STOURPORT-ON-SEVERN, WORCS.

Telegram: STEATAIN, STOURPORT.
Presenting—the EDDYSTONE 358 COMMUNICATION RECEIVER

Attention is drawn to a new "EDDYSTONE" Production—the 358 Communication Receiver—a first-class engineering job embodying all essential features of a dependable Communication Receiver.

Based on proved design the 358 gives a high performance and its reliability is calculated to meet the exacting requirements of Service operation. It is eminently suitable for every general communication purpose and is the product of engineers with wide practical experience of communication work.

The 358 is the progressive development of previous well-known "EDDYSTONE" Receivers—it is designed to do a particular job of work—and to do it consistently well. When absolute reliability and outstanding performance are demanded the "EDDYSTONE" 358 will be found most fitting to the need—a fact given emphatic point by the orders already placed by Government Departments.

SPECIFICATION

Tuning range of 31,000 Kcs to 1,250 Kcs by the use of interchangeable range units. (Additional coil units will shortly be available to extend the range to 100 Kcs.) Power supply—A.C. mains (200-250 volts) for which a power unit giving 6 volts 1.4 amperes and 175-180 volts 65 mA. is provided. (Later it is hoped to offer the 358 to work from a 6 volt accumulator input.) Chasis of unit construction permitting ease of service. Housed in welded steel cabinet, rippled grey finish. Dimensions: 20 in. by 12 in. by 13 in. deep. Weight: 50 lbs. Selectivity: I.F. total bandwidth: Two kilocycles at 2.5 db. down. Ten kilocycles at 40 db. down. Sensitivity: Better than 3 microvolts: 30 per cent. modulation for 50 milliwatts output on all ranges. Audio Output: 1.5 watts.

<table>
<thead>
<tr>
<th>Image Ratio</th>
<th>At 30 megacycles</th>
<th>12</th>
<th>19</th>
<th>4.5</th>
<th>3</th>
<th>2</th>
<th>1.6</th>
<th>1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Ranges of Coil Units are:</td>
<td>20</td>
<td>100</td>
<td>210 (Range &quot;B.&quot;)</td>
<td>400</td>
<td>500</td>
<td>1,500 (Range &quot;D.&quot;)</td>
<td>8,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Range A</td>
<td>31,000—20,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range B</td>
<td>22,000—11,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range C</td>
<td>9,000—4,500</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range D</td>
<td>4,500—2,100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range E</td>
<td>2,100—1,200</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Output Circuit incorporates twin jacks for 120 ohm or 2,000 ohm Headphones. (Other impedances can be fitted to order.) To simplify maintenance a meter and test switch is fitted by which the emission of each valve can be checked while in position.

ENQUIRIES ARE INVITED FROM GOVERNMENT DEPARTMENTS AND ALL UNDERTAKINGS OR PERSONS ENGAGED ON WORK OF NATIONAL IMPORTANCE.

STRAWTION & CO. LTD.
BROMSGROVE STREET, BIRMINGHAM.

TELEPHONE: MIDLAND 3771.
TELEGRAMS: "STRATNOID," BIRMINGHAM
DECEMBER, 1940

Contents

EDITORIAL ........................................... 481
TESTING ELECTROLYTICS. By F. A. Boyer, B.Sc. .......... 482
SHORT-WAVE RECEIVING CONDITIONS .................. 484
ERRORS IN TRACKING. By W. Winder .................... 485
ATTENUATOR DESIGN. By S. S. West and E. D. McConnell . 487
TONE CONTROL. By E. O. Powell ........................ 491
PREMIER SHORT-WAVE S.G.3; Test Report ............... 492
RECEIVERS FOR FM TRANSMISSIONS ....................... 494
CURRENT TOPICS ..................................... 497
NEWS IN ENGLISH FROM ABROAD ......................... 500
COMPRESSED DIPOLES (Concluded) By E. L. Gardiner, B.Sc 501
LAMP CONTRAST EXPANDER. By S. W. Amos, B.Sc. (Hons.) 504
RANDOM RADIATIONS. By "Diallist" ......................... 505
UNBIASED. By Free Grid ................................ 508
RECENT INVENTIONS .................................... 509

WORLD CONTACT WITH A TROPHY

IN THESE HISTORIC TIMES WORLD LISTENING PROVIDES A NEVER ENDING SOURCE OF INTEREST AND ENTERTAINMENT.

THE TROPHY IS SPECIALY DESIGNED FOR ALL-WORLD RECEPTION

TROPHY 6 Valve incorporating all latest improvements. 6.5 to 545 metres. Built-in Speaker, A.C.
£11.11.0 or 45/- deposit and 34/- monthly

TROPHY 8 Valve A.C. A super communication receiver with amazing range. 7 to 550 metres.
£14.19.6 or £3 Deposit and 44/- monthly

PETO SCOTT CO. LTD. Showrooms at 77 CITY ROAD E.C.1. SEND FOR FULL SPECIFICATION.
During the war all the aluminium that we use must go into the apparatus that we make for the Services. There is none to spare for ganged tuning condensers, and if we are to carry on making radio sets to bring news and entertainment to the people, we must find a satisfactory substitute. Sheet zinc has been chosen for this purpose, and you may be interested, as we were, to discover that the zinc has some advantages over the aluminium it replaces.

When condenser vanes are pressed from sheet aluminium, the metal suffers a shearing action and the vanes produced are in a state of strain because the structure of the metal has been distorted. To relieve this strain it is necessary to anneal the vanes by clamping them together in large numbers between heavy metal plates to keep them flat, and heating them in a muffle furnace to a temperature between 300 and 350 degrees Centigrade. The vanes are then flat and strain-free. When these strain-free vanes are pressed into the rotor shaft or bonded together to form a stator, or when the condenser is matched to the standard law by adjusting the split end-vanes, strain is again set up by the bending and pressing of the metal. The vanes slowly relieve a part of this strain by small movements and changes of shape, so that some drift in the capacity of the condenser occurs, leading to small errors of ganging and of calibration.

Zinc has the valuable property that strain within the metal is easily and very quickly relieved at ordinary room temperature, so that the condenser vanes do not need annealing and there is very little tendency for them to creep after they have been pressed or bent. The zinc vane condenser keeps nearer to its initial adjustment.

It does seem that aluminium, although normally cheaper, lighter and somewhat easier to handle, may not have been the very last word in materials for condenser vanes, and that we have here a substitute with its own special merits—a substitute that we may well go on using after the war.
Exports: The Co-operative Effort

FOR many years it has been a standing reproach to the British wireless industry that, with one or two notable exceptions, the export of broadcast receivers has not been taken seriously. True, many manufacturers half-heartedly produced a so-called "export model," generally differing only from the home receivers in that it covered an extra short-wave band in place of the long waves, and had what was fondly believed to be a "tropical finish"—for some unknown reason all inhabitants of "foreign parts" were assumed to enjoy a tropical climate. Few determined efforts were made to ascertain and satisfy the diverse requirements of buyers in different overseas markets.

All that is now being changed, and for the solid results that have already been achieved we have largely to thank the co-operation between manufacturers brought about by the efforts of the Radio Manufacturers’ War Export Group, an offspring of the R.M.A. which enjoys the active support of the Board of Trade. Some overseas markets have been lost as a result of the war, but British firms are now energetically cultivating others in which they enjoy the advantage of being relieved, thanks to our blockade, of competition from enemy countries.

Writing in The Wireless World for July on the means whereby the British wireless industry could make its fullest contribution to the war effort, we urged "closer collaboration between all branches of the industry than anything it has known before . . . almost inevitably, a measure of sacrifice on the part of some of the interests concerned would clearly be necessary . . . team work is needed, and wasteful competition between ourselves is a luxury for which we must wait until peace returns."

It would seem that the present activities of the Export Group organisation go a long way towards giving effect to the ideas expressed in the sentences we have quoted; not only is there cooperation in the commercial sphere, but there is an interchange of technical information.

As a result, British firms are turning out some very fine receivers for various overseas markets. Not only has general design been improved, but there is greater attention to detail. Rightly, we are giving of our best to export needs, and the home market takes second place.

Pooled Service Organisations?

It is to be hoped that those principles of cooperation which are being employed in the production of British receivers for export will be applied to organising schemes for servicing and the supply of spare parts in those countries where a footing has been gained. We are well aware that one or two of the larger manufacturers have already built up in many countries an adequate organisation for dealing with these matters in so far as their own products are affected. But servicing is always a big problem to the smaller exporters, and especially to newcomers in the field, who can hardly afford to maintain efficient service depots abroad; they must, therefore, depend almost entirely on local firms. Unfortunately, British sets will tend to lose some of their attractiveness to the more cautious type of overseas buyer unless he is satisfied that there exists a good service for their upkeep. Even the supply of spare valves needs some organisation, as, according to an official statement, the principle of basing export receiver designs on British, rather than on International, types is to be followed.

DECEMBER, 1940.
There are several methods of measuring the leakage current in electrolytic condensers. In essentials it is only necessary to place a milliammeter in series with the condenser and the correct polarising voltage, but such a method may cause damage to the milliammeter if used by unskilled operators for rapid testing. The leakage current is of the order of ½ millamp. for a high voltage smoothing condenser of, say, 8 microfarads. If the condenser has not been used for some time the leakage current may be 20 milliamps on switching on, falling to a lower figure rapidly. On the other hand, the current may be several hundred milliamps for a faulty condenser, and as the test is intended to find faulty condensers, it is essential to be able to deal with currents from several hundred milliamps down to a half-milliamp without fear of damaging the apparatus, and also to be able to obtain fairly accurate readings around the lower current value. If, for example, a 0-2 milliammeter is used it is generally shunted by a

\[
I_3 = I_1 + I_2
\]

Fig. 1. The basic circuit, with slider of potentiometer R1 at zero. Current I3 flowing in part of R2 produces a bias voltage.

push-button so that it is only placed in circuit after the leakage has become normal. It is necessary to have a short-circuit test first, but even then the current may be sufficiently high to damage the meter. There are two other methods in general use. One is to use a voltmeter across the condenser, which is placed in series with a resistance and the polarising voltage. The greater the leakage the less is the voltage read on the voltmeter. This method is quite safe, but a direct reading is not obtained. Moreover, a multirange meter is required to give readings for different polarising voltages.

A third method is to use a neon lamp. Here we only get a visual indication which is only useful for a rough check.

**Accurate Checks**

The instrument to be described overcomes all these disadvantages. It can be subjected to a dead short without fear of damage. Accurate readings can be obtained between 0.5 and 30 milliamps. It is extremely rapid in use and any condenser can be checked in a few seconds. The reforming action can be followed visually, giving an indication of the state of the condenser. The polarising voltage can be changed to any values required, or could be made continuously variable. It is extremely cheap to build as it does not employ either a voltmeter or a milliammeter.

The basis of the design is a cathode-ray tuning indicator, with which the angle of the fluorescent light varies with the voltage on the triode grid. An Osram Y64 was the actual valve used. The principle employed is to cause the leakage current to change the grid voltage, and then by means of a calibrated potentiometer to back this voltage off to its original value, which is determined by obtaining the same angle of light as initially. Fig. 1 shows how this is done. R1 and R2 are both wire-wound potentiometers, while R1 and R2 in series with R2 provide a fixed potentiometer circuit to give 130 volts for operation of the tuning indicator and also to provide a load for the power supply. With the negative power lead connected at point C, the junction between R1 and R2, the upper portion of R2 carries the combined currents of the fixed potentiometer plus the valve. The voltage developed across this upper portion appears as a negative bias on the grid, so by varying the slider connected to the cathode we can vary the grid bias and hence the angle of the light. About 6 volts will close the angle.

Now turn to Fig 2. The negative power lead is connected to the slider of R1, and the load whose leakage we wish to measure is connected across A and B. The leakage current we wish to find now flows through the upper portion of R1, developing a voltage across it which changes the grid to a more positive
Testing Electrolytics—

As the slider is moved nearer to the grid this voltage becomes smaller and at the same time the cathode bias is increased, so that a point of balance can be reached where the voltages are equal and balance out, and the angular deflection returns to its original position.

The position of the slider of R1 can be calculated simply. If we call the leakage current I_L and the current in R2 I_3, and let the resistances of the upper and lower portions of R1 be R_{11} and R_{22} respectively, the voltage developed on the grid is I_L \times R_{11} and the extra voltage introduced into the cathode circuit is I_3 \times R_{22}. To return the grid voltage to its original value, we make I_L \times R_{11} = I_3 \times R_{22}, so we get that I_L = K \times \frac{R_{22}}{R_{11}}. Thus, the instrument could be calibrated in terms of the resistance of R_{11} for different slider settings, and knowing I_3, which is constant, the readings can be given in milliamps. In practice, it is much simpler to calibrate directly against a milliammeter.

Details of Design

A practical circuit with resistance values is given in Fig. 3. The values of polarising voltage required were 400, 30 and 20, which are those most commonly met. Any other voltage can be obtained by suitably tapping one of the two potentiometers, and knowing I_3, which is constant, the readings can be given in milliamps. In practice, it was found that using commercial resistances the values given were sufficiently accurate.

Some details of the circuit may require further elucidation. Two potentiometers are used, for two reasons. Firstly, a constant load is placed on the rectifier to prevent the voltage rising for small or no leakage currents, and secondly, if the taps were sufficiently accurate. Two potentiometers are used, for two reasons. Firstly, a constant load is placed on the rectifier to prevent the voltage rising for small or no leakage currents, and secondly, if the taps were sufficiently accurate.

In either case, the polarising voltage can be obtained by suitably tapping one of the two potentiometers.

For the low voltages are taken off the R2 potentiometer, a heavy leakage current will alter the anode voltage on the indicator. A number of one-watt resistances are used instead of a few higher wattage resistances. The one-watt resistances are standard items readily available, so it is a cheap arrangement. All the resistances are working well within their capacity, so that they should have a long life without deterioration, and, moreover, as they are all about the same value and size, any deterioration should affect them all equally, so the voltages will remain constant.

Points such as these are important to ensure some years of trouble-free operation.

In the 400-volt positive side is included a flashlamp bulb consuming 150 milliamps to act as an indicator of a dead short. A resistance of 3,000 ohms is included to limit this current to 150 milliamps. This is a useful refinement for rapid testing. Although the resistance will not be able to carry a constant load of 0.15 amp., it will be able to carry this for the time required to see that the condenser is faulty, and to disconnect it.

A switch is used to select the polarising voltage instead of having three different input terminals in order to use an on-off switch across the input terminals. With this switch in the "on" position the condenser is connected to 400, 30 or 20 volts as selected. In the "off" position the condenser is disconnected and discharged through a 10,000-ohm resistance, thus removing the danger of leaving the condenser charged or of obtaining a shock from the live terminal.

Calibration and Operation

Resistances R1 and R2 are both wire-wound potentiometers. R1 is fitted with a mains switch for foolproof working so that for calibration no leakage current flows, even though a condenser is left connected. R2 has a small knob marked CALIBRATE, while R1 is fitted with a large scale for calibration. When the slider of R1 is at the end connected to R2, the mains switch operates, and this point is marked OFF.

To obtain readings easily even in a bright light, the tuning indicator was placed inside a metal cylinder of the same diameter as the bulb, and which projected about three inches above the top of the bulb. It was painted dull black to stop reflected light getting on to the glass. The position for calibration, when the angle of light was just closing, was marked by pasting two pieces of black cotton on to the glass.

To operate the instrument, R1 is set to OFF and R2 is adjusted to set the light angle to the reference mark. After selecting the correct polarising voltage the condenser is switched on and R1 is adjusted to bring the light angle back to the reference mark. The leakage current is then read directly from the scale of R1. After the first setting, R2 need not be touched until the whole series of readings is completed, although it may be advisable to check every half-hour. The initial calibration can be done in a few minutes by placing a variable resistance in series with a milliammeter in place of the condenser, when the current can be varied and

---

Wireless World

DECEMBER, 1940

484
Testing Electrolytics—
the milliammeter readings can be marked by hand on the scale.

A note about the power supply. As only a small current is used, it was found that an ordinary receiver transformer gave sufficient volts, owing to its poor regulation and a smaller voltage drop in smoothing. Transformers giving 350—450 under load are quite common and cheap. The smoothing condensers must be at least 500-volt peak working.

Finally, the whole of the apparatus was mounted in a wooden box measuring 9in. by 6in. by 5in. high, making a compact and convenient unit that could be carried to any part of the workroom to test condensers without having to remove them from any of their associated equipment.

Short-wave Receiving Conditions

PROSPECTS FOR DECEMBER

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

In general, short-wave reception during October was slightly less favourable than during September.

Ionosphere storm conditions were reported to be in evidence on October 1st, 7th, 8th, 21st, 22nd, 25th and 26th. These conditions brought about relatively poor reception during the earlier and latter part of the month, in contrast to the more settled conditions which were associated with the period covered by the maximum number of consecutive "quiet" days, i.e., from October 9th to 20th, inclusive.

Readers may recall the fact that, in reviewing reception for the month of August in a previous issue of this journal, it was stated that the first and last few days of October might prove to be less settled than the middle of the month.1

Sudden ionosphere disturbances of the "Dellinger" type were not observed during the month.

Particulars of the broadcast bands which, it is considered, should prove most reliable during December 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.

(The times given in this report are G.M.T. on the 24-hour clock notation.)

Tokyo: Midt, 31 m; 0600, 19 or 25 m; 0900, 16 or 19 m; 1200, 19 or 25 m; 1500, 25 or 31 m; 1800, 31 or 41 m; 2100, 41 or 49 m.

At the Winter Solstice the sun has already set at Tokyo at the time of sunrise at London and in consequence the period of utility of the higher frequencies is considerably reduced compared with that prevailing during the summer months. The period from midnight to 0600 is likely to present the greatest difficulties.

"Echo" signals may be audible on occasions from one to two hours before to one or two hours after 0600.

Melbourne : 0800, 25 or 31 m (Westward); 1000, 19 or 25 m (Westward, via Pacific); 1200, 16 or 19 m (Eastward, via Calcutta); 1500, 19 or 25 m (Eastward); 1800, 25 or 31 m (Eastward).

It is considered to be extremely improbable that signals will be audible for any appreciable length of time between 2300 and 0500 on account of the high attenuation encountered at Melbourne; this factor, which imposes a definite limit on the number of hours for which reliable reception may be anticipated, probably attains its maximum value for the year at about 0200 daily during the month of December.

Montreal : Midt, 31, 41 or 49 m; 0900, 41 or 49 m; 1000, 25 or 31 m; 1400, 13, 16 or 19 m; 1700, 19 or 25 m; 2000, 25 or 31 m.

Bombay : Midt, 31, 41 or 49 m; 0900, 41 or 49 m; 0600, 25 or 31 m; 0800, 16 or 19 m; 1100, 13 or 16 m; 1400, 16 or 19 m; 1800, 25 or 31 m; 2100, 31 or 41 m.

Capetown: Midt, 31 or 41 m; 0900, 41 or 49 m; 0900, 25 or 31 m; 0900, 16 or 19 m; 1200, 13 or 16 m; 1500, 16 m; 1800, 19 or 25 m; 2100, 25 or 31 m.

In winter, whilst the frequency of atmospherics is generally considerably less than in summer, the instantaneous effect of such disturbances as may occur may sometimes be almost as great; for, although the source of disturbance with respect to this country may be somewhat more distant in winter, the consequent tendency for reduced intensity may be offset by the decrease in attenuation exhibited at this season. On certain relatively long routes this effect may be particularly in evidence at mid-day or early afternoon in those cases where the field strength of the distant signal at this time of day is not appreciably different in summer and winter.

At the time of writing this report, which is necessarily prepared some time before publication, it would seem to be not unlikely that relatively adverse conditions may be experienced during the middle and latter part of the month.

"RADIO DESIGNER'S HANDBOOK" A Comprehensive Manual for Radio Engineers and Experimenters

The publication of this handbook is an event which we have more than usual pleasure in announcing, for we feel that it is exactly what the radio set designer and experimenter has been wanting for some time, namely, a comprehensive collection of all the principal formulae involved in the design of receivers and components.

The book is divided into eight parts: (1) Audio Frequencies, (2) Radio Frequencies, (3) Rectification, Filtering and Hum, (4) Receiver Components, (5) Tests and Measurements, (6) Valve Characteristics, (7) General Theory, (8) Sundry Data. In addition to the formula themselves there are full explanations of their application, and each chapter concludes with a bibliography of the literature of the subject. It is, in fact, more than a mere reference book, and when used in conjunction with the "Wireless Servicing Manual" and the "Radio Laboratory Handbook," will lay the foundations of a liberal wireless education.

There are chapters on wireless mathematics, including vectors, simple trigonometry and the use of "j" in complex algebra, while the Sundry Data section contains, in addition to the usual wire tables, colour codes, etc., such elusive information as the frequency relations of the musical scale and the visibility curves of the human eye.

The handbook, which is edited by F. Langford Smith, B.Sc., A.M.I.E.E., should be available from our Publishing Department when this notice appears in print. The price, bound in cloth, will be 7s. 6d., or 8s. 1d. by post.
Errors in Tracking—And How To Reduce Them

This article explains the nature of circuit misalignment in superheterodynes, and—an important matter in these days when help from servicemen is hard to obtain—shows how errors may be cured without elaborate equipment.

The methods of ganging a superheterodyne are well known, but what is not so universally appreciated is the possibility of errors at points other than the trimming and padding points. In a well-built set these defects should not develop to any extent, but where coils are not perfectly matched it is easy for the circuits to get out of step. It is the purpose of this short article to show how tracking errors can be tackled by purely empirical means which, after all, are the only ones available to many readers.

If one trims and pads correctly, there are two points on the dial at which the set is properly lined up, but at an intermediate tuning point it is often found that twiddling the RF trimmers can bring about some appreciable improvement in the received signal. This means a tracking error—the oscillator and RF circuits are getting out of step with each other as the tuning knob is turned. If the IF coils are correctly tuned to their proper frequency, the cause of the trouble is usually that the oscillator coil is of the wrong inductance value to go with the others. If such is the case, fortunately something can be done about it.

To begin with, in these days of all-wave sets gang condensers with specially shaped oscillator vanes are almost museum pieces, and it is fair to assume that tracking is now always obtained by means of a padding condenser, as in Fig. 1(a). The actual circuit, however, is more truly represented by Fig. 1(b). Condenser X consists of the self-capacity of the coil plus the capacity of the associated wiring, say, about 15 m-mfds. Condenser Y is made up of the residual capacity of the gang condenser section when fully opened and of valve and wiring capacities, amounting in a practical case to, say, 30 m-mfds. In addition, there is a semi-variable trimmer which can add capacity either to X or to Y. In some cases the trimmer is wired straight across the coil and is therefore outside the influence of the padding condenser, and in others it forms part of the gang condenser assembly and is placed at Y. Although it is not generally realised, the choice of trimmer position has a distinct effect on tracking errors. Calculations were made, using coils which were known to produce tracking errors, and the curves of Fig. 2 drawn to show the amount of those errors for the alternative trimmer positions. From these it must not be assumed that B is always the better position for the trimmer. If the tracking error is of the opposite sign to begin with, changing the trimmer from A to B would merely aggravate the trouble. (See Fig. 3.)

Figs. 2, 3 and 4 show the whole story. A fixed RF inductance has been assumed for all cases, and the curves show the effect on tracking errors of varying oscillator inductance and trimming position. Incidentally, curve A on Fig. 3 is approaching the ideal, having three positions of zero error, and errors elsewhere being small.

Nature of Errors

Just a word about positive and negative tracking errors. It should be realised that when a superheterodyne is tuned in to any station the oscillator circuit automatically gets its correct setting. The RF signals dealt with by the set will be of a frequency calculated by subtracting the IF from the oscillator frequency, and this will differ from the actual setting of the RF circuits by whatever tracking error exists. Let us say that the RF circuits are tuned to f1 and that the oscillator frequency minus the IF is f2. If f1 is greater than f2 we will call the tracking error positive, and if less than f2, negative. Obviously, some such convention must be assumed.
Errors in Tracking—

The lessons of the above curves are that a positive tracking error can be corrected by (a) bringing part or the whole of the trimming capacity under the influence of the padding condenser, or (b) decreasing oscillator inductance. A negative error will, of course, need reverse treatment—that is, the trimming capacity will need to be placed partly or wholly across the coil direct, or oscillator inductance will need increasing.

A third method of treating tracking errors is to alter the IF tuning, but this is not to be recommended. Besides being relatively inefficient compared with the other treatments it has the disadvantage of upsetting ganging on other wavebands. However, for the sake of completeness, the reader may like to know that tuning the IF coils to a higher frequency will produce a positive tracking error, and to a lower frequency a negative error.

Procedure

The reader should now be in a position to set about achieving a high standard of alignment in his own set, but those who prefer rule-of-thumb instructions may be guided by the following. First of all make sure that the IF circuits are tuned to their correct frequency. Then proceed to trim and pad in the usual way, thus ensuring that the circuits are properly aligned at one point towards the bottom of the dial and at one point towards the top. Mark the setting of the RF trimmers. Now tune the set to a signal at an intermediate position of the dial, and then proceed with cure A. If at one intermediate position the RF trimmers need screwing in very slightly and at another unscrewing slightly, then the ganging is somewhere near its best.

 Cure A.—Put the oscillator trimmer across the appropriate section of the gang condenser instead of directly across the coil. If this only partially cures the trouble, or if the trimmer is already across the gang condenser, then it is necessary to make the oscillator coil smaller. If plenty of oscillator volts are available for frequency changing, the easiest way of reducing coil inductance is to fix a brass disc over the end of the coil, and to adjust its distance until the right position is found. If the valve is not oscillating very strongly to start with, it would be better to take off turns from the coil in order to reduce its inductance. The disc method increases HF resistance, and therefore introduces losses. After a small reduction in inductance the set should be re-trimmed and re-padded, and the new RF trimmer position should be marked. If the tracking error still persists, and if it is such that the RF circuits still need more capacity to bring them into line, a further reduction of the oscillator coil is called for. And so on, but after reganging, should the RF circuits need less capacity at the intermediate positions, then the cure has been taken too far.

 Cure B is just the opposite of Cure A. The first step is to see that the trimmer is directly across the oscillator coil. If more drastic treatment is necessary after this, then turns must be added to the oscillator coil (tuned winding). The actual number of such turns must be found by trial and error, but in a normal case only slight alterations will be necessary, say, one or two turns for a medium-wave coil.

Needless to say, no one should attempt any coil alterations unless they are sure what they are doing—otherwise their last state will be considerably worse than their first.
Attenuator Design

CALCULATING RESISTANCE VALUES FOR FIXED AND VARIABLE NETWORKS

By S. S. West and E. D. McConnell
(Baird Television, Ltd.)

When a potentiometer is being used as a gain control it is preferable that it should be logarithmically graded, as this provides a fixed ratio of attenuation which is simply converted to decibels.

To determine the values of Ro, R1, R2, etc., for a logarithmic potential divider as represented in Fig. 2 is quite simple, but is not readily shown with simple formulae. However, for those readers desiring to derive accurately the required values, a suitable formula is provided below.

\[ R_n = \frac{R}{\text{antilog}\left(\frac{Nn}{20}\right)} - \frac{R}{\text{antilog}\left(\frac{N(n + 1)}{20}\right)} \]

Where \( R_n \) denotes the value of the resistance \( n \) steps down the potentiometer, \( N \) is the number of decibels per step and \( R \) is the total resistance of the potentiometer. For the first step obviously \( R_0 \) becomes \( R \), here the numerical value of \( n \) is 0, for the second step \( R_1 \) becomes \( R \), so that the term \( Nw \) in the equation is, for the first step, \( N \) times 0 and for the second step is \( N \) times 1, and so on.

DECEMBER, 1940.
Attenuator Design

A little consideration shows that the value of the final resistance $R_f$, which is simply an "on-off" step and not therefore a real part of the attenuator, is given

$$ R_f = \frac{R_n}{\text{antilog} \frac{N}{20} - 1} $$

The value of $R_f$ can also be found by summing all the remaining elements and subtracting this total from the value of $R$. Whilst this method ensures absolute accuracy, it is felt that it may prove to be somewhat unwieldy in application. Accordingly the simpler method, provided by the graph, Fig. 3, is included.

It is also of interest to note that this graph will provide a ready means for converting voltage and current ratios into decibels.

The following example will indicate the procedure involved.

1. Assign a suitable value to $R$ which satisfies the circuit conditions. For example, let $R = 1,000$ ohms.
2. Decide the attenuation, say, 6 db. per step.
3. From the graph it is seen that 6 db. corresponds to a ratio of approximately 2 : 1, thus the first resistance

in the potentiometer, i.e., $R_0$ (see Fig. 2), is equal to $R - R/x$ where $x$ is the ratio given by the graph. In this case it is 2. $R_0$ is thus 1000 - 1000/2 = 500 ohms.

For the value of the second resistance $R_1$, the $R$ term in the equation naturally becomes $R - R_0$, that is $1000 - 500 = 500$ ohms. Thus $R_1 = 500 - 500/2 = 250$ ohms. Similarly for $R_2$ the $R$ term in the equation becomes $R - R_0 - R_1$ and for $R_3$ the $R$ term is $R - R_0 - R_1 - R_2$, and so on.

Consider the circuit diagram, Fig. 4, where we have a generator of impedance $Z_0$ feeding into a load $Z_L$ and assume that $Z_S = Z_L$, as is the case in most transmission line applications. Assume now that it is required to vary the potential across $Z_L$ without affecting the impedance match. It is apparent that an attenuator matching both the generator and load is entailed. The “T” type of attenuator depicted in Fig. 5 will fulfill these conditions.

Formulate for deriving suitable values is given here.

$$ R_1 = Z_0 \left(\frac{n - 1}{n + 1}\right) $$

$$ R_2 = 2Z_0 \frac{n - 1}{n} $$

Where $Z_0$ is the characteristic impedance and $n$ is the attenuation, i.e., the ratio of $E_2/E_3$.

It is of interest to note that these formulae are derived in the following manner, which is given in some detail as the method of derivation is conveniently applied to certain other types of symmetrical attenuators.

Fig. 5. “T”-type attenuator

If the series and parallel combination of resistances within the dotted frame, in Fig. 5, be assigned a value $A$, then, in order to obtain the required matching conditions, obviously $R_1 + A = Z_0$ or $A = Z_0 - R_1$.

$$ E_2 = \frac{E_1}{R_1 + A} \quad \text{and} \quad E_3 = E_2 \left(\frac{Z_0 - R_1}{Z_0}\right) $$

Substituting

(1) in (2) $E_3 = E_1 \left(\frac{Z_0 - R_1}{Z_0}\right) \left(\frac{Z_0}{Z_0 + R_1}\right) = E_1 \left(\frac{Z_0 - R_1}{Z_0 + R_1}\right)$

Therefore

$$ n = \frac{Z_0 - R_1}{Z_0 + R_1} $$

Similarly, by substituting this value for $R_1$ in the equation for the complete network, it can be shown that

$$ R_2 = 2Z_0 \frac{n - 1}{n} $$

The graph, Fig. 3, can again be used to obtain the ratio “$n$” in terms of decibels.

In Fig. 6 is depicted a “π” type attenuator. It has similar characteristics to the “T” type but, due to the
Attenuator Design—

high values which must be assigned to \( R_1 \) when high attenuation ratios are required, this type is unsuitable for radio-frequency purposes. However, as the value of \( R_2 \) in the “ T ” type becomes increasingly low for high attenuation ratios, some alternative arrangement is generally necessary. In this event probably the simplest plan is to employ one or more series-connected pads, as the following example will show.

Supposing we require an attenuation ratio, \( n \), of 100 with a characteristic impedance of 80 ohms. A single pad would have the values shown in Fig. 7 (a) and the difficulty of obtaining the low value of 1.6 ohms is not the least of the disadvantages of this arrangement. If two series-connected pads are employed \( n = \sqrt{100} = 10 \) and \( R_1 = 65.5 \) ohms, \( R_2 = 16.2 \) ohms. For three pads \( n = 3\sqrt{100} = 4.64 \) and \( R_1 = 51.6 \) ohms, \( R_2 = 36.2 \) ohms. These values are much more manageable in practice.

The formulas for the “ n ” type attenuator is as follows:

\[
R_2 = Zo\left(\frac{n+1}{n-1}\right) \text{ and } R_1 = \frac{Zo}{n+1}
\]

These formulae are derived in the following manner and are referred to Fig. 6.

The matching requirements state that

\[
\frac{I}{R_2} + \frac{I}{A} = \frac{I}{Zo}, \text{ therefore } \frac{I}{A} = \frac{I}{Zo} - \frac{I}{R_2}
\]

where \( A \) is the effective value of the series-parallel combination of resistances within the dotted frame.

The current

\[
I_1 = \frac{E_1}{A}, \text{ therefore } E_2 = I_1\left(\frac{R_2Zo}{R_2 + Zo}\right)
\]

Substituting for \( \frac{I}{A} \), \( E_2 = I_1\left(\frac{R_2Zo}{Zo} - \frac{R_2}{R_2 + Zo}\right) \)

Therefore \( \frac{I}{n} = \frac{R_2-Zo}{R_2+Zo} \) and \( R_2 = Zo\left(\frac{n+1}{n-1}\right) \)

\( R_1 \) is then derived by substituting this value for \( R_2 \) in the general equation for the network.

Symmetrical pads for employment with balanced lines have values derived from the basic formulae already given. However, the series elements, namely, \( R_1 \), become \( R_1/2 \) in each side of the line. (See Fig. 8.)

In its simplest form an attenuator with matched input and output can be arranged as a number of pads. Each has the required degree of attenuation and each is switched into circuit independently. Fig. 9 depicts such an arrangement. Included in this figure are suitable component values for two types of attenuators, (a) being a 6-position aerial attenuator having a 75-ohm characteristic and providing 6 db. steps, and (b) being an audio-frequency attenuator providing 6 steps of 6 db. each and having a characteristic of 600 ohms.

In the case of (a) a drawing is included to indicate a convenient form of construction.

An attenuator constructed on these lines had an excellent degree of accuracy at a frequency of 45 Mc/s.

Fig. 10 depicts a continuously variable “ T ” type attenuator which can consist of three suitably graded rheostats or, perhaps preferably, three stud switches, which are ganged. Suitable values of components for this arrangement are readily obtained from the formulae already given. One point requires consideration when this arrangement is employed. It will be
Attenuator Design

apparent that for high attenuation ratios the fact that the switch resistance can become comparable with the
actual resistance element renders the design somewhat difficult when trying to cover a wide attenuation range.

A conventional method often adopted for attenuator switching, and one which many operators prefer, arranges for different degrees of attenuation to be obtained by switching into the circuit various combinations of pads, these being connected in various series arrangements by means of suitable individual switches.

Fig. 11 gives an example of this form of attenuator switching and includes suitable values for an attenuator having a 600-ohm characteristic and giving any attenuation between 1 and 40 decibels in 1 db. steps.

In quite a large number of cases it is permissible to employ an attenuator having constant impedance in one direction only. This, obviously, is the case when the attenuator is located between two impedances where one is high in value compared to the other, e.g., a low-impedance line feeding to the grid of an amplifying valve. (See Fig. 12.)

These attenuators also are frequently employed as an output control on signal generators. Such an arrangement, whilst not being perfect, is far preferable to the straightforward potentiometer.

In Fig. 13 is given the circuit and component values for an attenuator which is suitable for inclusion in most types of service signal generators. It should be noted that the main purpose of employing an "L" attenuator as a gain control preceding a valve circuit is that it is far simpler to design such a device as compared to the potentiometer type, for it is only required to determine values for one step, all the steps then have the same values.

The formulae for deriving the component values of the ladder attenuator of Fig. 12 are as follows:

$$ R_1 = Z_0 \left( \frac{r - 1}{n} \right) $$
$$ R_2 = \frac{Z_0}{n - 1} $$

where $Z_0$ is the characteristic impedance and $n$ is the ratio of the input and output voltages. $R_1$ is included in order to simulate the condition of an infinite number of repetitive steps, it is made equal in value to $Z_0$.

It is felt that the data given in the table will prove useful as it permits suitable values for an attenuator to be derived with the minimum of effort.

The data are calculated (slide rule accuracy) for an attenuator having an impedance characteristic $R_i$ of 1 ohm. It is only necessary to multiply the values given for $R_1$, $R_2$ by the required characteristic impedance of the attenuator contemplated.

![Fig. 11. Attenuator suitable for use with AF measuring gear.](image)

![Fig. 12. Typical ladder attenuator for use between low impedance line and high impedance valve input circuits.](image)

![Fig. 13. Suggested design for an attenuator for use with signal generators.](image)
Tone Control
PROPORTIONING THE RESISTANCE VALUES

Tone correction in AF amplifiers is usually brought about (a) by a variable impedance forming part of the anode load of a valve, or (b) by a potentiometer of which the input/output ratio is a function of the frequency. The second method is preferable, since then the load on the preceding valve need not be very small at some frequencies. The effect of the first method, however, always takes place to some extent, and causes difficulty when a pure resistance-capacity network, used as a potentiometer, is arranged to give a response increasing with the frequency in the higher parts of the range.

Fig. 1 shows a typical network set up for simultaneous bass and treble lift. The potentiometer (enclosed within the dotted frame) has a basic ratio $\frac{R_b}{R_b + R_p}$. Now $R_g$ cannot be increased indefinitely, and in order (i) that the potentiometer formed by $R_p$ and $R_g$ shall not attenuate the signal too much, and (ii) that $R_g$ shall not at any frequency exercise an appreciable shunting effect on $R_b + C_b$, $R_p$ and $R_b$ cannot be very great. $R_p$ is conveniently made about $2 \times 10^5$ ohms; for a possible maximum lift of 20 db., $R_b$ will then have to be about $3 \times 10^4$ ohms. The input impedance at high frequencies is only about $R_b$; $R_a$ is generally of about the same order, so that the amplification of the preceding valve is reduced considerably, opposing the pure resistance-capacity system overcome by connecting a resistance $R_n$ between the points A and B of Fig. 1. Fig. 2 shows the modified circuit; its input impedance can never be less than $\frac{R_p R_n}{R_p + R_n} + R_b$, which can easily be made greater than $R_a$. Fig. 3 shows the relation between the output and input voltages of the potentiometer, expressed in decibels with the latter voltage as reference level, and calculated for the case in which $R_p = 2 \times 10^5$; $R_b = 3 \times 10^4$; $C_t = 2 \times 10^{-4}\mu F$; $C_b = 2 \times 10^{-7}\mu F$, and $R_n$ (in the modified circuit) $= 5 \times 10^4\Omega$. Fig. 4 gives the corresponding impedances.

These results are borne out in practice. In an amplifier in which $V_1$ had to be of higher anode impedance ($25,000\Omega$) than is usually necessary, the following values were used: $R_p = 2 \times 10^5 \Omega$; $R_b = 3 \times 10^4 \Omega$; $C_t$ variable, $0 - 5 \times 10^{-4}\mu F$; $C_b$ variable by 5-way switch, 0.2, 0.1, 0.05, 0.02$\mu F$; $R_n = 10^3\Omega$. The inclusion of the tone control had no audible effect on the quality of reproduction and there was ample variation to compensate for scale distortion and losses in other parts of the apparatus.

By E. O. Powell

DECEMBER, 1940.
Many people who have hitherto been content with the programmes provided by medium and long wavelengths and whose sets cover only these two wavebands are enquiring how best they can obtain an introduction to the short waves where B.B.C. and other programmes are now being relayed with regularity, and where the possibilities of world-wide reception are greater.

The simplest method is, of course, a short-wave frequency-changer or converter unit, but there is much to be said for a separate receiver specifically designed for short-wave work. The Premier S.G.3 is of this type, and its frequency range is much wider than that of the average converter unit, so that it will continue to satisfy the novice's growing interest in short-wave matters. Coils for additional wavebands are readily added, and the receiver gives an excellent all-round performance.

Circuit.—Pentode valves are used in the RF and detector stages, and a tetrode in the output. The aerial and RF coupling coils are interchangeable as the same number of turns is used in primary and reaction circuits.

RF gain is controlled by simultaneous variation of the grid and screen voltages in the first valve and by shunting the aerial circuit. The latter, incidentally, may be used either with a dipole or a normal single-wire aerial and earth.

Tuned grid coupling follows the RF stage with a special short-wave choke, damped by a shunt resistance in the anode circuit. The coupling condenser is variable.

The detector anode circuit includes decoupling and reaction is controlled by a variable condenser which is so arranged that it serves as an RF by-pass which increases in efficiency as reaction is advanced. Additional RF filtering is provided in the AF coupling by a series resistance and a by-pass condenser across the grid leak.

The AF output is parallel fed and one socket is earthed so that either high-resistance phones or a loud speaker may be used. If a moving-coil unit is employed it should include a transformer with a ratio designed to present approximately 5,000 ohms to the output terminals.

Performance.—We were very much impressed with the general tractability of this set. The novice should have no difficulty in obtaining good results from the more powerful stations right from the start, and as his skill improves he will be able to appreciate the good points which enable the expert to tune in distant transmissions with ease and certainty.

Reaction is smooth at all frequencies and each waveband is covered with a very small prograssive increase of the reaction condenser setting from the high to the low frequency end of the scale. There was no trace of "blind spots" anywhere in the range of the set.
Premier Short-wave S.G.3

fact which may be attributed to the correct choice of circuit constants in the choke coupling between the RF and detector stages and proper control of stray RF currents.

The set is lively and there is no doubt that the RF valve makes an important contribution to the sensitivity as well as acting as a buffer to keep oscillation out of the aerial circuit. The aerial trimmer setting is sharp and the tuned circuits have good intrinsic selectivity. Compared with a superhet, however, in which there are at least four additional IF tuned circuits, the normal overall selectivity may not serve to separate adjacent stations, but much can be done to improve matters by reducing the RF coupling trimmer on the underside of the chassis, though this will cause some falling off in sensitivity. A compromise setting must be found to suit local conditions and individual requirements.

A check of the tuning limits of each set of coils gave figures closely approximating to the maker’s rating, and using these as a basis it should be a simple matter to prepare calibration curves, using stations of known wavelength to obtain key points.

Mains hum is very low, and the only possible fault to find concerns the rigidity of the front panel which affects tuning if deflected. This would be overcome by installing the set in a cabinet or by fitting stiffening brackets at the sides if it is desired to operate the set in chassis form.

Constructional Features. — A semicircular 100-degree tuning scale is provided and a reduction gear of just the right ratio is incorporated in the main spindle of the two-gang main tuning condenser.

A compact chassis layout has been achieved without undue cramping of the components. The coils are easily changed and the aerial trimming condenser is accessible placed on the top of the tuning condenser frame. For maximum efficiency slight readjustment of this trimmer may be necessary when changing from one band to another, but we found the alteration required was so small that an average setting could be left undisturbed without appreciable loss of performance.

Components of good quality have been specified and the output AF choke has sectionalised windings. Well-fitting metal valve screens with top caps are provided for both the RF and the detector stages.

The receiver is obtainable ready made up, or as a kit of parts with circuit and wiring diagram. In the latter case the price is £14.10s.


Correspondence

High-quality Gramophone Records

Two or three years ago some of your correspondents gave their views on the choice of high-quality recordings. At the present time it would, I think, be of great help to many of your readers who are unable to use their high-quality equipment with the present transmissions if this correspondence were revived.

The compiling of a list of high-quality disc records need not necessarily be confined to the classics; any type of recording that complies with your readers’ standard of “high fidelity” would be welcomed, as I presume that the readers interested would not submit any but the recordings which satisfied their critical taste, by being free from “echo,” scratch, amplitude and frequency distortion, and at the same time giving good contrast and naturalness.

Even when recordings are carefully chosen I find it is essential to use a rather comprehensive tone control to give individual satisfaction. There is no doubt that the electric gramophone to-day can give far more entertainment value—if it is made to do justice to the best recordings—than many people even realise. The following list, I think, may interest your readers, who I hope will, through your valuable columns, respond with a few of their selections:

“Carmen” Suite; Sir Thomas Beecham and London Philharmonic Orchestra. Columbia LX. 829-824.

Overture—“Morning, Noon and Night”; Boston Promenade Orchestra. H.M.V. Cg206.

Overture—“Barber of Seville”; Arturo Toscanini and Philharmonic Symphony Orchestra of New York. H.M.V. D525.


Stoke-on-Trent. G. R. GINNS.

DECEMBER, 1940.

For the New Year

THE well-known “Wireless World Diary and Reference Book,” which has just made its appearance once again, is, as its name implies not only a wireless diary for 1941, but also a pocket reference book of technical and other data arranged in compact and handy form, suitable both for professional and amateur wireless men. Probably one of its most used features are the tabulated lists of medium and long wavelength broadcasting stations of Europe, and short-wave stations of the world; the latter has been rearranged for easier reference.

In the sections devoted to useful formulae and abacæ are to be found data which will materially assist all those concerned with both wireless and P.A. A large number of circuit diagrams is included, together with component values. Details of valve base connections of British, International and American types which have been so much appreciated in the past are again included, but in considerably revised form. Other sections include Practical Hints and Tips, Copper Wire Tables, Wattage Tables, and suggestions for eliminating electrical interference. The Morse Code and “Q” Code of Abbreviations are also to be found in this handy little volume.

The Diary and Reference Book, compiled by the staff of The Wireless World, is issued by our publishers, Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1, at 2s., Purchase Tax 2s. 7d. By post, including Purchase Tax, 2s. 7d.

493

EMERGENCY RECEPTION.” This is a corrected version of the diagram published on p. 456 of last month’s issue, in which it is regretted that two errors occurred.
The advantages of frequency modulation (FM), in which the carrier remains constant in amplitude but varies in frequency by an amount proportional to the strength of the audio modulation impressed upon it, have already been discussed in this journal. Briefly these are as follows:

1. Greatly improved signal-to-noise ratio since most noise impulses are in the nature of amplitude variations against which the receiver can be made to discriminate. Consequently, a much wider service area for a given power at the transmitter.

2. Better quality of reproduction, since a wider audio-frequency response is permissible at the high carrier frequencies which are suitable for FM broadcasts, and accidental overmodulation at the transmitter does not cause the unpleasant effects which similar carelessness would produce in a normal amplitude-modulation station.

These factors are of special bene-

...
in frequency modulation as a programme of high quality, readers some of the developments which design in America.

found; there is an additional "limiter" stage and the method of detection or demodulation is, of course, radically different from that of an ordinary receiver for amplitude-modulated signals.

The function of the limiter stage is to iron out all variations in amplitude before the signal reaches the detector stage, and its operation is similar to that of a grid rectifier when overloaded. A pentode valve such as the 6SJ7 is generally used with a screen voltage of about 50 to 75 and a plate potential limited to between 20 and 30 volts. The values most usually adopted for the grid condenser and leak appear to be 50 micro-mfd. and 20,000 to 25,000 ohms. It is essential that sufficient amplification should be provided prior to the limiter stage to produce from the weakest signals the 5 or 6 volts at which the output from the anode circuit levels off. Above this threshold the input can be increased to about 100 volts before the output falls from linearity.

The action of the limiter valve during alignment can be studied by inserting a microammeter in the earth return of the grid leak, and many receivers are fitted with sockets, shunted by a by-pass condenser, for this purpose. The negative potential developed at the grid end of the resistor may be used if necessary as supplementary AVC on the RF stage.

DECEMBER, 1940.
Receivers for FM Transmissions—

Since a good deal of the interference met with on the wavelengths at which FM receivers operate is caused by car ignition, a short time constant in the limiter grid circuit is essential. With the values suggested above the time constant is between 1 and 2 microseconds, which is satisfactory. Two limiter stages in cascade are used in a receiver recently developed by E. H. Scott Radio Laboratories to obtain the desired characteristics. By this means amplitude variation due to selective cut-off in the IF stages is levelled and single peaked transformers can be used.

The detector in a receiver for frequency modulation must first convert variations of frequency into amplitude variations before rectifying and applying them to the audio stages of the set. The circuit used is similar to that of the discriminator in sets with automatic tuning control. Its action may be summarised briefly as follows.

When the primary and secondary circuits of a loosely coupled IF transformer are tuned to the applied frequency there is a 90-degree phase difference between the voltages in the two circuits. This phase angle changes when the applied frequency deviates from resonance, and if the two voltages are added vectorially (by connecting primary and secondary in series) the resultant takes the form shown by the full line curve in Fig. 3 (a). If the sense is reversed, the converse dotted curve is obtained. Now there is always a 180-degree phase difference between opposite ends of the secondary winding, so if the primary voltage is injected at the centre of the secondary, the response with respect to earth is the difference between V1 and V2 and is zero at the resonant frequency. Further, the middle section is nearly linear and will not introduce distortion in the transfer from frequency to amplitude modulation.

The voltages from the ends of the secondary winding are applied to balanced diode rectifiers and the AF output is taken across the combined load resistance, one side of which is earthed (Fig. 1). A centre-zero voltmeter across the output terminals may be used as a tuning indicator. In the Scott receiver a 'magic eye' is used and is biased to cut-off, so that the shadow is normally closed. The control grid is connected through an AF filter to the top of the diode load, and any deviation from correct tuning causes the shadow to open or the edges to overlap.

RF Circuits

Precautions necessary in other parts of the receiver are determined by the high frequencies used for FM transmissions and the wider band width which must be passed by the IF stages. The region of the spectrum at present allocated to FM transmissions in America is from 50 to 43 Mc/s (6 to 7 metres) and the frequency variation equivalent to maximum depth of modulation is ±75 kc/s. Television practice is indicated, with the additional precaution of obtaining the highest possible gain in the aerial and RF stage in order to give a good input to the frequency changer, which has a comparatively poor signal-to-noise ratio. Neutralisation of the input conductance of the RF valve will improve the gain in the aerial circuit and give better image rejection. A variable-mu RF valve with some form of gain control is desirable to prevent overloading on strong signals which might otherwise produce a second harmonic which will beat with the second harmonic of the oscillator.

Frequency Stability

It goes without saying that frequency stability in the oscillator circuit is vital and temperature-compensated condensers should be employed. Even then about half a minute must be allowed as a warming-up period before final tuning. Any factor tending to produce frequency modulation of the oscillator such as microphony in coils or condensers, mains hum in the HT feed or noise due to heater-cathode leakage must be rigorously excluded.

Symmetry in the response curves of the IF stages is essential and some damping in the form of shunt resistances is helpful in preventing-phase shift and also in avoiding any free oscillation of the tuned circuits as the signal passes through the mean frequency. Particular care must be exercised in the alignment of the transformer between the limiter and detector valves to ensure symmetry in the AF output as indicated by the centre-zero voltmeter. Earlier stages may be lined up with the help of a microammeter in the earth return of the limiter grid leak.

The Wireless Industry

PARTICULARS have been received of the "Mastalite" rechargeable hand lamp, made by Runbaken Electrical Products, 71-73a, Oxford Road, Manchester, 1. No separate charger is required as a rectifier is housed with a dry accumulator in the carrying case. There is a cycle attachment and provision for a rear light. The price is 39s. 6d.

The offices of Wild-Barfield Electric Furnaces, Ltd., have now been transferred to Watford By-pass, Watford, Herts, and their new telephone number is Watford 6094.

We have received from Colt Ventilation, Ltd., Bush House, Strand, London, W.C.2, a technical catalogue of black-out ventilators suitable for workshops and factories.
Current Topics

Recent Events in the World of Wireless

PURCHASE TAX PRICE CHANGES

Higher Cost of Radio Apparatus

The reason being that, because of the multiplicity of valve types, dealers' stocks were necessarily low. Examples from the list of prices announced by the British Radio Valve Manufacturers' Association will suffice to give some idea of the increases:

<table>
<thead>
<tr>
<th>Old price</th>
<th>New price</th>
</tr>
</thead>
<tbody>
<tr>
<td>£ s. d.</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>8 0</td>
<td>10 4 2</td>
</tr>
<tr>
<td>10 10</td>
<td>12 15 2</td>
</tr>
<tr>
<td>14 11</td>
<td>17 17 2</td>
</tr>
<tr>
<td>23 2 0</td>
<td>26 1 4</td>
</tr>
<tr>
<td>25 5 0</td>
<td>31 17 11</td>
</tr>
</tbody>
</table>

It will, of course, be remembered that specialised valves for use with deaf aids are exempt from taxation.

The effect of the tax on gramophone records is exemplified by the following figures:

<table>
<thead>
<tr>
<th>Old price</th>
<th>New price</th>
</tr>
</thead>
<tbody>
<tr>
<td>£ s. d.</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>1 0 10</td>
<td>1 10 10</td>
</tr>
<tr>
<td>3 0 17</td>
<td>3 15 17</td>
</tr>
<tr>
<td>4 0 12</td>
<td>4 17 12</td>
</tr>
</tbody>
</table>

Records for the use of the blind having titles embossed in Braille and solely reproducing speech are not subject to the tax.

AMERICAN COMMUNICATIONS

Defence Board Created

The creation by President Roosevelt on September 24th of the United States Defence Communications Board is considered by some to be the first grim manifestation of the war's effect upon broadcasting in the States. It is, however, emphasised in official quarters that there is no intention of upsetting the status quo of broadcasting stations.

The terms of the order do not give the six members of the Board, which is led by the chairman of the Federal Communications Committee, any power of radio censorship or the right to assume control of any station.

President Roosevelt's statement regarding the Board announced that its task of planning is not confined to radio broadcasting, but also embraces common carriers such as commercial radiotelephone and radiotelegraph as well as other telephone, telegraph and cable facilities.

"The Board does not propose to interfere with the normal operation of broadcasting or other forms of communication any more than is necessary for the national protection. Through correlated planning, it will seek to gear the great and strategically valuable American communications system, in both the domestic and international fields, to meet any situation the national interest may require." So far as domestic broadcasting is concerned, the Board has to study the "physical aspects" and to "recommend such precautions, supplementary facilities and reallocations as it shall deem desirable under foreseeable military conditions.

FM PHOTOTELEGRAPHY

An interesting demonstration of the transmission of photos by frequency modulation was recently witnessed in America. The photographs were transmitted over four miles of telephone line to the FM station WEOD at Boston. The transmissions from this station were picked up 43 miles away and rebroadcast by the FM station WIXOJ, and finally received a further 44 miles away.

The pictures received were of excellent quality, as was indicated by the illustration published recently by our contemporary Communications.

NORTH AMERICAN STATIONS

Reallocation of Frequencies

The first wavelength allocation plan embracing the whole of the North American continent will be put into operation next March. It is reallocation, which will affect the stations in the United States, Canada, Mexico, Cuba, Haiti and the Dominican Republic, is the outcome of the North American Regional Broadcasting Agreement reached in Havana in December, 1937. The reason for the push in the last-mentioned region, according to the United States Defence Communications Committee, is considered by some to be the effect of the tax on gramophone records is exemplified by the following figures:

<table>
<thead>
<tr>
<th>Old price</th>
<th>New price</th>
</tr>
</thead>
<tbody>
<tr>
<td>£ s. d.</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>8 0 10</td>
<td>9 0 10</td>
</tr>
<tr>
<td>12 6 17</td>
<td>13 3 17</td>
</tr>
<tr>
<td>15 9 18</td>
<td>18 18 18</td>
</tr>
<tr>
<td>17 6 17 1</td>
<td>17 6 17 1</td>
</tr>
<tr>
<td>1 5 0 1</td>
<td>1 10 5</td>
</tr>
</tbody>
</table>

It will, of course, be remembered that specialised valves for use with deaf aids are exempt from taxation.

The effect of the tax on gramophone records is exemplified by the following figures:

<table>
<thead>
<tr>
<th>Old price</th>
<th>New price</th>
</tr>
</thead>
<tbody>
<tr>
<td>£ s. d.</td>
<td>£ s. d.</td>
</tr>
<tr>
<td>1 0 10</td>
<td>1 10 10</td>
</tr>
<tr>
<td>3 0 17</td>
<td>3 15 17</td>
</tr>
<tr>
<td>4 0 12</td>
<td>4 17 12</td>
</tr>
</tbody>
</table>

Records for the use of the blind having titles embossed in Braille and solely reproducing speech are not subject to the tax.

The tax has been felt much more suddenly where valves are concerned.

DECEMBER, 1940.
Current Topics —
Board and the Imperial Communications Committee.

Cpt. Nicholson, who retired from the Navy in 1920, was appointed Director of Wireless Telegraphy under the Government of India the following year, which position he retained until 1926.

BROADCASTING STATIONS AS RADIO BEACONS

U.S. Warning to Mariners

A result of the increasing use of broadcasting stations as radio beacons, it has been emphasised by the U.S. Hydrographic Office that the practice is not recommended except when better navigational aids are lacking and then only by personnel who appreciate the limitations and restrictions involved.

Before taking bearings on a station broadcasting entertainment programmes, says the official instructions, a mariner should consider that its frequency may differ widely from the frequency for which his set is calibrated; that the published location of the station may be that of its studio and not that of its transmitting aerial; that if the station is synchronised with other stations it may be impossible to tell on which station the bearing was taken; and that as the majority of these stations are inland, the coastal refraction may be excessive.

This caution applies particularly to merchant vessels which are normally calibrated on 300 kc/s, for obtaining bearings on the established U.S. Coast Guard radio-beacons. It should be pointed out that the calibration curves for 300 kc/s and the various broadcasting frequencies (550 to 1,600 kc/s) differ materially, and, if the operator does not have calibration curves available to suit the approximate frequency used by the broadcasting station, large errors may result in the bearing obtained.

WILWO DEDICATED

Since April, WLWO, the international short-wave station of the Crosley Corporation, has been operating experimentally with a power of 50 kW, but it was not until October 12th that the transmitter, which is situated adjacent to the medium-wave parent station WLW, at Mason, Ohio, was formally dedicated. Using a rhombic or diamond-shaped aerial, which is directed on Latin America, the station is licensed to transmit on six wavelengths. Application has recently been made to the F.C.C. for the power to be increased to 75 kW.

THE INSULATOR supporting the 40 tons of one of WBZ's two 400ft. masts is only 22 inches high and weighs 90 lbs. The entire mast can be raised by the cross arm to replace the insulator if damaged. Note the spark gap.

B.B.C. SHORT-WAVE TRANSMISSIONS

The regular transmission of the B.B.C. Home and Forces programme on 48.82 and 41.49 metres respectively has necessitated changes in the wavelengths used for the transmission of news in English in the European short-wave service.

The call signs and frequencies to be used during this month are:

- GSA, 6,050 Mc/s (49.59 m);
- GSB, 9,510 Mc/s (31.55 m);
- GRX, 9,690 Mc/s (30.96 m);
- GSN, 11,820 Mc/s (25.38 m);
- GSE, 11,860 Mc/s (25.29 m);
- GRW, 11,890 Mc/s (25.22 m);
- GSO, 15,180 Mc/s (19.76 m).

The times (B.S.T.) of the transmission of news and the calls used are:

- 0000: GSA, GSB, GRX.
- 0715: GSA, GSN, GSR.
- 1045: GSA, GSB, GSR.
- 1145: GSA, GSN, GSE, GSO.
- 1200: GSA, GSE.
- 1700: GSA, GSB, GRX.
- 2345: GSA, GSB, GRX.

The transmission of the Home programme on the short waves has meant the introduction of a new frequency, 6,145 Mc/s (48.82 m), in the B.B.C. short-wave service. Its call letters are GRW. Listeners to the Home Service now have a choice of five wavelengths. They are 48.82, 203.5, 296.2, 391.1 and 449.1 metres.

COMPANY MEETINGS

At the Ekco annual general meeting it was learned that the cessation of television transmissions in this country, had left the company with a stock of television apparatus valued at £30,000, cost price. Mr. W. S. Verrells, the chairman, referred to Ekco's interest in Scophony, which company, he said, had partly overcome the difficulties with which it was faced at the beginning of the war and...
Current Topics—
is now engaged on Government work.
Mr. T. A. Macauley, chairman of
Cosops, stated at the recent general
meeting that in spite of war conditions
the company’s general valve and re-
ciever business had been substantially
maintained. It was to be expected,
however, that as their Government
contracts increased, their production
of sets should decline. That the com-
pany’s proportionate position in the
radio industry had been maintained
was evidenced by the 30 per cent. in-
crease in sales as compared with the
previous year.

"HF" OR "FM"?
In the rules issued by the Federal
Communications Commission of
America governing the operation of
what has generally become known as
frequency modulation stations, the
term "high-frequency broadcast sta-
tion" is used. Commenting on this
change of nomenclature, Broadcasting
states that popular usage, however,
will probably force the retention of FM
rather than HF in other than official
records.

FROM ALL
QUARTERS

High-power FM

The General Electric Company of
America has asked the Federal Commu-
nications Commission for permission to
increase the power of its frequency-
modulated transmitter, W2XOY, from
2.5 to 50 kW. The station, which, to-
gether with the G.E. 10-kW television
transmitter, W2XB, is situated in the
Helderberg Mountains, operates on 43.0
Mc/s. Employing a special 3-bay "turnstile" aerial, it is planned to serve an
area of 16,000 square miles.

Scottish Servicing Pool

To meet the difficulties arising from
the scarcity of wireless servicemen, the
Scottish Radio Retailers’ Association has
formed a technical pool so that the avail-
able staffs may be utilised to the best ad-
vant;e. It is also intended to start a
training scheme for girls.

THE NOVACHORD
A Recent Development in Electronic Music

Made by the Hammond In-
strument Co., of Chicago,
this instrument, as its name
implies, has been designed to
produce a variety of new
musical tones and effects. It
has a single manual keyboard
of 72 notes and there are two
thermonic valves of standard
type associated with each note.
Above the keyboard are a
number of controls which are
divided into two groups. Those
on the left control the harmonic
content, while those on the right determine the shape of the "en-
velope," i.e. the form of the transient at the
moment of striking the key and the sub-
sequent decay of the sound. While the
Novachord can simul-
ate the tones of many
musical instruments, it
has been designed
primarily for experi-
ment in new forms of
musical expression.
The agents in this
country are Boosey
& Hawkes, Ltd., 295,
Regent Street, Lon-
don, W.1.

DECEMBER, 1940.

Wireless World

Obituary

We regret to record the deaths of two
radio personalities. Mr. George Hinde
Nisbett, whose name has for many years
been associated with British Insulated
Cables of which he had successively held
positions on the Works Management
Committee and the Board, and subse-
quently became managing director, passed away on October 21st, at the age
of 73. He was a pioneer in the use of
paper-insulated and concentric cables.
Mr. Sydney E. Smith, chairman and
managing director of Varley, died at his
home on October 27th, following a brief
illness.

R. Signals Comforts

We learn that there is a shortage of
books and magazines for inclusion in the
parcels which are being sent out by the
Royal Signals Association Comforts
Fund to signal units abroad. The need
is urgent, and readers who are able to
supply any reading matter for this pur-
pose are asked to send it to the Fund’s
new address, 801, Hood House, Dolphin

Morse Speed Tests

A series of Morse speed tests to bring
the receiving speed of American ama-
ateurs to 20 w.p.m. or more is being con-
ducted by the American Radio Relay
League. Readers desirous of improving
their speeds may be interested to learn
the practice speeds are transmitted by
the A.R.R.L. headquarters station
WIAW every day except Saturday at
4:15 a.m., B.S.T., simultaneously on
1,761, 3,825, 7,280, 14,254 and 28,510
kc/s.

American Radio Industry Wages

According to recently issued statistics
the American broadcasting industry
maintained its position during 1939 as
the best-paying industry. The average
weekly wage of its 19,873 full-time em-
ployees, including executives, was
$45.90.

Braille Amateur Books

The third publication of the American
Radio Relay League, to be transcribed
into Braille is "How to Become a Radio
Amateur," which is soon to be published
in America. Those already published
are the "Radio Amateur’s Handbook" and
the League’s "Licence Manual."

Too Loud Speakers

Reference is made in the report of
the Noise Abatement League to the
prevalent use of loud wireless re-
civers. It is recorded that the Wireless
Bill which the League had prepared for
presentation to Parliament had to be
temporarily abandoned at the outbreak
of war. The League is of the opinion
that only legislation on the lines pro-
posed will appreciably mitigate this form
of noise nuisance.

Wireless—a Weapon of War

"For advance penetration into neu-
tral and enemy territory, radio possesses
### Wireless World

**Current Topics**

special advantages," says the World's Press News. In the article which deals with the aspect of the Press and radio as front line allies, the fact is stressed that whereas in the war of 1914-18 our messages were conveyed to the enemy people by leaflets, to-day radio takes the place of pamphletting. It is to-day definitely a weapon of war.

**BLIND WORKERS IN THE INDUSTRY**

**Captain Sir Ian Fraser, C.B.E.**

Chairman of St. Dunstan's, recently appealed to the radio industry to afford his committee the opportunity of visiting their works to study the production methods with a view to obtaining openings for those who had lost their sight, but whose senses of touch and hearing were often much above the average.

**Baird Television**

In the Companies Court, London, a scheme was sanctioned providing for the merger of Baird Television with Cinema Television, to preserve its goodwill and retain the technical staff until television transmissions are resumed in this country. Subject to the sanction of the Board of Trade, it is proposed to retain the name of Baird.

---

### NEWS IN ENGLISH FROM ABROAD

#### REGULAR SHORT-WAVE TRANSMISSIONS

<table>
<thead>
<tr>
<th>Country : Station</th>
<th>Mc/s</th>
<th>Metres</th>
<th>Daily Bulletins (B.S.T.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>America</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WNB (B. Bound Brook)</td>
<td>17.780</td>
<td>16.87</td>
<td>4.0, 6.0, 12.45 a.m., 1.0 a.m.</td>
</tr>
<tr>
<td>WCAB (Philadelphia)</td>
<td>6.090</td>
<td>49.50</td>
<td></td>
</tr>
<tr>
<td>WOB (Milwaukee)</td>
<td>9.690</td>
<td>31.28</td>
<td></td>
</tr>
<tr>
<td>WIBX (Wayne)</td>
<td>9.570</td>
<td>31.23</td>
<td>11.45, 2.0, 3.0, 4.0, 4.15, 5.0 a.m., 7.0, 8.30 a.m.</td>
</tr>
<tr>
<td>WQEO (Schenectady)</td>
<td>9.530</td>
<td>31.48</td>
<td>3.30, 9.5, 11.25</td>
</tr>
<tr>
<td>WQEA (Schenectady)</td>
<td>15.330</td>
<td>10.67</td>
<td>1.0, 2.0, 7.45, 9.55</td>
</tr>
<tr>
<td>WPTT (Pittsburgh)</td>
<td>15.510</td>
<td>10.72</td>
<td></td>
</tr>
<tr>
<td>WRUL (Boston)</td>
<td>6.040</td>
<td>46.67</td>
<td>1.0 a.m.</td>
</tr>
<tr>
<td>WRUL</td>
<td>11.780</td>
<td>25.45</td>
<td>10.45, 1.0 a.m., 10.45</td>
</tr>
<tr>
<td>WRUL</td>
<td>15.200</td>
<td>10.67</td>
<td>1.0 a.m., 10.45</td>
</tr>
<tr>
<td><strong>Australia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VLG (Sydney)</td>
<td>9.615</td>
<td>31.20</td>
<td>7.0 a.m., 7.0, 9.30</td>
</tr>
<tr>
<td>VLB (Melbourne)</td>
<td>9.680</td>
<td>31.32</td>
<td>10.0 a.m., 3.0</td>
</tr>
<tr>
<td>VLR</td>
<td>11.860</td>
<td>25.32</td>
<td>9.0</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>XGOY (Chungking)</td>
<td>11.960</td>
<td>25.21</td>
<td>11.10 a.m., 12.10, 9.30, 10.30</td>
</tr>
<tr>
<td>Finland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OFD (Lahti)</td>
<td>6.120</td>
<td>49.02</td>
<td>12.15 a.m., 8.55 a.m., 7.15, 10.15</td>
</tr>
<tr>
<td>OFD</td>
<td>9.600</td>
<td>31.58</td>
<td></td>
</tr>
<tr>
<td>Hungary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAT (Budapest)</td>
<td>9.125</td>
<td>32.58</td>
<td>1.30 a.m., 1.0 a.m.</td>
</tr>
<tr>
<td>HAT</td>
<td>9.625</td>
<td>31.17</td>
<td>12.15 a.m., 12.30 a.m.</td>
</tr>
<tr>
<td>HAS</td>
<td>15.370</td>
<td>19.52</td>
<td>3.30</td>
</tr>
<tr>
<td>India</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VUD23 (Delhi)</td>
<td>9.990</td>
<td>32.28</td>
<td>9.0 a.m., 1.30, 4.50, 6.30</td>
</tr>
<tr>
<td>VUD3</td>
<td>11.630</td>
<td>25.26</td>
<td>0.0 a.m., 1,30, 4.50, 6.30</td>
</tr>
<tr>
<td>VUD3</td>
<td>15.590</td>
<td>19.62</td>
<td>9.0 a.m.</td>
</tr>
<tr>
<td>Iran</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQB (Teheran)</td>
<td>6.155</td>
<td>48.74</td>
<td>7.30</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JZ2 (Tokio)</td>
<td>15.600</td>
<td>25.42</td>
<td>9.2</td>
</tr>
<tr>
<td>JZK</td>
<td>15.160</td>
<td>19.79</td>
<td>9.5</td>
</tr>
<tr>
<td>Manchukuo</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MTCY (Harbin)</td>
<td>11.785</td>
<td>25.48</td>
<td>8.0 a.m., 10.5</td>
</tr>
</tbody>
</table>

It should be noted that at this time of the year changes of wavelength are frequently made and readers are, therefore, advised to try alternative wavelengths. The times of the transmission of news in English in the B.B.C. Short-wave European Service are given on page 498.

#### REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

<table>
<thead>
<tr>
<th>Country : Station</th>
<th>kc/s</th>
<th>Metres</th>
<th>Daily Bulletins (B.S.T.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bulgaria</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sofia</td>
<td>850</td>
<td>302.9</td>
<td>9.05 (Th. and Sat.)</td>
</tr>
<tr>
<td>Hungary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budapest</td>
<td>546</td>
<td>549.6</td>
<td>11.10</td>
</tr>
<tr>
<td>Ireland</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio-Eireann</td>
<td>565</td>
<td>531</td>
<td>6.45, 10.10, 10.5</td>
</tr>
<tr>
<td>Latvia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madona</td>
<td>583</td>
<td>514.6</td>
<td>10.0 (Tu. and Fri.)</td>
</tr>
<tr>
<td>Kuldiga</td>
<td>1,104</td>
<td>271.7</td>
<td>10.0 (Tu. and Fri.)</td>
</tr>
<tr>
<td><strong>Russia</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.S.R.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moscow</td>
<td>1</td>
<td>1,744</td>
<td>11.30</td>
</tr>
</tbody>
</table>

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only.  ‡ Sundays excepted.

---

DECEMBER, 1940.
Compressed Dipoles

REDUCING THE DIMENSIONS OF SHORT-WAVE AERIALS

HAVING ascertained the design data for dipoles compressed to one-half of their usual length, and found that no excessive loss in efficiency occurs, it became possible to proceed to the practical aspect of the subject, and to discuss the construction of a compact directional aerial. The matter will be considered mainly from the point of view of direction-finding on wavelengths in the neighbourhood of 5 metres.

A compressed dipole was made up to the dimensions already given, and to ensure rigidity was supported from small stand-off insulators screwed to a 4-foot length of a white-wopd pole, which was easily obtained by purchasing new broom handles and trimming off the rounded ends. The actual length of the dipole was 44 inches. A compressed reflector was next made up on exactly similar lines. In this case the loading coil was reduced to 10 turns, and a small tuning condenser permanently connected across the two central turns, so that the reflector could be tuned for optimum performance. The overall length of the reflector proved to be about 50 inches, and to enable it to fit along a 4-foot pole, the ends of the wires were bent at right angles for about 3 inches, without any noticeable bad effects. From the information mentioned in the previous article it was decided to employ a spacing of rather less than an eighth wave-length for the reflector in the interests of minimum backward radiation. The final assembly was less than half the size of that used last year, and is illustrated in Fig. 4. It could be carried about easily, and was light enough to be mounted and rotated upon a camera tripod of the usual light construction. The dipole and reflector were fixed at a spacing of 18 inches by means of light wooden cross-members, making the whole a rigid and self-supporting unit.

Directional Tests

The aerial was next coupled to the transmitter, and its directional properties measured. After careful tuning of the reflector to the wavelength used, curves typified by Fig. 5 were obtained. Under all conditions of adjustment two minima were always found, separated by approximately 75 degrees, but it was possible to achieve a ratio of maximum to minimum response reaching at least 30 to 1 on the assumption that the meter employed remains sensibly linear at the low readings obtained near the minimum directions. It is probable that the production of two minima is inherent in the use of a reflector spacing of less than an eighth wavelength, but in view of the very sharp minima obtained the aerial would seem quite useful for direction-finding work, the procedure being to find both minima on a signal and then to bisect the angle between them to give the direction from which the waves are arriving. It should be stressed that owing to the close reflector spacing, the signals picked up by this aerial are materially weaker than those received upon the compressed dipole alone. The voltage reaching a receiver is estimated to be about one-third that from a full-size dipole, the sole reason for adopting the system being portability combined with a high ratio between that maximum and minimum directions.

The curve of Fig. 5 shows two interesting features. First, it will be seen to be slightly unsymmetrical, no doubt due to the nearby guttering, which was noticed to have a similar effect when plotting the polar curve of the normal dipole and reflector described in the first article. Secondly, it was observed that on tuning the reflector by the variable condenser shown in Fig. 4 the point giving the smallest minima was not the same as that for maximum forward radiation. The latter was 67 units in the adjustment plotted when the minima were less than 2 units of field strength; whilst adjustment of the condenser for maximum forward radiation gave a reading of nearly 90 units whilst increasing the back lobe to 15 units, or about double its minimum value. The minima were then no longer sharply defined. The result of earlier tests using full-length dipoles were therefore confirmed in that the adjustments of the reflector for maximum forward or minimum backward radiation were not the same.

In cases where effective transmission or reception are of greater importance than a sharp directional
Compressed Dipoles

effect, the compressed dipole and reflector can be separated by the conventional quarter-wave spacing, when the polar curve resembles that given for a dipole and reflector in the former article. There will be a single minimum only, and by tuning the reflector in the manner that has been described, this is likely to be better than for the usual arrangement in which the reflector is approximately tuned by the adjustment of its length only. The efficiency of this array in the forward direction is little inferior to that of the full-sized array, whilst in size it will be approximately a 4-foot square, and thus quite reasonably convenient.

It would, of course, be perfectly possible to erect more elaborate directional arrays comprising several dipoles, reflectors and perhaps directors, all of the compressed variety. In fact, the compressed unit is clearly interchangeable with the half-wave resonators used in the construction of the many types of array described in any good textbook on aerial design, whilst their use will considerably reduce the size of the system, and indirectly the difficulties of erection. Since under domestic conditions the chief obstacle to setting up elaborate aerial systems is the limited total space available, these savings may render possible the use of an array which could not be accommodated at all if full-length resonators were employed.

Multi-band Working

It may be interesting to describe a particular application of the loaded dipole principle which the writer has found extremely convenient. As applied to amateur conditions, this aerial provides operation in any one of three adjacent wavebands, such as 5, 10 and 20 metres, for example, whilst occupying only the space required by a dipole for the middle band, in the case quoted a length of about 16 feet. It is changed from one to another merely by altering the feeder connections, whilst the provision of interchangeable plug-in loading coils will extend it to any desired wavebands intermediate to those mentioned.

Applied to general listening, the aerial will operate on the 7-metre waveband, for example, with extension to the 16-metre and the 30-metre broadcast bands, and any intermediate bands such as the 19- or 25-metre broadcast bands. In this case it might wisely be erected as a vertical system.

![Diagram](Image)

The arrangement of the aerial is illustrated in Fig. 6, and to facilitate description we will assume that it is for use on 5, 10, and 20 metres, on which it has been tested by the writer. In this example the overall length will be 16 feet, or that of a 10-metre dipole, and thus only half that usually needed for 20-metre working; the advantage of the system being that the 32-foot span normally required for the latter was not available between the two supports which had to be used. Many such cases will be encountered when an aerial must be erected entirely above the roof of a moderate-sized house, whilst the effectiveness of the arrangement will be found much superior to an untuned wire.

At the middle waveband, which in the example quoted is 10 metres, the aerial functions as a normal dipole, as shown in Fig. 6 (a). The 16-foot wire is broken in the centre, the ends terminating in two sockets mounted upon a piece of a good quality weatherproof insulator, such as a strip of Trolitul measuring ¾in. by 1½in. wide. The 80-ohm feeder cable used is also terminated by two plugs, b, b to fit the sockets a, a, thus completing the dipole as sketched. To operate on 5 metres, these plugs are withdrawn, and a loading coil wound on a Trolitul former and fitted with two identical plugs is inserted between the points a, a. Across a few turns at the centre of this coil are soldered two similar sockets, c, c, to which the feeder is now attached. The aerial now resembles Fig. 6 (b) and functions as two half-wave radiators in phase on 5 metres, giving a broadside directivity as before, but with improved directional properties and radiating efficiency.

Current Distribution

To illustrate the method of operation the current distribution is shown by the dotted line, and it will be seen that the loading coil forms a "mat phasing section" equivalent to the quarter-wave matching stub familiar to amateur operators. The dimensions of the coil in this case are somewhat critical, since it must resonate at 5 metres by virtue of its own self-capacity and the slight loading effect of the two radiating arms, which vary considerably with the proximity of the earth or of nearby objects. To avoid difficulties in finding the best inductance, a small tuning condenser can be joined across the coil without detriment to its performance provided that steps are taken to protect this from the weather. A satisfactory solution if the aerial is only used on the 5-metre band for limited periods is to place a compact type of 15-µF variable condenser inside the coil former, with its spindle protruding through the side, between a widely spaced pair of turns. A six-turn coil of ½ or 1¼ inches diameter having the feeder tapped across from one to two turns can now be used, and will be found to resonate sharply at a point within the range of the 15-µF condenser specified.
Compressed Dipoles—

To operate the aerial on 20 metres, or any longer wavelength between the limits of 10 and about 30 metres, it is only necessary to plug in a fresh loading coil having the appropriate number of turns to transform the aerial into a compressed dipole at the desired wavelength. The conditions are sketched in Fig. 6 (c), and an idea of the size of coil required can be arrived at from the data of last month’s instalment.

Adjustments

It will most probably be quite unnecessary to provide a variable condenser in this case, since the tuning of the system is not so sharp that a satisfactory adjustment cannot be reached by the removal or addition of turns. In making this adjustment it will be found very helpful to connect a variable condenser across the coil temporarily by means of crocodile clips, preferably providing an insulated support of some kind by which the condenser can be held in the hand and an insulated extension spindle to reduce hand-capacity effects. If it is then found that the aerial resonates to the desired wavelength with the condenser vanes partly in, as shown by maximum signal strength in reception, or increased aerial current in transmission, the coil is too small and should be increased until it gives maximum results with the temporary condenser at zero or disconnected. No signs of an optimum setting of the condenser suggests too large a coil from which turns should be removed.

From the foregoing remarks it will have become obvious that the aerial system described must be erected in such a way that feeder connection to it is accessible. This can, however, often be arranged, and may be preferable to the use of several fixed aerials. In the writer’s case the aerial is erected above a flat roof, and it is the work of a moment only to climb a step ladder kept handy for the purpose and from which the loading coils can be reached. In more difficult cases it may be necessary to provide a rope and pulley at one end of the aerial by which it can be quickly lowered to permit of changing the coils.

Incidentally, the plugs and sockets used should be a tight fit to prevent the feeder from pulling out, whilst they may with advantage be of the shrouded pattern which are almost weatherproof when assembled. Since the sockets are arranged to point downwards, they do not easily get filled with rain at times when no plugs are inserted, whilst no serious falling off in performance has been noticed when the loading coils are wet, bearing in mind, of course, that a waterproof type of former such as Trolitul or porcelain must be used. In other situations the aerial may well be erected vertically. It is then not difficult to arrange that the central point comes just outside a window, from which the loading coils can be readily interchanged. It thus provides an excellent solution for the listener who requires an efficient aerial which will be useful for short-wave listening over a wide range of wavelengths. It need hardly be repeated perhaps that whilst transmission has been frequently referred to in this description, the remarks apply equally to aerials used entirely for reception, whilst it is perfectly possible to extend the system by the addition of a reflector similarly provided with interchangeable loading coils whereby it can be used on several wavebands.

A SERVICE MAINTAINED

The present situation is rendering it increasingly difficult to obtain journals from abroad with any degree of regularity. Our sister journal, The Wireless Engineer, is, however, maintaining its abstracts and reference section even if on occasion the number of pages occupied by this regular feature are slightly reduced. In addition to the abstracts from and references to nearly 300 recently published articles on wireless and allied subjects given in the November issue it also contains an article in which is discussed the problems connected with velocity modulation. The behaviour of resistors at high frequencies is dealt with editorially in the same issue. A comprehensive index to the abstracts published throughout the year will be included in the December issue, which will be available on the first of the month. The Wireless Engineer is obtainable to order through newsagents or direct from the Publishers, Dorset House, Stamford Street, London, S.E.1, at 2s. 8d. post free.

Wireless World

The “Fluxite Quins” at work

“Look out!” cried EE with a roar
As his wireless set dived to the floor.
See the grin on his face,
Not a wire out of place.
Thanks to Fluxite—could one expect more?

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 2/6.

Ask to see the FLUXITE SMALL-SPACE SOLDERING SET—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.), DRAGON WORKS, BERMONDSEY STREET, S.E.1

ALL MECHANICS WILL HAVE FLUXITE

IT SIMPLIFIES ALL SOLDERING
Lamp Contrast Expander
ITS OPERATION AND EFFECTIVENESS ANALISED

By S. W. AMOS, B.Sc. (Hons.)

This is a well-known fact that the resistance of a metal filament lamp increases with increase of temperature, and hence with increase in the voltage across it. By virtue of this fact such lamps can be used in contrast expansion circuits. Experiments were therefore made on an ordinary 2.5 volt torch bulb with an ammeter and a voltmeter in order to see how great the increase in resistance was. The following readings were obtained:

<table>
<thead>
<tr>
<th>PD across Bulb (Volts)</th>
<th>Current through bulb (Amps)</th>
<th>Resistance (Ohms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.10</td>
<td>1.60</td>
</tr>
<tr>
<td>1.00</td>
<td>0.20</td>
<td>3.00</td>
</tr>
<tr>
<td>2.00</td>
<td>0.27</td>
<td>7.41</td>
</tr>
<tr>
<td>3.00</td>
<td>0.33</td>
<td>9.00</td>
</tr>
</tbody>
</table>

The variation is hence considerable, which is not really surprising when it is realised that the Coefficient of Increase of Resistance with temperature of most metals lies between 0.003 and 0.005, and that the temperature of a white-hot filament must be over 1,000°C. Moreover the relationship between resistance and temperature cannot be considered linear over such an enormous range of temperature. The simple law:

\[ r = r_0 (1 + at) \]

only holds for temperature ranges of up to 100°C. Above this value a third and possibly fourth term will come into play thus:

\[ r = r_0 (1 + at + bt^2 + ct^3 + \ldots) \]

Consider a bulb such as the one whose characteristics are given above to be connected in parallel with the speech coil of a receiver, and suppose that the resistance of the speech coil (supposed constant for sake of simplicity) is 5 ohms. This gives the arrangement shown in the accompanying diagram.

Imagine that a current of 0.1 amp. is flowing in the bulb. Then from the table above, the PD across it must be 0.1 volt, and hence the energy being absorbed by the bulb is 0.001 watt. Moreover, 0.1 volt must also be the PD across the speech coil, and thus this is taking a current of 0.1/5 = 0.02 amp. The energy being dissipated here, then, is 0.002 watt. By considering other currents in the bulb in the same way the table at the foot of previous column was obtained.

Thus as the total energy supplied by the output transformer increases from 0.012 to 2.80 watts (a variation of 1 in 230 approximately) the energy which the speech coil receives changes from 0.002 to 1.85 watts (a variation of 1 in 900). Thus the contrast between loud and soft passages has been increased by nearly 4 times.

Using this simple theory it can be shown that in general the ratio in which the contrast is increased is given by the expression:

\[ \frac{r_1 (R + r_1)}{r_2 (R + r_2)} \]

where \( R \) = resistance of speech coil

\( r_1 \) = resistance of bulb when cold

\( r_2 \) = resistance of bulb when hot.

Thus substituting the values appropriate to the above example we get:

Ratio of expansion = \[ \frac{9 (5 + 1)}{1 (5 + 9)} \]

\[ = \frac{54}{14} \]

\[ = 4:1 \] nearly, as before.

Now so far we have assumed the speech coil resistance to be constant, as it would be if it were handling direct current all the time. In practice, however, it has to deal with alternating current, and very complex AC at that; hence its resistance (or more accurately impedance) varies according to the well-known formula:

\[ \text{Impedance} = \sqrt{R^2 + Lw^2} \]

where \( R \) = resistance of coil

\( L \) = inductance of coil

\( w \) = angular velocity of AC (= \( 2\pi f \) being frequency).

From this it can be seen that as the frequency of the current rises, so does the impedance. Moreover, as if to complicate matters, the impedance varies in practice much more quickly than this formula indicates, due to the "skin effect." This means that at high frequencies the bulb will not perform its duties so well as at low frequencies.

Fortunately, however, the inductance of the average moving coil is low so that the increase of impedance is not serious enough to prejudice unduly the performance of the contrast expander. The ratio of increase of contrast is, no doubt, smaller on account of this than the simple theory predicts, but, in the writer's opinion the inclusion of the bulb is still well worth while.

In practice, the simplicity of the scheme will readily be appreciated when it is pointed out that it is merely necessary to connect an ordinary torch bulb holder to the extension loudspeaker sockets of the receiver. The bulb should light brilliantly on loud passages and should not light at all on soft ones.

The improvement in the reproduction is quite marked, especially in the rendering of gramophone records, where a reduction in needle hiss is apparent. It was found that a 2.5-volt bulb displayed an alarming tendency to burn out on very loud orchestral crashes, and so a bulb of 5-volt rating was substituted. This proved most satisfactory.

It must be realised that even a 2.5 volt bulb consumes 1 watt when burning brighty, and so the receiver to which it is connected must be able to supply this, in addition to the energy needed for the loudspeaker. It is obvious, too, that some diminution of volume is to be expected when the bulb is in circuit.

This arrangement does not give such good results as two bulbs used in a Wheatstone bridge circuit such as the Crossley Expander, described in The Wireless World of May 22nd, 1936, nor is it as good as those systems using valves which have been described since then. The expansion, too, does not follow any particular law, i.e., is not linear. But it is worth while when the negligible trouble and cost of adding it to a receiver are considered.

<table>
<thead>
<tr>
<th>Current to Bulb (Amps)</th>
<th>PD across bulb (Volts)</th>
<th>Energy in bulb (Watts)</th>
<th>Speaker Current (Amps)</th>
<th>Speaker Energy (Watts)</th>
<th>Total Energy (Watts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.10</td>
<td>0.01</td>
<td>0.02</td>
<td>0.002</td>
<td>0.012</td>
</tr>
<tr>
<td>0.20</td>
<td>1.00</td>
<td>0.20</td>
<td>0.20</td>
<td>0.40</td>
<td>0.60</td>
</tr>
<tr>
<td>0.27</td>
<td>5.00</td>
<td>0.54</td>
<td>0.40</td>
<td>0.80</td>
<td>1.34</td>
</tr>
<tr>
<td>0.33</td>
<td>8.00</td>
<td>1.00</td>
<td>0.60</td>
<td>1.80</td>
<td>2.80</td>
</tr>
</tbody>
</table>
Random Radiations

By "DIALLIST"

Frequency Modulation

It won't be for want of trying on the part of those who are developing it if frequency modulation fails to make rapid headway in the U.S.A. Several regular broadcast services are now running, and the system has also been adopted by some municipalities for their police and other services. I wish I had the chance of sampling FM reception to see how far it lives up to the claims made for it of better quality and decreased interference. If it's as good as its sponsors believe it is there should be a wonderful future for it. Quite apart from quality, interference and means of avoiding it are amongst the biggest radio problems of to-day. And so much apparatus of radiating kinds has been sold to the public since the war began that we're going to find conditions pretty bad when peace allows us to get down to serious wireless once more. I see that adaptors are now being sold in America which enable one to convert a standard amplitude-modulation set for receiving FM transmissions. I don't know whether FM signals are reaching this country, for I haven't handled an USW set since the war began. If they are it would be thrilling to try reception with one of these adaptors.

Pay Up and Look Pleasant!

Your wireless set, if you buy a new one, will cost you more! That's one of the blows that wartime brings, and we can but grin and bear it. Though no one likes taxes—except possibly those that apply to others and not to oneself—we really haven't much to complain of as regards the purchase tax on radio goods. All the money collected goes to the best of good causes, that of winning the war. And, after all, it does not make prices unreasonable, especially when one considers that we have been engaged for fifteen months now in the greatest war in history. The set that cost eight guineas is now going to cost a little over £10; the four-and-nineteenpenny valve will run to 55. 6d., and the six-bob HTB to 7s. 6d. Not too bad, all things considered. There's sure to be some falling off in sales in this country, but that doesn't mean that either the country or the radio industry will suffer. Far from it; there has for some time been a big drive to develop wire-
Battery Salvage

In past years heaps of people have said to me: "Why can't something be done with old dry batteries? It seems such a waste to throw them into the dustbin." I'm not going to pretend that these remarks were made by altruists. Those who gave vent to them nearly always had in mind a haunting wish that they could be recharged and made fit for further service. That can't, of course, be done, but there are some fine pickings for salvage purposes in old batteries, and I'm more than glad to see that our discards are no longer to be allowed to become mere waste material. Several firms are specialising now in recovering the valuable materials present in even the most worn-out of HTB's, flashlamp batteries, and so on. Some genius has invented a machine which squeezes out in one stroke the whole of the carbon rods of a HTB. And after a wash and brush up these carbon rods are as good as new, for in the cells they act merely as conductors and undergo no chemical action. Dry cells work by "burning up" zinc. In the ideal cell, I suppose, the last active milligramme of electrolyte would consume the last milligramme of zinc just in time for the depolariser to make its expiring effort at keeping down the internal resistance. But things don't work out like that in practice. As the zinc forms the container of the cell, its perforation in one spot is the most usual cause of the cell's demise. Hence in a defunct cell there is a surprising proportion of the original zinc still left intact. And then, of course, there are the bitumen or wax seals, the paper wrappings of the cells and the cardboard of the cell compartments and the battery case. All of these things are now salvaged: even the solder of the joints is run off and made ready for fresh use. Don't fling your old dry batteries and cells away as was once your wont. Local authorities, acting often through the wireless shops, will be glad to have, and to send to the proper place, all that you can give them.

Some'll Believe Anything!

What the public will believe about wireless is just amazing. Some years ago I recall advertisements of a gadget which was guaranteed to rejuvenate dry HTB's suffering from senile decay. One of these affairs came into my hands and I spent a short but interesting time in examining it. The HTB and a 2-volt accumulator were to be connected, according to the directions in the accompanying leaflet, to two sets of terminals. The writer of the leaflet explained that in this way "live current" from the secondary cell was passed through the HTB with the result that the latter took on a new lease of life. On the back of the leaflet were several glowing testimonials from purchasers who had benefited in this way. I think that the testimonials were probably perfectly genuine. Those who wrote them really believed that a miracle had been worked! And lately I was shown by a civilian in the part of the world where I am stationed what he called a new wonder aerial—or rather aerial eliminator. He had paid quite a number of shillings for something that acted more or less as an ordinary fixed condenser. Connect this between the earthy lead of the set and earth (there's another wire to the aerial terminal), and you get reception of a sort. But, as I demonstrated to the victim, you get far better reception by using the earth lead in the ordinary way and fixing up almost any kind of aerial. Was he grateful? I don't think so!

Screening and Interference

In the huddled camp in which I've dwelt and moved for so long now, we have a good deal of interference due to one man-made source or another. Lately I've been interested to compare the performances of one or two different receivers under these conditions, and without the use of any sort of anti-interference aerial. I'd long believed, that not a little of the interfering sounds experienced under certain conditions was due to direct pick-up on the part of the set. That belief has been strengthened. One of the sets tried was pretty sensitive, and it was found that it would bring in not only the B.B.C., but also other transmissions as well with no aerial at all. Another was equally sensitive when yoked to an aerial, but seemed completely dead when the aerial plug was removed. Now, number one brought in (and brought out!) all the nasty noises that were going, whilst number two was far freer from them. It's obvious, I think, that the first could pick up broadcasting stations and interference simply on its poorly screened wiring and components. The second, well screened, could make nothing of transmissions unless it had an aerial, just because its screening was so good. And that same good screening kept out a lot of local interference.

Lesdix "Nitday" Charger

Designed for charging a 2-volt accumulator cell, this unit consists of a well-made mains transformer, a metal oxide rectifier and a small series resistance. It is strongly made and well finished and may be obtained in two types, the NA/23 at Rs. 6. for bench fixing, or the NA/23P at Rs. 5. for wall mounting. The latter is enclosed in a sheet metal cover of modern design.

To test the cool functioning of all three components in the unit testified to the generous factor of safety which has been allowed in their design. The mains transformer has an iron core of good cross section and the...
primary is wound to accommodate AC mains voltages from 200 to 250.

The charging current ranged from \( \frac{1}{2} \) to 1 amp., depending upon the state of the battery, but was never less than 0.5 amp.


**Book Review**


Here is a book that makes a very opportune appearance. The demands of the fighting forces have made serious inroads on the servicing, maintenance and testing staffs of wireless firms of all kinds, and new entrants are required to carry on the work of those who have joined up.

As the author points out in his preface, the book has been planned as a concise guide to practical receiver operation, and is intended to help newcomers in their initial training, while at the same time serving as an introduction to more advanced books in which some prior knowledge of the subject is assumed. There can be no doubt as to the book's conciseness, and a great amount of information has been packed into a small space.

After a very short introductory chapter on elementary electrical and wireless theory, the author proceeds to explain receiver operation. Later chapters deal with receiver components, valves and their operation, reading circuit diagrams, record-reproducing accessories, servicing equipment, and finally with the actual tracing of faults. The chapter on components, in which both functioning and construction are described, seems to be particularly helpful.

In one or two instances the sequence of the explanations appears susceptible to improvement, but admittedly any rearrangement might detract from the conciseness of the book. *Introducing Radio Receiver Servicing* can be safely recommended to the type of reader to whom it is addressed.

H. F. S.

**Club News**

**British Short-Wave Correspondence Club**

Headquarters: The Watering, Parham, Woodbridge, Suffolk.

Hon. Sec.: Mr. A. Richardson. The Watering, Parham, Woodbridge, Suffolk.

Members are invited to exchange their S.W.L. cards through the Q.S.L. Bureau. Those wishing to use this service should send six cards and an S.A.E. to Mr. D.G. Garrard, 135, Hervey Street, Ipswich, Suffolk, when they will be sent a list of members, whose cards are also for exchange, from which they can make their choice. Return postage must always be sent when communicating with club officials. Club stationery may now be had on application.

**Books on Wireless**

*Issued in conjunction with The Wireless World*

<table>
<thead>
<tr>
<th>Title</th>
<th>Price</th>
<th>By Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foundations of Wireless, Second Edition</td>
<td>5/-</td>
<td>5/6</td>
</tr>
<tr>
<td>Radio Laboratory Handbook, by M. G. Scroggłe</td>
<td>8/6</td>
<td>9/1</td>
</tr>
<tr>
<td>Wireless Servicing Manual, by W. T. Cocking</td>
<td>8/-</td>
<td>8/6</td>
</tr>
<tr>
<td>Handbook of Technical Instruction for Wireless Telegraphists</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wireless Direction Finding, by R. Keen. Third Edition</td>
<td>2/-</td>
<td>2/1</td>
</tr>
<tr>
<td>Radio Data Charts, Second Edition</td>
<td>2/-</td>
<td>2/9</td>
</tr>
<tr>
<td>Television Receiving Equipment, by W. T. Cocking</td>
<td>7/-</td>
<td>8/-</td>
</tr>
<tr>
<td>Radio Interference Suppression, by Gordon W. Ingram</td>
<td>5/-</td>
<td>5/1</td>
</tr>
<tr>
<td>Learning Morse, Fourth Edition</td>
<td>6/-</td>
<td>6/1</td>
</tr>
<tr>
<td>Radio Designer's Handbook, by E. Langford Smith, B.S.E., B.E.,</td>
<td>7/6</td>
<td>8/1</td>
</tr>
<tr>
<td>The Wireless World Diary and Reference Book for 1941</td>
<td>2/5j</td>
<td>2/7</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

DECEMBER, 1940.
Unbiased

By FREE GRID

It is extraordinary what a wide variety of trades and occupations there are in the world and how ignorant most of us are concerning the manner in which our next-door neighbour gets a living. For years past, when partaking of my evening pint at the village inn by which I live, I had noticed the same old faces evening after evening, year in and year out, but with the habitual reserve of the Englishman I had never actually spoken to any of their owners, as we have never been introduced. Indeed, had it not been for Adolf’s miraculous little hand-generator to pump the necessary AC into the coil.

Salvaging the XXX.

I was my good luck to be literally thrown into the arms of another habitué of the inn, whom I had for a long time past suspected of being connected with the wireless industry owing to the intelligent look on his face. And so it proved to be, although in my wildest dreams I never suspected the fantastically unusual connection with wireless which he proved to have. He was, he told me, a professional watch demagnetiser.

It appears that in the early days of wireless when ‘‘leakage’’ of magnetic fields was considerable, and home construction was rife, casualties among wrist watches were extraordinarily high, owing to set builders constantly bringing their wrists into close proximity to moving coil loud speakers. As time went on, the amount of home construction grew less, and simultaneously the external field of the loud speakers grew less owing to improved design. The result was that watch casualties, and consequently the demagnetising trade, fell off considerably.

The thing which surprised me most about the whole business was to learn that it was possible to go up to the Clerkenwell Road district—the home of the clock-making industry—and buy a demagnetiser for home use. Needless to say, I took the first opportunity of going up there to see these things, and I was considerably surprised at what I was shown. The AC model consisted virtually of a large air-cooled choke which plugged directly into the mains. The current is switched on, and the watch is placed in the centre of the core, and then slowly withdrawn. For people on DC mains, or on no mains at all, there were other models fitted with a natty little hand-generator to pump the necessary AC into the coil.

So the next time you pay for your watch to be demagnetised, you can dismiss from your minds all thoughts of a hard-working watchmaker sitting up until the small hours of the morning taking the watch to pieces and painstakingly demagnetising each separate component.

DECEMBER, 1940.
**Recent Inventions**

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns.

---

**TELEVISION AERIALS**

It is not always practical or convenient to erect a dipole aerial for receiving television programmes over and outside the roof of the house. Nor, except at close range, is it desirable to use an indoor aerial. It is accordingly proposed, by way of compromise, to erect the aerial so that it projects halfway through the roof, the inside limb being accommodated in the attic.

The dipole is supported by an insulator tile, which is made to resemble one of the ordinary roofing tiles, so that it is unobtrusive. The insulator tile is drilled at a slight angle so that the dipole projects vertically from the slope of the roof.

The same arrangement can also be used to carry a support for an aerial, or to take the downlead from it.


---

**TUNING BY REMOTE CONTROL**

A LOCAL oscillator, situated at a point remote from the wireless set, is used to operate a relay associated with the set, thereby stopping a motor when the circuits are in tune with the desired station. The selection is made by varying the frequency of oscillations generated at the remote tuning point.

As shown, a motor M drives an auxiliary condenser AC, the ordinary tuning condenser C, and a disc D, which (as shown separately) carries a contact arm A moving over fixed contacts T. The motor is connected to its supply terminals S through a switching relay R, which is also coupled to a valve relay V. The rotating contact arm is normally arranged to reverse the direction of the motor M when it reaches one or other of the contacts T.

---

**VISUAL TUNING INDICATORS**

RELATES to cathode-ray tuning indicators of the kind in which the resonance point is shown when a dark shadow or sector contracts to a narrow line on the fluorescent screen. It is found that, when handling strong signals, there is a tendency for the sector to contract to the full extent some time before the true tuning point is reached, so that the final adjustment is not clearly defined.

In order to overcome this difficulty, a second control electrode is mounted on the opposite side of the cathode to the first, and is connected to the latter by a resistance which holds it at a different potential. The differential effect of the two shadow-control electrodes ensures that the dark sector contracts gradually, right up to the final tuning point, even when the signals come from a powerful or near-by station.

The M.O. Valve Co. and C. W. Cosgrove. Application date November 30th, 1938. No. 521953.

---

**AUTOMATIC DIRECTION FINDERS**

SIGNS received on an Adcock frame aerial are combined through a radio-ometer with those received on a vertical or non-directive aerial in the phase required to produce a cardioid or heart-shaped response curve, the major axis of which points directly towards the distant transmitter. The resulting voltages are then applied to a pair of push-pull amplifiers which are connected, in turn, to the two field coils of an induction motor.

When a frequency, corresponding to a selected station, reaches the valve relay V from the distant "control" oscillator O, the time comes when the auxiliary condenser AC brings the circuit of the relay V into tune with the control oscillations. As soon as this happens, the switching relay R is operated to break the supply and so stop the motor M. The condenser C will then have brought the receiver circuits into tune with the selected station.

In a more elaborate arrangement, discriminator circuits are added to replace the reversing switches and apply a direct "homing" control to the motor M.


---

**ULTRA-SHORT-WAVE GENERATORS**

THE Figure shows the electrode arrangement of a valve of the magnetron type suitable for generating very short waves. The cathode or filament C is strung from supports S, S along the length of a tube T, which is made of insulating material. The tube is placed between the two pole pieces P, P, of an external magnet, so that the field is axial. A number of bar "anodes" A, each half a wavelength long, are supported as shown by a central ring R connected to the high-tension supply.

As shown, a motor M drives an auxiliary condenser AC, the ordinary tuning condenser C, and a disc D, which (as shown separately) carries a contact arm A moving over fixed contacts T. The motor is connected to its supply terminals S through a switching relay R, which is also coupled to a valve relay V. The rotating contact arm is normally arranged to reverse the direction of the motor M when it reaches one or other of the contacts T.

---

**DECEMBER, 1940.**
RADIO LANDING-SYSTEM FOR AIRCRAFT

In the so-called "leader-gear" type of installation, the boundary of an aerodrome, or the location of a landing field, is marked out in space by the fields of force which spread out inductively from cables fed with comparatively low-frequency currents. This aid to air navigation is to be distinguished from the production of a guiding course, or a blind landing path for aircraft, by the use of overlapping beams radiated on a comparatively short wavelength. The invention is concerned with a system of the first-mentioned type designed to produce a landing beam of constant energy, similar to that obtained in landing systems of the second type. As shown in plan in Fig (a), alternating current of, say, 300 cycles per second is fed from a source S into a network of buried cables, comprising two main lines L, L1, which converge at the landing position P. The main lines are cross-connected by a series of shunt lines with series resistances R, so that the inductive fields of force spreading from them progressively diminish in strength towards the landing position. As shown in elevation in Fig (b), this produces a distribution of energy in the region above the cables, such that a pilot following a course of constant field strength would fly down the sloping line OP and reach the ground tangentially at P.


BRIGHTER TELEVISION PICTURES

The original effect of incident light on a photo-sensitive cathode is increased by causing the electrons liberated from that surface to follow a circular path along the axis of a ring-shaped tube until they strike against the back surface of the cathode. Here they strike a coating of fluorescent material mounted on a semi-transparent layer of thin aluminium. Some of the light so produced passes through, or to the front surface, and so liberates a further supply of electrons from the photo-sensitive material.

In this way a regenerative action is applied, through the electron stream, to intensify the original effect of a light image focused from outside the tube on to the photo-electric side of the cathode. The circular path of the electron stream is controlled, in part by a pair of positively charged anodes mounted inside the tube, and in part by an external magnetic winding, so as to ensure that the image formed on the back of the cathode coincides exactly with that originally projected on its front surface. H. G. Lubszynski. Application date December 20th, 1938. No. 529951.

AMPLIFIER VALVES

In practice a limit is set to the amplification of a valve by the inherent "noise" due to the irregular emission of electrons from the cathode. This depends partly upon the absolute temperature at which the cathode is run, and partly upon the way in which the electron stream is divided between the anode and other positively biased electrodes inside the tube.

The essential fact is that the electrons are emitted from the cathode in more or less intermittent spurts or gushes, instead of in a steady stream. If, however, all the electrons which go to make up the working stream had the same uniform velocity, the background of noise, or "shot," effect practically disappears, and the amplification could be pushed to a much higher level than is now feasible.

The inventors achieve this object by subjecting the electrons emitted from the cathode to the action of an external magnetic field, so that those possessing the same initial velocity are deflected to a much extent, and so are able to escape through a "barrier" which stops all the others. A working stream of uniform velocity is thus made available.


FRAME AERIALS

The turns of a frame aerial, particularly one used for direction finding, are wound on a flat spiral over a powdered-iron core, preferably in the shape of a toroidal ring. The arrangement is stated to reduce the electrostatic pick-up, thereby improving the signal-to-noise ratio. At the same time, for a given size of coil, the signal pick-up is improved and the "Q" factor increased. The powdered-iron core is also stated to increase the efficiency of the aerial when used as a transmitter.


A RADIO ALTIMETER

The height of an aeroplane above ground is measured by transmitting a radio wave from the machine and comparing the phase of that wave, after it has been reflected back from the earth, with a locally generated wave of the same frequency. The phase difference is proportional to the total distance travelled during the outgoing and return journey of the reflected wave; in other words to twice the height of the machine. The outgoing wave is transmitted from an aerial mounted at the end of one wing of the plane, and the reflected wave is received by an aerial mounted at the opposite end of the other wing.

The indicating device is coupled to two detectors. One is fed by the reflected wave as picked up by the receiving aerial, and the other receives a fraction of the outgoing wave fed directly to it through a transmission line from the transmitter. The latter serves as a standard against which the reflected wave is compared, the resulting phase difference being recorded on a scale calibrated to show the corresponding altitude in feet. The receiving aerial is also connected to the transmitting aerial through a network which counterbalances any direct radiation from the transmitter.


DECEMBER, 1940.
Speech coil impedances may vary—valve loads may fall within a very wide range, yet, as this chart shows, you can always match up correctly with the ONE type Goodmans Transformer—the “101.” A typical example is shown. An 8 ohm coil to match a 10,000 ohm load...the correct ratio indicated is 36 : 1B. The tapping instructions provided with each transformer show the correct connections. It’s as simple as that for any valve and coil combination. And because of the unique system of series and parallel winding, an exceptionally high degree of efficiency is attained almost irrespective of the tappings used. Send coupon for full description and chart with tapping instructions.

**GOODMANS 101 MULTI-RANGE REPLACEMENT OUTPUT TRANSFORMER**

**GOODMANS INDUSTRIES, LTD.**
Lancelot Road, Wembley, Middx. Phone: Wembley 4001 (5 lines).

**LIST PRICE**

6/3

**POST THIS COUPON to:**
GOODMANS INDUSTRIES LTD., Lancelot Rd., Wembley, Middx.

Please send me full particulars of GOODMANS “101” Multi-Range Replacement Output Transformer together with chart and tapping instructions.

W.W.2439 Please attach this to your card or letter heading.
ADVERTISEMENTS

CHALLENGER RADIO CORPORATION

Our New Wartime Policy. "One Super Efficient Receiver for All," our new model 2164. Stamp for the illustrated catalogue of this model. Also still available valves at competitive prices, and P.A. speakers. - Challenger catalogue of this model. Also still available valves at watts tnode output, ideal for quality reproduction amplifier, 10 valves, including tone control stage, 8 Radio Corporation, 31, Craven Terrace, London, W.2.

Glasgow. [9288]

Evesham. [9318]


dales, Albert St., Hebden Bridge. Tel. : 247. [9232]

To keep up a smiling philosophy in these strenuous times is essential, and if it means that we—you and us—have to suffer a bit in the process we must take it standing up and with cheerfulness. A very limited number of the latest EX*88 chassis so favourably reviewed in the October issue of "The Wireless World" are still available to "W.W." readers. We are making every effort to ensure a "skeleton" supply of our chassis and you can rest assured that whatever we supply will be of the same high quality.

ARMSTRONG

DIFFICULT TIMES!

You know it and we know it! After many years of selling Armstrong Chassis andurguing you to buy what we new to be good, circumstances beyond our control have compelled us, with the greatest reluctance, to decline many orders. It can't be helped. Raw material is urgently needed by the Government for purposes far more important to all of us than C.P. 12-volt Battery and A.C. Mains Model, as wanted.

ARMSTRONG COMPANY SERVICE DEPARTMENT REQUIRE

WANTED, H.M.V., R.G.D., Bush, Murphy or other well-known makes of new or second-hand sets and all tube. 10% off cash, complete self-Advanced sets bought.

P.O.R. Sale or Exchange, three 120-volt A.C. Vacuum Tubes, good condition, list price $7. Gegenau, Albert St., Hedden Bridge. Tel.: 247. [9207]

ARMSTRONG Company Service Department Require

10 A.M. to 12 noon, 1 p.m. to 5 p.m., Saturday 10 a.m. to 12 noon. 250-volt 250 m.a. Full Wave Speaker, field grade. 250-250,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up.

To our Trade Friends.

We have written to you explaining our supply difficulties and regret that for the time being we are unable to accept trade orders. This is a very regret but we shall keep you informed as to the progress of your order. Should the position ease at a later date, we shall be only too happy to notify you immediately. Armstrong Manufacturing Co., Warley Rd., Hounslow, London, N.7.


(RECEIVERS AND AMPLIFIERS)

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

WANTED

MIDWEST (English make) 1939 Model, 6-waveband, 6 valves, 10m., speaker, jack for phones, output 9-watts. Box 2547, c/o "The Wireless World."

PUBLIC ADDRESS

VORTEXION P.A. Equipment

IMITATED, but unequalled.

We Invite You to a Demonstration.

A.- 25 15-20 watt Amplifier, 25-100,000 cycles, independent mile am and grams, inputs and controls, 0.037 volts required to full load, output for 4, 7.5, and 15 ohms, complete.

B.- 20 12-volt Battery and A.C. Mains Model, as wanted.

C.P. 20 12-volt Battery and A.C. Mains Model, as used by R.A.F. output as above; 12 gns.

A.- 30, in portable case, with Collard motor, Pieno pick-up microphone, £25.50, complete.

D.- Complete in Case, with turntable, B.T.H. Pieno pick-up and shielded microphone transformer, £25.50.

80-Watt Model, with negative feed back; £25, complete.

120-Watt Model, with negative feed back; £40, complete.

250-Volt 250 m.a. Full Wave Speaker, field grade. 250-250,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up, with tone control, complete with valve and glass; Box 2547.

WE ARE COMPETEED THROUGH RISING COSTS TO INCREASE OUR PRICES by 10%.

L.P. A. Accessories and Stock; trade supplied.

Table of Advertisement on page 57 (Ed.)

VORTEXION Ltd., 557, The Broadway, Wimbledon, S.W.19. Phone: Lib. 2814
HOW can we stop the evil growth
Of Nazi hate and horror
How can we clip our wings
And make a bright to-morrow?
How can we crush the sordid schemes
Matched by a cunning mind?
How can we halt their bestial dreams
Throughout the world in to-day, and
Bring to all a happier way
HOW?
One way is clear for all to see,
Cut out the needless spending,
For what you buy really means
And delays this great war's ending.
The smallest piece of metal rough
Has important work to do,
It helps to make a gun or plane
Which'll bring us smiling through.

THAT'S HOW!

For many years we've sold to you
Our Chokes and our Transformers,
Knowing well that you would find
They were the best performers.
But now we say "Unless you must,
Please forgeo that new replacement."
Use what you have, search high and low
From attic to the basement.

We thank you for your loyal support
And if you really need us
You'll find us at your service still,
"Nunquam non paratus."
Covered by all Candler Courses. There's no royal road to learning—but there IS a quick sure request, full information is given concerning the subjects in the "BOOK OF FACTS," which will be sent FREE on operators, including many in the Services, have proved the way to genuine CODE skill. Thousands of Candler Trained from that, has kept me 'miles in front' of others who relied on obsolete means of learning code.

W. T. HENLEY'S TELEGRAPH WORKS
SOLDERING IRON
Handyman model supplied complete with Resin-Cored Solder, Flex and Lamp Adaptor. Solon Resin-Cored Solder 6p. per reel.

W. T. HENLEY'S TELEGRAPH WORKS CO. LTD.
(Depot 22 E.), Engineering Sales Dept., Gravesend, Kent.

Miles in front!
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 start which I have obtained through taking 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.”

CANDLER CODE COURSE
There is a Candler Code Code Course for beginners and also for those who desire to increase their w.p.m. speeds.

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

NAME
ADDRESS

Post Coupon in Id. unsealed envelope to London Money

CANDLER SYSTEM CO.
Wireless World

Advertisements

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

GALPINS

ELECTRICAL STORES—75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13

Telephone: LEE GREEN 3240

Terms: Cash with Order

Wireless Electronic Check-Me ters, small, latest type, complete with lead, ready for use. Supplied for 200/250 volts 50 c.p.s. 1,000,000 ohms, 100 mfd., 3-1/2" long, 1-1/2" deep. Price 95/- Compressed 12 months.

PHILIPS HIGH VOLTAGE CONDENSERS. Infat. at competitive prices. Supplied complete."
SITUATIONS VACANT
AIR MINISTRY.

APPLICATIONS are invited for Appointments as
Civilian W/T Operators at Certain Air Ministry W/T
Stations. These are permanent appointments of a
remunerative nature in the first instance, but it may be possible to
secure a permanent post if the candidate is sufficiently
qualified, and if a permanent establishment after conclusion of hostilities.

APPLICANTS, who should be between the ages of
21 and 45 years at the date of issuing application,
should preferably possess the 1st Class Post-
master-General's Certificate or the Air-Operator's
Certificate, 2nd Class Postmaster-General's and have had
experience in radioelectricity, direction finding and main-
tenance work.

SALARY is at the Rate of 75/- a Week for the
First Two Years, thereafter rising by annual in-
crements for approved service to a maximum of
£4/12/6 per week, rising by annual increments of
2/6 a week to a maximum of £5/2/6 a week.

THE Normal Hours of Duty are 45 ± Week, exclu-
sive of meal times, day or night, or 180 in periods of
Emergency.

ARRANGEMENTS Will be Made for Suitable Can-
didates to be Interviewed at Renfrew, Manchester,
London or Bristol.

REQUESTS by Postcard for Forms of Application
Should be Addressed to the Under-Secretary of State,
Air Ministry (S.l.E.), Julian Rd., Bristol, 9, and
should state the town at which an interview is
desired.

RADIO Service Engineer, experienced all
modern radio apparatus and wiring. Salary as above.

SERVICE Engineer, wanted, over military age, or,
except from service.—Apply by letter, giving age
and address, (Plymouth area) to Electrical Radio Co.,
69, High St., Plymouth, S.E.11.

VACANCIES:—Exist for Civilian Wireless Instructors
at the Electrical and Wireless Schools, Royal Air
Force, at the rate of pay of £5/2/6 a week, rising by
annual increments of 2/6 a week to a maximum of
£6/2/6 a week.

CANDIDATES Must be Capable of Lecturing and
have a Sound Knowledge of Electrical Prin-
ciples. Two-year's experience in Radiotelephony,
direction finding and maintenance work.

APPLICATIONS Should be Addressed to the Under-
Secretary of State, Air Ministry (S.I.E.D.), Dept.
J.K., London, W.C.2, giving full particulars as to
previous experience, age, etc.

CANDIDATES, who must be over 30 years of age,
will be required to appear before a Selection
Board at the schools for interview and test, but may
be reimbursed the cost of third class locomotion
expenses for this purpose. The test will include the
writing of a lecture on any subject which may be
chosen by the candidate involving the principles of
modern radio. Lecturing sequence and style are most
desirable. 

APPLICANTS should have a certifi-
cate in Wireless Telegraphy and have had experi-
ence in radiotelephony, direction finding and main-
tenance work.

CANDIDATES Must be capable of lecturing and
teaching, but consideration will be given to others who
consider themselves capable.

RADIO Service Engineer, experienced, and ex-
cept military service preferred, write, stating age, ex-
perience, wage required, enclose copies of refer-
cences; telephone 340, 21 and 45 years at the date of
making application.

ARMSTRONG Company Have Staff Vacancy for
Electrical Engineerings

APPLICANTS should have a Sound Knowledge of
Electrical Principles, good technical drawings, etc.,
and experience, to Electro Radio Co., 68, High St.,
Plumstead, S.E.18.

DIRECTORATE of Signals.

APPLICANTS, who should be between the ages of
21 and 45 years at the date of embarking applica-
tion, should preferably possess the 1st Class Post-
master-General's Certificate or the Air-Operator's
Certificate, and have had experience
in radioelectricity, direction finding and main-
tenance work.

SALARY is at the Rate of 75/- a Week for the
First Two Years, thereafter rising by annual in-
crements for approved service to a maximum of
£4/12/6 per week, rising by annual increments of
2/6 a week to a maximum of £5/2/6 a week.

THE Normal Hours of Duty are 45 ± Week, exclu-
sive of meal times, day or night, or 180 in periods of
Emergency.

ARRANGEMENTS Will be Made for Suitable Can-
didates to be Interviewed at Renfrew, Manchester,
London or Bristol.

REQUESTS by Postcard for Forms of Application
Should be Addressed to the Under-Secretary of State,
Air Ministry (S.I.E.), Julian Rd., Bristol, 9, and
should state the town at which an interview is
desired.

RADIO Service Engineer, experienced all
modern radio apparatus and wiring. Salary as above.

SERVICE Engineer, wanted, over military age, or,
except from service.—Apply by letter, giving age
and address, (Plymouth area) to Electrical Radio Co.,
69, High St., Plymouth, S.E.11.

VACANCIES:—Exist for Civilian Wireless Instructors
at the Electrical and Wireless Schools, Royal Air
Force, at the rate of pay of £5/2/6 a week, rising by
annual increments of 2/6 a week to a maximum of
£6/2/6 a week.

CANDIDATES Must be Capable of Lecturing and
have a Sound Knowledge of Electrical Prin-
ciples. Two-year's experience in Radiotelephony,
direction finding and maintenance work.

APPLICATIONS Should be Addressed to the Under-
Secretary of State, Air Ministry (S.I.E.D.), Dept.
J.K., London, W.C.2, giving full particulars as to
previous experience, age, etc.

CANDIDATES, who must be over 30 years of age,
will be required to appear before a Selection
Board at the schools for interview and test, but may
be reimbursed the cost of third class locomotion
expenses for this purpose. The test will include the
writing of a lecture on any subject which may be
chosen by the candidate involving the principles of
modern radio. Lecturing sequence and style are most
desirable. 

APPLICANTS should have a certifi-
cate in Wireless Telegraphy and have had experi-
ence in radiotelephony, direction finding and main-
tenance work.

CANDIDATES Must be capable of lecturing and
teaching, but consideration will be given to others who
consider themselves capable.

RADIO Service Engineer, experienced, and ex-
cept military service preferred, write, stating age, ex-
perience, wage required, enclose copies of refer-
cences; telephone 340, 21 and 45 years at the date of
making application.

ARMSTRONG Company Have Staff Vacancy for
Electrical Engineerings

APPLICATIONS should be addressed to the Under-
Secretary of State, Air Ministry (S.I.E.), Dept.
J.K., London, W.C.2, giving full particulars as to
previous experience, age, etc.

CANDIDATES, who must be over 30 years of age,
will be required to appear before a Selection
Board at the schools for interview and test, but may
be reimbursed the cost of third class locomotion
expenses for this purpose. The test will include the
writing of a lecture on any subject which may be
chosen by the candidate involving the principles of
modern radio. Lecturing sequence and style are most
desirable. 

APPLICANTS should have a certifi-
cate in Wireless Telegraphy and have had experi-
ence in radiotelephony, direction finding and main-
tenance work.

CANDIDATES Must be capable of lecturing and
teaching, but consideration will be given to others who
consider themselves capable.

RADIO Service Engineer, experienced, and ex-
cept military service preferred, write, stating age, ex-
perience, wage required, enclose copies of refer-
cences; telephone 340, 21 and 45 years at the date of
making application.

ARMSTRONG Company Have Staff Vacancy for
Electrical Engineerings

APPLICATIONS should be addressed to the Under-
Secretary of State, Air Ministry (S.I.E.), Dept.
J.K., London, W.C.2, giving full particulars as to
previous experience, age, etc.

CANDIDATES, who must be over 30 years of age,
will be required to appear before a Selection
Board at the schools for interview and test, but may
be reimbursed the cost of third class locomotion
expenses for this purpose. The test will include the
writing of a lecture on any subject which may be
chosen by the candidate involving the principles of
modern radio. Lecturing sequence and style are most
desirable. 

APPLICANTS should have a certifi-
cate in Wireless Telegraphy and have had experi-
ence in radiotelephony, direction finding and main-
tenance work.

CANDIDATES Must be capable of lecturing and
teaching, but consideration will be given to others who
consider themselves capable.

RADIO Service Engineer, experienced, and ex-
cept military service preferred, write, stating age, ex-
perience, wage required, enclose copies of refer-
cences; telephone 340, 21 and 45 years at the date of
making application.
**Wireless**

**BUSINESSES AND PROPERTY FOR SALE, TO BE LET, OR WANTED**

"THE Wireless and Electrical Trader" is an essential part of the equipment of every Wireless Trader, and forms the very latest turn of trade events, and is read by all the leading dealers and manufacturers, and includes all businesses offered or wanted. By subscription, to the trade only, 17/6 per annum, post free—send your trade card for specimen copy to Dorset House, Stamford Street, London, S.E.1.

**TELEVISION RECEIVING EQUIPMENT**

"By W. T. H. Potter, AM.I.E.E. The book is intended for use by everyone interested in cathode-ray television equipment. The complete visible and sound receiver is described and the treatment throughout is substantially non-mathematical. Price £1.6 net. By post 8/-, from Illiffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.


**CLASSIFIED ADVERTISEMENTS**

Intended for the January Issue can be accepted up to Friday, December 6th.

**INDEX TO ADVERTISEMENTS**

<table>
<thead>
<tr>
<th>PAGE</th>
<th>Advertiser</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>Fred's Radio Cabin</td>
</tr>
<tr>
<td>15</td>
<td>Galpin's Electrical Stores</td>
</tr>
<tr>
<td>15</td>
<td>Goodman Industries, Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>Henley's, W. T., Telegraph Works Co.</td>
</tr>
<tr>
<td>14</td>
<td>Hey's, Leonard</td>
</tr>
<tr>
<td>14</td>
<td>Institute of Wireless Technology</td>
</tr>
<tr>
<td>14</td>
<td>International Correspondence Schools</td>
</tr>
<tr>
<td>14</td>
<td>Lockwood &amp; Co., Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>Masteradio, Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>McClure, John, Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>M.R. Supplies</td>
</tr>
<tr>
<td>14</td>
<td>Murphy Radio, Ltd.</td>
</tr>
<tr>
<td>14</td>
<td>Partridge, N.</td>
</tr>
<tr>
<td>13</td>
<td>Peto-Scott Co., Ltd.</td>
</tr>
<tr>
<td>13</td>
<td>Pitman &amp; Sons, Ltd.</td>
</tr>
<tr>
<td>13</td>
<td>Player's Cigarettes</td>
</tr>
<tr>
<td>12</td>
<td>Premier Radio Co.</td>
</tr>
<tr>
<td>12</td>
<td>Radio Clearance</td>
</tr>
<tr>
<td>12</td>
<td>Ryall, G. A., C.</td>
</tr>
<tr>
<td>12</td>
<td>Savage, W. Bryan, Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Simmonds Aerocessories, Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Steatite &amp; Porcelain Products, Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Stratton &amp; Co.</td>
</tr>
<tr>
<td>11</td>
<td>Taylor Electric Instruments, Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Telegraph Condemner Co., Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Truex Electrical Company (The)</td>
</tr>
<tr>
<td>11</td>
<td>United Insulator Co., Ltd.</td>
</tr>
<tr>
<td>11</td>
<td>Voigt Patents, Ltd.</td>
</tr>
<tr>
<td>10</td>
<td>Whitely Electrical Radio Co., Ltd.</td>
</tr>
</tbody>
</table>

**Advertisements**

**B.I.**

**RADIO MATERIALS**

We have had a long experience in the manufacture of all kinds of Cables and Wires, Aluminium Sheets and Strips, Static Condensers, Insulators and Iron Work, Telephone Cords and Copper Earthing Rods, for Radio use.

---

**BRITISH INSULATED CABLES LTD**

CABLE MAKERS AND ELECTRICAL ENGINEERS

Head Office:

PRESCOT, LANCS. Tel. No. PRESCOT 6571

---

**THE NEW ERSKINE McMURDO 15-17 RECEIVER**

Chassis price complete with valves and speaker - - 50 gns.

- 15 valves (including four duplex valves).
- R.F. stage on all bands.
- POLYSTYRENE COIL FORMERS.
- SILVER-PLATED COPPER TUBE COILS.
- 10-2000 metres coverage.
- Variable selectivity.
- Distortionless negative feedback detector.
- 15 watts push-pull output with negative feedback.
- 15" loudspeaker.
- Beat frequency oscillator.
- Inter-station noise suppression.

We are confident that the amazing performance of this new receiver will astonish even the most experienced enthusiast.

*May we send you details now.*

ERSKINE LABORATORIES LTD.

PROSPECT WORKS, NORTH STREET, SCARBOROUGH.

Tel.: Scaby 83.

---

**Keep that happy expression**

In good times or bad, wherever you are, keep to that happy expression "Player's Please." The cigarette which makes happy expressions everywhere.

**Players' Please**

PLAYER'S NAVY CUT CIGARETTES. MEDIUM OR MILD.

PLAIN OR CORK TIPS.
35 YEARS’ SPECIALISED EXPERIENCE

ADVERTISEMENT OF THE TELEGRAPH CONDENSER CO., LTD.