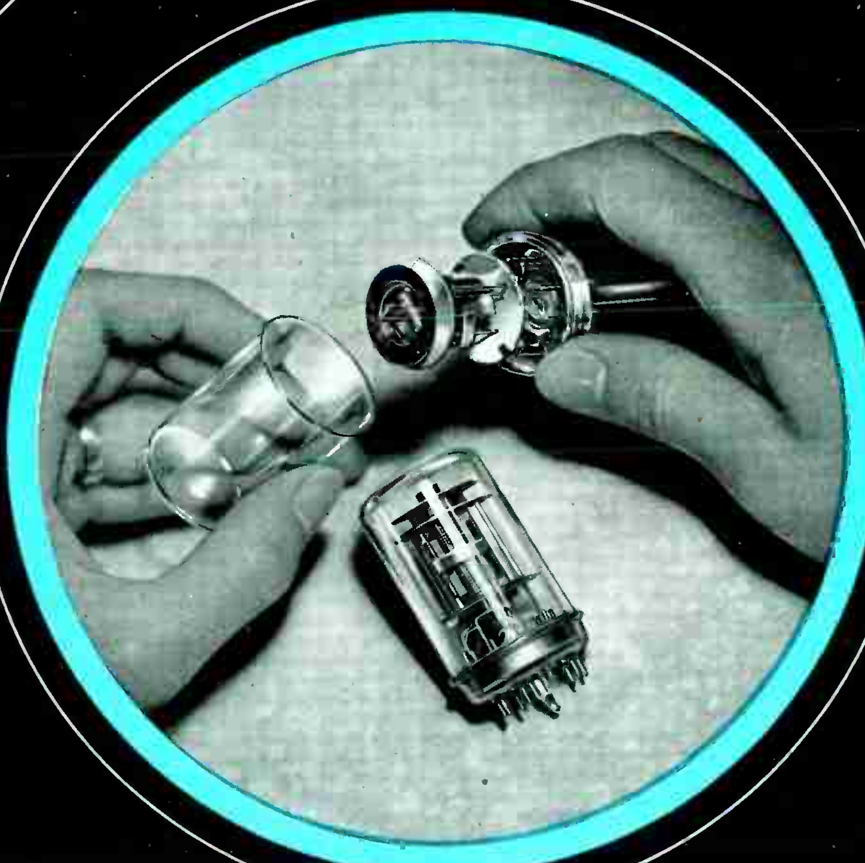
Wireless World

RADIO and ELECTRONICS

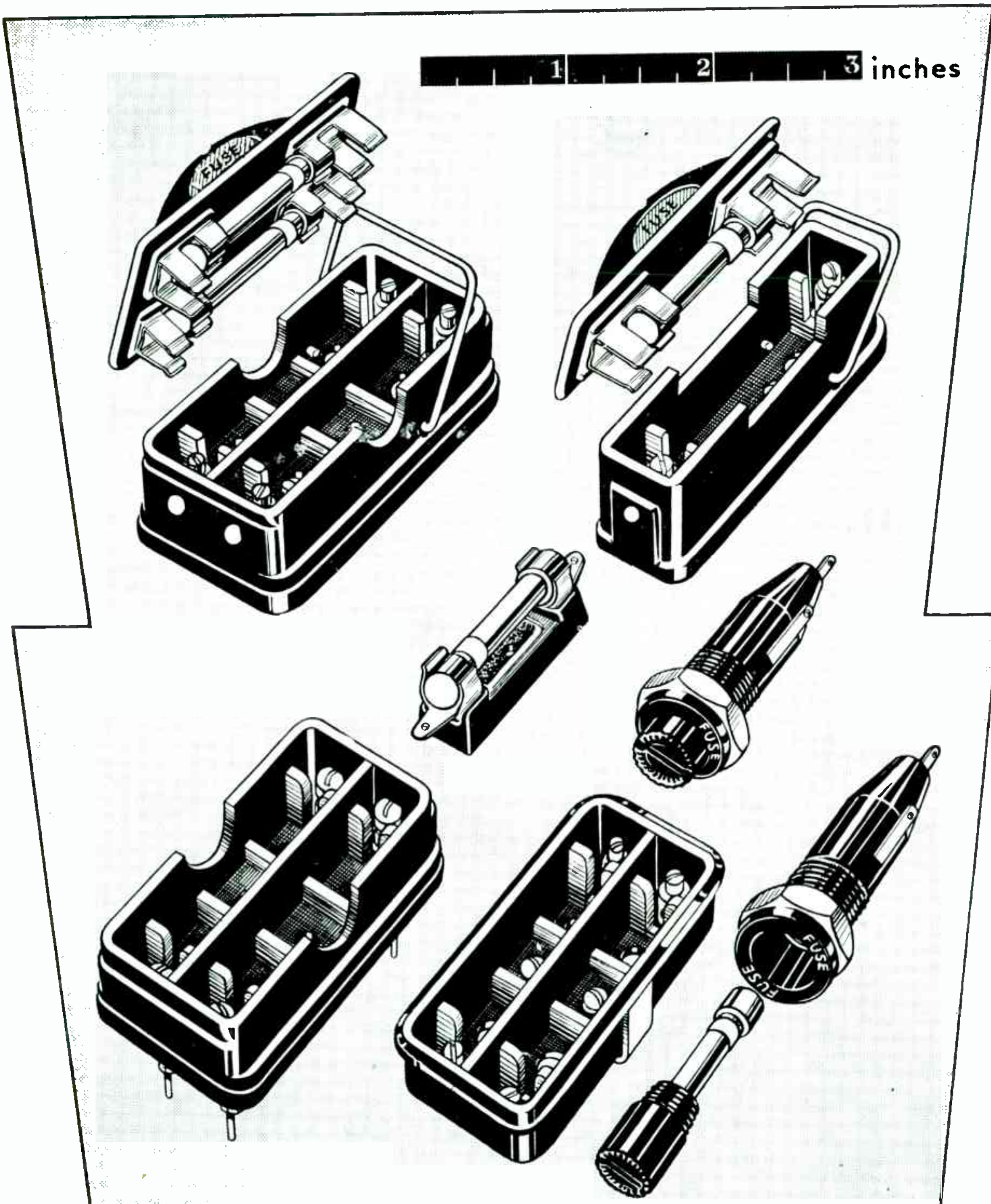


APRIL 1945

1/6

Vol. LI. No. 4

IN THIS ISSUE: PROGRESS IN COMPONENT DESIGN


1 2 3 inches
FUSE

50-range Model 7
Universal AvoMeter


VARNISHED ART SILK
0·5 TO 10 M/M.
VARNISHED COTTON
0·5 TO 35 MM TO A.M. SPECFN.
ROLLED SILK
0·5 TO 10 MM TO A.M. SPECFN.
DELAFLEX
SLEEVINGS
"DELAFLEX" CAN ALSO BE SUPPLIED
WITH METAL SCREENING IF DESIRED
De La Rue Insulation Limited
IMPERIAL HOUSE • 84 REGENT STREET • LONDON W1 • TEL REGENT 2901


GOODMANS
New T 2-12"
LOUDSPEAKER
for the SERVICES
and all PUBLIC ADDRESS PURPOSES
including FACTORIES, WORKSHOPS, CANTEENS, ETC.
Goodmans INDUSTRIES, LTD.
LOUDSPEAKER & TELEPHONE ENGINEERS
WEMBLEY, MDX.


TYPE
APPROVED

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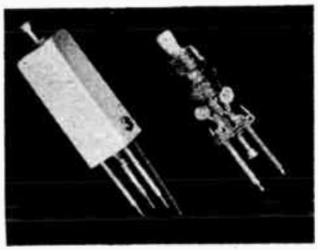
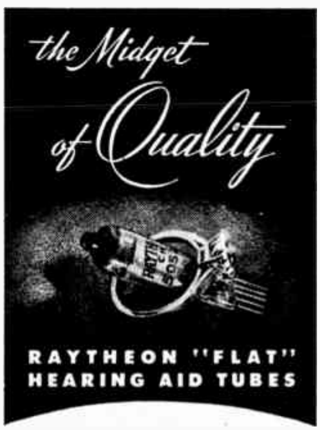


WORLD'S LARGEST RADIO COIL MANUFACTURERS

RADIO FREQUENCY INDUCTORS
INTERMEDIATE FREQUENCY TRANSFORMERS
RADIO FREQUENCY COIL CHOKES
MICA COMPRESSION CONDENSERS
AIR DIELECTRIC CONDENSERS
MICA MOULDED CONDENSERS
SICKLES SILVER CAP CONDENSERS
GANGED PERMEABILITY TUNING
COMMUNICATIONS EQUIPMENT
F.M. EQUIPMENT PARTS
U.H.F. RADIO EQUIPMENT
SPECIAL ELECTRONIC EQUIPMENT

The F. W. SICKLES Co.
CHICOPEE, MASS., U.S.A.

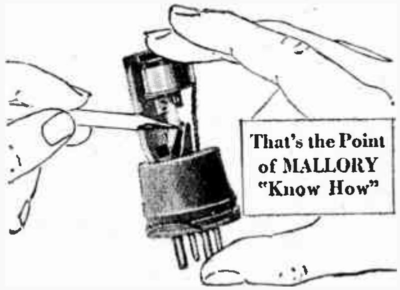


They fit inside a delicate ring, they are so small ; but they are mighty in dependable performance for hearing aid apparatus. Long lived with low battery drain, RAYTHEON Flat hearing aid tubes give quality performance for electronic hearing aids.

RAYTHEON
PRODUCTION CORPORATION
HEARING AID TUBE DIVISION
Newton, Massachusetts.

ARMY-NAVY "E" WITH STARS
Awarded all four Divisions of Raytheon for Continued Excellence in Production.

P. R. MALLORY & CO. Inc.
MALLORY
VIBRATORS
ARE ALWAYS DEPENDABLE



Contacts in a vibrator take a lot of punishment. They must operate under widely varying conditions of temperature and must " make and break " 115 times a second. Small wonder that alert engineers think of contacts first when selecting a vibrator !

For over 20 years, Mallory has been industrial headquarters for every type of electrical contact. It has introduced new contact compositions . . . evolved better designs . . . formulated improved surface finishes.

As a result of this wide experience, Mallory equips its vibrators with special grade tungsten contacts which are cut in its own plant from material made to its own specifications. They give longer life, are subject to a minimum of erosion and transfer.

Mallory is ready to apply its special vibrator " know how " to your specific applications.

P. R. MALLORY & CO. INC.
INDIANAPOLIS, INDIANA, U.S.A.
Radio and Electronics Division

ALSO
" MYKROY " CERAMIC INSULATING MATERIALS
GENERAL ELECTRONIC VACUUM CONDENSERS

FOR THE FUTURE

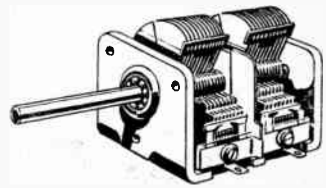
These Manufacturers will help solve your post-war problems.

Register your name now for full details which will be sent you when supply conditions again permit.

FRANK HEAVER
LIMITED
Kingsley Road, BIDEFORD, N. Devon

G. I.

VICTORY PRODUCTION



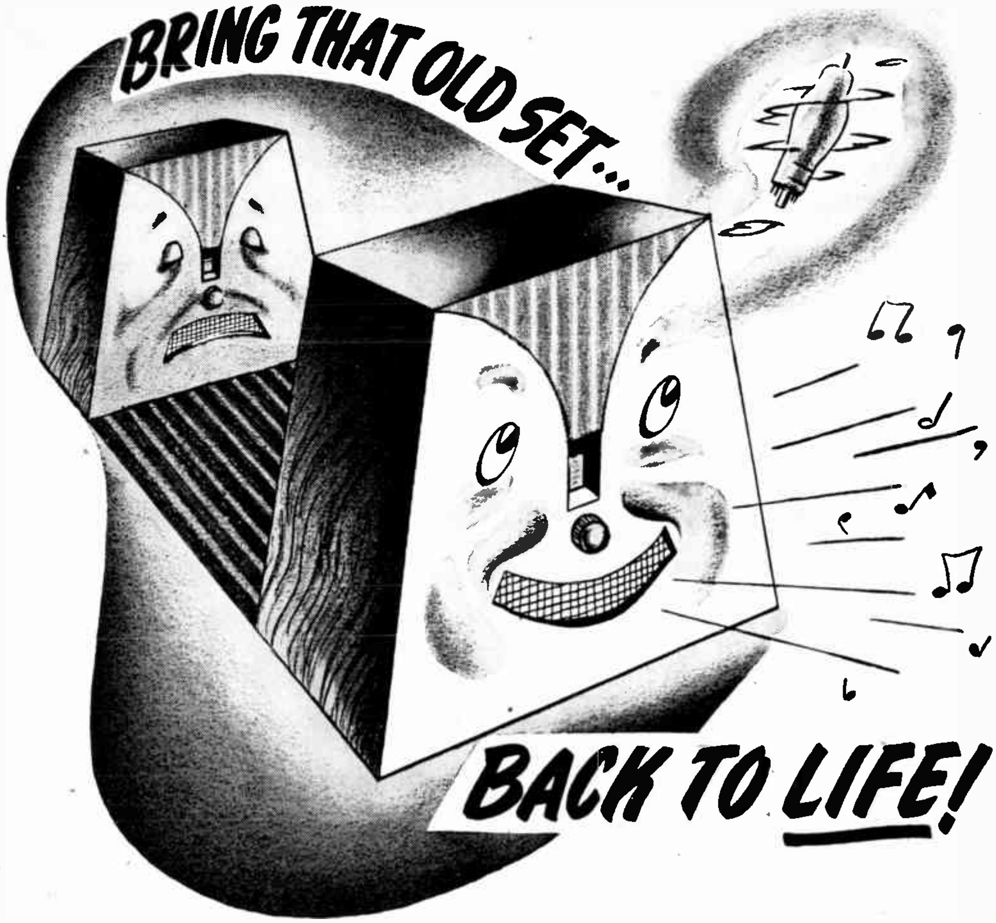
TYPE 2600 MIDGET VARIABLE CONDENSER

WHEN the mission of complete victory is accomplished, General Instrument will help " Win the Peace " by making the best use of still greater knowledge and experience in the manufacture of variable condensers and drives.

THE GENERAL INSTRUMENT CORPORATION
ELIZABETH, N.J., U.S.A.

TWO-WAY radio communication systems, like the plastic-cased beauty illustrated, are one of the new developments leading industrial designers are thinking of to speed the work of a busy post-war world. Applications of this compact, plastic-cased 'walkie-talkie' are almost unlimited. Naturally, this is only one of thousands of uses plastics will be put to after the war, but it will serve to remind you that post-war planning is being done . . . Kurz-Kasch designers, engineers, toolmakers and moulders . . . specialists for a generation in plastic planning and moulding will help you with your problems.

KURZ-KASCH INC.
Planners and Moulders for the Age of Plastics
DAYTON · OHIO · U.S.A.



If your set is on the shelf because of valve trouble, you will be pleased to hear that in spite of heavy service demands the Government is releasing more MAZDA Valves for civilian radios.

New Mazda Valves in your old set, whether it is completely out of action or only showing symptoms of wear and tear, will make all the difference.

Your Dealer has details of all available types of MAZDA Valves, but in case of difficulty please write to us.

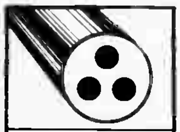
MAZDA
RADIO VALVES

THE EDISON SWAN ELECTRIC CO. LTD., 155, CHARING CROSS RD., LONDON, W.C.2.
R.M.26.

Technical Reasons Why

★ ERSIN MULTICORE SOLDER

Is the Finest Cored Solder in the World



3 CORES OF FLUX

Three Cores of Flux ensure flux continuity. No lengths without flux are wasted. Consistent high quality joints are obtained with comparatively unskilled labour. Exactly the correct proportions of solder to flux are provided. Separate fluxing operations are obviated and no extra flux is required. The three cores of flux being evenly distributed over the cross section of the solder provide thinner solder walls than otherwise. This gives rapid melting and speeds up soldering. The flux does not tend to run out of the cores; so there is always a supply available for the next joint. The utmost economy of solder and flux is achieved.

Ersin, contained in the three cores of Ersin Multicore Solder, is the fastest non-corrosive flux. Possessing all the non-corrosive advantages of rosin, it enables joints to be speedily made on oxidised or "difficult" surfaces such as nickel. Ersin not only avoids oxidation during soldering but removes surface oxide already present—this is particularly advantageous in respect of materials that have been in stock or apparatus that is being serviced. The use of Ersin Multicore, with correct soldering technique, avoids "HR" or dry joints.

10 SWG

22 SWG

Double actual size.

Ersin Multicore Solder is made in most gauges between 10 and 22 S.W.G. (·128—·028") (3·251—·7109 m/ms). For general radio and electrical production and maintenance 13 and 16 S.W.G. are in most demand.

Virgin Tin & Lead

Five alloys of Ersin Multicore Solder, made from virgin metals, are available—all antimony free. Under present circumstances 45% tin and 55% lead is the most widely used alloy.

Technically, Ersin Multicore Solder is far superior to any other cored solder. A practical laboratory or production test will demonstrate this and show you that it is the most economical solder to use. The majority of British and overseas manufacturers already enjoy the advantages of Multicore. If you do not, and are engaged upon Government contracts, write for further technical information and free samples.

Single reel rate nominal 1 lb. reels.

13 SWG	-	4/10
16 SWG	-	5/3

Above prices subject to usual trade discount.

¼ cwt.—ton lots at bulk rate. 6d. cartons for home use, available at most good radio and electrical dealers, ironmongers, etc.

MULTICORE SOLDERS LTD. Commonwealth House, New Oxford St., London, W.C.1 Tel.: CHAncery 5171-2

LOOKING AHEAD

The day that hostilities cease may be a little late to start deciding who shall supply the Transformers and Chokes for your post-war product.

Why not let us have a rough idea NOW of what you will want, and let us submit suggestions and prototypes?

Just at the moment we are extremely busy making hundreds of thousands of transformers for the battle front, but we are able to devote a certain amount of thought and planning for post-war.

Installed in our new factory is the very latest in Coil Winding Machines, vacuum impregnating plant, test equipment, and everything necessary for the production of the finest transformers that are made.

Drop us a line and let us show you the latest fashions. You are bound to be interested!

WODEN TRANSFORMER CO. LTD.

MOXLEY ROAD, BILSTON, STAFFS.

Telephone: BILSTON 41959-0

Accuracy and Uniformity

WEGO CONDENSERS

"BUILT BY SCIENTISTS FOR SCIENTISTS"

WEGO CONDENSER CO. LTD.

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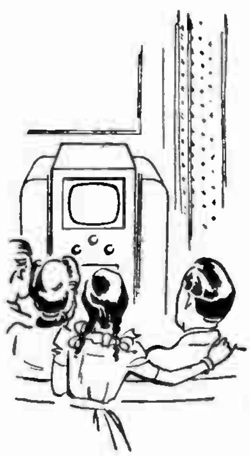
TELEPHONE: PERIVALE 4277

Over to you - OVER!

Intensive research and experiment by scientists and technical experts in collaboration with the service departments, have resulted in important developments in design and technique. To-day the output of Osram Valves is devoted to the war effort. But Osram Valves for maintenance of existing equipments are available. Consult your usual supplier.

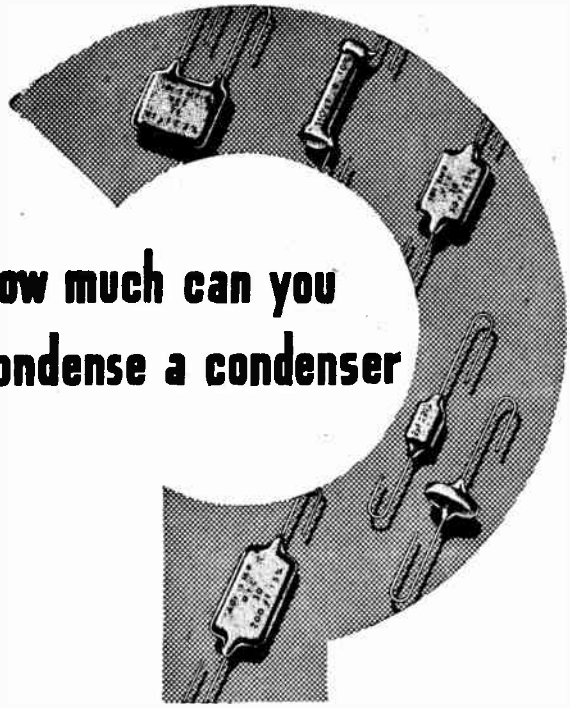
One day — perhaps soon — the progress and developments that have been made will be of the greatest interest and benefit to all. Then it will be, over to you — over !



Osram Valves

MADE IN ENGLAND

Advt. of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2



How much can you condense a condenser

UIC

Midget Condensers

Midgets in size but giants in performance are these U.I.C. Miniature Condensers. Especially suitable for use in the latest Service type miniature radio transmitters and receivers, they are efficient and dependable under all climatic conditions. Made to specification K.110. Type approved. Full details on request.

UNITED INSULATOR CO. LTD.
12-22 LAYSTALL ST., LONDON, E.C.1
Tel: TERminus 7383 (5 lines) *Grams: Calanel, Smith, London*

THE PIONEERS OF LOW-LOSS CERAMICS

Something to beat the big drum about

No, we're not at all modest about the "Universal Fifteen" . . . it's a fine job—we're proud of it—and we want you to know it. Made in the R.S. tradition of quality first, the design of the "Universal Fifteen" both electrically and physically has proved to be one of the most efficient ever produced in portable P.A. Equipment. And it *is* "portable" in the fullest sense of the word for it will operate on any mains, either AC or DC, and at any voltage from 200 to 250! Write now for fullest information.

R.S. *Amplifiers*

R.S. Amplifiers Ltd., 3-4 Highfield Road, Shepperton, Mdx.
Telephone: Walton-on-Thames 1019

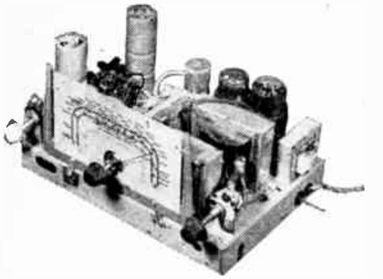
a Signal Generator of unusual design

RANGE: 100 Kc. to 30 mcs.
R.F. OUTPUT: 1 μV. to 100 mV.
Full details sent upon application.

ADVANCE COMPONENTS LTD.
BACK RD. SHERNHALL ST. LONDON. E.17. *Tel: LARkswood 4366-7*

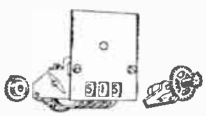
◆ LINAGLOW LIMITED ◆

T.R.F. 3-WAVEBAND 4-VALVE CONSTRUCTORS KIT, 17-2,000 m.



Aluminium screened coils, excellent short wave reception (the special coils used in this circuit give a performance equal to a superhet), 4½ watts output, complete with loudspeaker, all parts, wiring and theoretical diagram—nothing extra to purchase. Chassis dim.: 12in. × 8in. × 6in. to top of dial. 200/250 v. A.C. Including Tax. **11½ Gns.** Case and packing, 5/- extra.

MAINS TRANSFORMERS. 350/0/350, 4 v. 6 amp. C.T., 4 v. 2 amp., 100 m.a. Heavy Laminations, pre-war stock. Bargain, each **27/6**; 350/0/350, 6.3 v. 3 amp. C.T., 5 v. 2 amp. 100 m.a., each **32/6**.
LOUDSPEAKER TRANSFORMERS. Pentode Output 40:1, 50 m.a., **4/6**. Midget Multi Ratio 60:1, 80:1 40 m.a., **8/6**. Multi Ratio, 40:1, 60:1, 80:1, and push-pull 80 m.a., **12/6**. Pentode Output, 12/15 ohms, 100 m.a., **12/6**. Heavy duty, multi ratio, 24:1, 41:1, 48:1, 58:1, 82:1, 116:1 and P.P. 80 m.a., **15/6**. 3:1 Inter-valve, **10/6**. Push-Pull Output 20 watt. 4,000-0-4,000 Primary. 2.5, 7.5 and 12/15 ohms. Secondary, **25/-**.



REVOLUTION COUNTERS

0-999 WITH GEAR DRIVE AND GEARS, 3/6

LOUDSPEAKERS. 3 ohm Voice Coil. 6½in. Celestion, with transformer, **30/-**; 8in. Rola, **19/6**; 8in. Goodman, **22/6**; 10in. Mains Energised, 250, 500 and 1,200 ohms, **35/-**; B.T.H. Model R.K. 10in. Mains Energised Loudspeakers, 1,000 ohms field, 15 ohms speech, weight 28 lbs., reconditioned as new. Ideal for P.A. work, **£6.6.0.** See transformers above to suit.
AERIAL AND OSCILLATOR COILS. Best D.S.C. wire wound, colour coded on bakelite formers. Short, Medium and Long Wave, 16/50 m.; 200/550 m.; 1,000/2,000 m.; with circuit diagram, **15/-** the set.
I.F. TRANSFORMERS. 465 K.C.'s. Iron-cored Litz wound, aluminium can. Limited quantity. **17/6** matched pair. **9/6** each.
S.M. & L. T.R.F. COILS. Phillips, best quality in screened aluminium cans, 17/51, 200/585, 725/2,000 metres. (These coils equal to performance of superhet). Complete with circuit diagram, **9/6** the pair.
M. & L. T.R.F. AERIAL COILS. Aluminium screened Phillips, 200/585, 725/2,000 metres, complete with circuit diagram, **2/9** each.
WAVE CHANGE SWITCH, to suit all above coils, **5/9** each.
WANDER PLUGS, in 2 colours, **3/-** per doz.
ELECTRIC SOLDERING IRONS. 60 watt, 200/250 v. AC/DC, chrome plated. Usually 13/9. **9/6.**
SCREENED INTERLACED FLEXIBLE MICROPHONE CABLE. Twin 6 yards for **6/9**. Single, **1/-** per yard.

SERVICE KITS

S1. 1 8-mfd. 400/500 v. Electrolytic. 12 each assorted Tubular Paper Condensers, Carbon Wire End Resistors, Silver and Moulded Mica Condensers. New, ex-television, **10/9.**

S2. 1 8-mfd. 400/500 v., 1 32-mfd. 320 v. Electrolytics, 12 each Tubular Paper Condensers, Silver and Moulded Mica Condensers, Carbon Wire End Resistors, 1 Volume Control. New, ex-television, **21/6.**

S3. 1 8-mfd. 400/500 v., 1 32-mfd. 320 v., 1 16 × 8 mfd. 400/450 v. Electrolytics, 25 each Tubular Paper Condensers, Silver and Moulded Mica Condensers, Carbon Wire End Resistors, **37/6.**

S4. 3 8-mfd. 400/500 v., 3 32-mfd. 320 v., 1 8 × 8-mfd. 400/500 v., 1 16 × 8-mfd. 400/450 v., 1 10 × 10-mfd. 400/500 v. Electrolytics, 25 each Tubular Paper Condensers, Silver and Moulded Mica Condensers, Carbon Wire End Resistors, 6 yds. sleeving, 6 yds. P.V.C. Cable, 3 Tone Controls, 6 assorted Valveholders, **£5.**

offer

UNIQUE OPPORTUNITY

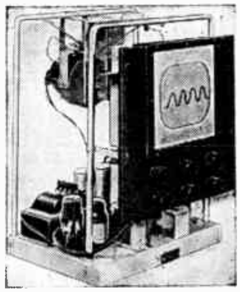
to procure pre-war stocks of new Radio Components including:

Milliammeters, Ammeters, Volt Meters, Moving Coil Type, by Weston, Ferranti, etc., Browns and Ericsson Headphones. Push-pull intervalve and output transformers. Heavy duty L.F. chokes. Heavy Duty Mains Transformers, H.F. Chokes. I.F.'s. Aerial Coils. Clarostats, Wire Wound Volume Controls. All above by Parmeko, B.S.R., Pye, Eddystone, Varley, etc. Epoch Loudspeakers. Advertisement space available does not permit full details. Please send for list.

ELECTRIC POWER METERS. As new, pre-war manufacture. 1/- in slot type. Suitable for electric fires, cookers, etc. Ideal for boarding houses, hotels. Complete, less locking key. Makers' price 70/-. Each **35/-.**
WESTINGHOUSE METAL RECTIFIERS. Type H1, 2½ v. D.C. 10 m.a. Bargain, each **3/6**. W.6, 25 m.a., **5/6** each.

CATHODE RAY OSCILLOSCOPES

CONSTRUCTORS KITS



Designed by prominent well-known radio engineer. All parts supplied—theoretical and practical wiring diagrams and full instructions for assembly and operation. All parts new, ex manufacturer's pre-war stock. Demonstration model can be seen working. Specification: Magnetic deflection and focussing. C.R.T. 7in. screen. Multi-stage amplifier and linear time base incorporated. Mains input 200/250 v. 50 cycles. Anode potential 5,000 v. Oscilloscope when completed is in chassis form, mounted on tubular metal frame **£22.17.6**

Case and packing, 7/6 extra.

VALVES. American types, at B.O.T. controlled retail prices. For replacement purposes only. 6F5, 12F5, 12J5, 12SF5, 1H5, **9/2**; 5Y3, 1C5, 1N5, **11/-**; 6Q7, 12Q7, **11/7**; 6F6, 6K6, 6K7, 6L7, 12J7, 12SJ7, 36, 1A7, 6V6G, **12/10**; 6A8, 6B7, 6SA7, **14/-.**
Also British Valves at manufacturers List Prices. 6X5, UU4, UU6, **11/-**; H141DD, TDD4, **11/7**; AC/VP2, CL4, EF39, KTW61, Pen 45, SP41, SP42, T41, VP41, **12/10**; D1 diode 1in. Peanut valve with valve holder, **12/10**; ECH3, FC13, X63, 12Z3, 25Z5, 35Z4, **14/-**; AC6 Pen*, EL35, Pen 46*, U21, **18/3**; prices include Purchase Tax. Add 3d. per valve post.
* Post Office permit necessary.
VALVEHOLDERS—AMPHENOL TYPE. International or English Octal, chassis mounting, **1/-** each. **10/6** per dozen. English Wafer type, 4-, 8-pin, 6 for **2/6.**
LOUDSPEAKER FRETS. Coppered brass, 14¼in. × 9½in., **8/9.** Silk covered, 12in. × 9in., ⅜in. ply, 6½in. hole, **4/6.**
LINE CORDS. 3-way heavy duty, .3 amp., 360 ohms, **9/6**; 480 ohms, **13/6**; 600 ohms, **15/9**; 2-way, 360 ohms, **5/6**; 480 ohms, **7/6**; 600 ohms, **9/3.**
WIRE END CARBON RESISTORS. ¼, ½, 1 and 2 watt manufacturers' types. New, ex-television. Parcel of 100, assorted, **22/6.**
WIRE WOUND RESISTORS. 50-15,000 ohms, 5-watt type. **1/9** each. 10-watt type, **2/3** each.
MAINS DROPPER RESISTORS. .2 amp. 950 ohms, with fixing feet. **6/9** each.
TUBULAR PAPER CONDENSERS. 350/500 v. D.C. working. New, ex-television, .0001, **3/-**; .0025, **4/-**; .01, **6/-**; .02, **7/-**; .04, **8/-**; .08, **9/-**; .1, **10/-**; .25, **12/-** per dozen. Parcel of 50 assorted, **22/6.**
STRIPLIGHT METAL REFLECTORS. Made from heavy gauge steel, 14in. long, complete with two B.C. lampholders, less lamps, **10/6** each.
RADIO MECHANIC'S EXTRA LONG-NOSED PLIERS, ex-Government stock, re-conditioned like new, exceptionally cheap, 8½in. long, **10/6** each.

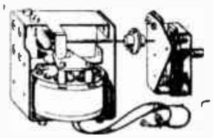
N.B.
Owing to depleted staff, we can only accept Cash with order. No C.O.D. Delivery 14 days.

ALL-WAVE SERVICE SIGNAL GENERATOR

A.C. mains 200/250 v. 50 cycle. Range covers from 20 M.C. to 100 K.C., all fundamentally in 5 bands without gaps. S/M Dial Direct calibration in frequencies. Coarse and fine output attenuator. Internal modulation 400 C/S. Iron-cored coils. The Generator is entirely screened in heavy metal cabinet with carrying handle. Dim., 10in × 10in. × 12in. Each **£13 10 0**

RADIO MECHANIC'S SIDE CUTTERS, ex-Government stock, reconditioned like new, exceptionally cheap, **4/6** each.
HIGH VOLTAGE BRAIDED SLEEVING. 1 and 1½ mm., first-class quality, **3/6** per dozen yards.
P.V.C. CABLE. 14/36, Red, Green, Blue, Yellow and Black. **2/-** per dozen yards.
ENAMELLED COPPER WIRE. 30 s.w.g. 1 lb. spools, **5/-** per spool.
VOLUME CONTROLS. 1, 5, 10, 20, 25, 50 and 100 thousand ohms, ¼, ½, 1 and 2 meg., without switch, **4/9** each. As above with switch, **6/9**; 100,000 ohms, ½ meg., Double Pole Switch, best American, **7/6**; 2,000 ohm only, wire wound, **3/-**; 1,000 ohm only, carbon, with screw adjustment, **1/6** each.
TUMBLER SWITCHES. 2-way, ex-Government contract, 5 amp., exceptional value, **1/9** each.
L.F. SMOOTHING CHOKES. Finest quality, 20 and 60 henries, 150 m.a., **16/9** each.
UNIVERSAL RAZOR RESISTORS. Finished in bakelite case, 2-pin mains connectors, suitable for practically every type of electric razor. Drops voltage from 200/250 v. to 100/110 v., **10/6.**
VARIABLE CONDENSERS. 2-gang (small), .0005 ceramic with trimmers, fixing feed, slow motion drive, dial frame and pointer. **17/9.** 3-gang .0005 ceramic insulation with slow motion drive, pointer and dial frame, **12 6.** 3-gang .0005 ceramic insulation. Special offer, **7/9** each.
SUPERIOR QUALITY KNOBS. Ex-television, suitable for radio. For ¼in. spindles with grub screw. 1½in. **1/3** each, 2in. **1/9** each.
PICK-UP HEADS. Garrard type. Finest quality Piezo Crystal. Complete with screened lead and needle screw, **£3 7 6** each, including Tax.

SYNCHRONOUS MOTORS



200/250 v. A.C. 12 m.a., suitable for electric clocks, etc. Supplied complete with gears. Each **27/6**

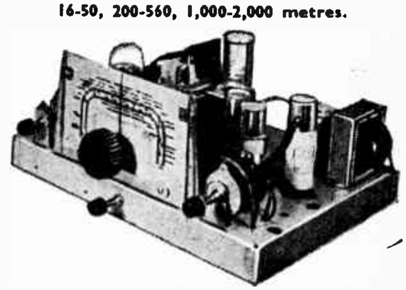
RELAYS

Complete with circuit breaking switch, 200/250 v. A.C. 60/80 v. D.C. 300 m.a. 15 amp. switch. Each **7/6**

RELAY AND METAL RECTIFIER AND MAINS TRANSFORMER complete. Input 200/240 v. A.C. Output, 12 v. D.C. 150 ohm, 20 m.a., **35/-.**
VIBRATORS, 4-pin 6v., best quality American, **15/6.**

"LIBERTY SIX" ALL-WAVE 6-VALVE CONSTRUCTORS KIT

16-50, 200-560, 1,000-2,000 metres.



A SUPER-SENSITIVE & SELECTIVE CIRCUIT HUNDREDS OF SATISFIED USERS.

Brief Specification: Frequency Changer with two valves, separate Oscillator, six tuned circuit, 465 K.C. iron cored I.F.'s. Separate tone and volume controls, 5-watt output, 8in. P.M. speaker with baffle and output transformer, all valves, chassis, Practical and Theoretical diagrams, Parts List, Nuts, Bolts and Wire, ready to assemble 200/250 volts A.C. Including purchase tax. **16 gns.**
As above with the addition of Magic Eye Tuning Indicator and parts. **17 gns.** Case and packing 5/- extra.

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Wireless World

Radio and Electronics

35th YEAR OF PUBLICATION

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

Wireless World

Radio and Electronics

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Monthly Commentary

Competitive Broadcasting

THE well-being of every branch of wireless is vitally affected by the progress of broadcasting. It represents the "big money" side of the art, contributing directly or indirectly in dozens of ways to advancement in other spheres. It provides incentive and funds for research to an extent secondary only to war; the resulting developments find applications, sooner or later, in other branches of wireless technology. No radio industrialist, technician or trader, in whatever branch he may be concerned—including the electronic offshoots of radio—can face with equanimity the possibility of a decline in the influence of broadcasting.

Before the B.B.C. Charter expires next year, decisions must be made that will profoundly affect the future of British radio. No pains should be spared to ensure that those decisions are the right ones. It is indeed gratifying that so much importance is attached to the topic that many lengthy, well-informed and serious discussions on the reorganisation of broadcasting have been published in the lay Press.

By general consent, the fundamental issue is still whether broadcasting should be conducted and financed as a monopolistic public service or as a commercial enterprise supported by advertising revenue. And, as a secondary issue, if it is to be monopolistic, how can the supposed defects of a monopoly—timidity and dullness—best be overcome? How can the spirit of competitiveness be infused into such an organisation?

Wireless World derives great satisfaction from the almost unanimous rejection, by so many organs of public opinion, of the idea of commercial advertising broadcasting in this country. That seems to be a truly representative decision, reflected in publications of such widely divergent political views as *The Times* and the Communist Party's booklet "The B.B.C." As *The Times* said (February 12th): "British listeners have become accustomed to the conception of broadcasting as a public service." Commercial broadcasting might have a temporary success through its novelty, but we are convinced that its adoption would in the long run restrict development.

But, though we emphatically reject commercial broadcasting, we hope and expect to see drastic changes in the present system. *Wireless World* has long held the view that the element of competitiveness is desirable, and, moreover, that it is not incompatible with a monopolistic public service. We are glad to see that view is quite widely shared.

Some of the advocates of competition, inspired probably by B.B.C. public pronouncements, seem to think that the desired aim can be achieved by encouraging "a healthy rivalry" between B.B.C. Regional organisations. That, in our view, falls far short of what is needed. Listeners in one region will know little of what is being achieved in another except when a local programme is relayed over the National service.

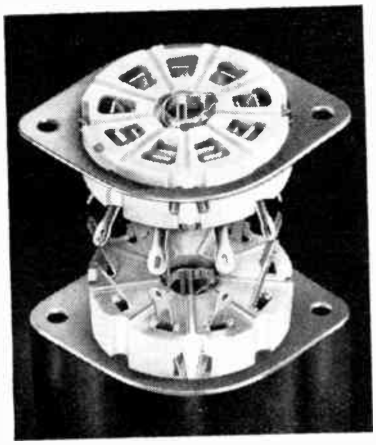
Independent Broadcasters

A more interesting proposal is that put forward by *The Economist* in a series of well-considered articles published at the end of last year. Briefly, the scheme provided for three independent broadcasting concerns: one a public corporation like the B.B.C., the second a co-operative enterprise, governed by directors elected by its staff, and the third a profit-making company providing its own capital but not broadcasting advertisements. All would derive revenue from a fixed proportion of each licence fee, and, in addition, each listener would nominate the corporation of his choice to receive a further proportion of his licence fee. The obvious objection is that the scheme would be costly, almost certainly involving an increased licence fee. Admittedly, *Wireless World's* own less ambitious proposal, put forward in October, 1942, was open to similar criticism. We advocated two entirely independent "Programme Boards" under directors responsible only to Parliament. It seems inescapable that the stimulus of competition must be paid for, but, in an art like broadcasting, it seems to be worth something.

TRENDS IN COMPONENT DESIGN

Review of a Wartime Exhibition

ALTHOUGH the recent exhibition of components organised by the Radio Components Manufacturers Federation (under the auspices of the Radio Industry Council) was primarily for the purpose of showing what is available for designers of Service equipment, even the most superficial examination showed that many of the exhibits will be directly applicable to peacetime uses. Other components embody new manufacturing methods or techniques that are certain to find wider applications in the future. It is with these ideas in mind that this short review of the exhibition is written.



Top and bottom views of "Clix" type B9G valve-holder for all-glass valves. The sockets are anchored to minimise the risk of flash-over between pins or breakage through misalignment.

In addition, this description will help to show, in greater detail than has hitherto been permissible, the manner in which the British radio industry has met the needs of the Armed Forces.

The importance and implications of two of the more obvious trends of design—miniature components and "tropicalisation"—need hardly be stressed. The first will greatly widen the possible applications of radio, while the second should help in putting our post-war export trade on a sound foundation. A manufacturer who can satisfy the exacting demands of the Services should find it easy to produce components capable of withstanding any climate.

It should be emphasised that the productions described in this review are not necessarily commercially available at the present time, though doubtless many of them—perhaps with modifications—will eventually become so.

Connectors and Switches.—The war has seen a wide expansion in the number and types of multiple plugs and sockets for interconnecting the various units in communication equipments, and considerable thought has been devoted to the effects of vibration.

Attention has been given to the prevention of wire breakage at the point where the multiple cables leave the plugs and sockets, and many types are now shrouded in moulded rubber with a long tapered extension to distribute bending strains over several inches of the cable. In the Pye snatch plugs and sockets the contacts are solid and are bonded directly to the rubber.

So far as spring contacts are concerned the problems of the designer have been eased to some extent by the remarkable properties of beryllium copper alloy, which is the ideal non-ferrous spring material. Its resistance to bending fatigue is exceptionally high and the temper of the metal is unaffected by soldering.

The performance of switches has also been improved by the use of this new alloy. Rotary switches of the wafer type still appear to hold the field for circuit switching, but there were also many new types, including miniature snap action plunger switches for operating safety devices, temporarily inserting meters in supply lines and a score of other purposes.

A standard moving-coil unit is used both in the microphone and the earpieces of the No. 10 headset shown by Goodmans.

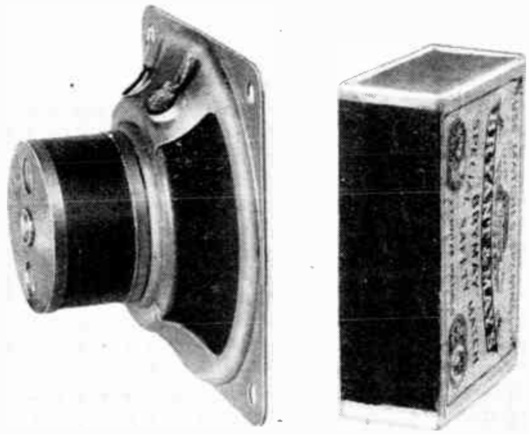
Valveholders have improved considerably under the strenuous conditions of war, and particular attention has been given to the question of securing continuous contact under severe vibration. In the "Bericon" valveholder of Radio Instruments, Ltd., for instance, silver-plated beryllium copper is used for the spring sockets. The new all-glass technique in valve manufacture has also called for a revision of principles in valveholder design. Fully floating sockets which may set at different angles when wired with heavy-gauge conductors have given trouble by putting undue strains on the valve pins. This has been overcome in the Clix B9G valveholder by rigidly locating the soldering tag while leaving independent movement to the spring element of the socket. The insulated body of these holders may be either Frequentite "R" or silica-loaded polystyrene, and another interesting feature is the method of fixing the metal saddle or flange, which permits top or bottom panel fixing in the same diameter hole.

Acoustic Devices.—These were represented mainly by microphones and earpieces. The moving coil principle predominates in both applications, chiefly on account of its reliability, and, in the case of the microphone, the absence of the necessity for an external source of power. Moving-coil headphones have been found to give better intelligibility through the high background noises prevailing in tanks and aircraft, possibly because of the absence of peaks in the response over the frequency range employed. Improvements in permanent magnet alloys and skill in manufacture have reduced the size of these movements to extraordinary small proportions. In the Goodman's Type 10, for instance, the moving coil is only ½in. in diameter and consists of four layers of 46 SWG in a 0.032-inch gap. The permanent magnet is less than 1in. in diameter.

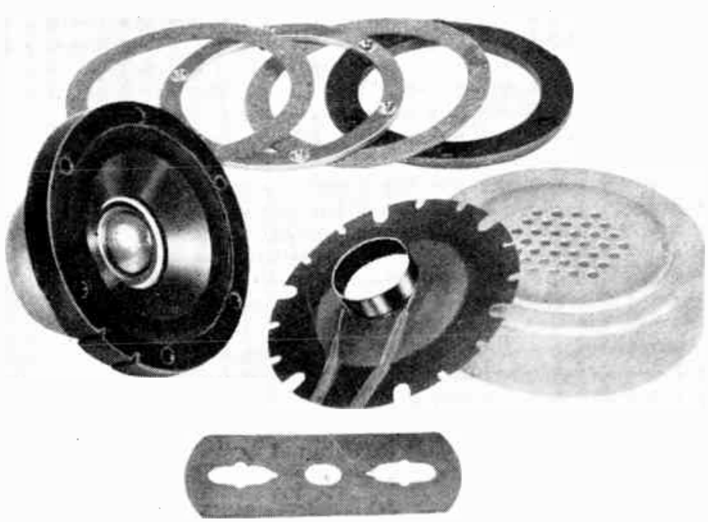
Another interesting earpiece development was shown by Cosmocord. This consists of a piezo-electric capsule moulded in very thin plastic material and shaped to fit into the ear. There is no air passage and sound is transmitted through the thin casing so that the crystal element is completely protected against the effects of moisture.

Before leaving the subject of microphones, mention should be made of the Telephone Manufacturing Company's "Sound Powered Microphone." This is essentially a balanced armature movement of high sensitivity incorporated in a typical telephone hand set and designed to work without batteries—a very desirable feature for marine use.

As far as domestic loudspeakers are concerned, manufacturers have so far formed only tentative plans for post-war models.



(Right). Celestion 2¼in. speaker, Model P2VO.



(Below). Component parts of the Goodman's No. 10 moving-coil movement compared with a safety razor blade. An ingenious self-centring magnet assembly is employed and moisture is excluded from the diaphragm by a thin polythene membrane.

Thought is being given to the improvement of high-fidelity speakers for use with quality amplifiers and also to the question of providing an economical and acceptable standard of reproduction for post-war mass-produced sets. The probability that personal portables and other types of miniature receivers will figure prominently in the post-war programme has not escaped attention. The P2VO Celestion unit with 2¼in. diaphragm weighing only 3½ oz. is a typical example. In the design of the Celestion P6Q1 6in. loudspeaker the trend towards smaller wireless sets has been taken into account. Advances in permanent magnet alloys have enabled a much smaller magnet volume to be employed, and not only is the depth of the unit reduced but the design of the chassis is such that components can be mounted on either side much closer to the speaker axis.

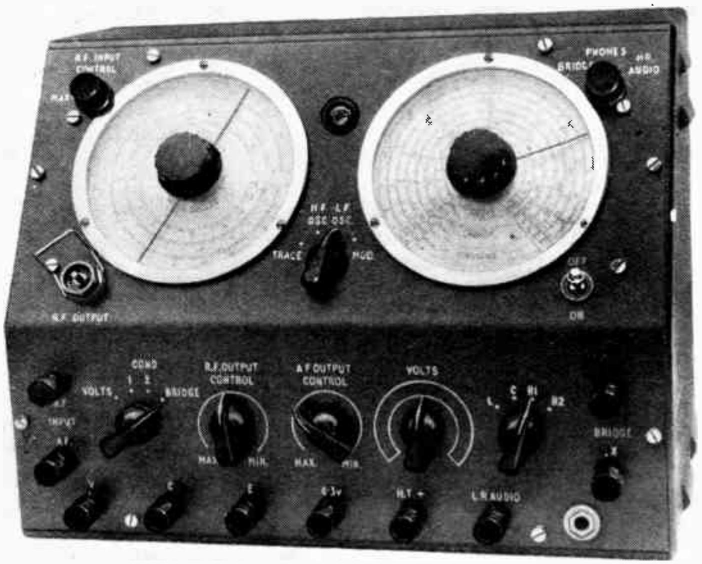
Measuring Instruments. — In

Comparison between the pre-war Celestion Model PM CDB (right) and the new Model P 6Q1 speaker (left), showing reduction in space occupied. Both units have 6 inch diaphragms.

Trends in Component Design—

basic design meters do not appear to have changed much, but one or two novel features were noted. The 2in. Ferranti meters, for instance, have been produced in a hermetically sealed case which nevertheless retains an external zero adjustment. A series of these instruments were shown working in an aquarium with tropical fish to point the moral. Even smaller types are envisaged for the post-war period, and a $1\frac{1}{2}$in. model was shown with an experimental Perspex front cover designed to give a wider angle of vision. Salford Electrical Instruments were showing an advanced model of a general test meter for voltage, current and resistance in which an ingenious mechanical interlocking system is provided for the range switches. An automatic cut-out, which can be reset by a press-button, affords additional protection for the meter.

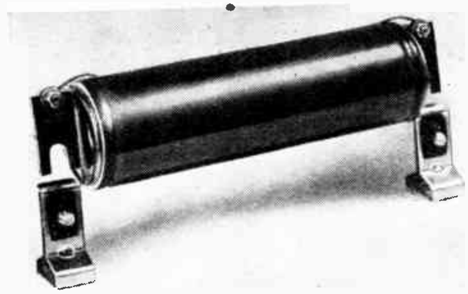
A useful test instrument for the service bench was shown by Labgear. This is known as the "Electronic Fault Tracer" and comprises RF and AF oscillators which can be combined to provide a modulated signal source, and also a 1,000 c/s bridge for measurements of inductance, capacity and resistance over wide ranges. The oscillator valves can also be switched to form a simple det-AF receiver for signal tracing.



Labgear "Electronic Fault Tracer" for general testing and service work.

A neon lamp serves both as an insulation tester for condensers and as a peak voltage indicator calibrated for AC and DC above 50 volts.

Cables.—The use of increasingly high radio frequencies for all purposes has stimulated the cable industry to great activity and the possibilities of new materials have been exploited to the full. The excellent dielectric properties and low water absorption of polyethylene have secured for it a dominant position as a spacing material. Some examples of terminated coaxial lines by Callender's Cable and Construction Company were noted for their excellent workmanship. This firm was also showing a series of flexible joints for wave guides. The Telegraph Construction and Maintenance Company were showing flexible coaxial cables with spiral thread, fin and disc spacers in "Telcothene" and also balanced twin cables with polyethylene insulation. For extremely high frequencies (of the order of 1,000 Mc/s) solid polyethylene dielectric is used, as the discontinuities of spacers give rise to reflections. Semi-flexible cables of this type were shown by Callender's and T.C.M.



Bercohm heavy-duty vitreous enamel resistors fitted with knife-blade end contacts. Shown also is the fixed contact with clamping device, which are also manufactured with insulated fittings for metal panels.

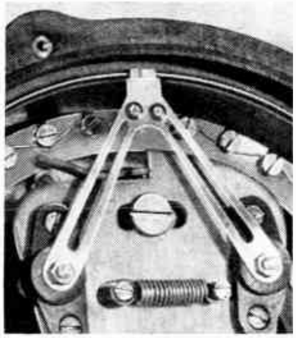
Resistors.—Three distinct lines of development can be traced in the latest types of fixed resistors. First, there is the general one of "tropicalisation," secondly, the expansion of the midget ranges, and thirdly, the further development of the high-stability, close-tolerance types. Whilst the first-mentioned is largely a wartime measure, so many advantages attend this form of construction, not only for overseas use after the war but also for home consumption, that it is to be hoped they will survive the war period.

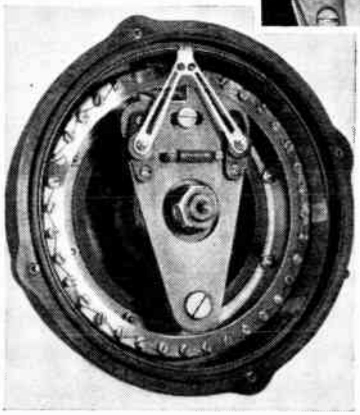
Protection is sometimes provided by totally enclosing the resistor in an hermetically sealed tube, as typified by the Dubilier and Mullard tropical variety, sometimes by a hard coating of a protective material, as in the Welwyn Electrical Laboratories miniature vitreous enamel type and the Bercohm series made by the British Electric Resistance Company. The alternative method of enclosing the resistor in a plastic moulding is adopted by Erie for some of their latest midget styles.

Vitreous enamel wire-wound resistors for heavy-duty purposes are now being made by quite a number of firms, prominent among which are British Electric Resistors, Erg, Erie and Painton.

Rheostats and Potentiometers.—Excluding precision and laboratory-type variable resistors in which class abnormal values are not uncommon, the production by Reliance Manufacturing Company of a 0.5 megohm wire-wound potentiometer in a case under

Correction for non-linearity is effected at every 10 degrees of rotation in the Colvern cam-corrected 6½in. potentiometer. Details of the mechanism are shown in the enlarged section on the right.





3in. in diameter is a notable achievement. Although extremely fine gauge wire has to be used, precautions are taken in manufacture to prevent any lateral movement of the turns by the friction of the moving contact.

Potentiometers designed for continuous rotation, and suitable for being driven by a motor if required, were shown by P. X. Fox. Toroidal windings are employed and it is claimed that the linear accuracy is better than 0.1 per cent. for all values up to 30,000 ohms, which is the maximum in this style.

An unusual type of precision potentiometer in which any non-linearity in the winding and random variations in the resistance of the wire itself can be compensated for in individual potentiometers has been developed by Colvern. The moving contact is not driven directly by the operating spindle, but is actuated by a spring-loaded subsidiary lever, the rate of rotation of which is retarded or accelerated by the contour of a circular ramp over which it rides. The contour of this ramp is adjustable at every 10 degrees of rotation in the 6½in. diameter potentiometers and at every 20 degrees in the 3½in. diameter models. Resistance values up to 100,000 ohms are obtainable in this form, which is described as a cam-corrected potentiometer.

A number of laboratory-type variable resistances, potentiometers and attenuators were shown by Muirhead and Labgear.

Capacitors.—The latest improvements in fixed condensers take the form mainly of reduction in size and special methods of manufacture to withstand high ambient temperatures and excessive humidity. In some cases the condensers are impregnated with special waxes, whilst in others the units were enclosed in light metal cases hermetically sealed to exclude moisture. The main interest lies in the methods adopted to seal the container, especially as insulated terminals, or lead-out wires, have to be provided.

The Telegraph Condenser Company fit a resilient synthetic rubber end-plug in the metal cases used for their latest range of Metalmite paper condensers and Picopack and Micropack miniature dry-electrolytic condensers. Metalmite tubular paper condensers vary in size from 0.2 to 0.34in. in diameter, and in capacity from 0.001 mfd. to 0.1 mfd. at working voltages up to 500 DC. With body dimensions of 1 9/16in. by 0.34in. diameter the Picopack electrolytics are probably the smallest of their kind. At one end of the range is a 20-mfd. 12-volt working condenser, while at the other there is a 1-mfd. 350-volt type.

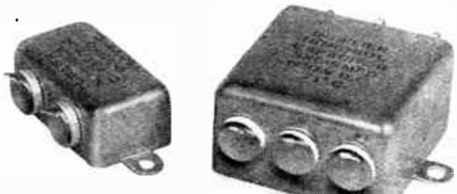
Ceramic bushes, with parts of their surfaces metallised for soldering into the container, are used by Dubilier for terminal insulation on their latest Nitrogol range of condensers. Nitrogol is a new impregnant having some of the advantages of a mineral oil, but, being less volatile, is far less prone to creepage. It possesses a high insulation resistance, especially at high temperatures, and so a considerable reduction in size of a condenser for a given set of working conditions is made possible.

The range includes large capacity as well as medium capacity condensers for operation at high and low voltages. There is also a number of sizes of flat condensers with the connections brought out through the sides to facilitate under-chassis assembly. For example, a 3 × 0.05-mfd. condenser for 600-volts DC working is assembled in a sealed metal case measuring 2in × 2in. × 1in. approximately.

British Insulated Cables have a new range of tubular condensers

B.I. tropical pattern tubular condenser assembled in ceramic tube with soldered-on end-caps.

assembled in ceramic tubes with metallised ends to which are soldered metal end-caps. This exemplifies but another of the several processes now adopted for hermetically sealing condensers to comply with what is described as tropical specification.



Under chassis type Dubilier Nitrogol condensers with side contacts and ceramic insulation. This is a tropical style suitable for use under conditions of high ambient temperatures.

Trends in Component Design—

Almost all makers of fixed condensers have produced one or more series of sealed miniature condensers, some typical examples being found among the products of such firms as Bulgin, British N.S.F., Dubilier, Erie, Hunt, Mullard and T.C.C.

Variable Condensers.—These appear to have been subject to fewer changes in construction or in design than most other components. Leaving out the special patterns evolved to meet particular requirements the principal changes are in the production of some really miniature gang assemblies.

The precision assembly work needed to manufacture midget variables of large capacity when directed to the production of small UHF condensers has resulted in the appearance of some minute

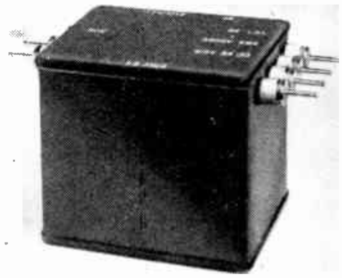
Good response over the essential speech frequency band is claimed for these midget AF transformers made by Bulgin. Bakelite cased and open types are available.

variables. A single bearing of generous proportions is generally used, thus avoiding loops in the framework likely to produce spurious resonant circuits.

Such condensers should find many applications in television receivers, as the extremely small dimensions will enable a really efficient layout of the RF circuits to be effected. These miniatures were shown by Cyldon, Jackson Bros., Plessey, Stratton and Wingrove and Rogers.

AF and Power Transformers.—With but a few exceptions the improvements made in the technique of transformer construction take the form of improved processes of impregnation and new methods of winding to minimise the risk of breakdown, especially in the extra-high-voltage type of transformer.

Bulgin now has a range of miniature AF transformers that must surely be the smallest so far



Haynes tropical-type transformer with heat dissipating terminal stems and discs to protect the ceramic bushes when soldering external connections.

produced as a production article. By the use of Mumetal cores a primary inductance adequate for most practical purposes of speech reproduction is obtained provided the transformer is shunt-fed.

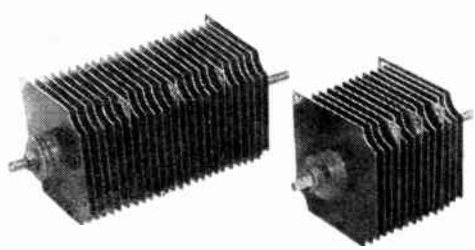
Some interesting departures from recognised practice were observed on examination of the latest range of "tropicalised" chokes and transformers made by Haynes Radio. These are assembled in hermetically sealed metal cases, and in order to obtain an air- and water-tight joint at the leading-out terminals metallised ceramic insulators are soldered into the container at these points. The metallising only extends, of course, over that portion of the ceramic material adjacent to the metal container.

Some of the power transformers were remarkably small for their rating, but it transpired that these were for use on AC supplies of well over 1,000 c/s. The employment of these high supply frequencies for operating radio equipment must contribute very largely to a reduction both in size and weight of the associated transformers and smoothing equipment.

Further examples of the use of metallised ceramic terminal insulators soldered into metal containers to achieve a "tropical" form of construction were found in a range of small transformers made by English Electric. This firm are also makers of that lesser-known type of transformer known as a rotary transformer, now very largely used as the power supply unit in all kinds of mobile radio equipments. Celestion and Standard Telephone were also producing many types of these machines.

Rectifiers.—A range of HT and LT selenium-type rectifiers known as the Westalite series was introduced by Westinghouse Brake and Signal Company in 1939, since when further development has resulted in all rectifiers in this series now being capable of operation at twice the original voltage for the same current rating. In effect, this means that for a given voltage and current rating the weight and bulk are reduced to approximately half the former values.

The modification takes the form of doubling the reverse resistance of the rectifier element, which in its present form is now described as the double-voltage Westalite rectifier. It is claimed that the new type shows an efficiency of about 87 per cent. on full load. The model 15B/168, a double-voltage rectifier for bridge connection and rated at 140 volts, 125 A, measures 1¾in. × 1¾in. × 2in. long. In addition to HT and LT types the double-voltage elements are now assembled in



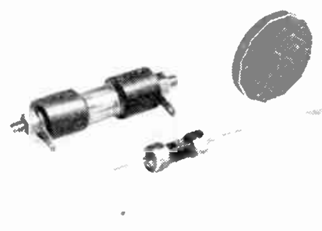
Westalite selenium HT rectifiers: both have the same voltage and current rating. The smaller is the new "double - voltage" type. The models illustrated are designed for use as bridge-connected units.

rod form for use as extra-high-voltage rectifiers for cathode-ray tube equipment.

Another innovation is the introduction of a miniature version of the well-known Westector. Type designations W and WX are retained, as the electrical characteristics remain unchanged; only the dimensions are affected, the new model measuring approximately $\frac{1}{2}$in. long by $\frac{7}{32}$in. diameter. Four of these miniature type WX1, for example, used in bridge connection will form an instrument rectifier for meters having a full-scale deflection of 0.1 milliamp, thus giving an AC voltmeter with a resistance of 10,000 ohms per volt.

A wide range of selenium rectifiers in improved form were shown also by Standard Telephones and Cables.

Relays.—The score or more of different types of relays shown by Relay and Key Panel exemplifies the widespread use now being made of relays, not only for remote control purposes but also as a means for simplifying the operation of quite complicated radio equipments. The Standard Telephones pulse-operated automatic keying unit, which can be used either for distress signals or as a calling device, also operates on the relay principle; further examples were found in the high-speed telegraph relays made by Telephone Manufacturing Company and by Automatic Telegraph and Transreceiver Company.



Miniature Westector and its larger prototype, compared with a threepenny piece. The rating of both is the same.

The Carpenter relay produced by T.M.C. gives absolute smooth operation up to 750 words per minute morse, whilst even higher speeds are claimed with quite satisfactory reliability. The A.T.T.C. showed actual recordings on tape made with their high-speed keying relay at 350 w.p.m. and at 900 w.p.m. The clear-cut regularity of the morse characters was remarkable.

REFLECTIONS ON THE COMPONENTS SHOW

Ideas for the Industry

By "RADIOPHARE"

THE most noticeable feature of the recent Exhibition was, to my mind, the solidity of the modern component. Rationalisation and tight specifications have led to the design and production of components which appear to be "finished" and robust. Things look as though they are built to last nowadays. This was particularly noticeable on the stands showing mains transformers: too often in the past the most intimate details of a transformer's structure have been revealed to a curious world. Now we have completely enclosed and sealed transformers with smooth, clean lines. Whether these things are available in quantity is not very clear: exhibitions always tend to be optimistic. The use of ceramics and of polythene moulding techniques also show the same "solidification" tendency: more and more the component is becoming a minimum sub-assembly. Some exhibits show this development very clearly. Of course, we must bear in mind that the components shown were not designed for use in broadcast receivers, but were intended to provide the reliability demanded for Service needs.

The component makers are coming to realise that their prosperity does not depend upon themselves alone. A strong and healthy equipment manufacturing industry is needed to provide their steady basic market. While the main support must come from the broadcast receiver industry, the specialist firms making transmitters, signal generators and such things are of considerable importance in the long-term view, particularly when export trade is considered. The specialist firms have national prestige value which affects the broadcast set market, and thus the component trade. Some of the component makers realise that in the years to come they must play their part in an integrated industry. On the one hand they must keep costs down by every hundredth of a penny, so that simple receivers can be made at the lowest possible prices; on the other hand, they must help the makers of transmitters to avoid every second possible of "technical hitch." In addition, the assembly of receivers in various parts of the Empire—particularly India and Australia—opens up a new market which must not be neglected. The present high standards must be maintained, and some continuance of standardisation of sizes and shapes is desirable. If there is a return to design anarchy there will be no hope of a healthy industry when the post-war boom is over. If we export rubbish we shall soon find that we have no export trade left.

Although, as I have said, components nowadays are very good, there is still not enough known about their actual properties. It is known that certain specification requirements are met, but it is very difficult to find anyone who can say just how good or how bad a particular component is. This means that an equipment designer must always use full specification limits if he is conscientious. A view expressed by some exhibitors was that the batch sampling clauses of the I.S.C.Tech.C. specifications, which are, in fact, a sort of quality control, will provide the opportunity and incentive for the continuance of research and study which so often stop when a satisfactory product has been achieved. Whether it is only the more enlightened manufacturers who will accept quality control with a good grace is not known. But it promises well for the future that these issues were clearly seen by at least some of the exhibitors.

LIST OF EXHIBITORS

The following list of exhibitors at the R.C.M.F. Components Exhibition, reviewed in the preceding pages, gives the principal classes of components shown by each manufacturer.

Firm	Classes of Exhibits
A.B. Metal Products, Ltd., Hatton Works, Great South West Road, Feltham, Middx.	Switches, sockets, stampings.
Advance Components, Ltd., 25a, Back Rd., Shernhall St., Walthamstow, London, E.17.	RF and AF coils, chokes and transformers.
Aeronautical & General Instruments, Ltd., Purley Way, Croydon, Surrey.	Precision instruments, dials, switches, transformers, valveholders, etc.
Aladdin Radio Industries, Ltd., Aladdin Building, Greenford, Middx.	Iron-dust cores.
Antiference, Ltd., Plender Pl., Plender St., London, N.W.1.	Aerial equipment, chokes, suppressors.
Associated Technical Manufacturers, Ltd., Vincent Works, New Islington, Manchester, 4, Lancs.	Insulating sleeving.
Automatic Telephone & Radio Transceiver Co., Ltd., 329, High Holborn, London, W.C.1.	Telegraph relays.
Belling & Lee, Ltd. Cambridge Arterial Rd., Enfield, Middx.	Aerial equipment, suppressors, terminals, plugs and sockets, valveholders, miniature components.
Bird, Sydney S., & Sons, Ltd., Cambridge Arterial Rd., Enfield, Middx.	Variable condensers.
Bray, Geo., & Co., Ltd., Leicester Pl., Blackman Lane, Leeds, 2, Yorks.	Ceramic products.
British Electric Resistance Co., Ltd., Queensway, Ponders End, Middx.	Potentiometers, wire-wound resistors, switches.
British Electrolytic Condenser Co., Ltd., Vicarage Lane, Ilford, Essex.	Electrolytic condensers.
British Insulated Cables, Ltd., Prescot, Lancs.	Cables, wires, condensers.
British Mechanical Productions, Ltd., 1, Church Rd., Leatherhead, Surrey.	Plugs and sockets, connectors, valveholders, mouldings.
British N.S.F. Co., Ltd., Dalton Mills, Dalton Lane, Keighley, Yorks.	Condensers, plugs and sockets, resistors, switches, vibrators.
British Rola, Ltd., Georgian House, Bury St., St. James, W.1.	Loudspeakers, transformers, laminations.
Bulgin, A. F., & Co., Ltd., Bye Pass Rd., Barking, Essex.	Radio components of all types.
Bullers, Ltd., The Hall, Oatlands Drive, Weybridge, Surrey.	Ceramic products.
Callenders Cable and Construction Co., Ltd., Hamilton Hse., Victoria Embankment, London, W.C.2.	Cables, cable connectors, sleeving, mouldings.
Carr Fastener Co., Ltd., Stapleford, Nottingham.	Metal stampings, eyelets, fasteners, soldering tags, plugs and sockets, valveholders, etc.
Celestion, Ltd., Kingston-on-Thames, Surrey.	Loudspeakers, transformers, valveholders, plugs and sockets.
Colvern, Ltd., Mawneys Road, Romford, Essex.	Wire-wound resistors, potentiometers.
Cosmocord, Ltd., 700, Great Cambridge Rd., Enfield, Middx.	Piezo-electric crystal products, remote control units, transformers.
Cossor, A. C., Ltd., Cossor House, Highbury Grove, London, N.5.	Fixed condensers, coils, chokes, potentiometers, transformers.
Daly Condensers, Ltd., West Lodge Works, The Green, Ealing, London, W.5.	Electrolytic condensers.
De La Rue Insulation, Ltd., Imperial Hse., 84/86, Regent St., London, W.1.	Dials, laminated plastics, sleeving, wires.
De La Rue Plastics, Ltd., Imperial Hse., 84/86, Regent St., London, W.1.	Plastic mouldings.
Diamond H Switches, Ltd., Gunnersbury Ave., London, W.4.	Rotary and toggle switches, plugs and sockets.
Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Rd., N. Acton, London, W.3.	Condensers, resistors.
Duratube and Wire, Ltd., Faggs Rd., Feltham, Middx.	Cables, wires, sleeving.
Electrothermal Engineering, Ltd., 270, Neville Rd., London, E.7.	Valve retaining devices.
English Electric Co., Ltd., Queen's Arch, Kingsway, London, W.C.2.	Chokes, transformers, etc.
Erg Resistors, Ltd., 1021a, Finchley Rd., London, N.W.11.	Wire-wound resistors.
Erie Resistor, Ltd., Carlisle Rd., The Hyde, London, N.W.9.	Condensers, carbon and wire-wound resistors.
Ferranti, Ltd., Hollinwood, Lancs.	Meters, condensers, chokes, transformers.
Film Industries, Ltd., 60, Paddington St., London, W.1.	Loudspeakers, microphones.
Fox, P. X., Ltd., Hawkesworth Rd., Horsforth, Yorks.	Potentiometers.
Goodmans Industries, Ltd., Lancelot Rd., Wembley, Middx.	Loudspeakers, headphones, microphones, transformers, volume controls.
Gresham Transformers, Ltd., Twickenham Rd., Hanworth, Middx.	Chokes, transformers.
Haynes Radio, Ltd., Queensway, Enfield, Middx.	Transformers.
Hunt, A. H., Ltd., Bendon Valley, Garratt Lane, London, S.W.18.	Condensers.
Imhoff, Alfred, Ltd., 112/116, New Oxford St., London, W.C.1.	Instrument cases, panels, chassis, terminals.
Injection Moulders, Ltd., Westmoreland Rd., London, N.W.9.	Plastic mouldings.
Jackson Bros. (London), Ltd., Kingsway, Waddon, Surrey.	Variable condensers.
Johnson Matthey & Co., Ltd., 73/83, Hatton Garden, London, E.C.1.	Beryllium copper products, contacts, fuse and resistance wires, precious metal products.

Firm	Classes of Exhibits
Labgear, Ltd., Willow Place, Cambridge, Cambs.	Test instruments, RF and AF coils, chokes, resistors, switches, transformers.
London Electrical Manufacturing Co., Ltd., Watt Rd., Hillingdon Estate, Glasgow.	Condensers.
Long and Hambly, Ltd., 51, Highgate Hill, London, N.19.	Rubber mouldings.
Masteradio, Ltd., Vibrant Works, Rickmansworth Rd., Watford, Herts.	Vibrators.
Micanite and Insulators Co., Ltd., Empire Works, Blackhorse Lane, Walthamstow, London, E.17.	Insulating materials, fabrics and sleeving.
Morgan Crucible Co., Ltd., Battersea Church Rd., London, S.W.11.	Resistors, volume controls.
Muirhead & Co., Ltd., Elmers End, Beckenham, Kent.	Precision instruments.
Mullard Wireless Service Co., Ltd., Century House, Shaftesbury Ave., London, W.C.2.	Condensers, resistors, loudspeaker magnets.
Multicore Solders, Ltd., Commonwealth House, New Oxford St., London, W.C.1.	Cored solders.
Mycalex Co., Ltd., Ashcroft Rd., Cirencester, Glos.	Condensers, insulation material.
Orr Radio, Ltd., 30/35, Drury Lane, London, W.C.2.	Valveholders.
Painton & Co., Ltd., Kingsthorpe, Northampton.	Attenuators, resistors, switches.
Panels, W. and Y., 137, Victoria St., London, S.W.1.	Relays, telephone type keys.
Parmeko, Ltd., Aylestone Park, Leics.	Chokes, transformers.
Plessey Co., Ltd., 56, Vicarage Lane, Ilford, Essex.	Condensers, chokes, transformers, loudspeakers, vibrators, etc.
Plessey Co. (The Breeze Division), Ltd., 56, Vicarage Lane, Ilford, Essex.	Conduit, plugs and sockets, miniature components.
Pye, Ltd., Radio Works, Cambridge.	Connectors, plugs, switches, transformers.
Reliance Manufacturing Co., Ltd. (Southwark), Sutherland Rd., Higham Hill, Walthamstow, London, E.17.	Potentiometers, resistors, volume controls.
Reproducers & Amplifiers, Ltd., Frederick St., Wolverhampton.	Loudspeakers, transformers.
Ripaults, Ltd., Southbury Rd., Enfield, Middx.	Aerials, cables.
Rothermel, R. A., Rothermel House, Canterbury Rd., Kilburn, London, N.W.6.	Piezo-electric crystal products, volume controls.
Siegrist, E., Ltd., 39, Berners St., London, W.1.	Rubber sleeves, cable markers.
Spicers, Ltd., 19, New Bridge St., London, E.C.4.	Insulating sleeving.
Standard Telephones and Cables, Ltd., Connaught House, Aldwych, London, W.C.2.	Communications equipment of all kinds.
Static Condenser Co., Ltd., Toutley Works, Wokingham, Berks.	Condensers.
Steatite and Porcelain Products, Ltd., Stourport-on-Severn, Worcs.	Ceramic products.
Stratton & Co., Ltd., Eddystone Works, Alvechurch Rd., West Heath, Birmingham, 31, Warwickshire.	Variable condensers, coils, insulators, junction boxes.
Suflex, Ltd., Aintree Rd., Perivale, Greenford, Middx.	Insulating sleeving.
Symons, H. D., & Co., Ltd., Park Works, Kingston, Surrey.	Insulating sleeving.
Telegraph Condenser Co., Ltd., Wales Farm Rd., North Acton, London, W.3.	Condensers.
Telegraph Construction & Maintenance Co., Ltd., Telcon Works, Greenwich, London, S.E.10.	Cables, sleeving, aerials, laminations, dust cores.
Telephone Manufacturing Co., Ltd., Hollingsworth Works, Martell Rd., West Dulwich, London, S.E.21.	Relays, plugs and jacks, coils, condensers, keys.
Tenaplas, Ltd., Upper Basildon, Nr. Pangbourne, Berks.	Insulating sleeving.
Tucker (Geo.) Eyelet Co., Ltd., Walsall Rd., Birmingham, 22, Warwickshire.	Eyelets, tags, terminals.
United Insulator Co., Ltd., 12/22, Laystall St., London, E.C.1.	Condensers, coil formers.
Varley Dry Accumulators, Ltd., Bye Pass Rd., Barking, Essex.	Accumulators.
Varley (Oliver Pell Control), Ltd., Cambridge Row, Burrage Rd., Woolwich, London, S.E.18.	Chokes, transformers, resistors, switches.
Walter Instruments, Ltd., Exhibition Buildings, Earls Court, London, S.W.5.	Condensers, switches, pointers.
Walter, J. & H., Ltd., Farm Lane, London, S.W.6.	Chassis, press work, stampings.
Wego Condenser Co., Ltd., Bideford Ave., Perivale, Greenford, Middx.	Condensers.
Welwyn Electrical Laboratories, Ltd., 70, Bridge Road East, Welwyn Garden City, Herts.	Carbon and wire-wound resistors.
Westinghouse Brake & Signal Co., Ltd., Chippenham, Wilts.	Metal rectifiers.
Wimbledon Engineering Co., Ltd., Garth Rd., Lower Morden, Surrey.	Vibrators.
Wingrove & Rogers, Ltd., Polar Works, Old Swan, Liverpool, Lancs.	Variable condensers, drives.
Wright & Weaire, Ltd., 740, High Rd., Tottenham, London, N.17.	Coils, transformers, switches, vibrators, plugs and sockets.

SERVICES COMPONENTS STANDARDISATION

A FULL list of the Specifications for radio components so far issued by the British Standards Institution (28, Victoria Street, London, S.W.1) on behalf of the Inter-Service Components Technical Committee is given below. The index and the first-mentioned sixteen of these BS/RC Series cost 6d. each, the remainder 3d. A scheme is available whereby newly issued specifications are posted to subscribers as soon as they are issued.

	Index
BS/RC.G/1	General Guide on Radio Components.
BS/RC.S/1	General Specification for all Radio Components in the BS/RC Series.
BS/RC.S/110	Group Test-Specification for Fixed Resistors.
BS/RC.S/110.1	Test Schedule for Fixed Resistors.
BS/RC.S/120	Group Test-Specification for Variable Resistors.
BS/RC.S/120.1	Test Schedule for Variable Resistors.
BS/RC.S/130	Group Test-Specification for Fixed Capacitors.
BS/RC.S/130.1	Test Schedule for Paper-dielectric Fixed Capacitors.
BS/RC.S/130.6m	Test Schedule for Miniature Paper-dielectric (metallised paper type) Capacitors.
BS/RC.S/130.2	Test Schedule for Mica-dielectric Fixed Capacitors.
BS/RC.S/130.3	Test Schedule for Ceramic-dielectric Fixed Capacitors.
BS/RC.S/130.4	Test Schedule for Electrolytic Capacitors.
BS/RC.S/141.1m	Test and Performance Specification for Miniature Variable Capacitors' (Air-spaced Ganged Type).
BS/RC.S/165m	Group Test-Specification for Miniature Relays.
BS/RC.S/165.1m	Test Schedule for Miniature Normal Type Relays.
BS/RC.S/165.4m	Test Schedule for Miniature High-speed Type Relays.
BS/RC.S/130.1m	Test Schedule for Miniature Paper-dielectric Fixed Capacitors (excluding metallised paper types).
BS/RC.S/130.2m	Test Schedule for Miniature Mica-dielectric Fixed Capacitors.
BS/RC.S/130.7m	Test Schedule for Miniature (High K) Type Ceramic-dielectric Fixed Capacitors.
BS/RC.G/110	Guide on Fixed Resistors.

A New Versatile TONE CONTROL CIRCUIT

2.—Bass and Treble Lift without Variation of Middle Frequencies

By G. N. PATCHETT,
B.Sc., Grad.I.E.E., A.M.Inst.E., Assoc. Brit.I.R.E.

A COMPLETE circuit realising the objects discussed in the first part of this article is shown in Fig. 12. The input is fed into the phase-splitting valve V_1. If fed between A and E, V_1 acts as a cathode follower with an anode resistance R_{12}. (When $R_1 = R_{12}$ this is a well-known phase-splitting circuit used in push-pull amplifiers.) This has the advantage that the loading of the two tone control filters across the cathode resistance R_1 does not produce any distortion in the valve V_1 owing to its low output impedance, the disadvantage of this connection being that the output from across R_1 is only about 0.9 of the input voltage, and if $R_{12} = R_1$ the output from across R_{12} is of similar magnitude. If the input is fed to A and B, as can often be done in a superhet or with a pick-up, the amplification of the valve V_1 is obtained, but, since there is now no negative feedback due the resistance R_1, slightly more distortion may be produced, although, as is shown later by the oscillograph record, this distortion is negligible when the values of the components are correctly chosen. The voltage across the cathode resistance R_1 is fed through the DC blocking condenser C_1 to the bass tone control filter consisting of R_3, C_2 and R_6 and the treble tone control filter consisting of C_3, R_8 and R_{10}. The output from each tone control filter is amplified by the twin triode valve V_2 and fed to the next audio frequency stage through the blocking condensers C_9 and C_{10}, and the isolating resistances R_{18} and R_{19}. The purpose of the latter is to prevent the low impedance of one section of V_2 loading the other section. The voltage independent of frequency is obtained from the anode of V_1 and fed to the output through the blocking condenser C_6 and the isolating resistance R_{17}. The phase-splitting valve V_1 is necessary due to the 180-degree phase shift given to the tone control voltages by the valve V_2.

Only approximately one-third of the output from the valves V_1 and V_2 is obtained across R_{20}, due to the use of the isolating resistances R_{17}, R_{18} and R_{19}. This means that if $R_1 = R_{12}$ and terminals A and E are used, the output at the middle frequencies is only about one-third of the input. The maximum available gain under these conditions at the low and high frequencies is approximately equal to the amplification given by the valve V_2. If such a large increase is not required, greater gain can be obtained at the middle frequencies by decreasing the value of R_1. This increases the output at the middle frequencies since the ratio of the voltage across R_{12} to the voltage across R_1 is determined by the ratio of R_{12} to R_1 and the voltage across R_1 is approximately equal to the input. For example, if an increase of only three times (approx. 10 db) is required, R_1 may be made one-third of the resistance R_{12}, in which case the voltage across R_{12} will be equal to approximately three times the input, thus making up for the loss in the isolating resistances, giving a final gain at the middle frequencies of unity.

By using terminals A and B an amplification of approximately one-sixth of the amplification due to V_1 is obtained if $R_1 = R_{12}$. (Half of the amplification is lost due to the use of the split load R_1 and R_{12}.) Some increase in the amplification may again be

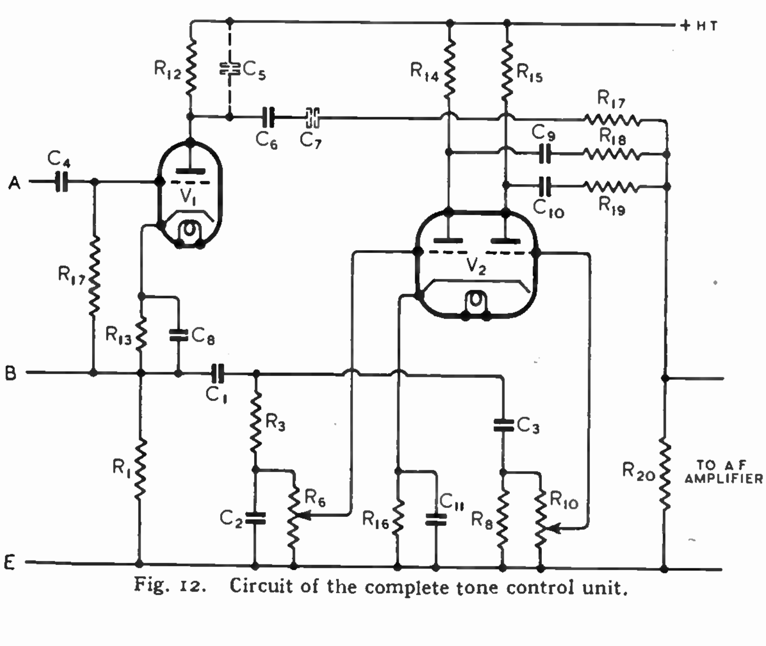


Fig. 12. Circuit of the complete tone control unit.

Component Values (Fig 12)

C_1 -0.5 μF.	R_1 -50,000 Ω.
C_2 -0.05 μF.	R_3 -50,000 Ω.
C_3 -0.0005 μF.	R_6 -2 MΩ.
C_4 -0.05 μF.	R_8 -50,000 Ω.
C_5 -0.01 μF.	R_{10}-250,000 Ω.
C_6 -0.1 μF.	R_{12}-50,000 Ω.
C_7 -0.003 μF.	R_{13}-1,000 Ω.
C_8 -25 μF.	R_{14}-50,000 Ω.
C_9 -0.1 μF.	R_{15}-50,000 Ω.
C_{10}-0.1 μF.	R_{16}-1,000 Ω.
C_{11}-25 μF.	R_{17}-100,000 Ω.
V_1 -6C5.	R_{18}-100,000 Ω.
V_2 -6N7 (or two single triodes, e.g., 6C5's.)	R_{19}-100,000 Ω.
	R_{20}-1 MΩ.

The numbering of these components is the same as that used in the basic circuits.

obtained by increasing R_{12} and decreasing R_1 but at the expense of the maximum increase available at the low and high frequencies.

The characteristics of the complete tone control unit, as shown in Fig. 12 (C_5 and C_7 being omitted)

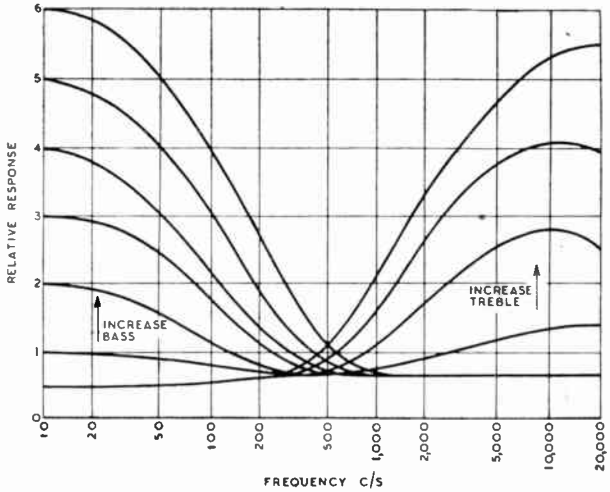


Fig. 13. Experimental results obtained from the circuit as shown in Fig. 12, omitting condensers C_5 and C_7. The "increase bass" readings were taken with the treble tone control at minimum and the "increase treble" readings with the bass tone control at minimum.

was measured by feeding a constant voltage to the terminals A and E and measuring the output by means of a cathode-ray oscillograph, the frequency being varied in steps throughout the audio-frequency range. The results are plotted in Fig. 13, where the actual settings of the tone control are purely arbitrary since the only "volume controls" available were of the non-linear type, these probably being an advantage in actual use. It will be seen that these results agree closely with those calculated and shown by the curves of Figs. 6 and 11. These curves vary slightly from the calculated due to effects which were not brought into the calculations, one of these being that the voltage independent of frequency does not add directly to the "tone control voltage" due to the inevitable phase shift in the tone control filter. This phase shift occurs in practically all tone control circuits, but fortunately does not matter, since the ear does not discriminate between voltages of different phase, but only of different frequency and amplitude. The "droop" at the high-frequency end of the treble increase curves is, no doubt, due to the loss of the very high frequencies in the amplifying valve V_2, due to the stray capacities. This is of little practical importance since it only occurs above 10,000 c/s. It was found that the value of R_{10} should not be made too large otherwise there is a considerable loss of the high frequencies due to this resistance and the input capacity of the valve V_2. The characteristics were also measured using terminals A and B, and found to be very similar, except for a reduction of about 20 per cent. in the maximum increase at the high frequencies, most probably due to the effect of the stray capacities across the load R_1 of the valve V_1. This capacity is not important when terminals A and E are used since the valve V_1 acts as a cathode follower having a low output impedance.

The tone control unit was checked for distortion by a double-beam cathode-ray oscillograph and the oscillograms taken are shown in Figs. 14, 15 and 16. On the oscillogram of Fig. 14, the top waveform is the output and the lower waveform the input, both being to the same scale. The input which was fed to the terminals A and E, was 2.5 volts at a frequency of 10,000 c/s with the treble tone control in the maximum position and the bass tone control in the minimum position. Fig. 15 was obtained with the same input to terminals A and E but at a frequency of 1,000 c/s. with both controls set at minimum. Both waveforms are shown to the same scale but not to the scale of Fig. 14. Fig. 16 was obtained using terminals A and B with a frequency of 50 c/s, with the bass tone control set to maximum

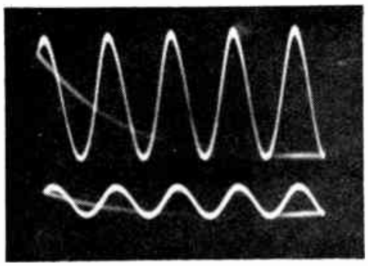


Fig. 14. Oscillogram of the output (top) and input (bottom) at 10,000 c/s. with the treble tone control at maximum and the bass tone control at minimum.

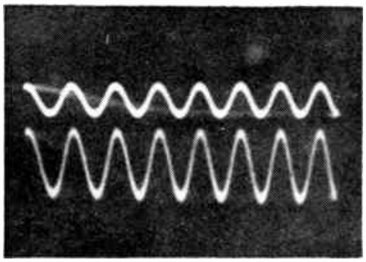


Fig. 15. Oscillogram of the output (top) and the input (bottom) at 1,000 c/s. both tone controls set to minimum.

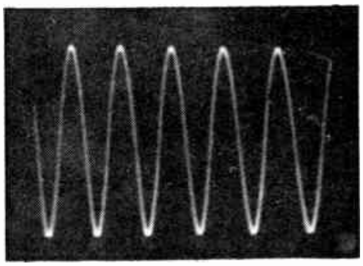


Fig. 16. Oscillogram of the output at 50 c/s. with the bass tone control at maximum and the treble tone control at minimum.

and the treble tone control at minimum. This record was taken with an input of ½ volt, since with this connection the amplification of the valve V_1 is utilised. In all cases the distortion is negligible.

In the arrangement so far described, no facility is made for the reduction of the bass or treble frequencies. This is not always required, since there is normally a reduction in the magnitude of these frequencies due to the imperfections of the loudspeaker and amplifier, and, when on radio, due to sideband cutting. This deficiency can easily be overcome by arranging to feed a voltage from the valve V_1 to the output, which decreases in magnitude at the low and high frequencies, instead of being of constant amplitude. This is achieved by the two condensers shown dotted in Fig. 12. C_5 acts as a partial bypass at the high frequencies and C_7 as a partial block to the low frequencies. Suitable values are 0.01μF for C_5 and 0.003 μF for C_7. The characteristics were taken with these condensers connected and the result is shown in Fig. 17. It will be noted that the results are similar to those of Fig. 13 except that now a decrease in the response at the low and high frequencies is available. The increase at the bass frequencies is greater than before, presumably due to the high reactance of the condenser C_7 at the low frequencies preventing the loading of the output by the valve V_1 through the isolating resistance R_{17}. This method of cutting the low and high frequency response is far preferable to deliberately reducing the response of the main amplifier at the low and high frequencies as this would seriously limit the treble and bass increase available, since the increase in the tone control unit would have to overcome the cut in the main amplifier before any actual increase took place, which is not the case with the above arrangement.

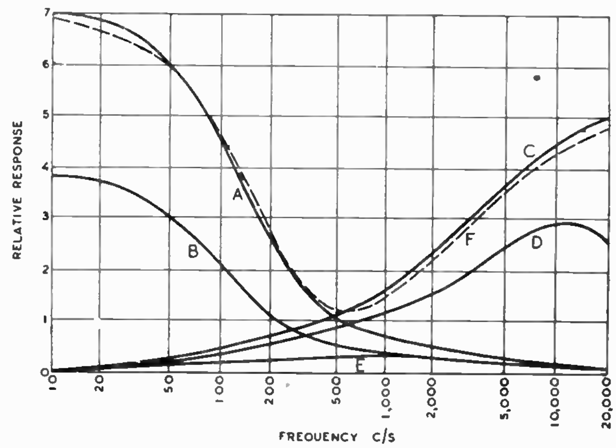


Fig. 17. Measured characteristics of the circuit as shown in Fig. 12 with $C_5 = 0.01\ \mu F$ and $C_7 = 0.003\ \mu F$.

A Max. bass, Min. treble.
B ½Max. bass, Min. treble.
C Min. bass, Max. treble.
D Min. bass, ½Max. treble.
E Min. bass, Min. treble.
F Max. bass, Max. treble.

If a more versatile arrangement is desired the condensers C_2 and C_3 may be varied by means of a selector switch, so that the frequency at which the increase starts may be altered. The values given for C_2 and C_3 are suggested more as a guide rather than being the most suitable values since they are best obtained by trial, the values depending somewhat on the remainder of the apparatus in the reproducing chain and also to some extent on the individual.

The tone control unit can be modified so that it may be used as a tone-compensated volume control, as well as for tone control. As is well known, if the volume is reduced with the normal volume control the reproduction tends to be become " thin " due to the reduced sensitivity of the ear at low and high frequencies when the volume is low. In order to compensate for this, the bass and treble frequencies should be increased relative to the middle frequencies, as the volume is reduced. This may be achieved in the circuit shown in Fig. 12 by making the resistance R_1 in the form of a fixed resistance of say 15,000 ohms with a variable resistance of 150,000 ohms. When the terminals A and E are used, the voltage across the cathode of V_1 (the voltage feeding the tone control filters) is nearly independent of the value of R_1 and is approximately equal to the input. With the variable resistance at the minimum value the output from the anode of V_1 will be at a maximum since the voltage on the anode is approximately equal to R_{12}/R_1 of the voltage across R_1, which is very nearly the input voltage. This corresponds to the maximum volume position. The bass and treble may be altered by about 10db. by R_6 and R_{10} and should be set for the best reproduction at this volume. As the variable resistance is increased the output from the anode will decrease since R_{12}/R_1 is decreased, thus reducing the volume, but since the input to the tone control filters remains the same, the bass and the treble frequencies will increase compared with the middle frequencies, i.e., at half volume they will be twice as great com-

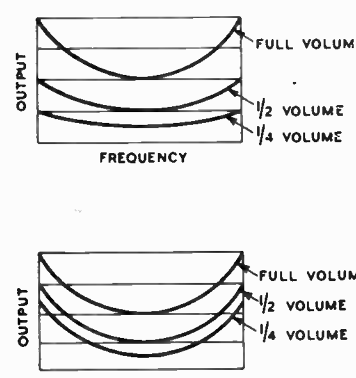


Fig. 18. The upper sketch shows the effect of a normal volume control, while the lower sketch shows the effect of the variation of the variable portion of the cathode resistance R_1.

pared with the middle frequencies as they were at full volume. This is shown in Fig. 18. If this change in the response curve is too drastic, a result in between this and that given by a normal volume control may be obtained by ganging the variable resistance portion of R_1 and the normal volume control together. Variation of R_1 should, of course, only be used for the normal volume changes, the volume being set approximately correct either by a preset volume control or by the design of the amplifier.

Two other modifications have occurred to the author, but have not actually been tried, and are mentioned as ideas which may appeal to some readers. Firstly, by using two heptode valves (such as 6L7's) to replace V_2, the tone may be controlled by varying the DC potential on the third (oscillator) grid of the valves. This type of circuit is used in many volume expander circuits.

This is very adaptable to remote control, since the wires may be extended for considerable distances without having any ill effects on the response of the amplifier, as the wires only carry a DC potential. Secondly, instead of mixing the output from the valves V_1 and V_2 (two sections), as in Fig. 12, these could be fed into three audio-frequency amplifiers feeding three loud speakers, one designed for low frequencies, one for middle frequencies and one for low frequencies. This arrangement would prevent any intermodulation of the high frequencies by the low frequencies in the loudspeaker. The author hopes to try this sometime in the future.

Although the circuit of the tone control filter may at first appear complicated, most of the components are cheap and the author has found the circuit well worth while and has used it on a high-quality reproducing equipment for over a year with every satisfaction. It is obviously only suitable for high-quality reproduction, its merits not being obtainable if the remainder of the equipment has a poor frequency response, produces distortion or is very limited in output power.

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POST-WAR AMATEUR TRANSMISSION

As a result of conversations that have taken place between the Radio Society of Great Britain, the Post Office and other Government departments, the Society recently issued a statement on questions affecting the licensing of amateur transmission after the war. Some of the principal points from the statement are given below. It should be emphasised that final decisions cannot be reached until hostilities end.

It is the intention of the G.P.O. to restore facilities to all pre-war, full-licensed amateurs who make application after a date to be announced later. The G.P.O. is likely to agree that artificial aerial licences shall be abolished, and, if so, pre-war holders of such licences would be able to obtain full licences subject to proof of Morse proficiency. Applicants for new licences will normally be required to pass a Morse test and a simple technical examination, but ex-Service applicants who can produce proof of proficiency may be excused one or both of the tests, depending on the nature of their wireless experience gained in any of the Services.

Three classes of licence are envisaged: A, 25W (telegraphy only except by special application) to all new applicants; B, 150W (telegraphy and telephony) after 12 months; C, high power, for experimental work of scientific value.

The R.S.G.B. has asked that all frequency bands allotted internationally for amateur use should be available; the G.P.O. has also been asked to support the request that, in addition to the normal bands ranging from roughly 1.7 to 60 Mc/s, permission should be given to use the 21-22 Mc/s band as well as a number of new "sample bands" in the VHF region. If it is not possible to continue the harmonic relation beyond 56-60 Mc/s, it is suggested that a new datum point be assigned at, say, 130 Mc/s, doubling to 260 Mc/s, 520 Mc/s, etc. Although it cannot yet be stated whether these requests will be granted, the Society intends to press for the most liberal treatment of British amateurs.

Letters to the Editor

Miniature Radio • Technical Training • Television Ethics

Our New Receivers

MAY I suggest that, when post-war production of broadcast receivers gets under way, radio manufacturers call a halt to the inexplicable tendency towards producing smaller and still smaller chassis?

One expects compactness in car radios and in sets designed as midgets, but I have seen consoles and large radiograms in which the chassis has been not much bigger than a cigar box.

From a service-man's angle, apart from any technical considerations, these tiny metal trays, crammed with components and masses of wiring are nothing short of a nightmare.

Perhaps, too, with the advent of a reasonably sized chassis, the weakest link in the modern receiver—the high voltage electrolytic condenser—might give way to the larger but more reliable paper type, and so eliminate at least twenty per cent. of all breakdowns.

S. GOULD.

Swindon.

Future of Miniature Radio

HAS miniature radio any future? If a Gallup Poll were taken on the subject the general reply would be a definite "No." General opinion seems to be that the public require nothing more than a mains broadcast receiver of a good pre-war standard at a reasonable price, and that a miniature receiver might hold a brief interest as a mere novelty.

But there is a matter of great social concern which is frequently referred to by the B.B.C.; it is the question of the over-noisy wireless set. Engineers and sociologists have sought various ways of finding an answer to noise, but they have failed to look in the right direction. Sound-proof flats are not sound-proof, and the turning off of receivers at 11 p.m. is only a palliative and not an answer to the problem.

Furthermore, there is an internal problem to be solved in the home. Father likes listening to the Brains Trust, mother likes listening to good music, and the children like swing. Under the present circumstances a two-thirds majority have to give way, not an easy matter, but the miniature receiver does the trick; each member of our family has an efficient pocket set and listens to his own selected programme. The new midget earpieces which require no head band put the finishing touch to the design.

What a boon to the family, what a boom for the industry!

C. M. R. BALBI.

London, S.E.20.

"Radio Engineering Education"

Author's Reply

THE letters on this subject in last month's issue show a nice balance of opinion. I cannot swallow Dr. L. E. C. Hughes' statement that at 22 we are too old to learn: indeed, I now find J. M. Keynes' estimate* of 30 rather harsh. I agree that continuity of education is desirable, and that the idea of a sabbatical year in industry is bad. Surely the present long-vacation courses in industry are ideal. They provide an opportunity for meeting the men at the bench, for finding out what a factory is really like, and for getting used to the idea of using the hands to control more than a slide-rule and fountain pen.

Mr. Bayliss is right: I am very impatient, because I suspect that sectional interests are trying to build vast educational empires on the wartime prestige of the older universities. His "authorised textbook" scheme is attractive, but he overlooks the endless committees which would cluster around it, and the fact that a Treasury clerk can write poetry for profit, but a scientific civil servant will get no money for a technical book.

* *General Theory of Employment, Interest and Money* (Macmillan).

I have left Dr. Drakeley's immoderate outburst to the last. "No case, abuse plaintiff's attorney" is the method he appears to favour. Was it wise, Dr. Drakeley? True, I did not know that "polytechnic" was Greek for "London technical college"; my remarks were intended to apply to all the technical colleges, and I think that this was clear in the text. Nor is the organisation of education six hundred years ago relevant. As for his statement about entirely untrained entrants, most of the young men I meet in the laboratories have had a formal training. They can't get jobs unless they have some qualifications, nor are they exempt from military service.

THOMAS RODDAM.

London, S.W.

AS one who has had some ten years' experience in industrial training of radio engineering recruits of different grades, I feel that the following comments on your January editorial and Roddam's article are apposite.

The merits of the industrial pre-University year put forward by Professor Willis Jackson are counter-balanced by the disadvantage of a break in educational continuity. The 3-4-year lapse would make a return to the student stage much more difficult, and my own view is that an extension of vacation courses is a more satisfactory solution to an admittedly difficult problem. Roddam's criticism is provocative but not always justified. He ignores altogether the fact that education in its widest sense is undergoing critical examination. An investigation of the causes of failure or reasons for the successes of others should not be ignored by the prudent man, and cannot be classed as "looking over one's shoulder."

The new Education Act does not force a child to decide his career at the post-elementary stage, though it does (wisely, I believe) guide him into either the practical or academic channel for which he may be suited, and it does not prevent him from making an interchange later if this seems desirable. A wrong attitude of according a lower social status to the technical and modern school has caused us to underrate the worth of the hand worker to the community. Roddam is unduly hard on the polytechnics—I presume he includes technical colleges as well—many of whose faults will be remedied if the McNair report is put into effect. I am glad he stresses the need for better mathematical training. Too few engineers are able to handle one of their most powerful tools.

Yes, "a change in outlook" is required; too many would-be engineers imagine that academic qualifications are all-important, whereas they are of little or no value until they are applied to the solution of practical problems.

K. R. STURLEY.

London, W.9.

OTHER preoccupations have kept me from an earlier reading of Mr. Roddam's stimulating article, and I am now a little surprised to find that I agree with some of it, though not all. First, I agree that for the man who is fit to be a leader of science, engineering or anything else, nothing less than a full-time university course is good enough. Also, I agree that education should not be diverted to specialised technical training before the age of 16; I believe the system of multilateral secondary schools is the best means of avoiding an early division between vocational and liberal education and of facilitating choice of subjects at any age. To attempt to pre-determine a career at age 11 is most undesirable.

I cannot, however, support the view that works training is necessarily or usually better than polytechnic education, particularly if the latter is part-time day rather than evening. Perhaps few realise the difficulties of the polytechnics when they are asked to cater for (a) matric. and university degree courses, (b) Ordinary and Higher National Certificates, (c) craftsmanship and workshop administration courses, to provide all these both as evening and as part-time day classes, and during the past few years to train at the same time large numbers of Service men from radio mechanics upwards. In spite of this, some polytechnics have produced useful results; apart from the obvious step of paying polytechnic lecturers more than Treasury clerks, I believe the efficiency of polytechnics could be multiplied four-fold by these three reforms:

1. Relieve them of the burden of training men for the Services. (This should happen automatically fairly soon.)

2. Make all university degree courses full-time.

3. Transfer the bulk of evening classes to part-time day. Admittedly, this would impose less full loading on laboratory equipment, but staff is probably the more serious shortage and the rationalisation of classes which would result from points 2 and 3 would simplify organisation, and give staff a chance to keep up with out-of-class duties, not forgetting the revision of lectures and syllabuses to keep pace with industrial progress.

Polytechnics could then get on with their proper job, which is not to be the poor man's university but to provide instruction in all the arts, crafts and techniques of industry at all levels from the bench to the designs department.

Mr. Roddam's idea of instruction in the factory seems to me very optimistic. Too often the boy who starts as a messenger is left in that job not for a few months but for a year or two, becoming thoroughly bored; and since radio is largely a mass-production industry employing the minimum of skilled labour, how good are the chances that he will eventually get really thorough training in a skilled trade?

The Hankey courses in "physics with radio" at the universities are, I hope, only an emergency wartime measure. Many of the students have made themselves useful in the war effort, but it must be admitted that the time allocated is not sufficient to produce either a good scientist or a good technician, let alone a scientist with a background of radio technology. Those students who have the makings of good scientists should be sent back to the universities to finish their education. (As far back as January, 1943, the War Policy Committee of the American Institute of Physics published a recommendation that, after the war, men with a wartime training in physics who wished to make physics a permanent career should have a further "rounding and maturing" course. See *Journ. Applied Physics*, Vol. 14, p. 1, 1943.)

The remedy for bad education is not less education, but better education; and although my own place is in industry and not in teaching, I believe that systematic education is better provided by those who can give their full time to it, including the polytechnics, than by the amateurs in industry.

D. A. BELL.

London, N.21.

Engineer's Conscience

FROM time to time great schemes are described for bigger and better television in the future. As an engineer I must agree that the television problem is an interesting one; as a citizen I am uncertain of the virtues of television. To project a sound and an image from a studio to a layman's home is a fascinating activity for the designer. But what is the image to be? No one has yet shown any reason why I should want television in my home. I do not want to see Mr. Alvar Liddell reading the news. I do not want to see an elaborate *montage* of the B.B.C. Orchestra; I do not even wish to see Mr. Tommy Handley, who has devised a satisfactory technique without the help of vision. [But, surely, with its help he might evolve an even better technique?—Ed.]

Has any study been made of what programmes we can afford to see? A film costs, I believe, about a million dollars: we cannot have a new film every night. The Boat Race and the Derby take place only once a year, at an inconvenient time of day.

I am concerned, Sir, only for the reputation of my profession. If we sell television to the Great British Public because we like working on it, we shall discredit

Letters to the Editor—

applied science in our generation. Mr. Churchill has said "His Majesty's Government are entirely opposed to sharks." So was the White Knight. We should be careful that our enthusiasm does not land us in bad company.

JOHN HARMON.

Brevity

"DIALLIST" asks (your February issue) why "call it Radar?" I can give one good reason, and that is brevity.

L. H. KENNY.
King's Lynn, Norfolk.

The Electro-Cardiograph

WITH reference to the short article on the Cossor-Robertson Electro-cardiograph for Stalingrad Hospital which appears in the February issue of *Wireless World*, the statement relating to muscle voltage is not strictly correct; the filter circuits employed in the instrument will allow any muscle action voltage within the frequency range of the amplifier to be amplified.

It is therefore essential for the patient to be fully relaxed when taking records, as movement of the limbs will cause action voltages of a low frequency which can interfere with the electro-cardiograph.

The second point which requires correction is in the information regarding sensitivity of the amplifier. Input voltage of 1 millivolt—not 1 microvolt as stated—gives a spot excursion of 2 centimetres.

K. RICHARDS,
(A. C. Cossor, Ltd.)

Gramophone Records

WHY must gramophone record manufacturers use a gold-coloured metallic dust with which to print the record labels?

The dust succeeds in becoming firmly lodged in the grooves, and, even if it is not an abrasive, it does seem to me that it is undesirable for any form of foreign matter to enter the track.

On recent recordings the dust appears to be less well anchored to the label and if the gold surface is merely touched with the finger it comes off very readily, and if you allow the record dusting brush to pass over the label so much dust is removed that it becomes lodged in the grooves and is almost impossible to remove. The action of placing the record in its envelope is also sufficient to produce this effect.

While on this subject I should like to mention three other thoughts; first, a plea for a stroboscopic edge to *all* record labels. This edge should be segmented for 50 and 60 c/s. mains.

Secondly, the part or side numbers should be larger and plainer and always in the same relative position on the label.

Lastly, a plea for plain black-on-white or white-on-black labels. When properly designed I believe they would be very pleasing to the eye.

LEONARD G. WOOLLETT.
London, S.E.26.

BOOK REVIEWS

High Frequency Transmission Lines. By Willis Jackson, D.Sc., D.Phil. Pp. 152 + vii; Figs. 46. Methuen, 36, Essex Street, Strand, London, W.C.2. Price 6s.

AT the present time, when quantity rather than quality is the prevailing characteristic of radio literature, it is an unusual pleasure to read a new book that is authoritative, clear, well-organised, free from numerous blemishes, and that fills a sharply defined gap. Professor Willis Jackson has written such a book. It is true that many of the larger text-books contain sections dealing more or less adequately with transmission lines up to frequencies of the order of 100 Mc/s. It is also true that for frequencies higher than about 3,000 Mc/s interest in transmission lines switches over to wave guides. But in between these limits transmission lines almost dominate radio technique, and also manifest various phenomena that can generally be neglected at the lower frequencies. Dr. Jackson's monograph not only does a valuable service in compactly presenting a subject that has hitherto been scattered among various books and papers, but approaches it in a way appropriate to the modern trend towards higher frequencies. His treatment is, in fact, analogous to that of Dr. Lamont's well-known volume in the same series on wave guides, and the two books together cover the subject of modern high-frequency guided-wave transmission systems.

The treatment is, of course, largely mathematical; but the reader whose mathematical knowledge is quite elementary and who cannot follow the derivations from fundamental wave equations will find that the argument is carried along in "plain language" sufficiently for the results and their conditions to be understood. Moreover, before plunging into abstract theory, the author, in a non-mathematical introductory chapter, briefly reviews the numerous applications of transmission lines at very high frequencies. Most of the transmission line treatises that are within the range of the less erudite readers assume (not always with due notice) that the wavelength is very large compared with the cross-sectional dimensions of the conductors, and contain no hint of the effects that become serious when this assumption is not applicable. By strict conciseness Dr. Jackson leaves himself room to deal with the problem generally before going on to offer such simplifications as are permissible under specified conditions.

The volume is valuable not only as a text for the student but also as a reference book for the engineer. It includes formulæ covering most of the cases likely to be met, and tabulated examples showing the degree of approximation on certain assumptions. Although measurement technique is not described in detail, methods are indicated; and the closing chapter and appendices provide data on circle diagrams—the valuable practical aid recently the subject of an I.E.E. paper by the author and Dr. L. G. H. Huxley.

When the book is used for reference it must be noted that the author adopts the M.K.S. system of units, and, therefore, such dimensions as the radii of coaxial conductors are in metres, *not* centimetres. The reviewer suggests that an index of symbols, referring to the page where each is defined, would increase its usefulness still further for reference. Some explanation might also be given of the oscillator system of Fig. 6, which is by no means obvious. There ought to be early opportunities, resulting from demands for further editions, for introducing such refinements.

M. G. S.

"WIRELESS WORLD" INDEX

OUR Publishers announce that the Index for Vol. L of *Wireless World* (Jan.-Dec., 1944) will be ready in a few days, price 1s. 1½d. by post. A binding case, complete with index, can be supplied at 4s. 10d. by post. Readers' copies can be bound in the Publishers' case, with index, at a cost of 10s. 9d., including return postage.

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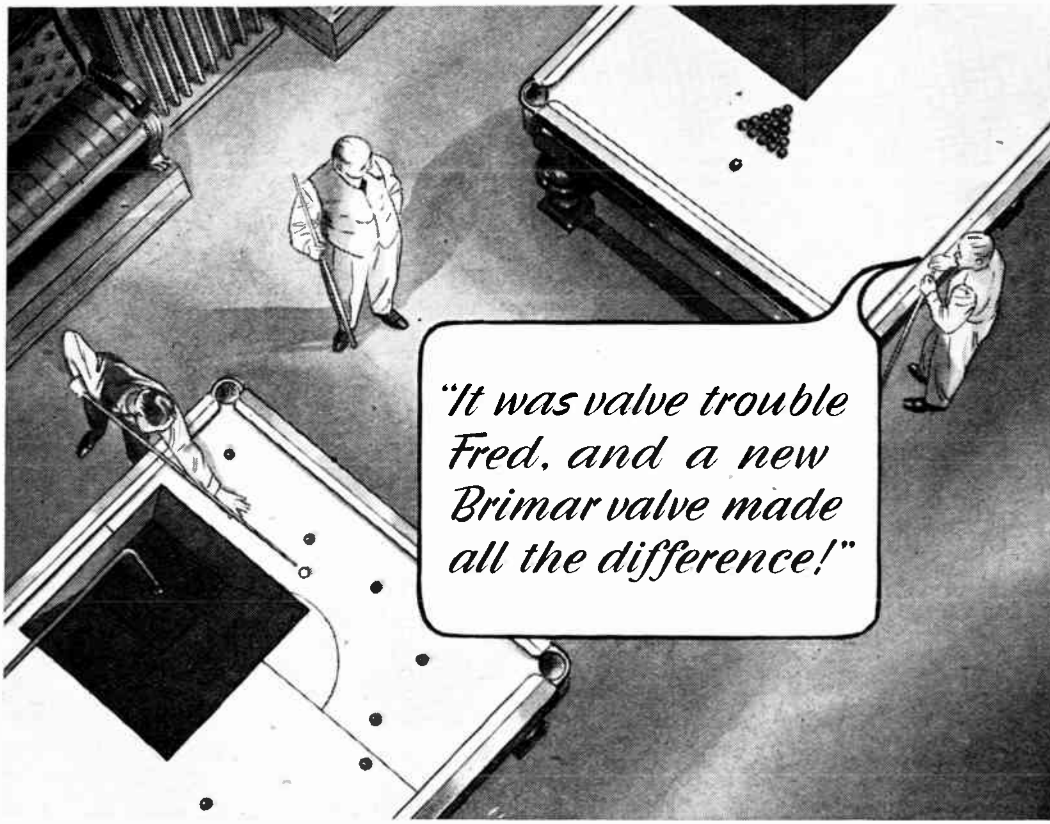

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WHAT'S IN A NAME? (Mark II.)*

Thoughts for the Rising Radio Generation

By "CATHODE RAY"

HAD it not been for occasional references to me by my fellow scribes "Diallist" and "Free Grid," the older generation might have supposed that my heater was burnt out, while the purely wartime radio boys would not have known that I had ever excited these pages into fluorescence. The fact is, of course, that my beam has been deflected off the *Wireless World* screen by the present regrettable international situation, which necessitates different activities for most of us. However, the sloppy technical language I see on all sides has built up such a colossal tension that it is X-shifting me back here to flicker acrimoniously for a few brief cycles before fading again from public view. [But not for long, we hope.—ED.]

So many writers and speakers seem to think it does not very much matter about the technical terms they use being the most correct or appropriate or logical, so long as they have the blessing of custom and, therefore, are understood by the old hands. If the vastly greater number of new hands stumble over them, well, it'll just show how clever they have to be to tackle the subject that we wise old birds have mastered. So it seems.

Now if we were Members of Parliament, with long centuries of custom and tradition to bind us, there might be some excuse for being reluctant to scrap language that is no longer—if it ever was—strictly logical. No large-scale difficulty or confusion is likely to result from referring to switching on the electric lights in the House as "bringing in the candles," and it affords harmless amusement to the occupants of the public gallery. But radio technicians reckon to be among the most enlightened and up-to-date of men, dealing with matters of precision and exactitude. And just now there is strong emphasis on better training. So should we not go to some trouble to remove unnecessary difficulties from the paths of those who will have quite enough to do to enter into so rapidly expanding a field of knowledge?

A writer has recently deplored such "new-fangled terms" as *capacitor*. *Condenser* is good enough for him. Maybe it is. I for one still talk about condensers. But I am sure that *capacitor* is the better word and will ultimately prevail. In the meantime I try to encourage the transition by slipping in *capacitor* here and there. The longer a reform is delayed the more difficult it is to accomplish, because so many more people become used to the old word. An obstinate refusal to have anything to do with the new one is a drag on progress and a symptom of mental arterio-sclerosis. On the other hand, experience shows that it is generally against the interests of reform to attempt to introduce it too suddenly or too soon. Hence the policy of gradual infiltration and re-education.

Intolerant Old-timers

But *why* is capacitor better than condenser? As the writer already referred to points out, nobody is likely to confuse a condenser (radio) with a device for converting steam into water. So why bother to uproot a word that has served everybody in radio—or wireless—right from the start up to the present day?

Well, old-timer, try to imagine that you, like thousands of young persons, are just beginning to learn it all now. You are learning that the whole affair is founded mainly on three things—resistance, inductance, and capacit—(?). If you have a sufficiently tidy mind for it to be worth your while embarking on the job at all you will certainly prefer *-ance* to *-y*. It will help to remind you that these three things are all in the same class, of abstract properties.

It is now an established convention in electrical terminology—not only in the radio part of it—that the suffix *-or* denotes an appliance for doing something, that something being indicated by the main body of the word. So without being told any more, the learner knows the names of components embodying resistance, inductance and—capacitance. At least, he thinks he does, until he is told that a thing embodying inductance is an inductance (or coil), and a thing for capacitance is called—why, heaven knows!—a condenser.

The Americans are not always to be trusted in general nomenclature; a liking for the long word, presumably, impels them (for example) to introduce a four-syllable word, *elevator*, when our monosyllable *lift* is quite as expressive (both words fail on the return journey). But in scientific matters their generally more receptive and less conservative minds are readier than ours to scrap things that have nothing better than custom or tradition to keep them going. And so in their technical literature *inductor* and *capacitor* are in general use as the names of components embodying inductance and capacitance. Credit is due largely to American example that we have already adopted *resistor* in place of the ambiguous use of *resistance* in both abstract and concrete senses. Not long ago, *resistor* sounded just as "new-fangled" as *inductor* or *capacitor*. But now nobody feels self-conscious saying it, and the wartime generation need never know that we old-timers used to go to a shop to buy "a resistance."

An inflexible loyalty to all three of the old words would at least be consistent, and worthy of a certain respect; but what can

*Mark I was published in the November 23rd, 1934, issue.

What's in a Name?—
one say of a state of mind that accepts one of the logical terms and spurns the other two as "new-fangled" — that sneer which has at some time or other been evoked by practically everything that is now accepted as normal and beneficial!

When discussing capacitance it is usual for reference to be made to an *electrostatic* field, even when it is clear that the field in question may be alternating at a very large number of cycles per second. When the field is varying at such a remarkable rate, what is the purpose of dragging in *-static*, which means stationary? Curiously enough, the authorities who talk about electrostatic fields not uncommonly refer in the next breath—or the preceding one— to *magnetic* fields. Why not *magneto-static*? I have never seen or heard any accompanying explanation of what appears, to the open mind of the student, to be an anomaly. My sympathy is with the student. He ought not to be made to put up with this sort of thing. If the energy in an oscillating circuit cannot be referred to in terms of electric and magnetic fields, and they *have* to be electrostatic and magnetic, it is the duty of the exponent to supply a reason for the lopsidedness.

When two alternative technical terms are equally accurate, the shorter is generally to be preferred. That may be why *frequency-changer* is so rapidly giving place to *mixer*. Brevity, however, though it may be the soul of wit, is certainly not top priority where technical terms are concerned. If *mixer* were technically as good as *frequency-changer*, I would scrap the latter without hesitation. But here, it seems, the American influence that is so praiseworthily occupied among the *-ors*, is playing us false. *Frequency-changer* does tell us the essential purpose and function of the thing. *Mixer* doesn't. It is much more suggestive of the cocktail bar or building site than of radio technology. Even if it is granted that it refers to something radio, it is not at all clear what. Quite a number of radio devices might at least equally well be so called.

And no wonder. Some of the things called mixers don't even mix. Take the crystal or diode types used for frequencies too high for hexodes and such like. The incoming signal and the local oscillation have to be added together *before* they are fed to the so-called mixer. The hexode type certainly seems to have more claim to the title, as it does do a bit of mixing. But there is a very good reason why, of all the varied things that might be called mixers, frequency-changers of all types should be kept out. One of the commonest radio errors is the belief that adding together, or mixing, currents or voltages of two different frequencies, results in the formation of currents or voltages of sum and difference frequencies. Actually, of course, it is necessary to do either of two things—to rectify the mixture, or to vary the amplitude of one of the component signals in proportion to the instantaneous amplitude of the other. Diodes and crystals are examples of the first kind, and hexodes of the second. Calling them *mixers* is about the best possible way of promoting the fallacy that mere addition of the two component frequencies gives rise to two others.

Adjectival Obscurity

Non-linear distortion is a curious expression. On the face of it, *non-linear* appears to be an adjective qualifying *distortion*. If you were to ask an intelligent non-technical man what it meant, he would say he supposed it meant distortion that was non-linear. But the unintelligent technical men who use the term do not mean that at all. What is it that is non-linear? The distortion? It may be. But so may other sorts of distortion that nobody calls non-linear. The thing that is non-linear in so-called non-linear distortion is the unspecified cause of the said distortion.

Take a loudspeaker. If you were to draw a graph of speech-coil displacement against speech-coil current, you would probably find that from zero up to a certain current the graph was a straight line, i.e., linear. There would be no distortion due to this characteristic. But greater currents would cause the coil to move beyond the region in which the magnetic field was reasonably uniform, and the displacement graph would bend over. The displacement/current characteristic would be non-linear. Distortion would result whenever the coil was driven beyond the limit of linearity. A graph of *distortion* against current would, it is true, be non-linear, too. But if you drew a graph of what is generally called frequency distortion against frequency, that also would be non-linear. Yet it would not be "non-linear distortion."

I know that the habit of using nouns as adjectives may, if carried to excess, lead to dreadful things like the German language. And that *non-linear distortion* has precedents, such as "The Black Death." But they belong mainly to the age of superstition and inexactitude. I submit that in the interests of clear thinking *non-linear distortion* should be replaced by *non-linearity distortion*. A small point, but symptomatic.

There are two alternative words relating to transmission lines that seem to be used indiscriminately (even by the same writers) and neither to have gained the upper hand. They are *concentric* and *coaxial*. Now there are quite enough technical terms in circulation for the wretched learner to acquire, without adding to them unnecessarily by using more than one word meaning exactly the same thing. It is not just the slight extra effort of having to learn two words instead of one. It is the risk of confusion and misunderstanding when a student has been reading about concentric feeders and then (elsewhere, or in the same book) comes across coaxial feeders. Or vice versa. It is reasonable to suppose that different names are given because there is some difference, however slight or subtle, in the things named. But the way these two names are used in radio technology, there just isn't.

Obviously, then, one of them ought to be chucked out. But which? Well, by derivation, *coaxial* means that the axes are common; *concentric* means that the centres are common. Any cross-section drawing of the feeder in question is *concentric*, because it consists of circles having their centres at the same point. *Coaxial*, however, applies to the whole of the feeder itself, and therefore is more precise. The inner and outer conductors could not be arranged coaxially in any other way than they are in a feeder, but they could be arranged concentrically (i.e., with their centres together) as shown in Fig. 1, which isn't quite what people have in mind when they talk of concentric feeders.

It irritates me to see *grounded-grid*, except in American literature, where, of course, it is perfectly consistent and appropriate.

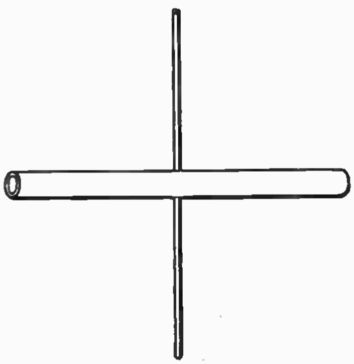


Fig. 1. This pair of feeder conductors is concentric, but not coaxial.

But people who wouldn't dream of marking the "earth" terminal of a receiver *ground*, and who habitually talk about earthing this and that, seem to find something wrong with *earthed-grid*. Why? Just because it would be clear and straightforward and consistent, and so, of course, would never do?

These are some of my pet phobias. I confess that until I began to write this there was another, which has not been able to survive close consideration. It was the statement that the amplified voltage at the anode of a resistance-coupled valve is 180 degrees out of phase with that at the grid. My objection was that the student, having been informed at the appropriate stage of the course that *phase* is a *time* relationship, might get into his head the idea that the process of valve amplification introduces a time delay of half a cycle between grid and anode, and so involve himself prematurely (and incorrectly) in the phenomenon of electronic transit time. And to clinch the thing, Fig. 2 (*b*) was to show what it meant by a 180-degree phase shift in relation to (*a*) (one cycle of the signal at the grid), whereas (*c*) is what actually does happen at the anode. Therefore (it appears) instead of talking about the signal being phase-shifted 180 degrees in the process of amplification, one should say it is *inverted*.

I am not at all sure that it wouldn't be better in any case to cut out the 180-degree business in this connection (*inverted* or *upside-down* is so much easier for most people to understand), but not for the reason given above. Because, you see, there is a fallacy in it. The real nigger is the "lagging" and "leading" story that is told in lessons on phase. Although these are convenient terms for referring to the relative phases of alternating quantities, they are dangerously liable to lead one to suppose that an actual shift in time takes place. For example, in an inductive circuit the current "lags" behind the generated voltage. If this is understood to mean that, say, positive peaks of current occur at a certain fraction of a cycle later than positive peaks of voltage, well and good. What one is liable to think, however, is that each positive peak of current is related to the preceding positive voltage peak, through a sort of delaying action introduced by the inductance. This idea comes up against a horrid difficulty when *leading* currents are considered; the student, if bright, sees that his time-shift idea was false, or, if not so bright, decides to accept the thing as part of the general mystery of electrical science. And that is a thoroughly bad thing.

Looking again at Fig. 2, suppose (*a*) is an isolated cycle of voltage applied to an entirely inductive circuit in which "the current lags the voltage by 90 degrees." Does the resulting current cycle look like (*b*) except for being 90 degrees behind instead of 180 degrees? Not at all. The current starts at the same time as the voltage, and its waveform is quite different from that of the voltage. It is only after a large number of similar voltage cycles have followed continuously that the current wave takes on the same shape and a 90-degree lag. So the visual "proof" breaks down. Phase difference doesn't necessarily involve displacement in time (think of a three-phase alternator, for example), and so there is no theoretical objection to saying that the anode signal is 180 degrees out of phase with the grid signal. Of course, there are things that do introduce a real lag (never a lead!)—transmission lines, propagation through space, and mechanical devices such as film or wire recorders—but they must not be allowed to mislead one about phase generally.

It wouldn't surprise me if some of the bricks I have disrespectfully thrown at authority were to be hurled back with interest. But I don't think that would upset the moral and sum of the whole matter, which is that persons who take on themselves to teach ought to be extraordinarily careful in the terms they use. It is perhaps too much to expect that the muddle will be completely cleared up so far as radio is concerned (it is like those problems about A emptying a bath and B and C filling it), but when it is not possible to avoid confusing or erroneous terms they should never be introduced without appropriate warnings. That is hard, because one forgets the difficulties

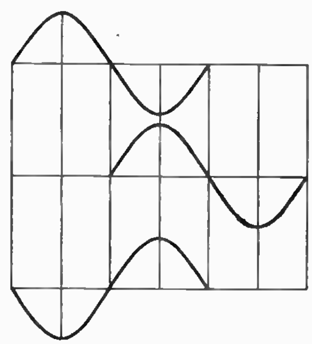


Fig. 2. Is (*b*) 180 degrees out of phase with (*a*) or is (*c*), or both ?

of one's youth, or perhaps most teachers were too bright to experience them. But if accepted as an ideal, the resolve should enable the rising radio generation to get a fairer deal than we had.

ALL-GLASS VALVES

OUR cover photograph shows stages in the construction of a Mullard "all-glass" valve. The envelope, a partially finished assembly, and a complete valve (without "getter") are illustrated.

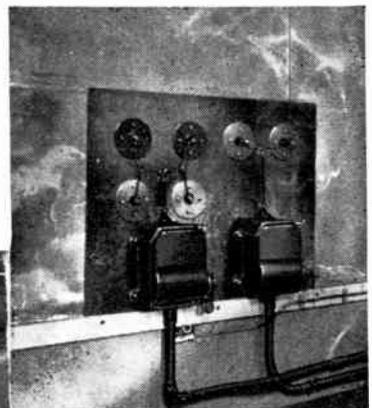
SCREENED TESTING BOOTHS

Protection Against Electrical and Acoustic Interference

FREEDOM from electrical interference, as well as from acoustic noise, is essential for the routine factory testing of radio equipment. It is generally achieved by carrying out testing in well-screened cubicles within the factory. The design of these cubicles can present quite a problem, especially when the equipment to be tested happens to be extremely sensitive ultra-high-frequency apparatus and the nature of the tests are such that no extraneous interference whatsoever can be tolerated. Such was the problem which recently confronted the technical staff of Ultra Electric, by courtesy of which firm this description of how the problem was solved by them is published.

With the of help Post Office engineers a design was finally evolved for a screened unit comprising three separate cubicles, each measuring inside approximately 11ft. 6in. long, 6ft. wide and 6ft. 9in. high. With a 3-ft. wide bench along one side there is just sufficient room for the occupants of the cubicle to move about in comfort. As the bench runs the "long" way of the booth it accommodates quite a considerable quantity of apparatus.

Inside the screened cubicle showing the ample bench space for test equipment. (Right) Power supply panel showing the main switches and special UHF filter condensers.



Basically the electrical screening consists of a box within a box; the two are joined together at one point only and from this common connection a short stout earth lead is taken. Each of the three cubicles is constructed in this fashion and each is further enclosed in a double skin of soundproof material. The electrical screening is carried out with 30-SWG copper sheet and all joints are soldered. The earth lead consists of a length of 2-in. × ¼-in. copper bar connected to a large copper earth plate buried beneath the concrete floor of the factory. A separate earth is used for each cubicle. Inner and outer copper skins are about 6in. apart. The general arrangement of the cubicles is shown in the accompanying drawing.

Describing the design as basically a box within a box enables the general form of construction to be visualised, but there are certain details that require amplification. For instance, means of entry capable of perfect sealing, as well as a supply of fresh air for the workers, must be provided.

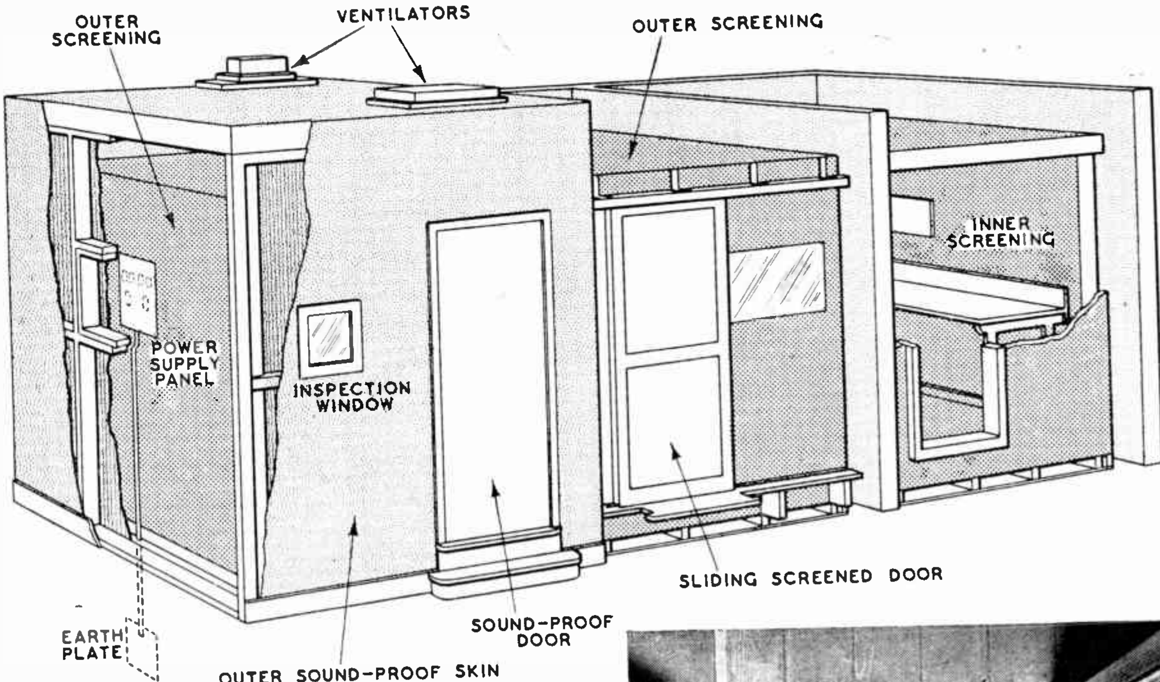
Each cubicle is fitted with two sliding doors, one forming a part of the inner copper skin and the other completing the outer screen. These run on rails fixed to the floor and guides keep the door in position at the top. One face of each is covered with copper sheet, whilst round the edges are phosphor-bronze brushes, which in the closed position ride over a copper-covered inclined ramp forming the jambs, lintel and step of the entrance. Furthermore, each door is wedge-shaped when viewed from the top or bottom, the thick end of the wedge being the trailing edge of the door. The accompanying photograph shows the entrance with the doors pushed into their recesses on the right. There can also be seen the two rails on which the doors run, the tapered copper-covered floor ramp, and the contact springs on the leading edge of the doors. There is also an outer hinged door to complete the acoustic screening.

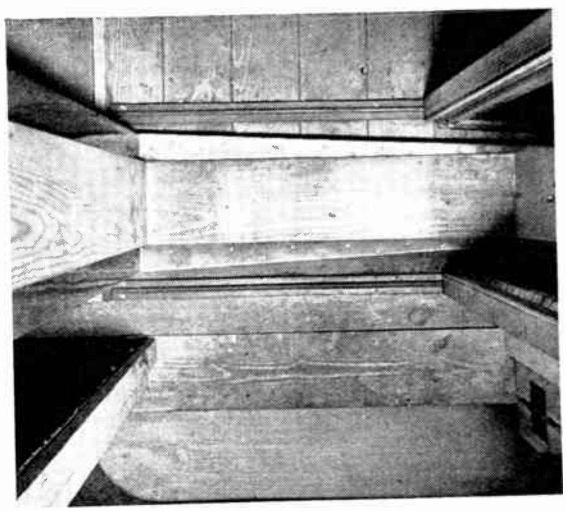
Ventilation is provided by two apertures in the roof of the cubicle closed by two sheets of copper gauze soldered to the surrounding copper sheet of the inner and outer skins respectively. A shallow box is built above each aperture and in one are housed an electric air fan and tubular electric heaters. Both apertures are lined with sound-absorbing material.

Electrical supplies inside the cubicles comprise two separate AC sources of different frequency and one low-voltage DC circuit. These supplies are very thoroughly filtered, both inside and outside the cubicles, the filters being mounted on copper panels fixed to the inner and outer screening walls. On the outer wall is a panel similar to that shown in an accompanying photograph, but in place of switch boxes are three anti-interference suppressors.

The circular plates seen on the wall are special UHF filter condensers. Two of these are used in each input line, one on the inner wall and another on the outer. Of G.P.O. design, these filter condensers consist of a large brass disc about $\frac{3}{8}$in. thick recessed on one side to accommodate a sandwich comprising a brass disc of smaller diameter and two pieces of mica. The centre disc is fixed to an insulated lead-through spindle and forms the "live" condenser plate. The "earthy" plate is the recessed container, which is bolted directly on to the copper wall of the booth.

The effectiveness of the screening system as a whole was demonstrated by operating a fairly high-power UHF transmitter immediately outside the booth and "looking" for a signal on an oscilloscope connected to a sensitive receiver inside one of the cubicles. No trace whatsoever could be found of a signal from the outside with the doors closed. Opening the doors completely filled the screen of the CR tube.





General arrangement of the screened booths used by Ultra Electric for testing UHF equipment. Double screening for electrical and acoustical interference is provided. (Right) Entrance to a screened cubicle showing the floor rails on which the two doors slide and the two copper-covered tapered ramps to seal the entrance.

WAVETRAPS WITH INFINITE Q

Use of a Simple Balanced Filter Circuit

By THOMAS RODDAM

WHEN I read S. W. Amos' article in last month's *Wireless World*, it brought back memories of an attractive mahogany box. The lid was hinged with a piano hinge, and on being raised revealed an ebonite panel with three, or was it four, terminals and a condenser dial. I was proud of that wavetrap, which must have cost as much as a 1939 midget receiver, and which never seemed to have much effect. It was time to be reminded that a wavetrap can be a very cheap device, and that properly designed it can be very useful.

There is one very interesting addition which can be made to the ordinary wavetrap to improve its performance. This trick is well known in some applications, but does not seem to have been generally applied. It is, in fact, regarded as a rather highbrow text-book device, although actually it is a simple and practical circuit.

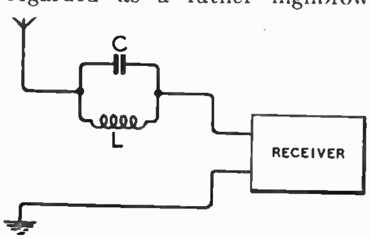


Fig. 1. Conventional wavetrap circuit

The usual wavetrap circuit is shown in Fig. 1. The anti-resonant frequency of the LC circuit is rejected, as at this frequency the circuit has a very high impedance; the rejection efficiency for a given L/C is proportional to the Q of the circuit for high values of Q. In practice, no one is going to make a wavetrap unless the signal to be rejected is a serious nuisance; therefore, the design should be such that the maximum rejection is obtained. Maximum Q and maximum L/C ratio will therefore normally be adopted. Unfortunately, maximum L/C ratio broadens the rejection bandwidth and maximum Q means careful coil design. We therefore turn to the circuit of Fig. 2 (a); in this, the coil has been tapped at its centre and a resistance returned to earth from this point. This "cancellation resistance" enables an exact balance to be found at the rejection frequency and thus gives the effect of a tuned circuit of infinite Q. Of course, this improvement must be paid for somehow; at the frequency of the wanted signal there is a small loss of energy due to the presence of the short resistance. We shall see, however, that the resistance value is of the order of 10,000 to 100,000 ohms; the loss introduced is therefore very small.

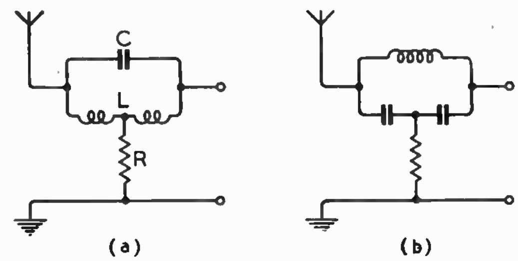


Fig. 2. Centre-tapped rejector circuits with "cancellation resistance"

For the particular circuit of Fig. 2 (a), the value of the shunt resistance is given by $R = \frac{1}{4}(\omega LQ)$, where ω is $2\pi \times$ rejection frequency, and Q is the value of $(\omega L/R_L)$ at the rejection frequency, R_L being the coil resistance. If we have a 200 μH coil, and wish to reject a frequency of 798 kc/s ($\omega = 5 \times 10^6$), we find that $R = 250Q$ ohms.

A coil having a Q of 40 will therefore require a resistance of 10,000 ohms; a Q of 200 will require 50,000 ohms. Still higher values are obtained as we increase rejection frequency or inductance and a carbon track variable resistor of about 500,000 ohms maximum value will be found convenient for most medium-wave circuits.

It is much easier to set up this circuit if the adjustments are made in the right order. The resistance should be at its maximum value while the capacity is being adjusted. When a minimum output of unwanted signal is obtained, the value of R is reduced until a minimum signal for this variation is obtained. Often it will be found necessary to retrim the capacity when R has been adjusted, as the anti-resonant frequency is not exactly $1/2\pi\sqrt{LC}$. Any attempt to adjust R before C is nearly correct will lead to utter confusion.

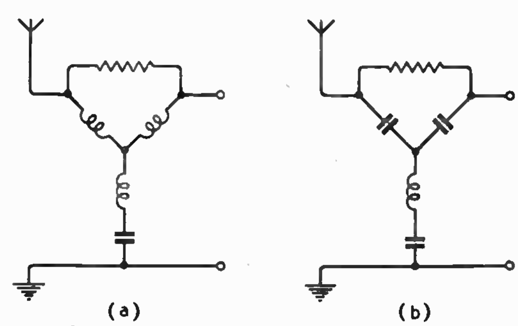
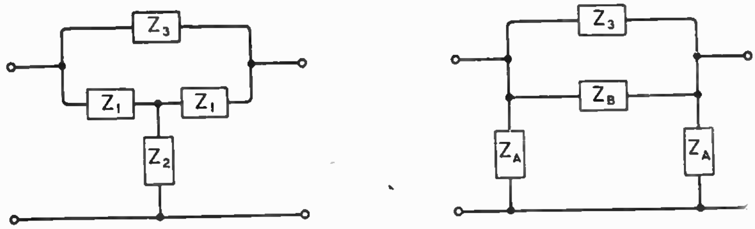


Fig. 3. Series-tuned shunt insertion wavetraps

A number of variations on this simple theme are known. For example, the centre-tap can be provided by a twin condenser as in Fig. 2 (b). A series-tuned shunt insertion wavetrap can be designed to have the circuit of Fig. 3 (a) or 3 (b), and in each of these two circuits the series-tuned arm appears to go down to a complete short circuit at the resonant frequency.



(a) (b)

Fig. 4. The original bridged-T circuit (a) can be rearranged to the form of (b) by the usual star-delta transformation.

The use of resistance cancellation is not restricted to wavetraps. Any filter circuit which has as its principal function the rejection of a single frequency can be improved by this method. Two particular examples are "high-class" power pack design, in which an anti-resonant circuit is included as a series element in the smoothing circuit, and in home recording using a compressor with a pilot tone to drive the reproducing expander. It is rather important to notice the qualification in the second sentence of this paragraph. Only a politician will offer you something for nothing; engineers, and the statesmen of my party, never do this. The following reasoning is tempting: resistance cancellation increases the effective Q; the rounding of filter cut-off is the result of a bad Q; therefore filters can be improved at cut-off by cancellation. This is not true; cancellation works only at a single frequency; at the cut-off frequencies the total losses are increased by the added resistor and there is, if anything, rather more rounding.

APPENDIX

The cancellation circuit is the bridged-T of Fig. 4 (a): this can be converted into Fig. 4 (b) by the usual star-delta transformation of $Z_1Z_2Z_1$ into $Z_AZ_BZ_A$, where

$$Z_A = Z_1Z_2/(2Z_1 + Z_2)$$
$$Z_B = Z_1^2/(2Z_1 + Z_2)$$

If we use the particular circuit of Fig. 2 (b), we have $Z_1 = 1/j\omega C$, $Z_2 = R$, and therefore

$$Z_B = -1/\omega^2C^2(R + 2/j\omega C)$$

Writing—

$$Y_B = 1/Z_B$$
$$Y_B = -\omega^2C^2R + 2j\omega C$$

The admittance, $Y_3 = 1/Z_3$ is in parallel with this, so that the total admittance of the series arm (Z_3Z_B) is

$$\frac{R_L - j\omega L}{R_L^2 + \omega^2L^2} - \omega^2C^2R + 2j\omega C$$

$$= \frac{R_L - \omega^2C^2R(R_L^2 + \omega^2L^2) - j\omega L + 2j\omega C(R_L^2 + \omega^2L^2)}{R^2 + \omega^2L^2}$$

$$= 0, \text{ if } j\omega L = 2j\omega C(R_L^2 + \omega^2L^2) \text{ or } \omega^2 = (1/2LC - R_L^2/L^2)$$

and $$R \doteqdot \frac{\omega^2L^2}{4R_L} = \tfrac{1}{4}\omega L \cdot Q$$

Thus we see that the cancellation resistance is proportional to Q, and the rejection frequency is not exactly the $1/2\pi\sqrt{LC}$ value.

The analysis for the various other forms can be carried out in the same way, either by transforming $Z_1Z_2Z_1$ into a π network, or $Z_1Z_3Z_1$ into a T network.

AMATEURS' HANDBOOK

WE are informed that the Radio Amateurs' Handbook for 1945, published by the American Radio Relay League, is expected in this country in a few weeks' time.

Copies will be obtainable direct from A. F. Bird, 66, Chandos Place, London, W.C.2, price 12s. 6d., postage 7d.

The handbook can also be ordered through the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1, for delivery from America in about three months' time, at a cost of 10s. 6d. For security reasons, the handbook cannot be sent from America to Services or Government establishment addresses.

WORLD OF WIRELESS

TELEVISION COMMITTEE'S REPORT

The long-awaited Report of the Government Television Committee, appointed under the chairmanship of Lord Hankey in September, 1943, was presented to Parliament on March 8th.

Readers of *Wireless World* will be familiar with many of the ideas expressed in the recommendations and conclusions, for they have been the subject of discussion in the pages of this journal for many months past. We do not, therefore, propose dealing very fully with the mass of information contained in the Report, which is obtainable from the Stationery Office, priced 6d., but to confine ourselves to the salient points.

It should be pointed out that the Report contains recommendations only and is not, therefore, conclusive.

It is recognised by the Committee that whilst the pre-war standard of definition (405 lines) gives a satisfactory picture in the home, it is inadequate for large-screen projection. It is, however, recommended that the television service should be restarted on the old standard rather than await the development of a new system which, it is foreseen, would take some years to produce. "The [pre-war] service could, we believe, be in operation within 9 to 12 months of the release of the requisite staff," the Report states.

If the recommendation to re-open the service in London on the old basis is approved, then the question arises whether that system should be extended to the provinces or whether the extension should await the development of a new system. It is suggested that the 405-line service from London should be extended by cable or radio link to six of the most populous provincial centres as soon as possible after the reinstatement of the London service. The hope is expressed that the first, at Birmingham, may be in operation within about a year after the London transmitter restarts.

It would, however, be unjustifiable to proceed with this extension if the intention was to discard it after a few years in favour of an entirely new system. The assumption is that the two systems would be operated side by side for some time.

The opinion of the Committee is that the definition should eventually be of the order of 1,000 lines.

It is understood the responsibility for the resumption of research work on the problems relative to cable and radio links between stations will be assumed by the Post Office.

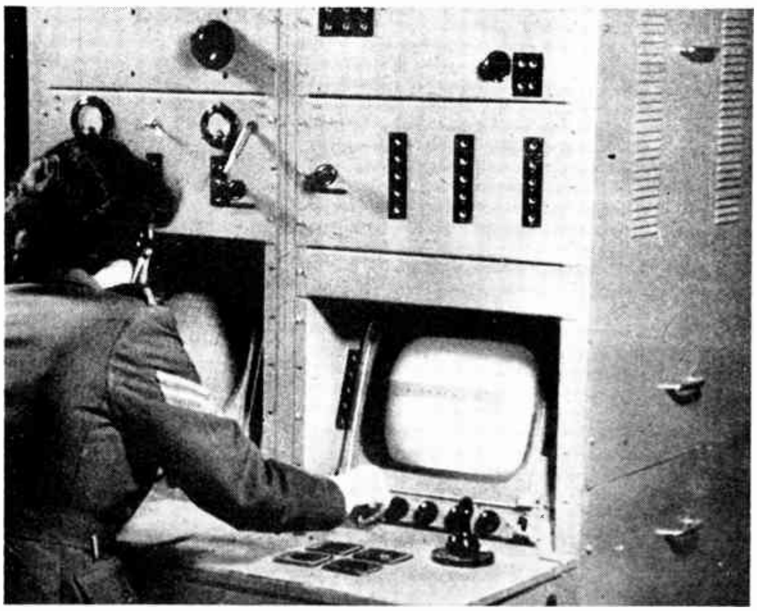
The Committee recommends that the Postmaster-General should be granted the necessary powers to enforce the suppression of electrical interference.

Each of the three possible sources of revenue for the television service, namely, domestic licences, cinema licences and sponsored programmes, has been considered by the Committee. A licence fee of £1 for domestic television reception, in addition to the existing sound broadcasting licence, is suggested. A special licence for cinemas is also recommended. Sponsored programmes could not be expected to provide a substantial contribution towards the cost of the television service in the early stages. "In these circumstances, and without prejudicing the matter for the future, we feel it would be premature to come to a conclusion on this question."

Cinemas in general are likely to await the advent of the new system before installing television projection equipment.

The co-ordination of research under Government auspices is recommended.

The Television Committee having prepared the plans for the reinstatement and development of the television service after the war, for which purpose it was appointed, recommends the setting up of a permanent Advisory Committee.



RADAR IN U-BOAT WAR. A member of South Africa's Special Signals Service operating the anti-U-boat radar apparatus. This picture is from a recent Pathé News Reel which illustrated the work of this Service in the location and destruction of U-boats off the coast of S. Africa.

ANTI-U-BOAT RADAR

From an enemy spokesman—Admiral Doenitz—came the first public tribute to radiolocation as an anti-submarine weapon of the United Nations.

"At the end of 1943 and the beginning of 1944," he said, "one development became very obvious which long ago, even in peacetime, had been feared, that the enemy might deprive the U-boat of its essential feature—the element of surprise—by means of radiolocation. With these methods he has conquered the U-boat menace.

"The scientists who created radiolocation have been called the saviours of their country. So, it was not superior strategy or tactics that gave him success in the U-boat war, but superiority in scientific research.

"Germany made the great mistake of calling up her scientists into the Armed Forces instead of letting them continue their researches."

Britain did not make this grave error. Her scientists were immediately marshalled on priority research within and without the Armed Services. The Admiralty, for example, employing over three thousand scientists in its various laboratories and departments, has gone a step further than in any other country and embodied them into the Royal Naval Scientific Service.

RADIO REPAIRS

THE question of licensing radio supply and repair shops was recently raised in the House of Commons. In reply, the President of the Board of Trade said that new retail shops which supply wireless goods require a licence under the Location of Retail Businesses Order. But, to ensure the widest possible facilities for repairs, a general licence has been issued enabling anyone to "carry on the business of repairing his customers' goods without requiring an individual licence."

WHAT THEY SAY

RAILWAY RADIO.—I am advised that there is as yet no wireless apparatus which would afford a satisfactory remedy for the failure to observe signals. It is not at present practicable to carry out the experiments required to perfect this apparatus. I hope that this work will be undertaken after the war.—*Philip Noel-Baker, Parliamentary Secretary to the Ministry of War Transport, replying to a question on the possibility of engines being fitted with radio-telephony.*

TRIBUTE TO B.B.C.—One of the great virtues of the B.B.C. is that extremists on both sides of the House dislike it so much.—*Brenden Bracken, in the House.*

RIGHTS OF MAN.—All men have the inalienable right to transmit and receive by means of radio.—*From the Cambridge University Wireless Society's "Charter of Radio."*

IN BRIEF

Canadian Short Waves. — The Canadian Broadcasting Corporation opened its new short-wave broadcasting station at Sackville, New Brunswick, on February 25th, the date originally announced. Transmissions on 15.22 Mc/s (19.71 metres) are radiated daily from 1045-1325 and 1600-2000 GMT.

Radio Charter.—The Cambridge University Wireless Society has drawn up a "Charter of Radio," the first Article of which is quoted above. The underlying principle is that all radio communication shall be conducted for the greatest good of the greatest number. The need for an extension of the principle of international control is stressed, and much attention is given to the needs of amateurs.

Cable and Wireless announce that all telegraphic traffic between London and Chungking will now be sent by a direct circuit, but to supplement this in certain circumstances, traffic between Britain and China will be relayed automatically via Colombo. A radiotelephone service between Port-of-Spain, Trinidad and Paramaribo, Surinan (Dutch Guiano), has been recently opened.

Sets for Palestine.—A firm in Palestine wishes to get into touch with a British manufacturer of broadcast receivers (medium and short wavebands) with a view to becoming sole distributors. Letters addressed "Palestine," care of the Editor, will be forwarded.

PERSONALITIES

Keith Henney, editor of our New York contemporary, *Electronics*, has been awarded the plaque of honour for 1944 at the Rochester Fall meeting of the American Institute of Radio Engineers. The award was made for "his many years of unselfish service to the radio and electronic industry through the technical Press.

W. H. Nottage has retired after 34 years' service with Marconi's W.T. Co. For the past 17 years he has been Joint Chief of the Patent Department. He is succeeded by **Dr. G. F. Brett.**

MEETINGS

Institution of Electrical Engineers

Ordinary Meetings.—"The Place of Radiant, Dielectric and Eddy-Current Heating in the Process Heating Field," by L. J. C. Connell, B.Sc., O. W. Humphreys, B.Sc., and J. L. Rycroft, B.Sc., April 5th.

Thirty-Sixth Kelvin Lecture. "Electric Currents in the Atmosphere," by Sir Edward Appleton, K.C.B., D.Sc., F.R.S., April 26th.

Informal Meeting.—"Electrical Aids to Public Speaking," discussion to be opened by P. G. A. H. Voigt, B.Sc., April 23rd.

Radio Section.—"Studio Technique in Television," by D. C. Birkinshaw, M.A., and D. R. Campbell, April 4th.

"Design of Broadcast and Television Receivers for the Post-War Market," discussion to be opened by L. H. Bedford, O.B.E., M.A., B.Sc., April 17th.

All the above meetings will be held at the I.E.E., Savoy Place, Victoria Embankment, London, W.C.2, at 5.30.

Cambridge Radio Group.—"Aircraft Wireless Aerials," by F./Lt. C. B. Bovill, April 24th, at 6.0 at the Technical School, Collier Road, Cambridge.

North-Western Centre.—"Frequency Modulation," by K. R. Sturley, Ph.D., B.Sc., April 20th, at 6.0 at the Engineers' Club, Albert Square, Manchester.

South Midland Radio Group.—"Energy Conversions in Electronic Devices," by Dr. D. Gabor, on April 25th at 2.30, at Loughborough Technical College.

British Institution of Radio Engineers

North-Eastern Section.—"Dielectric Heating by the Radio-Frequency Method," by L. Grinstead, April 18th, at 6.0 at the Neville Hall, Westgate Road, Newcastle-on-Tyne.

Royal Society of Arts

"The Work of the Department of Scientific and Industrial Research," by Sir Edward Appleton, on April 18th, at 1.45, at the Royal Society of Arts, John Adam Street, London, W.C.2.

MAQUIS RADIO

A Personal Story from France

By E. AISBERG

(Editor, "*Toute la Radio*")

A vivid first-hand picture of the part played by wireless in the French resistance movement. Our contributor, who used to write for *Wireless World* before the fall of France, tells us that his own journal, *Toute la Radio*, and also our other French contemporary, *L'Onde Electrique*, are due to resume publication as soon as paper is available.

IT was on August 20, 1944, that the people of Paris rose against the German oppressors. On that very day, mixed with the first rifle shots and bursts of tommy gun fire, Parisians heard a new voice—that of free Paris Radio. Not the hated voice of German-controlled Radio-Paris and its Vichy lackeys; not even the voice of the B.B.C., which for four years had been for millions of Frenchmen a source of hope, courage and truth. The new voice came from Paris itself on a wavelength of 206 metres and with a power of 0.5 kW.

The fact that a broadcast transmitter was functioning under the very noses of the occupying forces was all the more difficult to explain as we knew that the Germans had either removed or destroyed the gear of all the six stations in the Paris district. In fact, the only one eventually found to be capable of repair was the Villebon station (24 kW, 386.6 metres) which resumed transmissions on September 2.

It was not until the final liberation of Paris that the mystery was cleared up. In preparation for the insurrection transmitters had been secretly constructed in unit form in several large radio factories. When the day came, only a few interconnections were needed to put the gear in operation. It was in this way that the station built by the Sadir firm became the first to make heard the voice of insurgent Paris during the great days of August.

At about the same time a 200 W transmitter built by the Société des Procédés Loth started work on 41 m. Four days later, the Société Française Radioelectrique started up a 1.5-kW transmitter on 31.19 m., and a station built by L.M.T. began work on 312.8 m. with the surprisingly high power of 12 kW.

To appreciate the difficult condition under which these transmitters were set up, the reader should know that all large radio factories were, during the occupation, under the control of German supervisors. These were generally competent engineers who had formerly worked for such firms as Telefunken, Lorenz or A.E.G.; such men could not be bluffed into mistaking a master oscillator for a valve voltmeter!

Two Vital Problems. — Those who worked for the resistance movement were faced with two fundamental problems: to ensure communication with London and also between the different resistance groups and units of the Maquis. In both cases radio presented the best, and often the only, solution. To this end, the construction of clandestine transmitters was carried out by many radio firms in the face of grave difficulties at every stage.

And what difficulties there were! Components such as valves, quartz crystals, morse keys were almost unobtainable. The Germans had even seized all high-power AF output valves such as 6L6s, in the fear that they might be used for transmission. As already stated, the factories had to submit to rigorous control. Moreover, the transport of transmitters brought about great risks. One of my friends, who bore the *nom de guerre* of Regenton, was aboard a tramcar at Lyons, loaded with a bulky transmitter of which the wrapping paper was torn, showing the panel with its control knobs and meters. A German officer saw the gear and, assailed by suspicion, asked what it was. With perfect imperturbability, Regenton answered "electro-medical apparatus." Fortunately, that closed the incident.

Eluding the German DF.—It is easy to guess how assiduously the Germans hunted the clandestine transmitters. For this purpose they made use of numerous mobile DF equipments, of which some were installed in ordinary touring cars of the most innocent appearance.

Several methods were used to throw the German DF off the track. For communication with London we used fixed transmitters, generally installed in densely populated built-up areas. Three transmitters, working on the same frequency but situated at different points, divided between themselves the transmission of a single message, following a strictly observed and carefully worked-out time schedule. For example, transmitter A would stop sending in the middle of a sentence at the end of three minutes. Transmission would then be taken up by station B, which in its turn would be followed by C, and so on. The effectiveness of the method was such that the Germans were never able to trace by DF methods the source of transmission. The only time that they succeeded in arresting (at Lyons) a resistance group carrying out clandestine transmission was as a result of treason on the part of one of the members.

For internal communication, and especially for communication between the Maquis groups, we generally used mobile equipments. These were operated either in villages or in the open country near overhead power supply lines. To pick up the power supply we used metal hooks carried on long poles for hooking on to the wires. But some operators preferred to open, with the aid of skeleton keys, the doors of transformer kiosks, inside which they could work out of sight and at the same time obtain all the electrical energy necessary.

With the Maquis in Haute-Savoie.—A year after the occupation, as a result or denunciation to the Gestapo, the author of these lines was forced hastily to leave Paris for Haute-Savoie, there to breathe the free air of the mountains. This health trip gave him an opportunity to take part in the formation of the first Maquis groups and to follow the evolution of the active resistance movement.

At the beginning of 1944 the Germans, seriously perturbed by the growth of the resistance forces, tried, with the help of bands of traitors who formed the infamous Militia, to carry out vast mopping-up operations. These operations were preceded by a number of preliminary measures, which included the limitation of movement along the roads, of movement within specified regions, and the suppression of telephone communications.

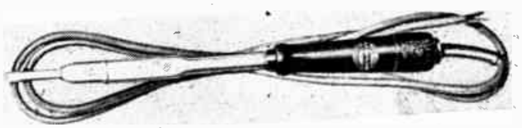
This last - mentioned measure proved particularly troublesome, as it deprived the Maquis of means of communication between groups; it was no longer possible to give warnings when the enemy was sending out punitive expeditions. Thus there arose an urgent need for a radio communication system. With the help of a brave manufacturer at Thonon, the author undertook the assembly of low-power transmitters. Receiver components were the only ones available, and a thousand-and-one difficulties had to be overcome before the desired results were achieved. For example, receiver-type variable condensers were found to act as spark-gaps when a voltage of 500 was applied across them! To remove half the rotor and stator plates and then to equalise spacing with washers is not nearly so easy as it sounds!

I am not going to boast of the modernity of the gear that we set up. Push-pull oscillators, without frequency control . . .; there was nothing up-to-date about our transmitters. But they worked, and, on wavelengths between 60 and 80 metres (which proved most suitable for mountainous country), they proved quite reliable.

We also managed to pick up an American transmitter from a Flying Fortress which made a forced landing near Abondance, close to the Swiss frontier. After arranging for the safe conduct of the crew into Switzerland, we stripped the aircraft of all its wireless and electrical apparatus, machine guns and other useful gear. When a German patrol arrived, an hour after the crash, nothing remained except a useless shell. Unfortunately, we could not get the radio gear working before the Liberation, as we lacked the necessary high-capacity accumulator.

It will be evident that all the brutal efforts of the oppressor failed to stop a people struggling for its liberty from displaying prodigies of ingenuity and perseverance to keep contact with friends, both abroad and in the interior. In this struggle radio waves, which ignore Gestapo barriers, played a leading part.

"SOLON" LOW-VOLTAGE IRONS



Two new models have been added to the range of "Solon" electric soldering irons made by W. T. Henley's Telegraph Works. They are designed to work with 12 or 24 volts and the rating in each case is 65 watts. In addition to the replaceable pencil bit type shown above, there is a model with a heavier oval tapered bit.

SEMI-STABILISED HT SOURCE

Use of a Small Auxiliary Valve for Ripple Suppression

By E. A. HANNEY,
M.Eng., Ph.D., A.M.I.E.E.

THE voltage of AC mains is varying all the time, by small amounts and with considerable rapidity, due to fortuitous changes in the loads connected to the system. These changes find their way to the output side of a power-pack. It is very interesting to connect a power-pack output through a blocking condenser and amplifier to a cathode-ray tube; if the amplifier has a reasonable performance down to 10 c/s or less, the output voltage will be seen to be subject to violent and random variations. It would be a bad case where the variations exceeded a fraction of a volt, but they can be a greater nuisance than slow variations of larger amount.

There are several well-known stabilising circuits, all of which are characterised by features which have disadvantages in wartime. The output current in many cases has to be passed by a large valve, or by a battery of valves in parallel; or gas-discharge stabilising tubes are needed; or the load is paralleled by a large valve so that the total current always equals the full-load rating.

The circuit to be described removes almost the last trace of

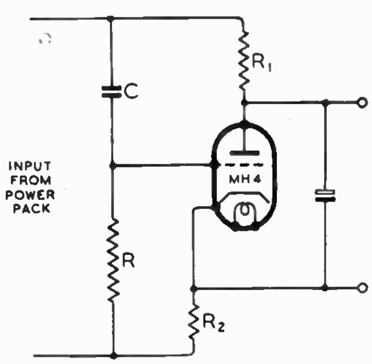


Fig. 1. Circuit suitable for fixed load

ripple from the output of a power-pack. At the same time it removes all but the slowest of those variations due to mains voltage fluctuations.

The components needed are of standard type, easily procurable even in wartime. In essence the arrangement consists of a normal power-pack, with ordinary smoothing designed to reduce the ripple to a value well within the capacity of an ordinary triode. This triode has a low anode-circuit resistance, and acts as an amplifier, giving phase reversal but neither loss nor gain. By this means the normal ripple is neutralised. Simultaneously, if the time-constant of the grid circuit of the triode is large, relatively slow variations superimposed on the ripple are also neutralised.

Analysis shows that, in Fig. 1, $R_1 = 1/g_m$ where g_m is the mutual conductance of the valve. R_2 must have a value designed to give a suitable grid bias, and this value clearly depends on the fixed load current. C should have very low leakage, and should be as large as possible, say, up to 2 microfarads; R should be 1 megohm. A large condenser or a further decoupling circuit is essential, across the output terminals, to lower the impedance presented to voltages arising in the load. For an MH4, R_1 should be about 300 ohms, and for the best results the final adjustment of value should be made with the aid of a cathode-ray oscilloscope. Due to the presence of R_1, the voltage regulation is made worse by about 1 volt for every 3 mA in the load.

Fig. 2 shows a modification suitable for, say, a laboratory power-pack which may be used on various fixed loads without further adjustment. The performance is independent of the load, but this is at the expense of voltage regulation. R_1 should now have a value of $1/g_m + R_3(1 + 1/\mu)$. Using an MH4, R_3 can be 750 ohms, and R_1 will have to be 1,070 ohms. But again, for best results, adjustment should be made by the use of a cathode-ray oscilloscope. The resistance r is included to limit grid current when the load is suddenly increased; it can be 50,000 ohms. The voltage regulation is here made worse by about 1 volt for every milliampere in the load.

In both these circuits there is little objection in using output

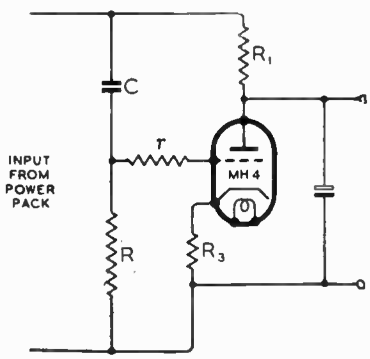


Fig. 2. Circuit suitable for any value of fixed load, without further adjustment.

voltages up to 350. The MH4 is not likely to be damaged so long as the anode dissipation is kept below 2.5 watts, because the anode voltage variation is small.

The author's examples built to these circuits have shown a residual ripple of not more than one millivolt in 300 volts. Moreover, the random jumpiness of output voltage has completely disappeared.

The chief application has been the supply to oscillators. In this case the oscillator portion of the instrument is connected to the semi-stabilised output, whilst the anode circuit, grid circuit and cathode circuit of the power stage are connected to the unstabilised power-pack direct; the chassis and case are also, for safety, connected to the negative end of the power stage supply, and to one output terminal.

The circuit of Fig. 1, which is believed to be almost a traditional method of "electronic smoothing," was brought to the writer's attention by his colleague, Mr. C. Stokes. We have not been able to trace any actual reference to it, but the full implications brought out by this note are believed to have some novelty.

VALVE STANDARDISATION

Discussion on "Some Technical Aspects of Valve Standardisation" at a Meeting of the Radio Section of the I.E.E., February 20th, 1945

THE discussion was opened by A. H. Cooper, B.Sc., who pointed out that the success of valve standardisation depended on the extent to which valves could be made interchangeable, and therefore on the stringency of current conditions of use. In about 1930, most valve applications could be met equally well by valves from different manufacturers, but since then the demand for higher performance for a given cost and the choice of operating conditions depending on parameters which the valve maker finds it uneconomical to test or control has impaired interchangeability. If valve standardisation was to work it would be necessary for valve and circuit engineers to agree not only on the types of valve required, but in reasonable ways of using them. If standardisation were not to act as a brake on progress, this "code of practice" must be kept alive and ahead of the needs of users.

In the discussion which followed several speakers underlined the danger that standardisation might act as a brake on progress, but it was pointed out that this difficulty would not arise if agreement were restricted to types performing established functions. One speaker thought that about ten types could be standardised at once and that these should be sold at a lower price. Valves outside this group could then compete for a place on the standard list on their merits.

A specific proposal for valve standardisation which had appeared recently* was criticised in detail and it was generally agreed that there was need for wider discussion between valve manufacturers and receiver designers to ensure that the types finally decided upon would be acceptable to all concerned. This was particularly necessary in the case of multiple types where the interests of the set designer and the valve manufacturer were to some extent opposed.

Standardisation of valve bases and the physical dimensions of valves presented no insuperable difficulties and it was agreed that one or at most two types of base would meet present-day requirements. It was disclosed that a committee appointed by the British Radio Valve Manufacturers' Association is already working on the question of standardising physical dimensions.

The standardisation of valve characteristics would be dependent on agreement not only on the characteristics which it was desirable to measure but also on the method of measurement. Several speakers called for an extension of standardisation to what may be called the secondary parameters of the valve. Valves with ostensibly similar main characteristics might differ widely in their secondary parameters owing to differences in the technology of manufacture. Against this it was argued that there was an economic limit to the number of tests which could be employed in each case and that in general only those characteristics related to the function for which a valve was intended could be controlled. It was not reasonable to ask the manufacturer to test for all the ways that the ingenuity of "wicked or clever people" might devise for using a valve outside the scope of its normal function.

It was pointed out that there was a brief period when we had complete valve standardisation—this was just after the first and before the second valve had been made! That ideal state would never again be approached, in the view of Mr. Cooper, who replied briefly to the discussion, for it was now clear that a valve was very like a cheese; its manufacture was a complicated blend of mechanical, physical and chemical processes. Some degree of standardisation was possible in the salient characteristics, but there would be subtle and often obscure qualities which should not be exploited before they were understood and could be brought under stable control.

* Presumably this refers to the new Dutch valves which were described in the February sue of this journal. [Ed.]

RANDOM RADIATIONS

By "DIALLIST"

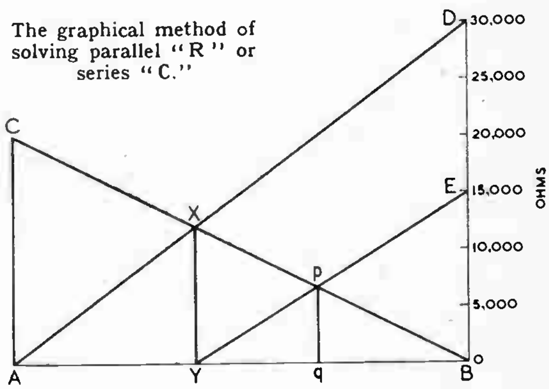
A Great Man

IT was with profound regret that I heard a few days before writing this of the death at the age of 72 of Dr. Charles F. Burgess, founder and president of the Burgess Battery Company of America. I had known him well for some twenty years, both from his letters and on his visits to this country. In him science in general and wireless in particular lose a great enthusiast and a great brain. Burgess was that very rare combination of a scholar and a big business man. His early career was academic. After brilliant years as a student and graduate, he became Professor of Metallurgy in the University of Wisconsin, and during his tenure of that office made contributions to the science of metallurgy which received wide recognition. In the course of his researches he investigated the decomposition of zinc in primary batteries and came to the conclusion that the dry cell, as it then was, was a long way from being as efficient as it could be. This led to the formation, in quite a small way, of a dry battery manufacturing company, which was destined to become one of the largest and most important in the world. Metallurgy was by no means his only subject: he was an expert in electricity and acoustics, and was responsible for many inventions and developments in both. With all his attainments he was the most modest of men. A stranger meeting him for the first time would quickly appreciate his brilliance, his strong sense of humour and his charm. I am sure that many railway travellers in this country formed such impressions of the unknown American whom they met in a third-class smoker — he liked travelling "third" because, he said, you met interesting people that way—but I am equally sure that no word of his gave any clue to his eminence or his wealth. Though I had a standing invitation to his home, I was never able to visit him there, for I was not in America between the two wars.

□ □ □

Series "C" and Parallel "R"

IN last month's issue of *Wireless World*, "H. E. S." described an interesting and useful method of working out the results of combinations of series capacitors or parallel resistors by reversing the slider of a slide rule. There's an even simpler and quicker method (see *Wireless World*, Sept., 1942) which answers admirably so long as round-figure answers are all that are needed. This is the graphical, illustrated in the accompanying figure. Let's suppose that we have, to take a simple example, R1 of 20,000 ohms in parallel with R2 of 30,000. On a piece of squared paper draw a base of AB of any convenient length. Draw AC 20,000 units long and BD 30,000 units long. Join CB, DA: Drop a perpendicular from X, then XY represents the resistance of the combination, and XY measures 12,000 units. If the combination is of three resistors, say 20,000, 30,000 and 15,000 ohms, proceed as before with any two of them. Then, using YB as the base, joining EY and *pq* gives the answer — in this case 6,666 ohms. The proof? Here it is. From similar triangles



The graphical method of solving parallel "R" or series "C."

$$\frac{XY}{BD} = \frac{AY}{AB}$$

and

$$\frac{XY}{AC} = \frac{BY}{AB}$$

Adding: $$\frac{XY}{BD} + \frac{XY}{AC} = \frac{AY}{AB} + \frac{BY}{AB}$$

$$\therefore \frac{XY}{BD} + \frac{XY}{AC} = 1$$

Divide by XY

Then, $$\frac{1}{BD} + \frac{1}{AC} = \frac{1}{XY}$$

Or, $$\frac{1}{R2} + \frac{1}{R1} = \frac{1}{R}$$

The "Rescapper"

This method proved so useful that I made up a little resistance or capacitance calculator, which I call the Rescapper. It consists of a sheet of good graph paper stuck on to a piece of cardboard. The paper is marked off on the vertical edges into units suitable for resistors (right) and capacitors (left). At the points corresponding to A and B in the figure holes are pierced, and through these are passed fine silk threads, the ends on the underside of the board being knotted to prevent them from being pulled adrift. To the far end of each thread is fixed a small lead weight, or "mouse." To work out any problem concerning combinations of series capacitors or parallel resistors is simplicity itself. Instead of ruling lines you stretch the threads and read the resultant (XY) of any combination of two series capacitors or parallel resistors from the appropriate scales. If there are more than two of them, one thread is laid after the first operation from A to the vertical scale reading on the right-hand edge corresponding to X and the work goes merrily forward. With good graph paper and the kind of practice in making interpolations in scale readings that comes the way of most wireless and electrical workers, you can obtain remarkably accurate results in this way.

□ □ □

"Argumentum ad Feminam"

SPEAKING of interpolation reminds me that one of the most difficult jobs in training radiolocation girls was to teach them to read accurately the many meters that they had to use. The only dial, I suppose, that most of them had ever read before was the face of a clock, and such a thing as "ten-and-a-half minutes to ten" was as near as any of them had previously got to the art of interpolation. As very few had even a nodding acquaintance with decimals, we had to teach them first of all something about these; this was also necessary because they had to know the meaning of a metre as a measure of wavelength. The best way, I found, was to rub into them that an inch is roughly 2.5 centimeters and a metre a yard *plus* ten per cent., and then to get them to work out their own waist measurements and heights in metres. They became very keen on the metric system when they found how much easier it was to discover the cost of 3.25 metres of material at 64.50 francs than that of 3¼ yards at "seven-eleven-three"! The next step was to make each draw a line exactly one inch long and then to make a dot at an estimated "point four" or "point seven," afterwards verifying with a ruler. Then they had to read large dummy dials or to set their pointers to given figures. After that they soon grew expert with voltmeters, ammeters, and so on. They were, in fact, as keen as mustard and quick to learn, and soon became good at finding rapidly and with all the accuracy called for the answers to problems such as: "A half-wave dipole is so many feet and inches long; what is the frequency of the apparatus connected to it?" Not bad for ex-shopgirls, ex-factory hands, ex-typists and ex-waitresses! A good many of them, I think, will astonish their former employers, if they return to the jobs that they had in civil life.

□ □ □

Protecting Joints

SOME joints, as for example, those between fine wires and those where you want the end of a piece of flex soldered to a tag or a terminal to remain rigid, need rather more solid protection than that afforded by ordinary insulating tape. I had a job the other day (actually the "electrification" of a hot-plate or "sluggard's joy" previously heated by spirit lamps) where something of the kind was needed and the experiment then made proved so successful that I pass it on. As the joints in question were liable to get pretty hot, they were made with hard solder and given a preliminary binding with stranded asbestos string. Next, a two-inch plaster-of-paris bandage was bought from the chemist and about a foot of it torn into strips half an inch wide. A strip was rolled up, damped as per directions on the box, and then wrapped tightly over the asbestos. These bandages set hard in a few minutes and you then have a joint as rigid and as well protected as you could wish.

GOODS FOR EXPORT

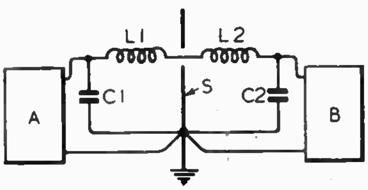
The fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.

RECENT INVENTIONS

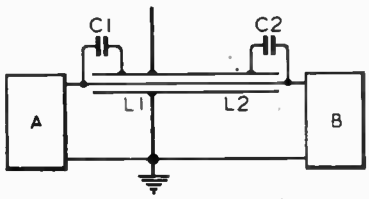
A Selection of the More Interesting Radio Developments

RF COUPLINGS

THE circuit shown in diagram (a) acts as a transformer coupling between the two tuned circuits A and B, giving a voltage ratio which is inversely proportional to the two capacities C1, C2. The arrangement is distinguished from the ordinary two-coil type of transformer coupling by the fact that it is not subject to the stray capacity losses as the coupling is tightened. The whole network, comprising the series inductances L1, L2 and the shunt capacities C1, C2, is resonant to the working frequency; and so are the two component circuits L1C1 and L2C2. A screen S prevents stray capacity coupling between the two circuits.



(a)



(b)

Screened RF couplings.

The inductances L1, L2 may be merged into one, or both of them may be replaced by an equivalent length of transmission line. Diagram (b) illustrates the last-mentioned arrangement, in which the screen S may be replaced by separate screens protecting the two condensers.

C. S. Bull. Application date February 20th, 1944. No. 563689.

RECEIVING CENTIMETRE WAVES

INSTEAD of using an ordinary aerial, the incoming signals are intercepted by a slotted baffle plate. This gives rise to an interference or diffraction pattern at the rear of the slots, where one or more dipole-and-crystal detectors are arranged at points of maximum field strength. The system is particularly suitable for phase- or frequency-modulated signals transmitted on a carrier wave of the order of centimetres; it obviates the use of ordinary resonant circuits.

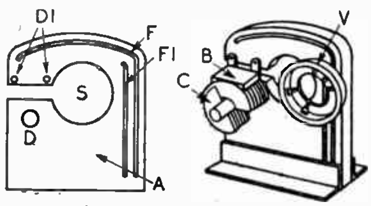
For a FM carrier of one centimetre, the baffle plate should include at least 100 slots, each 1 cm. wide and 10 cms. long, with a mutual spacing of from 1 to 10 cms. The receiving dipoles should be 0.5 cm. in overall length and may be distributed over an imaginary cylindrical surface, being interconnected by metallic strips and, if necessary, by phasing elements to a common receiver. The spacing is such that each dipole is situated at a point of maximum pick-up from the modulated carrier. This occurs when the carrier is at its maximum frequency deviation, and is best determined in practice by making a preliminary trial with an unmodulated wave adjusted to that frequency.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of W. R. Ferris). Convention date (U.S.A.) January 30th, 1942. No. 563686.

USW SETS

THE baseplate or chassis of the set also serves to provide the major part of the inductance of the circuit. As shown in diagram (a), a flat rigid plate A, preferably of silver-plated brass, is made with a central aperture S, having an open-ended slot, across which a variable tuning condenser C is connected in shunt, as shown in diagram (b). The plate acts as the equivalent of a single coil, its inductance depending upon the area of the cut-away parts.

The spindle carrying the rotary vanes of the condenser C is mounted in a drilling D, whilst the fixed vanes are carried by a bracket B which is fastened through holes D1 to the opposite side of the slot S, thus avoiding the use of insulation. For centimetre working, no part of the plate A is cut away, the rotor and fixed vanes of the condenser being then connected to spaced points on a solid plate.



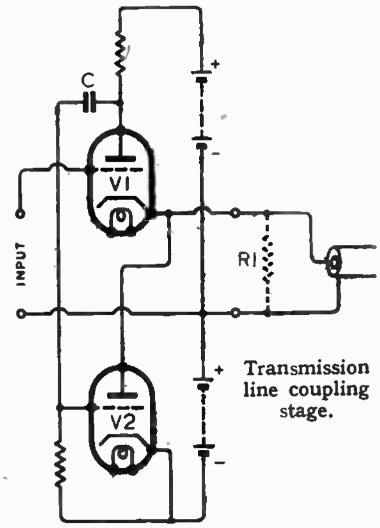
Tuner unit for high radio frequencies.

The plate may also carry a valve-holder V, the anode and cathode supply leads being laid in grooves F, F1, which, since the RF currents are confined to the surface of the plate, provide sufficient screening.

W. S. Percival. Application dates April 25th and October 1st, 1940. No. 563463.

PUSH-PULL AMPLIFIERS

THE two valves V1, V2 feed television signals to a transmission line without using a transformer. The line, or low impedance load, represented by the dotted line resistance R1, is included in the cathode circuit of the valve V1 and in the anode circuit of the valve V2, the grid of the latter being coupled to the anode of the former through a condenser C.



Transmission line coupling stage.

A positive-going impulse applied to the input terminals increases the current from the valve V1 to the line. Simultaneously the drop in the anode potential of that valve is applied through the condenser C to the grid of the valve V2 to reduce its output, so that the two amplifiers work in opposite phase. Both grids are initially biased so that for positive signals the whole load is taken by one valve, and for negative signals by the other, the mean anode current being kept at a minimum. The arrangement thus compares favourably with a single cathode-follower valve giving the same power output. When the input is a television signal of the usual waveform, one of the valves can be made to take the picture signals only, while the other passes the synchronising impulses which are in a different range of amplitude.

The circuit is useful for other kinds of signals, particularly those consisting largely of sharp pulses.

E. L. C. White. Application date, September 7th, 1940. No. 564250.

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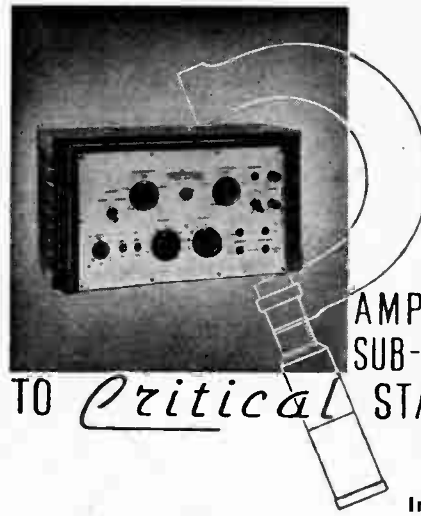

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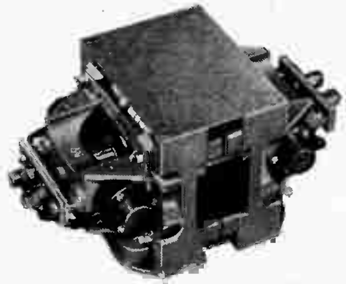

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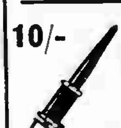

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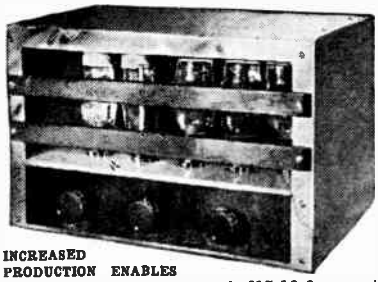

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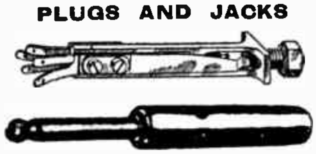

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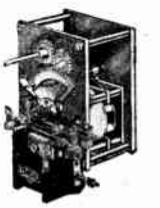

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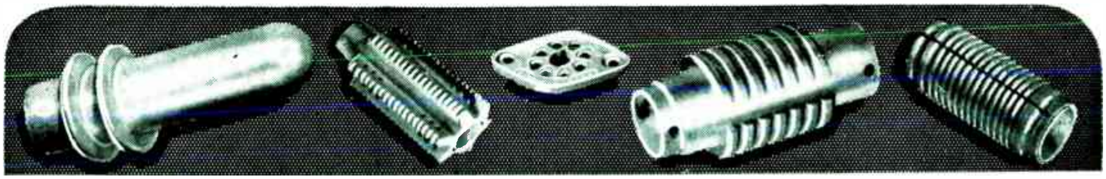

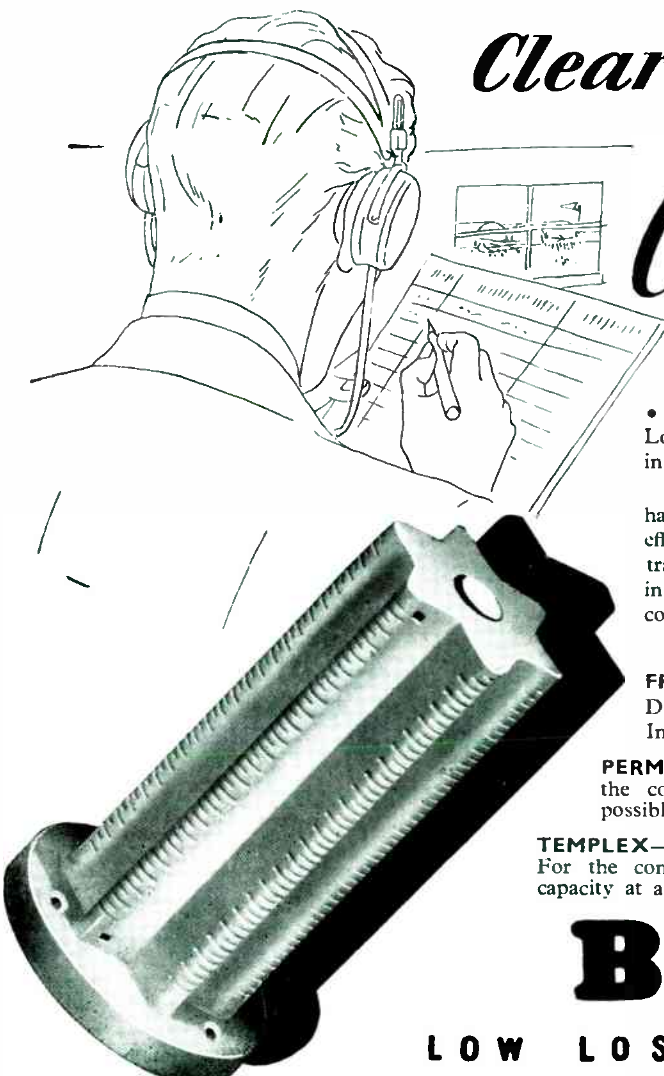

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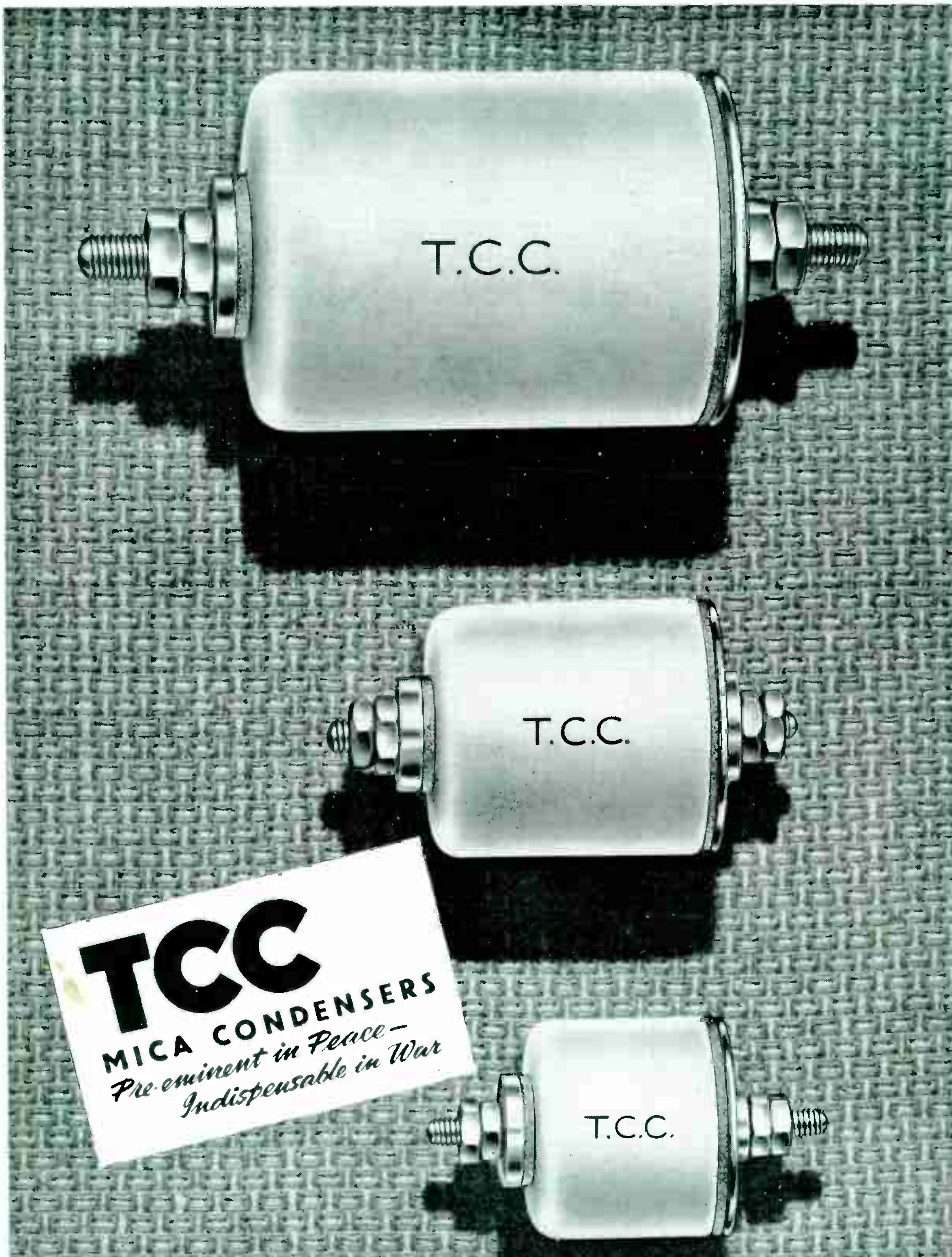
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