


4^D

The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, September 10th, 1930.



P.M.

**FIRST-
BECAUSE OF
THE FILAMENT**

Mullard
THE MASTER VALVE

EKCo

ALL-ELECTRIC RADIO

*"At all the
Best Receptions"*

Write for Free Booklet on "All-Electric Radio" and details of Easy Payments to:-
E. K. COLE, Ltd., Dept. W.
"Ekco" Works, Southend-on-Sea.

Utility DIFFERENTIAL CONDENSER



Stocked by all good dealers and the best value in a Condenser of this type that you can possibly obtain. The capacity is .0001 mfd. and the design provides smooth reaction at all points of the scale. Fully guaranteed for efficiency and finish by "Utility" — makers of the Dial, Condensers and Switches that experienced constructors always choose. Illustrated list free for a p.c.

Other Prices:	'00015	7/-
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WILKINS & WRIGHT LTD.,
"Utility" Works,
Holyhead Road, BIRMINGHAM.

6'6

DEPENDABILITY



Licensed under design Reg. No. 723271.

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CONDENSERS

7.C.C. CONDENSER
2 MF
PAT. 13345/25

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*Here's
more power
to your*

PORTABLE SET...



P.220A CHARACTERISTICS

There's no need to sacrifice quality to economy if you use this wonderful new valve in your portable set—it gives you both.

Filament volts	-	-	-	-	-	2.0
" amps	-	-	-	-	-	0.2
Max. H.T. volts	-	-	-	-	-	150
Amplification factor	-	-	-	-	-	6.5
Anode A.C. resistance (ohms)	-	-	-	-	-	1850
Mutual A.C. conductance (mA/V)	-	-	-	-	-	3.5

It is easy on H.T. and L.T. Batteries and the resulting tonal quality has to be heard to be believed.

PRICE 13/6

With Mazda valves in all positions your set will give a performance many times better than before.

Used as the output valve in an ordinary 2-valve loud speaker set it will give wonderful quality and sufficient volume for most domestic purposes.

The amazing

MAZDA

RADIO VALVES

**See the amazing
Mazda Valves on
the EDISWAN
Stand No. 67
at OLYMPIA**



THE EDISON SWAN ELECTRIC CO., LTD.
Incorporating the Wiring Supplies, Lighting Engineering, Refrigeration and Radio Business of The British Thomson-Houston Co., Ltd.

Radio Division:
1a Newman Street, Oxford Street, W.1
Showrooms in all the Principal Towns

EDISWAN

V.72

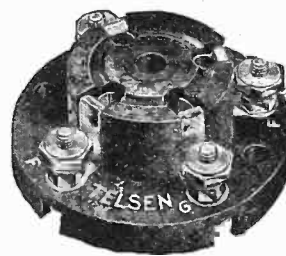
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**Every component
DEPENDABLE
in its
PERFORMANCE**

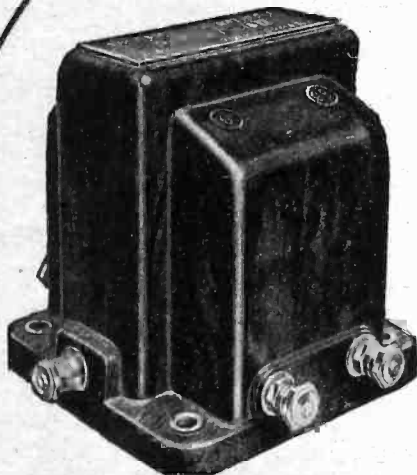


Telsen H.F. Chokes, designed to cover the whole wave-band range from 18 to 4,000 metres, extremely low self-capacity, shrouded in Genuine Bakelite. Inductance 150,000 microhenrys, resistance 400 ohms. Price 2/6 each.

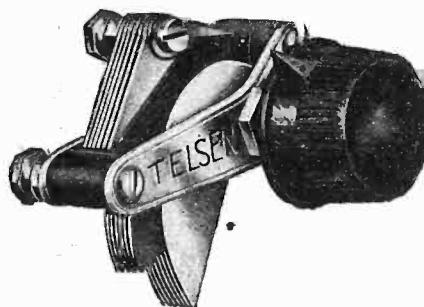
Telsen Valve Holders. Pro. Pat. No. 20285/30. An entirely new design in Valve Holders embodying patent metal spring contacts which are designed to provide the most efficient contact with the valve legs, whilst allowing the valve to be inserted or withdrawn with an easy movement instead of being subjected to undue strain, which often causes damage and loss of efficiency to the valves. Low capacity, self-locating, supplied with patent soldering tags and hexagon terminal nuts.



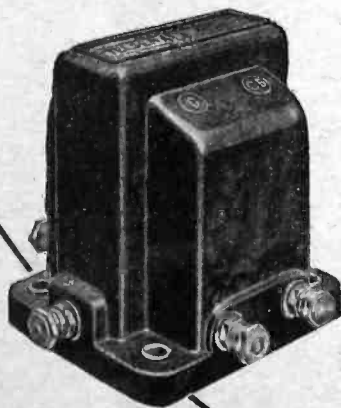
Price 1/- each.



Telsen "Radiogrand" Transformer, new model, shrouded in Genuine Bakelite, with new windings and core, fitted with earth terminal. Made in ratios 3 : 1 and 5 : 1. Price 12/6 each



Telsen Variable Condensers (Bakelite Dielectric). Particularly designed for use as a reaction condenser, may also be used as a neutralising condenser where large capacity is necessary. All vanes are insulated with Bakelite which eliminates the possibility of a short circuit between the moving and fixed vanes. Made in three capacities: .0005, .0003, .00015, supplied complete with pointer knob with one-hole fixing for panel mounting. Price 3/- each.



Telsen "Ace" Transformer, the ideal model for all Portable Sets and where space is limited, gives perfect reproduction throughout the musical range. Shrouded in Genuine Bakelite, with new windings and core, fitted with earth terminal. Made in ratios 3 : 1 and 5 : 1. Price 8/6 each.

NOW is the time for every radio enthusiast to commence building his new season's set: or perhaps in many cases it will only need revising to bring it up to present "Regional" requirements. In the Telsen range of components you are assured of the finest technical perfection it is possible to obtain; each component is the outcome of research into the "cream" of radio component design. No finer range of components could possibly be specified for any set; no finer range could be chosen for replacements of any kind; no finer range could be selected at any price! They are "Radio's Choice" for "Better Radio Reception."

**TELSEN
COMPONENTS**

Advt. of Telsen Electric Co., Ltd., Birmingham.

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Varley

FAMOUS SINCE BROADCASTING BEGAN



Impedance Matching
Output Transformer.

Six Ratios—

8 : 1, 10 : 1, 12 : 1,
15 : 1, 20 : 1, 25 : 1,

Price
each
£1.2.6



Long before Broadcasting became what it is to-day, Varley's had won fame for their coil winding.

On this experience is founded Varley's latest achievement in radio. Varley Impedance Matching Output Transformer—a new component of advanced design—gives six different ratios. Accurately and without difficulty you can match loudspeaker and output valves.

Remember that Varley Components are descendants of a long line. Since radio came Varley ideal has been quality. The Varley Impedance Matching Output Transformer is the only answer to a modern radio problem.

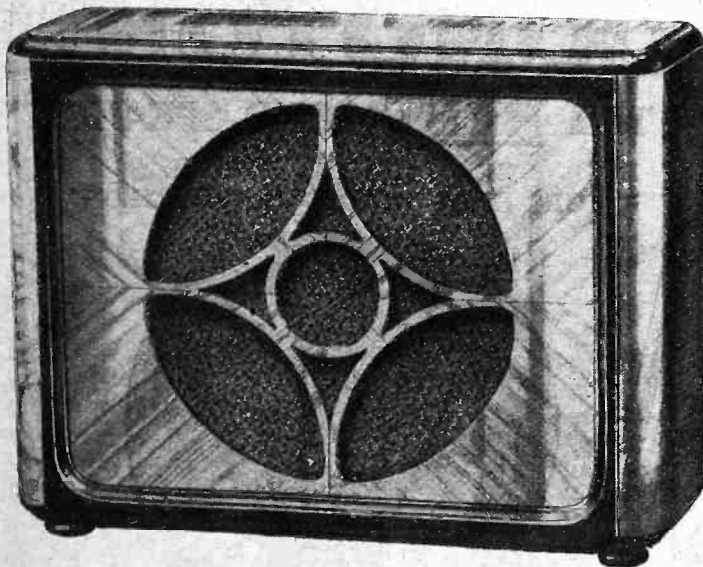
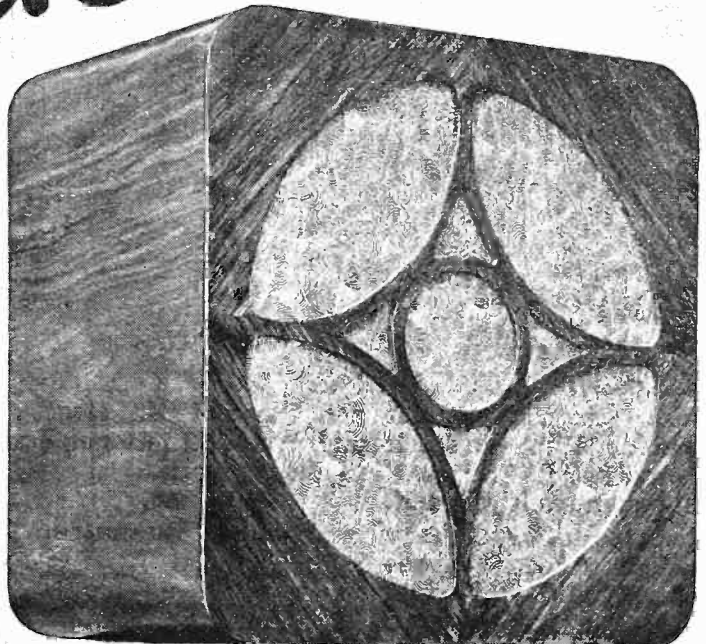
STAND
No. 105
OLYMPIA
Sept. 19-27.

Advt. of Oliver Pell Control Ltd., Kingsway House, 103, Kingsway, London, W.C.2. Telephone: Holborn 5303.

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Two wonderful Speakers!

These two new speakers represent all that is highest in loudspeaker reproduction. They are both fitted with the finest unit in the world, 66R, and they are both perfect pieces of the cabinet makers' art. Both are housed in beautiful walnut cases, the 51R being of unconventional design to suit the modern room.



**BLUE
SPOT
71R
£4.15.0**

**BLUE
SPOT
51R
£4.4.0**

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BRITISH BLUE SPOT
COMPANY LTD. •**

Blue Spot House, 94/96, Rosoman Street,
Rosebery Avenue, London, E.C.1.

Phone: Clerkenwell 3570. Grams: Bluospot, Smith, London.
Distributors for Northern England, Scotland and North Wales: H. C. RAWSON (Sheffield and London) Ltd., 100, London Road, Sheffield; 22, St. Mary's Parsonage, Manchester; 183, George Street, Glasgow.

Meet us at:

OLYMPIA, SEPT. 19-27—STAND No. 217.

MANCHESTER RADIO SHOW, OCT. 8-18—STAND No. 30.

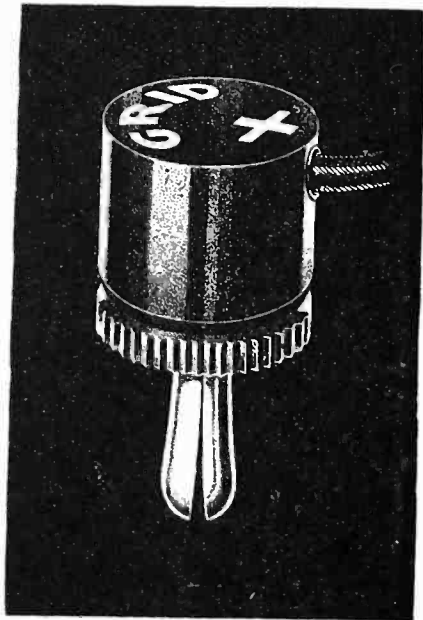
BLUE SPOT



TRADE MARK

FITS EVERY BATTERY SOCKET

— and it stays put



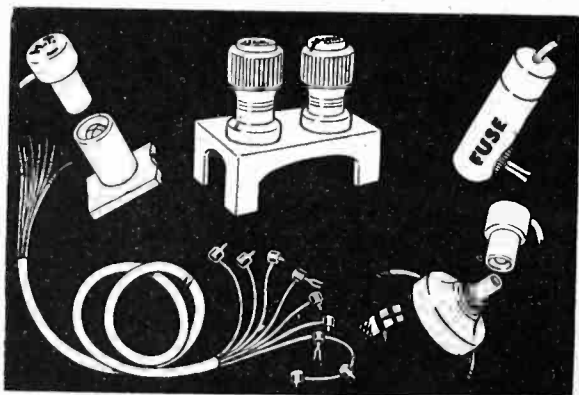
Here is the perfect Wander Plug—push it in and it STAYS “put” till you move it yourself. It grips ANY battery socket, too, because each Plug is tested in sockets larger and smaller than those of any battery made.

Special ‘D’ section hard-drawn wire prongs. Side entry for flex, which is grip-

- BELLING-LEE TERMINALS.**
 Type “B” - - - - 6d.
 Type “M” - - - - 4½d.
 Type “R” - - - - 3d.
TWIN PLUG & SOCKET 1/6
(Panel portion 6d. Flex Portion 1/-.)
INDICATING SPADE TERMINAL 4½d.
S.G. ANODE CONNECTOR 6d.
BATTERY CORDS, 9-way 5/9
Also made in 5, 6, 7, 8 and 10 way.
The Belling-Lee Bakelite Terminal Mount - Price 8d.
The New Wanderfuse .. 1/6
Spare Fuses (150 m/a) .. 9d. each.

Price 3d.

STAND No. 134
 NATIONAL RADIO EXHIBITION.
 OLYMPIA.

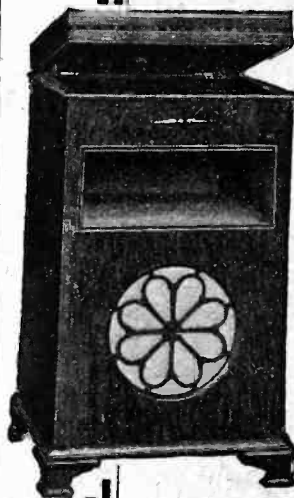


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FOR EVERY RADIO CONNECTION

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HOUSE your Set in the Camco “Waverley” Cabinet. Supplied with 15” baseboard. Loud Speaker compartment is 18” x 18” x 15”. Will take panels 18” x 7”. Height 38”. In Oak as illustrated, £5 10s.; Mahogany £6 15s. (Carriage extra). Send for 24 pp. Catalogue or see full range at our Showrooms:
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 Phone: Holborn 8202.
 (Factory: Camco Works, S.Croydon).
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costs only **£5-10-0**

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DONOTONE

THE **BEST** LOUD SPEAKER

NEW IDEAL MODEL
 FOR REAL RADIO ENJOYMENT



Price **6 GNS.**

Diameter of Case, 18 inches; depth, 9 inches.
 DEMONSTRATIONS DAILY.

THE DONOTONE (Regd.) LOUD SPEAKER
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1923

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ELECTRICAL

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1930

AND LARGER VALVES

A Long Line of Famous

OSRAM

POWER VALVES

The Valves with a Pedigree

Each has become the standard in its own class. Experts in sound reproduction always choose OSRAM POWER VALVES for reliability in performance, consistency in characteristics, and maximum undistorted output.

MADE IN ENGLAND



A NEW BOOKLET

"OSRAM VALVES

for Power Amplification"

containing invaluable information of all types of large OSRAM POWER VALVES from 5 watts up to valves big enough for talking picture and public entertainment amplifiers, hints as to their use, explanation of characteristic curves and complete technical data.

WRITE for copy. Sent Post Free

Osram Valves

Sold by all Wireless Dealers.

for POWER AMPLIFICATION

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

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EVERYTHING **The G.E.C.** ELECTRICAL
your guarantee

THIS WILL SET YOU THINKING

PRICE
13/6
 FOR THE
 TRIPLE CAPACITY
 UNIT



NOW

**GET ONE TO-DAY
 AND YOU'RE WELL
 ON THE WAY TO
 SAVING THE COST
 OF A NEW BATTERY**

*The complete range of
 "MAGNET"
 WIRELESS BATTERIES*

includes:

TRIPLE CAPACITY TYPE
 L.4903, 60 volt

Price **13/6**

STANDARD UNIT TYPES

L.4920 60 volt
 Price 7/11

L.4922 100 volt
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GRID BIAS BATTERIES

L.6095 6 volt
 Price 1/3

L.6096 9 volt
 Price 1/9

L.4908 16½ volt
 Price 3/3

MADE IN ENGLAND.

**AN ENTIRELY
 NEW BATTERY
 THAT WILL GIVE YOU
 A MONTH'S
 FREE H.T.**

THE NEW
"Magnet"
 TRIPLE CAPACITY
 H.T. BATTERY

You probably did not know that months and months of patient research could make such a wonderful change in H.T. Battery value as this! Now, for the first time, you can buy the New MAGNET Triple Capacity Battery which, at less than twice the price, gives three times the capacity of a standard small unit battery!

SOME SAVING THAT'S WORTH SAVING!

Sold by all Wireless Dealers.

TRIPLE CAPACITY GIVES A MONTH'S FREE H.T.

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Australia's
Best
&
Britain's
Best
DISCRIMINATING
ON
BRADMAN!



Of course it's a M^cMICHAEL!
—and he's taking it with him to Australia...

SOME OUTSTANDING DETAILS

1. Screened Grid Amplification rendering the set highly selective and wide in range.
2. Simple dial tuning and volume control making simplicity the keynote of its operation.
3. Fitted in handsome furniture hide suitcase with patent locking clips which makes the set not only extremely convenient for picnics and parties, but quite suitable for the most luxurious surroundings.
4. Low battery consumption ensuring economy of operation.

Owing to the high degree of selectivity in this, and our other Screened Grid Portable Receivers, we are

able to guarantee complete selectivity between all main B.B.C. stations under the new scheme of wavelengths, as proved by an actual test under the twin aeriæls at Brookman's Park, when both programmes were received separately without interference, and in addition a number of other British and foreign stations. This test was made on a standard "Super Range Four" receiver under an independent Press observer, and was repeated at half-mile intervals with similar results.

Ask at any high-class Radio store for a demonstration of this unique Receiver—or call at our London Showrooms.

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Olympia - Sept. 19-27
Stand No. 57

L. M^cMICHAEL LTD

Manufacturers of Wireless and Scientific Apparatus
WEXHAM ROAD, SLOUGH, BUCKS.
Telephone: Slough 441-442. Telegrams: Radiether, Slough
London Showrooms: 179 STRAND, W.C.2 (Tel.: Holborn 2466)

CASH PRICE 22 GNS.
Including all equipment and Royalties. Or by our special "Deferred Payments on Hire Purchase Terms" system, £5 down and 10 monthly payments of £2:1:0

**THE M^cMICHAEL
SUPER RANGE PORTABLE FOUR**

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EVERYTHING **The S.E.C.** ELECTRICAL
your guarantee.

THIS WILL SET YOU THINKING

PRICE
13/6
 FOR THE
 TRIPLE CAPACITY
 UNIT



AN ENTIRELY
 NEW BATTERY
 THAT WILL GIVE YOU
 A MONTH'S
 FREE H.T.

NOW

GET ONE TO-DAY
 AND YOU'RE WELL
 ON THE WAY TO
 SAVING THE COST
 OF A NEW BATTERY

The complete range of
 "MAGNET"
 WIRELESS BATTERIES

includes:

TRIPLE CAPACITY TYPE
 L.4903, 60 volt

Price **13/6**

STANDARD UNIT TYPES

L.4920 60 volt
 Price **7/11**

L.4922 100 volt
 Price **12/11**

GRID BIAS BATTERIES

L.6095 6 volt
 Price **1/3**

L.6096 9 volt
 Price **1/9**

L.4908 16½ volt
 Price **3/3**

THE NEW
"Magnet"
 TRIPLE CAPACITY
 H.T. BATTERY

You probably did not know that months and months of patient research could make such a wonderful change in H.T. Battery value as this! Now, for the first time, you can buy the New MAGNET Triple Capacity Battery which, at less than twice the price, gives three times the capacity of a standard small unit battery!

SOME SAVING THAT'S WORTH SAVING!

MADE IN ENGLAND.

Sold by all Wireless Dealers.

TRIPLE CAPACITY GIVES A MONTH'S FREE H.T.

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

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

**Australia's
Best
&
Britain's
Best**

**DISCRIMINATING
DON
BRADMAN!**



Of course it's a M^cMICHAEL!
—and he's taking it with him to Australia...

SOME OUTSTANDING DETAILS

1. Screened Grid Amplification rendering the set highly selective and wide in range.
2. Single dial tuning and volume control making simplicity the keynote of its operation.
3. Fitted in handsome furniture hide suitcase with patent locking clips which makes the set not only extremely convenient for picnics and parties, but quite suitable for the most luxurious surroundings.
4. Low battery consumption ensuring economy of upkeep.

Owing to the high degree of selectivity in this, and our other Screened Grid Portable Receivers, we are

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National Radio Exhibition
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Manufacturers of Wireless and Scientific Apparatus
WEXHAM ROAD, SLOUGH, BUCKS.
Telephone: Slough 441-442. Telegrams: Radlether, Slough
London Showrooms: 179 STRAND, W.C.2 (Tel.: Holborn 2466)

CASH PRICE 22 GNS.

Including all equipment and Royalties. Or by our special "Deferred Payments on Hire Purchase Terms" system, £5 down and 10 monthly payments of £2:1:0

**THE M^cMICHAEL
SUPER RANGE PORTABLE FOUR**

PRELIMINARY ANNOUNCEMENT!

First Prize
£50
in Cash

SECOND PRIZE

Voucher for the purchase of apparatus to the value of £20 from firms exhibiting at the Olympia Show.

THIRD PRIZE

Similar voucher for £15.

FOURTH PRIZE

Similar voucher for £10.

FIFTH PRIZE

Similar voucher for £5.

The
Wireless
AND
RADIO REVIEW
World

OLYMPIA SHOW COMPETITION

Following the successful competitions organised in previous years, "The Wireless World" offers cash and other valuable prizes for the 1930 Show Competition, in which readers are invited to vote for the best apparatus exhibited at Olympia. Make up your mind now to enter for this interesting competition.

An Entry Form will appear in each of the Three Special Show Numbers.

(Dated Sept. 17th, 24th, and Oct. 1st).

ILIFFE & SONS LTD., LONDON, E.C.4.

If you have A.C. mains

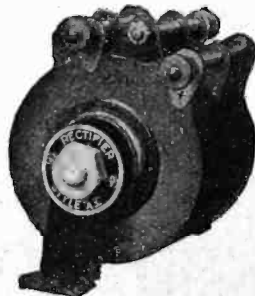
in your house, you have the cheapest and most reliable supply of current for your set, and

WESTINGHOUSE

METAL RECTIFIERS

enable you to adapt this supply in the simplest and most reliable way.

Here are three of the popular units—for high tension, low tension, and grid bias—and there are, of course, several other types, suitable for all radio purposes



All the leading radio manufacturers are now incorporating the Westinghouse Metal Rectifier in their eliminators, chargers and mains sets. You can do the same.

Full details, circuits and instructions are given in our 32-page book,

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Send a 2d. stamp with your name and address for a copy, to:—

The Westinghouse Brake & Saxby Signal Co., Ltd.,
82, York Road, King's Cross, London, N.1.

EVERYTHING **The G.E.C. your Guarantee** ELECTRICAL

FROM ONE END OF EUROPE TO THE OTHER

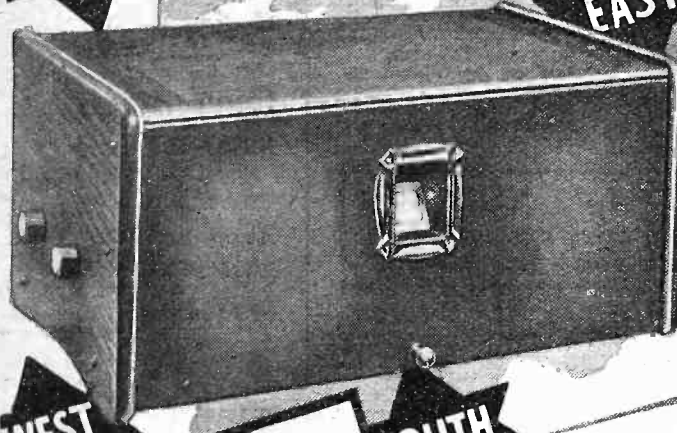
NORTH

EAST

WEST

SOUTH

ON THE NEW **Osram** MUSIC **4** MAGNET



- SPECIAL FEATURES**
- 1 The two Screen Grid stages give extreme selectivity and sensitivity with an unrivalled range.
 - 2 Enormous amplification with perfect stability is given by the complete shielding of H.F. Circuits.
 - 3 Equal efficiency guaranteed on both wave-length bands.
 - 4 Change of wave-length is effected by an external switch and the set need not therefore be opened.
 - 5 Maximum ease in tuning with a single knob controlling triple gang condenser.
 - 6 Assembly is the essence of simplicity.
 - 7 Volume control is not only provided as such, but to procure extreme selectivity.

Wherever you reside you may expect to receive dozens of stations with thrilling realism on the powerful "OSRAM MUSIC MAGNET 4." It has been tested up and down the country and everywhere results are the same . . . station after station is tuned in with full volume, perfect purity, and free from interference. Do not put up with an out-of-date receiver when you can get this equipment for only £11/15/0.

WRITE for POST FREE full-size Instruction Chart which will give you full information. Fill in the coupon below.

HIRE PURCHASE TERMS
You can either buy your "OSRAM MUSIC MAGNET 4" for cash or on these attractive HIRE PURCHASE terms: £1. 3. 6 deposit and 12 monthly payments of 18/6.

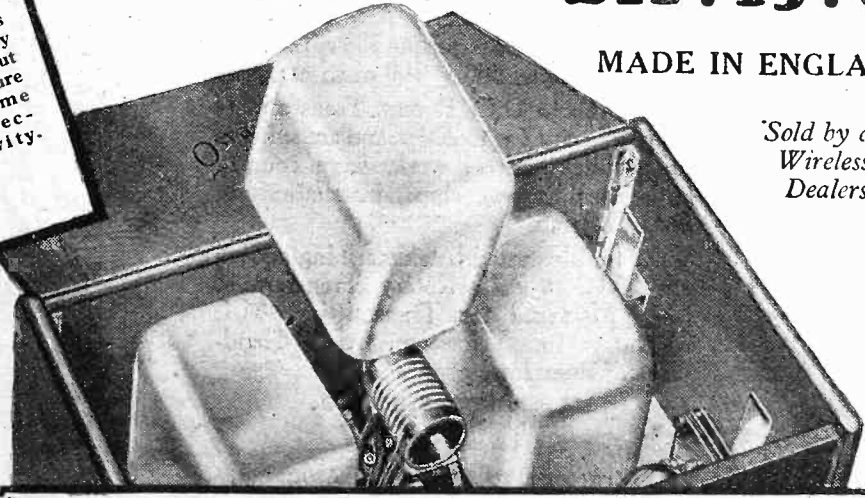
PRICE INCLUDING
Osram Valves, Gecophone Components and Polished Heavy Oak Constructor's Cabinet

£11. 15. 0

Prices apply only in Great Britain and Northern Ireland.

MADE IN ENGLAND

*Sold by all
Wireless
Dealers*



POST COUPON NOW for FREE CHART

Please send Instruction Chart to

Name _____

Address _____

The "Osram Music Magnet 4" Instruction Chart, The General Electric Co. Ltd., Magnet House, Kingsway, London W.C.2

Cut out coupon and paste on postcard or enclose in unsealed envelope Halfpenny postage in either case.

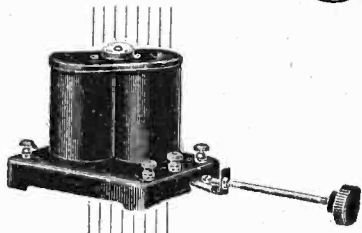
THE SET THAT BRINGS THE CONTINENT TO THE BRITISH ISLES

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

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Your High and Low Wave-Lengths

Controlled by a Single Knob



Lewcos Dual Binocular Coils. The Lewcos Dual Range Binocular Coils have wavelength ranges of 235-550 m. and 1,000-2,000 m., the wavelength range being selected by a simple push-pull switch which protrudes through the receiver panel.



Ref. D.B.A. Price 17s. 6d. each.
 Ref. D.B.G. Price 17s. 6d. each.
 Ref. D.B.P. Price 17s. 6d. each.

THE LEWCOS
 gives efficient performance on all wavelengths from 2,000 down to 20 metres.



TESTED VALUES.
 Self Capacity, 1.62 Micro-microfarads (N.P.L. Test).
 Natural Wavelength, 5,200 metres. (Tested with Moull in Voltmeter.)

H.F. CHOKE
 Size 1 1/4" x 2 1/2" x 3 3/8" high.
 Price - 7s. 9d. each.

VISIT OUR STAND NO. 41
 At the **RADIO EXHIBITION**
 SEPT. 19-27.

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED,
 CHURCH ROAD, LEYTON, LONDON, E.10.
 Stocks held at Belfast, Birmingham, Cardiff, Dublin, Glasgow, Leeds, Liverpool, London, Manchester, Newcastle, Nottingham.

D · C

to **D · C**



D.C. TO D.C.

ROTARY TRANSFORMER

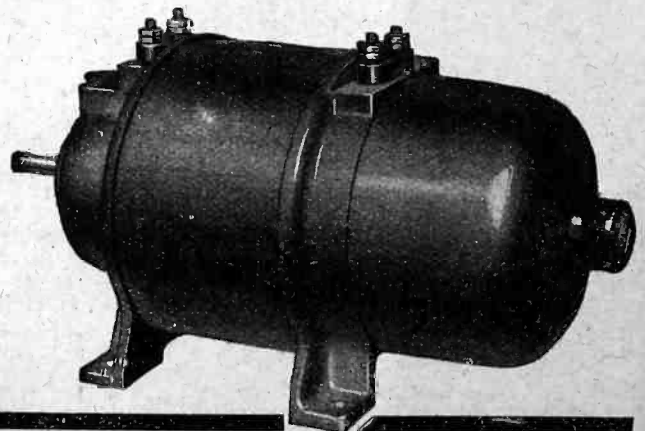
FOR RECEIVERS, AMPLIFIERS, RADIO-GRAMS requiring 300 v. 120 m.a., 400 v. 150 m.a., 500 v. 100 m.a., etc.

M-L D.C. to D.C. Rotary Transformers operate from 12 v. to 200 v. and are suitable for Public Address work, large country house installations, ships, installations in D.C. Districts.

Write for illustrated lists describing above; also D.C. to A.C. Rotary Transformer, M-L Machines for Transmitting, M-L Machines for Television, M-L Hand-driven Generators.

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Contractors to the Air Ministry,
 The British Broadcasting Corporation,
 The General Post Office,
 Marconiphone, The Gramophone Co. Ltd., etc., etc.



NATIONAL RADIO EXHIBITION 222

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The most economical H.T. The Exide Battery gives the cheapest form of H.T. Instead of replacing it, as you would a dry battery, you merely recharge it—and it costs much less than a mains unit.

Makes reception pure — an Exide adds no noise to your reception — no buzz, no crackle, no howl. It's silent right to the end of its charge—helps to eliminate harshness too—distant stations come in clearer. Aids selectivity—helps to cut out interfering stations because voltage does not fluctuate.



The Exide Battery is in almost all the big speech amplifiers. Wherever

clarity and reliability are vital they choose an **Exide**

Prices per 10-volt unit: W.J. 2,500 milliamps 5/6 • W.H. 5,000 milliamps 6/3 • W.T. 10,000 milliamps 12/6

Obtainable from Exide Service Stations or any reputable dealer. Exide Service Stations give service on every make of battery

Exide Batteries, Clifton Junction, near Manchester. Branches at London, Manchester, Birmingham, Bristol and Glasgow

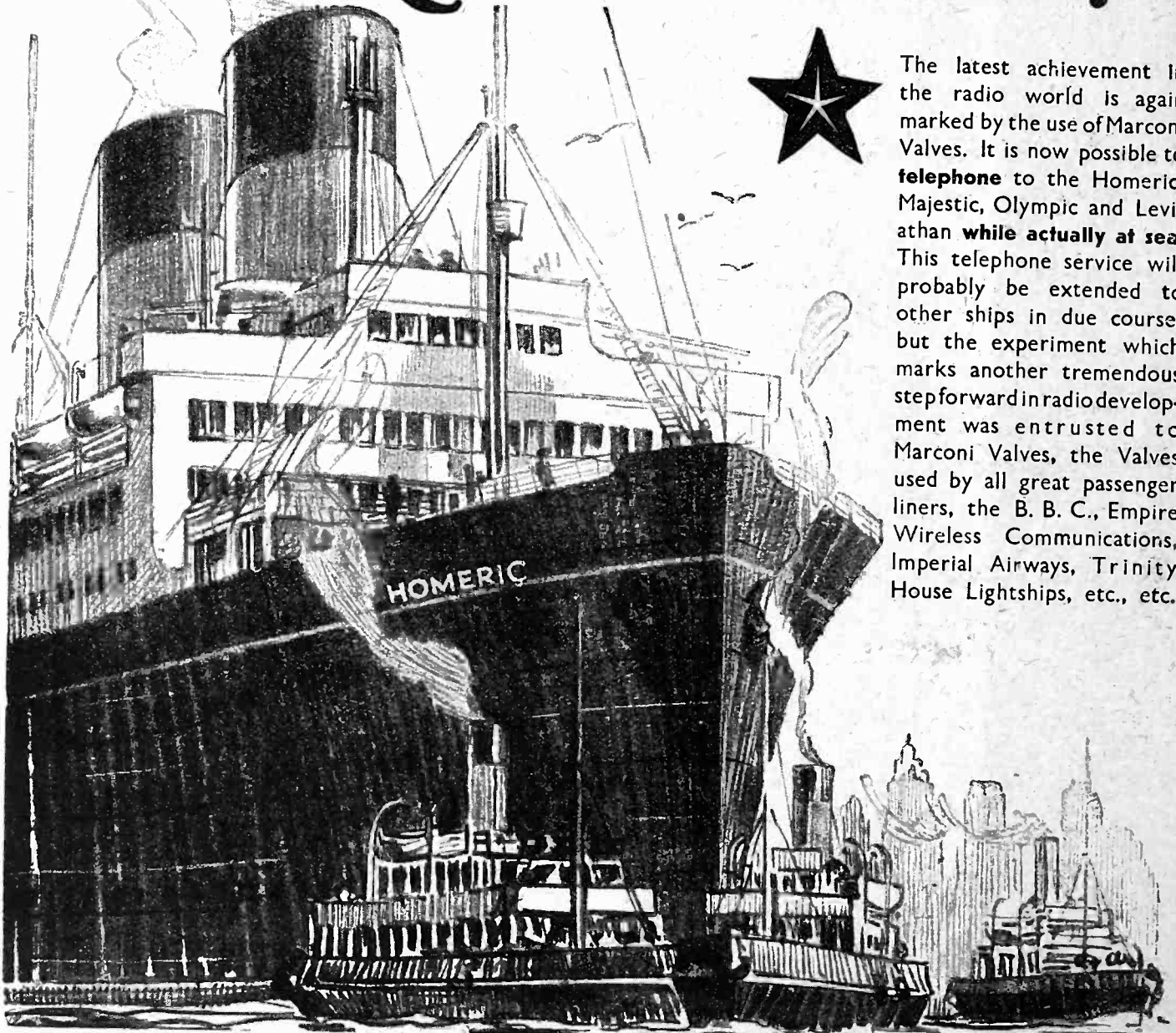
LII

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The latest achievement in the radio world is again marked by the use of Marconi Valves. It is now possible to **telephone** to the Homeric, Majestic, Olympic and Leviathan **while actually at sea**. This telephone service will probably be extended to other ships in due course, but the experiment which marks another tremendous step forward in radiodevelopment was entrusted to Marconi Valves, the Valves used by all great passenger liners, the B. B. C., Empire Wireless Communications, Imperial Airways, Trinity House Lightships, etc., etc.



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The Wireless World

AND
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(18th 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.

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OLYMPIA SHOW COMPETITION.

THE WIRELESS WORLD voting competition has now become an established feature of the annual Wireless Show, and, to judge from the number of entries in the Competition, its popularity has grown from year to year, whilst we are confident that its usefulness to the manufacturers as an additional guide to the public choice of the best at Olympia is fully realised.

The Olympia Show opens to the public this year on Friday, September 19th, so that the Show will be in full swing within a fortnight from to-day. As the Show grows from year to year the diversity of products increases and it becomes even more interesting to search for what is the best in the various classes into which, for the purpose of the Competition, we divide the exhibits as a whole.

The object of the Competition, it will be remembered, is to decide what, in the opinion of our readers, are the best products of British manufacture at the Exhibition. The Competition has again been organised on the basis

that every reader of *The Wireless World* shall be entitled to one vote for what he considers to be the outstanding single exhibit at the Show in any classification, and to vote also for the best item in each of the various classes into which the exhibits are grouped.

Our classification of apparatus is as follows:—

- (1) Receivers of all types, either mains or battery operated.
- (2) Radio gramophones.
- (3) Batteries of all kinds, including accumulators for both high tension and low tension.
- (4) Mains supply units, both D.C. and A.C.
- (5) Loud speakers of all types.
- (6) Valves.
- (7) Other apparatus, not classified above. Also amplifiers, component parts, such as transformers, condensers, tuning coils, resistances, etc.

How Readers Should Enter.

Details of the Competition will be found on the entry form which will be published in the next three numbers of *The Wireless World* amongst the advertisement pages, these three issues constituting the Special Show Numbers reviewing the Exhibition.

As before, we are offering cash and other prizes in connection with the Competition to the competitors whose votes agree with the opinion of the majority in the selection of the outstanding single exhibit, and also in the largest number of classes.

The Prizes will consist of:—

- 1st. £50 in cash.
- 2nd. A voucher for the purchase of apparatus to the value of £20 from the firms exhibiting at the Show.
- 3rd. A similar voucher for £15.
- 4th. A similar voucher for £10.
- 5th. A similar voucher for £5.

As in previous years, the voting is confined to products exhibited at the Olympia Show, and competitors are asked to bear in mind when completing their ballot forms that their choice should be guided largely by a consideration of the value of the apparatus at the price asked for it, rather than basing their decision on quality alone.

Entry forms should not be sent in until after the appearance of *The Wireless World* Exhibition Review Number, to be dated October 1st, but they must reach the Competition Editor not later than Monday, October 6th.

We are anxious that every reader of *The Wireless World* should enter for the Competition because, naturally, the value of the results must be proportional to the number of votes cast.

Pentode as Detector Amplifier

Measuring Power Output and Distortion.

By E. YEOMAN ROBINSON

(Chief Engineer, Radio Valve Department, The Cosmos Lamp Works, Ltd.)

THERE has recently been described in this journal a one-valve loud speaker set from which comfortably loud signals could be expected from the local station. This innovation in receiver design has been made possible by the advent of a pentode—the A.C./Pen.—which is capable of delivering as a power grid detector between a quarter and half a watt of undistorted A.C. energy to the loud speaker when the input grid swing is quite modest. When a single valve performs the dual rôle of detector and power amplifier the method of calculating power output is not the same as that for a triode functioning as an amplifier only. New fields of investigation have to be explored, and it is the purpose of this article to describe a series of measurements taken under working conditions which give a reasonably accurate determination of distortion and output.

It is believed that the set with detector-fed loud speaker will become of serious interest in view of the important advantages that accrue from the absence of low-frequency couplings. Low-frequency oscillation, hum and motor-boating are prevented with the minimum of smoothing equipment. For distant reception the detector may be preceded by one or more high-frequency stages.

In order to investigate the performance of an indirectly heated pentode valve as a power grid detector it is necessary to plot the dynamic detection characteristics. No simple method has yet been devised which will enable these characteristics to be derived from the ordinary anode current/anode voltage characteristics of the valve, but they can be determined quite accurately by the

following rather roundabout experimental method. The detection characteristics are dependent upon the load impedance of the anode circuit of the detector valve. Having decided upon the value of this impedance, the detection characteristics of the valve used with a resistance coupling in the output circuit are determined, using the circuit shown in Fig. 1. In order to determine accurately the characteristics shown in Figs. 3 and 4 measurements were made at 50 cycles, and appropriate adjustments made to the by-pass condensers. Grid and anode by-pass condensers of 2 microfarads were employed which correspond to condensers of 0.0001 microfarad at a frequency of one million.

A characteristic similar to that shown in Fig. 2 is first obtained in which the anode current is plotted against the applied A.C. grid voltage. This is the characteristic of the valve used as a resistance-coupled amplifier. Supposing the unmodulated carrier wave is 3 volts, the operating conditions are represented at O. If the carrier wave is modulated 100 per cent. the applied A.C. grid volts will vary from 0 to 6. The dynamic characteristic of the valve as a detector will therefore be COC_1 (see Fig. 2). There is a very considerable D.C. voltage drop in the resistance R (Fig. 1), with the result that the anode voltage on the valve is not equal to the applied battery voltage. It is therefore necessary to compute the voltage which is actually applied to the valve anode when an unmodulated carrier wave is being received. This is effected by subtracting from the battery voltage the voltage drop in the resistance R for the current flowing at the mean point of the

ONE of the advantages of feeding a loud speaker directly from a power grid detector valve is the absence of couplings which are likely to pass on low-frequency disturbances. The very minimum of smoothing equipment, therefore, is effective in preventing hum, motorboating and L.F. instability when a receiver embodying such an output stage is operated from the mains. The measurement of power output and distortion for a valve performing the dual function of detection and power amplification cannot follow accepted practice, and it is the purpose of this article to describe a new method of calculation which takes into account the various depths of modulation likely to be met in broadcast reception.

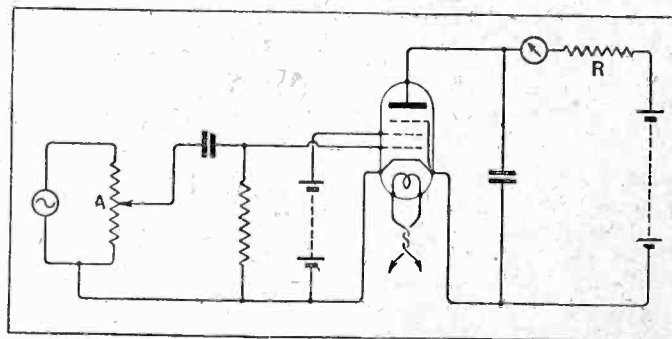


Fig. 1.—The circuit used for determining detection characteristics with resistance output coupling.

Pentode as Detector Amplifier.—

characteristic. Thus COC_1 (Fig. 2) is the dynamic characteristic of an A.C./Pen. valve when used with 500 volts H.T. and a resistance output circuit of 8,000 ohms for a carrier wave of 3 volts. The current at O is 46 mA., and the drop in the resistance is 368 volts, so that the curve COC_1 is also the dynamic characteristic for the valve when used with transformer output for a supply voltage of 132 anode volts for the same conditions, namely, 8,000 ohms load impedance and 3 volts RMS carrier wave. Similarly, CO_1C_2 is the dynamic characteristic with a 4-volt carrier wave for 500 volts H.T. and a resistance coupling of 8,000 ohms, or with transformer or choke output coupling with 156 volts H.T. and a load resistance of 8,000 ohms.

Second and Third Harmonic Distortion.

It will be seen, therefore, that the determination of the dynamic characteristics for a transformer or choke output circuit is a matter of trial and error. First, the dynamic characteristics for resistance coupling must

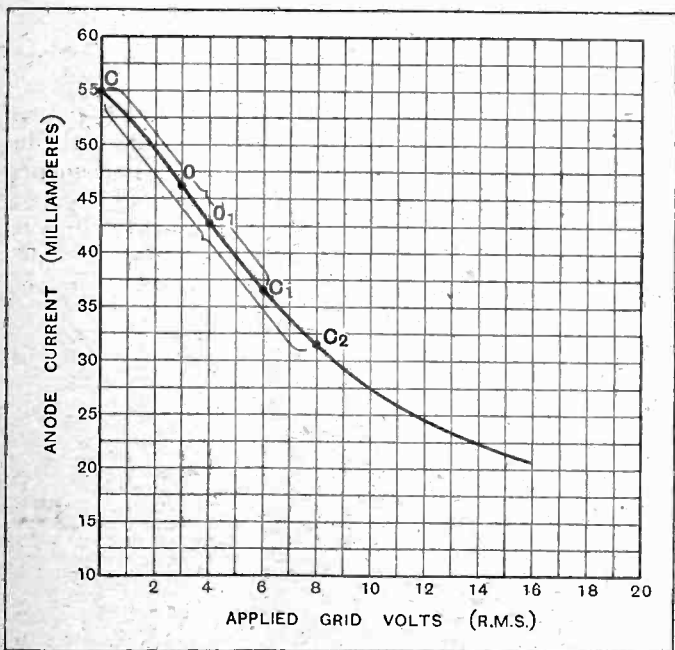


Fig. 2.—Dynamic characteristic of the A.C./Pen. valve as detector and power output valve combined. The load is 8,000 ohms.

be determined; secondly, the permissible grid swing determined from a consideration of the distortion introduced, and finally, the equivalent battery voltage for transformer coupling computed. A family of characteristic curves using resistance coupling is therefore necessary. These curves are given in Fig. 3. The dynamic characteristics using transformer coupling have been computed for a battery voltage of 200 in the manner described above and are given in Fig. 4, in which the change in anode current is plotted against the applied A.C. grid voltage for various values of carrier wave. This information is also given in tabular form in Table I at the end of the article.

It will be seen that the maximum carrier wave which can be applied without more than 5 per cent. second

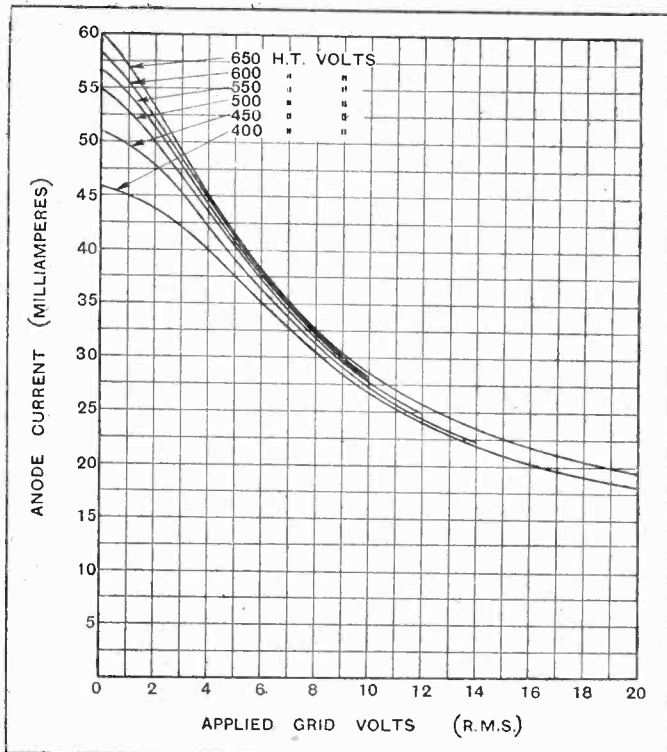


Fig. 3.—A family of detection characteristics with resistance coupling. The load is 8,000 ohms and the grid leak 1 megohm.

harmonic distortion occurring when it is fully modulated is 5 volts R.M.S. It will also be noted that, with greater input than this, third harmonic distortion becomes of major importance.

The undistorted power output of a P.240-type valve is 300-350 milliwatts with 150 volts H.T. With 100-120 volts H.T. the power output is considerably less, and that of the average battery-fed portable receiver is 160-200 milliwatts, so that compared with this standard the Mazda A.C./Pen., when used as a power grid detector, has very adequate power output. It should be pointed out, however, that it is not equivalent in practice to an ordinary output valve of 0.75 watt output, but rather

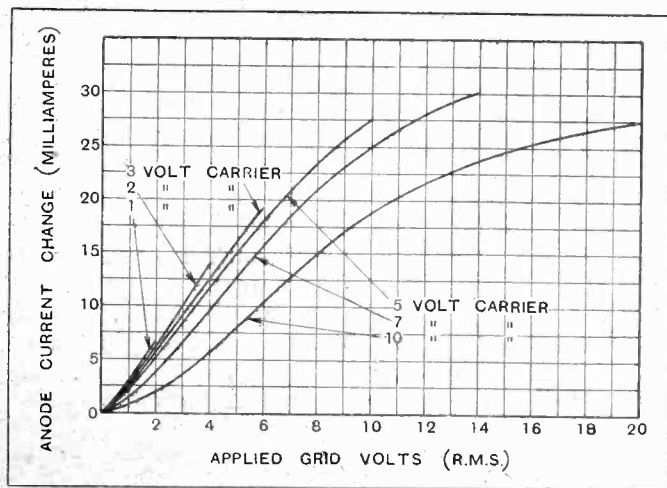


Fig. 4.—Dynamic detection characteristics of A.C./Pen. valve for various signal voltages. The following conditions were maintained during the measurements: anode voltage 200, screen voltage 200, load 8,000 ohms and grid leak 1 megohm.

Pentode as Detector Amplifier.—

to a valve of 0.4 watt output. The reason for this appears to be that the maximum power output is dependent upon the depth of modulation. If the maximum depth of modulation of the transmitter is 70 per cent. the power output from the valve is only 0.37 watt, assuming 0.75 watt for 100 per cent. modulation.

TABLE I.

Amplitude of unmodulated carrier wave (volts R.M.S.)	1	2	3	4	5	6	7	8	10
Power output for 100% modulation (milliwatts).....	46	195	380	520	760	900	900	900	750
Per cent. second harmonic distortion	2.2	3.5	2.5	1.0	4.5	10.0	13.5	15.0	18.0

Owing to the fact that the detection characteristic is linear, the valve, as compared with an anode bend or cumulative grid detector, is less selective, and if one tuned circuit is used in the receiver some reaction must be used to give a complete separation of the National and Regional transmitters. This is no disadvantage, but it does necessitate the use of a tapped aerial coil, so that when working on a large aerial the aerial coupling can be reduced to enable reaction to be employed without overloading the valve.

A further characteristic is that the valve is more sensitive when a very weak carrier wave is being received than when it is received at full strength. This leads to the set having a strange "feel" in that if one station to which the set is mistuned is heard very faintly, tuning-in to the carrier wave of another station "wipes out" the weak station.

When the valve is used to operate a loud speaker the screen volts and anode volts should not exceed 200. If, on the other hand, the valve is used as a power grid detector followed by a power output valve, best results are obtained by using a low auxiliary grid voltage of 30 or 50 volts and a high anode voltage.

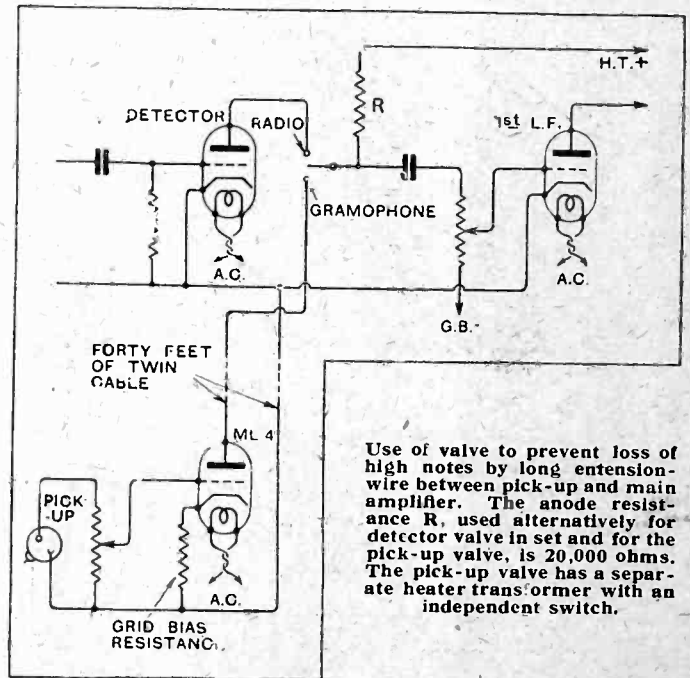
THE DISTANT PICK-UP.

It must often happen that the arrangement of a room in which it is desired to have both a wireless receiver and a gramophone working in conjunction with it is such that the two have to be separated by quite a considerable distance. It then becomes difficult to arrange for a suitable connection between the pick-up and the amplifier.

The capacity between the two wires is more than sufficiently large to by-pass all the upper notes provided by the pick-up, so that the final reproduction becomes intolerably "woolly," and the words of songs become almost entirely unintelligible. The capacity across the wires is, roughly speaking, of the order of 0.001 mfd,

in a piece of flex some 40ft. in length. While this capacity would be harmless enough if shunted across a low-resistance output, it would effectually kill all high notes when placed in parallel with the average pick-up, which, at the highest frequencies, may have an impedance rising to 30,000 ohms or more. To make matters worse, the writer had set his heart on the "Marconi-phone" pick-up, which has a much higher impedance than the bulk of such instruments.

Bearing in mind that it is not the capacity of the wire, in itself, that is harmful, but the conjunction of this capacity with a high-impedance source of high notes, attention was turned to the possibility of converting the high-impedance output into one of low impedance. Calculation showed that the capacity of the leads would not result in serious high-note loss if shunted across an output of impedance not greater than some 5,000 ohms. This figure could, of course, be reached by the use of a suitable transformer, but no transformer designed for the purpose was available. Instead, the pick-up was connected directly across grid and filament of a low-impedance valve, which was installed in the gramo-



phone itself. Since the A.C. resistance of the valve amounted to only a few thousand ohms under operating conditions, it was considered quite safe to connect its anode to the rest of the amplifier by the 40ft. connecting wire.

To economise in batteries (or mains equipment) it was arranged that the valve in the gramophone should be supplied with its anode current and grid-bias from the amplifier, with the result that no extra equipment other than a small bell transformer to supply the heater had to be purchased. The circuit of the whole arrangement, including the relevant parts of the wireless receiver and the switching employed, are shown in the accompanying diagram, below which various practical details are given.

A. L. M. S.

NOW THE AF7 TRANSFORMER

The need for a low-ratio transformer of superlative quality has been apparent for some time.

Many constructors requiring greater L.F. amplification than is practicable with one stage find that two stages with transformers of the old standard ratio give excessive amplification—and excessive amplification is liable to prove exceedingly troublesome, as is readily seen on consideration of the conditions.

Take first the case of a single L.F. stage employing the standard transformer ratio of 1:3½. The amplification factor of the modern detector valve is about 16, and that of an output valve of the P625 class is 6. This gives the total L.F. amplification from the detector to the output as:—

$$16 \times 3.5 \times 6 = 336.$$

This may be increased by using a transformer such as the AF6 which, with its higher ratio of 1:7, would give:—

$$16 \times 7 \times 6 = 672.$$

Compare the above with two stages, employing the same valves and transformers of the standard ratio. The total amplification from the detector to the output becomes:—

$$16 \times 3.5 \times 16 \times 3.5 \times 6 = 18,816$$

We believe these figures will be interesting, and perhaps surprising, to those who have not considered the question from this angle. What is required is some combination capable of giving appreciably more amplification than the single stage, but appreciably less than that obtained from two.

Several methods offered a solution, but after investigation of all the possibilities we decided that a transformer with a ratio of 1:1½ had, amongst others, one great advantage: the reduction in the secondary allowed us to increase the primary, thereby securing a primary inductance of 210 henrys when carrying 1 milliamp. This transformer is therefore clearly the most suitable transformer to follow an anode bend detector.

Compared with the figures given above, the total amplification using this transformer would be:—

$$16 \times 1.75 \times 16 \times 1.75 \times 6 = 4,704.$$

This new transformer is the AF7, price 30/-. It is available for push-pull, AF7c, price 34/-.



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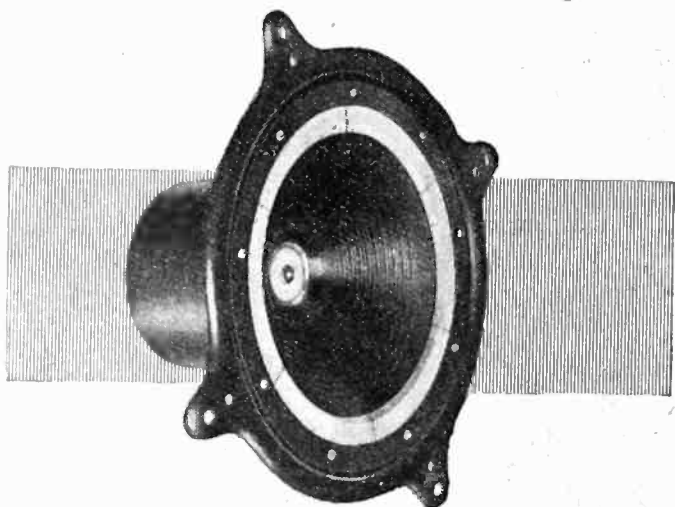
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The price is exceptionally reasonable when the remarkably fine reproduction is compared with that of other speakers and therefore offers excellent value for money. There are three other R.K. Reproducers—the Senior with built-in rectifier for use with A.C. mains, price £11 10s., and the Standard Senior, price £7 7s., and Junior Model, price £6 6s., all of which are obtainable through your radio dealer.

Ask your dealer for particulars of hire purchase terms.

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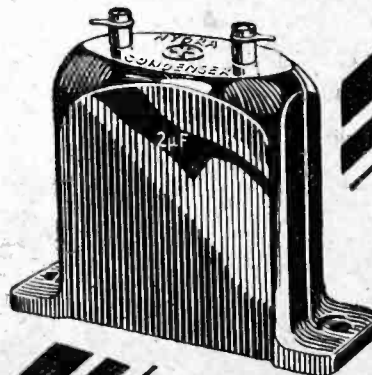
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BERLIN RADIO SHOW



Germany's Latest Sets.—New Telefunken Valve, Selenium Rectifier, Infra-red Sensitive Photo Cells, Electrostatic Loud Speaker.

New Apparatus Seen at the Stands.

By Our Staff Representative Visiting Berlin.

THE seventh annual Radio Exhibition in Berlin was opened on August 22nd by Dr. Bredow, the Secretary of State, who acts as Broadcasting Commissioner for the whole of Germany. The exhibition had been advertised far and wide in a very striking manner. For example, a fleet of boats was to be seen on the Havel near Wannsee, a popular Berlin resort, with masts resembling the well-known broadcasting tower with the restaurant halfway up, which forms such a striking landmark of the Exhibition. The leading boat carried a loud speaker and radiated music; the others contented themselves with the distribution of balloons, some of which contained free tickets for the show. A week before the opening of the Exhibition I visited a cinema at Weimar, in Thuringia, and this boat display formed an item of the topical news film; in this way the propaganda had doubtless reached every town in Germany. The opening was noteworthy because, in addition to the beautiful music—the real thing—which was provided by a magnificent orchestra, Professor Einstein gave an address in which he reminded the company that the source of all technical achievement is the divine curiosity and research of the experimenter. He recalled the names of Maxwell, Hertz, and others, and made a humorous reference to those who availed themselves of the wonders of science without understanding anything more of their spirit than does the cow of the botany of the grass which she devours with such relish.

For the first time the Exhibition included both radio and "phono," if one dare use the latter term to denote every known method of the reproduction of sound. This

has led to a very great increase in the size of the Exhibition. Occupying four sides of a square, the Exhibition buildings consist of six halls, providing 270,000 square feet, the number of exhibiting firms being 350. It should be said at once that a great amount of space is taken up by the exhibits of the Imperial Post Department and by the Broadcasting Company. The exhibition was really a combination of a trade show on the lines of the Olympia Show with a national cultural exhibition. The latter occupied nineteen rooms, in some of which one could hear gramophone reproductions of strange foreign music such as Gurkha songs, Tibetan temple music, Scottish bagpipes, a Madagascar chorus, and so on, the players being

projected on a screen. I was disappointed to see that the bagpipes were played by a man in trousers. In other rooms one could hear speeches by Edison, Berliner, Ebert and Hindenburg; in others short extracts from the leading historical broadcasts of the year in sport, politics, etc. Seven rooms were devoted to an exhibition of historical apparatus showing the development of the gramophone and talking film.

The exhibit of the Broadcasting Company was devoted very largely to the subject of interference, its causes and cure. This subject has become of paramount importance, and every effort is

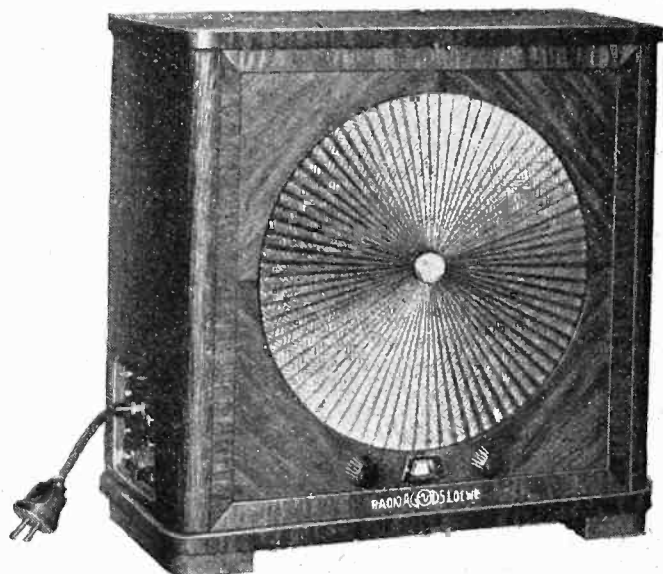
being made to educate the public in the matter. In the larger centres of population, where the people live mainly in large blocks of flats and where electrical apparatus is used for many purposes, the interference with broadcast reception has become a very serious problem, more especially with sets supplied from the mains. The Broad-

BERLIN'S annual radio show is of unusual interest. New apparatus like the "rod" valve, the electrostatic loud speaker, the copper-oxide photo cell and the selenium rectifier to be seen this year are entirely novel, while an opportunity is afforded of comparing the receiving sets of this country with Germany's latest products.

The absorbing of the gramophone, which in its present-day form depends so much upon radio development, into the wireless exhibition reveals an important tendency towards the combining of all sound reproduction under the term "Phono."

Berlin Radio Show.—

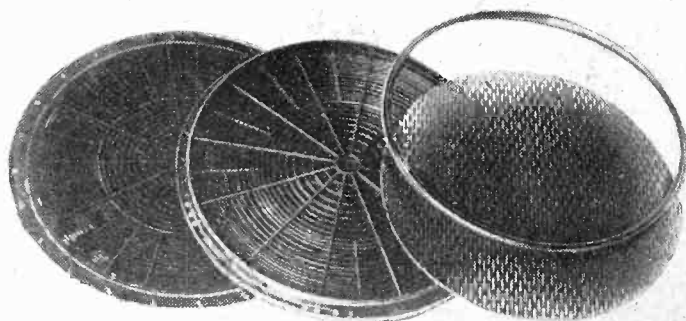
casting Company has organised a body of volunteers who look into every reported case of interference, trace the cause of the disturbance, and give advice as to its elimi-



An all-mains three-valve set selling at six guineas. In addition to the A.C. rectifying valve a three-element valve is included, two units of which are of the screen-grid type.

nation. They have issued a number of pamphlets dealing with the problem, and at the exhibition had fitted up a number of ingenious diagrams in which the various current paths could be illuminated by turning a switch, with the object of helping the layman to understand why such an apparatus as a vacuum cleaner can cause interference to a neighbour's wireless reception, and how it is possible by means of chokes and condensers to eliminate the trouble at its source. Several firms specialise in the supply of disturbance preventers. It was stated that in the month of June 6,322 cases of disturbance had been reported, of which 3,705 had been cured; these were classified as follows: high-voltage lines and networks, 99-24; electric trams and railways, 435-118; oscillation due to reaction, 896-572; motors, 1,150-542; high-frequency apparatus, 1,322-898; miscellaneous, 2,410-1,551; the first number being the cases reported, and the second the cases satisfactorily dealt with.

A model tramcar ran backwards and forwards on a short track, the bow contact being of metal when running in one direction and of carbon when running in the other direction. A near-by wireless receiver with

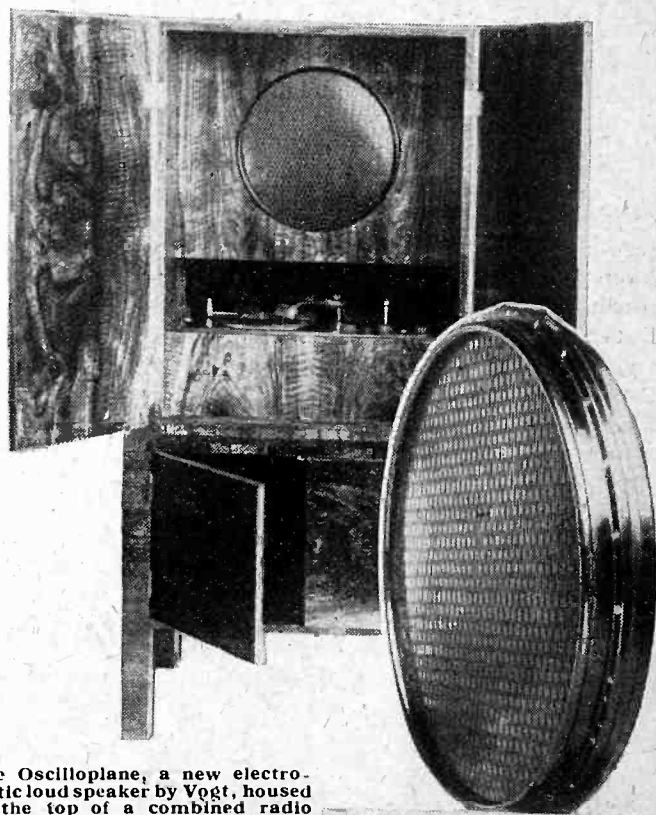


Dismantled Oscilloplane loud speaker, showing the bakelite metal-coated plates, dust screen and ring.

a loud speaker was relatively silent when the carbon contact was in use, but very noisy when the metal contact was used. On expressing the view that this exhibit, although interesting, could have little propaganda value beyond making the public angry with the tramway companies, I was told that this was the object, as the latter could only be forced by public opinion to adopt protective measures. Two of the booklets referred to above deal exclusively with the disturbances caused by electric trams and railways.

Broadcasting Company's Technical Exhibits.

A very interesting exhibit by the Broadcasting Company was a complete installation of the apparatus employed to control the degree of modulation both on the low-frequency side to avoid distortion due to overloading microphones and amplifiers, and on the high-fre-



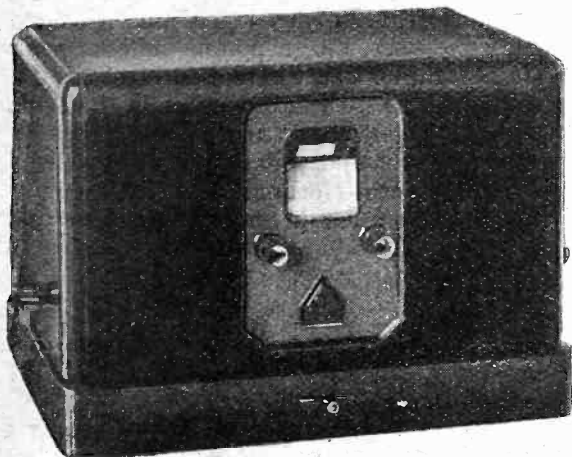
The Oscilloplane, a new electrostatic loud speaker by Vogt, housed in the top of a combined radio gramophone. An enlarged view of the Oscilloplane is shown on the right. The elevated position of the loud speaker is a good feature.

quency side to avoid over- or under-modulation. Here and throughout the exhibition one noticed how the gramophone record and pick-up was utilised for the purposes of demonstration. Very few of the multiplicity of sounds heard emanating from what would have been silence cabinets had their doors been closed had their origin in a radio wave; even if there had been no separate gramophone section the exhibition could rightly have been called a radio and phono show.

An exhibit of the Broadcasting Company which caused great interest was the actual production of a record on a wax blank from a voice in an adjacent microphone, the record then being played back through a loud speaker.

Berlin Radio Show.—

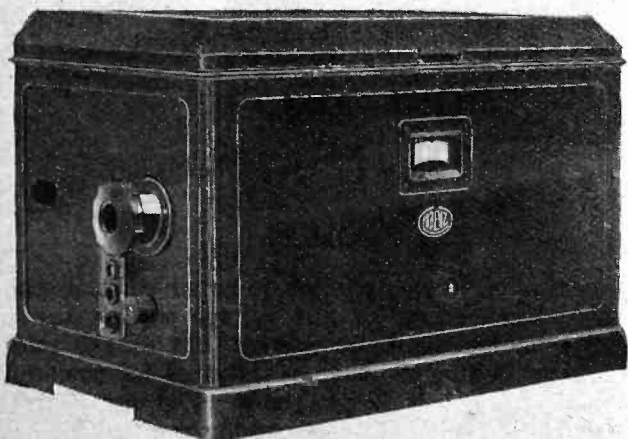
A large room was devoted to television, demonstrations being given by two companies, viz., the Fernseh A.G. and the Telehor A.G., the former being associated with Baird and the latter with Mihaly.



A somewhat unusual feature is the inclusion of a switch giving alternative anode bend or leaky grid detection. The Mendel three-valve receiver.

Before leaving the cultural and turning to the trade section we should like to mention that a large reading room was provided with wireless papers classified according to language. The section headed England and Ireland contained 16 copies of various papers, all but one published in London, the exception being published in New York; there is apparently some doubt as to the geographical situation of the latter city.

On enquiring at most of the stalls as to whether they had anything new of importance, I was answered by a shrug of the shoulders. Striking novelty there was none, with the exception, perhaps, of the new Telefunken valve or "rod" as they prefer to call it, but as compared with previous years, there was a marked improvement in the design of sets, both externally and internally. The all-mains type predominated. One of the most striking features was the almost entire absence of portable sets, only four or five firms appearing to devote any attention to this type of receiver.

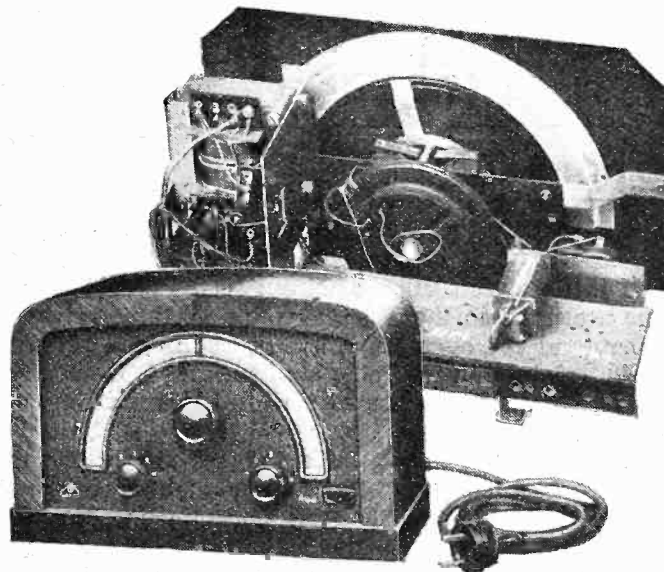


The Lorenz receiver fitted with a control which enables resistance to be inserted in the tuned circuits. By this means excessive sharpness of tuning can be avoided when long range reception is not required.

The lowest priced three-valve all-mains set with loud speaker was the Loewe set shown on the previous page, which retails at six guineas. It appears to have only two valves, one being the rectifier, but the other is the well-known Loewe multiple valve, containing three elements in a single bulb, two of which are of the screened-grid type. Nearly every firm had a three-valve all-mains set with built-in loud speaker; some consisted of detector and two low-frequency stages, others of a high-frequency stage, a detector and a pentode output stage; most firms build both types.

The New Telefunken Valve.

The principal novelty of the exhibition was undoubtedly a new type of valve which, because of its shape, has been called the Telefunken "rod" or "staff," but which is distinguished from the usual valve by having no grid, the control being exercised by an external metal coating. The idea is not new, as de Forest patented this in 1906, a year before it occurred to him to insert a grid between the anode and cathode. With a valve of the ordinary shape the amplification is too small to make



A Siemens and Halske receiver with a single tuning scale covering a wave range of 200 to 2,000 metres. Tuning is by ganged variometer and condenser.

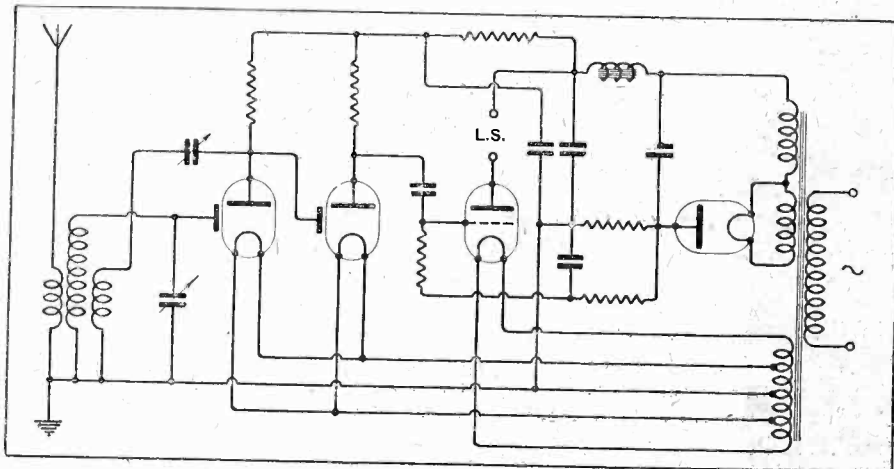
the idea practicable, hence the peculiar construction which has been adopted. The glass tube, about 4 or 5 in. long, is squashed flat, while the cathode consists of a straight filament running from top to bottom at one side of the flattened section, and at the other is the anode of sheet metal bent into an oval shape and pinched by the glass walls, thus giving it mechanical support. The control electrode consists of a metal coating squirted on to the glass and entirely surrounding it. It is impossible to obtain static characteristic curves for such a valve, because if a positive voltage be applied to the coating it attracts a negative electron charge on the inner wall, which neutralises its effect. For the same reason the grid bias is of no account, and one can connect the coating directly to the anode of the preceding valve without any condenser, which simplifies and cheapens the set. For high-frequency amplification and detection the valves are

Berlin Radio Show.—

made soft, but for audio-frequency amplification they are made with a high vacuum. The type of glass employed for making the valve is important, since the insulation resistance and consequent leak through the glass wall between the outer coating and the inner layer of ions and electrons plays an important rôle; it is this leak that makes the gas-filled valves unsuitable for audio frequencies. One rather unexpected but very important advantage of this valve is that the filament, which takes 0.2 ampere at 1 volt, can be supplied with alternating current without any trace of hum. Notwithstanding this, it is claimed that it amplifies the low audio frequencies. This valve is not only cheaper than other types, but lends

Specially small rectifiers have been developed for insertion in the cases of moving-coil instruments to enable them to be used for the measurement of alternating voltages; the constancy and reliability of the selenium rectifier holds out great promise of its successful application to A.C. measurements.

The same firm have developed the so-called dry electrolytic condenser, i.e., a porous material soaked in electrolyte separating two aluminium electrodes. These condensers are made by winding strips in the same way that Mansbridge condensers are made. It is claimed that, providing the stated voltage is not exceeded, these condensers never need reforming, and that they preserve their capacity when left in storage for long periods.



Circuit of the Telefunken 12 W three-valve all-mains set showing the use of "Rod" valves as detector and L.F. amplifier.

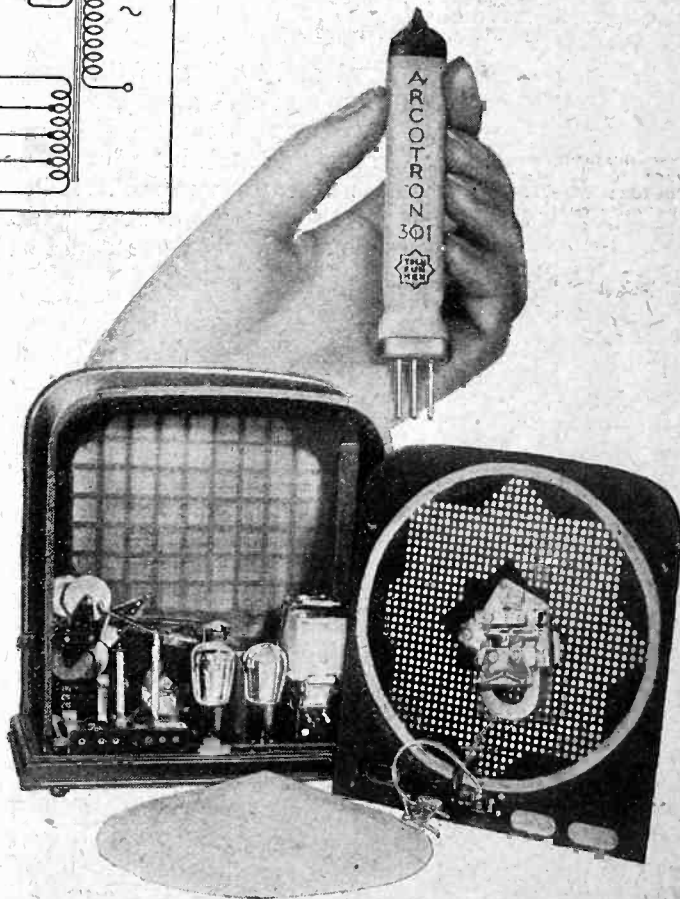
itself to the construction of cheap sets. Valves of this type are fitted in the Telefunken 12 W three-valve receiver, and the circuit shows their use in the first two stages. A built-in four-pole loud speaker is included in this receiver, and, arranged for all-mains working, retails at eight guineas.

An interesting novelty was the set shown by the Mende Co. This set is fitted with a knob whereby one may employ either anode-bend detection if the station is near, or the more sensitive leaky grid detection when receiving a distant station. Another somewhat similar device has been introduced by the Lorenz Company into their high-grade five-valve receivers; by means of a knob one can introduce resistance into the tuned high-frequency circuits, and thus improve the quality when great selectivity is not found essential.

Selenium Rectifier.

An interesting exhibit was that of the Süddeutscher Apparate-Fabrik. This firm has developed the selenium rectifier, a dry metal rectifier which it is claimed is superior to the copper-oxide type. Thin sheets of selenium have a layer of metal squirted on to them on one side, a sheet of foil being pressed against the other side. Such an element possesses unilateral conductivity up to a potential of 20 volts, the back current being less than 0.1 per cent. The efficiency of the rectifier is from 60 to 65 per cent. The high voltage per element makes the selenium rectifier peculiarly suited for the construction of high-voltage rectifiers.

Telefunken type 12 W all-mains three-valve set with built-in four-pole loud speaker. The new "Rod" type valves can be seen on the left. This valve is the principal novelty of the exhibition and its size can be judged from the illustration.



The maximum voltage appears to be 12 volts, a 3,000-microfarad condenser for this voltage costing 14s. A special type for the same voltage, but of 150 microfarads, and costing 2s. 6d., is intended for smoothing grid-bias circuits; it weighs only 35 grammes. The larger sizes are suitable for smoothing rectified filament-heating current.

The only firm showing any novelty in audio-frequency

Berlin Radio Show.—

transformers was Dietz and Ritter, of Leipzig, whose "Korting" transformer, with a ratio of 3 or 4 to 1 and a weight of 300 grammes, showed excellent characteristic curves. Its main interest lay in the claim that



Few portable sets were to be seen. The Ideal Blue Spot five-valve portable. It is a superheterodyne.

it utilised iron, which was free from the defects of Permalloy and similar alloys. Further particulars could not be obtained.

Constant-output Transformers.

This firm also exhibited what must be regarded as one of the important novelties of the exhibition, viz., a transformer which, on a given load, maintained an approximately constant secondary voltage when the primary voltage varied from 180 to 280 volts. Each transformer must be specially adjusted for the load on which it has to work. Patent considerations prevented any explanation being given beyond the facts that it depended on the knee of the saturation curve and that a condenser was involved. The secondary voltage in a given case was 212 for a primary voltage of 180; it rose to 223, and then fell to 210, as the primary voltage was increased to 280. Such a transformer should prove useful to those who have a mains supply subject to large fluctuations, but the dependence of the regulation on the load will prove a serious drawback in many cases.

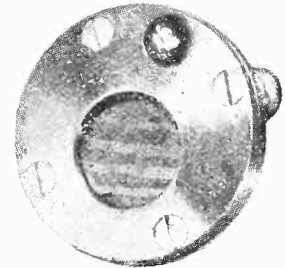
The Rectron Company exhibited a device whereby on switching on an all-mains set the anode voltage is not applied to the valves until the filaments are heated. The anode circuit contains a switch operated by a bimetallic strip, which is heated by a coil connected across the low-voltage secondary of the transformer. The time taken for this switch to operate allows the valve filaments to become heated.

A 25

The Blue-Spot Ideal Company exhibited a new type of electrostatic loud speaker which has been developed by Hans Vogt, of talking-film fame. The patent rights of this speaker are held by the Oscilloplan-Holding A.G., and the English rights have been acquired by the Graham Amplion Co. We were greatly struck by the excellent quality of reproduction, which was certainly equal to anything heard at the Exhibition. It combined clear, high notes without any unpleasant shrillness and deep bass without boom.

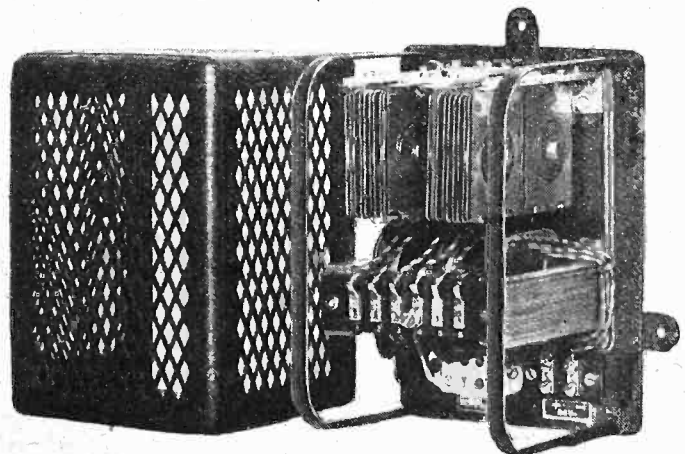
A very thin metal diaphragm, but a minute fraction of a millimetre thick, and a foot in diameter, is stretched

New type of photo-electric cell making use of copper-oxide plates very similar to those used in rectifiers. Rapidity of action, sensitiveness to infra-red light and the fact that an enclosing globe is not necessary are among its advantages. Exhibited by Radiosender G.m.b.H.



between two bakelite-moulded, ribbed discs about 2 mm. apart. The faces of these discs are made conductive by means of graphite and treated with a special varnish. A special high-vacuum rectifier maintains a potential of 800 volts between the diaphragm and these faces; the audio-frequency voltage causes an increase of potential on one side and a decrease on the other, thus causing the diaphragm to vibrate. A novel feature is the gradation in the size of the air holes in the bakelite discs, which decrease towards the centre, and thus provide increased air cushioning where the amplitude would normally tend to be excessive. The quality obtained was certainly very striking. This loud speaker was not on sale as a separate unit, but only as a part of the complete sets exhibited by the company.

One of the attractions of the exhibition was provided by the giant Blatthaller loud speaker, which Siemens and Halske installed at the top of the wireless tower. The announcements which it gave out could be heard far beyond the limits of the Exhibition. It is claimed that it can be heard up to a distance of twenty kilometres. The "membrane" consists of corrugated aluminium



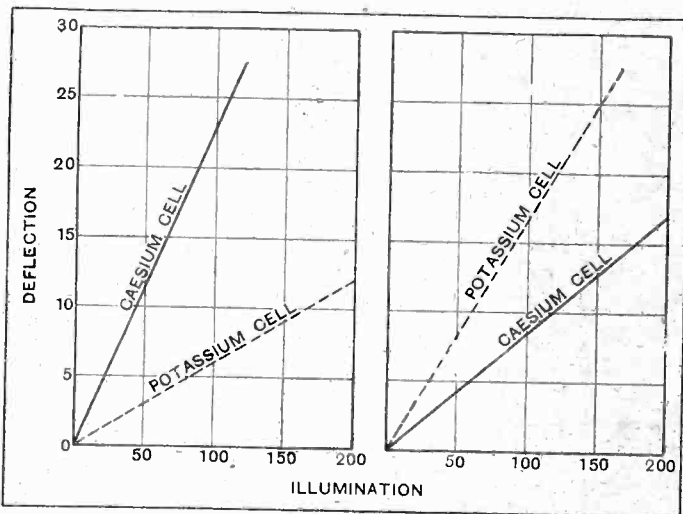
Selenium rectifier produced by the Süddeutscher Apparate-Fabrik. The output is 0.35 ampere.

Berlin Radio Show.—

sheet 1.5 mm. thick, and its extreme movement is 2 cms. The principal novelty on the Siemens and Halske stand was the large scale which was fitted to all their sets, the pointer of which carries a small lamp which brightly illuminates the portion of scale of interest at the moment. A further novelty was the covering of the whole range from 200 to 2,000 metres by means of the 180-degree rotation; it is this, of course, that makes the large scale essential. This range is obtained by causing the spindle to operate a condenser and a variometer simultaneously. In the type shown in the illustration, the variometer is of the flat type with "D" shaped coils. Similar sets were shown with three and four valves; in this case the two spindles are geared together by an endless steel band, each spindle operating a condenser and variometer.

Short-wave Receivers.

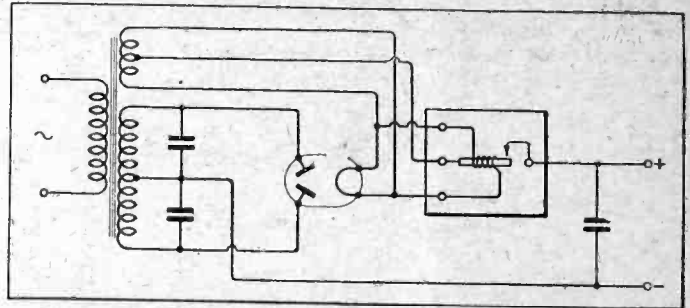
Little attention appears to have been given to the reception of short waves, but a very simple set was exhibited by the Telefunken Company. This was on the lines of an ordinary three-valve broadcast receiver,



Relative sensitivity of potassium and caesium photo-electric cells. Left—glow lamp as source of light. Right—mercury paper lamp as source. By the use of the caesium cell which was exhibited by Otto Pressler of Leipzig, less amplification is necessary in talking film apparatus.

except that special care had been given to the design of the coils and condenser of the high-frequency stage. The range from 13.9 to 100 metres was covered by five coils, which were corrected to a five-way switch. The condenser was unusual, in that its rotor had twelve posi-

tions, moving from one to the other with a spring snap. Intermediate positions were obtained by a small movement of the stator, corresponding, however, to a 360° rotation of the adjusting knob. It was claimed that the set was capable of accurate calibration, and that this was not affected by the aerial. Another type had two ranges, viz., 13.9 to 50 and 200 to 550 metres. These



Heat-operated relay of the Rectron Company arranged to delay the switching on of the H.T. supply to a receiver fitted with indirectly heated valves.

sets are built for battery supply, and have a screened grid output valve designed to supply the high-resistance winding of the Arcophon 4Z loud speaker.

There was an enormous choice in gramophone pickups. The Loewe Company use no needle-clamping screw, but trust to the magnetic field to hold the needle in position. This reduces the weight of the moving part and puts up its resonant frequency, so that it is in the neighbourhood of 7,000 or 8,000.

Photo-electric Cells.

One of the best-known makers of photo-electric cells, Otto Pressler, of Leipzig, showed a large variety of cells for various purposes. This firm claim to have brought the caesium cell to a high degree of perfection; it has the advantage over the potassium cell of being very sensitive in the yellow and infra red, whereas the latter has its maximum sensitiveness at the violet end of the spectrum. It is claimed that the use of a caesium cell in the place of a potassium cell may save one stage of amplification in talking film apparatus.

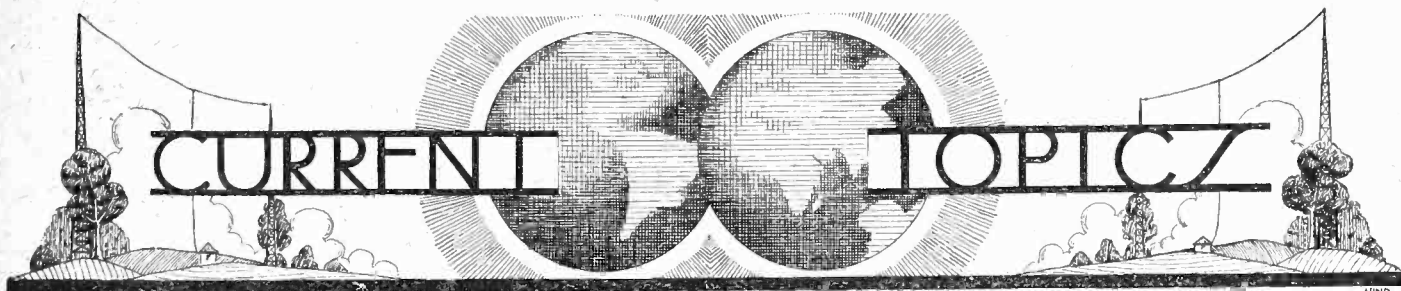
Radiosender G.m.b.H., of Berlin, exhibited a very novel type of photo-electric cell. They found that the copper oxide plates used in their rectifiers acted as photo-electric cells with a decided maximum of sensitiveness in the infra-red and with great rapidity of action. There is no enclosing globe, the light simply passing through the hole in the front plate and falling on the oxide surface which is exposed to the air.

OLYMPIA RADIO SHOW

SEPTEMBER 19th to 27th

**THREE
SPECIAL
ISSUES**

Next Week - - FORECAST—First Details of New Apparatus
 Sept. 24th - - FULL REPORT OF THE SHOW
 Oct. 1st - - - THE NEW DESIGNS REVIEWED



Events of the Week in Brief Review.

DECLINE IN GERMAN LICENCE FIGURES.

On June 30th the number of licensed listeners in Germany amounted to 3,224,944, showing a decline of 13,452 on the preceding quarter.

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THE TRUTH ABOUT OSLO.

The trials with the Oslo new 60-kilowatt transmitter have not given satisfaction. The tests are temporarily suspended, and we understand that two or three weeks must elapse before the requisite modifications can be completed.

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HAVE YOU HEARD THIS ONE?

With the call letters PFI-IDZ, the Idzerda Radio Works at The Hague broadcast experimental transmissions every Saturday night between 11.40 p.m. and 1.40 a.m. on 299 metres. Short broadcasts of talks and gramophone music are made, the announcer informing listeners between items that they originate from Idzerda Radio, Den Haag.

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RADIO REPAIRS BY THE BLIND.

A blind student has just passed successfully through the gramophone and radio service course held at the "H.M.V." mechanics' school, Hayes, Middlesex. He is Mr. J. H. MacMichael, a music dealer, of Alloa, Clackmannanshire. Mr. MacMichael felt his way about the parts of the instruments on which he received instruction, and did the best work in his class, needing only the help of a boy to read the meters.

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POLYTECHNIC WIRELESS COURSES.

Classes in wireless and high-frequency engineering will re-open at the Polytechnic, 307-311, Regent Street, London, W.1, on September 22nd. The facilities include a transmission laboratory with a complete commercial installation for telegraphy and telephony (6RA). Radio instruction can also be obtained at the Northampton Polytechnic Institute, St. John Street, London, E.C.1.

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THE OLDHAM-U.S.L. BATTERY.

Behind the announcement of Mr. John Oldham that the Oldham battery will in future be sold as the "Oldham-U.S.L. battery," lies an interesting history of successful efforts by the British organisation to co-operate with one of the largest battery producing concerns in the world, viz., the U.S.L. Battery Corporation of Niagara Falls, America. While making available fresh sources of research and

production facilities, the new arrangement does not affect the nationality of the Oldham firm, which, established in 1865, remains entirely British in regard to capital, labour, and material used.

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PROHIBITION: RADIO VARIETY.

Amateur transmission, except by clubs, is forbidden in Germany. The latest estimate places the number of illicit amateur transmitters at 1,500.

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A POWERFUL STATION.

If the new Radio Paris 60-kilowatt transmitter at Essarts-le-Roi fulfils expectations, writes a correspondent, France will at last have a national station covering the greater part of the country.



"STEREOSCOPIC" BROADCASTING.
A double microphone shown at the Berlin Radio Exhibition by the Reich Rundfunk Gesellschaft. It is claimed that, by introducing a slight phase difference, the microphone gives the listener a sense of direction.

There is a faint suggestion, however, that the sponsors of the new transmitter are over-estimating its capabilities, since they state that "excellent reception will be obtained by crystal sets within a zone of 315 miles."

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DUAL TRANSMITTERS FOR HUNGARY.

We understand that plans are maturing for the construction at Budapest of a powerful new broadcasting station, modelled on the lines of the British Regional stations. Two programmes will be transmitted simultaneously

HAPPY HERTS.

"A radio set in every other home," is the record claimed for the counties of Hertfordshire, Oxfordshire, and Surrey. The percentage of families holding radio licences is 55.4 in Hertfordshire, 53.9 in Oxfordshire, and 50.2 in Surrey.

The average all over the country is 30.9, with Durham lowest at 10.9.

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TELEVISION TESTS FROM BERLIN.

On 419 metres (716 kc.), with a power of 1.7 kW. in the aerial, the Berlin Witzleben (Germany) transmitter carries out a regular series of television transmissions, according to the following time-table: From 13.00 to 13.30 B.S.T. daily (Monday to Friday inclusive), with extra transmissions from 09.00 to 10.00 B.S.T. on Mondays, Wednesdays, and Fridays; on Saturdays a special test is also made between 01.00 and 02.00 B.S.T.

The Königswusterhausen high-power station relays these experiments and also transmits its own tests on Thursdays (01.45-02.45), and on Saturdays from 09.00-10.00 B.S.T. The wavelength utilised is that adopted for the programmes, namely, 1,635 metres (183.5 kc.) and the power is 35 kW.

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A WIRELESS COLOUR-SCHEME.

To rob wireless repair work of one of its greatest bugbears is the object of the new standard colour code incorporated in H.M.V. and Marconiphone instruments at the coming Radio Exhibition. To diagnose the trouble in a refractory receiver the service man has first of all to identify the various circuits amid the maze of wires in the instrument, and this is sometimes the hardest part of his task.

The colour coding system has been in use by the telephone industry for many years and has been used sporadically for constructional purposes by various manufacturers. The "H.M.V." system, however, represents the first attempt to standardise the code, so that a dealer seeing a brown wire in a 1930 instrument will know that a brown wire will identify the same circuit in a 1940 model.

The code is being released generally to the wireless and music trades, and will be introduced into all "His Master's Voice" and Marconiphone service manuals. We understand that credit for the preparation of the code is largely due to Mr. Whitehouse, of The Gramophone Company.

PRACTICAL HINTS & TIPS

ALTHOUGH considerable attention has been directed to the need for taking certain precautions when a D.C. mains supply is used for anode current feed, it seems that these measures are often neglected. According to the producers of the

**BURNT-OUT
AERIAL GRID
TRANSFORMERS.**

Ferranti "kit" set, aerial-grid transformers made by that firm are

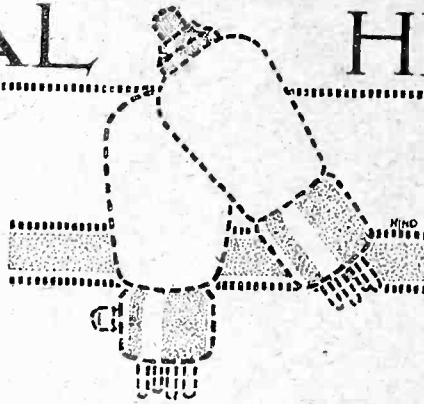
constantly being returned to them as defective; an examination almost always shows that one or both of the primary windings are burnt out, and further investigation of the conditions of use generally brings to light the fact that the customer's set is fed from D.C. mains with a positive earth.

Now, these burn-outs are due to more or less complete short-circuits between aerial and earth. It is generally realised that some precaution (as a rule in the form of an added condenser in the earth lead) must be taken in order to isolate the mains from earth, but this affords hardly sufficient protection in all cases.

A consideration of Fig. 1 will show how the trouble under consideration may arise when the receiver is joined to positively earthed mains. An aerial short-circuit is indicated by a dotted line, and it will be seen that there is direct continuity, via "earth," through the feed wires and the transformer primary; this in spite of the presence of the protective condenser C.

The remedy is simple. All that is necessary to ensure complete immunity from the sort of trouble is another fixed condenser; a capacity of 0.001 mfd. is almost always amply large, and a component with mica dielectric should be chosen. The condenser is inserted between the aerial lead-in wire and the aerial terminal of the set.

Although the Ferranti "kit" set has been used as an illustration, it must be pointed out that these precautions are applicable to every type of receiver. Before leaving the sub-



ject, it should be pointed out that an aerial short-circuit may also cause damage to smoothing chokes and voltage-absorbing resistances, and that these accidents are as often as not due to the operation of lightning safety switches or similar devices. Finally, it should be realised that an aerial at a potential of perhaps as

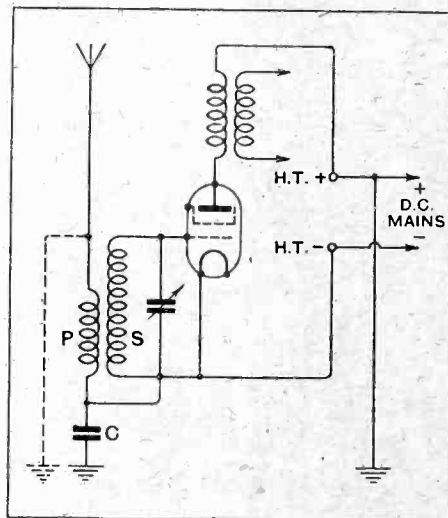


Fig. 1.—Simplified diagram showing how an aerial short-circuit may cause damage to a receiver fed from positively earthed D.C. mains.

much as 240 volts with respect to earth is a possible source of danger to anyone who may touch it.

A PROPER appreciation of the properties of band pass filters, combined with the preparation of precise data for their practical application, is probably one of the most important advances in the world of wireless during the past year. But the undoubted success of these devices should not be allowed to lead us to ignore the fact that a certain price has to be paid for the advantages of "flat-topped" tuning curves.

As a rule, a filter will be rather

less selective—as the term is generally understood—than a two-circuit tuner, although it is not easy to arrive at a fair basis of comparison. At the root of the matter is the fact that the component circuits of a filter cannot be made very "good." Further, it is bound to provide rather less signal strength—the actual loss may be about 30 per cent.—as compared with the other arrangement when properly adjusted with optimum coupling between its circuits.

This is the debit side of the band-pass filter account; to its credit, we have the very important advantage that its two circuits may be controlled by a single dial—indeed, they *must* be in a really practical design. This makes for easy operation, while the adjustment of an ordinary two-circuit tuner calls for a certain amount of dexterity, even if one is aiming at nothing more than maximum signal strength. To obtain from it a broad resonance curve, such as is automatically provided by a properly designed and adjusted filter, requires more than the ordinary degree of skill.

THE introduction of a single-valve loud speaker set, as described in *The Wireless World* for August 6th and 13th, opens up a pleasant prospect to those of us who believe that the future trend of broadcast receiver design will be towards simplicity—but without the sacrifice of the really desirable features that we now consider to be essential for a satisfactory performance.

The new set certainly comes as a wholesome corrective to the present-day tendency towards elaboration. Designers in the past have been attracted by the idea of driving the loud speaker directly from the detector, but until the new and highly efficient A.C. pentode was intro-

**FILTERS AND
TWO-CIRCUIT
TUNERS.**

**A RADICALLY
NEW
RECEIVER.**

Hints and Tips.—

duced have been unable to put their aspirations into practice. Readers may be reminded that the power pentode detector is capable of delivering up to 350 milliwatts of L.F. energy to the loud speaker—quite as much as the output of most of the super-power valves ordinarily used for domestic reception—when an H.F. signal of 5 volts is fed to its grid circuit.

We must not expect too much from a single valve. Its first and most obvious limitation is that of range, and the radius of action of the set referred to is given as a maximum of 30 miles from a high-power station. This figure will be considerably reduced when its sensitivity is considered in relation to an ordinary "main" station of average power, or where receiving conditions are below the average.

and consequently this principle is available to those who live at a distance from any transmitting station or to those who need a greater choice of programmes than can be provided by an unaided detector. It is the purpose of this note to offer a few suggestions as to how the "Regional One" may be converted into a "Regional Two" with a much more extended range—but with some inevitable sacrifice of its pristine simplicity.

There is no need to abandon the more attractive features of the set, such as its band-pass input filter and inexpensive and compact eliminator; these can be retained by following the general lines of the circuit given in Fig. 2, where those components of the receiver which may still have unchanged values are indicated by their original reference letterings. Strictly speaking, filter circuits of lower re-

ductive relationship with the H.F. transformer secondary. This latter component will be chosen with regard to the user's needs in the matter of sensitivity; any intervalve coupling of sound design will serve, as the design of this part of the circuit is governed by accepted practice.

Positions of essential inter-circuit screens are indicated, but, where high amplification is aimed at, it would be essential to enclose the intervalve coupling components in a metal box. There is no need to budget for a greater eliminator output than that provided in the original design, as the drop in voltage due to the demands of the added H.F. valve is positively negligible. The 30,000-ohm resistance shown for regulating the anode voltage fed to this valve will be correct for the average specimen likely to be used.

A set of this kind is hardly com-

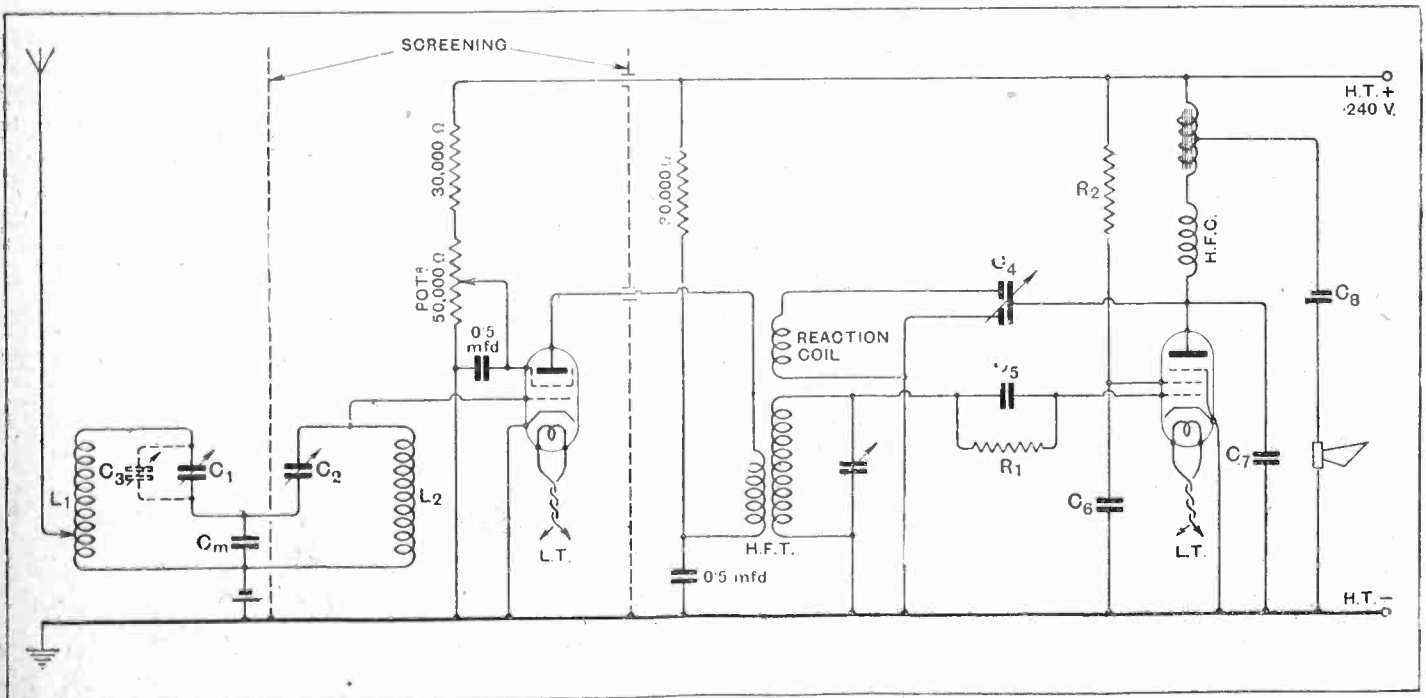


Fig. 2.—The "Regional One," modified for medium-distance reception by the addition of an H.F. stage.

But having overcome the major problem of direct loud speaker feed, the question of maintaining a sufficient signal voltage on the detector grid fades into insignificance. Theoretically, under any conditions or at any range, this can be done by the usual expedient of fitting an H.F. amplifier to provide the necessary magnification. Practically, the range of a "power detector" set is no more limited than that of any other,

sistance, with more clearly defined peaks, would be permissible in a set with another single tuned circuit—that of the H.F. amplifier—to fill up the depression between the peaks. Of course, condensers C₁ and C₂ would be ganged in any case.

No reaction coil is needed for the second filter coil L₂; instead, regeneration must be provided between plate and grid circuits of the detector, and so this coil will be placed in in-

plete without some kind of pre-detection volume control; the amateur may follow his own inclinations in this matter, but it is worth while remembering that, if a series aerial condenser is chosen—and one might do worse—the trimming condenser for the input circuit should be mounted in an accessible position, so that an adjustment may readily be made to compensate for variations in effective aerial capacity.

TWO NEW S.G. VALVES

The Cossor 220 S.G. and 215 S.G. Valves Reviewed.

ALTHOUGH the screened valve in the indirectly heated class has lately shown remarkable progress, hitherto the same could not be said of the battery type. The two new Cossor S.G. valves with 2-volt filaments reviewed in this article are a welcome addition to the range of high-frequency amplifying valves. Their characteristics mark an important advance for not only is the interelectrode capacity extremely low but there is also the added advantage that grid current does not flow until the grid is positive. A high mutual conductance is maintained under working conditions and the high-frequency losses in the valve base are negligible. A stable stage gain of well over 300 times can be attained with well designed circuits.

THE rated characteristics of the two new screen-grid valves with which the present review deals are given by the makers as follows:—

	215 S.G.	220 S.G.
Filament volts	2.0	2.0
Filament current	0.15 amp.	0.20 amp.
A.C. resistance (impedance)	300,000 ohms.	200,000 ohms.
Mutual conductance, or slope	1.1 milliamps per volt.	1.6 milliamps per volt.
Max. anode volts	150	150
Screen-grid volts	60 to 80	60 to 80
Residual anode-grid capacity, of the order of	0.001 μ F.	0.001 μ F.

It will be observed that the 215 S.G. has rated characteristics not markedly different from those of many other screen-grid valves on the market, except that the residual capacity is considerably lower than the average. This latter point should make it possible to use quite low-loss coils with the valve without any appreciable danger of oscillation, provided, of course, that the screening external to the valve is sufficiently good.

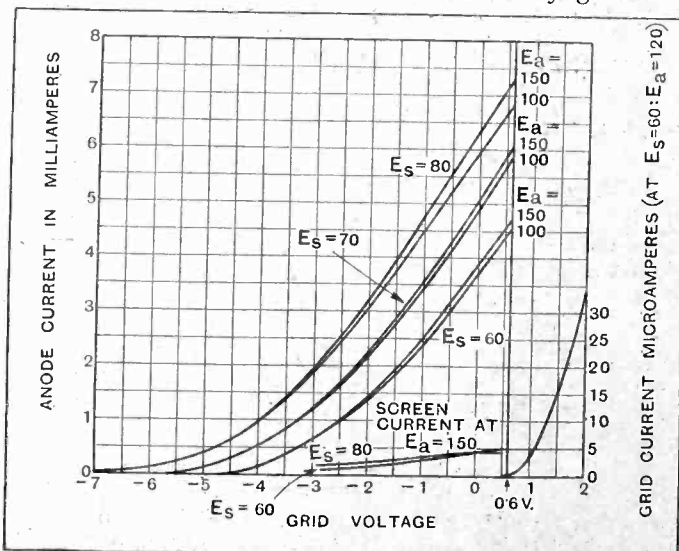


Fig. 1.—Grid-volts anode-current curves of Cossor 215 S.G. valve. It is especially to be noticed that grid current does not start until the grid is made just over half-a-volt positive. The valve therefore needs no grid bias. The screen current is low, as it should be.

In the 220 S.G. we have a valve which combines an unusually high mutual conductance with moderately low A.C. resistance, which should make it especially suitable for use with coils that make no particular claim to low resistance. The exceptionally perfect screening

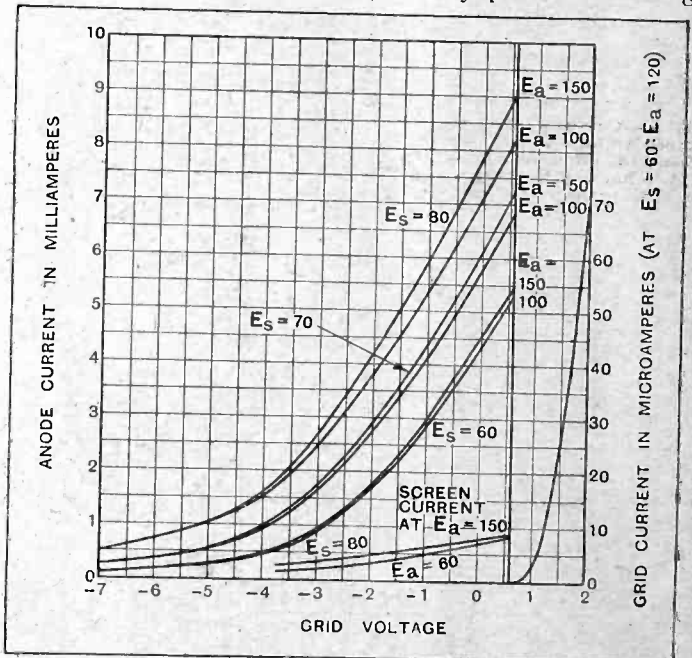


Fig. 2.—Cossor 220 S.G. valve. Grid-volts anode-current curves. The characteristics of this valve are similar to those of the 215 S.G.

that characterises the 215 S.G. is, of course, a feature of this one also.

Measurement of the mutual conductance and A.C. resistance at $E_s=60$, $E_a=120$, and $E_g=0$, which are the voltages usually applied when taking the characteristics of screen-grid valves for catalogue purposes, gave the following results:—

	215 S.G.	220 S.G.
Mutual conductance	1.48 milliamps per volt.	1.76 milliamps per volt.
Anode A.C. resistance	520,000 ohms.	330,000 ohms.
Amplification factor	770	570

Two New S.G. Valves.—

These figures are in both cases definitely better than those claimed by the makers; although the A.C. resistance is higher than they state, this is more than offset by the corresponding rise in amplification factor, as can be seen by the fact that the slope actually found, which is a good measure of the amplifying powers of a screen-grid valve, is greater than the maker's figures.

Figs. 1 and 2 give a fairly full set of curves, plotted in the form of mutual conductance curves (grid volts— anode current) for the two valves. Attention is very

will be seen that unless the input to the valve is kept very small, rectification, with consequent loss of selectivity, may occur. This can be combated either by using a small negative bias, which will permit the valve to accept a larger input before rectification begins, or by preceding the valve with a band-pass filter, which will keep the input from an unwanted station down to a low value. The latter method is strongly to be preferred, as it retains unimpaired the amplifying powers of the valve. The more "low loss" the tuned circuit that follows the valve, the more troublesome this source of unselectivity is likely to be.

Curves for the 215 S.G. are not given, for reasons of space; they are very similar to those of the 220 S.G., and one can draw the same morals from them.

Figs. 5 and 6 may be regarded as giving a summary of all the preceding figures; they show the variation of amplification factor, A.C. resistance, and mutual conductance of the two valves with changes in screen-grid voltage. In compiling these curves it was assumed that the anode voltage would be 150, with zero grid bias, as these are the best conditions under which to work the valve. A drop in anode voltage to 120 would not alter the curves to any very serious extent, except perhaps towards the extreme right of the diagrams. In making any calculations during the designing of a set, it is the

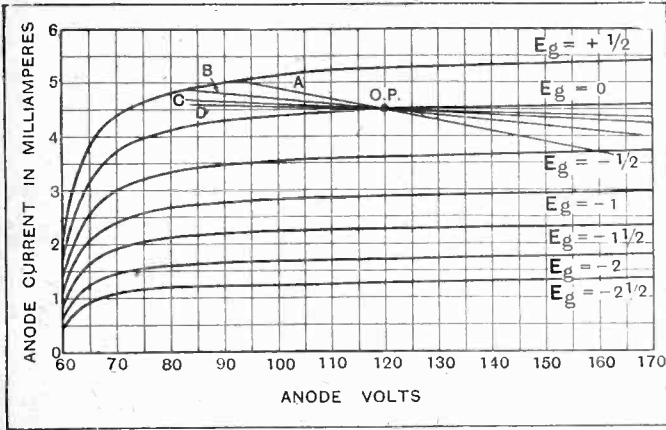


Fig. 3.—Cossor 220 S.G. Anode-volts anode-current curves for a screen voltage of 60. Load lines corresponding to anode circuits of several different values of dynamic resistance R are plotted: if R is high, only a very small grid swing can be accepted. The 215 S.G. gives very similar curves. The anode voltage is not taken low enough to show the negative resistance "kink."

particularly drawn to the curves representing the grid current, for these two valves are, we believe, unique in the fact that the control grid can be made positive to the extent of over half a volt before grid current begins to flow. It is in consequence possible to operate the valve with zero grid bias, which not only avoids the necessity for accommodating a dry cell in some inaccessible corner of a screening box, but in addition enables the high figures of mutual conductance which have just been quoted to be realised in actual practice in the set. With the majority of screen-grid valves the need for biasing the grid negatively to avoid grid current results in a serious drop in mutual conductance.

Rectification Affects Unselectivity.

With both valves, the screen current, which is also plotted in Figs. 1 and 2, is commendably low. The bulk of the energy drawn from the anode battery is therefore consumed in the anode circuit, where it can do most good. The fact that the anode current is rather high is, perhaps, a drawback; it is, however, probably an inevitable condition for getting high slope. At the most, it is a small fraction of the total current consumed by any set with pretensions to adequate output.

Figs. 3 and 4 give the impedance curves (anode volts— anode current) of the 220 S.G. with two different values of screen-grid voltage. The operating point suggested with each of the two voltages is marked as O.P. in the diagrams, and through this point load-lines have been drawn corresponding to anode circuits (coils) of several different values of dynamic resistance. It

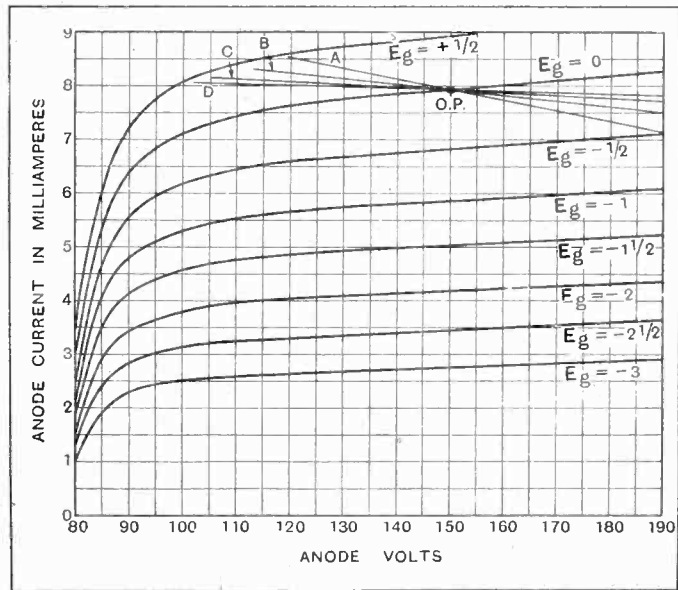


Fig. 4.—Cossor 220 S.G. valve. Anode-current anode-volts curves for a screen-grid voltage of 80. Load lines are plotted for anode loads of several dynamic resistances R. If tuned circuits of very low loss are to be used, it will be advisable, in the interests of selectivity, to apply about 1/2-volt of negative grid bias.

values given on these curves, and not the rated values, that should be taken.

It will be noted that with the highest operating voltages the mutual conductance of the 220 S.G. rises to 2.0 milliamps per volt, and that of the 215 S.G. to 1.66 milliamps per volt. These figures are in each case exceptionally good, and will result in achieving unusually good amplification with coils of but moderate efficiency. In calculating the stage gain attainable with any given

value of screen-grid voltage, the formula $A = \mu \frac{R}{R + R_0}$

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will normally be used (where R is the dynamic resistance of the tuned circuit following the valve), but when R_o exceeds one megohm or thereabouts the simpler formula

$$A = \frac{gR}{1,000}$$

will generally be found sufficiently accurate.

For this reason the curves for μ and R_o have been allowed to run off the diagrams, so that g only is given for the lower screen-grid voltages.

Measurements of stage gain have not been made, but calculation gives the following values, which may be

A.C. resistance, and consequent higher amplification factor. Further, it will be noticed that the less efficient coils require a much higher screen-grid voltage for greatest amplification; the valve has to supply much more power to compensate for the losses in the tuned circuit in these cases.

We have several times had occasion in the past to criticise very unfavourably the magnitude of the losses introduced into the grid circuit of a screen-grid valve by the material of which the base is made. It is therefore with real pleasure that we find the high-frequency losses in the base of both the two valves here tested to be negligible. In figures, our measurements gave the result that in connecting either valve across a tuned circuit the losses incurred at 250 metres were less than those resulting from connecting a five-megohm grid leak in the same position. With even the most ultra-low-loss circuit, decapping these valves would result in increasing the signal strength by 10 per cent. at the most; with some valves we have tested the same procedure would raise signal strength 150 per cent.

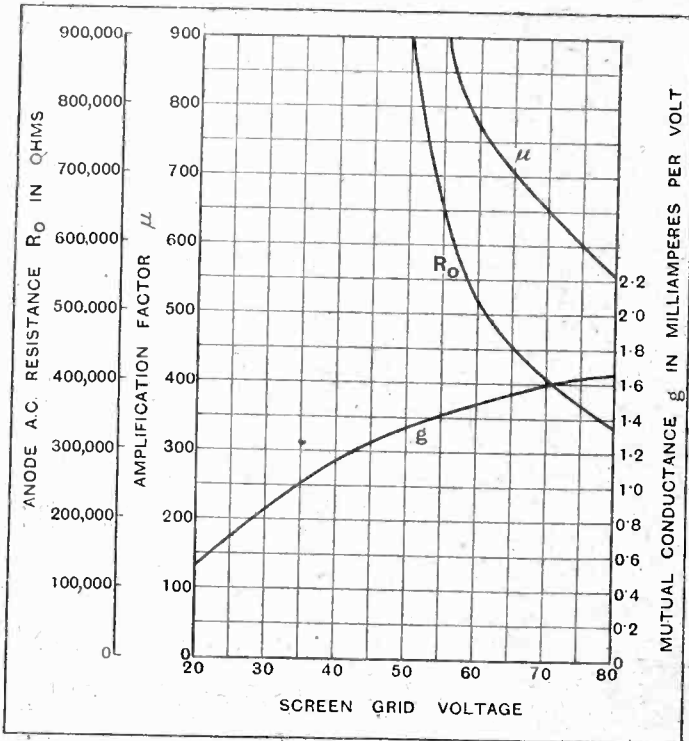


Fig. 5.—Cossor 215 S.G. valve. Variation of A.C. resistance, amplification factor and mutual conductance with screen-grid voltage. Measured at zero grid bias, with anode volts 150, which gives optimum working conditions.

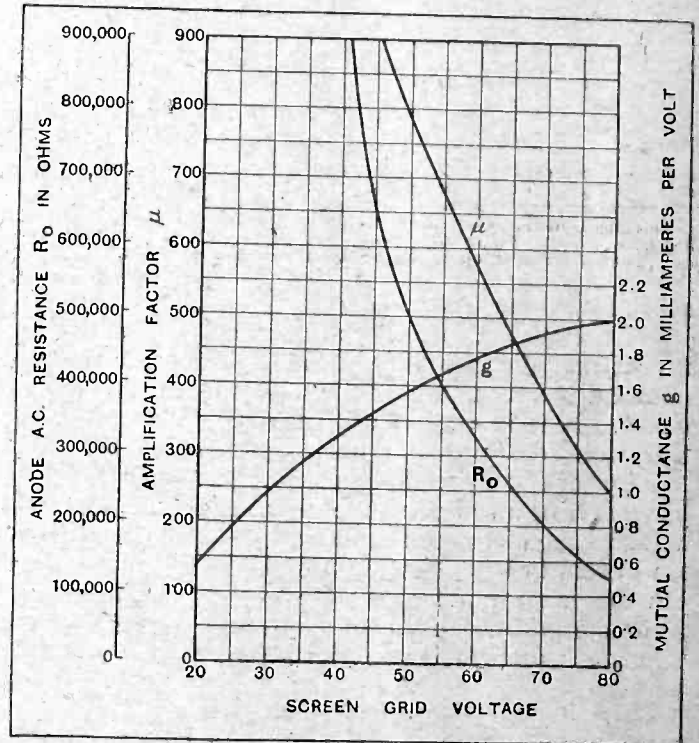


Fig. 6.—Cossor 220 S.G. valve. The variation of A.C. resistance, amplification factor and mutual conductance with changes in screen-grid voltage. Measured at zero grid bias, anode volts 150, which gives optimum working conditions.

relied upon within fairly close limits. They are correct for tuned-anode or tuned-grid circuits with coils of the dynamic resistance named; the description of the coil is a rough guide only.

Coil.	220 S.G. Valve.		215 S.G. Valve.	
	Gain.	Opt. S.G. Volts.	Gain.	Opt. S.G. Volts.
4 in. Litz R. 460,000.	450	30	420	50
3in. Litz R. 225,000.	246	45	240	55
1½in. solid wire . R. 100,000.	135	60	125	70
Good plug-in . . . R. 50,000.	75	65	70	80

It will be noticed, first, that the 215 S.G. gives very nearly as great an amplification as the 220 S.G., in spite of its lower slope. This is, of course, due to its higher

To take full advantage of this most excellent feature, the user of either of these valves must be positively fussy in his choice of valve holder; it must be made of ebonite throughout, and should be of skeleton construction at that. No holder built up from large chunks of synthetic insulating compound of unknown composition should be even considered; if such holders *must* be used, they should be put on the L.F. side of the set where they can do no harm.

Finally, we made an estimate of the residual anode-grid capacity which, it will be remembered, is claimed to be of the order of 0.001 $\mu\mu\text{F}$. We could not confirm

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this extremely low figure; our measurement, though rough only, is thought to be sufficiently accurate to show at least that the residual capacity is somewhat higher than 0.001 $\mu\mu\text{F}$. Our actual results were 0.004 $\mu\mu\text{F}$ for the 220 S.G., and 0.003 $\mu\mu\text{F}$ for the 215 S.G., though they cannot be relied upon implicitly. By winding copper gauze round the valves, and earthing this little auxiliary screen, we were able to make an appreciable reduction in the residual capacity, which dropped by about 25 per cent. in each case.

It is only fair to point out that these figures are only disappointing in view of the extremely low value claimed; taken on their merits they represent a perfection of screening considerably in advance of the average. We would venture the statement that the screen-

ing is more thorough than in any other battery-heated valve, were it not that we do not yet know what the forthcoming Show will produce in the way of new screen-grid valves; such a statement might become obsolete before being published.

If we accept the values of 0.0035 $\mu\mu\text{F}$ and 0.0025 $\mu\mu\text{F}$ as being fairer to the valves than the values actually found, we conclude that the stage gain attainable before oscillation sets in is about 300 times with the 220 S.G. valve, and about 350 times with the more perfectly screened 215 S.G. Comparison of these figures with the table showing the amplification to be expected with different coils will make clear that unless coils of the very lowest losses are used there will be no trouble from oscillation, so long at least as only one stage of amplification is attempted.

Valve.	Max. Anode Voltage.	Optimum Screen Voltage (depends on coils used).	Average Anode Current (mA.).	Amplification Factor.	A.C. Resistance.	Anode-Grid Capacity ($\mu\mu\text{F}$).	Max. Stage Amplification Unneutralised	H.F. Performance Factor.	Optimum Transformer Ratio.	Stage Amp. with 3 to 1 Transformer.	Price.
COSSOR. 215 S.G.	150	70	5.0	650	400,000 ohms	.0025	360	103	1	127	20/-
220 S.G.	150	60	4.5	570	330,000 ohms	.0035	306	100	1	133	20/-

This table is on the lines of the "Wireless World Valve Data Sheet" (Dec. 4th, 1929) and gives the characteristics of the valves under actual working conditions with the screen-grid voltage shown. With comparatively low-impedance valves such as these, no one screen-grid voltage can yield best results under all conditions of use, so that some of the figures shown above are susceptible of appreciable improvement.



THE "TANNOY" RADIO GRAMOPHONE.

A Well Designed Mains-fed Receiver-amplifier.

MANY so-called radio gramophones at present offered to the public do not justify their title; they are essentially electrical-reproducing gramophones in which the radio section is a subsidiary part capable of receiving only one or two powerful local stations. This criticism cannot be levelled at the "Tannoy" radio-gramophone, for the radio side includes an efficient H.F. stage which provides a range and variety of broad-

cast reception capable of rivalling the best library of gramophone records.

The receiver is normally operated with an outside aerial with aperiodic coupling to the tuned grid circuit of the screen-grid H.F. valve, but provision is made for using the perforated metal grille in the back

panel as a small-capacity aerial where it is desired to move the set from room to room. This miniature aerial is joined directly to the grid of the H.F. valve.

The valve filaments are A.C. heated, the screen-grid, detector and first L.F. indirectly, and the power valve—a P.X.4—directly. Automatic grid bias is provided throughout.

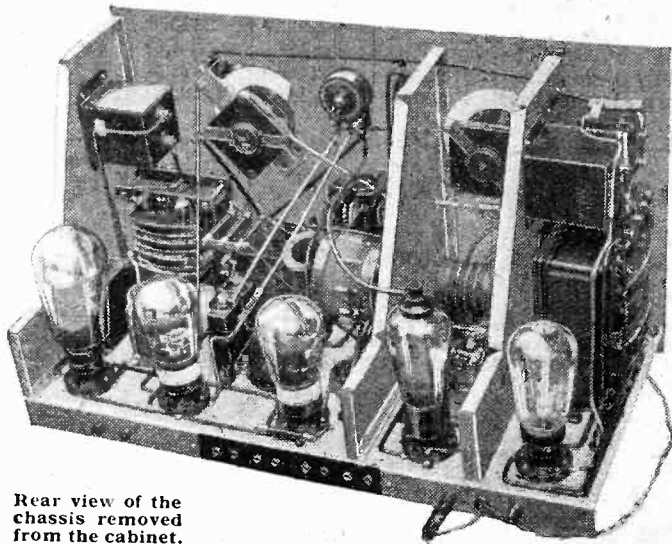
Transformer coupling is used between the screen-grid H.F. valve and the power grid detector, capacity controlled reaction being applied to the transformer windings.

The first L.F. valve is resistance coupled, the grid leak taking the form of a potentiometer volume control. The input from the gramophone pick-up is applied to the grid of the detector, so that the post-detector volume control serves for both gramophone and broadcast reproduction. Infiltration of radio signals during gramophone reproduction is prevented by a special arrangement of the contacts on the centralised control switch, and the change of bias necessary to convert the detector into an amplifier is performed by the same movement of the switch. A pre-set potentiometer across the pick-up windings enables the volume of gramophone

The "Tannoy" Radio Gramophone.—

phone reproduction to be set at any desired level independently of the variable volume control. Refinements of this kind are unusual and indicate that the designers have spared no pains to make the circuit technically as sound and up to date as possible. Support for this contention is provided by the coupling between the first L.F. stages and the power valve, in which a filter is used to divert the D.C. component of the anode current from the primary winding of the intervalve transformer.

A "Rola" moving-coil loud speaker is built into the base of the cabinet and is coupled to the P.X.4 output valve through a step-down transformer. If desired, an additional external loud speaker can be connected to the output circuit through a condenser built into the set, the primary of the output transformer serving as the anode choke.



Rear view of the chassis removed from the cabinet.

Anode current for the valves is derived from a U5 rectifier and is first passed through the loud speaker field winding, where it is smoothed while providing the necessary flux for the moving coil. Each anode circuit, with the exception of the output stage, is efficiently decoupled.

We have heard this instrument in operation at the works of Tannoy Products, 1-7, Dalton Street, London, S.E.27, and there can be no doubt that the performance justifies the care displayed in the design of the circuit. An extended test on the medium-wave band was not possible as the visit was made during the early afternoon, but, judging from the general feeling of liveliness in the controls and the negligible degree of reaction necessary to bring 5GB up to full loud speaker strength, there is every reason to believe that the range after dark should be sufficient to give a wide selection of Continental programmes. The long-wave range was, of course, less affected by daylight, and Huizen, Radio Paris, etc., came in with power in hand.

The quality of reproduction from both radio and gramophone was well up to the standard which one demands from an instrument of this class. The upper frequencies were well represented, without over-emphasis of needle scratch or sibilants in speech, and

the bass was full without undue tendency to "booming." As a special test for transients, pianoforte and xylophone records were played through, at our request, at a fairly high volume level; no evidence of cracking could be detected, credit for which must be shared by the loud speaker and the power handling capacity of the output valve.

The excellence of the gramophone reproduction is in no small measure due to the steady running of the Paillard induction motor and the small background noise consequent upon the absence of brushes.

The chassis layout gives easy access to the valves, which project through holes in the cover plate, and the chassis construction and wiring bear the stamp of a sound engineering job.

There are three types of cabinet work, and the prices are as follows: Oak, 55 guineas; walnut or mahogany, 60 guineas; de luxe model (quartered walnut panels), 65 guineas. Each individual model is given an extended test and kept under observation for permanence of valves for several days before despatch.

CHECKING THE SCREENS.

IT is not uncommon for a high-frequency amplifier, especially if it should contain more than one stage, to show a decided tendency towards instability when it is first built. The possible causes of this are many and various, the two most likely ones being inter-stage coupling, due to insufficient decoupling of the various battery leads, and imperfections in the screening system.

It is not very generally realised that, while a small hole in a screen is usually quite harmless, an imperfect electrical contact along one edge of a screening-box results in a very serious decrease in the efficiency of the screening. The difficulty of detecting a bad contact of this kind is often very considerable, and much time may be spent in searching for it.

The present note does not offer any new suggestions for tracing "leaks" in the screening system, but is written to draw attention to a simple and reasonably reliable means of determining whether instability is due to imperfections of screening or to interstage coupling along battery leads. If a frame aerial is connected to the receiver, it may be found that the set is stable when the frame is pointing in one direction, but oscillates when the frame is rotated. In this case one may at once be sure that the coils and wiring are not being isolated completely by the screening-boxes within which they are placed, but are giving rise to external fields which can affect the frame. The assumption may then quite confidently be made that the screening system is not so good as it should be, and that a detailed search for imperfections is likely to be well worth while. If, on the other hand, rotating the frame is found to have no effect on stability, the screening may be exonerated from blame, and resort to a more effective decoupling system is indicated. In overhauling this, attention should not be restricted to the H.T. leads; in addition, the grid connections often require to be decoupled, and it is sometimes even necessary to "tie down" the L.T. + leads with a 1-mfd. condenser.

WIRELESS THEORY

SIMPLIFIED

By
S. O. PEARSON,
B.Sc., A.M.I.E.E.

(Concluded from
page 226
of previous issue)

Comparison of Anode Bend and Leaky Grid Detection.

ALTHOUGH the merits of a valve as a detector can be determined from the D.C. or static characteristic curves on the lines already described, the process is rather laborious, and accurate information is obtained much more easily from an experimentally determined curve showing the mean anode current for various amplitudes of alternating voltage applied to the grid circuit.

The apparatus necessary for finding such A.C. characteristic curves is quite simple, the only component that has to be made up specially being a resistance divided into ten equal parts. It is not as a rule easy to measure alternating voltages below four volts or so, and the sub-divided resistance enables known fractions of a known or measured voltage to be tapped off. If the valves to be tested are of the A.C. indirectly heated cathode type, a transformer with a 4-volt secondary winding will probably be available, and the subdivided resistance as well as the heater circuit can be connected across this winding. In any case, a source of alternating current will be necessary. The potential divider can be simply constructed by connecting ten equal resistance wires between eleven terminals on a board, each resistance being anything from 2 to 10 ohms.

A suitable circuit for obtaining the A.C. characteristic curve under both anode bend and leaky grid rectifying conditions for an A.C. valve is shown in Fig. 1. For a filament valve the same circuit would be used, except that the filament itself would be heated by current from an accumulator. With the switch closed on contact A the conditions are set for anode bend rectification, the grid-bias battery GB being brought into the grid lead to provide the necessary negative grid bias. On contact G the grid battery is cut out and the grid-leak resistance is connected across the grid condenser C.

The value of the voltage V across the ends of the potential divider P can be fairly accurately estimated if the rating of the mains transformer is known. If a low reading A.C. voltmeter is available so much the better. Any fraction, in tenths, of the voltage V can be

applied to the grid circuit of the valve; for instance, if V is 4 volts (R.M.S. value) and connection is made to the centre terminal of the potential divider, five-tenths of 4 volts, that is 2 volts, will be applied to the grid circuit. This is an R.M.S. value, and if the amplitude is required it is only necessary to multiply by $\sqrt{2}$ or 1.414, assuming a sine-shaped wave. So in the example given the amplitude or peak value of the voltage obtained is $2 \times 1.414 = 2.83$ volts.

Practical Measurements.

Measurements conducted in this manner have been made on a general purpose valve of the indirectly heated cathode class, the actual valve chosen being a Mazda AC HL. For anode bend rectification the plate voltage was maintained at 100, and the negative grid bias was 3 volts. The anode current as measured by a moving-coil milliammeter was noted for different values of alternating voltage applied to the grid. Although the anode current will actually contain an alternating component, the moving-coil instrument will indicate the mean or D.C. component only. The results obtained are given in the form of a curve in Fig. 2.

the voltage applied to the grid being expressed in terms of the amplitude or peak value.

With anode bend rectification the anode current is a minimum when no alternating or signal voltage is applied to the grid, but the mean current increases as the signal voltage is raised. The change of plate current from the normal value, produced by an applied alternating voltage at the grid, is sometimes called the *rectified current*, although this term is not strictly correct when applied in this manner. The change of

anode current caused by different amplitudes of voltage applied to the grid of the valve has been deduced from the curve of Fig. 2, and these values are shown by the lower curve of Fig. 4. But before considering the merits or otherwise of this curve the practical determination of the corresponding curve relating to the leaky grid method of rectification will be briefly touched upon. We shall then be in a position to make a fair

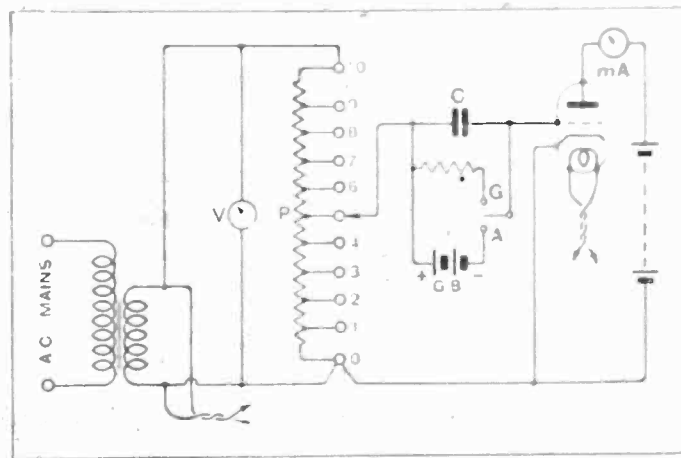


Fig. 1.—Practical circuit arrangement for determining experimentally the A.C. curves of a valve. The switch enables measurements to be made under conditions of either anode bend or leaky grid rectification. For a filament valve the filament would be heated by current from an accumulator.

Wireless Theory Simplified.—

comparison of these two popular models of rectification under working conditions.

A Necessary Precaution.

In obtaining the A.C. characteristic curve for grid rectification, the procedure is precisely the same as for anode bend rectification—the switch arm is merely put over to contact G instead of A in Fig. 1, and readings

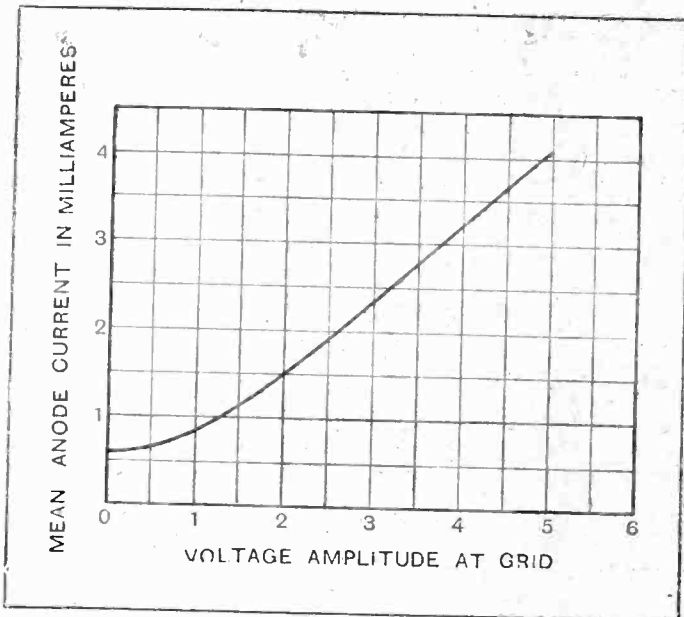


Fig. 2.—Anode bend detection. Curve showing how the mean anode current depends upon the amplitude of alternating voltage applied to the grid of an AC/HL valve with an anode potential of 100 volts and grid bias of -3 volts.

are then taken in the same manner. But it must be remembered that we are dealing with a 50 cycle alternating voltage and not a radio frequency, and for this reason it is not permissible to employ the same value of grid condenser capacity as would be used under normal receiving conditions. The reactance of the condenser should be of the same order of magnitude as that obtained at the high frequency in an actual receiving set. At 300 metres, or 10^6 cycles per second, a 0.001 mfd. condenser has a reactance of just over 1,500 ohms, and at 50 cycles per second a 2-mfd. condenser would have the same reactance.

Since an unmodulated voltage is employed for obtaining the A.C. characteristic curves, the time constant of the shunted grid condenser does not come into the question. It was found that increasing the capacity of the grid condenser above 1 microfarad made no perceptible difference to the readings, but that the rectifying properties began to fall off rapidly if the capacity was reduced below 0.5 mfd. In the actual measurements a 1-microfarad condenser and a grid-leak resistance of 0.25 megohm were employed. No grid bias was used, and the anode potential was maintained at 100 volts.

The curve of Fig. 3 shows the values of mean anode current obtained with various amplitudes of alternating voltage applied between the cathode of the valve and the left-hand side of the grid condenser. In contrast

to the case of anode bend rectification, the anode current here has its maximum value when there is no applied alternating voltage, and then falls in the manner shown by the curve as the amplitude of the alternating voltage is increased from zero. The normal value of anode current is 6.1 milliamps, and by subtracting from this the value of the mean current for any particular voltage, the change in anode current produced by that voltage is obtained. The changes of anode current produced by various amplitudes of applied alternating voltage when the conditions are set for grid rectification are shown by the upper curve of Fig. 4.

Conditions for Distortionless Rectification.

When radio telephony is being received the high-frequency voltage applied to the grid circuit of the detector valve has its amplitude varied or modulated in accordance with the low-frequency variations representing the actual speech or music, and it is these low-frequency variations which must be reproduced faithfully on the anode or output side of the detector valve, the radio-frequency component being suppressed or eliminated from the voltage to be passed on to the grid of the next valve.

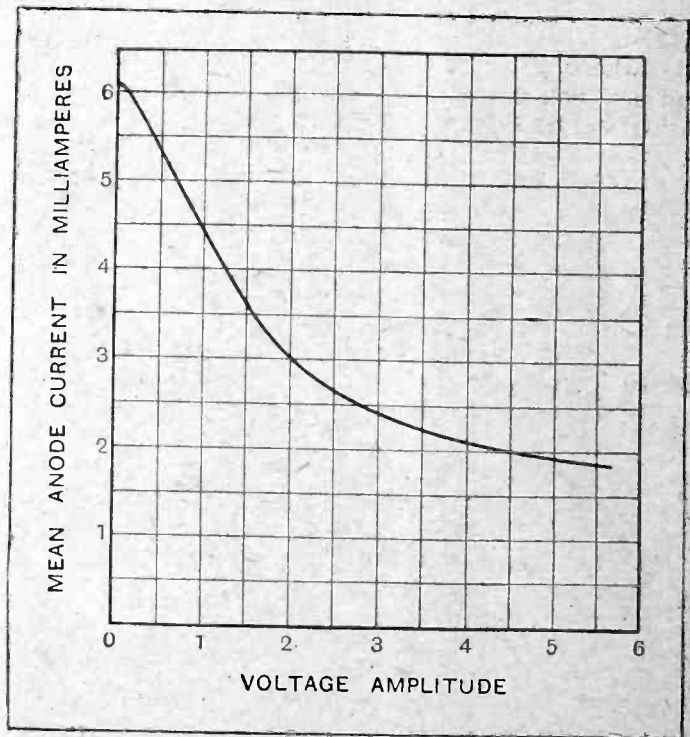


Fig. 3.—Leaky grid detection. The curve shows the mean anode current with various amplitudes of alternating voltage applied between the cathode and grid condenser. The valve is the same one to which Fig. 2 refers. The test frequency is 50 cycles, grid condenser 1 mfd., grid leak 0.25 megohm.

If the detector is to function without introducing any distortion of the low-frequency wave shape, the change of mean anode current must be exactly proportional to the change in amplitude of the voltage applied to the grid circuit. Now as the depth of modulation of the high-frequency waves is always less than 100 per cent. for ordinary broadcasting, it follows that

Wireless Theory Simplified.—

no distortion will be introduced if the curve showing the change of anode current against applied grid voltage (Fig. 4) is straight over the range through which the amplitude of the high-frequency voltage varies. The point is that the curve need not be straight over its whole length, unless the modulation reaches a depth of 100 per cent., in which case the amplitude of the high-frequency voltage would vary between zero and an upper limit equal to twice the unmodulated value. But this latter condition is rarely met with in practice.

The Two Methods Contrasted.

Turning now to the curves of Fig. 4 we see at a glance that each has a portion which is moderately straight, but that they differ rather widely in character; with leaky grid rectification the straight portion of the curve is near the lower end, whereas for anode bend detection the straight portion is at the upper end, the straight part not being reached until the voltage amplitude exceeds 2.5 volts. Below this figure there is a pronounced bend.

Now let us consider these curves in turn and see to what extent they fit in with the conditions necessary for distortionless rectification of a modulated wave; taking the leaky grid rectification curve first we see that it is practically straight between voltage amplitudes of 0.25 and 1.5 volts. The middle of this straight part or operating range thus occurs at a voltage midway between these points, namely, at about 0.875 volt. Thus if the voltage amplitude due to the unmodulated carrier wave were adjusted to 0.875 volt (by means of a pre-detector volume control) a degree of modulation allowing the voltage amplitude to swing between 0.25 and 1.5 volts could be permitted without introducing distortion due to curvature. Half this maximum permissible variation of amplitude is $\frac{1.5-0.25}{2} = 0.65$ volt,

which is about 75 per cent. of the carrier voltage. Hence a depth of modulation as high as 75 per cent. could be dealt with without noticeable distortion. This is excellent and meets all the requirements of modern broadcasting.

Analysing the anode bend curve in the same way we find that the conditions are not nearly so good; the straight portion of the curve occurs above 2.5 volts, and therefore to allow (theoretically) the same percentage modulation as before, namely, 75 per cent., without distortion, the mean or carrier voltage amplitude would have to be set at 11 volts. This figure is

quite impractical, not only on account of the high degree of radio-frequency amplification that would be required, but also in view of the fact that grid current flows immediately the voltage amplitude approaches to the value of the grid-bias voltage employed. In this case the grid bias used was -3 volts, and since for this valve grid current commences when the grid potential is about -0.5 volt, grid current will flow whenever the amplitude of the applied alternating voltage exceeds about 2.5 volts. To prevent grid current then, the valve would have to be operated so that range of amplitude variation falls well within the curved portion of the graph and distortionless rectification would be impossible.

On the leaky grid rectification curve the upper limit of the working range is determined by the curvature, but with anode bend detection the upper limit is determined by the voltage amplitude at which grid current commences. Thus the conditions of anode voltage and grid bias under which the lower curve of Fig. 4 were obtained are not suitable for efficient rectification.

To obtain a higher range of oscillation voltage amplitude without the occurrence of grid current, a higher negative grid bias would be necessary, and this, in turn, calls for a higher value of anode potential in order that the valve shall work on the lower bend of the grid voltage/anode current curve. In any case, with anode bend detection the valve can never be worked entirely over the straight portion of the A.C. curve, and for this reason the percentage modulation which can be dealt with satisfactorily is relatively low.

Controlling Factors.

In case the foregoing remarks should appear to savour of an argument in favour of leaky grid over anode bend detection in general, it should be pointed out that the comparison only refers to the particular type of A.C. valve chosen as an example. With a filament valve of the usual type the disparity is not nearly so great; in fact, until quite recently it has been usual for designers of sets to recommend anode bend detection where quality of reproduction was the first consideration. The A.C. indirectly heated cathode valve lends itself better to leaky grid detection because the grid current curve has a much sharper bend (due to the equipotential cathode) and rises much more steeply. This property enables the newer type of valve to give efficient rectification with the use of a much lower capacity grid condenser and a lower resistance leak, with the result that the time lag inherent in the grid circuit

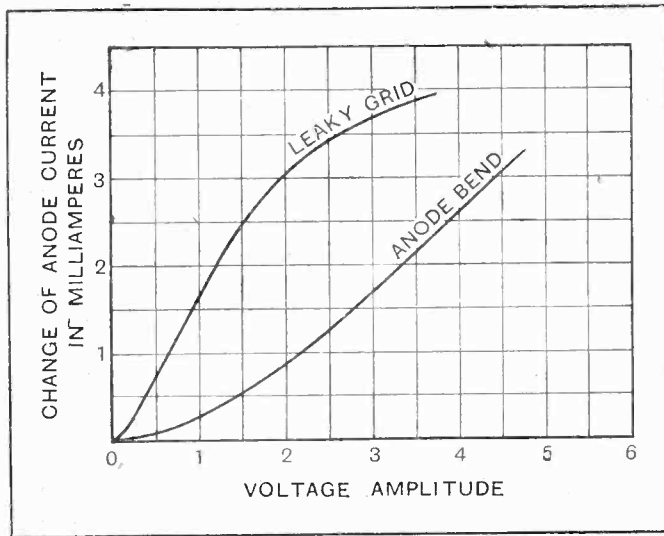


Fig. 4.—The curves show the actual change of mean anode current produced by various amplitudes of voltage applied to the grid circuit both for anode bend and leaky grid rectification. The relative merits of the curves are discussed in the text.

Wireless Theory Simplified.—

is very much less, and there is in consequence no serious loss of high-note frequencies.

However, the suitability of either method is not determined alone by the quality of reproduction. The effect of the detector on the efficiency of its tuned grid circuit and the conditions in the anode circuit as regards A.C. resistance are also factors which have to be taken into consideration. The leaky grid detector depends for its action primarily on the flow of grid current, and therefore naturally has a greater damping effect on the preceding tuned circuit than an anode bend detector

adjusted to function without the flow of grid current. On the other hand, with grid rectification the detector valve is operated over the straight and steepest part of the anode current characteristic curve so that the differential or A.C. resistance of the valve is a minimum, whilst with anode bend detection the valve is operated at or near the lower bend of the anode characteristic curve where the slope is relatively small and the A.C. resistance is therefore very much higher. As regards coupling to the succeeding valve, the method of rectification where there is the lower anode A.C. resistance has the advantage.

OPERATING A.C. SETS FROM D.C. SUPPLY.

The Crypto Rotary D.C. to A.C. Converter.

EXPERIMENTERS and others whose electric supply is of the direct-current type must find it difficult to keep abreast of the times now that A.C. sets, eliminators, and other associated equipment is so widely used. To afford those so placed an opportunity to extend their activities into this field, a number of rotary converters, the function of which is to provide an A.C. supply, have been developed. The machines made by the Crypto Electrical Co., Ltd., Acton Lane, London, N.W.10, are excellent examples.

The sample which we tested was rated at 400 V/A. output, giving a nominal voltage of 220 at 50 cycles. This machine is wound for a 220-volt D.C. supply, but they can be obtained to suit all standard mains voltages.

This model has a double-wound armature with a 48-section commutator at one end and two slip rings at the other end. Carbon brushes of generous dimensions are fitted.

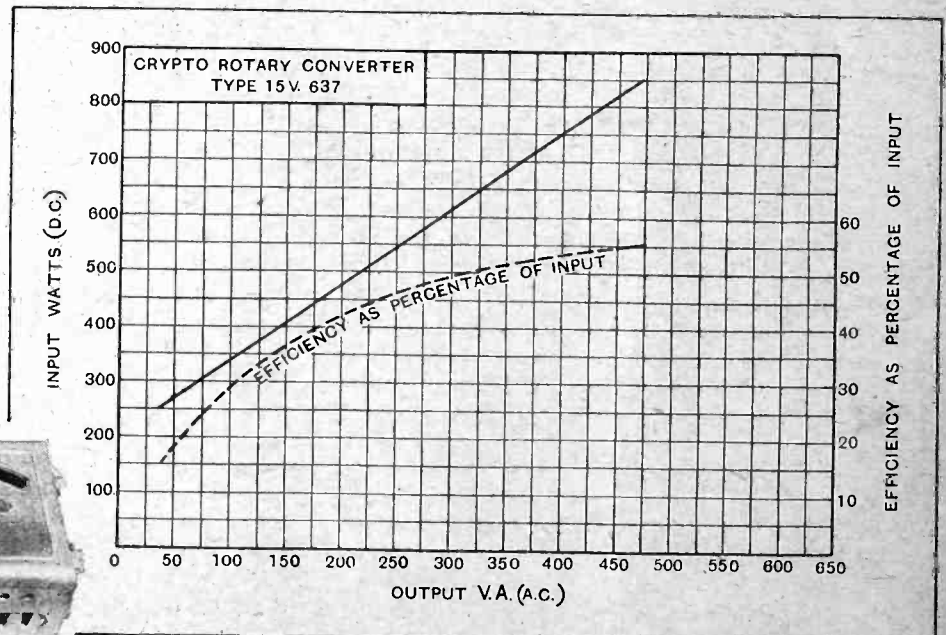
On an extension of the armature spindle is mounted a fan which maintains a constant current of air through the armature tunnel and prevents heating of the coils. The effectiveness of this was demon-

The current drawn from the D.C. mains was measured at various output loads, and these are tabulated below:—

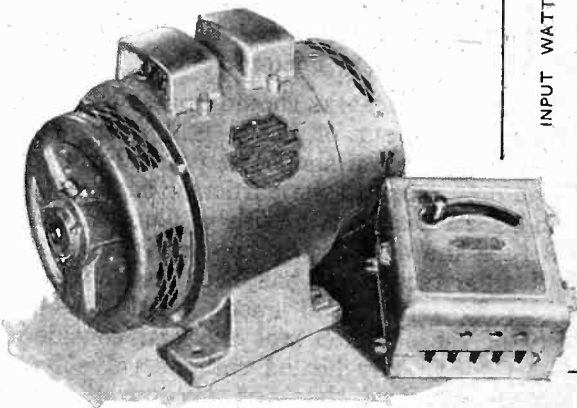
D.C. Input.			A.C. Output.		
Volts.	Current in Amps.	Watts.	Volts.	Current in Amps.	Volt/Amps.
215	1.16	250	250	0.15	37.5
215	1.33	286	247.5	0.25	61.9
215	2.0	430	235	0.7	164.5
215	2.4	515	227	1.0	227
215	2.84	610	218	1.35	294
215	3.22	694	209	1.7	355.5
215	3.5	755	200	2.0	400
215	3.96	850	188	2.5	470

Some practical tests were then undertaken. When supplying current to gramophone amplifiers and the more simple type of wireless receivers, there was no trace of interference, but when used in conjunction with a sensitive receiver, incorporating H.F. stages, a noticeable background of hum appeared. This was rendered less vicious by including the special anti-interference units, types A.I.F.8 and A.I.F.Z, made for use with this machine by the Dubilier Condenser Co. (1925), Ltd. Even so, a small residuum of disturbance was left which became apparent when the set was adjusted to a condition of maximum sensitivity.

By expressing the output volt/amps—



Curves showing relationship between input watts and output volt/amps. The broken line curve gives the efficiency as a percentage of the input watts.



Crypto D.C. to A.C. rotary converter type 15V637 rated at 400 V/A output at 100 volts 50 cycles.

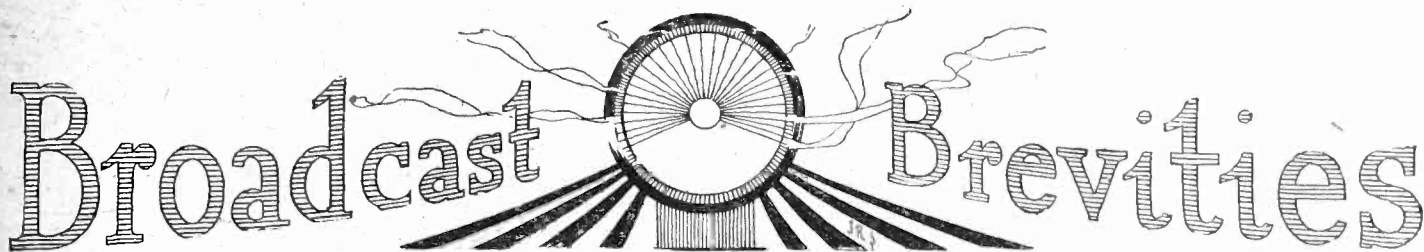
strated by the fact that after a lengthy run on full load there was no appreciable rise in temperature in the coils or in the frame.

as a percentage of the input watts, we get a curve as shown by the broken line on the graph. The full-line curve is the relationship between the input and the output. On full load, 400 V/A, the efficiency is 53 per cent.

In addition the machine should find a wide application in many kinds of A.C. tests.

The price of the converter, which is built on very generous lines, is £14 13s., and the starter costs £1 7s.

Broadcast Brevities



By Our Special Correspondent.

Western Regional.—Tatsfield Again.—Dominion Programmes for Britain?

Queer Happenings on the Quantocks.

Who are these mysterious strangers on the Quantock Hills, near Minehead? Discerning holiday-makers declare that they are neither tourists nor natives, and, further, that they pronounce the name of the neighbouring village of Cothelstone as Cot-hélston. Now this is the pronunciation recommended by the B.B.C.

Are the strangers B.B.C. engineers?

○○○○

A Site for Western Regional?

Is it possible that they are searching for a site for the Western Regional station? Recently I have heard the opinion expressed at Savoy Hill that the Cardiff area, originally chosen for the station, is too far north, in view of the fact that the Northern Regional station will cover a large portion of the Principality. If the Western Regional station were placed in North Somerset, not only would the possibility of a clash be avoided, but Devon and Cornwall would be assured of a much better service.

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Almost a Certainty.

We may be fairly certain that the strangers are indeed B.B.C. engineers and that the Quantock Hills are considered a very suitable locality for the new station.

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The America's Cup.

The engineers at the Tatsfield receiving station will make a determined effort to give British listeners a relay of the U.S. National Broadcasting Company's running commentaries on the races for the America's Cup. The commentator will be Mr. Samuel Wetheril, associate editor of the American journal, "Yachting."

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Tatsfield on Trial.

The *Shamrock V* and its rival will fight their first battle on Saturday next, September 13th. The B.B.C. will attempt to pick up the short-wave transmission from Schenectady between 5 and 5.10 p.m. (B.S.T.), when the commentator will describe the start of the race. If possible another ten-minute relay will be staged between 10 and 10.30 p.m., when the yachts are approaching the winning post.

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Thrills on the Atlantic 'Phone.

Six more races may be necessary to determine ownership of the Cup, which will be secured by the yacht which first

wins four races. So we may expect an exciting relay each evening from September 15th to 20th. I understand that in the case of the deciding race the B.B.C. will employ the transatlantic telephone service via Rugby to ensure satisfactory reception.

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Empire Premiers at the Microphone.

The forthcoming Imperial Conference is to be "covered" by a series of weekly talks which, in all probability, will be given by the Prime Ministers of the various Dominions. I understand that Mr. Ramsay MacDonald will open the series with a broadcast address on the aims and scope of the Conference.

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Dominion Programmes for Britain?

Empire broadcasting has already received full discussion at the Colonial Conference, and will merely be the subject of a report, though it is possible

that the Dominion delegates may offer suggestions on the question of payment for the service. There is a strong feeling in some quarters that the best arrangement would be a scheme of reciprocal transmissions in which the Dominions would contribute a share of the programme material.

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Talks from Geneva.

The running commentary to-day (Wednesday) on the ceremonial opening of the League of Nations Assembly at Geneva will be followed to-morrow and the three succeeding Thursdays by talks direct from Geneva given by members of the British delegation. Fortunately there will be no singing, so the B.B.C. will be saved the trouble of arranging an elaborate land-line system such as is used for foreign concerts. The ordinary Continental telephone will be employed.

Before the close of the session, listeners in Britain will hear a talk by the Foreign Secretary, Mr. Henderson.

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An Electric Violin.

An electrically played violin is, I believe, a real novelty, so those fortunate listeners who can tune in the National programme at noon to-day (Wednesday) should have something to talk about when the workers return in the evening. With their characteristic willingness to perform experiments, the B.B.C. have placed a studio at the disposal of the makers of the Mills Violano Virtuoso, an instrument which combines an electric piano with an electric violin. Selections will be given between 12 and 12.45 p.m.

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Pianists, Violinists, 'Cellists.

The list of soloists who will appear at the B.B.C.'s winter series of Symphony Concerts at the Queen's Hall reads like a directory of the world's musical talent. To take only the pianists, we find Backhaus, Bartok, Cortot, Dohnanyi, Gieseking, Myra Hess, Lamond, Moesewitsch, Rubinstein, Samuel, Solomon, and Stravinsky. The solo violinists include Busch, Catterall, Sammons, and Szigeti, and solo 'cellists Casals and Suggia. The names of vocalists would fill another long paragraph.

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Why Worry?

This should be a memorable winter for musical listeners, who, with all due deference to Sir Hamilton Harty, consider that wireless music is not "an imperfect and debased substitute for the real article."

FUTURE FEATURES.

- National (261 and 1,554 metres).**
 SEPTEMBER 15TH.—"Alice Through the Looking Glass," a play adapted from Lewis Carroll's book.
 SEPTEMBER 17TH.—Orchestral concert.
 SEPTEMBER 18TH.—Caernarvon Choral Society—Concert from Cardiff.
 SEPTEMBER 20TH.—Vaudeville programme.

London Regional.

- SEPTEMBER 14TH.—Orchestral concert.
 SEPTEMBER 15TH.—Vaudeville programme.
 SEPTEMBER 16TH.—"Alice Through the Looking Glass."
 SEPTEMBER 17TH.—"Here's a Health . . ." a light-hearted feature of songs of revelry both Ancient and Modern.
 SEPTEMBER 19TH.—"Music of the Country-side," Instrumental concert.
 SEPTEMBER 20TH.—Police Band concert.

Midland Regional.

- SEPTEMBER 18TH.—Choral concert.
 SEPTEMBER 20TH.—Military Band concert.

West Regional (Cardiff).

- SEPTEMBER 14TH.—Orchestral concert of Works by Mozart.
 SEPTEMBER 20TH.—Military Band concert relayed from Bristol's Annual Exhibition at Colston Hall, Bristol.

North Regional (Manchester).

- SEPTEMBER 14TH.—Concert of Old English Music.
 SEPTEMBER 17TH.—"George Proposes," a comedy (James Hodgson).
 SEPTEMBER 18TH.—Songs of Lakeland.

Glasgow.

- SEPTEMBER 20TH.—Eye-witness Account of the Scottish League Association Football Match, Celtic v. Rangers, by Mr. Campbell Bilney.

Belfast.

- SEPTEMBER 15TH.—Wagner Orchestral programme.
 SEPTEMBER 18TH.—"St. Patrick's Day, or The Scheming Lieutenant," a farce by Richard Brinsley Sheridan.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

A.C. Valves for D.C. Supplies.

I am a comparatively new reader of your journal, and should be obliged if you would tell me if you have ever described a three-valve H.F.-det.-L.F. set in which indirectly heated valves are connected in series for feeding from a D.C. mains supply. Please refer me to any back numbers in which sets of this type have been discussed. H. M. T.

We have never described a three-valve set of this type, but a modified version of the "New Foreign Listeners Four" with A.C. valves arranged for D.C. mains feed was discussed in our issue of May 28th. This was a four-valve set, but with the help of information given on the series connection of indirectly heated valves, it should be possible for you to modify some other design to meet your needs.

Adjustable Free Bias.

I am going to make a set similar to the "All D.C. Three," as described in your issues of August 20th and 27th, but wish to make provision for using a pentode output valve, which consumes the same filament current as the triode specified, but requires a different value of grid bias. Will you please tell me how to arrange for adjustable negative bias for this valve? C. R. M.

The easiest and simplest way of solving your problem is to make a number

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is only available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(3.) Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(4.) Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind, in the course of a letter.

(5.) Practical wiring plans cannot be supplied or considered.

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

of tapplings—half a dozen should be ample—on the existing bias resistance (denoted by R_7 in the published diagrams).

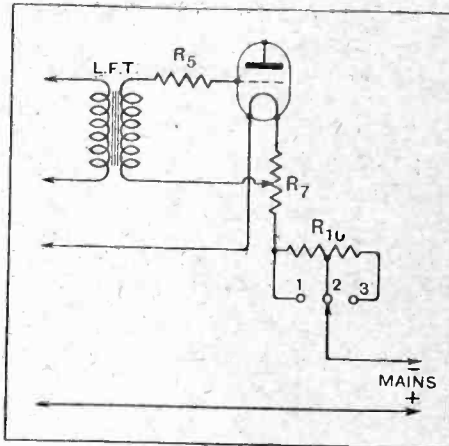


Fig. 1.—D.C. for filament heating and negative bias: how provision may be made for adjusting grid voltage.

Instead of taking the output grid return lead directly to the negative end of this resistance, it should be joined to one of the tapplings, as shown in Fig. 1.

As a guide to the correct position for this connection, it may be pointed out that from 7 to 8 volts will be given if the lead is joined to the centre point of the resistance as it is unlikely that a lower negative voltage than this will be required, your tapplings might all be fitted between this point and the end remote from the valve filament.

Natural Wavelength of Electrical Interference.

I am troubled by electrical interference, which seems to be mainly confined to the upper end of the medium broadcast waveband. Is this a normal effect? I find it rather hard to see why induced low-frequency currents should be "tunable" in this way, and should expect the parasitic noises to be equally prevalent over the whole of both wavebands covered by my set.

H. L. R.

It is by no means unusual to find that interference of this nature is more or less restricted to one wavelength, or to a narrow band of wavelengths, as it is often due to high-frequency impulses generated by electrical machinery, such as sparking contacts, commutators, etc. The natural wavelength of these impulses is, of course, determined by the capacity and inductance of the circuits associated with the offending piece of apparatus

Fixed Resistances.

Will you please tell me how to estimate the value of fixed resistances wound with Eureka wire on cylindrical formers?

W. H. J.

The first step is to ascertain the length of wire by multiplying the actual number of turns by 3.14 times the diameter. Unless the coil is of the single-layer type, it will be necessary to take the mean diameter as a basis.

Having then ascertained the thickness of wire, either with a micrometer or wire gauge, the total resistance can be estimated with the help of tables published in most electrical text books (including *The Wireless World Diary*), or supplied by the manufacturers.

If you have access to a set of copper wire tables only, it is useful to know that the figure applicable to this metal may be converted for Eureka wire by multiplying it by 29.

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Pot Magnet Current.

The pot magnet winding of my moving-coil loud speaker consumes 1 amp. at 6 volts, and is fed by an accumulator. Would it be practicable to supply current to it from my 240-volt D.C. mains by interposing a suitable resistance? I realise that this plan would be rather extravagant; can you give me some idea of the sort?

C. N. M.

This scheme is practicable enough, but, if put into practice, will be found to be extremely wasteful. Consumption will amount to 240 watts, and so a unit will feed the winding for very little more than four hours.

We suggest it would be much better to rewind your magnet with fine wire to suit the mains voltage. Even if you are unable to do this work yourself, the cost of having it done for you would soon be saved.

FOREIGN BROADCAST GUIDE.

RABAT (Morocco).

Geographical Position: 34° 2' N, 6° 50' W.
Approximate air line from London: 1,260 miles.

Wavelength: 416 m. Frequency: 720.3 kc.
Power: 10 kW.

Time: Greenwich Mean Time. (Morocco does not adopt B.S.T.)

Standard Daily Transmissions.

13.30, 17.00, 20.30 B.S.T. gramophone records; 21.00 main evening programme; 22.00 or 23.00 relay of foreign transmissions or gramophone records, or dance music from Rialto (Casablanca).

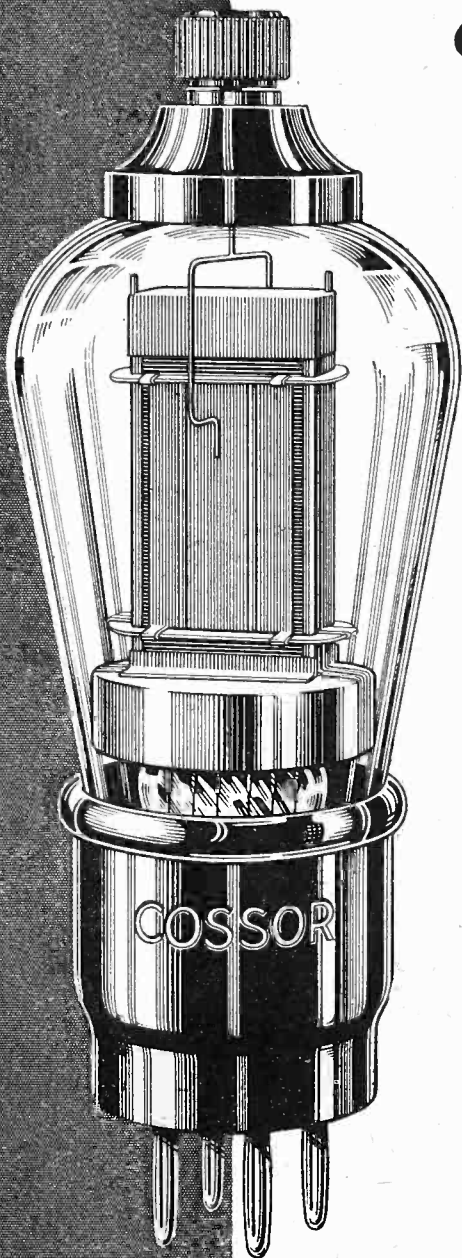
Man and woman announcers. Call: *Allo! Allo! Ici la station de radiodiffusion de l'Office Cherifien de Radio-Moroc a Rabat.*

Interval Signal: Metronome.

Closes down with usual French formula and *La Marseillaise.*

Highest *effective* amplification

yet attained with a
Screened Grid Valve



Radio technicians know that it is useless to expect a substantial stage gain from any Screened Grid Valve—however good its other characteristics—which has a high inter-electrode capacity. Cossor engineers have been striving for months past to reduce the self-capacity of Cossor Screened Grid Valves to a negligible figure. So successful have they been in their efforts that the new Cossor 215 S.G. has an inter-electrode capacity of only .001 micro-microfarads—so small, in fact, that none but the most elaborate and specially-designed apparatus can measure it. As a result, this new Cossor Valve permits a degree of effective amplification which a year ago would have been considered utterly impracticable. No other make of Screened Grid Valve has such a low inter-electrode capacity or can, therefore, equal the remarkable stage gain which it permits.

THE NEW **COSSOR** 215 S.G.

Cossor 215 S.G. 2 volts, .15 amp.
Impedance 300,000. Amplification
Factor 330. Mutual Conductance
1.1 m.a./v. Normal working
Anode Volts 120. Positive
Voltage on
Screen 60-80. Price **20/-**

Record low inter-electrode capacity

5885

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is :

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to **FIRST POST** on **THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to **LIFFE & SONS Ltd.**, and crossed **& Co.** Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Liffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain Radio Doctors.—Read advertisement under Miscellaneous. [0264]

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sioane 1655 0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169]

PHILIPS 2515 2-valve Set, 240v. A.C., used about 3 months, perfect; £8/15, or highest offer.—Box 7386, c/o The Wireless World. [1361]

IDEAL HOME Receiver ("Wireless World" March 19th, 1930). London made to specification, lock-up table cabinet; £12, or nearest; valves included; cost £17.—Blood, Church St., Eye, Suffolk. [1354]

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

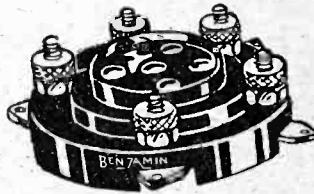
WITHOUT FEAR—

Send your material for credit—where radio part exchange began. A service ruled only by economics, above bargaining or petty gain.

Particulars from the Secretary.

HONOR OMNIA **APPLEBY'S**,
SUPER Chapel St., Marylebone, London

THE 5-PIN



An anti-microphonic valve holder whose five sockets are designed specially to give an excellent grip contact either with solid or split-pin valves. Many constructors are getting first-class results when using this holder for the new solid four pin valves. Terminals numbered and tinned tags in one piece with grip sockets. Write for the Benjamin Radio Catalogue. **1/9**

THE BENJAMIN ELECTRIC LTD.
Tariff Rd., LONDON, N.17 Tottenham 1500

BENJAMIN

SEND TO-DAY
FOR OUR FREE
36 PAGE
BOOKLET
"SOUND
ADVICE."



Super Power Moving
Coil Speaker.

The Finest
High-grade
Speaker in
the World

PERFECT
RECEPTION FOR
MUSIC LOVERS

BAKER'S
"Selhurst"

RADIO
Offices: 89, Selhurst Rd.,
S. Norwood, S.E.25.
Works: 42, Cherry Orchard
Rd., E. Croydon.

FREE 1931
CATALOGUE
TO CALLERS, BY POST 6d.
VISIT STAND 25
AT OLYMPIA
WILL DAY LTD.,
19, LISLE ST., W.C.2
Regent: 0921-22.

Receivers for Sale.—Contd.

APPLEBY'S.

1919-1931?

SEASON 1930-31.—A comprehensive catalogue of new season's radio apparatus of convenient size for the pocket will shortly be issued; price 9d., post free; as this catalogue will be a pocket guide to modern radio material, it will be in wide demand; those desiring to secure a copy, would greatly assist us by kindly making application now, enclosing 9d. in stamps; a copy will then be forwarded as soon as issued, about the time of the exhibition; the 9d. may be deducted from any following order before the end of 1930, in excess of £1.

PLEASE Apply Early! Please send in your radio material for part exchange credit early—and avoid the rush; it will be a great season, good sets, good components, and fine workmanship.

APPLEBY'S, where radio part exchange began.—Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines). [0340]

BURNEPT Latest Model, Universal Screened Five, for A.C. mains, covers 3 wavelengths, 16-38, 220-560, 900-2100, without coil changing, 3 degrees of selectivity on each wavelength, very powerful; cost £43, bargain, £23/10.—Box 7349, c/o The Wireless World. [1346]

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., 38, Rabone Lane, Smethwick. [8734]

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere, and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226]

TWO 3-valve All-mains Sets, Pye, as brand new, 200-240 volts, list price £25; Philips 230 volts, as new, list price £23; no reasonable offer refused, cash required.—Box 401, c/o The Wireless World. [1402]

WIRELESS World Kilomag Four, to specification, including valves and baseboard, less cabinet, attachment on same panel converting into powerful superhet. for ultra short waves; nearest offer £15.—Box 7396, c/o The Wireless World. [1392]

KIT of Parts for Mullard Orgola Senior, exactly to specification, with baseboard and oak panel, with or without valves; offers wanted also for Marconi moving coil speaker chassis, 6-10-volt model, guaranteed as new.—Ward, "Four Winds," Boscawen. [1393]

FERRANTI S.G.3, speaker, set and batteries contained in handsome oak cabinet; £15, cost £26; buying mains.—Daniel, 14, Sunny Hill, Hendon. [1375]

PRIVATE Sale; each set real value.—Famous McMichael S.G.4 table transportable, month old, £19/10, present price £27/6; Cossor 2-valve Reinartz, in metal cabinet, with valves, £4/15, 14in. attache case 2-valve portable, complete, £5; also many components.—Clark, 8, Blue Hall Mansions, Hammersmith, W.6. [1363]

PHILIPS 2-valve All-electric Receiver, 200v. 50c., only been used few weeks; owner made unforeseen move to D.C. district; absolutely new condition, carrying makers' guarantee; 10 guineas.—Blackburne, Sea Rd., Bexhill. [1365]

ACCUMULATORS—BATTERIES.

ZINCS.—Best quality (wired), No. 1, 8d. per doz.; No. 2, 9d. per doz.; order valued 5/- carriage paid, otherwise 6d. for postage.—British Battery Co., Clarendon Rd., Watford, Herts. [0258]

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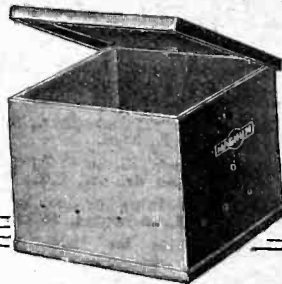
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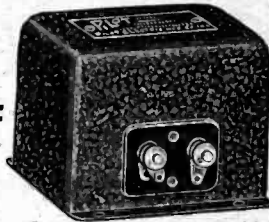
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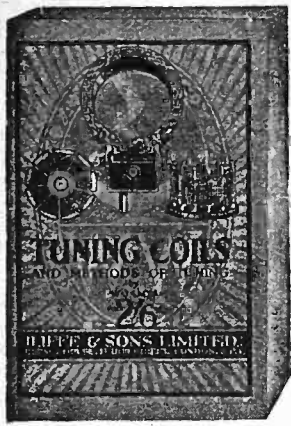
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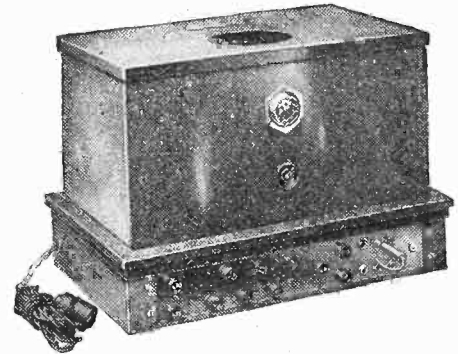
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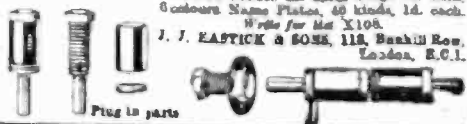
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RADIO HOBBY, HUDDERSFIELD, issues the Reliability Wireless Guide, which will be sent post free upon request by Messrs. J. H. Taylor and Co., 15, Macaulay St., Huddersfield. [7823]

PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228]

LIVERPOOL Amateur's Surplus—Westinghouse rectifier, R422, 16/-; mains transformer for ditto, 210v.-0v., 5/-; H.T. transformer, 210v., 200v. at 50 m.a., 12/-; R.I. transformer, 4/-; 25-1 transformer for M.C. speaker, 5/-; Browns and B.T.H. phones, 3/6 each; Wearite dual range tuner, with reaction, 8/-; 3 tropoformers, 5/- each; Blue Spot pick-up, 10/-; 2 Osram P625As, 7/6 each; Mazda L.F.607, 5/-; Marconi D.E.P.610, 5/-; 2 P.M.3, 4/- each; U4 rectifier, 5/-; U5 rectifier, 7/6; all guaranteed perfect.—Green, 4, Harrow Rd., Wallasey. [1352]

EXPERIMENTER'S Surplus, mostly used; cost over £5, accept £1; postcard for list.—Tetley, 9, Prince Wales Terrace, W.B. [1399]

SIFAM Moving Coil Milliammeter, 12/6; L.T. charger, 10/-; send for list.—F. W. Forshaw, Flixton Rd., Urmoston, Manchester. [1385]

WIRELESS Components for Sale, 6-volt valves, Bionic coils, etc.—Write Morris, 256, St. Helens Rd., Bolton. [1376]

BARGAINS Purchased from Manufacturer Now Out of Business.—Centralab 500,000 ohm volume controls, 3/-; Igranio 10,000 ohm ditto, 2/6; G.E.C. transformers, 3 to 1 ratio, 7/6; R.I. output transformers, ratio 25 to 1, 10/-; Ferranti O.P.M.4 output, 12/6; valve holders, Lotus, Harlie, and W.B. 4- and 5-pin types, 6d. each; Ferranti 8.G. coils, R.F.1 and 2, 10/- pair; Utility new type lever switches, S.P.D.T. 2-, D.P.D.T. 2/6, 3-, 4-, 6-throw 3/- each; Mel-Vick resistances, 500,000 ohms, 6d.; Mullard grid leak type resistances, 10,000, 50,000, 1 meg. and 2 meg. 6d. each; genuine Harlie tone arms and pick-ups, complete, 22/6; Mansbridge condensers, 500-volt test, 1 M.F. 1/6, 2 M.F. 2/-, 4 M.F. 2/6, 6 M.F. 3/6; Blue Spot 66K units, 10/-; a quantity of Zenite vitreous resistance tubes, various ohmage values, 2/6 each; black and mahogany finish 1 1/2 in. pointer knobs, 1/2 in. hole, 2d. each; 100-volt A.C. eliminator for H.T. L.T. and grid bias, Met Vick, 50/-; B.T.H. tone arms, less pick-up, 7/6; Igranio pick-up, 12/6; Edison Bell pick-up, 6/-; Thorens double spring gramophone motors, 25/-; Ediswan loud-speaker units, 7/6; 6 in. x 3 in. ribbed ebonite formers, 1/-; Harlie moving coil loud-speakers, 100-volt field, 30/-; double linen loud-speakers, approximately 19 in. x 14 in., fitted with genuine ultra units, 40/-; mains transformers at less than one-third cost, 200-350-volt, 300-0-300 volta, 7 1/2-volt 2 amp., 4-volt 2 amp., 4-volt 3 amp., 30/-; ditto, for 25 cycles, 32/6; all centre tapped; mains transformers, 200-250 volta, 200-0-200, 4 volta 3 amp., 4 volta, 25/-; heavy type smoothing chokes, 15/-; Superitone Talkie pick-up and tone arm, 35/-; carriage paid all orders over £1; highly polished mahogany finish ebonite panels, drilled and engraved, various sizes, 1/- each.—Hughes, 149, Chepstow Rd., Newport, Mon. [1372]

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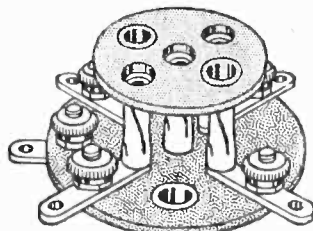
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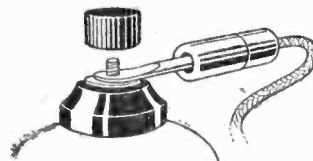


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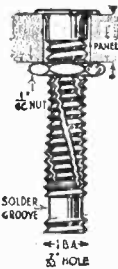
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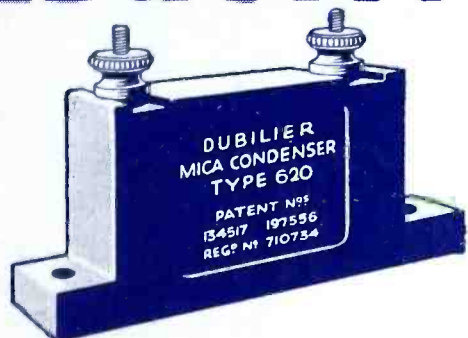
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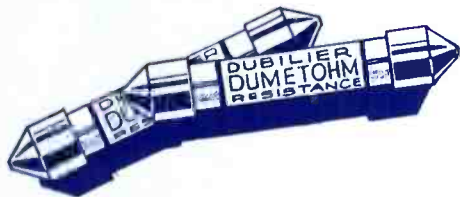
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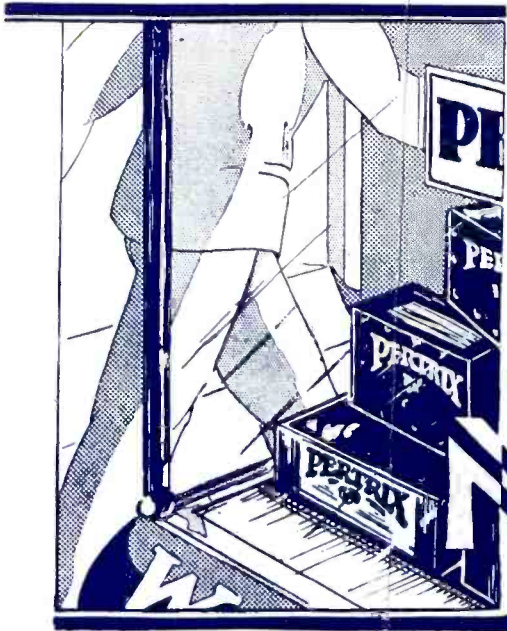
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