RADIO and ELECTRICAL Review

TELEVISION - COMMUNICATIONS - SERVICE - SOUND

Incorporating "RADIO and ELECTRONICS"

SEPTEMBER, 1st 1955

VOL. 10, NO. 7

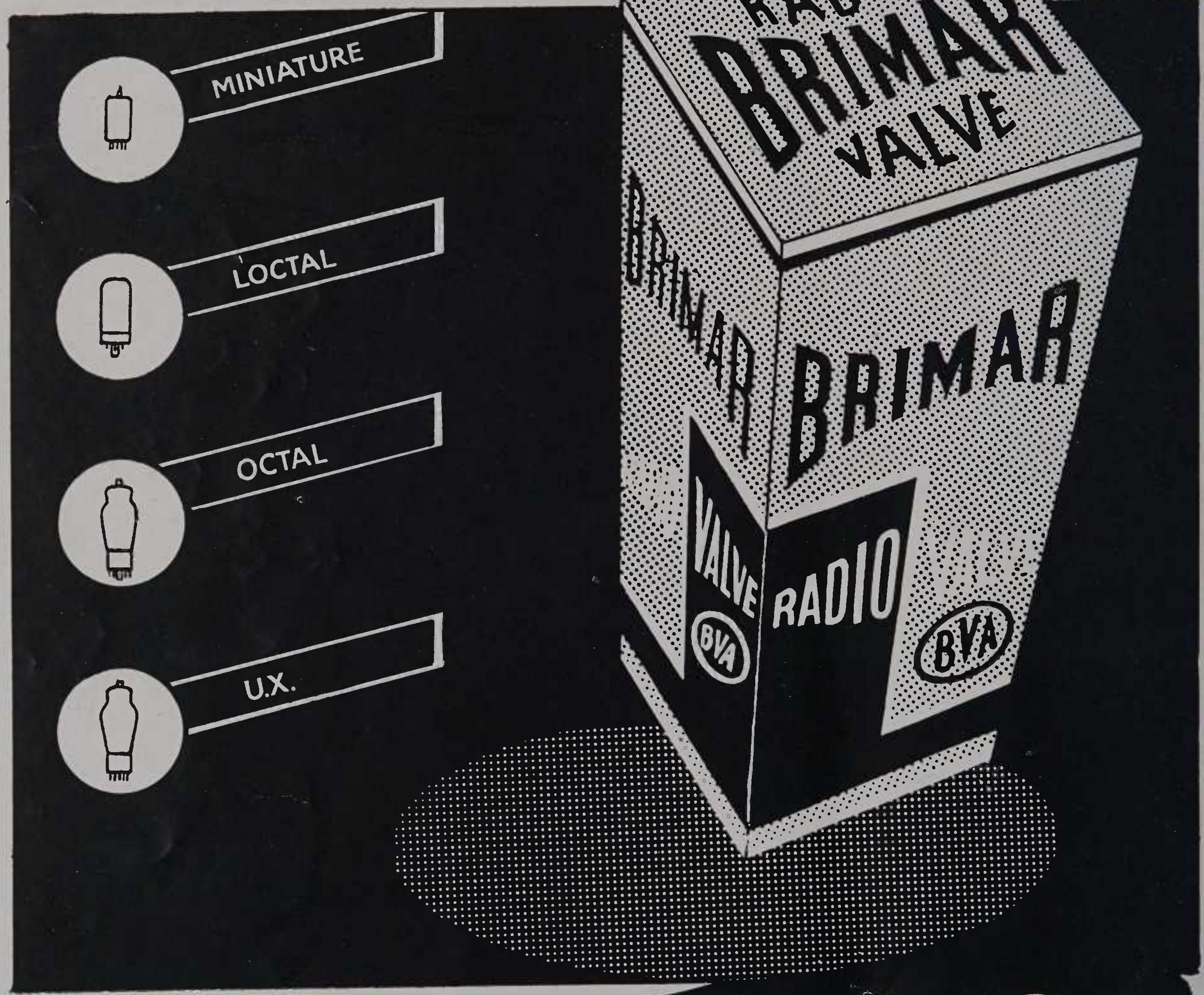
PRICE 1/10

BRITISH MADE

There's a BRIMAR replacement

RADIO VALVES

for every position



Now is the time to *BRIMARIZE

STANDARD TELEPHONES & CABLES PTY. LTD.

AUCKLAND	WELLINGTON		CHRISTCHURCH	WANGANUI
BOX 571	BOX 593	STC	BOX 983	BOX 293

Radio and Electrical Review

VOL. 10, No. 7 SEPTEMBER 1st, 1955

OUR COVER:

Operator working in Dust-free Special Valve Assembly Rooms at Research Laboratory of General Electric Co. Ltd., England. See story on page 31.

Official Journal of
The N.Z. Electronics Institute (Inc.).
The N.Z. Radio and Television Manufacturers' Federation.
The N.Z. Radio and Electrical Traders' Federation.
N.Z. Radio, TV and Electrical Assn. (Inc.).

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Advertising Manageress:
Miss D. JAMIESON

Subscriptions:
1s. 10d. per copy; 23s. 6d. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
All correspondence and contributions should be addressed to:

The Editor,
"Radio and Electrical Review,"
P.O. Box 8022,
Wellington, N.Z.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.), Ltd.,
46 Mercer Street, Wellington.
Telephone, Wellington, 70-216.
Telegrams and Cables:
"Radel," Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., 28 New Bridge Street, London, E.C.4.
Telephone City 5118.
Cables: Cowlawads Cent, London.

Contents

	Page
Editorial	15
Audio: Response Compensation for L/P Records	16
Canadian Trade Shows	18
Circuits for the Experimenter: Useful Low-level Modulator Circuits	19
Book Review: "Simple Electronic Musical Instruments" by Alan Douglas	20
Tape Recorder Servicing: by P. G. Read	21
Dividing Networks for Loudspeakers—Part 2	24
N.Z.A.R.T. Notes	27
Philips Experimenter No. 95: A Portable Transmitter-Receiver for the 160 Metre Band, Part 3	28
Missing and Stolen Radios	30
Assembling Special Valves Under Dust-free Conditions	31
Record Talk, by John Gray	32
Publications Received	33
Commencement of Electrical and Trade Section	35
Tubular Heating Elements	35
New Products Price Corrections	37
New Products	38
Dry Battery Technotes: No. 1: Shelf Life	42
The New Zealand Electronics Institute (Inc.)	42
The Editor's Opinion: The B-J Pick-up Arm	43
Trade Winds	44
For the Technician: Erection and Maintenance Instructions for Xpelair Window Fans	46

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

PRINTED BY HARRY H. TOMBS, LTD., WINGFIELD STREET, WELLINGTON.

Now Made in New Zealand

to the most stringent Australian Specifications

A full range of ROLA

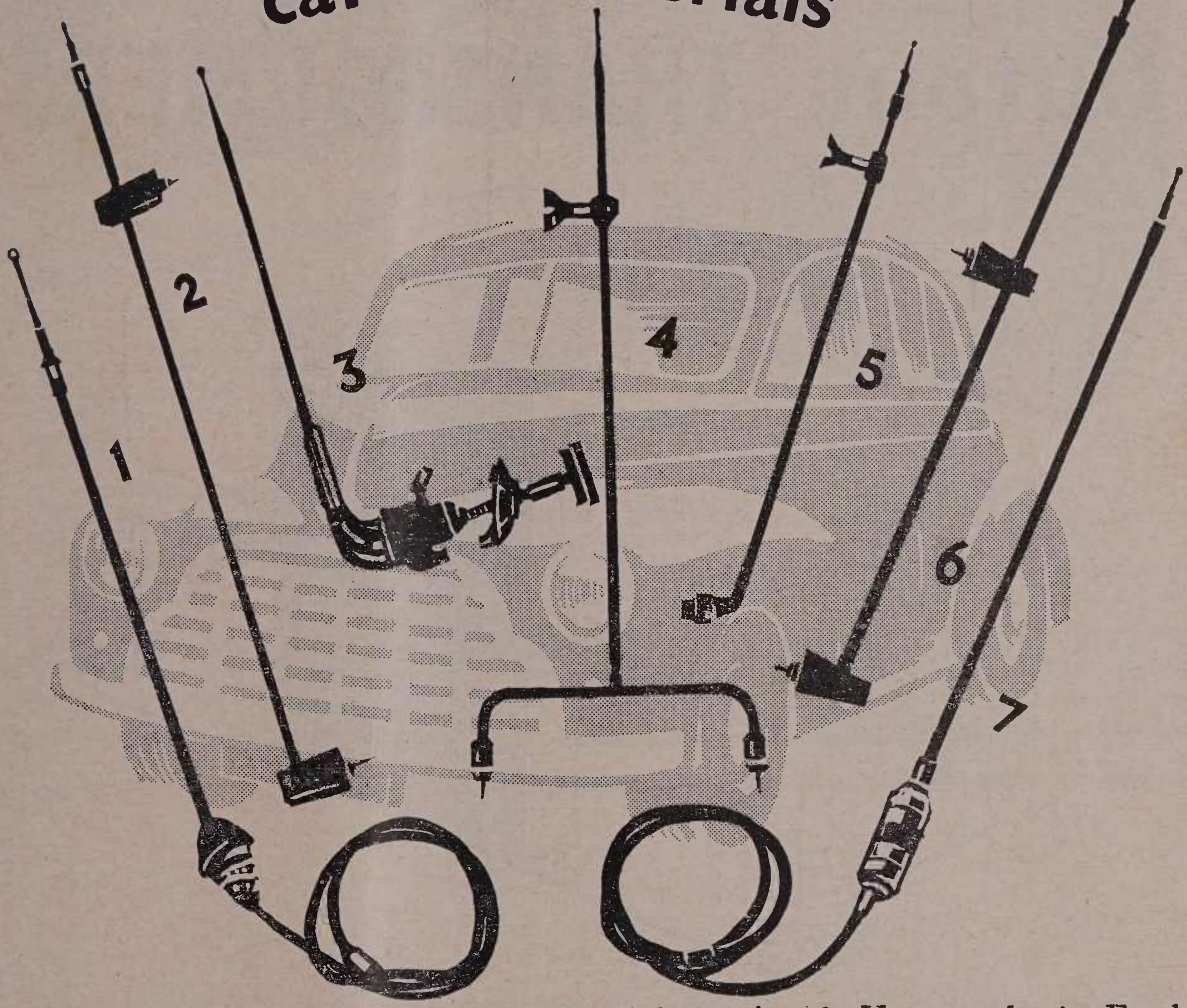
Concert Type 12 inch Loudspeakers

Full Technical Details from

LOUDSPEAKERS (N.Z.) LTD. KENT TERRACE WELLINGTON

FERRIS

car radio aerials



1. Top Cowl. 2. 9 ft. 3-piece, Side Telescopic. 3. Vanguard. 4. Ford Mercury, Windscreen. 5. 3-piece Windscreen. 6. Standard 3-piece, Side Telescopic. 7. Fender.

The Ferris range carries an aerial for every type of car. Staunchly constructed in brass, with high-quality chrome-plated finish . . . and when properly fitted, completely rattle-free. Each type is available with both three and four-feet lead-ins.

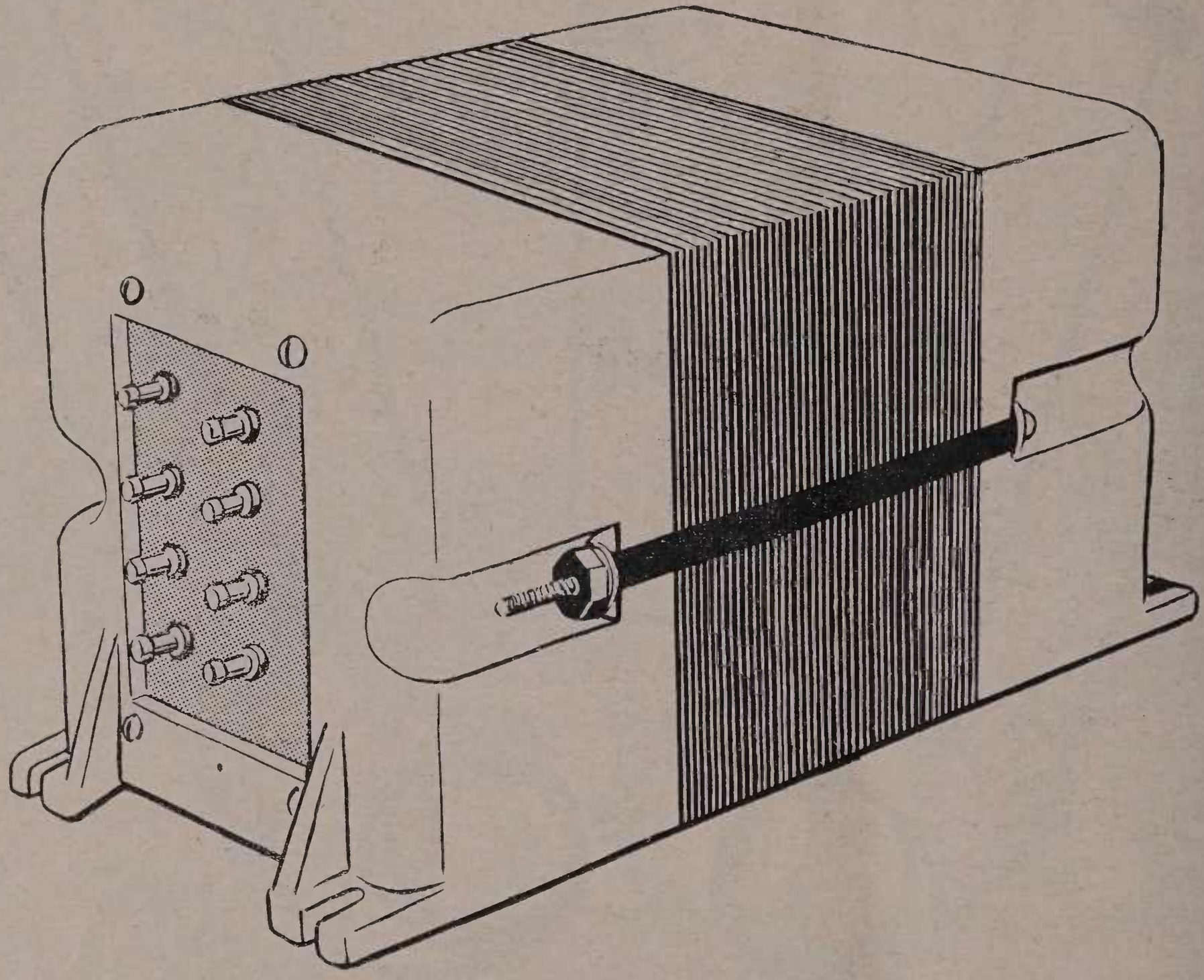
Competitively priced, Ferris can bring you big business with a comparatively low stock range of car aerials.

SOLE NEW ZEALAND AGENTS:

TURNBULL and JONES LTD.

Auckland Wellington Christchurch Dunedin Hamilton Palmerston North Invercargill and Nelson

ULTRALINEAR
Output TRANSFORMERS



Considerable interest has recently been taken in the American ultralinear version of the famous Williamson Amplifier. A reduction in distortion and an increase in power output over that of the Williamson Amplifier has been claimed by the originators of the circuit. As in the Williamson Amplifier, a major part is played by the design and construction of the output transformer. BEACON makes a transformer rated at 30 watts which will work well when used in an ultralinear circuit. Screen taps are available so that push-pull KT66 valves, or similar types, may be used as pentodes with a sharing of load between screens and plates. The frequency response over the audio frequency band is excellent. We recommend this transformer for use in amplifiers where greater power output than that obtainable from the normal Williamson Amplifier is required. Cat. No. 53S66, 30-watt ultralinear output transformer, 6,600 ohms P to P to 1-4-9-16 ohms.

PHYSICAL DIMENSIONS

Width	Length	Height
$3\frac{3}{4}$ in.	7 in.	$4\frac{5}{8}$ in.

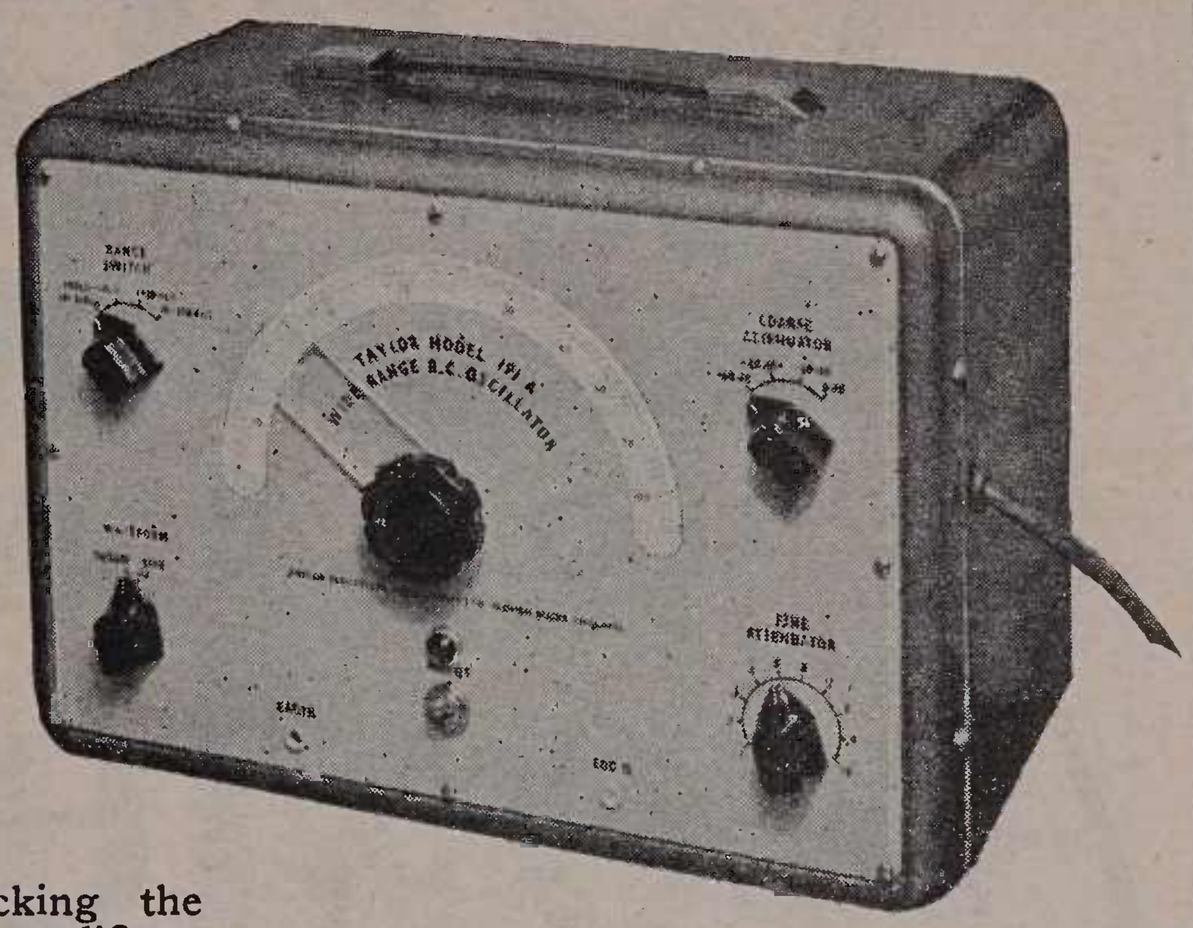
Mounting Centres	Weight
$6\frac{3}{8}$ in. x 3 in.	12 lb.

BEACON RADIO LIMITED

Corner BROWN and FITZROY STS. PONSONBY, AUCKLAND. P.O. BOX 2757. TELEPHONES 14-704 13-390

MANUFACTURERS OF ALL KINDS OF
TRANSFORMERS AND FLUORESCENT LAMP BALLASTS

Taylor



WIDE-RANGE R.C. OSCILLATOR

This instrument generates sine and square waves of exceptionally good waveform over the wide frequency range of 10 c/s. to 100 Kc/s., and provides a convenient source of voltage or low power for checking the frequency and transient response of amplifiers, transformers, loud speakers, etc.

It embodies a conventional Wien bridge type of R.C. Oscillator circuit, thermistor stabilized to give a pure sine wave form of practically constant amplitude at all frequencies within the range of the instrument.

MODEL 191A measures only 12½ in. x 8½ in. x 6 in. and weighs 16 lb. 6 oz.

New Zealand Agents:

A. R. HARRIS COMPANY LIMITED

74-76 MANCHESTER STREET • CHRISTCHURCH • C.P.O. BOX 1007.

NEW LINES

A Sample of the Components continually coming to hand which we trust will be of interest.

"G.C." Inspection Mirrors, 6/- each.

Test Prods and Leads; flexible rubber covered lead and fine-pointed prods; 10/- pair.

Tie Points, standard size; packets of 12 assorted. 3/3 packet.

Tie Points, miniature; packets of 12 assorted. 3/3 packet.

1/8 x 3/8 in. C.P., R.H. Screws; packets of six dozen, 1/9 packet.

3/8 in. Hex. C.P. Nuts; packets of six dozen, 1/9 packet.

Microphone Connectors, 3-pin; "Amphenol" type:
Chassis end, 7/6 each.
Cord end, 8/4 each.

25 ft. Coils Plastic 10/010 Hook-up Wire; assorted colours, 3/3 coil.

"Zeva" 70-watt, angle-bit Soldering Iron, 36/- ea.

"Trio Track" 3-speed Record Players; adjustable speed; with the amazing "self-thinking" pick-up; always starts on the first groove:
With "Ronette" O.V. Cart., £13.
With "Ronette" P. Cart., £13/10/-.

Long-playing Tapes, "B.A.S.F."
Pikkolo 213 ft. 3 in. spool, 17/3.
853 ft. 5 in. spool, £2/11/9
1146 ft. 5¾ in. spool, £2/17/3

Empty Tape Reels, clear plastic:

600 feet	5/6
850 feet	6/–
1200 feet	6/6

Signal Generators, "Grayshaw", A.C. operated; 100 kc/s. to 80 mc/s., £17/12/6

R.C. Bridge, "Grayshaw", 1 ohm to 10 megs., 10 pfd. to 100 mfds., £14/15/-

G.E. X100 Diodes, 3/4 each.

Cards of Transfers; each card has following words, fuse, tone, treble, bass, 78-L.P., volume, microphone, gramophone, speaker, radio, record, playback, selector, on, off; 6d. card.

Milliameters, 0-250 m.a.; moving iron, 29/- each.

Mullard Transistors:

OC50 and OC51	£3/4/– each
OC70 and OC71	£1/18/6 each

Fear's of Willis Street

31 WILLIS STREET, WELLINGTON, P.O. BOX 1243

20,000 ohms per volt

MODEL 8 UNIVERSAL

AvoMeter

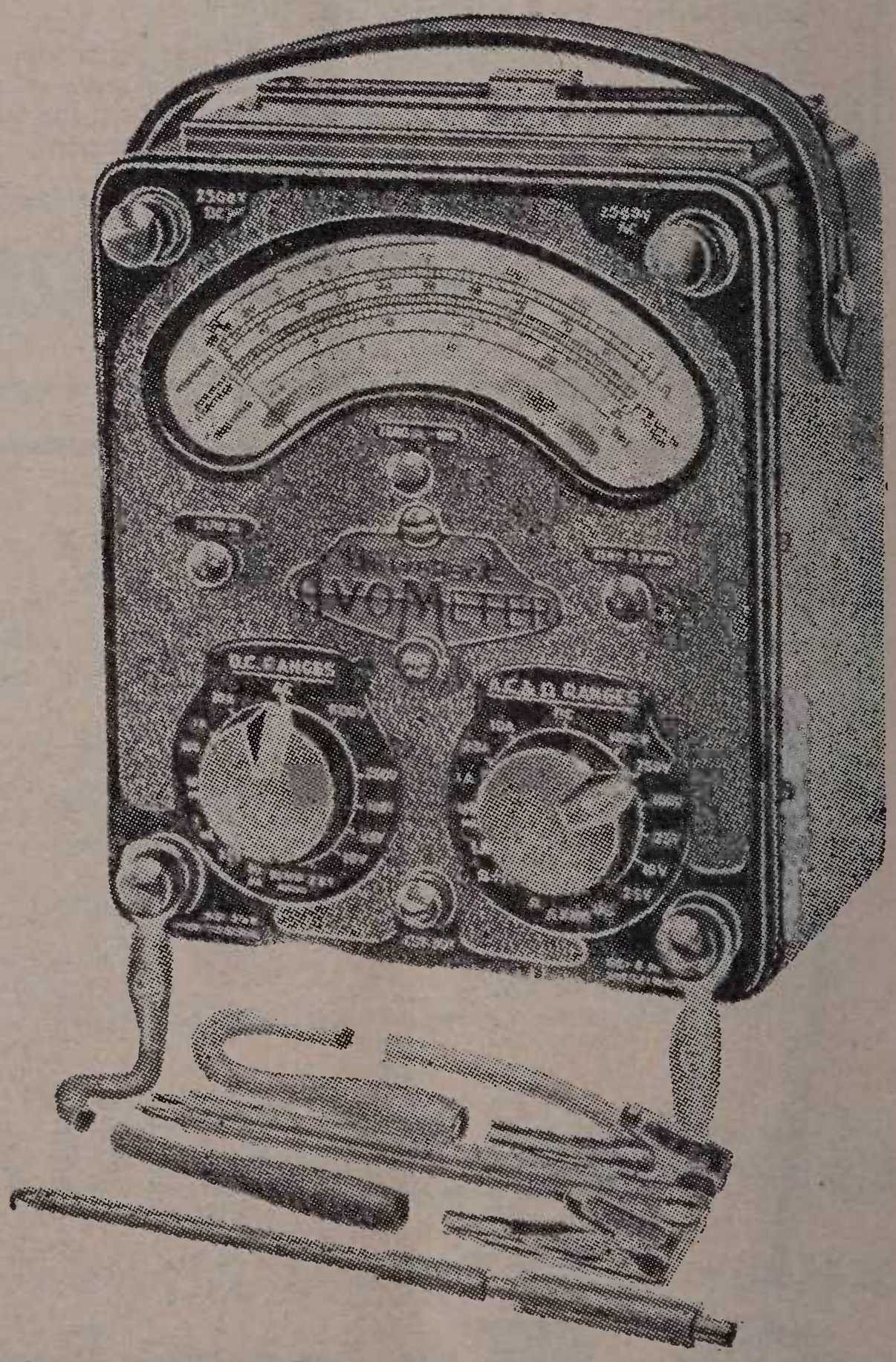
AVO REGD. TRADE MARK

This is a high-sensitivity version of the world-famous Universal AvoMeter, having a sensitivity of 20,000 ohms per volt on all D.C. ranges and 1,000 ohms per volt on A.C. ranges from 100 volts upwards. A decibel scale is provided for audio-frequency tests, also a press button for reversing the movement to obviate the inconvenience of changing over the leads when encountering opposite potentials about a common reference point.

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

D.C. VOLTAGE	D.C. CURRENT	A.C. VOLTAGE
2,500 V	10 A	2,500 V
1,000 V	1 A	1,000 V
250 V	100 mA	250 V
100 V	10 mA	100 V
25 V	1 mA	25 V
10 V	250 mA	10 V
2.5 V	50 mA	2.5 V

A.C. CURRENT	RESISTANCE
10 A	0—200 Megohms
2.5 A	0—20 Megohms
1 A	0—2000 Ohms
100 mA	



Size: 8½ x 7¼ x 4½ in. Weight: 6½lb. (approx.)

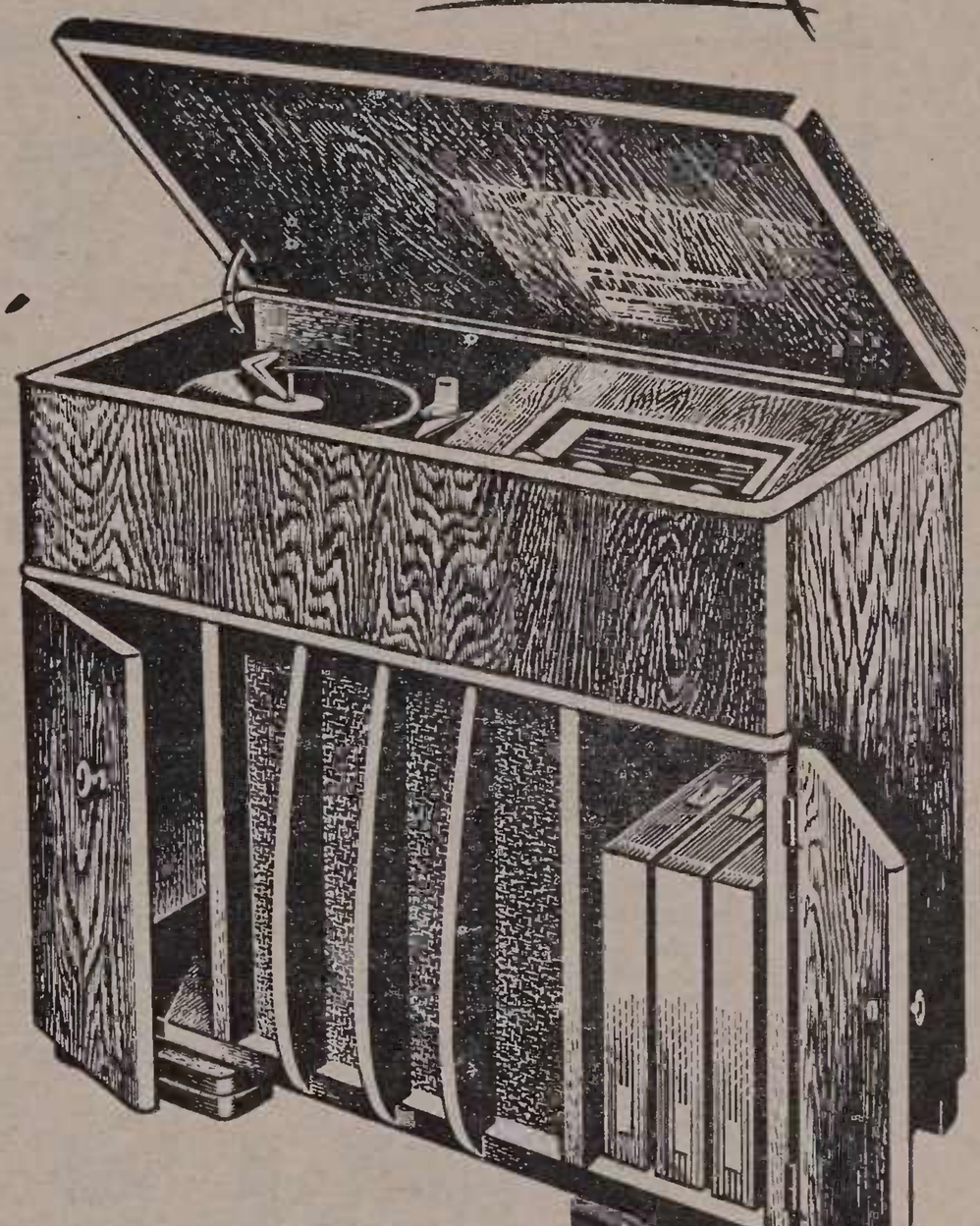
Write for full information to:

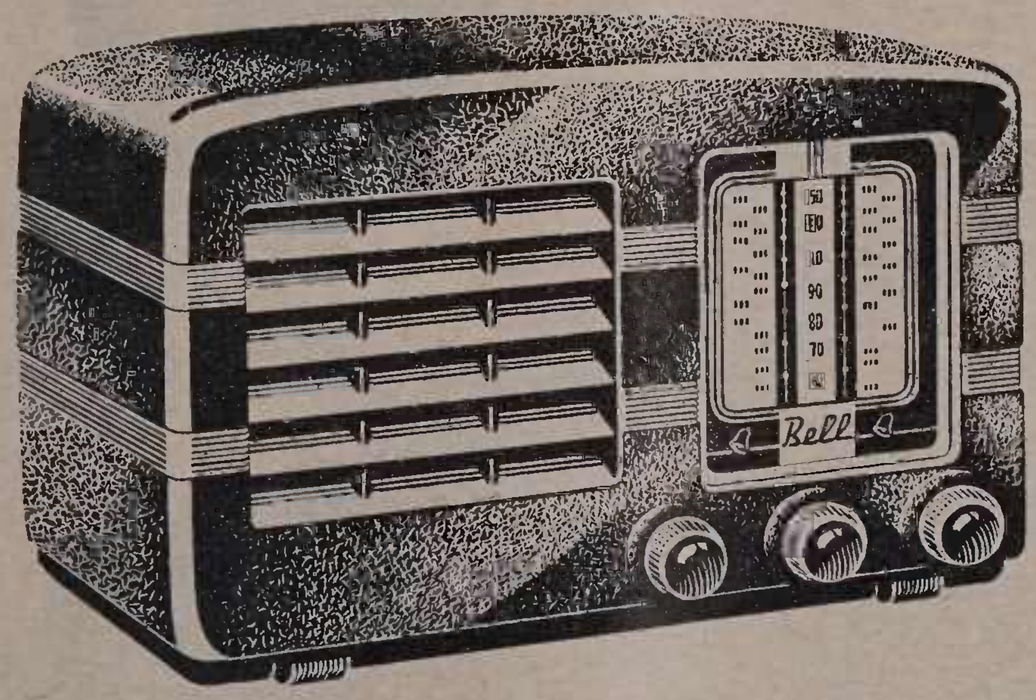
THE NATIONAL ELECTRICAL AND ENGINEERING COMPANY LIMITED

Auckland : Wellington : Christchurch : Dunedin : Hamilton : Wanganui : Hastings : Invercargill

CONSOLE - or mantel

the quality is the same...





POWERFUL 5 VALVE
gives Australian reception with built-in aerial

£13/19/6

All the latest features including variable tone control and floodlit dial. Choose from 4 shades of attractive plastic cabinets.

3 SPEED RADIOGRAM
featuring wide range record reproduction

£66/10/-

A new listening experience awaits you with this superb set. 6 valves, 12" heavy duty speaker, automatic record changer, solid oak cabinet.

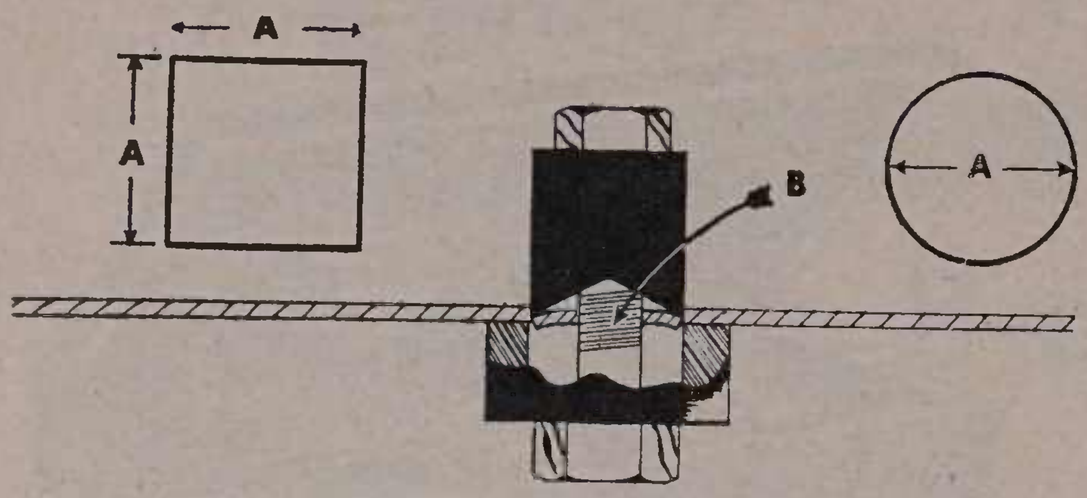
and they're made by

BELL Radio

NOW AT YOUR LOCAL DEALER

BELL RADIO-TELEVISION CORP. LTD., 274 DOMINION RD., AUCKLAND B11

ATTENTION
RADIOSERVICEMAN, ENGINEERS, HOBBYISTS



GREENLEE SOCKET PUNCHES

available at last!

- Large range of sizes from ½ in. to 2¼ in.

  Normal requirements:
  Round type: ½ in., ⅝ in., ¾ in., ⅞ in., 1⅛ in.
  Square type: Specially recommend ¾ in. or 1 in. for I.F. and Transformer work.

- Heavy construction with deep rake on punch.
- Simple to use, efficient, and fully guaranteed.

ORDER NOW WHILE STOCKS LAST!
Trade inquiries invited.

Fred Rothschild & Son

P.O. Box 170 79-83 Pretoria Street, Lower Hutt

TEEVEE RADIO LTD.

For quick service on all Radio Components

JAMES KNIGHT CRYSTALS
TRUVOX P.A. SPEAKERS
SOUNDMASTER TAPE DECK KITS
TAYLOR TEST INSTRUMENTS
ALL PIFCO PRODUCTS
ALL ACOS MICROPHONES AND PICK-UPS
ELECTRIX SELENIUM RECTIFIERS
CONDENSERS, RESISTORS, TRANSFORMERS, BATTERIES, VALVES, POTS., CAR AERIALS.

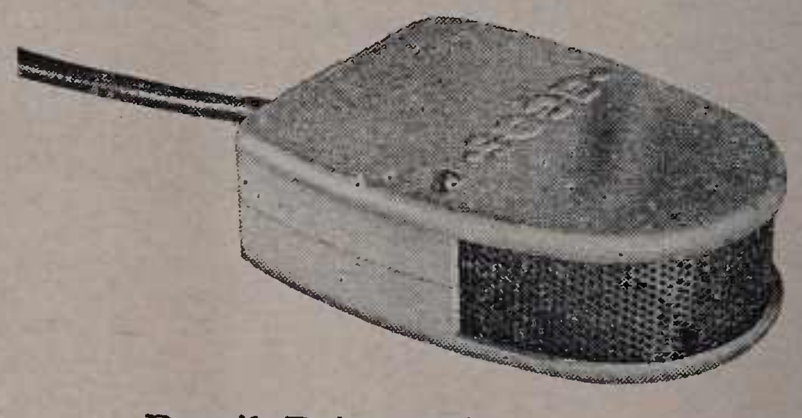
Phone 43-216 — 134 Albert Street, AUCKLAND — P.O. Box 5029

Trade only supplied

acos

Crystal Microphones

Retail Price 77/6.
Acos Type MIC 33-1
Designed for high-quality public address and home recording fields.



Retail Price 42/6.
Acos Type MIC 35-1
General purpose microphone with high sensitivity and substantially flat characteristic.

Acos Type MIC 36 Series High Sensitivity with omnidirectional pickup field. Attractive contemporary design. Alternative models with or without switch and suitable adaptor for floor or table stands

Retail Price 87/6.

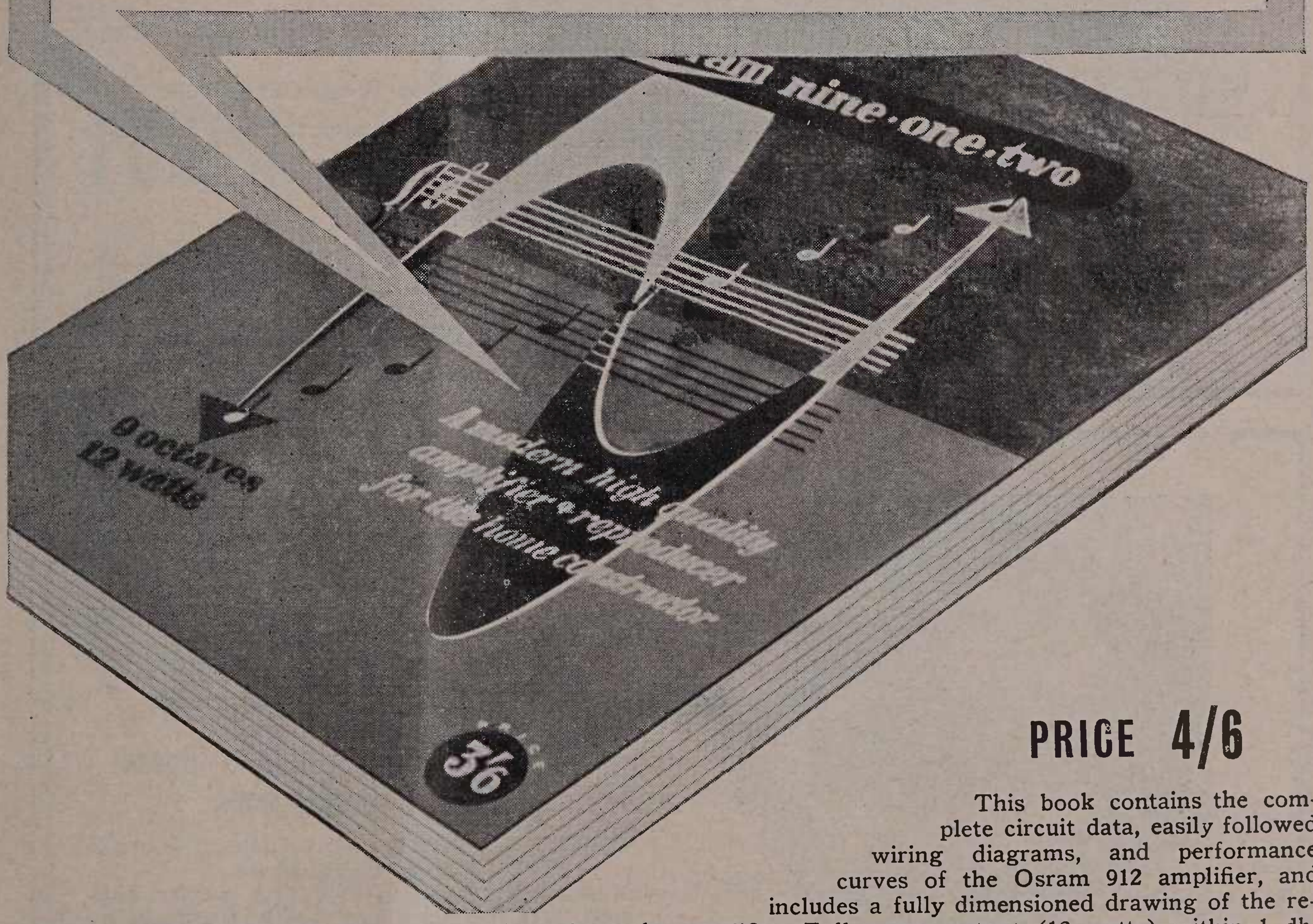
Manufactured by
COSMOCORD LTD.
Enfield, Middlesex, England.
Sole New Zealand Representative:
DAVID J. REID (N.Z.) LTD.
P.O. Box 2630, 271 Victoria St. West, Auckland.

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

THE Osram

"NINE-ONE-TWO"

A book you simply must get!



PRICE 4/6

This book contains the complete circuit data, easily followed wiring diagrams, and performance curves of the Osram 912 amplifier, and includes a fully dimensioned drawing of the renowned octagonal cabinet. Note these points about the amplifier: Full power output (12 watts) within 1 db. from 30,000 to 20,000 cycles/sec. (9 octaves). ★Provision for 4 controls of frequency response (in addition to volume control), to achieve the requirements of "Art" in listening. ★Uses the famous Osram Z729 low-noise pentode, acknowledged to have a lower measured microphony and hum level than any comparable valve in the world. ★Uses new Osram power pentodes type N709 in push-pull "ultra-linear" output stage, with selective feedback. ★Variable "slope" control allows for reduction of surface noise in older cherished records with minimum reduction in higher frequency response.

BRITISH GENERAL ELECTRIC CO. LTD.

Also at HAMILTON, NAPIER, and INVERCARGILL. WELLINGTON, AUCKLAND, CHRISTCHURCH, DUNEDIN.

ROVER RADIOPHONE "Pack Set"

ALREADY IN MASS PRODUCTION! THE LATEST AID IN VHF COMMUNICATIONS!
NEW ZEALAND'S VHF PIONEERS HAVE DESIGNED A LIGHTWEIGHT BATTERY POWERED TRANSMITTER/RECEIVER FOR THE 70 AND 100-MEGACYCLES BANDS.
TWO WAY SPEECH FROM BUILDINGS, FROM HILLSIDES, FROM ANYWHERE!
CONTROLLED FROM THE HANDSET THE "ROVER" CAN BE HAND-CARRIED OR WORN ON THE BACK!

This Great Aid to . . .

POWER BOARDS FIRE BRIGADES
EMERGENCY SQUADS and CIVIL ENGINEERS
IS READY NOW

★ The new "ROVER" is smartly designed to use seven modern tubes and standard dry batteries.
★ The unit measures $3\frac{3}{4}$ x $8\frac{1}{2}$ x $8\frac{1}{2}$ in. Weighs 12 pounds.
★ The aerial is telescopic—pops right into the case instantly.
★ Keeps you in touch—where e'er you walk!

COLLIER & BEALE LTD.

100 DIXON STREET, WELLINGTON

MAKERS OF COMMANDAIR BASE STATIONS, AIRLANE AND AIRCOM MOBILE SETS AND ROVER PACKSETS

A TRADE WINNER . . .
. . . for SOUND Reasons!

"REGENTONE"

Self-Contained Portable 3-Speed Electric Gramophone

The REGENTONE Self-Contained Portable Electric Gramophone

Music lovers are discriminating people. They make sure that their fine quality recordings are faithfully reproduced and that is why they choose REGENTONE electric gramophones. Make sure you have Regentone stocks on hand when your customers inquire! Every model in the Regentone range is designed to give high quality reproduction and tonal purity, and these factors combined with elegant appearance, portability and reasonable price make

REGENTONE

electric gramophones the automatic choice.

REGENTONE PORTABLE MODELS AVAILABLE

(1) B.S.R. 3-speed Unit in attractive scratch-proof carrying case .. .. .. Retail £10 19s. 6d.
(2) B.S.R. 3-speed Unit with rectifier and dual purpose valve amplifier and speaker .. Retail £18 12s. 6d.
(3) B.S.R. 3-speed Automatic Changer (Collaro) Model. HANDY-GRAM, with 3-valve amplifier and speaker .. .. Retail £26 17s. 6d.

TRADE INQUIRIES TO NEW ZEALAND REPRESENTATIVES:

DIRECT IMPORTS (N.Z.) LTD., P.O. BOX 72, HASTINGS [D14.55]

PUBLIC ADDRESS ENGINEERS

PUBLIC ADDRESS ENGINEERS

Here are the names to remember when you order new equipment:

TANNOY POWER LOUDSPEAKERS

RESLO P.A. SPEAKERS

RONETTE ALL-PURPOSE MICROPHONES

All available ex stock

Write, phone, or call

GREEN & COOPER LTD.

43 LOWER TARANAKI STREET, WELLINGTON

Phone 54-418

Telegrams: "Fidelatone"

7-range clip-on ammeters and volt-ammeters

Solid leather Carrying Case can be supplied at an extra price.

7-RANGE CLIP-ON AMMETER
TYPE 'A'

0-10-25-50-100-250-500-1000 AMPS.
Write for list IN.17A.

7-RANGE CLIP-ON VOLT-AMMETER
TYPE 'V'

0-10-25-50-100-250-1000 AMPS. and
0-150-600 VOLTS (or 0-250-500 VOLTS).
Write for list IN.17V.

SPECIAL FEATURES

SEVEN RANGES.—With single hand operation and thumb-operated selector switch with positive positions.

SAFE.—Can be used with complete safety on bare conductors up to 600 volts A.C. without fear of shock or risk of short-circuiting the conductor to an adjacent conductor or to earth. All metal parts except the actual magnetic contact surfaces are fully insulated.

ACCURACY.—Within 3% of full scale on all ranges. Variation of the position of the conductor from a central position in the frame has only a very small effect on the reading.

GOOD DAMPING.—Assured by the use of a rectifier type moving coil instrument.

SAFETY GLASS.—The dial is protected by a toughened glass.

FERRANTI

FERRANTI LTD.

Sole New Zealand Agents:

ARTHUR D. RILEY & CO. LTD.

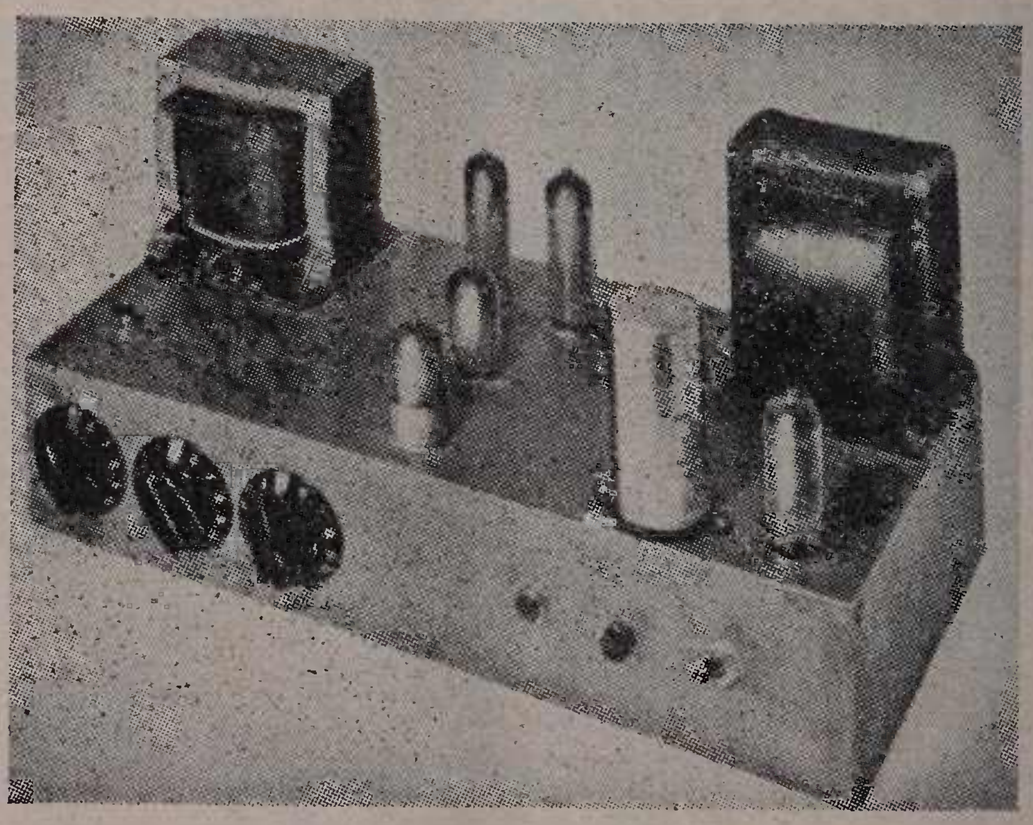
68 THE TERRACE, WELLINGTON.
Also at HOBSON STREET, AUCKLAND.

South Island Representatives:
R. REDPATH, 256 St. Asaph Street, Chrstchurch.

Mullard

5/10 HIGH QUALITY AMPLIFIER

Employing tubes specially developed for amplifier purposes



RADIO CONSTRUCTORS—Build this new and economical MULLARD AMPLIFIER

Circuit and full details of design, performance, tone control, output transformer and valve data, together with introductory notes on playback equipment, including equalization networks given in 86-page booklet

"MULLARD 5-VALVE 10-WATT HIGH QUALITY AMPLIFIER CIRCUIT"

Price 3/6

Obtainable from local radio dealer or direct from New Zealand Distributors:

C. & A. ODLIN TIMBER and HARDWARE CO. LTD.

P.O. BOX 1995 WELLINGTON.

"MUSTS" *for the* LIBRARY

RADIOTRON DESIGNER'S HANDBOOK—4th Edition

1500 pages; 1000 illustrations; size 8¼ in. x 5½ in. Edited by F. Langford-Smith, this is a comprehensive self-explanatory reference handbook for all interested in the design and application of radio receivers or audio amplifiers.

PRICE 55s. (Plus 2s. 6d. for postage)

R. C. A. RECEIVING TUBE MANUAL

320 pages; fully illustrated; size 8¼ in. x 5½ in. Published by the Tube Division, Radio Corporation of America Inc., this Manual contains comprehensive valve data specially prepared for engineers, service technicians, experimenters, students, radio amateurs, and all interested in electron tubes.

PRICE 7s.

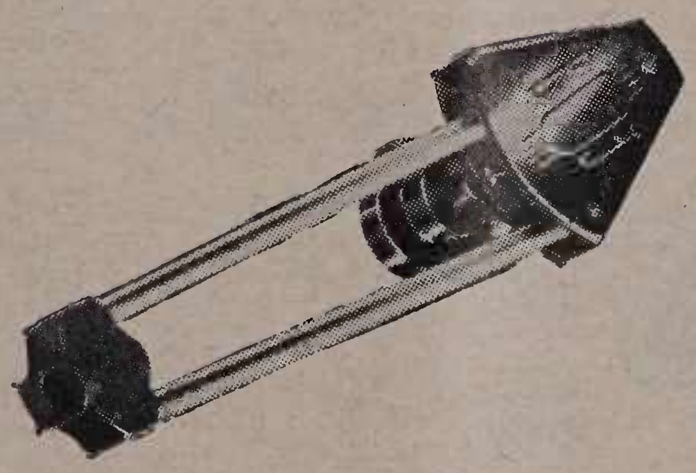
Obtainable from

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

P.O. Box 830, Wellington P.O. Box 1363, Auckland P.O. Box 2084, Christchurch

---

TANGENTIALITY with the B-J ARM



means

Perfect Tracking
Less Distortion
Less Wear
Less Noise

For use with Decca, Acos, and Chancery Heads

NEW ZEALAND DISTRIBUTORS:

A. G. LAWFORD & CO.

P.O. BOX 29, ARAMOHO
160 SOMME PARADE, WANGANUI

NOW—A BETTER, FASTER, MORE COMPLETE SERVICE TO THE RADIO AND ELECTRICAL DEALER

RADIO PARTS, VALVES, TRANSFORMERS, SPEAKERS, RECORD-PLAYING EQUIPMENT, ELECTRICAL APPLIANCES, and FITTINGS, Etc.

LEADING MANUFACTURERS REPRESENTED—CHECK WITH US FIRST—PROMPT DELIVERY TO ANY TOWN OR CITY IN NEW ZEALAND

S. C. DAVISON LTD.

WHOLESALERS & IMPORTERS,
P.O. Box 279 — Palmerston North — 323A Main St.

TAPE RECORDER ENTHUSIASTS

Surplus Stock Greatly Reduced to Clear

Heads: Bradmatic 6RP	.. .. ..	£3 19 0
5E	.. .. ..	£3 7 6
Burgoyne RP	.. .. ..	£2 0 0
E	.. ..	£1 10 0
Motors, BTH 4-pole	.. ..	£2 2 6
Head Covers, plastic	.. ..	5 0

Postage Free

FACSIMILE RECORDERS LTD.

159 St. Johns Road, Remuera,
AUCKLAND

TELL YOUR CUSTOMERS THAT COLLARO MAKES *GOOD SOUND* AND *GOOD SENSE* TOO

Your customer buys good records so that he can enjoy good sound. He fondles these records, and handles them ever so gently, because he knows that once the surfaces are marred, the quality will be gone forever.

He must realize then, that his record changer becomes an all-important factor in the matter of record quality. It must treat your records even more gently than he could himself, and it must contribute nothing which might impair the quality of the sound. Its tone arm must track at light stylus pressures and with free lateral compliance to protect the groove walls from wear. Its speed must be constant for correctness of pitch, and to avoid "wow". It must be free from rumble, and from audible resonances. It must retain and reproduce all of the quality in the record, protect it for future plays, and it must contribute no distortions of its own.

In the light of these requirements, examine the features of the COLLARO, and see if they don't meet all the exacting specifications that make this

The HIGH FIDELITY Record Changer for HIGH FIDELITY Reproduction

Only COLLARO has all these HIGH-FIDELITY features:

Intermixes 10 and 12 inch records at all speeds. Steady, Constant Speeds — No rumble or Wow.

Weighted, Rubber-matted, rim-driven Turntable. Four-pole motor with Self-aligning Oilite Bearings.

No Hum Pickup. Moulded Rubber Drives—No belts to slip or replace.

Automatic Muting Switch.

Stylus Pressure Adjustment—tracks at as little as 3 grams.

Absolutely jam-proof operation.

Ball-bearing mounted Turntable and Tone Arm.

Automatic shut-off after last record.

Tone Arm Clamp for Portable applications. Base dimensions:
$14\frac{3}{4}$ in. x $12\frac{1}{4}$ in.

Depth below Base:
$2\frac{1}{2}$ in.

STOCKED BY LEADING RADIO RETAILERS EVERYWHERE.

New Zealand Distributors:

RUSSELL IMPORT CO. LTD.

P.O. BOX 102 - - WELLINGTON

Collaro

FULLY AUTOMATIC

3-SPEED RECORD CHANGERS

for 7, 10 and 12 inch Records

THE CRYSTAL BALL

Ever since it first appeared, the transistor has stimulated a good deal of crystal-gazing on the part of engineers the world over, and one can pick up almost any technical periodical at all, these days, and find some reference to new applications for the new "wonder." It is easy to shrug off some of these predictions as being almost figments of the science-fiction writer's imagination, but it is dangerous to do so. Only too often one finds that what has been predicted yesterday as a scientific possibility has been turned over-night into reality! For example, how long ago would the idea of self-contained radio stations, powered directly by sunlight, have been greeted with politely raised eyebrows, at the very least? And yet such a device has already been produced, so rapid have been recent advances in techniques, the possibility of which arrived only a few short years ago.

In a recent issue of *Radio and Television News,* Mr. Oliver Read discusses the possibility of making transistorized car radio receivers. His article is based not on hypothetical equipment which may or may not be available in an unspecified period of time, but on transistors and components that exist today, and it does seem that, in making the suggestion, Mr. Read has hit upon a transistor application that is almost as desirable from the user's point of view as is the transistorized hearing-aid amplifier. One does not need to apply much imagination to realize what an excellent thing a transistor car radio would be. It would be powered directly from the vehicle's ignition battery, and would have a current drain measured in milliamps, as against amperes for existing sets. It would eliminate the whole conventional vibrator H.T. supply, with its attendant difficulties, such as "hash," and relatively short life. It could conceivably eliminate the audio output transformer, and yet deliver as much audio power to an ordinary moving-coil speaker as do valves, but with vastly improved efficiency. Reliability would be greatly improved, as transistors do not suffer from microphonics, and because all components would be operating at low voltages. Even without the development of specially small associated components, compactness would be greatly improved, mostly on account of the fact that there would be almost no heat to dissipate from inside the set. Present indications of the life-expectancy of transistors are such that it appears possible to count on few, if any, transistor replacements within the life of the set, which itself should outlast the car in which it is installed.

This list of possible advantages is sufficiently impressive to make one regret the fact that, in this country, suitable transistors for all the necessary functions are not available, even if they are in other places—notably in the U.S.A. While it is true that transistors are still expensive compared with valves, it is also true that transistor circuits, once developed, are so simple, and contain so few component parts, that even today the use of transistors can be economic from the manufacturer's point of view. It is this fact that places what appear to be engineers' dreams much closer to actuality than many people will credit. One thing is certain—namely, that no radio manufacturer today can afford to leave transistors out of his calculations altogether, the race for developing new and better products being what it is. By the same token, some time and effort spent in consulting the crystal ball (from a strictly engineering standpoint) is certainly not wasted.

A REVOLUTIONARY LOUD-SPEAKER

If there is one sphere of human endeavour that gives the lie more often than another to the old saying that there is nothing new under the sun, it is the electronic industry. We wonder how many of our readers have given more than a passing glance at a series of articles currently running in our contemporary, *Wireless World,* describing new developments in the field of electrostatic loudspeakers. The electrostatic speaker is not itself a new device, commercial examples having been in existence at one time or another over a long period, and the principle has certain technical advantages. These have hitherto remained almost unexploited, mainly because of a fundamental limitation in the device. The trouble is that, unless the moving diaphragm is strictly limited as to its amplitude of movement, the old type of electrostatic speaker is inherently non-linear, which simply means that it is a producer of distortion. A certain amount of this can be avoided by constructing the speaker in a push-pull manner, and feeding it in this way, but, even when this is done, the law of the device is still non-linear. However, by applying fundamental theory to the electrostatic principle, Williamson and Walker have discovered an exceedingly simple and elegant means of modifying the instrument in such a way as to remove at one stroke its basic disability. In this way, these two engineers have devised something that really is new, and for which they make a claim that is nothing short of astounding. It is, moreover, supported by the evidence of measurements actually made on developmental speakers embodying the new idea. What is it? Nothing less than that a speaker has been produced whose distortion can be made as low as that of a good modern amplifier—namely, of the order of one-tenth of 1 per cent.

This is news indeed, for hitherto, not only has the loudspeaker been the weakest link in the audio chain, but it has been such by quite a substantial degree. If the fruits of the development work are fully grown, then it seems that we will be indebted to Mr. Williamson and his co-worker for a great deal more than merely having demonstrated that amplifiers may be built with very low distortion levels. The new loudspeaker may well revolutionize the whole business of electrical reproduction of sound.

Audio

RESPONSE COMPENSATION FOR L/P RECORDS

Many amplifiers, commercial and otherwise, go to great lengths to provide individual compensation for a large number of different recording characteristics. This article discusses the problem of record compensation, and points ihe conclusion that all this trouble is quite unjustified, since identical results can be obtained much more simply.

INTRODUCTION

Ever since the introduction of the long-playing record, makers and users of high-quality record-reproducing equipment have been very concerned to ensure that the frequency response of the playing gear should match the curve with which the records are made. This is very natural, and displays a laudable ambition to have everything as "right" as possible. No one would suggest that it is possible to obtain even passable results from records without compensating for the fact that they are not made with a flat frequency response. The trouble starts when it is realized that there are a very large number of recording characteristics, and that, in theory at least, one ought to have a different playback curve for each type of record.

It is understandable, therefore, that the makers of commercial amplifying equipment should have been at some pains to cater for those who hold the view that nothing short of individual compensation for each recording characteristic is essential. What is less understandable is that so many people actually do subscribe to this view. At first sight, to express a contrary one might seem like heresy, especially to the perfectionist, but this is an imperfect world at best, and one of its undoubted imperfections, especially from the point of view of the purist, is that theoretical considerations can often be over-ridden by practical ones, allied to plain common sense.

Now, in our opinion, obtaining first-class reproduction from gramophone records is a difficult and costly enough business already, without surrounding it with difficulties and requirements which are based on false premises. In short, there is a great deal of nonsense talked and written on the technical aspects of the subject, and it is time that some of it was exposed. We strongly suspect that the use of unnecessarily complicated equipment often arises from a kind of technical snobbery—a case not merely of keeping up with, but of going one better than the Joneses. In other cases, there is a genuine, if mistaken, belief that if certain people, who presumably know what they are about, think that a complicated system is necessary, then no simple system is likely to be satisfactory.

However this may be, the fact remains that compensation for record characteristics can be properly done in a very simple manner, there being no need at all for a large number of play-back curves to be available in the reproducing equipment.

A POPULAR FALLACY

As we have already said, the belief that for every recording characteristic there must be a complementary play-back curve is based on a fallacy, and this in turn arises from a false premise, which is that all the various recording curves are so different that a single play-back curve, which may not fit any of them exactly, would not result in an overall response which was a close enough approximation to the flat one which is universally regarded as the ideal.

In point of fact, the differences between the various recording curves are not very pronounced at all, especially inside the range 150 c/sec. to 10,000 c/sec., with the result that it is quite possible to play a record with the "wrong" play-back curve without any marked effect on the resulting sound.

Now we quite expect a number of people to disagree with this statement, which at all events needs something by way of proof. Accordingly, we have drawn a number of manufacturers' recording curves to the same scale, in order to show just what the differences amount to.

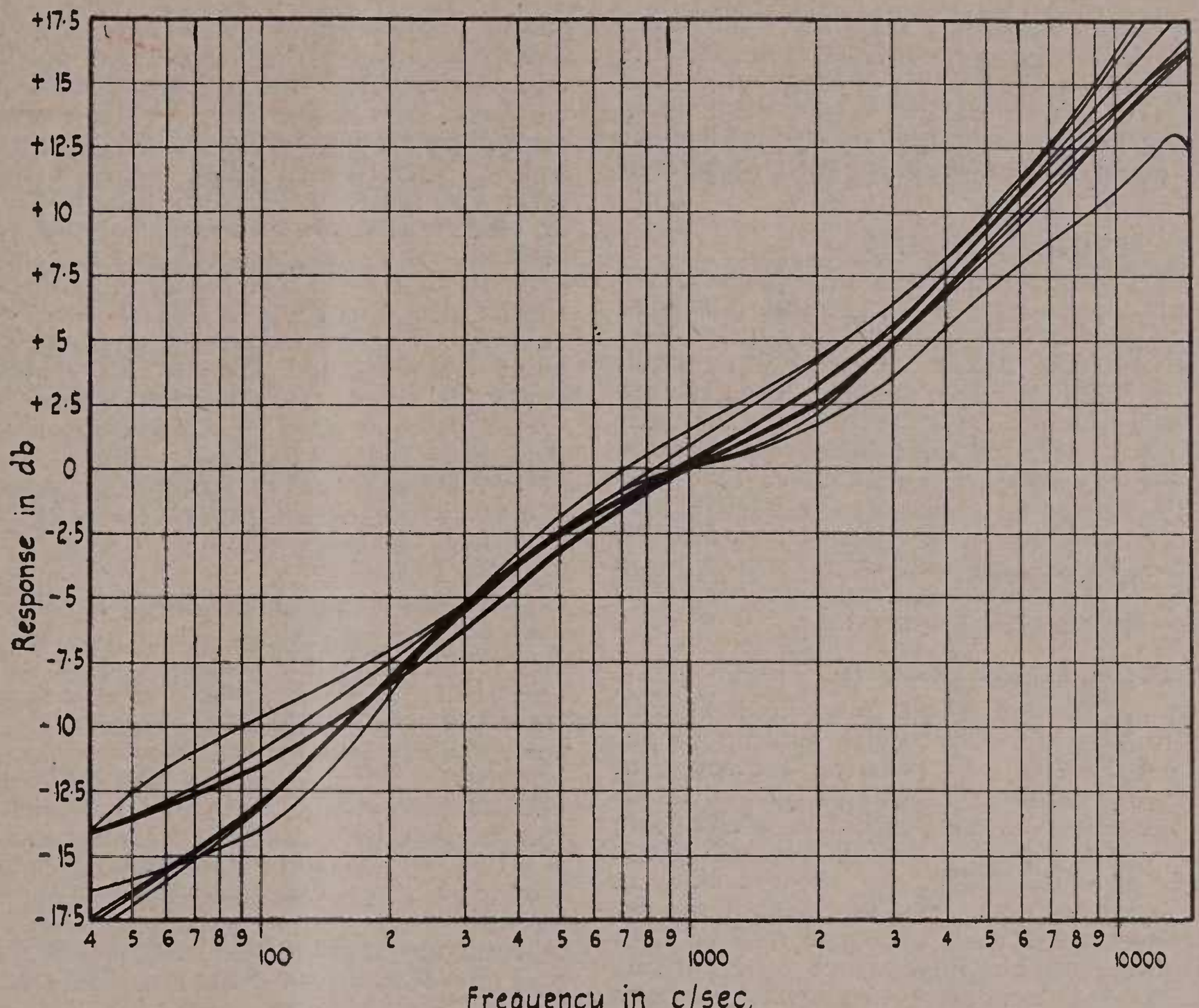
PRACTICAL DIFFERENCES BETWEEN RECORDING CURVES

It is immediately obvious that the greatest differences occur at frequencies below 200 c/sec. For example, at 100 c/sec., the greatest difference between any two curves is 5 db. Thus, if a play-back curve is used which lies midway between the extremes, the greatest possible departure from the theoretically required response, at any frequency from 100 to 10,000 c/sec., is only 2.5 db.

The question immediately arises, "Is this degree of difference noticeable in listening to musical programmes?"

It is not generally realized that the human ear is not particularly sensitive to small differences in sound intensity, or that it is almost impossible to detect differences smaller than about 2 db. in sound level, when the sound itself is a pure tone. The construction of fading controls as used in broadcasting equipment is based on this fact, which enables the control to be made in small jumps of 1½ to 2 db. instead of as a smooth variation, without the listener being aware of the fact. A visit to any broadcasting studio will confirm this if there are any unconvinced sceptics among readers. An important point is that this minimum observable difference in sound level of 2 db. applies only to the case where the sound is a pure tone—i.e., a single frequency—and it is known that, for complex programme material like music, the minimum observable difference in level is much greater.

Now the ear is much less sensitive to small changes in frequency response than it is to changes in overall volume level, so that one can quite truthfully say that a gradual rise or roll-off amounting to no more than 2½ db. at one end of the audio range would certainly not be noticeable. Why, then, go in for the multiplicity of play-back curves, none



of which differs from an average curve by more than an unnoticeable amount? Why, indeed? In short, a single well-chosen play-back curve will cope quite satisfactorily with all makes of L/P record, irrespective of the exact recording curve used.

THE A.E.S. PLAY-BACK CURVE

One of the anomalous things about the whole situation is that many commercial amplifiers provide a play-back curve labelled "A.E.S." IN ADDITION to curves intended to match exactly a number of the individual recording characteristics included in our diagram. Why doing so can be called anomalous is perhaps not readily apparent until one realizes the purpose of the A.E.S. play-back curve.

This is a play-back curve designed by the Audio Engineering Society (of America), and recommended by them for use as a standard reproducing curve by manufacturers of audio equipment. It was designed especially to solve the multiple recording curve problem, in recognition of the fact that the differences between them are quite small. The A.E.S. hoped that record manufacturers might change over to a recording curve which is the inverse of the A.E.S. play-back curve, but it was also realized that, even if record makers did not do this, the use of the curve by makers of play-back equipment would ensure that any L/P record could be played back with a frequency response error not greater than $2\frac{1}{2}$ db. at any frequency, irrespective of the technical details of individual record makers' own recording curves.

Briefly, the A.E.S. designed their standard play-back curve in recognition of the very fact that a multiplicity of curves is unnecessary.

OTHER FACTORS

No one will dispute the fact that there are great differences between the apparent frequency responses of many records, and that to obtain the most pleasing results, many records need to be played with varying amounts of bass boost or cut, combined with similar amounts of treble boost or cut. Accordingly, most play-back equipment is provided with independent bass and treble controls which will give these variations to the response curve, according to the taste of the operator. The point we want to make here is that the noticeable differences between the apparent frequency response of records are NOT due to differences in the recording curves at all, but are due to other factors which have a much greater audible effect than any that can be accounted for by the proven slight differences due to the recording and play-back curves. Perhaps the most important of these is that of microphone placement. Microphone techniques differ greatly from one recording studio to the next, and the effects of wide differences in record response can be obtained very easily by different placement and use of the microphones, especially in the recording of a large orchestra, with or without solo instruments. A microphone technique which emphasizes the brass section and at the same time underrecords the 'cellos and basses will give the effect of a frequency response deficient in bass and superabundant treble, especially when there is a good deal of brass in the piece being played.

Similarly, the acoustics of the room or hall in which the recording was made can have a much greater effect on the balance of sound as between the lower and higher-pitched instruments than can any likely

variation in electrical frequency response. The catch is that the two can well be confused one for the other. But from the listener's point of view, what does this matter? He is not interested in the mechanism of the effect, but in improving the result, and he has his remedy in the shape of the bass and treble controls.

CONCLUSIONS

Out of all this argument arises one plain fact—namely, that only one compensation position is needed for playing any type of L/P record, since the differences between recording characteristics are so small that they can scarcely be made audible. Even if they were audible, there are other effects which cause differences between records, of a much more noticeable nature, sufficient to swamp any real effect that may be caused by the recording characteristic itself. Thus, if an amplifier is provided with a limited amount of bass and treble boost and cut, one compensation position for 78 r.p.m. records and another for L/Ps will do all that the listener requires.

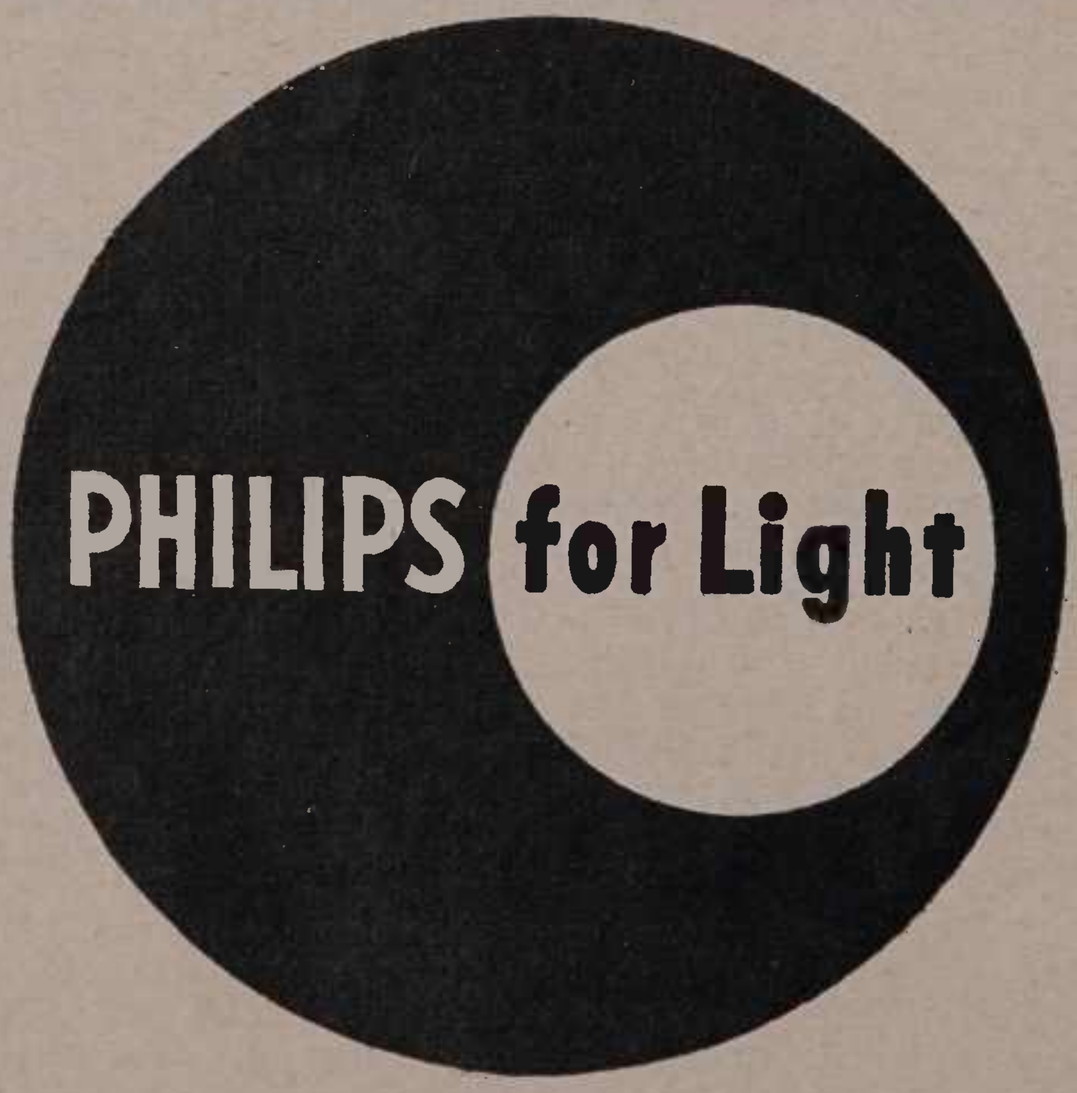
PRACTICAL PROOF

It is one thing to talk about facts and figures, impressive as they may be, but quite another to put the resulting conclusions into practice. However, at the recent demonstrations of high-quality reproduction given by the editor of this journal in Wellington, we were able to give practical demonstrations of the truth of our assertions. There, we showed how an amplifier with controls corresponding exactly to the above description could give identical results with those of a commercial amplifier which had entirely different compensation circuits, even when a magnetic pick-up was used with one amplifier and a crystal with the other! Moreover, this could be done with only very slight adjustment of the tone controls in either case, away from their "flat" positions.

Some readers, we suppose, are bound to ask why, if what we have said is true, do some makers of commercial amplifiers incorporate a multitude of playback curves? We do not think the answer is far to seek. Commercial practice can never be based on purely engineering considerations, however soundly based, because if the prospective purchaser has certain unshakeable notions, as, for example, the one we have been discussing, the man who aims to sell equipment to him must pander to those notions—at least to some extent. For instance, if one manufacturer puts out a good sales story making, to the non- or semi-technical purchaser, a good case for multi-position compensation switches, even though the case may be unsound technically, then other makers of similar equipment will be bound to follow suit. If they do not, salesmen and proud possessors of the multi-point compensation switch will certainly point the finger of scorn at equipment which is so naive as to possess only one L/P compensation position. We then have the spectacle of designers who DO know better, adding to the complexity and cost of their equipment purely in order to satisfy a demand that is unwarranted on technical, aesthetic, or any other grounds whatever!

One very famous manufacturer of high-quality gramophone amplifiers "gives the show away" very effectively in the instruction booklet which goes with one of his amplifiers, when, after instructing the non-technical user in the use of the various positions of the compensation switch, he says, "but if you do not like the sound of one of your records played with the switch in the 'official' position for it, by all means play it with the compensation switch in the position which gives the most pleasing result." In effect, this manufacturer says: "We have provided enough compensation arrangements to suit the uninformed purists, but you don't have to use them if you don't want to—you can still get a satisfactory result without."

With which, we can refrain from further comment.



Canadian Trade Shows

A LIST OF THE PRINCIPAL CANADIAN TRADE SHOWS HELD FROM SEPTEMBER TO DECEMBER, 1955

Eastern Canada All-electrical Show
Show Mart, Montreal.
September 19 to 23, 1955.

Toronto Fall Gift Show
Exhibition Park, Toronto.
September 20 to 30, 1955.
For information: Show Merchandising Ltd., 9 Duke Street. Toronto.

4th National Packaging Exposition
Exhibition Park, Toronto.
November 8 to 10, 1955.
For information: Packaging Association of Canada, 916 Yonge Street, Toronto.

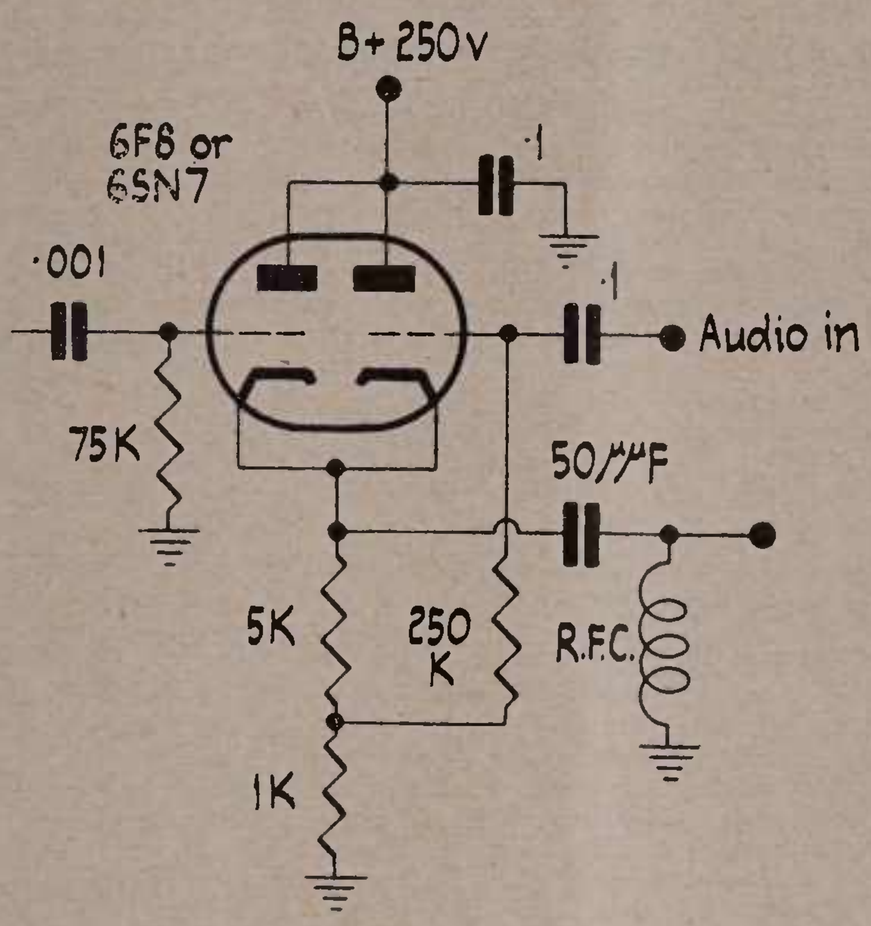
Canada's Power Show
Show Mart, Montreal.
November 8 to 11, 1955.
For information: General Secretary, Institute of Power Engineers, 410 Bloor Street East, Toronto 5.

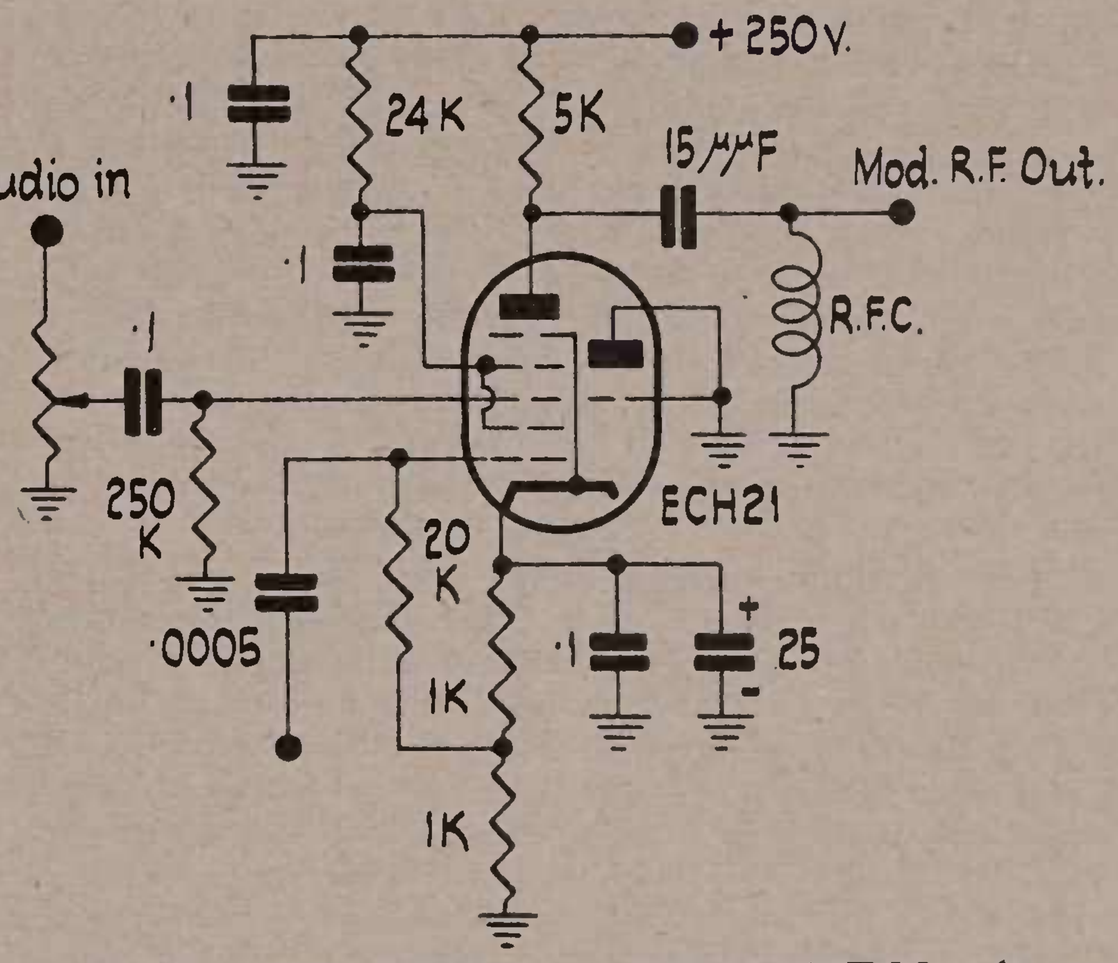
Royal Agricultural Winter Fair
Exhibition Park, Toronto.
November 11 to 19, 1955.
For information: Royal Agricultural Winter Fair, Exhibition Park, Toronto.

Automotive Transport Association
Exhibition Park, Toronto.
November 18 to 21, 1955.
For information: J. O. Goodman, 146 Wellington Street W., Toronto.

Circuits for the Experimenter

USEFUL LOW-LEVEL MODULATOR CIRCUITS





It is often very handy, in experimental work particularly, to have a means of applying any required kind of modulation to the output of an oscillator. This may be a conventional signal generator, or it may be one of the "lash-up" type, constructed specially for some particular job. The circuit shown here is an excellent one for this purpose. It is easy to build, has no peculiar difficulties of its own, and has several advantages, even when one has a modulated signal generator of the commercial variety.

One of the worst things about commercial signal generators (and this remark applies even to the most expensive of them) is that their internal modulation arrangements usually produce a large degree of frequency modulation as well as the wanted amplitude modulation. The reason, of course, is that self-excited oscillators are always used, and these are directly modulated. Under these conditions, unwanted F.M. is always produced. This can make the signal generator almost useless for aligning highly selective circuits, such as many amateurs build into their home-grown communications receivers. Now the modulator circuit described here has the great advantage that it gives the same percentage modulation irrespective of the amplitude of the R.F. input signal (within reasonable limits, of course), and so can be used AFTER the output attenuator of the signal generator. Even if the signal generator's output control is nothing more ambitious than a low-resistance potentiometer, using what is essentially a modulated amplifier instead of modulating the oscillator itself is exceedingly effective in eliminating unwanted F.M.

Another advantage of the circuit is that it enables the signal-generator or test oscillator to be modulated with any desired programme material—an audio oscillator, a gramophone pick-up, another radio receiver, a tape recorder, or what you will. It is true that many signal generators have a switch and an input socket which are supposed to enable the oscillator to be modulated by an external source, but quite apart from the question of unwanted F.M., the arrangement is rarely very satisfactory in practice, usually because the audio input terminal needs to be fed from a low-impedance source, such as the voice-coil winding of an output transformer, or a line nominally 500 or 600 ohms in impedance. If such is the case, it is quite impossible to modulate the oscillator from a number of convenient sources, many of which have high impedances. This circuit does not suffer from these disadvantages. Another disadvantage of externally modulating most signal generators is that the modulation characteristic is not flat over a sufficiently wide frequency range. It is therefore impossible to use an audio oscillator of constant output amplitude to modulate the R.F. oscillator for the purpose of doing overall frequency response checks on a receiver. At high audio frequencies, the percentage modulation drops severely, and this is debited against the receiver being tested. The present circuit, however, retains its percentage modulation up to well beyond the A.F. range—actually up to about 50 kc/sec., so that it is even possible to obtain good square-wave modulation, and certainly possible to use a variable frequency audio oscillator as the modulator with the assurance that one gets as much modulation at, say, 10 kc/sec. as at 1,000 c/sec.

Another application for this sort of modulator which is not likely to be needed here for some time to come is that of testing F.M. receivers for unwanted response to A.M. For this test, too, it is essential to have an amplitude-modulated signal that contains no frequency modulation.

THE CIRCUIT

The circuit itself is simple enough. It consists of the heptode section of an ECH21, the triode section being unused. Grid No. 1 is used as the input grid for the radio frequency signal that is to be modulated. Grids 2 and 4 are internally connected and form the screen, and these are supplied with about 100 volts

positive in the usual way, and are bypassed for both R.F. and audio. Grid No. 3 is ordinarily the oscillator injection grid when the valve is used as an oscillator-mixer, but here it is used for the A.F. modulating voltage. Audio input is via a high-resistance potentiometer, and so can be fed from such places as the plate of a resistance-coupled amplifier valve, a detector, or a gramophone pick-up, without affecting the frequency response to audio and without causing distortion in the source of audio signal.

The tube is cathode biased by a total of 2,000 ohms, which is bypassed for both audio and R.F. by a 25 μf. electrolytic and a 0.1 paper condenser in parallel. It was found that the best results were obtained with different values of bias on the R.F. and A.F. input grids, the latter requiring more than the No. 1 grid for best modulation. Accordingly, the cathode resistance is made up of two 1k. resistors in series, with the No. 1 grid's return taken to the junction between them, while the No. 3 grid's return is made to earth so that it gets the full bias voltage.

Output is taken across a 5k. resistor in the plate circuit, but not directly. A 15 $\mu\mu$f. coupling condenser feeds the output terminal, whose D.C. path is completed by an R.F. choke, which can be of the ordinary 2½ millihenry variety. This choke should on no account be omitted. The point is that an audio voltage is developed across the 5k. load resistor as well as the R.F. voltage, and if this is allowed to be applied to the input of the device under test, the result will sometimes be quite all right, but sometimes it will not be, particularly where the first valve could be overloaded by the presence of the audio voltage. The R.F. choke prevents the audio voltage from appearing at the output terminals at all, except when the modulating frequency is very high. In fact, it is this that limits the high-frequency modulation capability rather than frequency response.

If desired, a tuned circuit could be substituted for the R.F. choke, and this would be worth while where all the work was to be done on only one or two frequencies. It would be even more effective in removing the modulation frequency itself from the output, and would allow even higher modulation frequencies to be employed.

As to performance, the modulation is very good indeed as regards quality, provided that the audio input grid is not overloaded. Unfortunately, undistorted modulation is possible only up to 80 per cent., because, if further audio signal is put in, flattening of the positive modulation peaks takes place. However, this is only a slight disadvantage, because the quality of the modulation is very good indeed up to the maximum, and consequently distortion is very low.

POSSIBLE USE FOR THE TRIODE SECTION

Perhaps the most obvious application for the triode section of the ECH21 is to use it as an audio oscillator, whose output could be taken to the A.F. input potentiometer feeding grid No. 3. Alternatively, it could be used as a resistance-coupled amplifier, also feeding into the modulating grid. This would give a useful buffering action, preventing R.F. from accidentally being fed back to the source of audio signal, and, when required, producing some gain. The triode could also be used as one triode in a double-triode resistance-capacity oscillator, which could well be a variable-frequency one, thus making a very self-contained instrument, requiring only R.F. to be fed in to make it work.

BOOK REVIEW

"SIMPLE ELECTRONIC MUSICAL INSTRUMENTS FOR THE CONSTRUCTOR"

by Alan Douglas. Publishers, Norman Price (Publishers) Ltd. Distributed in Australasia by the Electronic Organ Company (Australia) 9-11 Cadow Street, Pymble, N.S.W.

Electronic music is one of those off-shoots of electronics which has the property of being intensely interesting to certain devotees, and yet of little interest to most of those whose work lies in what might be termed the main body of electronics. In this respect it resembles other highly specialized applications of electronic techniques, such as remote control. In some ways it is strange that the electrical reproduction of music from gramophone records (which could legitimately lay claim to the same title) has so many more devotees than has the subject of this book, but perhaps this is just another example of the performer being vastly outnumbered by the listener.

In spite of this, and in spite of the specialized nature of the subject, it does seem that more people today are taking an interest in electronically produced music, as distinct from electronically reproduced music. Although it has not happened yet, there still seems no reason why newly developed electronic instruments should not become as well known as the violin, nor why they should not ultimately find their way into the composition of the orchestra. Before this can happen, however, it will probably be necessary for a good many more people to become actively interested in the subject, which even in its present early stage of development has an extensive technique already developed.

Mr. Douglas is one of the few well-known writers on the subject of electronic music, and while this little book makes no attempt to be a treatise on the subject, it will certainly claim to be authoritative. It shows suitable circuits and mechanical arrangements for a number of simple instruments of various types, from a variable-frequency tone generator, arranged to be used as a single-voiced instrument itself, to a bass generator, complete with pedal system, for use with a piano to give more realism to organ practice. To those who have not previously dabbled in this sort of thing, there will be some surprises in store. First, quite complicated instruments can be built in which the tone-generating equipment uses no more than half a dozen valves. This does not mean that the instrument is not complex, for the switching associated with the production of the notes and the various tone colours is quite formidable, but even so it is remarkable how much can be done with relatively modest equipment. Indeed, what struck the present reviewer most forcibly on reading the book was the ingenious way in which instrument simulation can be effected, by first generating quite complex waveforms, and then modifying these in relatively simple ways. The ability to do this rests, of course, on extensive analysis of the frequency components of the various instruments, and in this respect the technique of electronic music is quite highly developed.

We can thoroughly recommend the book to those who wish to know a little about the subject without delving very deeply into it. This will obviously include prospective builders of instruments, and engineers wishing to know how such things "tick", without necessarily wanting to build them. The treatment is on quite a low technical level, and no one need be afraid that he will be out of his depth technically. However, the engineer will probably be annoyed by a few technical inaccuracies. In places the writing has the air of having been dashed off without sufficient thought, as when the author states "The electrical output varies as the square of the air-gap: so, as the gap is reduced, the volume will rapidly increase". One would hesitate to suggest that the author does not know that this is wrong, but if he allows inaccuracies of this sort to creep in he cannot be disappointed if someone does doubt his electrical credentials!

In spite of these blemises, the book can certainly be said to do what it sets out to do—namely to act as an introduction to a fascinating subject—and it is well worth having, even if some of it may have a somewhat hollow sound technically, in some places. Indeed, it has whetted this reviewer's appetite for more, even if he doubts his ability to summon the obviously unlimited patience possessed by amateur builders of keyboard instruments.

—W.D.F.

BINDERS FOR "R. & E."

These are available to hold 12 issues—price 5s. 6d.

TAPE-RECORDER SERVICING

By P. G. READ, Grad.I.E.E., Grad.Brit.I.R.E.

(*Reprinted from "Wireless and Electrical Trader," Vol.* 97, *No.* 1268)

As a result of the ever-increasing popularity of tape recording, quite a few radio and television service engineers are encountering, perhaps for the first time, servicing problems that are peculiar to this comparatively new medium. In order to gain confidence in tackling these problems, it is advisable to go back a little and look at the basic constituents of a tape recorder.

TWO SECTIONS

The recorder can be divided into two main parts, the electronic section and the mechanical/electrical section, the latter comprising what is known as the tape deck. Taking the electronic section first, it is perhaps true to say that the most important single item, and one which distinguishes this equipment from any other kind, is the high frequency bias generator. It is the R.F. (20/60 kc/s.) bias produced by this generator that, in effect, removes the undesirable hysteresis loop from the magnetic characteristic of the recording tape, and makes high quality recordings possible.

The next two items in the electronic section are the recording amplifier and the playback amplifier, each amplifier having a frequency response designed to accommodate the characteristics of both the recording tape and its respective head.

The final two items in this section are the power supply and the recording level indicator, the latter usually comprising a "tuning indicator" of the "magic eye" type used in radio receivers.

THE TAPE DECK

In the mechanical/electrical section are the main components of the tape deck itself, which include record/replay and erase heads, a means of transporting the tape past the heads at a constant speed, guides and pressure pads to keep the tape flat and in even contact with the heads, and, finally, a means of controlling the tape deck operations.

Now we are ready to consider the type of fault likely to be encountered in the various sub-sections. Generally speaking, those faults associated with the recording and playback amplifier circuits should cause little difficulty, as they will be of the type already experienced in A.F. amplifiers and in the A.F. stages of radio receivers. In fact, the only additional complication is caused by the common practice of using the same basic amplifier for both recording and playing-back. This, of course, calls for fairly involved switching in the input and output circuits of the amplifier, together with switching to modify the frequency response of the amplifier suitably for its two roles.

One other factor to be remembered when dealing with the amplifier circuits is that, owing to the relatively low output of the playback head, a high-gain amplifier is used on playback. In practice this means that the first valve following the record/playback head tends to be sensitive both to mechanical vibration and to hum fields. For this reason, the valve is usually fitted in a rubber-mounted anti-microphonic holder, and particular attention is paid to its heater supply, which may be balanced about chassis potential by means of a centre-tapped heater winding. Special mu-metal screens may also be employed to shield the valve and its associated components from the magnetic fields of the motor and mains transformer.

MAGNETIC HEADS

Turning now to the erase and record/playback heads, let us assume that the amplifier and R.F. generator circuits are functioning normally. If there is no output from the recorder on playback, or if there is no erasure of old signals on recordings, it is fairly safe to assume that the record/playback head, or the erase head, has an open-circuit winding.

But a word of warning here: if a continuity test is necessary, it must not be made with a D.C. continuity meter, for if either head is checked with a normal D.C. current-drawing continuity instrument its magnet system will be damaged, and it will probably need replacement whether it was originally faulty or not. This is because the current, which flowed through the head from the continuity meter, will have changed the characteristics of the mu-metal laminations used in the head. The only safe way to test the heads for continuity is to check the A.C. current they pass, against the manufacurer's figures.

Once again, assuming that the amplifier circuit has been checked by methods already familiar to the radio service engineer, and functions normally, the recorder may be found to exhibit signs of poor high-frequency response, particularly if it has had a lot of use. This may be due to a fine film of dirt building up on the face of the record/playback head, preventing the tape from coming into intimate contact with the gap in the head, or it may be due to wearing of the head face by the passage of the tape across it.

In the first case the fault can be remedied by careful cleaning of the head face with cotton wool and a volatile fluid such as lighter fuel. In the second case, the wearing of the head has caused its gap, normally about a thousandth of an inch across, to become wider, and thus cause a deterioration in its H.F. response. The only remedy here is to replace the head.

If the recorder reproduces its own recordings faithfully, but shows a lack of H.F. response when playing tapes recorded on other machines, then the physical alignment of the record/playback head is suspect. Correct alignment of the head occurs when its gap is exactly at right angles to the traverse of the tape. Instructions for the setting up of the head are usually given in the manufacturers' service information.

R.F. BIAS TESTS.

Faults connected with the bias generator or R.F. oscillator are usually fairly straightforward. If the oscil-

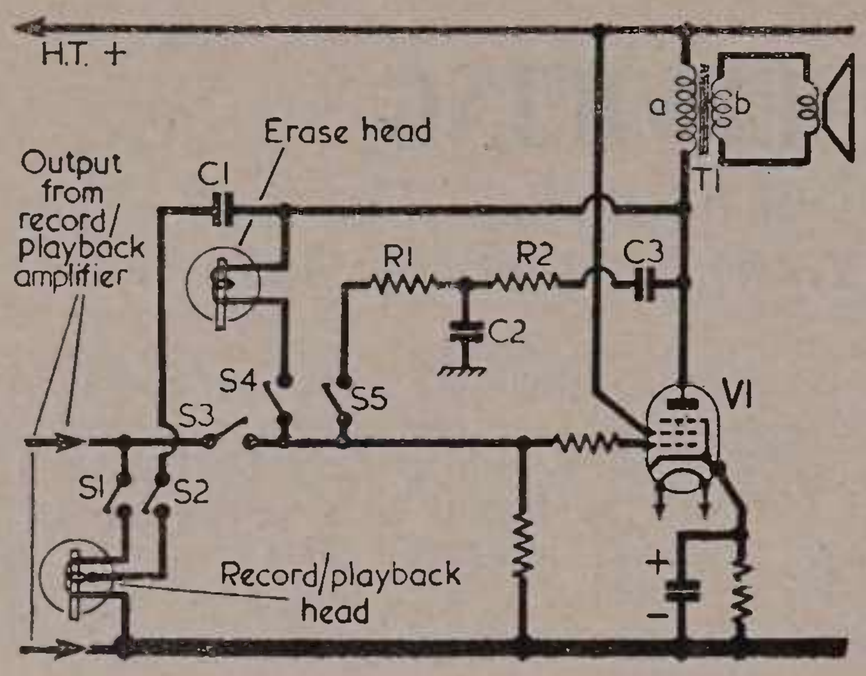


FIG. 1.—*Simplified circuit of the R.F. oscillator/playback output stage used in the Philips EL3530 tape recorder. The erase head forms part of the reaction feed-back path when V1 operates as oscillator.*

lator stops working altogether, the quality of recording, and consequently of reproduction, suffers markedly. This condition can be verified by a simple A.C. voltage check in the anode or control grid circuit of the oscillator (V1 in Fig. 1). V2 is the oscillator in Fig. 2, but the oscillator electrodes are then anode and cathode). The absence of an A.C. reading at these points is usually caused by a faulty oscillator valve or open-circuited oscillator coil.

Readings vary with different head impedances, but typical oscillator voltages, measured across the heads, are: Challenger (impedance 2.8k Ω) 60V; Motek (1.5k Ω) 35V; Bradmaster (20k Ω) 40V; Grundig (2.5k Ω) 60V.

If the output of the oscillator is low, only slight distortion may be apparent in recordings. If, in this case, the oscillator is also used as a source of R.F. erasing power, as it is in Fig. 1, previous recordings

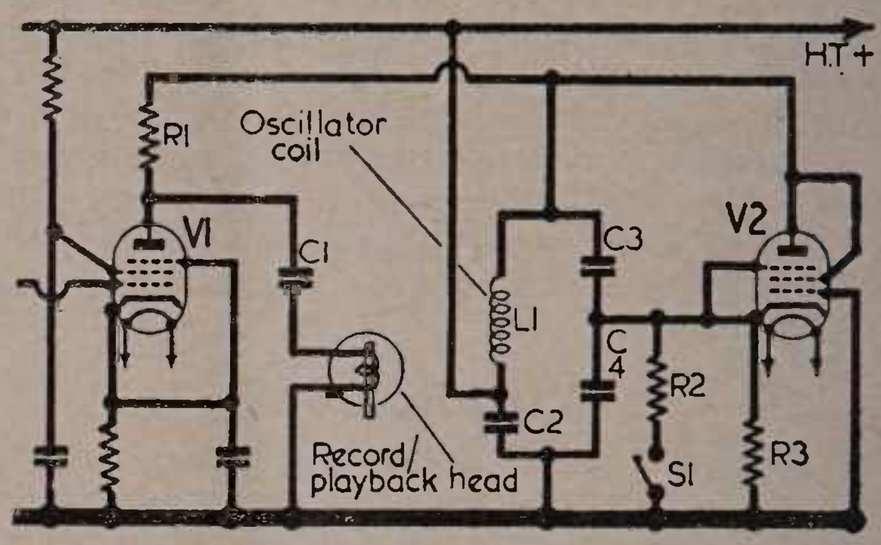


FIG. 2.—*Circuit of the recording output stage and R.F. oscillator as used in the Soundmirror TP411 recorder. For the sake of clarity, the record/playback switches have been omitted and the circuit is shown in the record position.*

on the tape may not be completely erased. Confirmation of these conditions can be obtained by checking the R.F. bias current flowing in the record/playback head, and the R.F. current flowing in the erase head, against the manufacturer's figures. With this type of fault, the cause is usually a low-emission

TELEFUNKEN
"Magnetophone" KL25

A modern miracle for the music-lover, the business man, the secretary, the public speaker, the teacher. The "life of the party" as the home entertainer.

★ Frequency Response at 7½ ins/sec. 50c.–15 kc., at 3¾ ins/sec. 50c.—10 kc.
★ Separate magnetic heads for recording, play-back and high frequency erasing.
★ Tape Spot Indicator.
★ Mains supply: A.C., 50 c.p.s. 110v. or 230v.
★ Compact, attractive appearance and extremely portable.
★ Simple to operate.
★ Built-in loudspeaker and microphone storage compartment.

New Zealand Representatives:

AMALGAMATED WIRELESS (A/asia) LIMITED

P.O. Box 830, Wellington. P.O. Box 1363, Auckland. P.O. Box 2084, Christchurch.

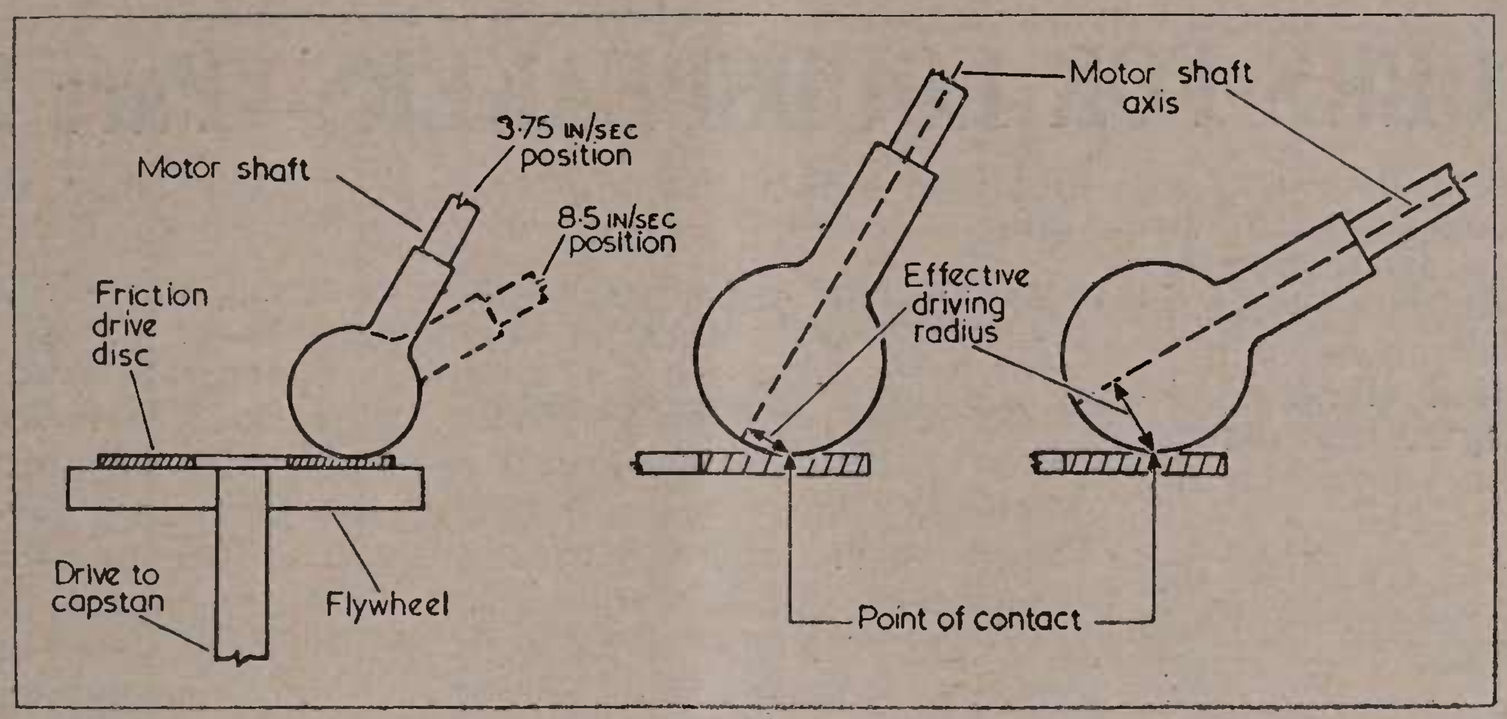


FIG. 3.—*Sketch of the continuously variable speed control used in the current Reflectograph models. The two enlarged sections of the ball drive illustrate how the driving radius is varied.*

oscillator valve, a high-resistance bias resistor (R3 in Fig. 2) or a low H.T. voltage.

Before leaving the electronic section of the recorder let us look again at the two sections of circuit to which we have been referring. Figure 1 is a slightly simplified version of the bias oscillator and playback output stage used in the Philips EL3530 transportable recorder. This is an example of further condensation of our basic recorder constituents. V1 is performing the dual roles of R.F. oscillator, with switches S1, S2, S4 closed, and playback output stage, with S3, S5 closed.

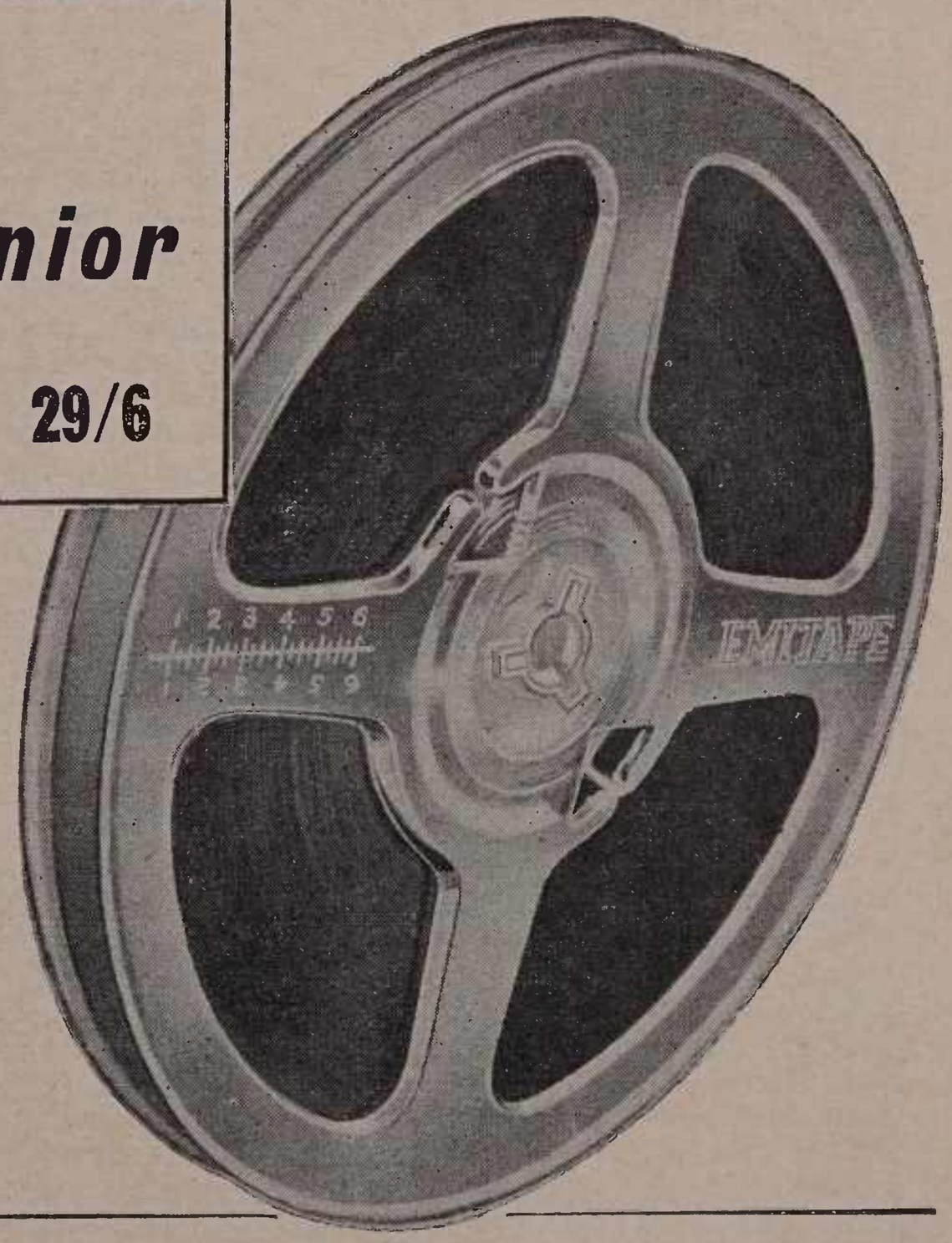
BIAS OSCILLATOR

The oscillator coil comprises the erase head itself, which is connected in the reaction feed-back path between the anode and control grid circuits of V1. Winding "a" of T1 operates as anode load both

(Continued on page 48)

Introducing the NEW
EMITAPE *Junior*
MAGNETIC RECORDING TAPE

5″ REEL 600 ft. Price 29/6



The popular Emitape '88' is now available in a convenient 5″ spool of 600 ft. length, suitable for recordings of up to one hour. This spool is identical to the larger 7″ (88/12), will fit all tape recorders, and is suitable for single or twin trackings. In addition it has a metallic contact strip to operate on machines fitted with auto-stops.

Emitape is unequalled for fidelity of recording and reproduction as well as for strength and length of life. It is used for recording by "His Master's Voice", Columbia and Parlophone. Emitape is also used by the world's leading broadcasting and other recording organisations.

Ask your local dealer for details or write to

E.M.I. SUPPLIERS

(Trade Division of H.M.V. (N.Z.) Ltd.)

P.O. Box 296 162-172 WAKEFIELD STREET, WELLINGTON Phone 54-890

DIVIDING NETWORKS FOR LOUDSPEAKERS—Part 2

Several times during the last several years, we have printed articles dealing with one aspect or another of the above subject. As we are constantly getting requests for information on this topic—which seems to be getting a very popular one—we have decided to consolidate the information already published, and to simplify the whole thing so that readers may design and build their own networks by referring to three simple graphs.

Last month's issue contained the first part of this project, which consisted of perhaps the most useful information of all to the home builder. Two graphs were printed enabling the number of turns to be found for winding inductances of any value up to 25 millihenries. This figure was chosen because it caters for all values of inductance likely to be needed for the purpose in hand. Indeed, it will enable networks to be built for any frequency between 400 and 4000c/sec., for almost any practical speaker impedance. The only restrictions applying to these curves are those of winding form and wire gauge. These two things have to be specified in advance if any such graphs are to be drawn at all, but an easily manageable winding form was chosen, such as would give suitably shaped coils, neither too small to make easily, nor too large to use conveniently, once made.

In this instalment, we propose to give a few hints on the choice of cross-over frequency, and other useful topics, after which readers will find two graphs from which the necessary value of inductance can be found without any calculation. In the third and final part, similar curves will be printed enabling the capacity values to be found.

DIVIDING NETWORK CIRCUITS

There are four circuit diagrams which are almost always those recommended in articles in the technical press on this subject. These are shown in Fig. 1. The first two are known as "quarter-section" filters, because they represent what is given this name in classical filter theory. The second two are half-section filters. There are two forms of each—a series form, and a shunt form. In the series arrangement, the two halves of the filter, and also the speakers which form the working loads for the filter, are in series, while in the shunt arrangement, both these are in parallel. The main difference between the two connections is only that the circuit values are slightly different. There need be no preference for one arrangement over the other, as their performances are identical. In some special applications, one might be preferred simply because it might give more easily obtained values of inductance or capacity than the other.

There are also two ways of choosing the circuit values for each of the arrangements shown in Fig. 1. One way gives what is known as "constant resistance" type of filter, and the other, an "m-derived filter". The audio enthusiast need not delve into filter theory to the extent of finding out just what these terms mean, again because there is little practical significance in the differences between them. The constant resistance type is to be preferred, however, because it makes both inductors in any one network identical in value, while the other scheme does not. The same also applies to the condenser values.

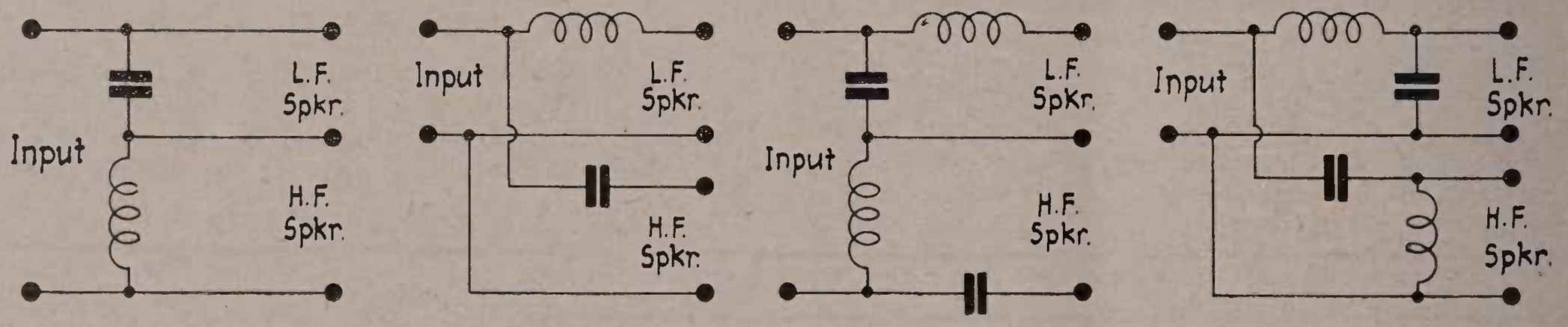


Fig. 1

RECOMMENDED CIRCUIT AND FILTER TYPE

Since this article sets out to reduce the design procedure for dividing networks to a simple matter of reading graphs, it is impracticable to give data for all the possible types. Instead, we have selected one circuit, and one filter type that will certainly do all that may be asked of it, and the single set of design curves have been drawn for this arrangement. The preferred circuit is re-drawn in Fig. 2, and as the L and C values are identical, it will be seen to be of the constant-resistance type. The formulae are also given for the benefit of those who

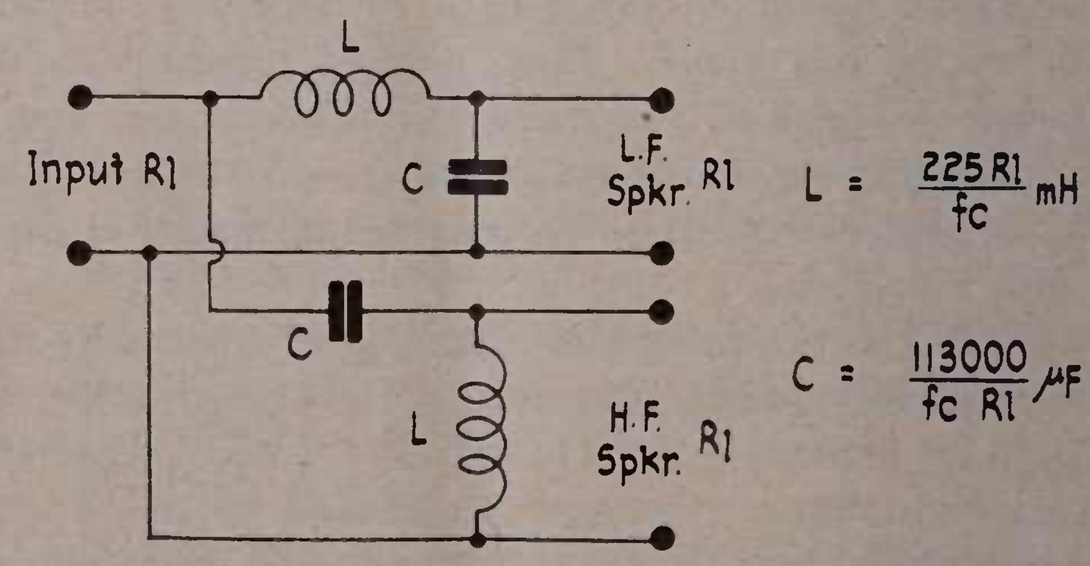
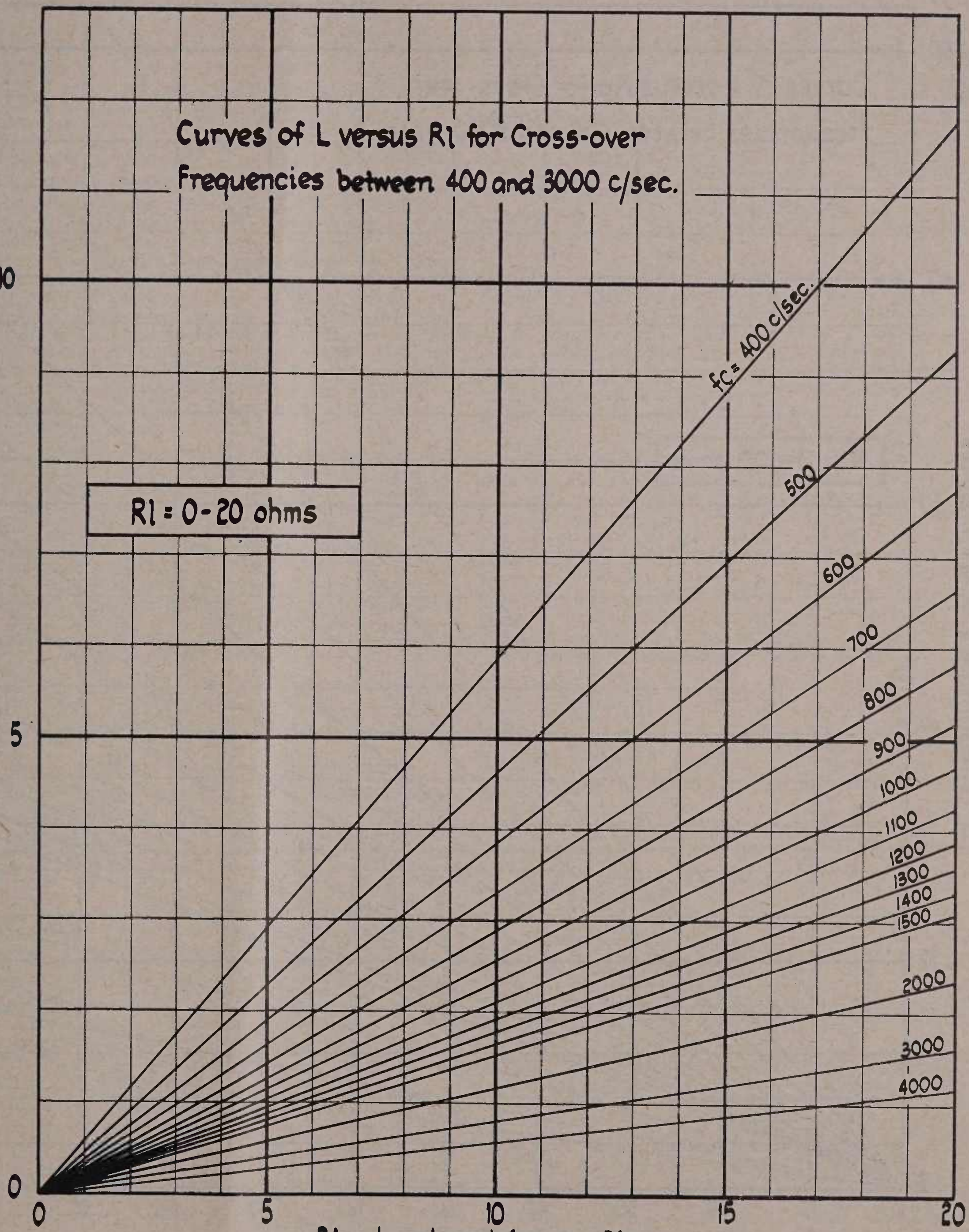
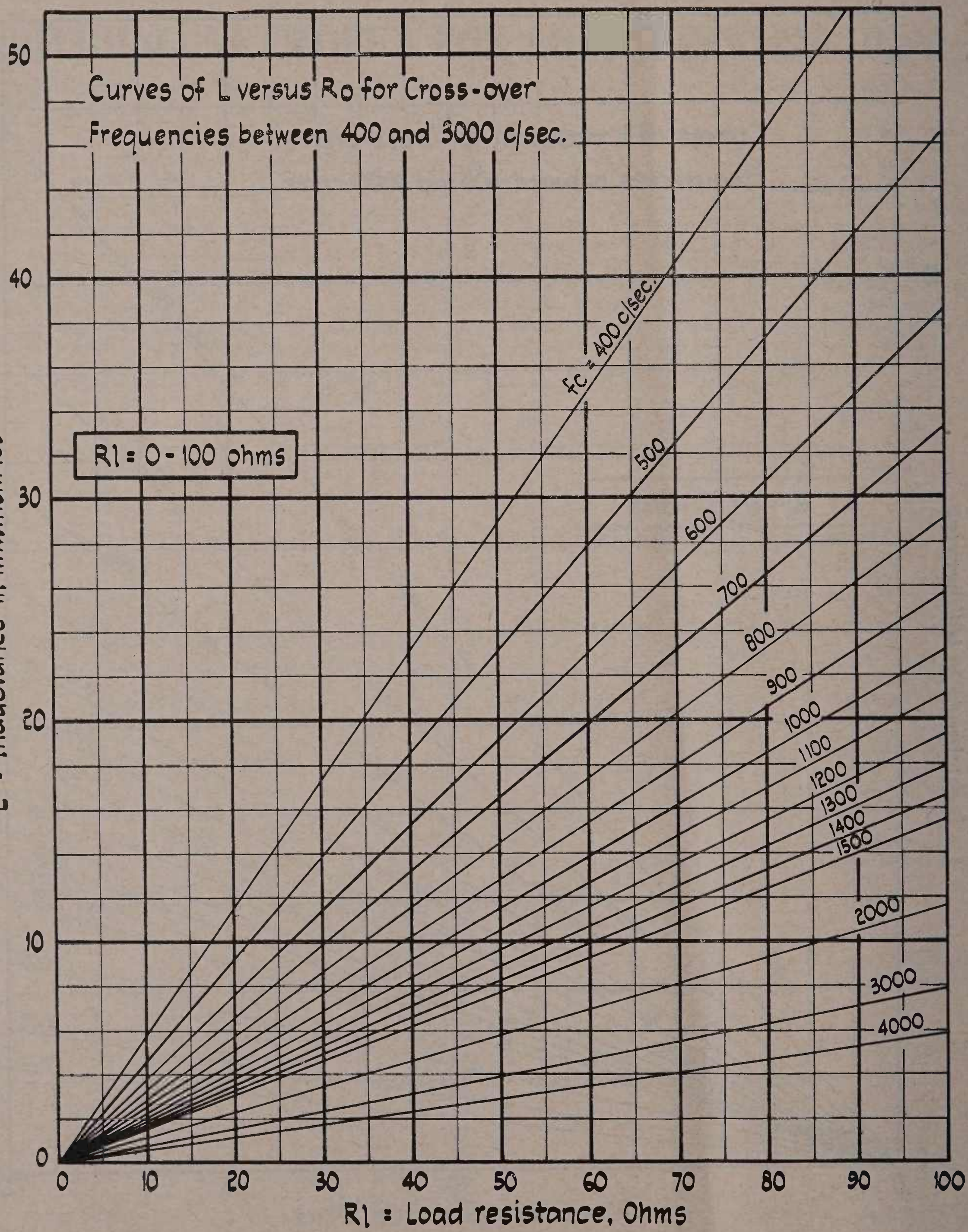


Fig. 2

may prefer to work things out for themselves. In these formulae f_c is the cross-over frequency in cycles per second, R_1 is the designed load resistance, which will be the impedance of the speakers to be used, and L and C are the inductance and capacity in millihenries and microfarads respectively.


Curves of L versus R1 for Cross-over
Frequencies between 400 and 3000 c/sec.
R1 = 0-20 ohms
fc = 400 c/sec.
500
600
700
800
900
1000
1100
1200
1300
1400
1500
2000
3000
4000
L - Inductance in Millihenries
R1 - Load resistance, Ohms
0
5
10
15
20


Curves of L versus Ro for Cross-over
Frequencies between 400 and 3000 c/sec.
R1 = 0 - 100 ohms
L = Inductance in Millihenries
R1 = Load resistance, Ohms
fc = 400 c/sec.
500
600
700
800
900
1000
1100
1200
1300
1400
1500
2000
3000
4000
0
10
20
30
40
50
60
70
80
90
100

USING THE INDUCTANCE CHARTS

Using the charts is simplicity itself. The charts each consist of a number of curves, each of which is applicable to a particular value of cross-over frequency. Once the curve belonging to the desired cross-over frequency has been located, a vertical line is erected at the value of R_1 that applies; where this meets the chosen curve, a horizontal line is drawn, and the value of inductance is read from the scale at the left of the diagram.

Two sets of curves have been given, one covering from zero to 20 ohms, and the other from zero to 100 ohms. The purpose of this is to make accurate reading of the graphs easier, especially at low values of load resistance, because this is the region in which most loudspeakers fall. Since the cross-over frequencies are spaced by only 100 c/sec. intervals most of the way, it will rarely happen that the desired frequency does not fall on one of the lines actually drawn. There is nothing to be gained from choosing the cross-over frequency to as close a limit as 50c/sec., so that interpolation between the curves will not be needed.

The second graph, taking the impedance range up to 100 ohms has been included for the sake of those who may have to work at higher impedances than the voice-coil of the speaker. Some theatre systems, for instance, run medium-impedance lines from the amplifiers to the speakers, and have line-to-voice-coil transformers at the speakers themselves. In this case it is an advantage to work the cross-over network at the impedance of the transmission line, still making use of the individual speaker transformers, which will be connected at the output terminals of the network.

Sometimes (especially in triple speaker installations) a network is needed to work at a quite high frequency, and for this reason the curves have been taken as high as 4000 cycles.

ESTIMATING FROM THE CURVES

Since the manner in which the various quantities change with increasing cross-over frequency, or increasing load resistance, is obvious from the graph, it is a very easy matter to estimate accurately values that are not actually covered by the curves. For instance, suppose the requirement is for a cross-over frequency of 1500c/sec., and the network is to be designed for insertion in a 600-ohm line. The curves do not go higher than 100 ohms, so that the answer for the required inductance cannot be obtained directly from them. Looking at the curves however, we note that as the load resistance gets higher, so do the required values of inductance. Furthermore, the inductance is directly proportional to the load resistance for any value of cross-over frequency. Thus, we can find the answer to the above problem by the following procedure.

If the required load resistance of 600 ohms is divided by ten, we get 60 ohms. This figure is on the curves, so we find the inductance needed for the required frequency of 1500c/sec., and a load resistance of 60 ohms. The answer is 9.3 millihenries. But our actual load resistance is ten times the value used, so that inductance will be ten times that found. Answer, 93 millihenries.

Another estimation that can be carried out is that of using the curves for cross-over frequencies lower than the 400c/sec., at which the curves stop. In this connection, it can be seen from the curves that for a given load resistance, halving the cross-over frequency doubles the inductance required. Thus, the inductance is inversely proportional to the cross-over frequency. Suppose then, that we want to use a cross-over frequency of 200c/sec., for a woofer in a three-way system. The answer can be obtained by working out the result for a frequency of 400c/sec., and doubling it, to obtain the desired answer.

Similarly, suppose a cross-over frequency of 6000c/sec. must be used for feeding an electrostatic speaker as tweeter. The answer can be found by working out (with the help of the graph) the result for a frequency of 3000c/sec., and halving it, or by using a figure of 1000c/sec., and dividing the result by six.

(To be concluded.)

N.Z.A.R.T. NOTES

After years of endeavour, the Association's Contest manager has at last obtained recognition of the Kermadec Group as a separate country for DXCC purposes. This will increase the totals of many South African amateurs, and it is hoped that later similar recognition will be accorded the Chathams and Campbell Island.

In the near future, Christchurch will once more become the publishing centre for our journal, "Break-In." As it is felt that much of the original meaning of its title has now been lost, a change of name seems now appropriate, and a competition will be held for this purpose.

During the annual memorial contest, held in June, conditions were poor and difficulties were experienced with at least one American station operating in a civil defence practice. In spite of his repeated replies, "Not in contest here . . . do not want a number," some of the hardy contestants finally managed to convince him that there was a contest on over here and his co-operation would be appreciated. DX, in general, was very poor, and had it not been for the abundance of Australians after the first night things would have been very slow. Real "eighty-metre" DX was provided by the odd American, Canadian, Samoan, Alaskan, and Fijian station. By way of a change, Rarotongan stations were conspicuous by their absence, though we have heard since that one station in ZK2 was active and hearing New Zealand signals though unable to make two-way communication.

According to unofficial reports, the Australian amateurs are to lose the six-metre band as from December 31, 1955, receiving in exchange the old five-metre band. The few additional megacycles will make some difference, especially to the Ross Hull Memorial Contest held annually on six during summer months. The question now is, who will be the first to work Australia cross band six to five?

Announcing the results of the Frequency Measuring Contest, Manager, ZL2GX, remarks on the overall improvement shown since the inauguration of this contest in 1952. Perhaps the most sterling performance was that of Bert Duffield, ZL2DT, who again returned an average deviation of 200 cycles on a frequency meter of his own construction. Bert is one of our, "White Stick Boys," with his dial calibrated in Braille. Its neatness exceeds many of the meters constructed by those with good sight.

In annexing the John McKim Memorial Trophy for the second year in succession, ZL1AG1, Brian Maunsell, returned an average deviation of seven cycles. One of his readings tallied exactly with that given as a standard by the Post and Telegraph station at Makara. Others who were close to official figures were ZL3RB and ZL3RZ. The section reserved for frequency meters of commercial origin was headed by Arthur Lyes, ZL3JD, who returned an average of 33 cycles.

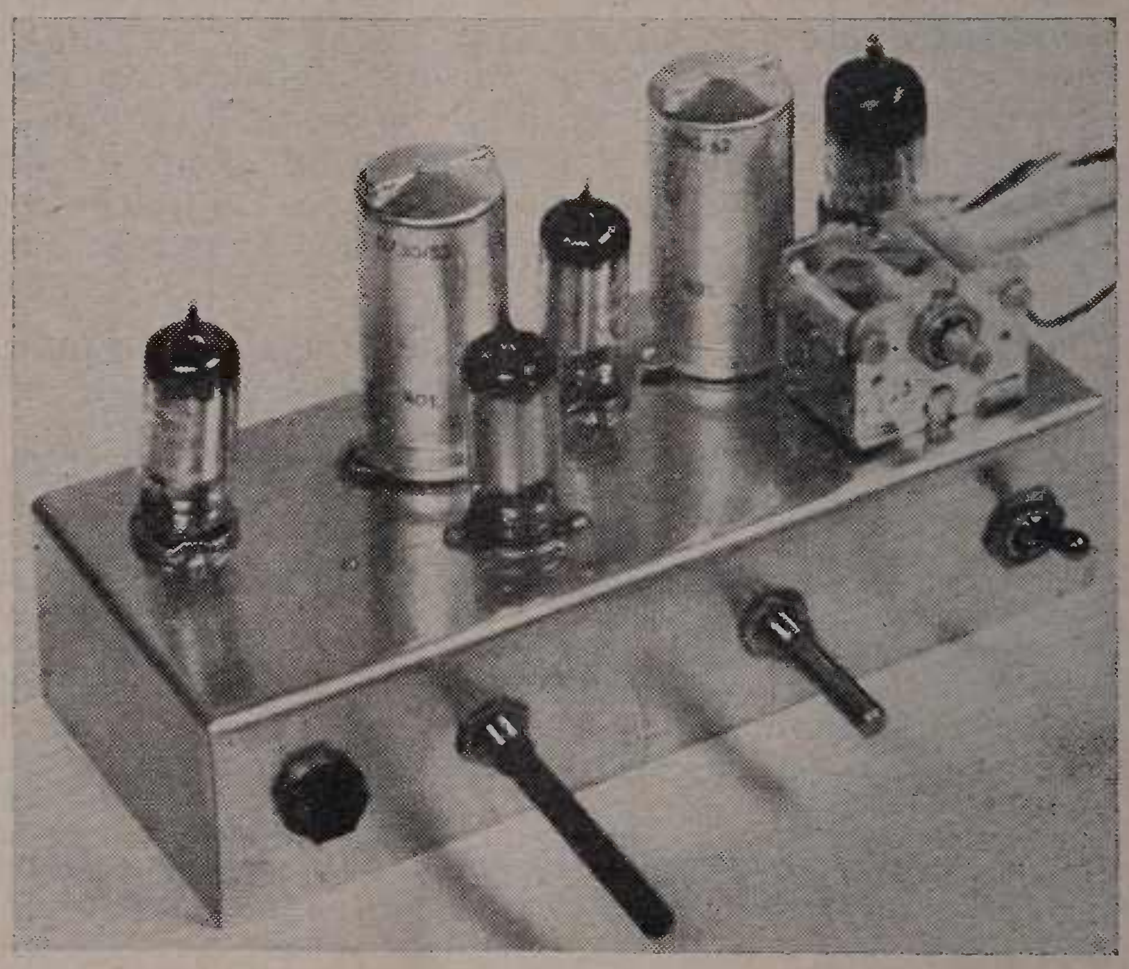
The PHILIPS Experimenter
An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 95: A Portable Transmitter-Receiver for the 160-Metre Band

Part 3: The Receiver Circuit

The design of a suitable receiver for applications like this one poses several problems, chief among which is that of obtaining adequate sensitivity with a simple and compact circuit arrangement. While it is all very nice to have R.F. amplifier stages, multiple I.F. stages, and all the "frills" that have come to be associated with communications receivers, something must be sacrificed to portability and low battery drain, and the receiver must be carved down to the bare essentials. It is here that some of the conventional features can be dispensed with, and it is often surprising how little the actual performance suffers in consequence.

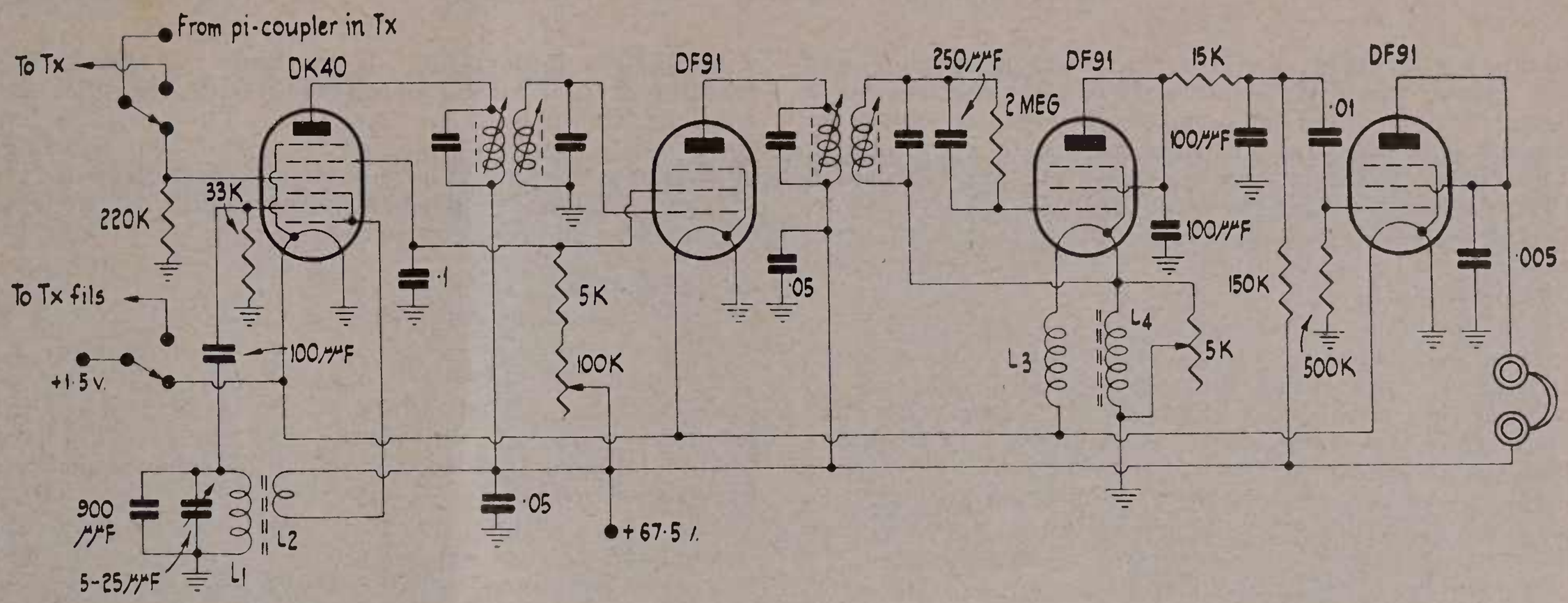
First of all, it was decided to do without an R.F. amplifier stage. While this would undoubtedly improve the weak-signal performance, its retention is a matter that requires considerable justification in a portable set. In this instance, it would have meant using a ganged condenser instead of a single one, and this would have necessitated a larger chassis. From the point of view of performance, it is doubtful whether the R.F. stage is worth its salt here, because external noise is the limiting factor to receiver sensitivity at the frequency we are dealing with, not valve noise. Thus, any improvement in weak-signal performance that might be expected would only be very small. Another reason for omitting the R.F. stage is that it would probably have been impossible to use such a compact lay-out, and stability might have become a problem. It was felt, therefore, that on balance, any additional gain would be better employed at the intermediate frequency rather than at R.F. This brings up the question of possibly including a second I.F. stage. However, when it is remembered that all but very weak signals can well be copied on a superhet comprising only a mixer and I.F. stage, it was considered that the addition of regeneration to the second detector would give almost as much advantage as an extra I.F. stage. Indeed, it will add more selectivity than will a second I.F. stage, and in addition it can be used as the B.F.O. for CW reception, eliminating the need for a separate B.F.O. We thus arrive at a four-valve receiver of excellent sensitivity and selectivity in spite of its simplicity, and one which could hardly be improved upon from the constructor's point of view, so easy is it to build and align. As a further simplification, A.V.C. has been omitted, and gain control is by means of variable screen voltage on the mixer and I.F. stages. No audio gain control is needed with this arrangement. The audio amplifier stage feeds a pair of headphones directly.



General view of the receiver. The left-hand shaft is the gain control, and the right-hand one the regeneration control.

THE INPUT CIRCUIT

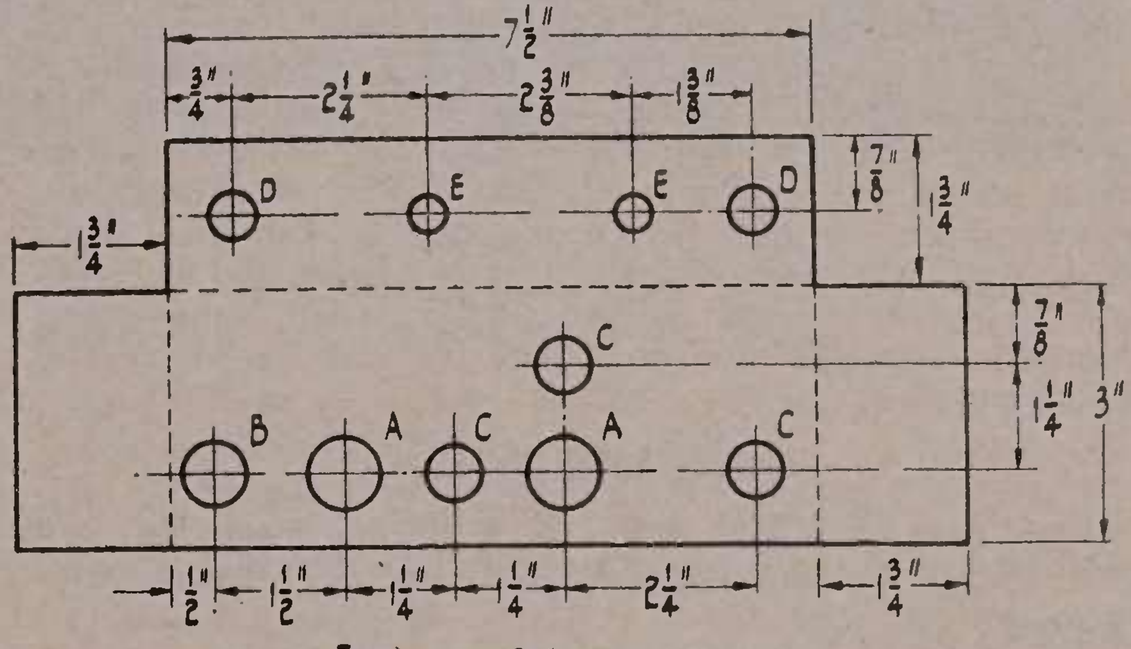
It will be remembered by those who read Part 1 of this series that the transmitter output circuit comprises a pi-section coupler which is matched to the aerial and the final by means of two variable condensers. This circuit is, of course, tuned to the working frequency, and, although a mis-match will occur when the plate end of the coupler is connected to the grid circuit of the receiver's first valve, the signal transfer to the first grid will be excellent, and is likely to be more effective than would be obtained if a conventional aerial coil were used in the receiver, with the aerial being switched from transmitter to receiver. The fact that the aerial tuning is not ganged with the receiver oscillator control will hardly be much of a disadvantage. Most of the time, a portable outfit like this will be "netted"—that is to say, transmitter and receiver will be using the same frequency. Thus, if the pi-coupler is tuned for best transmitter power output, it will not need readjusting when switched to the receive position. There may be a very small amount of de-tuning when this is done, but it is likely to be entirely negligible, as there will not be much difference between the output capacity of the final in the transmitter, and the input capacity of of the DK40 oscillator-mixer in the receiver. When the band is being searched, the selectivity of the aerial circuit is such that it will need to be re-tuned once or twice through the band if very weak signals are present, but in the ordinary way, it will only be neces-



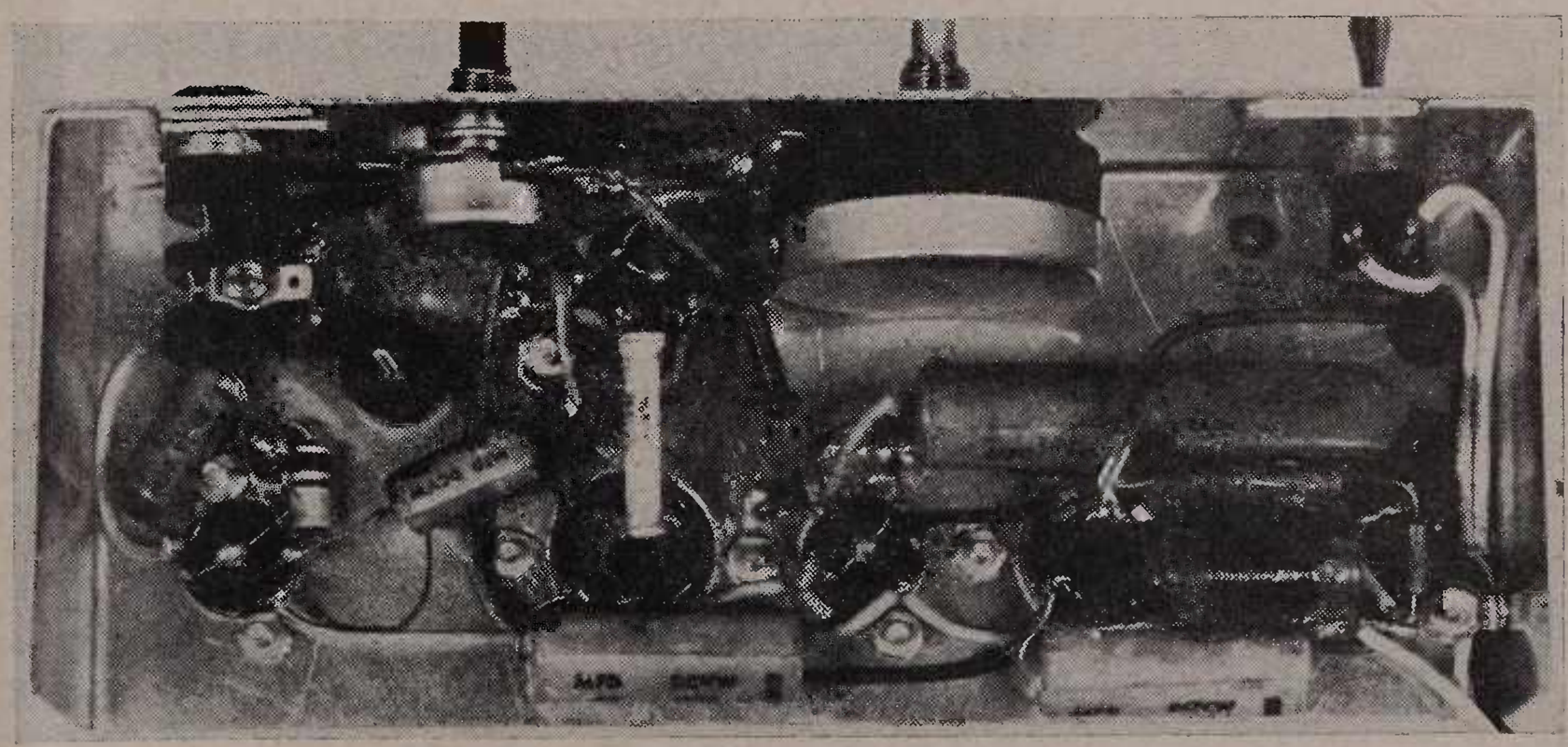
sary to peak it up on the signal once this has been found and tuned in. It would not be possible to use this arrangement if the band were not as narrow as it is. When used in the "receive" position, the aerial circuit has a half-power bandwidth considerably in excess of the 25 kc/sec. bandwidth of the 160-metre band itself, so that, provided that the coupler is left tuned to the transmitter frequency, re-peaking it on "receive" at any other frequency inside the band will produce only a small improvement in the signal strength at the detector.

CIRCUIT DETAILS

In the circuit diagram, the aerial tuning circuit is not shown, because it has already appeared in the transmitter diagram. A 220k. resistor is connected from the signal grid to ground to act as a grid leak, because the pi-section coupler does not provide a D.C. path itself.



The oscillator circuit is conventional, except that it uses a coil similar in construction to those in the transmitter, with the small piece of Ferroxocube rod for a core inside the ½ in. diameter former. In order to provide bandspread, and at the same time high oscillator stability, a 25 μμf. variable condenser is used for tuning, with a 900 μμf. fixed condenser across it as the band-setting condenser. The bandspread actually achieved is 30 kc/sec. over the whole range of the variable condenser, giving 5 kc/sec. to spare at the end of each dial. The screens of the DK40 and the DF91 I.F. amplifier are tied together and bypassed with a 0.1 μf. condenser, and H.T. is supplied to them through a variable dropping resistor which forms the manual gain control. There is a 5k. fixed resistor in series with the control, to give some decoupling even when the gain is at maximum. This is a stability precaution.



The DF91 detector is triode-connected, and regeneration is obtained by the now well-known cathode choke method. Hitherto, it was possible to use this method of regeneration control only with indirectly heated valves, because an air-cored, double-wound choke of reasonable dimensions would have too much resistance, and would thus drop the filament voltage. Since the advent of Ferroxcube, however, it has become possible to wind chokes of such small D.C. re-

sistance that this objection no longer applies, and the circuit may be used with every success on a battery valve. This is fortunate, because it saves the second I.F. transformer from having to be modified. The latter is almost an impossible job with the small Philips transformers we have used in the prototype, as the individual windings are so tiny. Modification would entail the addition of a tickler winding, and this would be beyond most of us.

The cathode choke method of obtaining detector regeneration has one other very important advantage. It provides one of the smoothest possible methods of control, and enables the reaction to be increased right up to the oscillation point with complete smoothness. Unless a regeneration control does work in this way, the full benefits of the regeneration are just not obtained, and the set is in effect much less sensitive than it should be.

An important feature of the detector is the R.F. filter in the plate circuit, comprising two 100 $\mu\mu$f. condensers and a 15k. resistor. This arrangement is just as effective as an R.F. choke, which for the I.F. of 455 kc/sec. would have to have a large inductance, and which would be quite bulky. Its stray field would probably cause stability problems as well, so that from all points of view the RC filter is preferable. However, it should on no account be omitted from the circuit, or instability will arise through I.F. voltage being amplified in the audio stage, and being coupled from the wiring back to the input of the I.F. amplifier.

CONSTRUCTION

First of all, here are the winding data for the oscillator coil and the detector regenerating choke.

Detector Choke

This is wound on a midget Ferroxcube core, type D14. The wire used is 36 S.W.G. enamel, and each winding has 25 turns. The manner of putting on the windings is important. It is done by taking two lengths of the wire, placing them side by side, and winding them both on together. This process ensures that the coupling between the two windings is as tight as possible, and that both halves of the filament will have identical impedances to earth as far as I.F. voltage is concerned.

Oscillator Coil

This is wound on a $\frac{1}{2}$ in. diameter former using 22 S.W.G. enamel for L_1 and 36 S.W.G. enamel for L_2. The tuned winding L_1 is spaced to occupy half an inch, and has eleven turns. L_2 has four turns, and is inter-wound at the earthy end of L_1. The coil former is $1\frac{1}{8}$ in. long, and is just filled with a piece of Ferroxcube rod.

The chassis diagram and photographs show the mechanical lay-out of the receiver quite clearly. The large potentiometer is the 5k. wire-wound regeneration control, and the smaller one is the R.F. gain control. The circuit is built with the oscillator-mixer at the right-hand back corner of the chassis. The I.F. stage then proceeds along the back of the chassis, and the detector valve is the one directly in front of the second I.F. transformer. The tube on the extreme left is the audio amplifier. The toggle switch at the right is the on/off switch for the whole set. There is no need for a switch in the H.T. lead, since there are no bleeder circuits that would draw current from the B battery when the valves are switched off. The send/receive switch, it will be remembered, is on the transmitter chassis. In the underneath view, the detector filament choke can be seen in front of, and slightly to the left of, the gain control potentiometer. It is mounted by means of an 10BA bolt passing through the chassis and through the small hole in the centre of the Ferroxcube pot.

The oscillator coil is mounted directly on its leads, these being made of stiff wire soldered to the lugs on the coil former, to which the coil wire is fixed.

MISSING AND STOLEN RADIOS

AUCKLAND:

H.M.V. five-valve, dual wave, "Argyle" model No. 525D, serial No. 25958, three tuning knobs, tone-control switch at rear of chassis, brown mottled plastic cabinet with white plastic grille, dial scale on slight angle at top of cabinet is integral part of chassis.

FRANKTON JUNCTION:

Autocrat, six-valve, 12-volt, broadcast auto radio; serial No. 12495; brown crackle finish.

HAMILTON:

Pye four-valve portable radiogram, serial No. R.29186; blue leatherette covering, four screws missing from turntable; size approximately 20 in. x 20 in. x 8 in.

Pye five-valve, bandspread, table model 95 TG, serial No. 61625; polished walnut cabinet, 13 in. x 18 in. x 15 in.

Pye three-speed, portable, model "R" radiogram, serial No. 63591; wooden cabinet, $6\frac{1}{2}$ in. x 14 5/8 in. x 14 5/8 in.; finished in dark blue art leather; weight, 21 lb.

WHAKATANE:

Autocrat eight-valve auto radio, serial No. 13407; cabinet 9 in. x 8 in. x 3 in.; in new condition; two knobs on front and open dial.

TE PUKE:

Autocrat six-valve, 12-volt auto radio.

TAIHAPE:

Ford eight-valve, 12-volt auto radio, serial No. 10782; brown metal cabinet with vibrator unit in brown metal oblong cabinet.

FEILDING:

Philips Model 375A, five-valve, dual-wave radio; serial No. 73900, Royalty No. 135788.

PALMERSTON NORTH:

Ultimate five-valve table-gram., serial No. 174170; in light oak cabinet.

Courier portable electric radio, serial No. R.A.W. 167864; in brown bakelite cabinet.

WELLINGTON:

Ariel seven-valve auto radio, serial No. 3620; brown enamelled welded steel cabinet, 9 in. x 8 in. x $5\frac{1}{4}$ in., with 4 in. x 6 in. elliptical heavy-duty speaker; two control knobs.

H.M.V. 12-volt auto radio, serial No. 15226; black metal case with dial figures and station selecting needle red; volume and selection knob black.

Autocrat five-valve, 6-volt "Universal" auto radio, serial No. 23496; radio and speaker in single unit, brown metal cabinet with two tuning knobs.

H.M.V. mantel model in fairly old cream plastic cabinet, 12 in. x 8 in. x 6 in.

H.M.V. "Radiomobile" speaker and tuning unit, serial No. 15375; speaker unit dark brown metal cabinet with crackle finish; tuning unit in light fawn plastic cabinet with two black tuning knobs.

H.M.V. "Universal" eight-valve auto radio, model 536/A, serial No. 40775; two control knobs with chrome disc missing from centre.

H.M.V. "Radiomobile" six-valve auto radio, model 496 A/R, serial No. 15824; cream enamel cabinet with two selection buttons.

Autocrat five-valve, 12-volt auto radio, serial No. 19751; radio and speaker in single brown metal cabinet with fine wire-mesh speaker grille; 6 in. dial with black figures.

CHRISTCHURCH:

Bell five-valve broadcast mantel model, serial No. 4601; brown bakelite cabinet, 11 in. x 7 in. x 5 in.

Rolls all-wave mantel radio, in brown varnished cabinet, 18 in. x 10 in., with oblong dial.

Assembling Special Valves Under Dust-free Conditions

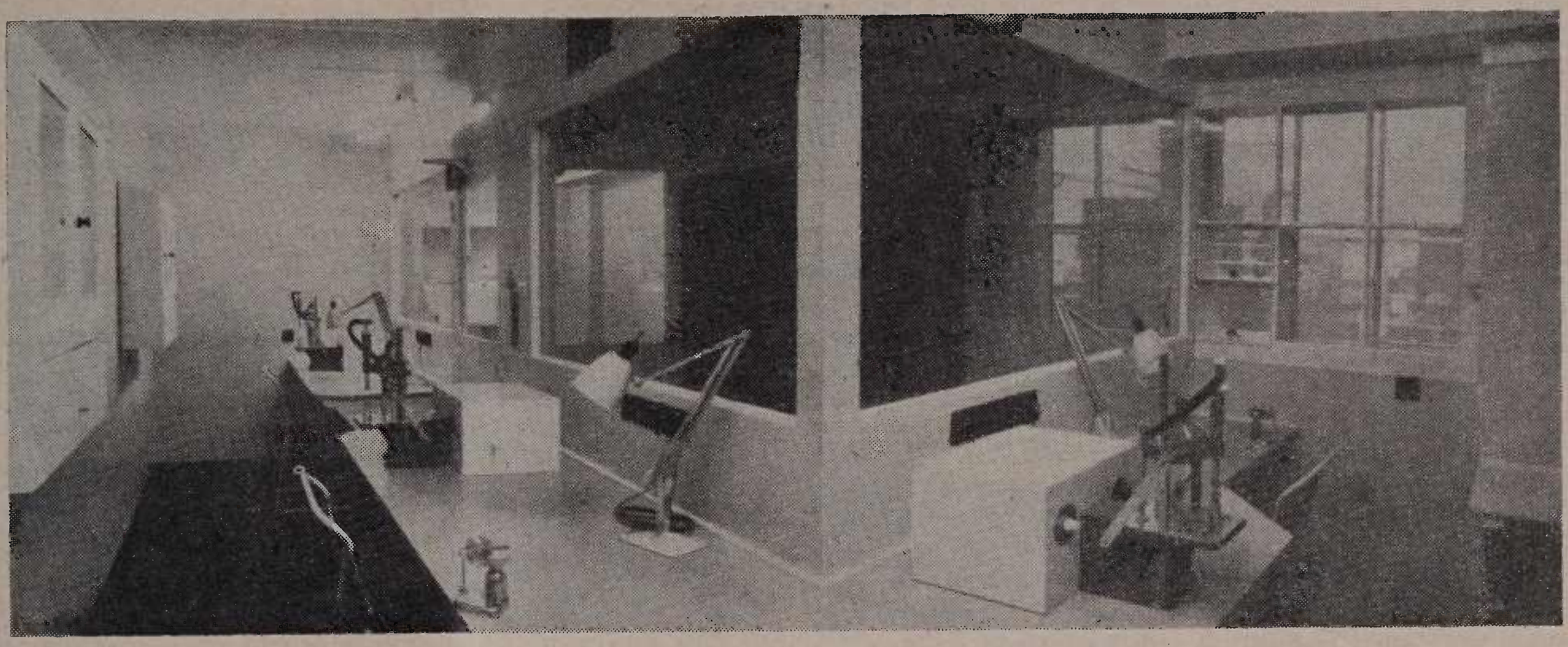


FIG. 1.—*General view of the "dust-free" rooms at the Research Laboratories at the G.E.C. for the assembly of special valves.*

In certain industrial manufacturing processes the presence of dust in the atmosphere seriously affects the quality of the product and may even add to the difficulties of production.

This is particularly the case in the assembly of special radio receiving valves, which have been in increasing demand in recent years. Certain of these valves contain grids wound with about 500 turns per inch and have interelectrode clearances of about one-thousandth of an inch. Particles of dust, cloth fibres and other airborne impurities, generally known as "lint", would, under normal working conditions, enter these valves during assembly. They cannot be removed during subsequent processing and some would eventually settle on the electrodes, causing premature failure of the valves during operation.

The high degree of reliability now required of these valves has led to the recent construction of specially designed "dust-free" rooms at the Research Laboratories of the The General Electric Co. Ltd., of England, where the valves are assembled. The space used measures 11 ft. x 20 ft. x 8 ft. high and is divided by hardboard partitions containing large sheets of plate glass. The resulting arrangement, shown in Fig. 1, gives a large "L"-shaped room, an additional rectangular room, and a small air lock which serves as a robing room.

The materials and colour schemes were selected with considerable forethought in collaboration with the Building Centre and the Building Research Station. The rooms receive little natural light, and every attempt has been made to make them pleasant to work in, within the limitations which dust-free conditions impose.

The egg-shell blue walls and white ceiling are given semi-matt finishes to avoid excessive disturbing reflections from the overhead fluorescent lighting, while wooden doors and partitions are covered with high-gloss cream paint. Tubular steel chairs have dark yellow frames with light brown plastic seats and backs. This style of chair has no padding of loose fibrous material. The floor covering of highly polished dark red linoleum adds warmth and colour to the pastel shades of the rooms. Benches, faced with green scratch-resisting Warerite, tool cupboards and hot cupboards, were carefully designed to produce the minimum of dust during use. Where possible, apparatus is enclosed in smooth metal boxes, and exposed metal parts such as vices and welding sets are electroplated or painted for ease of cleaning. These, and other minor details of design, combine to create a highly efficient working area with an entirely clean and pleasant appearance.

The ventilating system, housed in a gallery above the assembly rooms, draws in air from outside the building, filters out particles of dust more than 5 microns in diameter (1 micron = 0.001 mm.), and delivers 1,000 cu.ft. per minute of clean air to the workrooms below. This results in a complete change of air in the "L"-shaped room every 2½ minutes. The temperature of the air entering is regulated by a thermostatically-controlled 10kW. electric air heater mounted in the duct. Air leaves the rooms through non-return louvres built into each of the doors, and escapes into the main laboratory via the air lock.

Having supplied the rooms with clean, filtered air, it is equally important to prevent dust and "lint" entering from other sources such as operators' clothing. This is accomplished by keeping the traffic in and out of the rooms to a minimum and by providing all operators with special overalls free from loose fibres. The operators themselves are carefully selected for this assembly work and the maintenance of a high standard of cleanliness in the rooms depends on them to a great extent. They wear nylon overalls, buttoning at the neck, wrists and ankles, and fitted with a zip-fastener at the front. A nylon cap to cover the hair and leather slippers in place of shoes are also supplied. This clothing is stored in the air lock, where the operators change before entering the clean rooms. Our cover picture shows an operator at work in one of the rooms.

RECORD TALK

By JOHN GRAY

Festival have lately built up a substantial stock of extended play 45s in the popular market. On each you have four up-to-date tunes and the artists are such as Ray Bloch (XP45-448) and the Mills Brothers (490). Those who would like to sample Burl Ives without going to the expense of a full scale LP may be directed to XP45-487, whereon the inimitable folk singer does "Casey Jones" and three others. In the popular LP releases, nostalgic memories of the thirties are contained in Mildred Bailey's disc, CFR10-560. She repeats some of her enduring hits including the one which virtually became her theme song, "Rockin' Chair", and the disc is logically called "Memories of the Rockin' Chair Lady". Louis Armstrong joins the Mills Brothers in a group of hardy perennials (CFR10-655) while Hazel Scott's piano antics in CFR10-546, provocatively and accurately labelled "Classics in Swingtime", will touch off endless arguments about this "desecration" of the works of the immortals. There's plenty to argue about, and Miss Scott herself has most impartial ideas about what constitutes a "classic", for her material ranges from a Bach two-part invention to Vincent Youmans' "Hallelujah!"

Festival's classical issues always contain one or two numbers which make the keen music lover sit up and exclaim "Well I never thought we'd ever have a recording of that", or, on observing the details of some opus seemingly conjured out of the blue, "I've never even heard of it." All this shows an enterprise which should not go unrewarded. I'm not suggesting that every obscure piece by Schnitzelsdorfer or Frangipangi or Fuzz (whom you won't find in any reference book, as I've just invented them) is necessarily worth dragging into the light of day and perpetuating on a record. And it may be whispered that in one or two recent cases, the revival of neglected works by neglected composers has merely provided resounding justification for continuance of the neglect. But there are quite a few thoroughly enjoyable pieces which have fallen by the wayside through no fault of their own, and one is Rachmaninoff's first symphony, in D minor (Stockholm Radio Orchestra, CFR12-176). It's always interesting to hear the early works of a master so popular as Rachmaninoff now is, and this symphony should disappoint nobody. And some of the most attractive eighteenth century music is to be found in the work of Bach's sons. Perhaps the greatest of them was Karl Phillip Emmanuel, who is represented by a piano concerto and two short symphonies of "Sinfonias", loving performed under the direction of Henry Swoboda on Westminster WL 5040. Of the more regular classics, Schubert's fourth, "Tragic", and Mendelssohn's fourth, "Italian", symphonies are coupled on Vox PL 7860 and played under the direction of Otto Klemperer by the Lamoureux of Paris and the Vienna Symphony Orchestras respectively. One of Schubert's last and finest works, the Mass in E flat, is given by a Viennese ensemble under Rudolf Moralt on Vox PL 7840.

The Delta Trading Company have a strong line-up under their wing—Nixa, Argo, and Deutsch Grammophon with its companion "Archive Series", covering the whole early period of musical history. The Archive series is of a comprehensiveness that staggers the imagination. Among the releases more or less on the beaten track we find a set of the Brandenburg Concertos, scaled right down to the original chamber ensembles for which they were written; a vigorous, complete version of Handel's Water Music played by the Berlin Philharmonic under Fritz Lehmann (APM 14006) and the two well known Bach cantatas for bass voice. Nos. 56 and 82, effectively sung by Fischer-Dieskau (APM 14004). From the regular D.G. catalogue we have a splendid version of Schubert's great C major symphony by the Berlin Philharmonic under Furtwangler (18015-6). Comfortably spread over three sides, the music is spaciously set forth by the conductor and engineers, and the fourth side has an equally good performance of Hydn's Symphony No. 88. Recently several companies have produced discs containing both of the Liszt piano concertos. The D.G. one is well to the fore in this particular race, for the playing of Andor Foldes with the Berlin Philharmonic under Leopold Ludwig (DGM 18133) leaves nothing to be desired. I may be allowed the opinion that D.G. have also produced the best recording I have heard of Beethoven's ninth symphony, but it has not yet been released outside Germany and the set to which I listened had been procured from there by an enthusiast. The work is conveniently and economically presented on one small disc and one large one, and the performance is by orchestra and chorus of the Bavarian Radio under Eugene Jochum. There are also several very fine discs by our current visitors, the Koeckert String Quartet, traversing mostly the well known Beethoven-Haydn-Schubert repertory.

The interesting line of Argo records has a rare delight in a collection of "Songs of Jamaica", as sung by the superb Edric Connor (RG 33). It's good news that Connor has been signed to make more records for this firm.

The Philips procession of pop records goes merrily on; they have been rummaging in some vault or other and have come up with a couple of Glen Millar "originals" in the form of "Time On My Hands" and "I've Got Rhythm", which are now offered on B 21542. Percy Faith has two winners in "Suddenly" and "Genevieve" (B 21174) and the richness of sound produced by Kostelanetz does everything possible for "April in Paris" and "Sweet Surrender" as released on B21500. The Four Lads, now well established among the leaders in their field, have two curiosity-provoking titles in "Dance Calinda" and "The Average Giraffe" (B 25578), and Ken Griffin is on hand to please his many admirers with the everlasting "La Paloma" and "La Golondrina", coupled on B 21541. The Philips classics are mostly standard works this time: Beethoven's ninth symphony turns up again in a version by the Hague Residency Orchestra and the Amsterdam Toonkunst Choir under Willem van Otterloo (ABL 3030-1, three sides: the fourth has the Symphony No. 8 by the Berlin Philharmonic under Paul van Kempen). I have not been able to hear this set, but one respected English source values it very highly. There is also an "Emperor" concerto by Cor de Groot with the Hague Orchestra, again conducted by Otterloo (ABL 3032). Another very interesting, if seemingly more debatable production is an actual performance of Bach's St. Matthew Passion under the late Mengelberg, recorded in 1939 (ABL 3035-8). Mengelberg's ideas about interpretation have infuriated the Bach experts and needless to say the recording itself is not of the quality we would expect nowadays, but the performance must have something, since most of the sternest critics end their reviews by recommending it! One calls it "this maddening yet fascinating performance". I should say the set would be worth having for the sake of its historical interest, and the presence of the veteran German tenor, Karl Erb, in the role of the Evangelist—no European tenor of our time has ever surpassed Erb's interpretation of this music. Despite its eight LP sides, the work has been rather extensively abridged.

Prokofieff's sparkling third piano concerto is obtainable on a ten-inch LP (ABR 4022) as played by Alexander Uninsky and the Hague Orchestra under Otterloo, and the same orchestra and conductor have coupled Grieg's two "Peer Gynt" suites on ABR 4027, enlisting the aid of soprano Erna Spoorenberg to sing Solvieg's Song. Another soprano makes her appearance on BBL 7008. All I need say is that her name is Anna Russell.

Nat "King" Cole's latest success is "Darling Je Vous Aime Beaucoup" (Capitol CPL 391) coupled with "The Sand and the Sea", and he has another hit in the shape of "A Blossom Fell," which will be marketed by the time you read this. Les Paul and Mary Ford on CP 413 are on the old letter-writing theme, this time it is "No Letter Today", backed by a tuneful little number called "Genuine Love". But the most entertaining trifle currently on Capitol is Les Baxter's version of "Cherry Pink and Apple Blossom White", wherein the music runs down alarmingly and just as speedily recovers. You think something has gone wrong with either your motor or the power supply, and then, a little further on, the same thing happens again. This, however, is not a joke that will bear endless repetition.

Radio Corporation's LPs are worth investigating. On CLCX 034 they have a top flight interpretation of the Brahms violin concerto by Natan Milstein and the Pittsburgh Symphony under Steinberg that can stand comparison with any, and the same conductor's performance of Beethoven's Pastoral Symphony on CLCX 001 is in this class. Steinberg also conducts a group of Los Angeles wind players in the greatest of the Mozart wind serenades, that in B flat, K 361, on CLCX 037.

Louis Armstrong's gravel voice is heard nowadays almost more often than his trumpet playing, and he keeps up to the minute in his choice of material. Two recent hit paraders featured by him are "Ko Ko Mo" (Columbia DNZ 5072) and "Sincerely" (DNZ 5073). The phenomenally popular Slim Whitman will not disappoint his fans with "When I Grow Too Old to Dream" and "Cattle Call", which are on London HL 1027, and June Valli is among the first in the field with "Unchained Melody" (HMV HR 10087). More Glen Miller! Seldom can so many of an artist's records have been issued such a long time after his death. "Tuxedo Junction" and "King Porter Stomp" are to be had again on HMV EA 2541. Half a dozen cowboy titles by Wilf Carter released on Columbia DO 70156-8, are worth noticing. They are attractively sung and nicely recorded. And once again HMV have revived a number of older favourites. There will be a warm welcome for four Regal-Zono titles by pianist Gil Dech, whose disc of "Remembrance" is seldom missing from request sessions. Here it is again on G 21186, with its companion "Moonlight on the Danube". Another issue contains the almost equally popular "Robin's Return" backed by "The Two Larks" (G 21997). And there is a perennial seller in the old John Charles Thomas coupling "The Lord's Prayer" and "Just for Today" (HMV EC 30). We may sit back and watch the rush for Arthur Askey's "The Proposal" (C 3173) and dear old Harry Tate's "Running an Office" (Columbia DOX 524).

One of our latest musical visitors, Larry Adler, has been familiar on records for years. How many remember his pre-war Regal-Zonos, relics of the days before he ascended to the higher spheres of music making? As we know, Adler still keeps a foot firmly in each musical world, and HMV have made available some of his attractive lighter efforts—"La Mer" and "Shadow Waltz" on B 10672 and "Bach Goes To Town" and "Someone to Watch Over Me" on DO 3666. Those looking for permanent evidence of the heights to which Adler's humble instrument can climb may procure the Arthur Benjamin concerto and the Vaughan Williams Romance, both specially written for him and recorded on Columbia 33S 1023.

This brings us to LP and another HMV avalanche. Right at the top I would put Verdi's "Falstaff" in an incandescent performance under Toscanini (ALP 1229-31). This, like all the Toscanini HMV operas, originated in a radio broadcast made over the N.B.C. some years ago, but let no one be deterred by the fact. The glorious score (wrongly regarded as an opera for specialists rather than the regular Verdi public) comes to pulsating life under the old maestro's touch. Toscanini is on more debatable ground with Ferdi Grofe's Grand Canyon Suite (ALP 1232). Shall I be accounted a snob for suggesting this music is just not worthy of his attention? On the other hand, a first-class performance such as he secures may cause some to reconsider this picture postcard epic. The other HMV releases include a further instalment of Arthur Rubenstein's Chopin series—the Preludes, complete on ALP 1192, and two discs of French music conducted by the brilliant young Guido Cantelli, Debussy's "La Mer" and a suite from "The Martyrdom of St. Sebastian" on ALP 1228, and the Cesar Franck symphony (always classed as French music though the composer was in fact a Belgian) on ALP 1219. The Greig piano concerto turns up once again on CLP 1037; the soloist is Moura Lympany, and the record is worth noticing, not least because of the companion piece, which is Rachmaninoff's rarely heard and very listenable Concerto No. 1. Colin Horsley is the protagonist in a very interesting ensemble disc containing on one side Mozart's quintet for piano and wind instruments and, on the other, Lennox Berkeley's Trio for piano, violin and horn. He is joined in this latter by Manong Parikian, the Philharmonic Orchestra's leading violinist, and by the indispensable Dennis Brain. A "recital of baroque organ music" is given by Piet Kee on DLP 1053. "Baroque" is an even vaguer expression than usual here, for the music ranges from Sweelinck right up to Max Reger. Meanwhile Fernando Germani continues his mammoth task of recording all the Bach organ works. The last three of the six sonatas have appeared on CLP 1026; he uses the organ of All Souls' Church, Langham Place, London.

Columbia seem to have the most interesting repertoire of the EMI group nowadays. It was, for instance, a brilliant idea to combine the four Mozart Horn Concertos on to one record, though perhaps only the presence of so exceptional a player as Dennis Brain is guarantee against monotony. In any case, few people will want to play all four at once. But they are glorious music, and the soloist is given superb backing by the Philharmonia Orchestra under Herbert von Karajan (33CX 1140). Seemingly Karajan has yet to make a poor record. His latest major release, on 33CX 1206, is the Berlioz "Symphonie Fantastique", which receives what I am tempted to call a "once and for all" performance and recording. The hi-fi fans may be directed straightaway to the fourth movement ("March to the Scaffold") and all who have longed for a really adequate presentation of the most popular Berlioz major work need look no further. Then there is the latest "Cavalleria Rusticana", economically available on three sides of 33CX 1182-3, a La Scala production featuring the well-tried combination of Maria Callas and Giuseppe di Stefano in the leading roles. The melodramatic old shocker is done superbly, and once again Callas demonstrates that she can sing practically anything, though some may consider that the older operas are more worthy of her well nigh unique talents. There is another major operatic event in this release—"Der Rosenkavalier", conducted by Erich Kleiber with the complete ensemble of the Vienna State Opera on four Decca discs, LXT 2954-7. This uncut version is one of the great performances of our time, on or off records. An almost identical cast has been chosen to appear in it when the Vienna Opera House is re-opened in November. One would single out especially the magnificent Octavian of Sena Jurinac and the Baron Ochs of Ludwig Weber, but there isn't a weak link in the cast and the recording approaches the ideal. The orchestra is also heard in two hefty symphonies of the Viennese school, Bruckner's third conducted by Knappertsbusch (LXT 2967) and Mahler's first under Kubelik (LXT 2973). My own preference is for the Mahler which is one of his most colourful and approachable works, and is the first really up-to-date recording to be made available here. It makes a splendid introduction to the composer's highly individual orchestral style.

Chief among the lighter LPs comes a whopping great package simply labelled "Bing" (Brunswick LAT 8051-5). This is a musical autobiography of the greatest popular singer of our age, recalling something like 80 of his songs, compered by himself, and running for more than four hours. In some cases early recordings have been dubbed in, but for the greater part the favourites are newly sung. You will have to take all or nothing, since the five records (attractively assembled in a box) are sold as a unit only. Bing is represented also on LA 8674 whereon he renders a number of today's hits and is joined by his son Gary in at least one of them.

Many of Decca's popular artists are featured on 10-inch LPs; there is a melodious collection by Vera Lynn (LF 1183) harmony from the Stargazers (LF 1186) and melody from Mantovani (LF 1191). Other sure-fire attractions for middlebrows comprise a collection of musical comedy favourites by Andre Kostelanetz and his Orchestra (Columbia 33SX 1037), some favourite Hawaiian melodies rendered by Ken Griffin with guitar support from Andy Nelson (33S 1057) and, for the dancing public, further packages from Victor Silvester (33S 1062) and Joe Loss (HMV DLP 1068). The indestructible Benny Goodman "rides again" on Columbia 33SX 1038, with "Clarinet a la King", "Six Flats Unfurnished", "Darktown Strutters' Ball", and seven other vintage titles included. Jazz fans will also note issues by Jelly Roll Morton (DLP 1071) Fletcher Henderson (DLP 1066) Duke Ellington (DLP 1070) and Johnny Dodds (DLP 1073), and drummers will be interested in Gene Krupa's collection recorded on 33S 1051 under the title of "Drummin' Man".

PUBLICATIONS RECEIVED

From Amalgamated Wireless (Australasia) Ltd.:
- Aerial, April, 1955.

From Philips Electrical Industries of N.Z. Ltd.:
- Electronic Application Bulletin, Vol. 15, No. 6, 1954.
- Philips Serving Science and Industry, Vol. 1, No. 5, 1954
- Philips Technical Review, Vol. 16, Nos. 2 and 3, August and September, 1954.
- Communication News, Vol. XV, No. 1, August, 1954.

Droste Verlag u. Druckerei K.G., Pressehaus, Dusseldorf, Germany:
- German Exporter—Export Journal of the German Industry, 11/1955.

Radiofabrikantforeningen, 6 Kollegievej, Copenhagen CHL., Denmark:
- Export Edition of the Danish Publication, "Dansk Radio Industri, 1955."

From Data Publications Ltd., 57 Maida Vale Road, London:
- Radio Reprint No. 2: Frequency Modulation Tuner Units for Fringe and Local Area Receptions.

From F. J. Edwards Ltd., England:
- Machine Tools.

General Publications Received:
- Break-in, Vol. XXVIII, No. 7, July, 1955.
- Boletin del Centro de Documentacion Cientifica Y Technica Vol. 4, No. 4.
- das elektron.
- Electrical Communication, Vol. 32, No. 1, March, 1955.
- Electronic Engineering, Vol. 27, No. 328, June, 1955.
- N..Z Electrical Journal, Vol. 28, No. 7, July, 1955.
- Radio Electronics, Vol. XXVI, No. 6, June, 1955.
- Q.S.T., Vol. XXXIX, Nos. 5 and 6, May and June, 1955.
- Radio Electronica, Vol. 3, No. 5, May, 1955.
- N.Z. Manufacturer, Vol. 6, No. 11, June, 1955.
- La Radio et TV Revue, Vol. 7, No. 6, June, 1955.
- Service, Vol. 24, No. 5, May, 1955.
- Journal of the Television Society, Vol. 7, No. 9, January-March, 1955.
- Wireless and Electrical Trader, Northern Radio Show Report, Vol. 98, Nos. 1283-5.
- Wireless Engineer, Vol. 32, Nos. 5 and 6, May and June, 1955.
- Radiotronics, Vol. 20, No. 6, June, 1955.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

When there's a better switch
ARCOLECTRIC will make it
New Zealand Agents
GREEN & COOPER LTD. WELLINGTON.

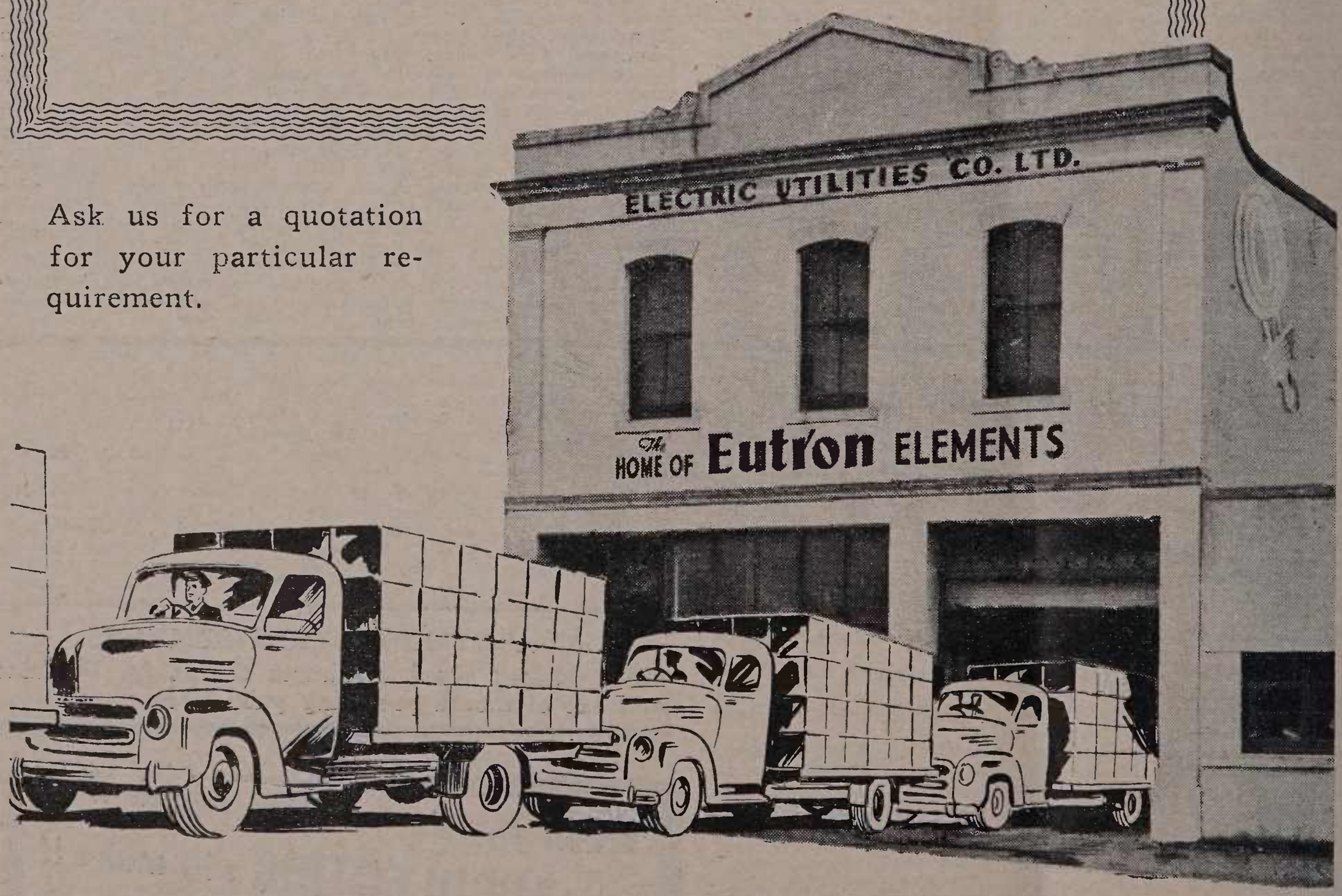
EUTRON manufacture

TUBULAR HEATERS

for all applications

AIR · OIL · RANGE
WATER · INFRA-RED
HEATING

Ask us for a quotation for your particular requirement.



ELECTRIC UTILITIES CO. LTD.

P.O. Box 3546 Head Office: 3 COLLEGE HILL, AUCKLAND Telephone 42-134

ELECTRICAL AND TRADE SECTION

TUBULAR HEATING ELEMENTS

(Reprinted from "Electrical Industries Export," Vol. 55, No. 2, 6 Cavendish Place, Regent Street, London)

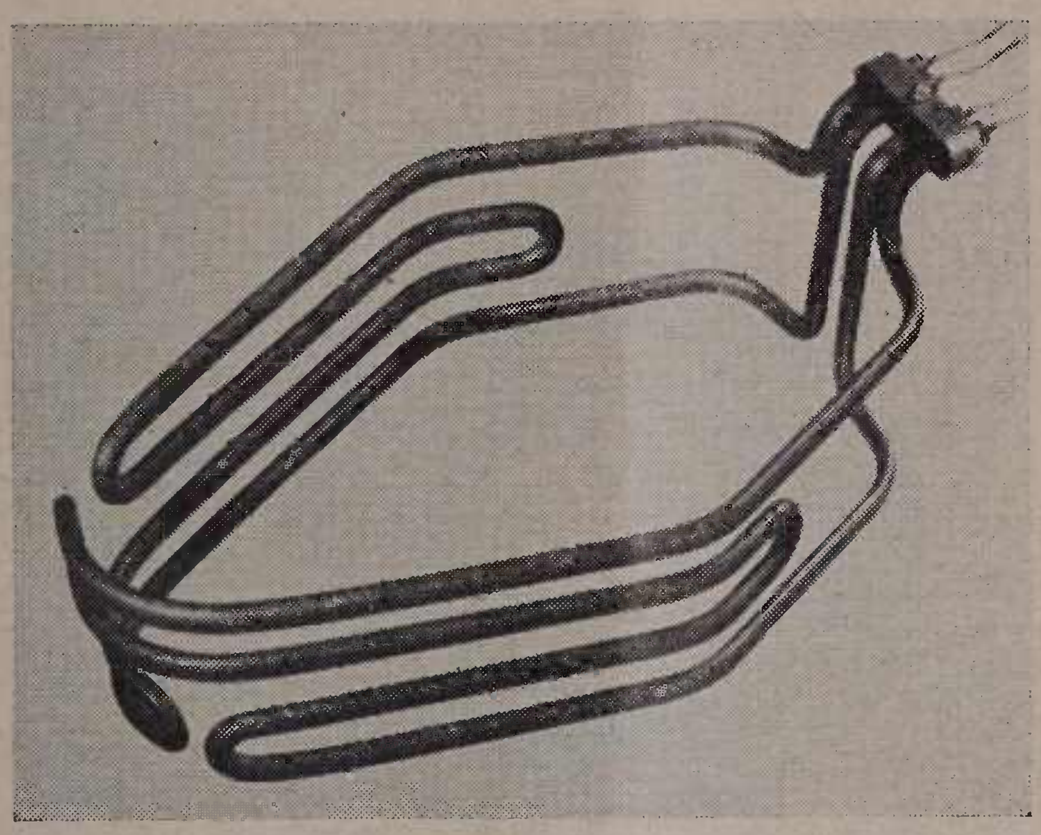


FIG. 1.— *Heating unit for a type-metal melting pot.*

Modern practice in the design of elements for cooker hotplates favours the tubular construction in which a spiral of resistance wire is enclosed in a metal tube, having a lining or filling or magnesium oxide.

This material, besides having good electrical insulating properties at high temperatures, has a very high thermal conductivity and enables the outer tube to run at a "radiant" temperature not much below that of the element wire itself.

The tubular element has so many advantages that it is being increasingly used for other applications even where operation at a radiant temperature is not required.

The Backer Electric Co. Ltd., of Yorkshire, one of the largest manufacturers of tubular elements in Great Britain, has supplied the following information about the problems involved, the manufacturing processes and the types of element produced.

Any heating element of the tubular type can be considered conveniently as being made up of four parts—the heat spiral, the sheath, the insulation and the mounting and connecting arrangement. Obviously these differ according to the nature of the application, the loading and other circumstances.

The material used for the heating spiral is either nickel-chromium or chromium-iron-aluminium-cobalt alloy.

Sheath tubes for boiling plates and similar high temperature applications (up to 800° C.) are made from "Iconel" on account of its heat resisting and anti-corrosive qualities.

For lower temperature uses, up to 550° C. such as oven elements, aluminium-brass alloys are largely employed. For applications that require elements casting into aluminium alloys, mild steel is generally employed. Monel as a sheath material is used for immersion in oils and fats and for certain other corrosive fluids and gases, also for general applications where the temperature does not exceed 475° C.

For elements to be used in dilute acids and metal melting pots (except zinc) stainless steel tubes are used. Copper sheathed elements are used for immersion heaters for water and other non-corrosive liquids.

It will be appreciated that the principal problem in the design and manufacture of these heating elements is the preparation and insertion of the magnesium oxide with which the tube is filled in

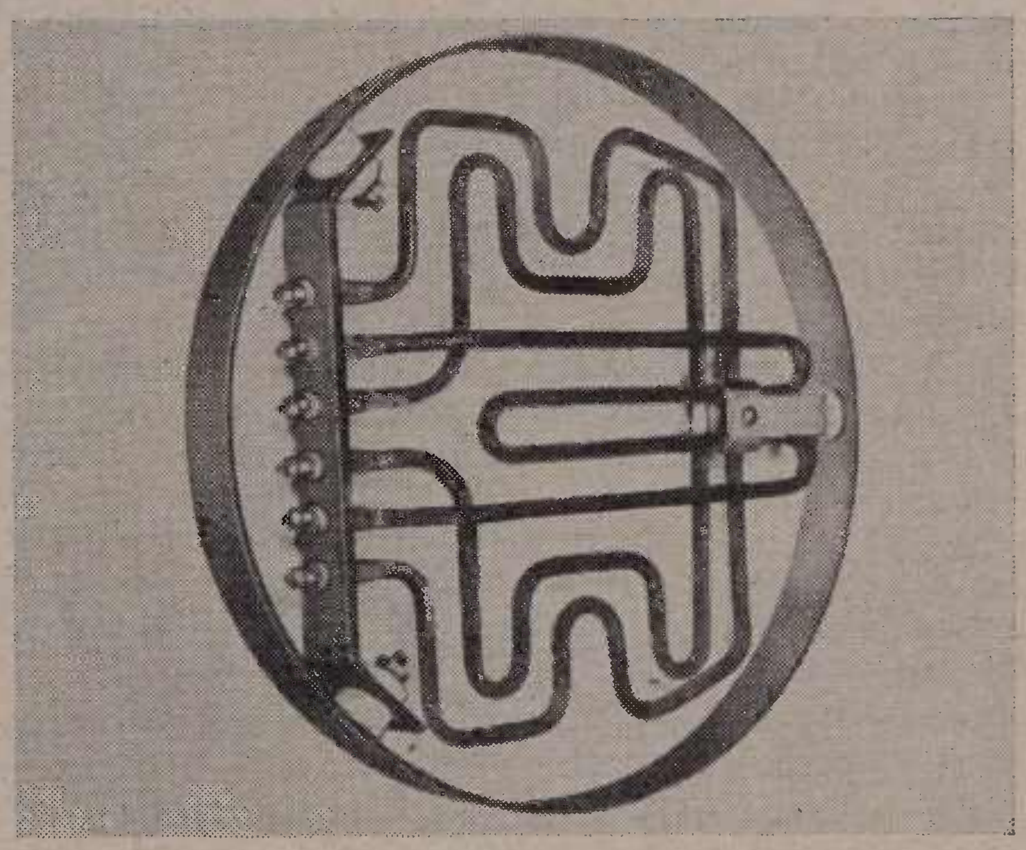


FIG. 2.—*A variable wattage element for an air heater.*

such a manner that efficient insulation is maintained at all times, in all positions, and at all temperatures, between the resistance spiral and the tube and between the individual turns of the wire. It is essential that the magnesium oxide be chemically pure and in the dehydrated crystalline state.

Melting point and electrical insulating properties are adversely effected by impurities while good heat conducting properties are related to the crystalline structure. The melting point of 99.9 per cent pure magnesium oxide is about 2,800° C.; it is inert to chemical reaction at all temperatures, and has no corrosive action on the resistance wire, even at a temperature near the melting point of the wire.

Another very important fact is that the heat conduction properties of magnesium oxide are a function of the density of the material, and compression therefore, improves this characteristic. Compacting or compressing the oxide also improves its electrical insulation properties and die-electric strength.

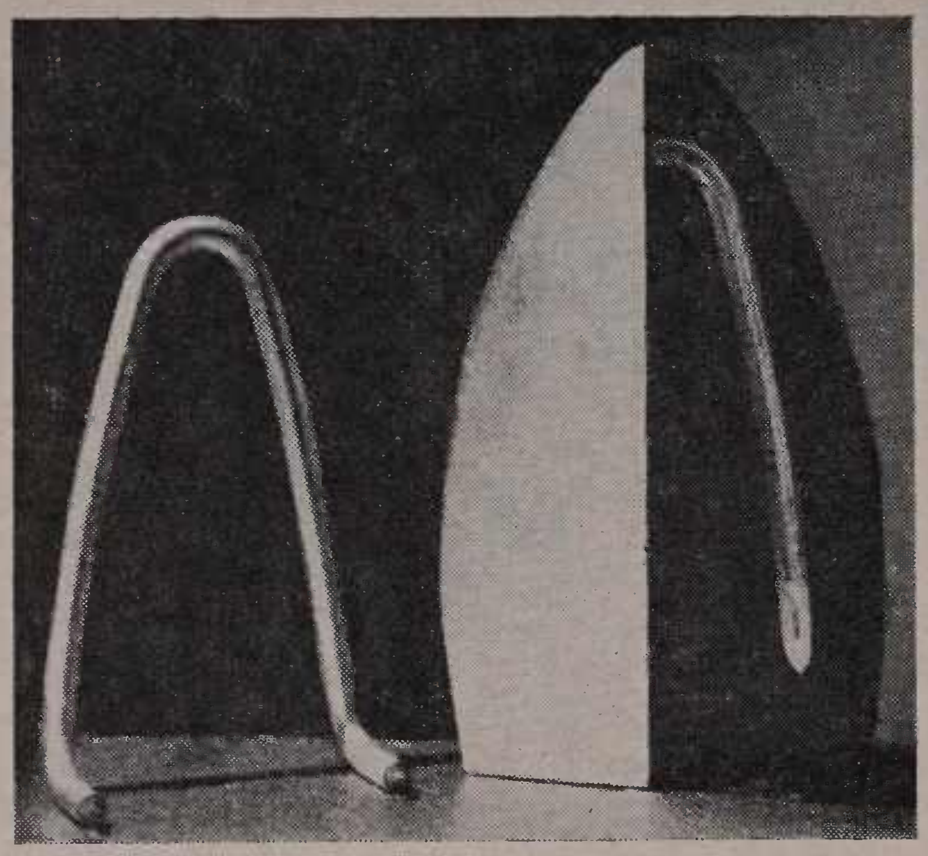


FIG. 3.—*Heating element cast into sole plate of electric iron.*

The factor of greatest importance in the design of heating elements is the temperature gradient between the embedded resistance wire and the external surface of the sheath. This factor imposes a limit to the surface operating temperature if a reasonably long life is to be obtained. In earlier types of sheathed element where the thickness of the insulation was of the order of 2mm. a difference of 230/250° C. was common.

In the present elements, where the insulation thickness has been reduced to 1 mm. or less, without loss of insulating properties, the temperature difference between the element wire and sheath has been reduced to less than 100° C. in high temperature elements. Thus a higher surface temperature, with higher loading and quicker boiling is obtained without impairing the life of the element.

In the Backer process of manufacture, the element spiral, enclosed in a cylinder of pure magnesium metal, is inserted in the tube sheath and the magnesium metal is then converted to magnesium hydroxide by oxidation in steam under pressure in an autoclave. It is then treated in an oven to dry off the excess water absorbed in the change in chemical composition.

Dehydrating is carried out in stages and the insulation is compacted following each stage. After initial drying the insulation is compacted by deforming the cross section of the tube in a press; then further drying out is effected at temperatures depending on the desired final properties, and thereafter, the insulation is again compacted. The final reduction is about 70 per cent. of the original volume. By this simple procedure the full advantages of the properties of crystalline magnesium oxide are secured, the practical results being as follows: (1) The necessary thickness of insulation is reduced to 1 mm. (in some cases to 0.7 mm.); this makes for highly efficient heat transfer from element to tube. (2) Dielectric strength is improved such that the elements will withstand a flash test of 2,000 to 3,000 V. cold, and 1,000 V. at maximum temperature reached on 40 per cent. overload. (3) Heat conductivity (with sp. w. 2.0) is improved to about 1.9 kcal/m3/deg. C./hr. (at 700° C.). (4) Leakage current is reduced to the order of 1.0 mA. per kW. of load at a tube sheath temperature of 700° C.; and finally, (5) temperature gradient between the element wire and surface of the tube is of the order of 80/90° C.

Not only is the radial thickness of insulation kept down to not more than 1 mm., but the insulation between turns of the element spiral can also be reduced to about 0.2 mm., which is fully adequate. This permits greater lengths of considerably thicker wire being utilized in an element of given dimensions, which further contributes to long life.

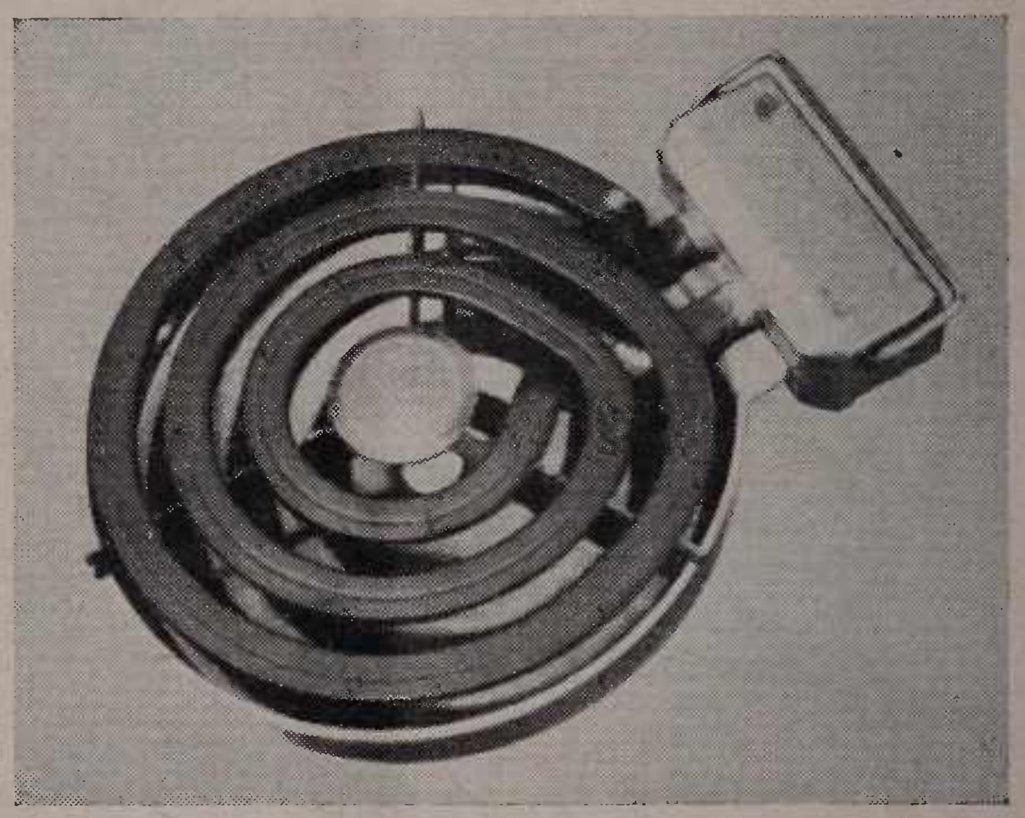


FIG. 4.—*The Backer type 8 MC multi-coil 1,800 W. boiling plate.*

TYPES AND MOUNTING

The elements are available in various cross sections as a result of the compacting operation, including square, rhombic, oval, elliptical, half round and certain other forms depending on the ultimate use and contact surface desired.

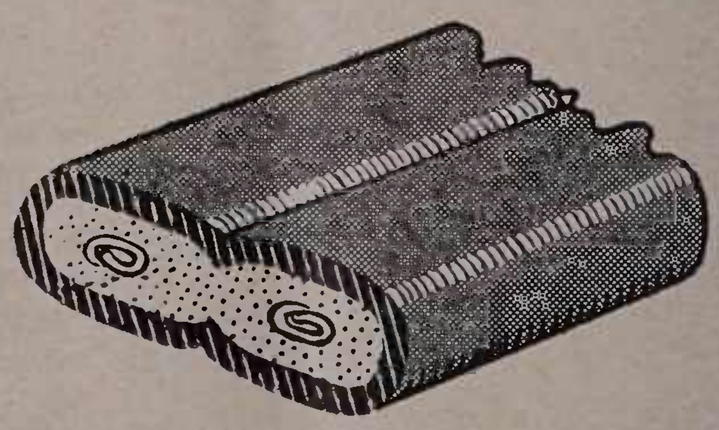


FIG. 5.—*Section of twin tube element.*

The standard method of making the termination is to bring the resistance wire end through a tube into which is threaded the stranded lead. The tube is then pinched up tightly in a press, a permanently sound contact being secured. The end of the tube is hermetically sealed with materials that are impervious to moisture.

Terminations are made in copper, nickel chrome or monel and can be fitted with porcelain beads or glass fibre sleeving as required.

Mounting arrangements depend mainly on the design of the appliance to which the element is to be fitted. So far as cooker boiling plates are concerned two main types are available—the British E.D.A. standard which is arranged to plug into a socket, and

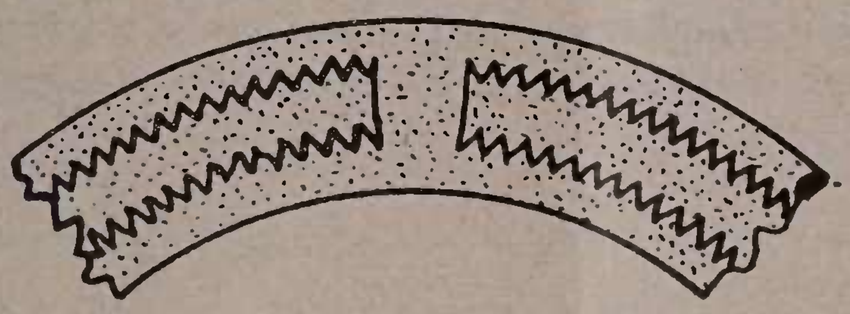


FIG. 6.—*The inner ends of the two spirals.*

the type in which the terminations are left as flexible leads as favoured overseas.

Backer elements for metal melting, air heating and for an electric iron (cast in) are shown in Figs. 1, 2, and 3.

BOILING PLATE CONTROL

In the case of boiling plates for cookers, it is necessary to provide adjustment of the heat developed, and two methods of doing so are in general use—by energy controller (Simmerstat) and by switching.

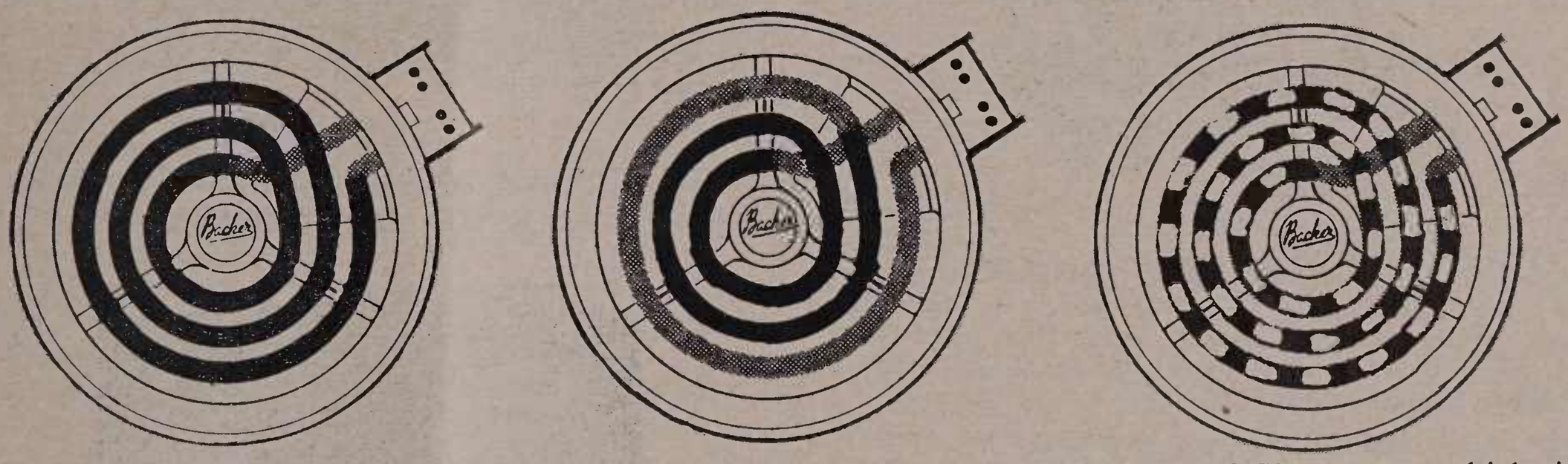


FIG. 7.—*Heat distribution of the Backer 8 in. multi-coil boiling plate—illustrating the feature of centre heat when used with a three-heat switch, in high, medium and low.*

In the energy controller system the plate has usually one heating element of fixed wattage and the energy controller is arranged to make and break the circuit periodically. The ratio of "on" to "off" is adjustable by moving the control knob. Maximum heat is obtained when the element is in circuit continually, minimum heat when the element is switched on for a very short period and then off for a long period. Intermediate ratios permit any degree of heat.

There are many varieties of switch control—the most common being the three-heat system in which, by using a two-element plate in conjunction with a rotary switch, the two elements are connected in parallel for maximum heat, one element only is brought into circuit for medium heat, and both elements connected in series for low heat.

Earlier designs of boiling plate for this arrangement had separate elements—one for each control.

In the latest Backer designs, two spirals are enclosed in a twin tube in the manner shown in Figs. 4 and 5.

As an alternative to the two resistance spirals lying side by side throughout the length of the tube, they may also be so arranged that one spiral starts at one end of the sheath and, after having run halfway through the sheath, it returns to the same end whence it started. The other spiral is arranged in a similar way in the other half of the sheath. The result is that the outer convolution of the boiling plate is heated by one of the spirals, and the inner convolution by the other spiral.

Fig. 6 illustrates the return arrangement of the spirals.

The effect of this is that, using the normal three-heat control, all the unit is in circuit at full heat, only the inner turns at medium heat, and all the element at low heat, as shown in Fig. 7.

With resistance spirals of 990 W. and 810 W. as used in the Backer 8 MC. plate (E.D.A. model or type 8 DXC) this gives 1,800 W. on full, 990 W. on medium and 445 W. on low heat. The important advantage of the construction is that on medium heat it is only the inner convolutions that are in circuit and thus small utensils can be heated without loss of heat from the unused outer convolutions—as occurs with single coil designs.

Energy control can also be applied to this plate by using a special form of Simmerstat which, in the full position, switches the whole plate on to full heat continuously; at another setting the centre coils only are at full heat continuously, and below this setting Simmerstat graduated heat control is applied to the inner turns only.

Another method of selective heat control giving up to nine different working temperatures employs a three-section hotplate in conjunction with a 6, 8, or 10 position rotary switch (Backer type 87 BT).

With element wattages of 675 (outer), 868 (inner) and 275 (centre) and a 10-position switch, it is possible to obtain the following nine gradations of heat—1,800, 1,125, 868, 636, 380, 257, 220, 197, and 153 W. The remaining switch position is, of course, "off".

"NEW PRODUCTS" PRICE CORRECTIONS

We offer our sincere apologies to Messrs. Pye (N.Z.) Ltd., and G. A. Wooller & Co. Ltd., for having incorrectly quoted the prices of the following "New Products" which were featured in our May and July, 1955, numbers.

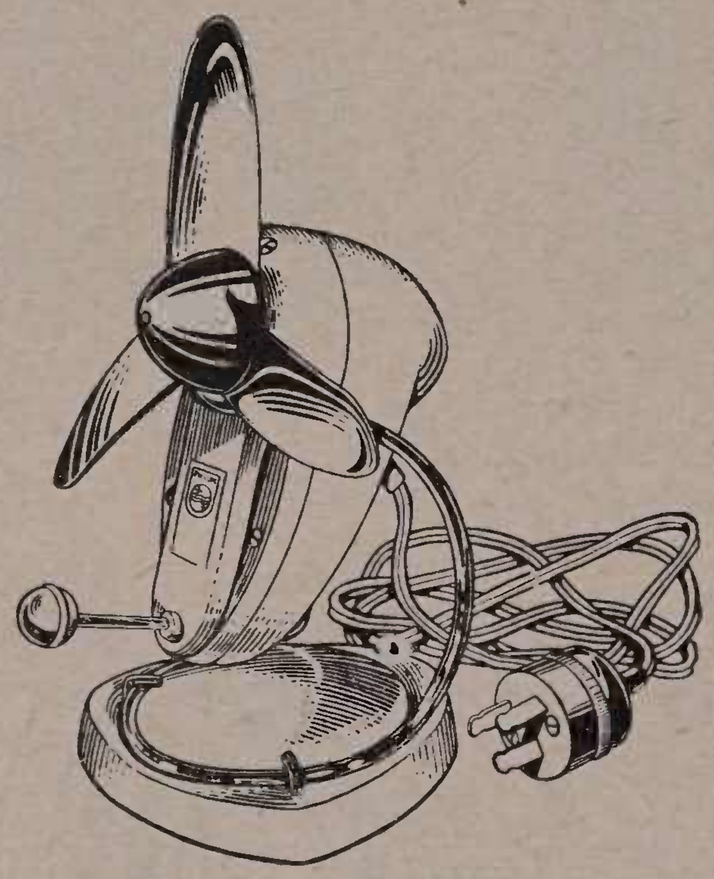
The correct prices are quoted hereunder against the appropriate product.

PYE MODEL 95 TG	£58 10s. 0d.
CLIPPER MODEL R24	£37 7s. 6d.
CLIPPER MODEL R28	£28 10s. 0d.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

PHILIPS INTRODUCE THE "PERSONAL" ELECTRIC FAN



In entering the small "personal" electric fan market Philips are breaking into a field which is virtually untapped. A comparable, small, reasonably priced yet highly efficient article has never before been offered on the New Zealand market.

In the countless cases where a "personal" electric fan would be a tremendous aid to their comfort and wellbeing, people have had to do one of two things:

(a) Do without, because of the unsuitability and high cost of the standard type of fan; or

(b) "Make do" with a fan which is not really suitable for the job they want it to do.

In most cases where a standard type of fan is used in homes or in small offices, it is found that, in order to avoid dangerous draughts, either it must be placed at the other end of the room or directed well away from the person it is supposed to cool. Alternatively, with expensive fans fitted with a speed regulator, if one is prepared to waste current, the fan can be run at low speed. If any of these things have to be done, it is clear that the fan is definitely not suitable for the job.

The Philips "Personal" Fan suffers from none of these disadvantages because it is specially designed for "personal" cooling.

But, although Philips have called it a "Personal" Fan, this doesn't mean that its usefulness is restricted to the cooling of one person. On the contrary, it is ideal for cooling small groups of people—as, for example, a bridge foursome. Despite its small size, it moves a remarkable volume of air—**silently and economically.**

The Philips "Personal" Fan is small and light in weight—instantly adjustable to **any** angle, either standing or hanging. The angle is selected by means of an extension knob, which also operates a built-in on-off switch.

Scientific propeller design and a smooth-running motor ensure really silent operation. It's ideal for the office, bedroom, sickroom, nursery . . . in fact, wherever a gentle, silent cooling breeze is required.

The fan is of shockproof all-plastic construction, with ivory base and body and coloured three-bladed propeller. No guard is necessary because the plastic propeller blades are flexible and have no sharp edges.

Technical Specifications:

Propeller diameter: 6¼ in.
Propeller speed: 2,000 r.p.m.
Motor: The proved Philips gramophone motor.
Lubrication: Sealed-in lifetime lubrication.
Power consumption: 9.5 watts.
Mains supply: 200/250 volts, 50 c/s. (A.C. only).
Price: £3 9s. 6d.

* * * *

ULTIMATE 7-VALVE BANDSPREAD MANTEL "DRUMMOND"

The popular Ultimate 7-valve bandspread mantel receiver has been modified and reissued in a new cabinet. This set is a well-tried and well-proven performer on both broadcast and shortwave and is in excellent demand.

The circuit is right up to date and features the well-known pentonic tone control which gives five distinct tone settings, each with its own tone network. The settings are: treble, normal, bass, increased bass, and high fidelity, and each gives rich deep tone that will do justice to any programme. A new magic eye makes provision for accurate tuning on both weak and strong signals, and will be a valuable feature.

The cabinet has been modified and features new and rich American walnut veneers. The plain wood parts of the old cabinet have given place to these veneers, and the general appearance of this excellent set has been enhanced.

Shortwave coverage includes both the 13-metre and 80-metre bands, and keen shortwave listeners will be quick to recognize the value of this shortwave coverage.

Specifications:

Valves: 6X4 rectifier, 7C6 second detector, 7S7 oscillator mixer, EF22 R.F. amplifier, EF22 I.F. amplifier, EL33 output tube, EM34 magic eye.

Speaker: 8 in. P.M. Rola.

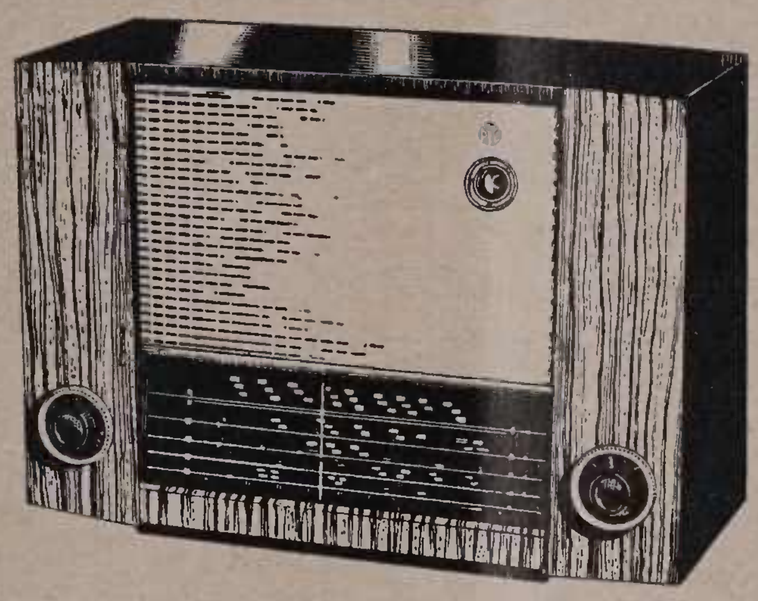
Dimensions: 13¼ in. high, 24 in. wide, 11 in. deep.

Coverage: 550 to 1600 kc/s. on band 1; 41, 49, 80 metres on band 2; 25, 31 metres on band 3; 16-19 metres on band 4; 13 metres on band 5.

Price: £56.

* * * *

ADVANCED TECHNICAL DESIGN PLUS GOOD LOOKS IN PYE 7-VALVE SET.



Where radios are concerned, Pye have always maintained that "it's the inside that matters". This however, does not deter them from producing exceptionally fine cabinets. To prove the truth of this one has only to see their new model 92.

Viewed from the point of performance, this 7-valve, 5 waveband set combines all the latest radio features:

1. Twin vision tuner to eliminate guesswork in tuning.

2. Bandspreading to greatly simplify station selection.

3. Tone control, continuously variable to suit each listener's individual need.

4. Concentric, illuminated dial knobs for easy finger-tip manipulation of the set.

5. 'Gram input sockets suitable for Magnetic, Ceramic, or Crystal pick-ups.

6. 8 in. Permanent magnetic speaker for remarkable, high quality reproduction.

7. Well designed chassis, fully tropicalized.

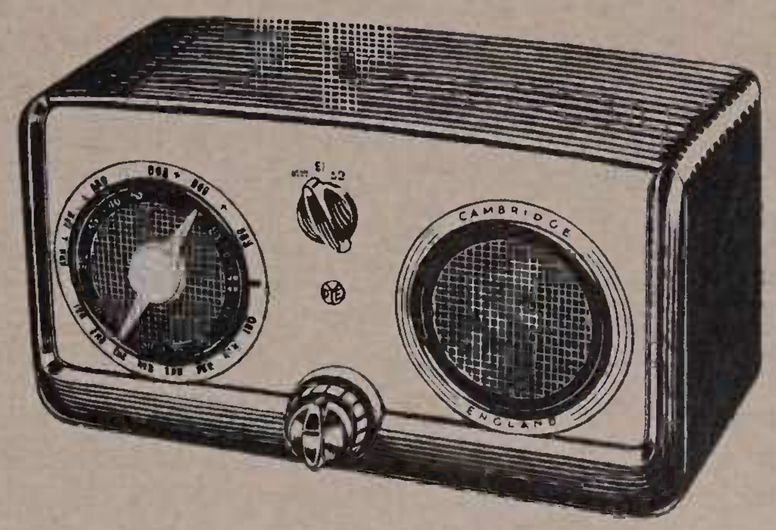
The cabinet design is tastefully modern. For the finish two unusual and attractive veneers have been used, the front veneer being Zebrano with a contrast of dark walnut on the top and sides. A brilliantly lit tuning scale adds extra colour. Cabinet dimensions: 20 in. long, 13¾ in. high, and 8¾ in. deep.

This model 92 must certainly appeal to discriminating listeners. Its retail price is just £44 6s. 6d. throughout New Zealand, and the radio is distributed by Pye (New Zealand) Ltd., P.O. Box 2839, Auckland.

* * * *

SMART NEW 5-VALVE MANTEL RADIO FROM PYE

Pye have once again indulged a fine flair for eye-catching design with their new mantel radio—the 98U. But though appearance sets a cracking pace, it



is readily matched by performance. For this reason, the 5-valve, 3 waveband model should be quickly, even enthusiastically, accepted by the New Zealand market.

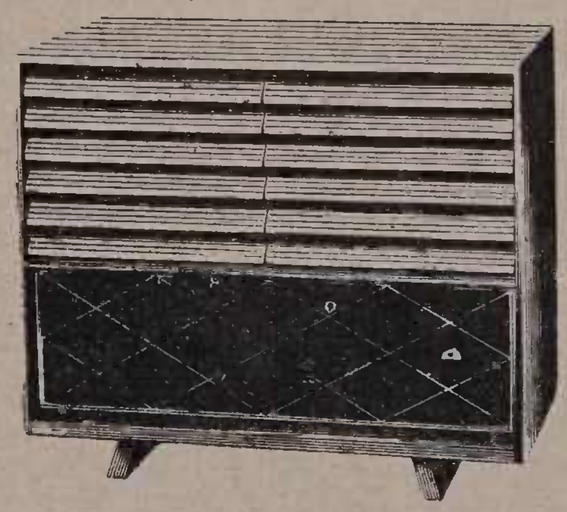
The 98U will strongly receive overseas and local programmes on its 3 wavebands, using little power. Unusually high quality reproduction is obtained from a 5 in. permanent magnet loudspeaker fed by the brilliant 5-valve circuit.

This model is fully tropicalized. Its moulded cabinet is available in attractive colours and another excellent feature is its lightness. Weighing only seven pounds, the 98U is easily moved from room to room. Overall size is 11⅝ in. long, 6 in. high and 5½ in. deep.

But perhaps the best thing about this 5-valve radio is its price. At £19 19s. it will be well within the range of New Zealand families who want good looks, good listening and versatility in their choice. Pye radios are distributed throughout New Zealand by Pye (New Zealand) Ltd., P.O. Box 2839, Auckland.

* * * *

H.M.V. "CONTEMPORARY STYLE" RADIOGRAM



H.M.V. (N.Z.) Ltd., is again to the fore with its new "Contemporary Style" radiogram which is to be introduced to the New Zealand market in late September.

Here traditional "H.M.V." quality is housed in a striking cabinet styled to harmonize with contemporary decorative schemes. The original louvre treatment conceals a 5-valve, dual wave, 3-speed automatic radiogram. Storage space for 300 records is located behind the lower panel, which comes in maroon, primrose or dove grey.

Cabinet dimensions: 36 in. wide by 31 in. high by 18 in. deep.

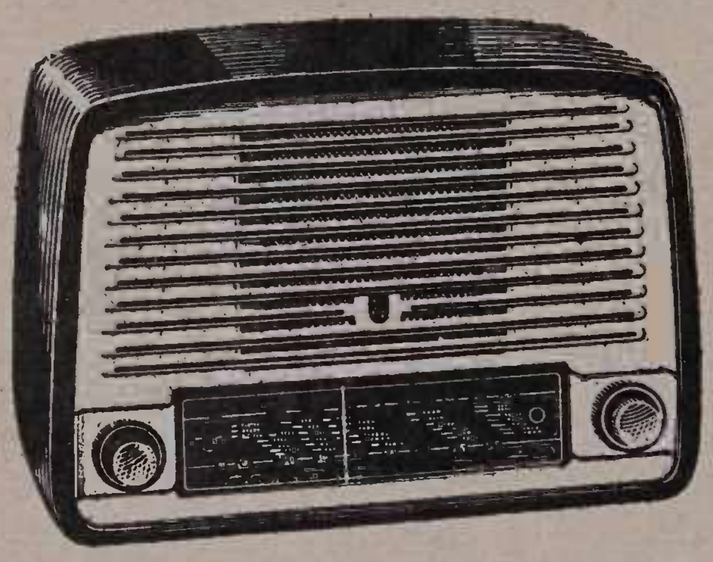
Watch for "Contemporary Style" in the stores of all H.M.V. dealers.

PHILIPS RADIOPLAYER MODELS 356/357

It is with pride that Philips Electrical Industries of New Zealand Limited introduce their two new radioplayer models 356 (Broadcast) and 357 (Dual Wave) to the New Zealand market.

Fitted with a 6 in. Ticonal speaker for crystal-clear reception and a large slide-rule dial for easy tuning, the radioplayers are housed in beautiful maroon cabinets with cream constrasting grilles.

Both models feature Philips' exclusive Ferroxcube components which provide the extra satisfaction of better listening through Ferrocoustics. Greater sensitivity is provided by the Ferroceptor built-in rod aerial, while the new "Micro 12" Band Pass Filters give high volume without distortion.



BROADCAST MODEL 356 (Price £24 17s. 6d.): Wave range 530 to 1,740 kc/s. Cabinet measures 14¾ in. wide, 10¾ in. high, 7¼ in. deep; full range continuously variable tone control; built-in Ferroceptor rod aerial, external aerial and earth connections provided; gramophone pick-up terminals; extension speaker terminals; concentric controls for ease of operation; valves—ECH81, EBF80, EL84, EBC41, AZ41.

DUAL WAVE MODEL 357 (Price £27 17s. 6d.): Same features as 356 with shortwave coverage from 5.5 to 19 mc/s.

These new radioplayers are obtainable from all Philips dealers throughout New Zealand.

* * * *

NEW MOFFAT "SPACEMASTER" ELECTRIC RANGE

Long awaited by the trade, the new Moffat "Spacemaster" range is now being distributed to retailers by Messrs. Turnbull & Jones Ltd., who manufacture it under licence from Moffats Ltd., Weston, Canada, in their Christchurch factory.

This entirely new Moffat, as its name "Spacemaster" implies, has overcome the space problem existing in so many modern kitchens. It occupies no more floor space than existing stoves (less than 4 square feet) yet offers much greater cooking capacity having the largest oven of any stove of comparable size.

Other features include automatic timing and temperature control for the oven, a built-in "minute-minder", large warming drawer with separate switch and warning light, choice of cast enclosed or radiant elements and a handy baking guide printed inside the oven door.

The range, which is of pressed steel construction, is available as a three or four-plate model. The automatic timing device is optional on all models as an extra.

Oven heat is maintained to the correct temperature by a Robertshaw Thermostat, no individual element switches being necessary.

Having proved a big seller in Canada, the new Moffat should be most popular in this country.

* * * *

ROLA SPEAKERS, MODELS 4x6F AND 4x6C

Loudspeakers (N.Z.) Ltd. have pleasure in announcing the introduction of the following new "Rola" speakers.

Model 4x6F is a new high-efficiency 4 in. x 6 in. elliptical speaker which replaces 4x6H. It employs the famous Rola Flux Master type magnet assembly and is designed for use in A.C. or battery-operated mantel receivers where space is at a minimum.

4x6F Specifications:

Power handling capacity, 3 watts.

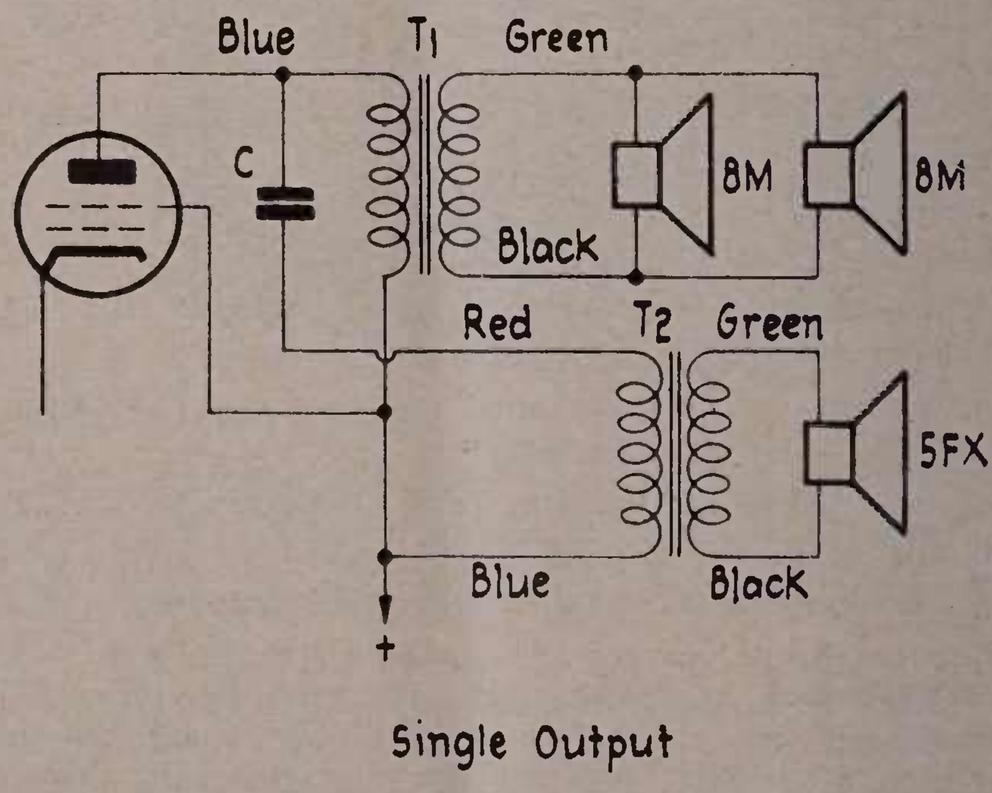
Diaphragm fundamental resonance, 135 c.p.s. ± 5 c.p.s.

Frequency response, 130 c.p.s. 6.5 k.c.
Voice coils impedance, 3.5 ohms at 400 c.p.s.
Air gap flux, 9,150 gausses.

4x6C Specifications:

Model 4x6C is a new elliptical model ideal for A.C. mantel receivers where space is at a minimum.

Power handling capacity, 2½ watts.
Diaphragm fundamental resonance, 135 c.p.s. ± 5 c.p.s.
Frequency response, 130 c.p.s. 6.5 k.c.
Voice coil impedance, 3.5 ohms at 400 c.p.s.
Air gap flux, 7,250 gausses.



Single Output

8M 5FX NETWORK

Model 5FX is a high-frequency speaker designed for use with a pair of 8M speakers (F59 Cone) as the low-frequency unit.

This speaker installation has been developed to meet the needs of those who wish to take full advantage of the extended frequency range of modern recordings but who are not prepared to incur the high expense of the special amplifier, high-fidelity transformer, and vented enclosure necessary when full-range speakers are used.

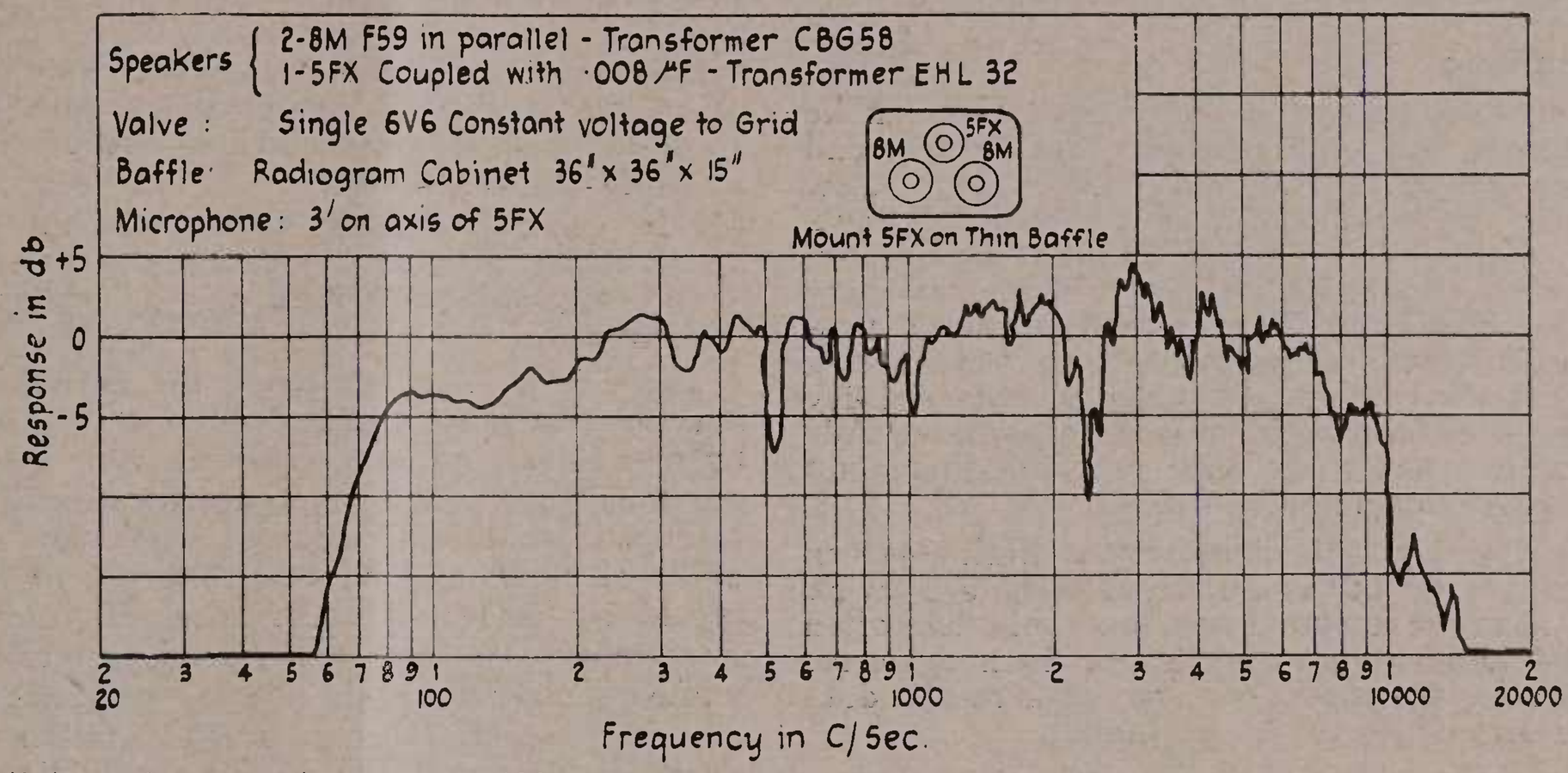
When installed with its appropriate transformers and cross-over network in a conventional radiogram

cabinet, the combination will provide a very smooth response from 80 c.p.s. to 10,000 c.p.s. when driven by a standard single pentode or tetrode.

Specifications for 5FX:

Diaphragm fundamental resonance F59 cone, 125 c.p.s. ± 10 c.p.s.

Frequency response, designed to operate from 3,000 to 10,000 c.p.s.



Voice coil impedance, 3.5 ohms at 400 c.p.s.
Air gap flux density, 9,150 gausses.

Transformers:

6V6, 6AQ5, 6BW6, A1. pentode 5,000 ohm load.
TI: CBG58.
T2: EHL32.
C: 0.008 μf.

6BV7, 6M5, A1. pentode 7,000 ohm load.
TI: CBG47.
T2, EGL35.
C, 0.006 μf.

PR. 6V6s or 6AQ5 in push-pull 10,000 C.T. ohm load.
TI: COL38.
T2: ECL68.
CI: 0.004 μf.
C2: 0.004 μf.

Mounting:

The three speakers should be mounted as closely together as practicable. If cabinet design permits, it is desirable to mount the speakers on the vertical axis with the Model 5FX at the top. The alternative is to mount them clover-leaf fashion with the 5FX close to the top edge of the 8-inch speaker housings.

The five-inch speaker should be mounted so that its pad ring is at least flush with the front of the cabinet, not set back by the thickness of the cabinet front as is normally the case. This can be achieved by cutting out a 4¼ in. diameter hole and then extending this hole from the front of the cabinet to 5 in. diameter for a depth of 7/32 in. This will allow the front of the speaker to be flush with the front of the cabinet baffle.

Feedback:

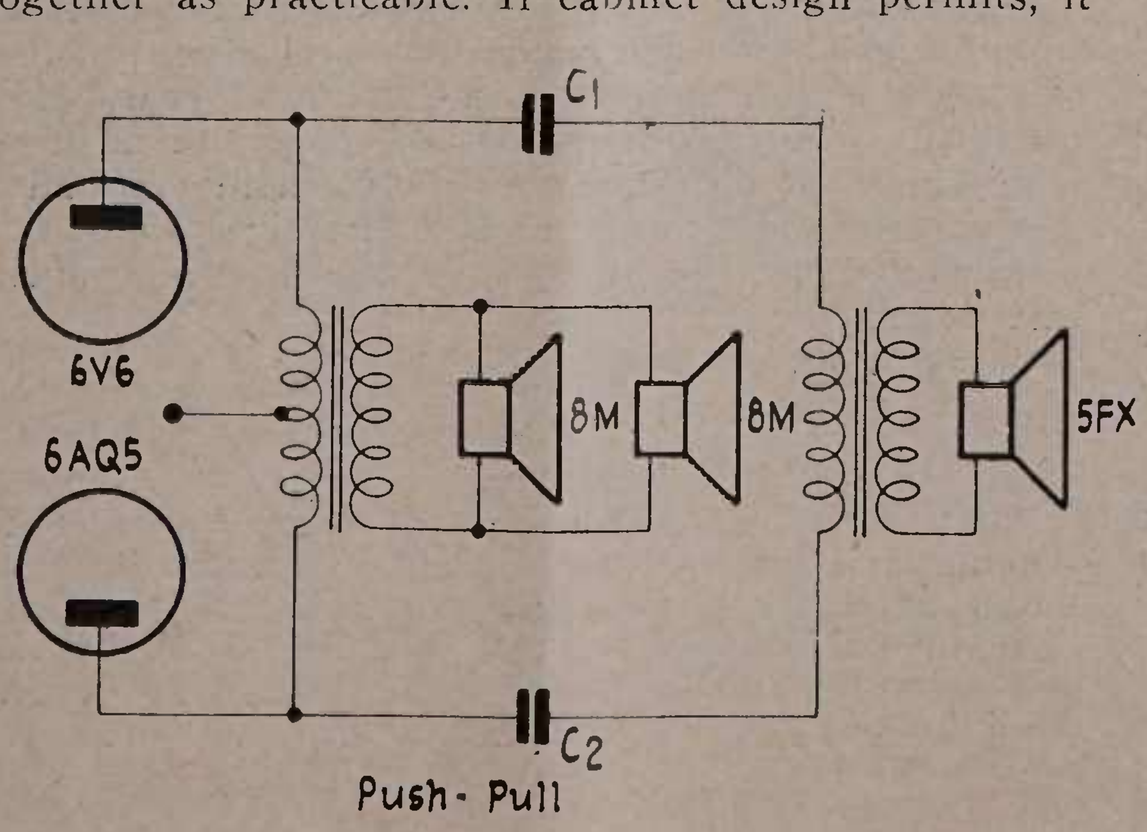
Final stage distortion is considerably reduced due to the flat impedance/frequency characteristic of this network and speaker combination, but it may be considered desirable to improve the distortion characteristic still further by applying feedback to the amplifier. If this is done, the feedback should be taken from the plate circuit of the final valve.

Phasing:

It is important that this speaker combination, particularly the two 8Ms, is correctly phased. To ensure this follow the colour code set out in the schematic diagram.

Incidentally, the price of these new loudspeakers is most competitive.

All inquiries should be addressed to Loudspeakers (N.Z.) Ltd., P.O. Box 6360 Te Aro, Wellington, or to any of the branches of their distributors, Messrs. Arnold & Wright Ltd., at Auckland, Wellington, Christchurch, Dunedin.



"R & E" TECHNICAL PHOTOGRAPHS

Copies of original designs produced in our laboratory and featured in these pages are available. Prices are: Size 6 in. x 4 in. 3s. 6d.; 8 x 6, 4s. 6d.; 10 x 8, 5s. 6d. Please remit cash with order to Radio and Electronics (N.Z.) Ltd., P.O. Box 8022, Wellington.

Dry Battery Technotes

No. 1: Shelf Life

There's no doubt about it, "Dry" batteries can be difficult animals, not only to make, but to sell, and even to use properly. National Carbon Pty., New Zealand, have the making part of it pretty well sewn up—that's their job—and they realize as well as anybody just what difficulties are involved in marketing batteries, and in getting from them the greatest possible usage in terms of hours' service per shilling spent. That is why a series of technical notes on dry batteries and their application has been prepared. We hope that sellers and users alike will find them, not only instructive, but actively helpful.

The life of a dry cell or battery is limited—even when it receives no use at all. Most of us are aware of this, in a vague sort of way, but only too often the practical implications of the fact do not receive enough attention by the user, who, as a result, does not get the service he thinks he should.

The main points about shelf-life are:—

(1) Even without use, a battery starts to deteriorate slowly as soon as it is put together.

(2) In any application, however intermittent there is a minimum cell size that can economically be used.

(3) There is an optimum current drain for a given size of cell. Both larger and smaller drains than this result in less efficient use of the battery's expendable material.

(4) In general, shelf-life is shorter the smaller the cell size, so that bigger cells are also called for in applications where use is extremely intermittent.

There is no need to stress the desirability of selling the freshest possible batteries. You can do this by matching your ordering with your sales as far as possible. Of course, this might mean a little research into just what your sales of particular sizes are, at different times of the year but you will be amply repaid by increased satisfaction of your customers. Remember also that the manufacturers' serial code numbers marked on the display pack are a guide for you in ensuring correct stock rotation, the lowest numbers represent the earlier production.

And, finally, talking of customers, explain to them that as batteries are like vegetables they should make their purchases only as and when required, and that by buying from you they can be assured of fresh stocks.

The New Zealand Electronics Institute (Inc.)

"The professional standing attached to membership in the Institute is gradually increasing," said Mr. W. L. Shiel, Dominion President, when presenting his annual report to the annual general meeting of the New Zealand Electronics Institute (Inc.), held in Dunedin on 30th June last.

This standing, he contended, can be increased further only by ensuring that every professional electronic engineer in New Zealand is a member of the Institute, and this can be effected only through the efforts of individual members in canvassing new members. During the past two years the experience of the Dunedin branch in its recruiting drive has proved that people WANT to join if given the opportunity.

Present membership stands at 181, comprising 7 overseas, 12 in Auckland, 59 in Wellington, 36 in Christchurch, 52 in Dunedin, and 15 in Invercargill. Finality concerning examination qualifications and the adoption of the new constitution should do much to encourage applications for membership.

During the year, the Admissions Committee, after careful examination of all factors, allowed: Auckland, 1 new A.M. and 4 transfers (2 to A.M. and 2 to Grad.); Wellington, 1 A.M., 1 Stud., and 4 transfers (2 to A.M. and 2 to Grad.); Christchurch, 1 A.M., 1 Grad., and 3 transfers to A.M.; Dunedin, 1 M., 2 A.M., 5 Grads., 1 Ass., and 2 transfers to A.M.; Invercargill, 2 transfers (1 to A.M. and 1 to Grad.).

Certificates according to the status granted were presented to members, all of whom were particularly requested to assist the advancement of the Institute by the suitable framing and display of their certificates.

The financial statement revealed prudent management of the Institute's finances, and it is hoped that increased membership will provide further funds for development purposes.

Concluding his report, Mr. Shiel thanked executive officers of branch committees and other members for their active support during the past year, all individuals who had delivered addresses and displayed equipment for the benefit of branch members, and all individuals and firms who had directly or indirectly contributed to the success of the Insttiute during the year.

As a result of a special postal ballot, a new constitution has now been adopted, and this will greatly facilitate the administration.

Officers of the Institute are Mr. W. L. Shiel, Dominion President, and Mr. A. Thornicroft, Dominion Secretary, the auditor being Mr. S. P. Scales. The official address is P.O. Box 546, Dunedin, Mr. Thornicroft's office being located in the Security Buildings, Stuart Street, Dunedin, C.1.

(Continued on page 50)

The Editor's Opinion

THE B-J PICK-UP ARM

Almost since the inception of electrical reproduction of gramophone records, it has been realized that conventional pick-up arms have serious disadvantages, mainly connected with what has come to be called angular tracking of the groove. Now, when a disc record is made, it has always been the custom to use a recording lathe in which the cutting stylus moves radially across the record. This means that the vibrations of the stylus are always directed along a radius of the disc. The importance of this scheme is that, at all times, the excursions of the groove are made by a stylus which moves at right-angles to the direction of the groove. Now, it might be argued that, as the groove is circular, this simple relationship cannot hold, but for all practical purposes, it does, because the radius of the groove is so great compared with the lateral excursions of the stylus tip. And, since the reproducing process is, or should be, the exact inverse of the recording one, it is logical to assume that the proper way to play the record made in this way is so that the vibration of the reproducing stylus is also at right-angles to the direction of the groove, which once more means in a radial direction with respect to the disc. Unfortunately, it is a difficult matter to make a freely-moving pick-up arm in such a way that this happens. Indeed, with a simple arm pivoted at one point, it is not possible, and we have what are known as tracking errors. With a simple arm, whose head is not offset, and whose needle swings through the centre of the record, the error is very great, reaching as much as sixteen to twenty degrees with practicable lengths of arm. It was many years before the simple expedient of off-setting the pick-up head was devised, and with a simple arm such as we have just described, the improvement was considerable, although errors of the order of six degrees still obtained. It was not until some back-room boy brought out his geometry books and showed that, by allowing the pick-up needle to overhang the centre of the turntable, and off-setting the head as well, the tracking error could be reduced to a matter of plus and minus two degrees, with an arm only eight inches long.

All this time, though, many people had been searching for a means of making a short arm that would eliminate tracking error altogether. Many weird and wonderful schemes were propounded, which proceeded no further than the drawing board, but some at least had a limited commercial life. It seems that the BJ arm will be the first of these special arms to attain any degree of popularity. Certainly it is unconventional in appearance as well as in design, but that will deter few of those who appreciate the advantages that excellent tracking performance can confer.

It can be shown quite conclusively that imperfect angular tracking gives rise to distortion of the pick-up output, so that the chief advantage of an arm which reduces tracking error to a minimum will undoubtedly be reduction of distortion. This will be the most attractive feature of the BJ arm.

CONSTRUCTION AND PERFORMANCE

Most readers will by now be sufficiently familiar with the appearance of the arm from the photographs which have appeared in this and other journals. The sector-shaped fitting houses the bearings for the two light alloy tubes, which, in turn, support the mount for the pick-up head. The two moving arms are of different lengths, and these, and the pivot positions, are so arranged that, as the pick-up swings over the record, its angle with respect to a line drawn between the stylus and the main arm pivot changes continuously. This change is calculated in such a way that the angular tracking error is reduced to very small proportions. In order to test the angular performance, the pick-up head was replaced by a card, clamped in position by a plug which fitted the socket on the end of the arm; this card was bent at right-angles so that the horizontal portion could slide on the turntable, and a straight line was inscribed on it passing through the position of the stylus, and at right-angles to the axis of the head. To test the tracking angle, another piece of card was placed on the turntable, and a radial line drawn on it. If the tracking angle is zero, then at every position of the arm, the line drawn on the piece of card clamped in the arm should coincide with the radial line drawn on the turntable. By this means, it was found that, between diameters of twelve and four inches, the error could not be put at more than half a degree, and this much could well be put down to experimental error. There is no doubt then, that the maker's claim for extremely good tracking is a just one. Mechanically, we found the arm good, without being outstanding. The movements in every direction were as free as could be desired, but there was a slight amount of play, torsionally, in the head mounting. This possibly could have been taken up by careful adjustment of the needle bearings, but to do this one would have to be very careful not to make any of them tight. However, the degree of looseness present was certainly no greater than one finds in many conventional arms, and probably was not enough to cause trouble.

The arm, as it stands, is organized to take a number of well-known heads, and adaptors are to become available for other popular makes of head. We have no doubt at all that the BJ arm will find a ready market among high-quality enthusiasts. To our way of thinking, the claims made for it by Mr. P. Wilson, Technical Editor of the "Gramophone", and quoted in the leaflet provided with the arm, are a trifle on the enthusiastic side, and are certainly not proven. However, a good product should not need this sort of eulogy, and the BJ arm, we think, should be able to stand on its simple merits as a device which does away with an old bug-bear, namely tracking error.

Not the least praiseworthy thing about it is the manner in which the makers have supplied an excellent mounting template and instructions to go with it. The arm does need more than average care in mounting if its advantages are to be realized, and the instructions and template make it easy for the most non-technical user to set it up correctly.

The agents for New Zealand are Messrs. A. G. Lawford and Company, 160 Somme Parade, Wanganui, P.O. Box 29, Aramoho.

TRADE WINDS

D. B. BILLING LEAVES TURNBULL & JONES

After twenty years with Messrs. Turnbull & Jones Ltd., Mr. D. B. Billing has resigned from his post as Manager of the Radio Department to enter into partnership with his brother Wynn, who has been carrying on the firm of Preston B. Billing Ltd., since the latter's retirement. Incidentally, this is one of the oldest radio servicing businesses in the country.

During his long and wide experience in the radio business, Dudley's special "babies" have been transformer design, high-quality audio work, and car radio installation and maintenance. There seems enough in these three specialist lines to keep most men going, but Dudley has also done sterling work in other directions, particularly for the Wellington Radio Traders' Association, of which he was President for three years, and for its national body, the New Zealand Radio Traders' Federation. He has been a member of the Standing Radio Interference Committee, representing the Traders on this body which is doing excellent work towards the reduction of radio interference.

We have no doubt that he will be missed at the Head Office of Turnbull & Jones Ltd., but it is good to know that he has not departed from the radio field. With his many friends throughout the trade and industry, "Radio & Electrical Review" wishes Dudley well in his new venture, which we are sure will be highly successful.

* * * *

ANNUAL SMOKE CONCERT

On Friday, 30th July, Radio (1936) Limited, in conjunction with the Auckland Marine Repair Works (their industrial neighbours), ran a very successful annual smoke concert.

About 180 guests gathered in Radio Ltd.'s cafeteria which was colourfully decorated with bunting and flowers for the occasion. A most enjoyable programme was presented. Excellent artists included a female impersonator (the only lady (?) at the gathering), a Hillbilly duo, a pianist, and a character impersonator.

The function was organized by the social clubs of the two companies, and those who attended voted this smoko a great success. A convivial time of good fun and friendship was enjoyed by all.

* * * *

PYE GROUP RESULTS: BIG INCREASE IN PROFITS

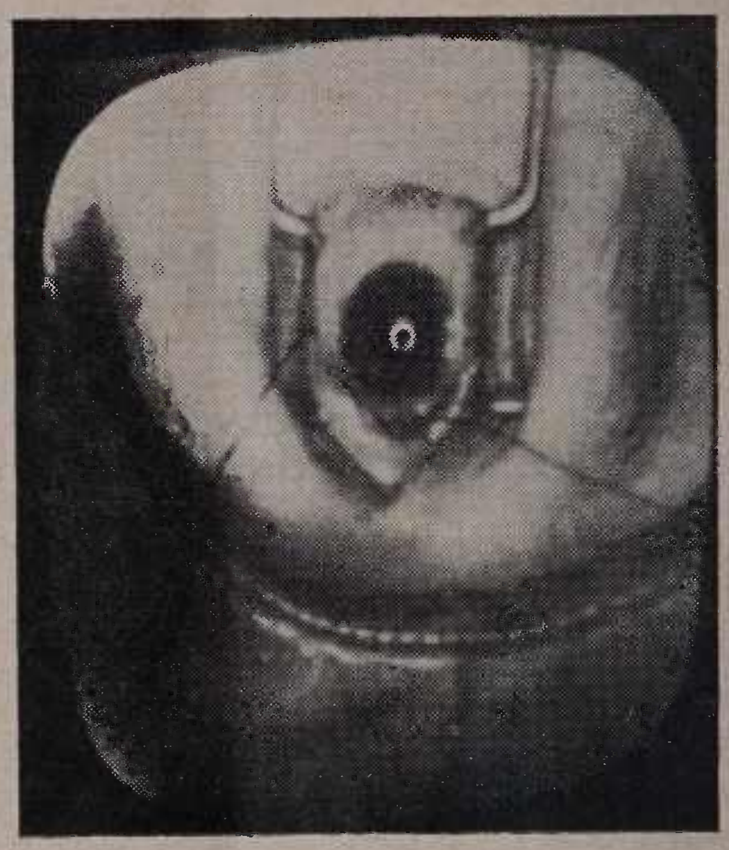
Cabled advice of the results (subject to completion of audit) of the Pye Group of Companies, Cambridge, England, discloses substantial increases in profits for the year ended 31st March, 1955.

Group profits before taxation total £2,199,302, against £1,127,886 last year. This year's figure includes £85,880 earned since the dates of the acquisition by subsidiaries acquired during the year. Taxation this year takes £1,161,677 (last year, £868,196); and group profits, after taxation are £1,023,560 (last year, £256,690).

Final dividend for preferred ordinary shares is recommended at 3 per cent. actual less tax and 2 per cent. participating less tax, making 10 per cent. for the year (unchanged). A bonus issue of 1 for 1 to deferred ordinary stock-holders and "A" deferred ordinary stock-holders (subject to capital issues consent) and dividend on the consequent increased deferred ordinary capital of 12½ per cent. less tax are also recommended. This payment will be equivalent to 25 per cent., against last year's 20 per cent.

* * * *

A.W.A. TELEVISION AT WELLINGTON HOSPITAL



The above photograph depicting an eye operation at the Wellington Hospital was taken, using a hand-held camera, from a 24 in. TV screen.

Last month A.W.A. provided a closed circuit demonstration of the R.C.A. television equipment at the Wellington Hospital. The series of operations occupied two full mornings, and of particular interest were the operations from the eye theatre. The video and audio signals were fed from the theatre over 500 yards of coaxial cables to two receivers in each lecture block; a fifth receiver was also used in the operating theatre to monitor the outgoing picture.

The results achieved with this equipment were outstanding, and the Hospital Board expressed their satisfaction with what they saw.

A.W.A. also plan to give a further public demonstration of television at the forthcoming Wanganui Industrial Fair.

* * * *

EUTRON NEWS

Mr. T. Nicholson, son of Mr. J. Nicholson, Managing Director of Electric Utilities Co. Ltd., Auckland, has been appointed a director of the company and is now in charge of production at the Grey Lynn factory.

Mr. W. Cervin has now joined the engineering staff and is combining his executive duties in this department with representation of the company on special development projects.

* * * *

PHILIPS PERSONALITIES

Mr. W. L. Farquharson, for many years branch manager for Philips Electrical Industries at Dunedin, has recently joined the Sales Office at Head Office, Wellington, where he is now in charge of radio sales.

His place at Dunedin has been taken by Mr. N. S. Williams.

The Record Department of Philips Electrical Industries is now situated at 31 Harris Street, Wellington, to which address all stock has been transferred from the company's Cuba Street premises. Mr. S. Vause, manager of the department, is assisted by Mr. A. G. McMillan, recently transferred from the Advertising Department.

Mr. J. D. Davey is now in charge of the Advertising Department which is situated at 104 Dixon Street, Wellington.

* * * *

"ROLA" IN THE TV FIELD

Fresh from a visit to Melbourne, Mr. H. Brown, of Loudspeakers (N.Z.) Ltd., has an interesting story to tell of the Australian scene, particularly with regard to the activities of his principals, the Rola Company Pty. Ltd., of Australia.

The Commonwealth is in the grip of TV preparations, and plans are on hand for the opening of a national station about December, 1956. In preparation for the Olympic Games, however, it is possible that there may be a commercial station on the air by about November, 1955. Ultimately, both Sydney and Melbourne are to have one national and two commercial stations. There will be no direct link between the two main centres, so that viewers in Sydney will see the games per medium of television films specially flown to the New South Wales capital from Melbourne.

Operating with a coverage of approximately 50 miles' radius, Melbourne TV should be available to about one and three-quarter million potential viewers. Standardizing for the most part on 17 in. screens, Australian manufacturers are endeavouring to achieve receivers within the £150 range.

In all this activity the Rola Company is playing its part in the manufacture of products allied to its normal work, e.g., horizontal flyback transformers, vertical output transformers, deflection yokes, P.M. focusing units, blocking oscillator transformers, and TV filter chokes, etc.

In addition, the new Rola factory at Harrisville is now in full production, working a staff of 80 in four shifts twenty-four hours a day, manufacturing winding wire.

Our congratulations to Rola on this splendid achievement.

* * * *

"PHILISHAVE" CARAVAN

With their specially designed and constructed caravan for the demonstration of Philishave Electric Dryshavers, Philips Electrical Industries of New Zealand Ltd., have recently introduced something outstandingly different in the way of advertising.

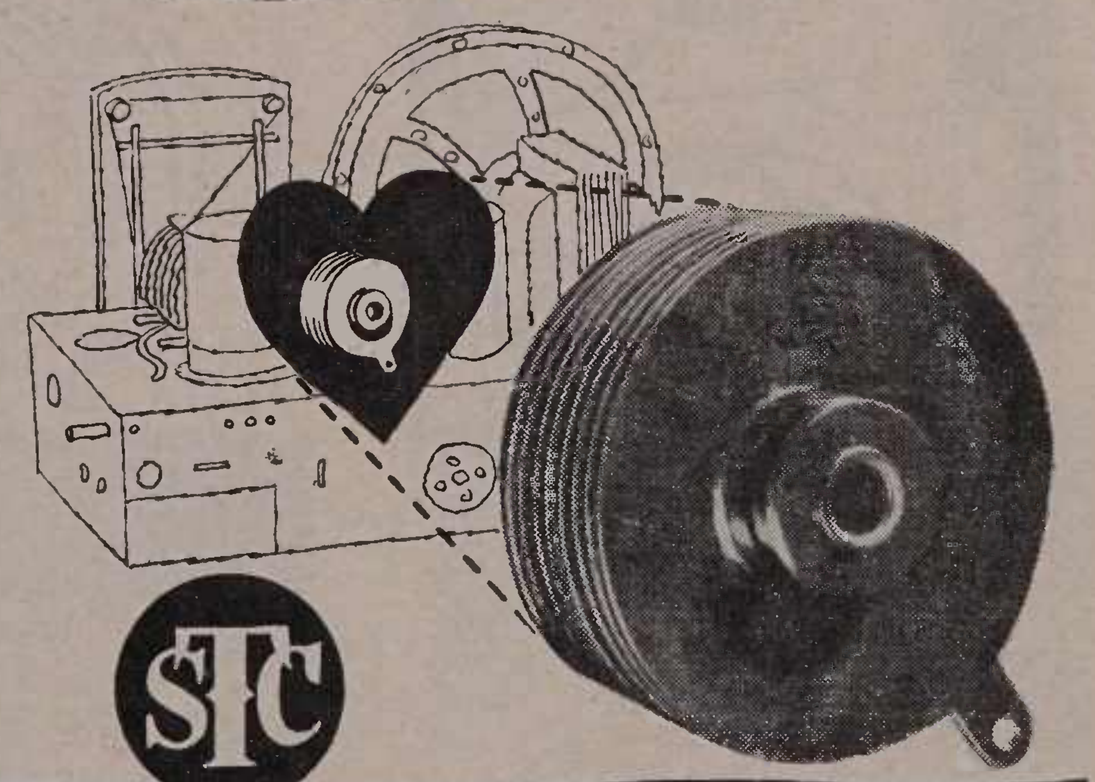
Following similar ventures by the British and European Philips Organizations, Philips in New Zealand have designed their self-contained demonstration unit so that it can be quickly transformed into an attractive show stand. Painted in royal blue and grey, with yellow lettering, the double-bogey caravan, 20 feet long, 7ft. 6 in. wide and 7ft. high, began its journeying at Wanganui Industrial Fair in late August. This month it is on location at the Wellington Diamond Jubilee Exhibition, and from Wellington it will tour throughout the North Island during the summer months.

Attached to the caravan is a specially-trained female staff under the control of Philips Philishave sales representative, Wim Botzen. All demonstrations will take place on the outside of the caravan, three illuminated shaving bars being provided on each side of the vehicle. General lighting is furnished by fluorescent tubes. Colourful awnings extend six feet out from each side, and also at the back, so that, when fully extended, the demonstration unit occupies a space approximately 30 feet by 20 feet.

In addition to Philishaves, many other Philips products are exhibited either on a display platform at the rear or in the large show window in the front. These include radios, records, record-players, TV sets, lamps, etc. Special fittings have been installed for the demonstration of the Philishave Battery Shaver.

Recorded programmes are played through twin loudspeakers mounted on the roof, while specially selected Philips films are shown on a 4 ft. by 3 ft. screen mounted at the rear of the caravan.

The HEART of the Portable



STC

MINIATURE RADIO RECTIFIER

★ Precision-built
★ Peak performance
★ Practically unbreakable

Servicing Portables? Replace with STC Miniature Radio Rectifiers. The world's standard first choice among progressive servicemen.

Write, phone, or call the Sole New Zealand Agents:

STANDARD TELEPHONES & CABLES PTY. LTD

WELLINGTON Box 593 AUCKLAND Box 571
CHRISTCHURCH Box 983 WANGANUI Box 293

For the Technician

Erection and Maintenance Instructions:

Xpelair Window Fans

The Xpelair is fitted into a window pane, panel or wall. For window pane or panel, cut a circular hole as follows:—

Models with 7½ in. dia. impeller: dia. of hole 9½ in.

Models with 9½ in. dia. impeller: dia. of hole 11⅝ in.

Window glass should not be less than 5/32 in. thick. Panels may be up to 1 in. thick.

Sash windows should have stops fixed to the upper sash on each side below the level of the unit so as to prevent it being damaged by raising of the lower sash.

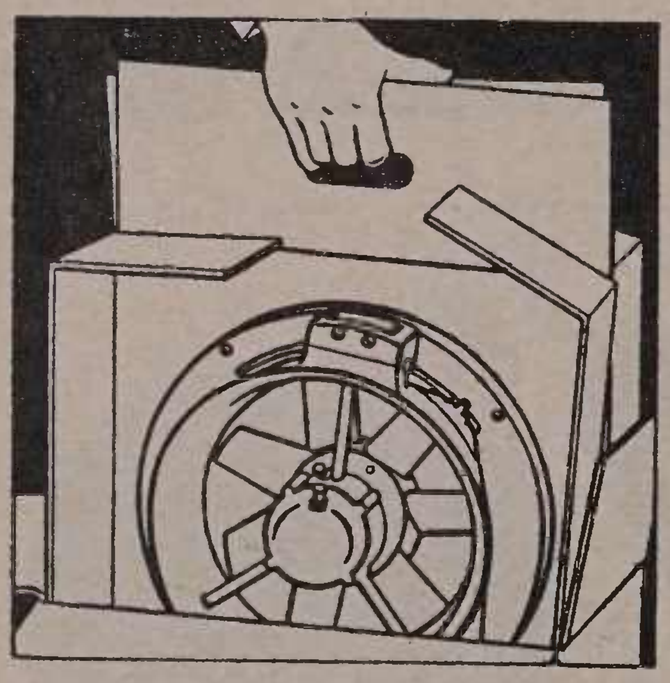
For wall mounting or for panels more than 1 in. thick, special long screws can be supplied—see diagram 8.

To obtain best results the Xpelair should be on an opposite wall to inlets. Adjacent windows should be kept closed to avoid short circuiting of air. The Xpelair should be situated directly above or as near as possible to the main source of heat, smoke or cooking odour.

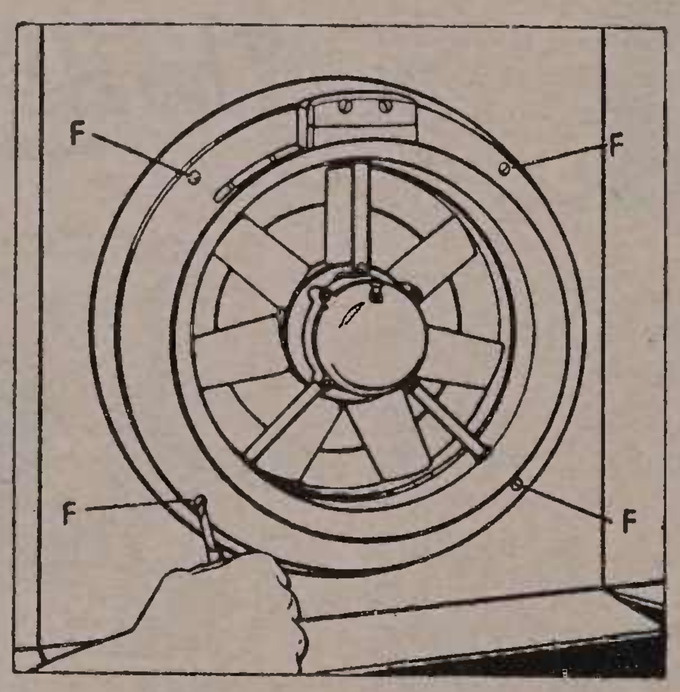
A speed regulator for this fan is available, and, if required, should be connected as shown on the regulator instruction tag.

LUBRICATION

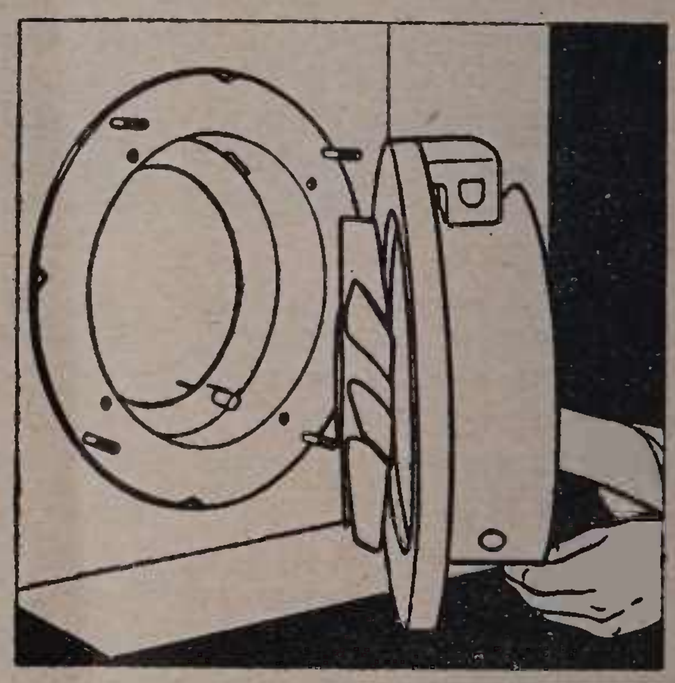
The fan motor is fitted with SASO sleeve bearings with sealed oil reservoirs of ample capacity. Under normal running conditions, several drops of a good light machine oil, for example, "3-in-1" oil, should be added to the lubricators every six months.



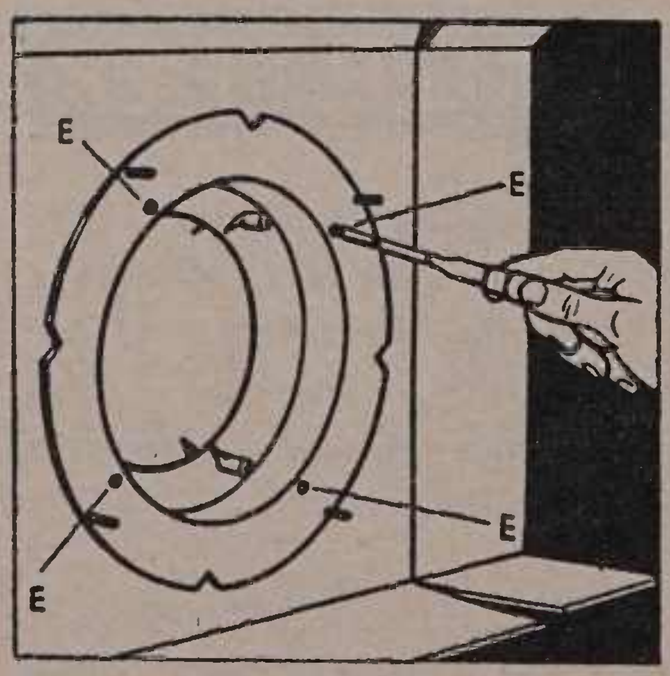
1. *The Xpelair is withdrawn from its carton mounted in a temporary diaphragm.*



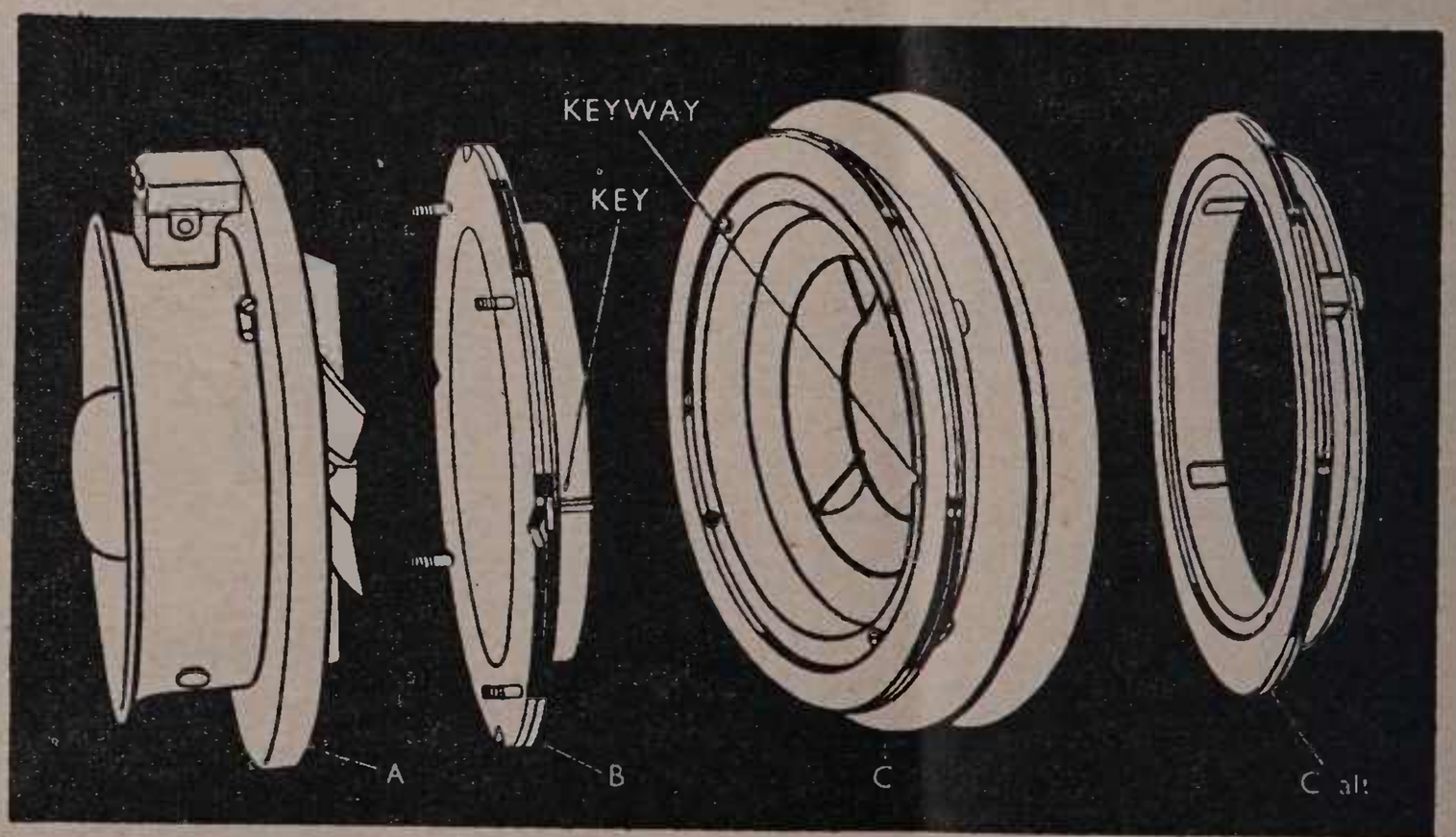
2. *To remove the fan from its temporary diaphragm first remove the four slotted nuts "F".*



3. *The fan unit is withdrawn leaving the clamp rings attached to the temporary diaphragm.*

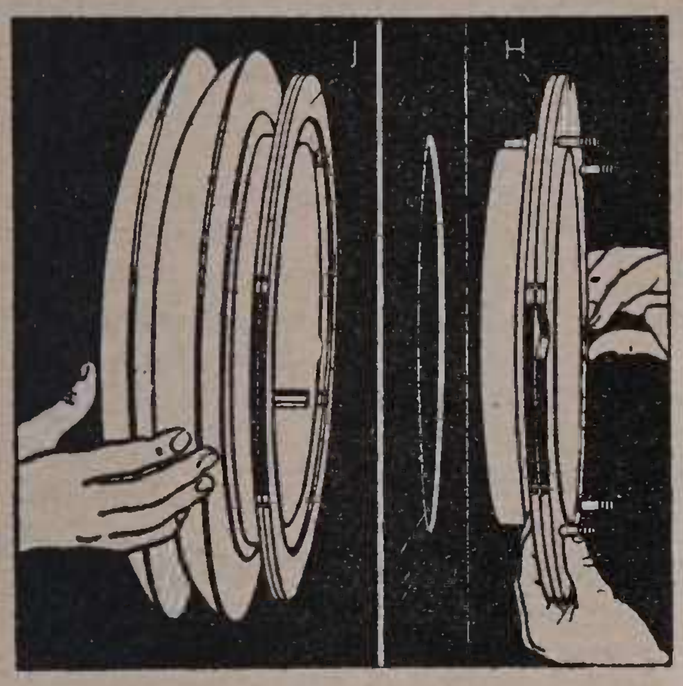


4. *Remove the four screws "E", at the same time supporting the outer clamp ring or cowl.*



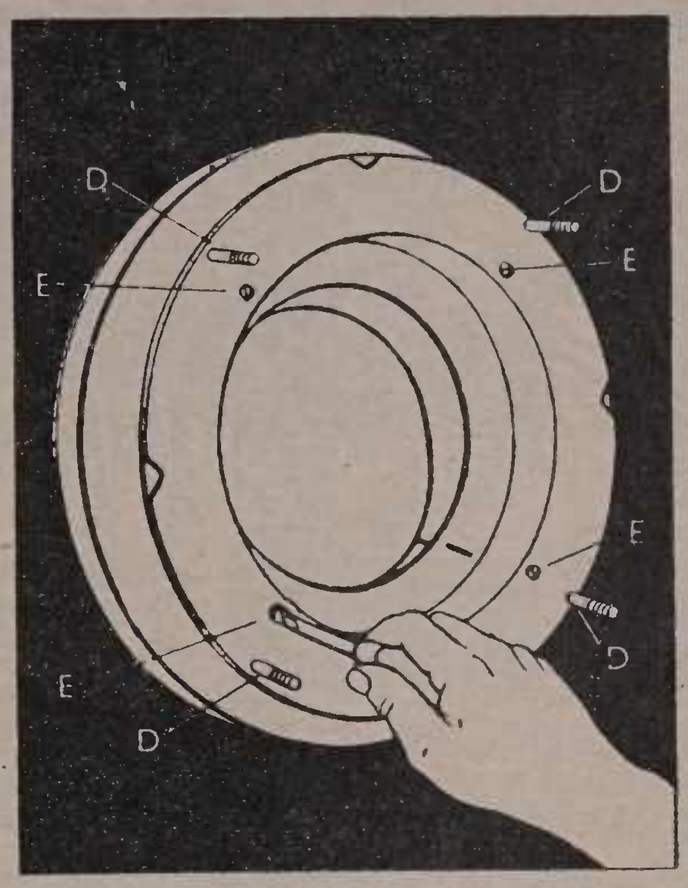
5. *The fan is now in three parts: "A" the fan unit; "B" the inner clamp ring with spigotted gasket;*

"C" the outer clamp ring, gasket and cowl, or "C alt." outer clamp ring and gasket only. Attention is drawn to the key and keyway on the inner and outer clamp ring respectively. The fan is now ready for mounting in the window pane or panel.

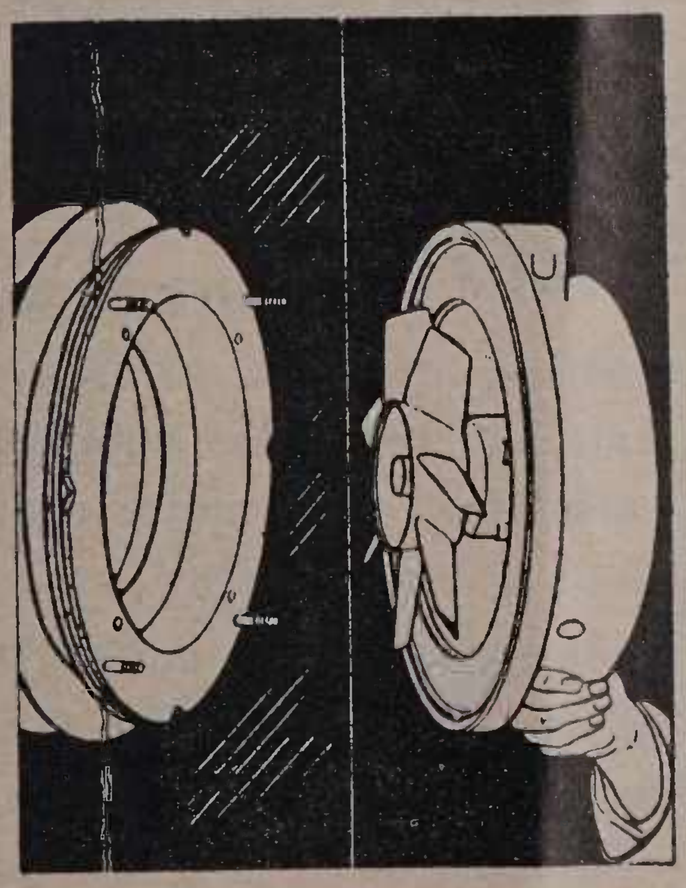


6. *The inner clamp ring should be offered to the window so that the spigot on its gasket "H" fits into the hole. From the other side, the outer clamp ring with its matching gasket "J" should be fitted over the projecting spigot of the inner clamp ring, the key in one engaging with the keyway in the other.*

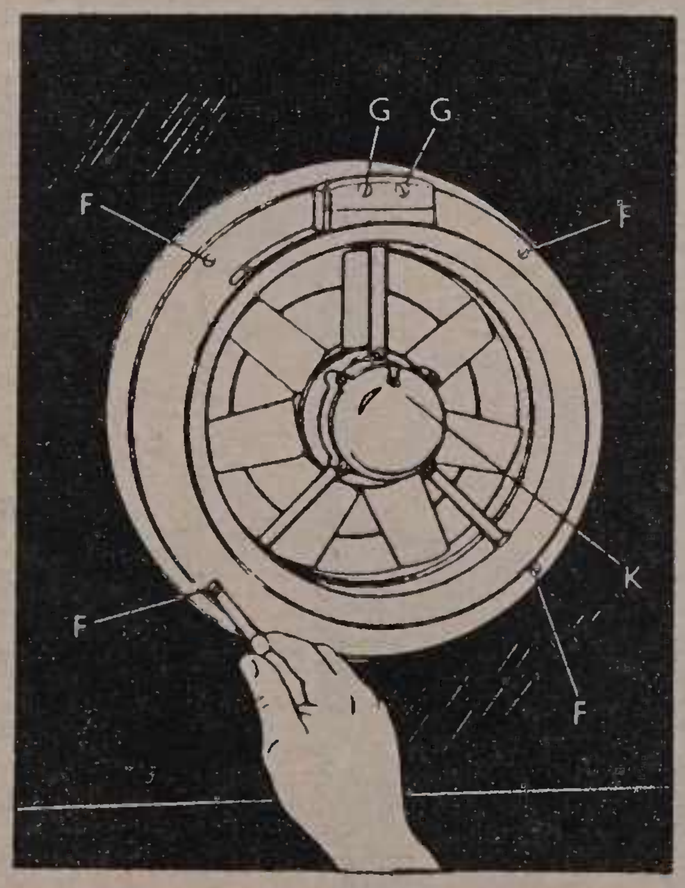
7. *With the inner and outer clamp rings positioned by the inter-locking of the key and keyway, the assembly should be rotated, if necessary, until the word Xpelair on the cowl is at the bottom. Where no cowl is required, the clamp rings are positioned so that the four studs "D" (see 8) are on the 45° centre lines.*



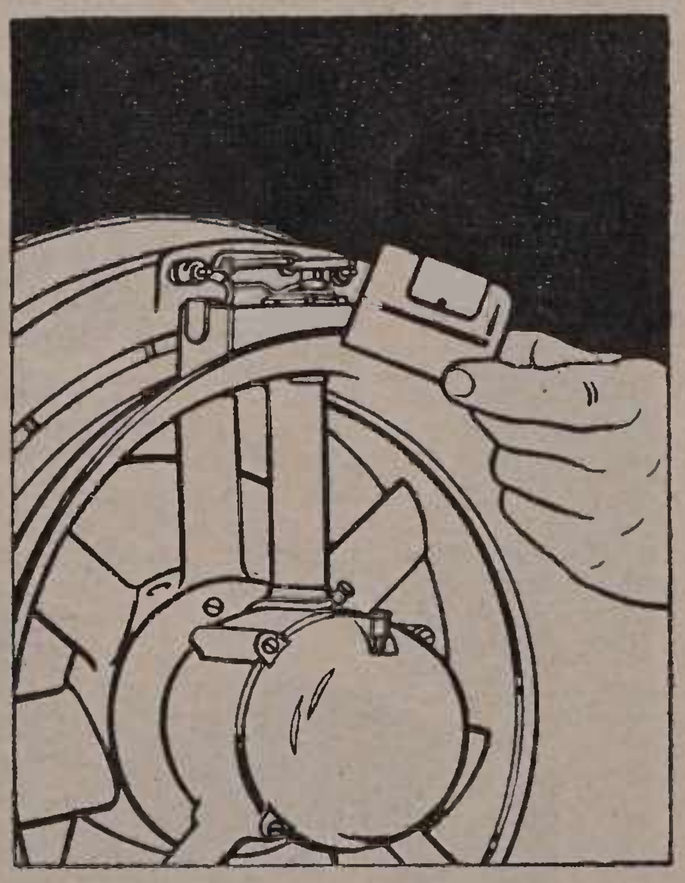
8. *Insert screws "E" and tighten. When Xpelairs are required for fitting in walls or into panels more than 1 in. thick, special 15 in. long screws can be provided which are suitable for a maximum wall thickness of 14 in., and can be shortened as required for other thicknesses.*



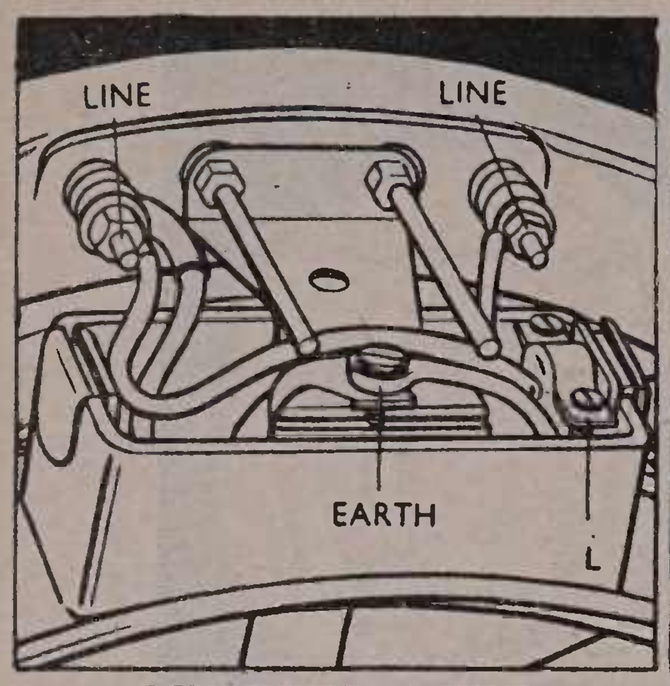
9. *The inner and outer clamp rings being secured, the fan unit, with its terminal box at the top, is offered to the studs "D" (see 8).*



10. *Screw the four slotted nuts "F" on the studs "D". The mounting is now complete and the Xpelair is ready for connecting to the supply.*



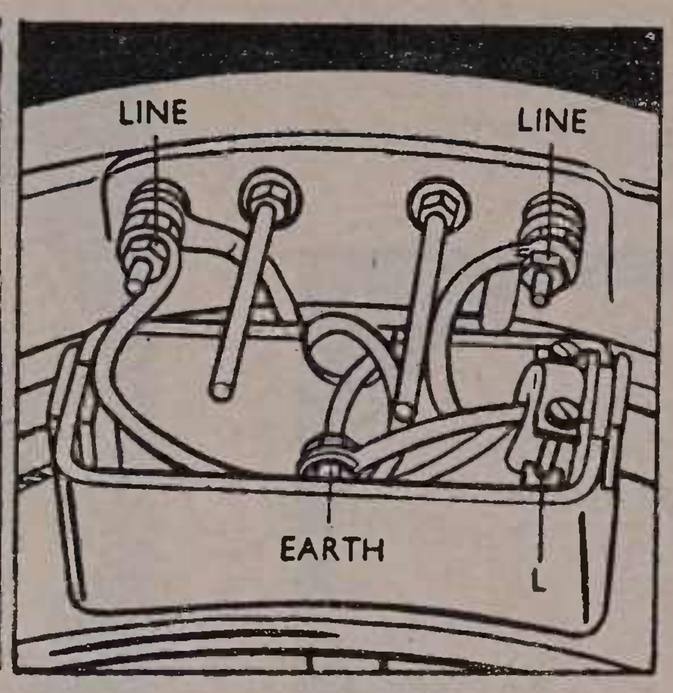
11. *Remove the terminal box lid by unscrewing the two domed nuts "G" (see 10).*



SHUTTER TYPE

12. *Three-core TRS cable should be used and should pass through and be secured by the clamp "L", which can be fitted on either side of the terminal box as desired.*

The two main cores and the earth core should be connected to the terminals indicated. The other end should be wired to an adjacent 3-pin plug and socket.



NO-SHUTTER TYPE

13. *The same wiring instructions apply as for the Shutter type except that the supply end of the cable should be wired to a 3-pin plug and socket with switch as no switch is incorporated in the no-shutter fan.*

Tape-recorder Servicing

(Continued from page 23)

on record and playback, and, in the latter position, the reaction feed-back path via the erase head is replaced by a negative feed-back tone correction path C3, R2, C2, R1. On record, R.F. bias is fed into the record/playback head via C1 and a tapping on the head winding.

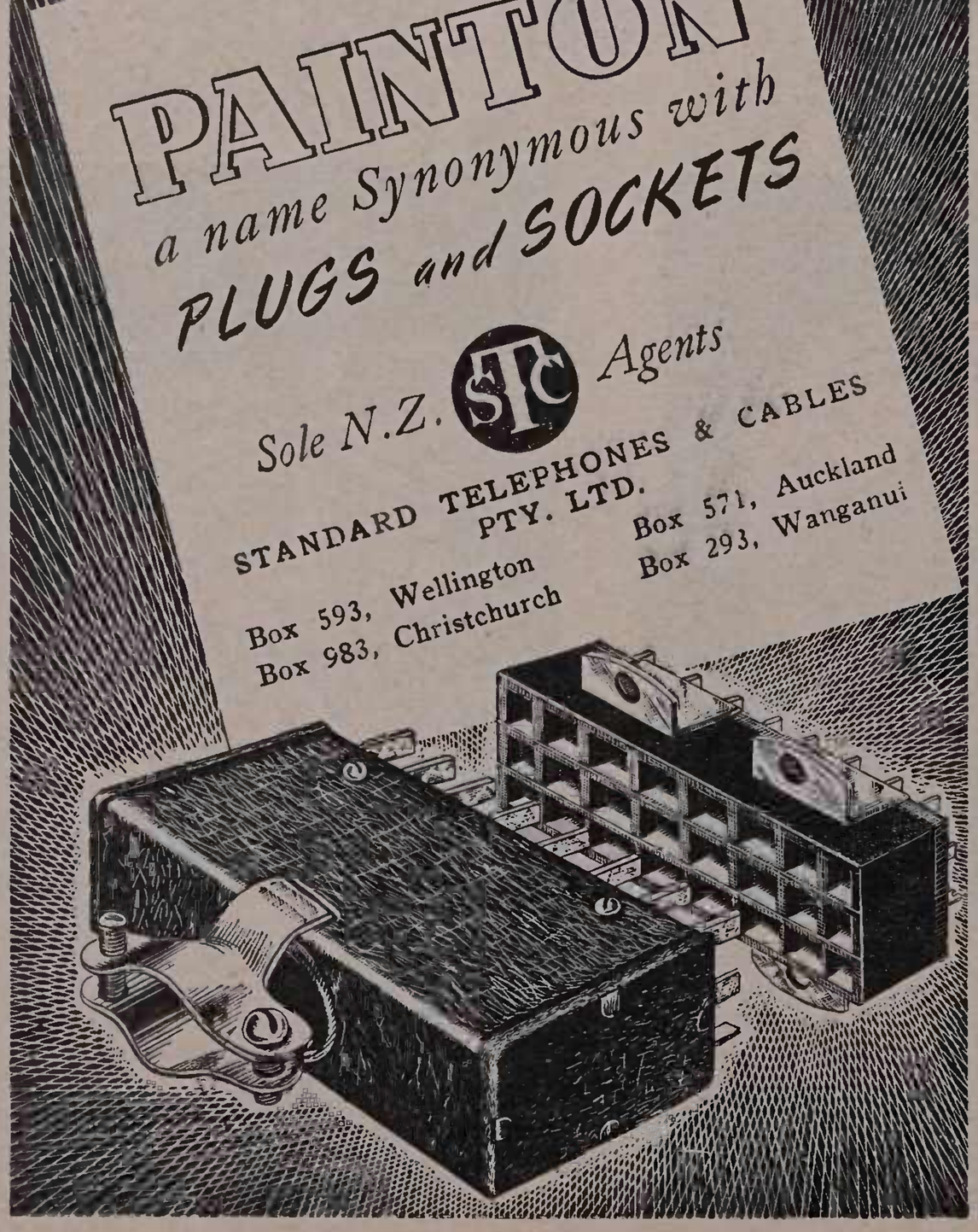
In Fig. 2 we have the oscillator and playback output stage of the Soundmirror TP411. Here the R.F. oscillator is used only to supply bias to the record/playback head, and is connected in a Colpitts circuit with L1, C2, C3, C4. The R.F. bias is introduced into the record/playback head by connecting the anode .load of the recording amplifier output valve, V1, to V2 anode instead of H.T. positive. The switch S1 permits the level of bias to be altered to suit different tapes. Erasure is performed by means of a four-pole Ticonal magnet, the poles being arranged in alternate north/south sequence to give an equivalent effect of A.C. to the moving tape.

DRIVE MECHANISM

We come now to the mechanical/electrical section of the recorder, where a combination of one, two or three motors may be employed to drive the capstan and take-up spools. These motors will generally develop the same type of electrical faults as do the the modern type of synchronous gramophone motor. Where only one motor is unsed, as in the Grundig TK9, for instance, there will also be driving belts and mechanical or magnetic clutches to contend

(Continued on page 49)

PAINTON
a name Synonymous with
PLUGS and SOCKETS
Sole N.Z. STC Agents
STANDARD TELEPHONES & CABLES PTY. LTD.
Box 593, Wellington
Box 983, Christchurch
Box 571, Auckland
Box 293, Wanganui



When you TRAVEL in NEW ZEALAND

USE "RAILWAY" TRAVEL SERVICES!

★ Comprehensive network of express trains, railcars, local and suburban trains, also bus and motor-coach services.

★ You'll appreciate the unrivalled economy and convenience of train or railcar travel . . . the ample luggage allowances . . . the spacious comfort . . . the amenities right on board!

Ride by Rail and Relax!

NEW ZEALAND RAILWAYS

Tape Recorder Servicing

(Continued from page 48)

with, but to the engineer experienced in servicing automatic-record changers, these features will be comparatively simple.

Up to now, two examples of current techniques in the electronic section of the tape recorder have been discussed, so finally, to round off this rather brief excursion into recorder servicing, let us look at an example of recent development in the mechanical section, as illustrated in Fig. 3.This shows a method of continuously variable tape speed control, as used in the current Reflectograph models. The drive from the capstan motor to the capstan flywheel is transmitted via a rotating ball on the end of the motor shaft. Control of the tape speed is effected by tilting the motor so that it pivots on the centre of the ball, changing the angle between the motor shaft and the plane of the flywheel, as shown in the drawing, thus varying the effective driving radius of the ball.

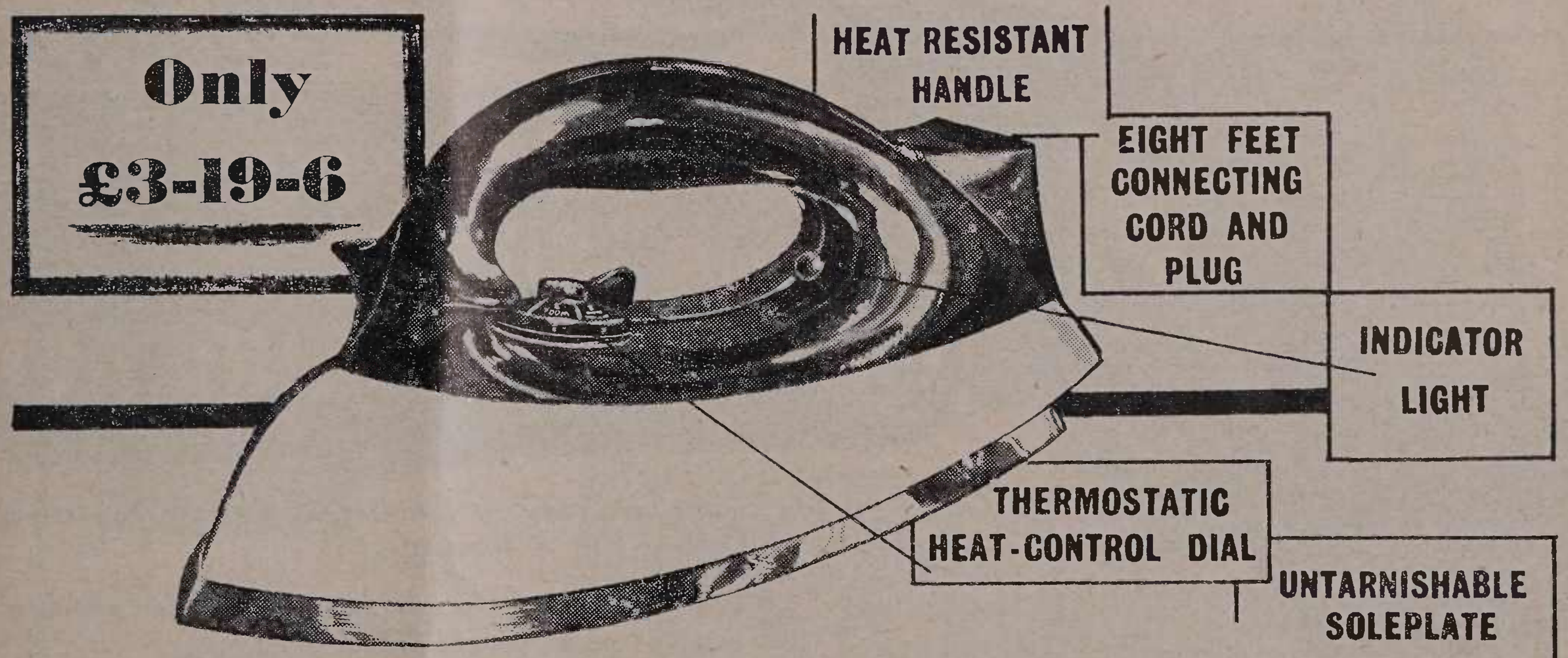
VALVES

Rare and hard to get! "Cambridge" have them

CAMBRIDGE RADIO & ELECTRICAL SUPPLIES
P.O. Box 6306 or 38 Cambridge Terrace, Wellington.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.



You sell quality when you sell the famous lightweight

H.M.V. HEAT-CONTROLLED IRON

Customer goodwill depends on satisfied customers, and here is something that will satisfy EVERY CUSTOMER.

Thermostatic heat-controlled dial; untarnishable soleplate; indicator light; heat-resistant handle; 8 ft. connecting cord —every feature that every customer wants in an iron is there at the amazingly low price of ONLY £3/19/6 retail.

Make inquiries now to

HIS MASTERS VOICE (N.Z.) LTD
Box 296, Wellington.

N.Z. Electronics Institute

(Continued from page 42)

Officers elected at the annual general meeting of the Christchurch branch were: Chairman, Mr. J. P. Senior; Secretary, Mr. H. B. Fletcher; Treasurer, Mr. J. A. Lee; Publicity Officer, Mr. L. D. Hepburn, Committee—Messrs. T. R. Pollard, W. E. H. Docherty, and A. L. Gardner; Branch Councillors, the Chairman and the Immediate Past Chairman, Mr. H. A. L. Wily.

During the year, members have heard addresses as follows: Mr. Yeabsley, "X-ray Tubes"; Mr. Seed, "Mechanical Methods of Plotting Electric Fields"; Mr. Ross, "P. and T. V.H.F. Mobile Services" (this was followed by a visit to the transmitting station at Cashmere); Mr. Templeton, "The Electro-stimulator"; Mr. Pollard, "The Brain as an Electronic Computor"; Mr. Withers, "Some Aspects of Impedance Matching"; Mr. Stanbury, "The Synchronization of Tape Recorders and Sub-standard Film Projectors," followed by a second talk on "Constructional Details of Tape Recorders."

In addition, the branch has joined with the Astronomical Society and the New Zealand Association of Radio Transmitters and held a joint meeting addressed by Dr. Ellyett about the information obtained at the Canterbury College radar field station on meteors and the ionosphere.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

FOR SALE: TAYLOR All-wave Signal Generator £17 10s.; Valve Tester, £20. WOOD, 29 Crofton Road, Wellington.

RADIO ENGINEER'S COURSE

Correspondence Course specially compiled to meet New Zealand Examination Syllabus. Free prospectus.

NEW ZEALAND RADIO COLLEGE

26 HELLABY'S BUILDING - - - AUCKLAND, C.1

Lighten up that Soldering Job!

Get right on the Beam!

with "SUPERTONE"

Electric Eye SOLDERING GUN

Light, compact, easy to handle, Supertone has these features:

- Low-tension Transformer with impregnated coilings.
- Double-contact trigger switch.
- Unbreakable bakelite casing insulated for 1,500 volts.
- Interchangeable tip with stainless steel tinned point.
- Bulb in head, illuminating area being soldered.

The Supertone Soldering Gun is built for A.C. 110/230v. input at 5 or 60 cycles with a consumption of 60w. Its net weight is only 1¾ lb and it is ready hot for use in 5-6 seconds.

Trade Inquiries Welcomed

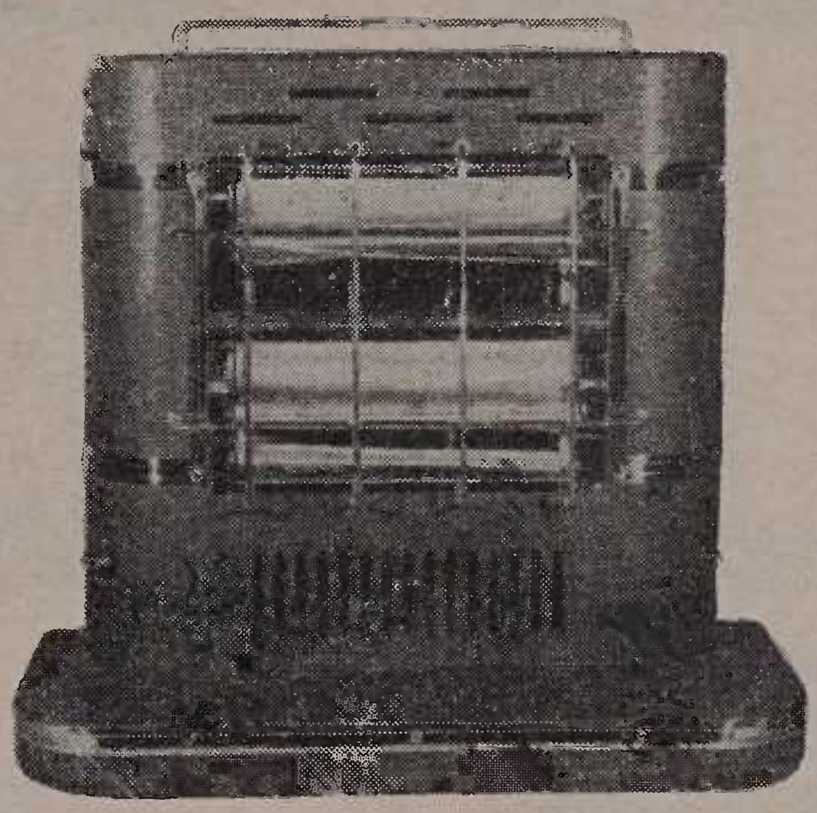
"SUPERTONE" ELECTRIC EYE SOLDERING GUN

New Zealand Agents and Stockists: W. & K. McLEAN LTD.,

P.O. Box 48 7 Anzac Avenue, Auckland Phone 34-54

EDINBURGH
Electric Radiator

ANOTHER PANAMA PRODUCT



★ **Two 10-inch bars**

★ **Individual Switching**

★ **Red Glow Visible at Base**

★ **Louvres for Heat Dissipation**

★ **Crackle Finish**

★ **Chromium Trimmings**

★ **Easily Portable**

Available from

CORY-WRIGHT and SALMON LTD.

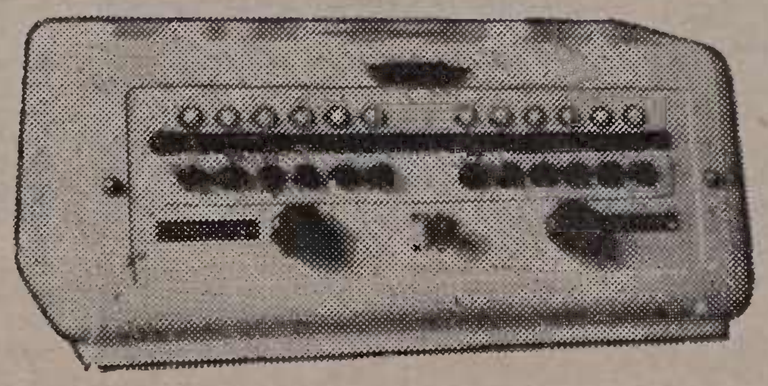
AUCKLAND WELLINGTON
CHRISTCHURCH DUNEDIN

All Ultimate

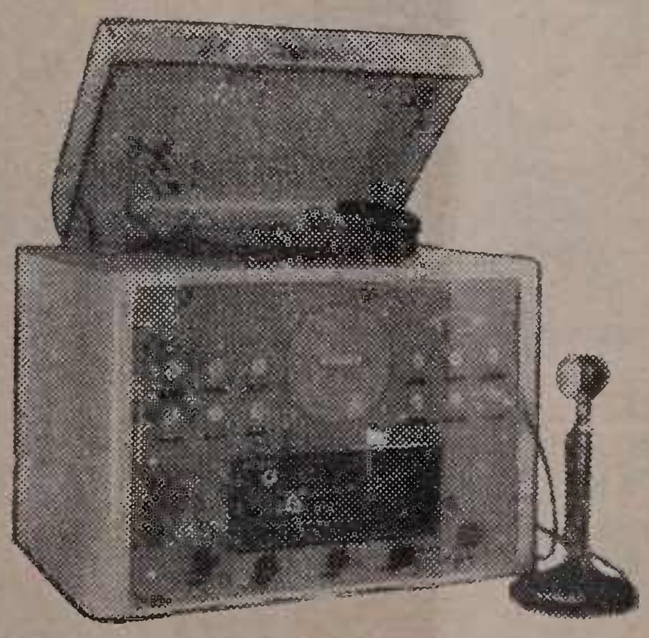
COMMERCIAL AND INDUSTRIAL EQUIPMENT IS DESIGNED

to the Highest Standard

Intercommunication

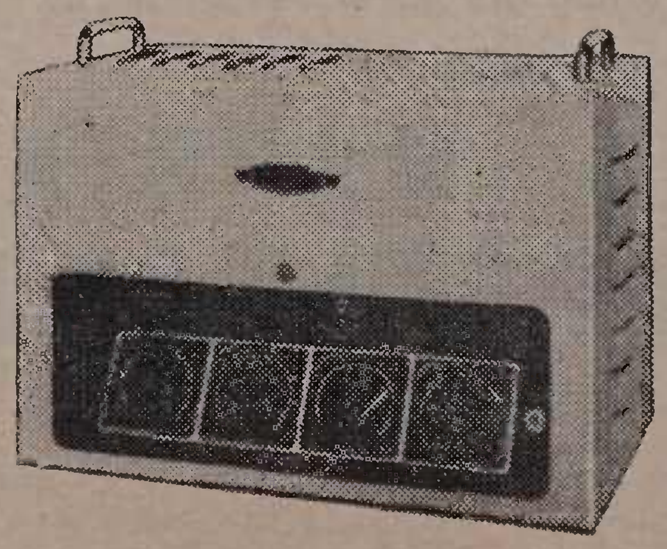


Control Equipment



Sound Equipment for Schools

Public Address Equipment



The ever-increasing demand for greater efficiency in business and industry can be greatly assisted by speedy communication . . . reliable and efficient ULTIMATE communication. The installation of such systems which will save you time and money calls for expert technical advice and skill.

We'll be pleased to advise you on any communication problem. It's no trouble . . . Write to us:

RADIO (1936) Ltd.

P.O. Box 1166, AUCKLAND

Telephone 30-195

Multicore meets every need for everything that needs core solder...

ERSIN MULTICORE SOLDER

Available ex-stock in a range of gauges and alloys to meet all requirements.

G4.55

New Zealand Distributors: GILES & ELLIOTT LTD.
Wellington, Auckland, Christchurch, Dunedin.

Also available from all branches of Turnbull & Jones Ltd.

just a minute .

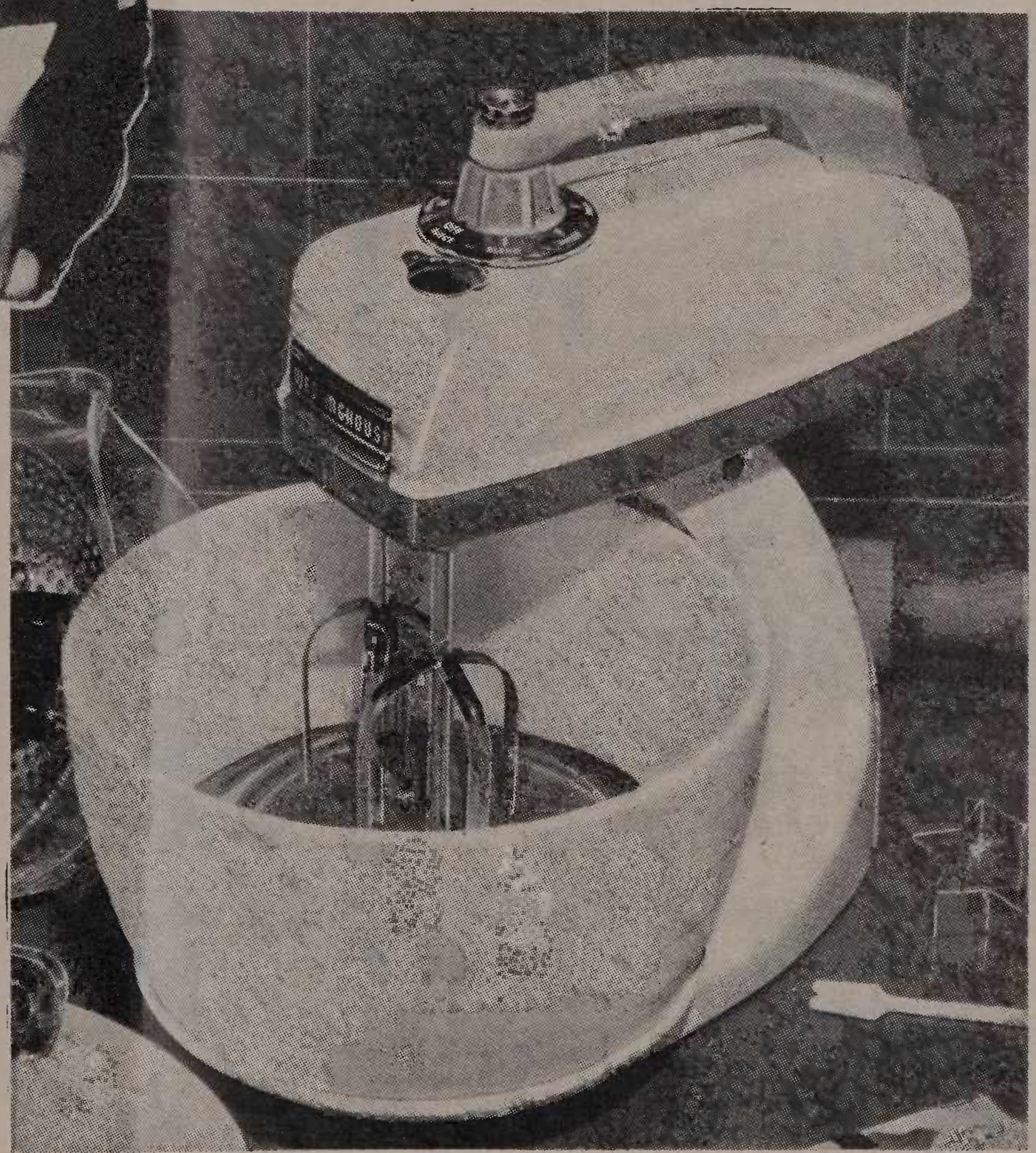
On the left: ONE of our automatic lathes makes any ONE of these parts at the rate of 1 per minute—on the right at the rate of 20 per minute. With many lathes in many minutes we can and do produce millions. The point is, combining speed with absolute accuracy, AUTO MACHINES are able to produce component parts, faster, better and more economically priced.

AUTO MACHINE MANUFACTURING CO. LTD.

18–20 Nelson Street. :: C.P.O. Box 179.
Tel.: 31-638, Auckland.

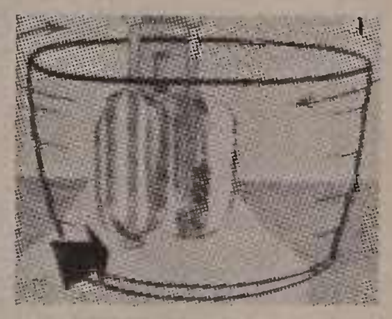
It's here!
FOOD CRAFTER
by Westinghouse

"Every house needs Westinghouse"



Thumb-tip Beater Ejector . . . just touch the button . . . and zipp, out come the beaters.

Mix Dial Up Front . . . swift—visibility of six basic speeds—plus twenty variations.



Merry-Go-Round Bowl . . . assures all ingredients are brought in to beaters for a complete mix.

Pitcher-type Juice Crafter . . . gets ALL the juice! Made of transparent plastic. Graduated in ounces.

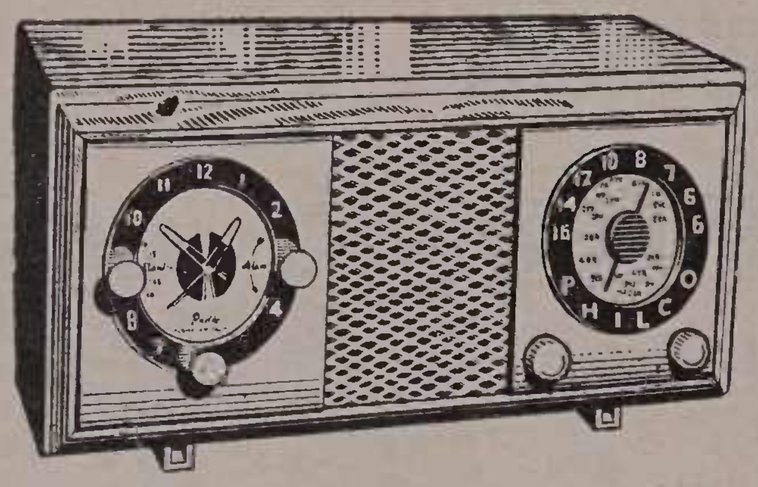
The Mixer with the *power* to do everything better! . . . Mixes the *heaviest* batters without "slow down." Long life sealed lubrication *never* needs oiling.

"FOOD CRAFTER" will bring more business into your store. Remember—

"YOU CAN BE SURE . . . IF IT'S WESTINGHOUSE"

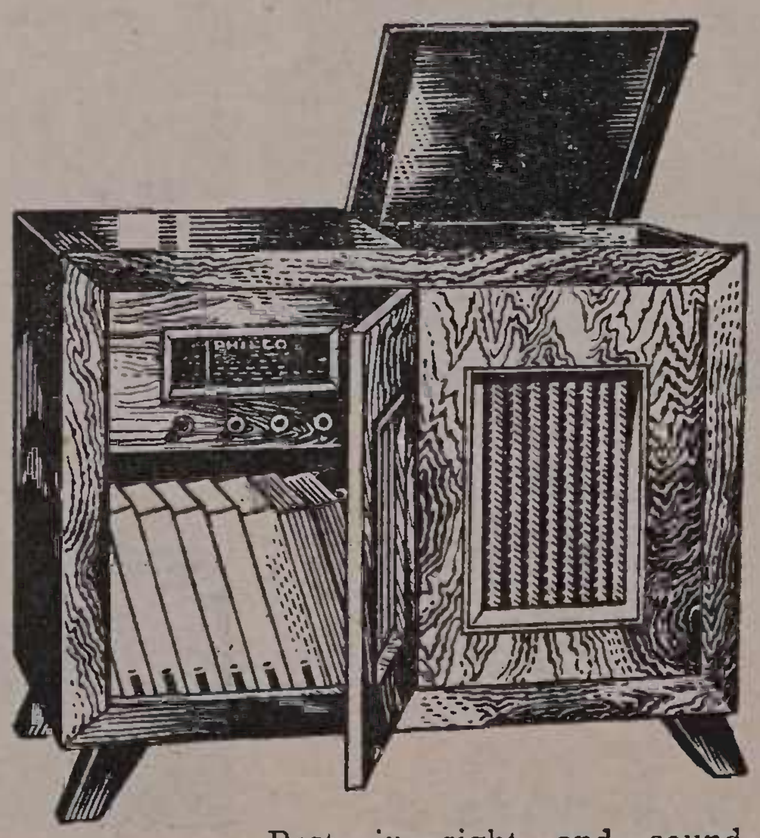
Distributed throughout N.Z. by H. W. CLARKE [N.Z.] LTD. ARNOLD WRIGHT LTD.
AUTOCRAT DISTRIBUTORS LTD. - - - Branches in all Centres

SETS THAT SELL!



It's always selling time . . . with PHILCO 804 CLOCK RADIO - £26 15s. 0d.

PHILCO MONTANA. A world-wave salesmaker at £18 18s. 0d.



Best in sight and sound. PHILCO 551.

3 GREAT PERFORMANCE AND VALUE LEADERS BY

PHILCO

- Complete range of 14 sales-building radios and radiograms.
- Backed by largest national consumer advertising campaign.
- Co-operative advertising scheme directly links dealers.
- All models guaranteed 12 months from date of retail sale.

New Zealand Distributors:

RUSSEL IMPORT CO LTD

P.O. BOX 102 :: 20 BOND STREET, WELLINGTON.

And at Auckland and Christchurch.

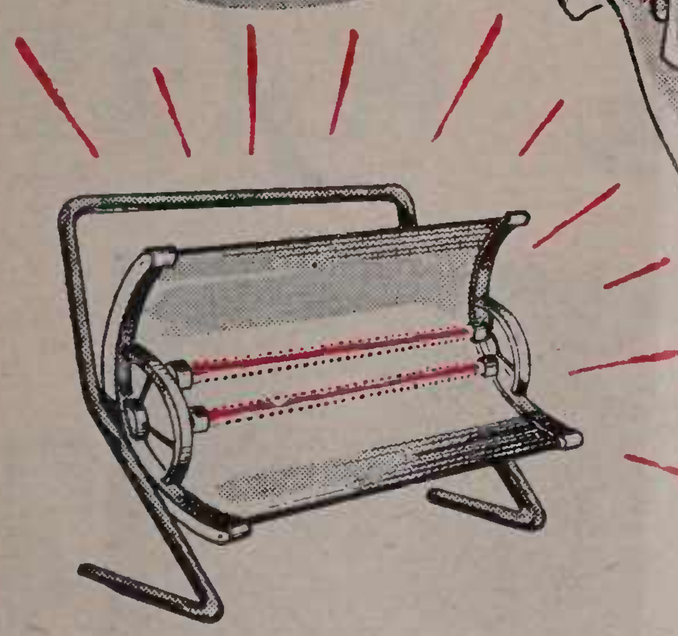
Available to franchised dealers only.

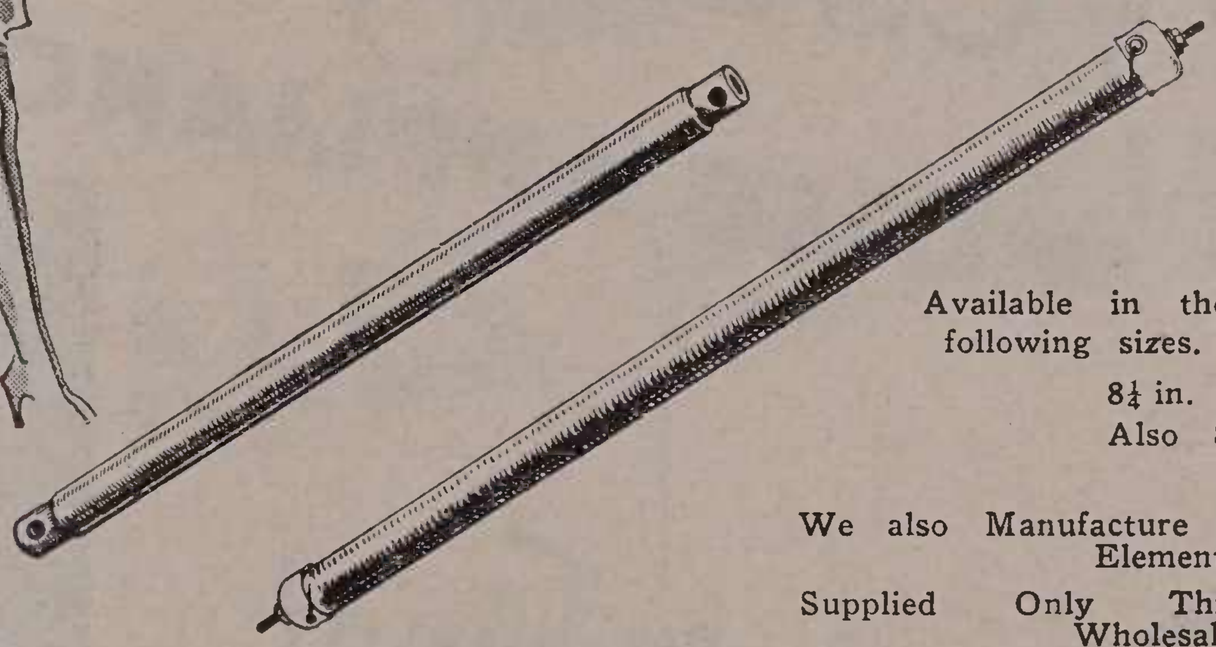
WINTER DRAWS ON!

Order Your Stocks Of

BJC

ROD ELEMENTS NOW!





Available in the following sizes.

8¼ in. and 11½ in.
Also 8 in., 9 in., 10 in., and 12 in.

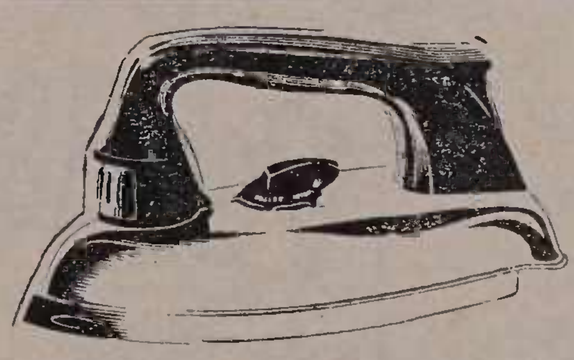
We also Manufacture Iron and Toaster Elements

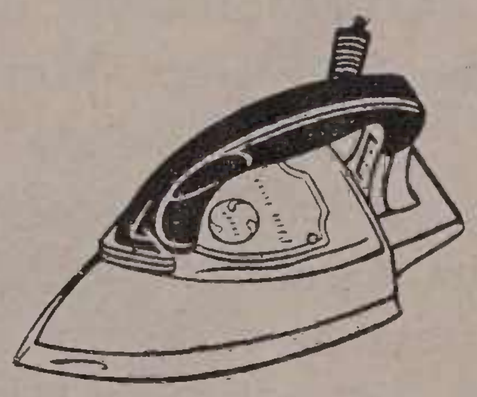
Supplied Only Through Electrical Wholesalers

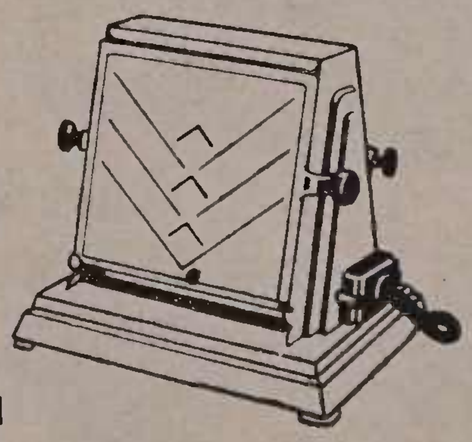
B. J. COCKSEDGE & CO. LTD.

82 Kent Terrace, WELLINGTON

Selling's Believing!







The attractive design and fine finish of Neeco electrical appliances helps keep them moving off your shelves and into the the homes of your customers. Of course, Neeco appliances are good performers as well as good lookers. That's why they are the first choice of discriminating New Zealand housewives.

NEECO

The NATIONAL ELECTRICAL & ENGINEERING CO. LTD.

AUCKLAND • WELLINGTON • CHRISTCHURCH • DUNEDIN
HAMILTON • WANGANUI • HASTINGS • INVERCARGILL

N5.5

AUTOCRAT DISTRIBUTORS LTD. are

pleased to announce

their appointment as
distributors for

Westinghouse
HOME APPLIANCES

Another world-famous name comes to New Zealand. Early releases from the Westinghouse group include the Westinghouse Food Crafter and the Cook-n-Fryer. Another popular appliance available immediately is the Kwik-Mix Liquidizer.

EVERY HOUSE NEEDS
A Westinghouse

✻ First Release!

The Westinghouse FOOD CRAFTER

Deliveries will commence on September 1st. Big features include: 20 Beating Speeds, Ejector Button to release both beaters, Fingertip Speed Control. The Food Crafter is supplied complete with 2 mixing bowls, graduated juice extractor and a plastic beater-cleaner. Inquire now regarding deliveries from the first shipment.

World Famous Westinghouse Appliances are distributed by

AUTOCRAT DISTRIBUTORS LTD.
P.O. BOX 2364, AUCKLAND.
Branches: Box 1049 Wellington, and Box 2012 Christchurch

NEW

Clipper

TEAM

Clipper '5' Valve Car Radio
for the smaller car, and for big cars, too. £25/15/–

Packs More SALES PUNCH!

★ Matching Grey Hammer Finish.

★ Matching Dials and Knobs.

★ Facia Adaptor Kitsets available to fit all modern cars.

★ 6 or 12-volt Units.

★ Speaker housing for the "5" available if required, at slight extra cost.

Clipper '8' Valve Car Radio
for the large car owner. £34/10/–

Clipper

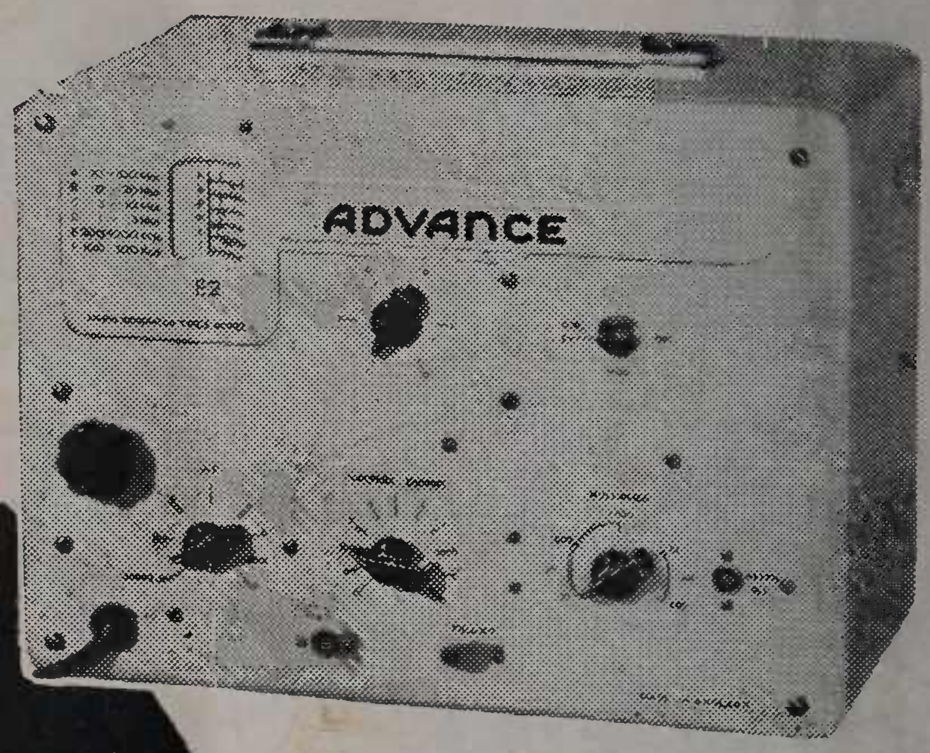
CAR RADIOS

Sole New Zealand Distributors: G. A. WOOLLER & CO. LTD., P.O. Box 2167, Auckland, and at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

AUDIO FREQUENCY SIGNAL GENERATOR FOR TELEPHONE AND COMMUNICATIONS SERVICING

Frequency Range 15 c/s to 50,000 c/s in three bands.

Frequency Accuracy: ± 2% ± 1 c/s.



"Advance" SIGNAL GENERATORS

New Attractive Price Range

We wish to announce our appointment as sole New Zealand Agents for "ADVANCE" Signal Generators, now available at a new attractive price range. In addition, "ADVANCE" manufactures constant voltage transformers in a range of 10 watts to 6 K/W; 11 types available in either standard or tropical finish. Also, "VOLSTAT" adjustable voltage stabilizers, "ADVOLT" automatic voltage boosters, and "KI" magnetizers.

Illustrated folders, giving full technical details, are available on request.

RADIO FREQUENCY SIGNAL GENERATOR

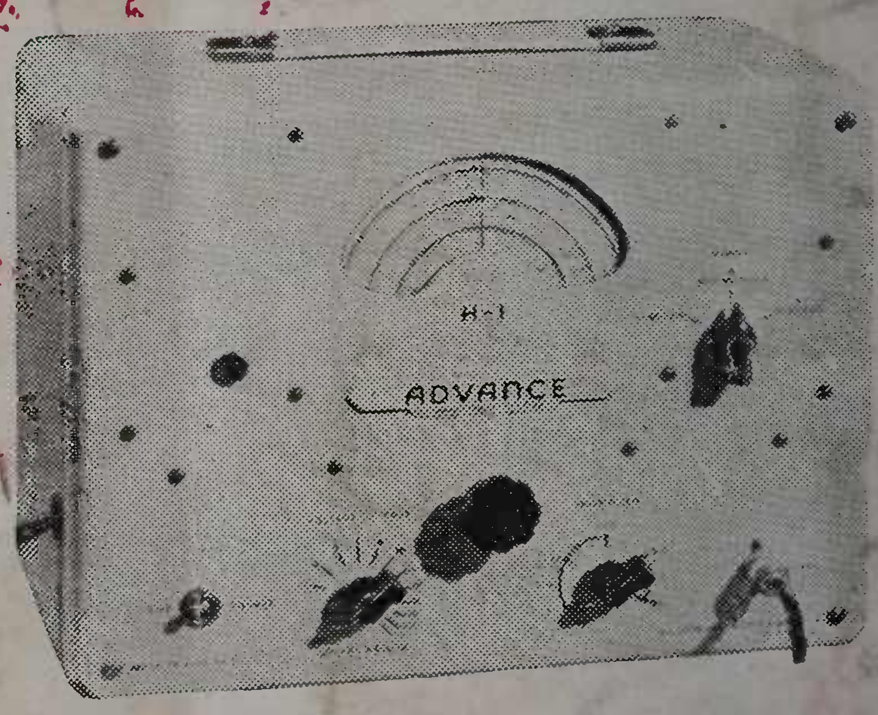
Frequency Range: 100 Kc/s to 100 Mc/s in six bands.

Calibration Accuracy: ± 1%.

AUDIO FREQUENCY SIGNAL GENERATOR FOR THE AUDIO ENGINEER

Frequency Range 15 c/s to 50,000 c/s in three bands.

Frequency Accuracy: ± 1% ± 1 c/s.



SERVICE OSCILLATOR

Frequency Range: 100 Kc/s to 100 Mc/s in six bands.

Calibration Accuracy: ± 1%.

AVAILABLE ONLY FROM N.Z. AGENTS:

TURNBULL & JONES LTD.

AUCKLAND · WELLINGTON · CHRISTCHURCH · DUNEDIN
HAMILTON · PALMERSTON NORTH
NELSON AND INVERCARGILL