

RADIO *and* ELECTRICAL

INCORPORATING "RADIO AND ELECTRONICS"

PUBLISHED MONTHLY IN THE INTERESTS OF THE N.Z. ELECTRONICS INDUSTRY

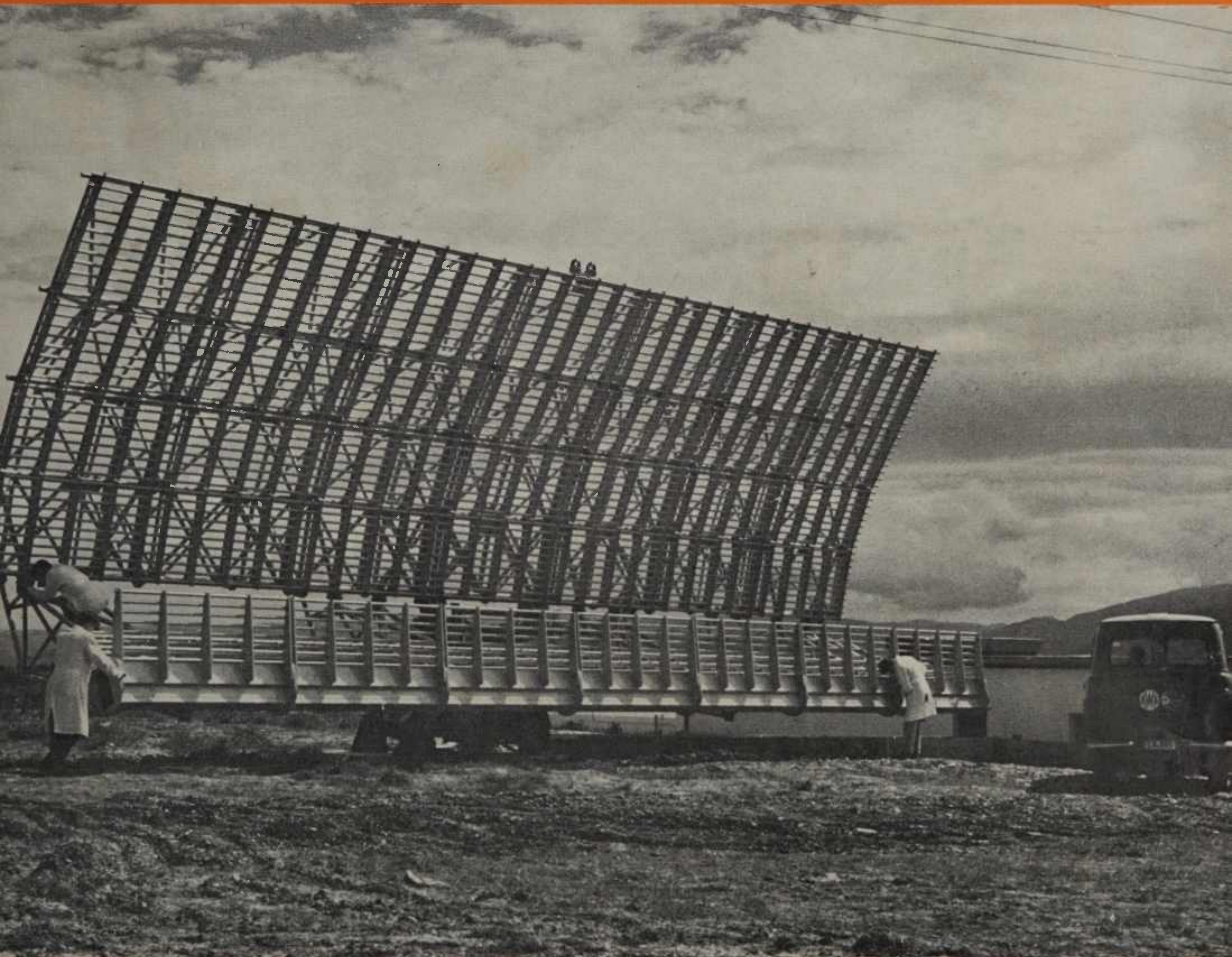
TV • AUDIO • SERVICE • AMATEUR RADIO



PRICE 2/3

VOLUME 17 NUMBER 6

AUGUST 1 1962



Advanced Radar for Dunedin Airport

SUPPLIED BY AMALGAMATED WIRELESS AUSTRALASIA (N.Z.) LTD.



	ON LAND		BRIMAR
	IN THE AIR		BRIMAR
	ON THE SEA		BRIMAR
	EVEN UNDER THE SEA		BRIMAR

BRIMAR are proving that there's
no substitute for *EXPERIENCE*

VALVES
TELETUBES

Brimar techniques and Brimar experience have produced one of the world's finest ranges of replacement valves.

PERFORMANCE PROVEN IN ACTUAL CIRCUITS

on land, at sea and in the air . . . in industry . . . in the services . . . everywhere the demands are for a guaranteed minimum life and utter reliability.

RADIO ENGINEERS

Your reputation is in safe hands when you specify Brimar Valves.

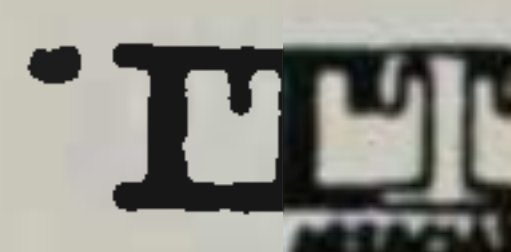
Now is the time to ***BRIMARIZE!***

*Remember, to Brimarize is to improvise, by utilizing Brimar equivalents.

STANDARD TELEPHONES



& CABLES PTY. LTD.



AUCKLAND
BOX 571

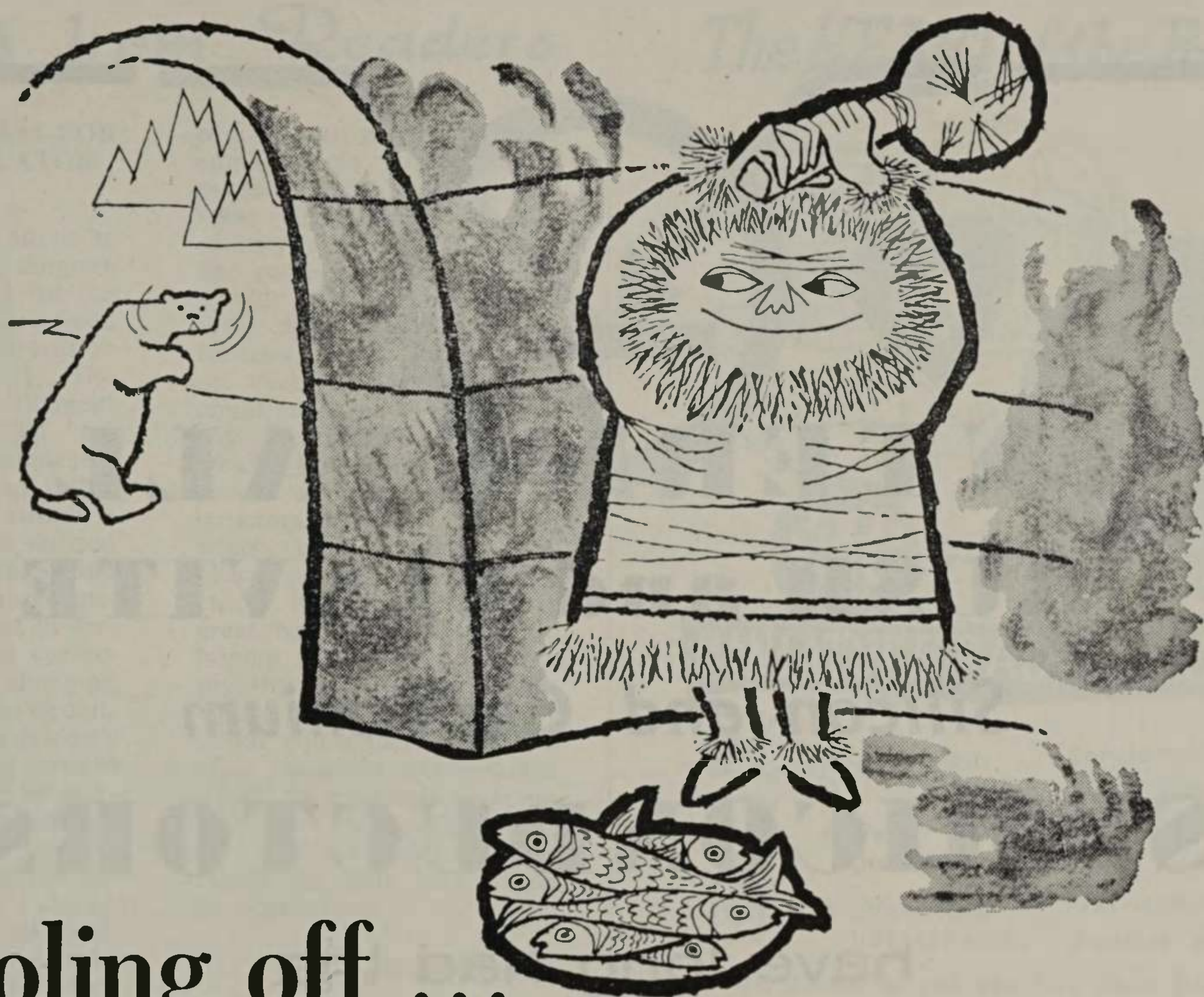
CHRISTCHURCH
BOX 983

WELLINGTON
BOX 593

WANGANUI
BOX 293

NEW PLYMOUTH
BOX 344

HAWERA
BOX 283



Cooling off ...

When it comes to lowering temperatures on the grand scale — there's nothing finer than the "ARCTON" range of chlorofluorohydrocarbon refrigerants made by I.C.I. And no wonder, for these products are manufactured to the highest standards of purity by the most modern methods. In the wide "ARCTON" range is a refrigerant ideally suitable for your particular use. Get in touch with us for any information you require.

N.Z. Stockists:

Electric Refrigeration N.Z. Ltd., 210/214 Lambton Quay, Wellington.

Ellis Hardie Syminton Ltd., Fanshawe St., Auckland.

Ellis Hardie Syminton Ltd., Thorndon Quay, Wellington.

Ellis Hardie Syminton Ltd., P.O. Box 1569, Christchurch.

Fisher & Paykel Ltd., 66/68 Lorne Street, Auckland.

A. W. McDonald Ltd., 5/7 Weld Street, Auckland.

Allan Newbold & Co. Ltd., Thorndon Quay, Wgton.

G. E. Patton Ltd., P.O. Box 92, Christchurch.

N. O. Pierson Ltd., 27a Southwark St., Christchurch.
Refrigeration & Heating Engineers Ltd., P.O. Box 976, Dunedin.

Seal Unit Service Ltd., Holland Street, Wellington.

H. Simpson Ltd., P.O. Box 583, Christchurch.

Simpson-Kane Refrigeration Ltd., 86 Vivian Street, Wellington.

Frigidaire Division of General Motors New Zealand Ltd., P.O. Box 795, Wellington,

and from a New Zealand-wide network of authorised Frigidaire Dealers.

'ARCTON'

REFRIGERANTS



IMPERIAL CHEMICAL INDUSTRIES (N.Z.) LTD.

P.O. Box 900,
AUCKLAND.

P.O. Box 1592,
WELLINGTON.

P.O. Box 1486,
CHRISTCHURCH.



INTERMETALL BRUSH and CLEVITE *Silicon and Germanium* SEMICONDUCTORS

have long had the
highest reputation for quality

The rapidly growing demand for Intermetall and Brush Semiconductors is the result of specialised production and engineering facilities and an exceptional quality control programme. Supported by the scientists and engineers of Clevite Research Centre in Cleveland, U.S.A., of which there are subsidiaries, Intermetall, G.m.b.H. and Brush Crystal Co. Ltd., are among Europe's largest manufacturers of semiconductors.

As Sole New Zealand Agents, E. C. Gough Limited can supply extensive information on their practical applications. Their engineers are able to help with application problems.

For further information on the above Companies' Products, please write or telephone
the Sole New Zealand Agents:

E.C. GOUGH LTD.

BOX 873

—

PHONE 62-254

—

CHRISTCHURCH

BOX 682

—

PHONE 16-100

—

AUCKLAND

Letters from Readers

CIRCUIT DIAGRAM FOR 50-WATT MODULATOR

Sir,

There appears to me to be a fault in the circuit diagram of the power supply for the 50 watt modulator described by you in the April edition of "R & E R" (P 21). The primaries of the filament transformer and "T₁" are shown to be connected in series and so that when the "on/off" switch is closed they are both shorted out, and also when the switch is open, all three primaries are connected in series. This would be corrected, I think, by the changing of this section of the circuit. This was possibly a printer's error, and anyway, would have been picked up by anyone intending to build the unit, or even just looking through the circuitry of the amplifier, as I was. I found it interesting, like all your articles which I have seen in "R & E R", and I would like to offer a suggestion for a constructional project — a low range (under fifty feet) transmitter for the sending of music, from a pickup, to a standard radio. A friend of mine recently constructed one, using, I believe, and OC77 transistor and a ferrite aerial. These are legal and can be useful and interesting. Anyway, there's the suggestion, for what it's worth.

G. S. LEES,
Masterton.

You will note we have already published a correction to this circuit — thank you for bringing it to our attention. We thank you for your comments and we will keep your suggestions in mind.

—Ed.

HAMILTON AMATEUR SEEKS INFORMATION

Sir,

I am writing to you to ask for some help but I am not sure if it does in fact come within your service. I have had an interest in radio for about four years and have built myself several relatively simple sets using parts that are available at the normal retailers. Now however I have embarked on more ambitious lines in the form

of a 20 watt general purpose amplifier, etc., and am hampered by not knowing just what firms, etc., in the country deal with amateurs like myself. For instance, I would like to know what firms deal in power transformers, output transformers or even rewinds. If you could assist me by supplying any addresses of firms which do cater for mail-orders from amateur constructors or in fact any firm which could supply surplus parts, transformers, etc., it would be a great help. Secondly, I am hoping that you could supply the name of any book which contains circuits for guitar amplifiers, mixers, etc., using say components which are relatively inexpensive, e.g., 6U6's, 807's, etc., of 10-15-20 watt output. Again any help here would be appreciated.

C. WHEATLEY,
Hamilton.

P.S. Is there a manufacturer of metal chassis and cases suitable for oscilloscopes, radios, etc., in the North Island.

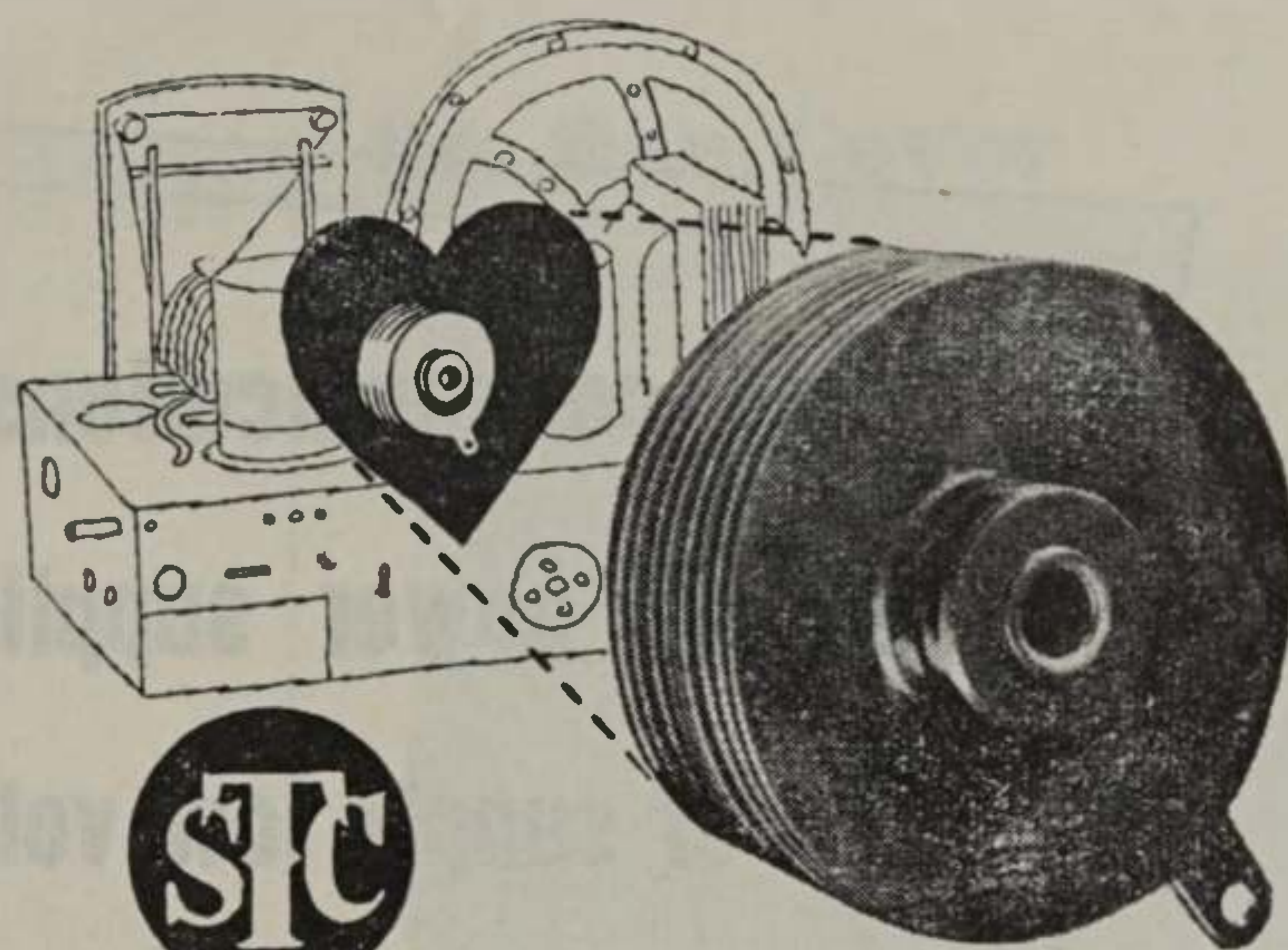
In reply to your kind letter we would like to advise that both Auckland Transformer Co. Ltd. and Beacon Radio Ltd., two of our advertisers, both have distributors for their products in most main centres. If you would like to write to them direct they will be only too happy to advise you of your nearest retail supplier.

With regard to field chassis work and cases, we use a number of types of auminium fabricated chassis which are available both in Auckland and Hamilton.

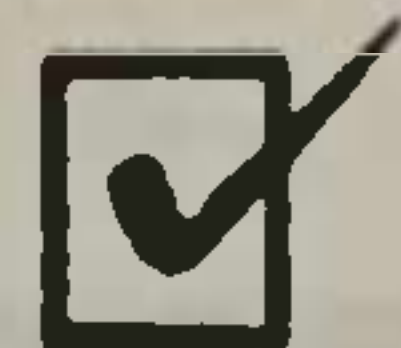
This magazine, over the past few years, has catered for amplifiers suitable for Guitars and other string instruments. However, we do intend shortly after Christmas to describe an amplifier of about 30 watt rating which would probably be the type of equipment you are seeking. With regard to books on this subject; here again our advertisers will no doubt be able to help you.

—Ed.

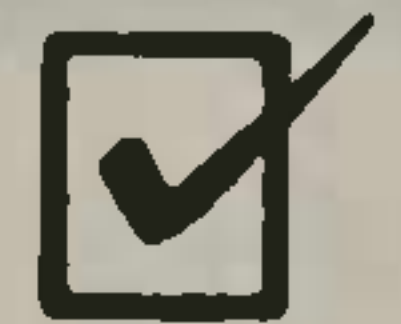
The HEART of the Portable



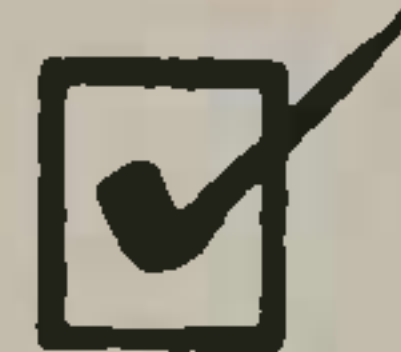
MINIATURE RADIO RECTIFIER



★ 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.

P.O. Box 140, UPPER HUTT AUCKLAND Box 571
CHRISTCHURCH Box 983



THE ONLY N.Z. MONTHLY
MAGAZINE DEVOTED TO THE
RADIO, TV and ELECTRONICS
INDUSTRY

RADIO & ELECTRICAL REVIEW

Published monthly for radio and electrical retailers and wholesalers, electronic engineers, radio and TV servicemen, amateur transmitters and radio constructors, by The Magazine Press Ltd., Publishers of Home and Building.

SUBSCRIPTION DEPT.

Radio & Electrical Review,
P.O. Box 1365, Auckland.

I wish to subscribe to RADIO & ELECTRICAL REVIEW.
I enclose: £1/7/- for 12 issues posted.
£2/14/- for 24 issues posted.

NAME: _____

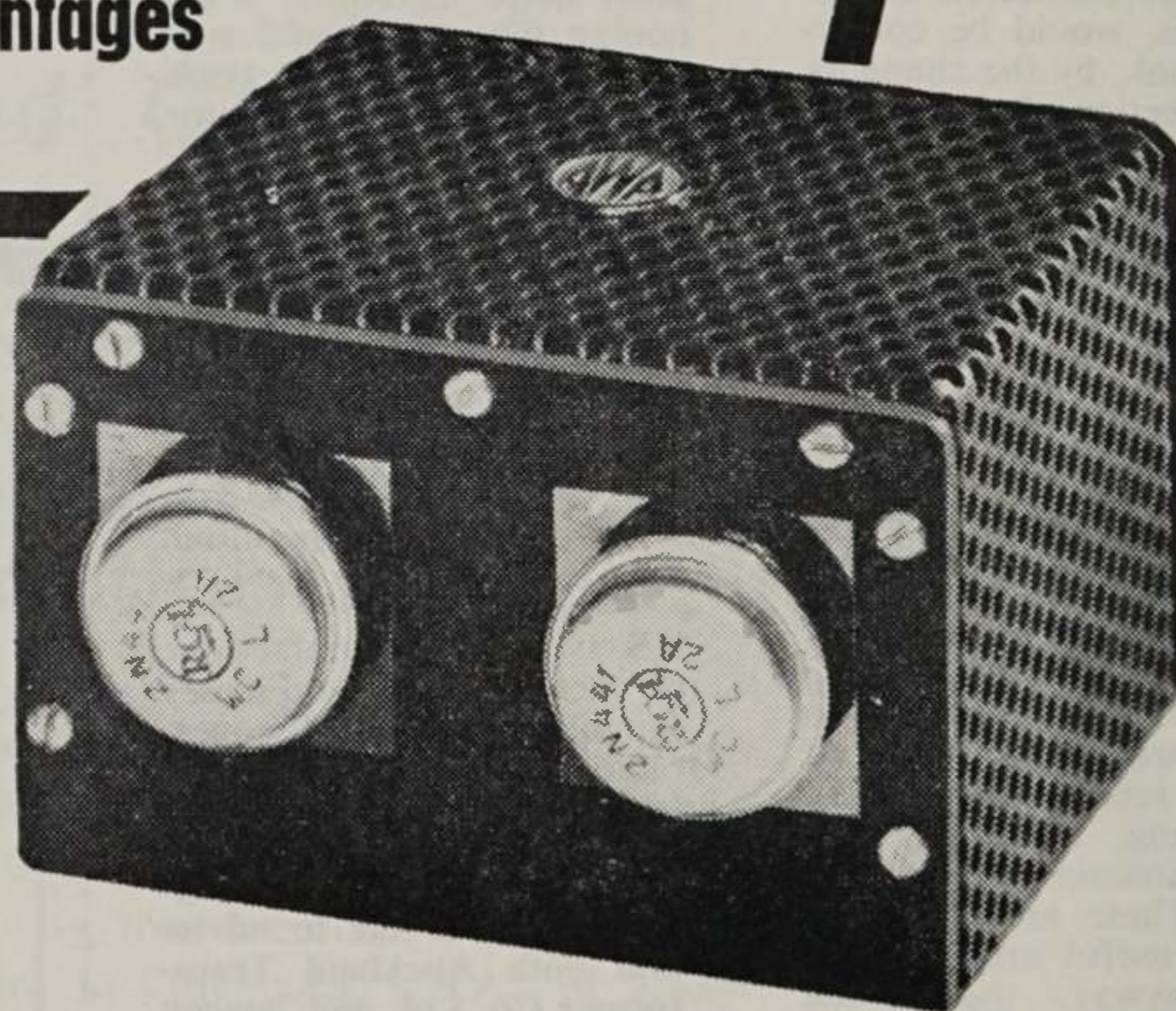
ADDRESS: _____

In new communications equipment or to replace vibrator power supplies the **AWA** transistor power supply low voltage DC to high voltage DC has these major advantages

- HIGHER POWER
- HIGHER EFFICIENCY
- LOWER OUTPUT RIPPLE
- MECHANICALLY AND ELECTRICALLY QUIET
- LOW PRICE

PLUS

- High efficiency exceeding 85% achieved by using H.C.R. alloy torroid.
- Instant starting reliability.
- Rugged, shock-resistant. Unaffected by moisture and vibration.
- Long-life. No moving parts.
- Steady DC output. Ripple less than 0.4%
- Excellent voltage regulation.
- Wide ambient temperature range (up to 140°F.).
- Neat package form size (4" x 3½" x 2½") Easy to mount.
- Weight only 1 lb. 8 oz.
- Price £15.19.0 plus Sales Tax.



SPECIFICATION

Input Voltage	- - - -	12v DC (Alternative model 24v DC.)
Output Voltage	- - -	250v and 500v DC. (Standard model other voltages available on request).
Efficiency	- - - -	Better than 85%.
Output Power Rating	- -	120 watts continuous rating. 130 watts intermittent service. For continuous operation at maximum ratings in high ambient temperatures additional thermal dissipation (heat sink) is required such as chassis measuring 7" x 7" x ½" thick.



AMALGAMATED WIRELESS (AUSTRALASIA) N.Z. LIMITED

2nd Floor, Commerce House, Wakefield Street, P.O. Box 830, WELLINGTON.

P.O. Box 1363,
AUCKLAND
Tel. 48-348

P.O. Box 2084,
CHRISTCHURCH
Tel. 62-158

P.O. Box 932,
PALMERSTON NORTH
Tel. 83-671.

P.O. Box 1026,
DUNEDIN
Tel. 88-058.

A16.0

Radio and Electrical Review

OFFICIAL JOURNAL OF
The New Zealand Electronics
Institute (Inc.).

The New Zealand Radio and
Television Manufacturers'
Federation.

CONSULTANT EDITORS:

W. D. Foster, BSc.,
A.M.Brit. I.R.E.

C. W. Salmon, Grad.I.E.E.
Assoc.Brit.I.R.E., Grad.N.Z.I.E.

I. H. Spackman, A.M.I.R.E.

MANAGING EDITOR:

Victor L. Beckett.

PRODUCTION MANAGER:

V. C. Williams.

* * *

RADIO AND ELECTRICAL REVIEW

(Established 1946)

Published Monthly by the
Proprietors:

THE MAGAZINE PRESS LTD.,

Publishers also of
HOME AND BUILDING

Director and Chairman:

Victor L. Beckett

Director and Secretary:

Wilma W. Beckett

at the registered office of the
company: Lumley House, 10
High Street, Auckland, C.1.,
N.Z. P.O. Box 1365, Auckland.
Telephone 41-508.

* * *

Sole New Zealand Distributors:

GORDON & GOTCH (N.Z.)
LTD.

From Newsagents — 2/3 per
copy. Or direct from the pub-
lishers 27/- per year in ad-
vance, post free throughout the
world.

* * *

Advertising Representatives for
the United Kingdom:

PUBLISHING & DISTRIBUTING
CO., LTD.,

177 Regent St., London, W.1.

* * *

Printed by Farrell Printing
Co. (1955) Ltd., Mt. Roskill,
Auckland. Registered as a news-
paper at the G.P.O., Wellington.

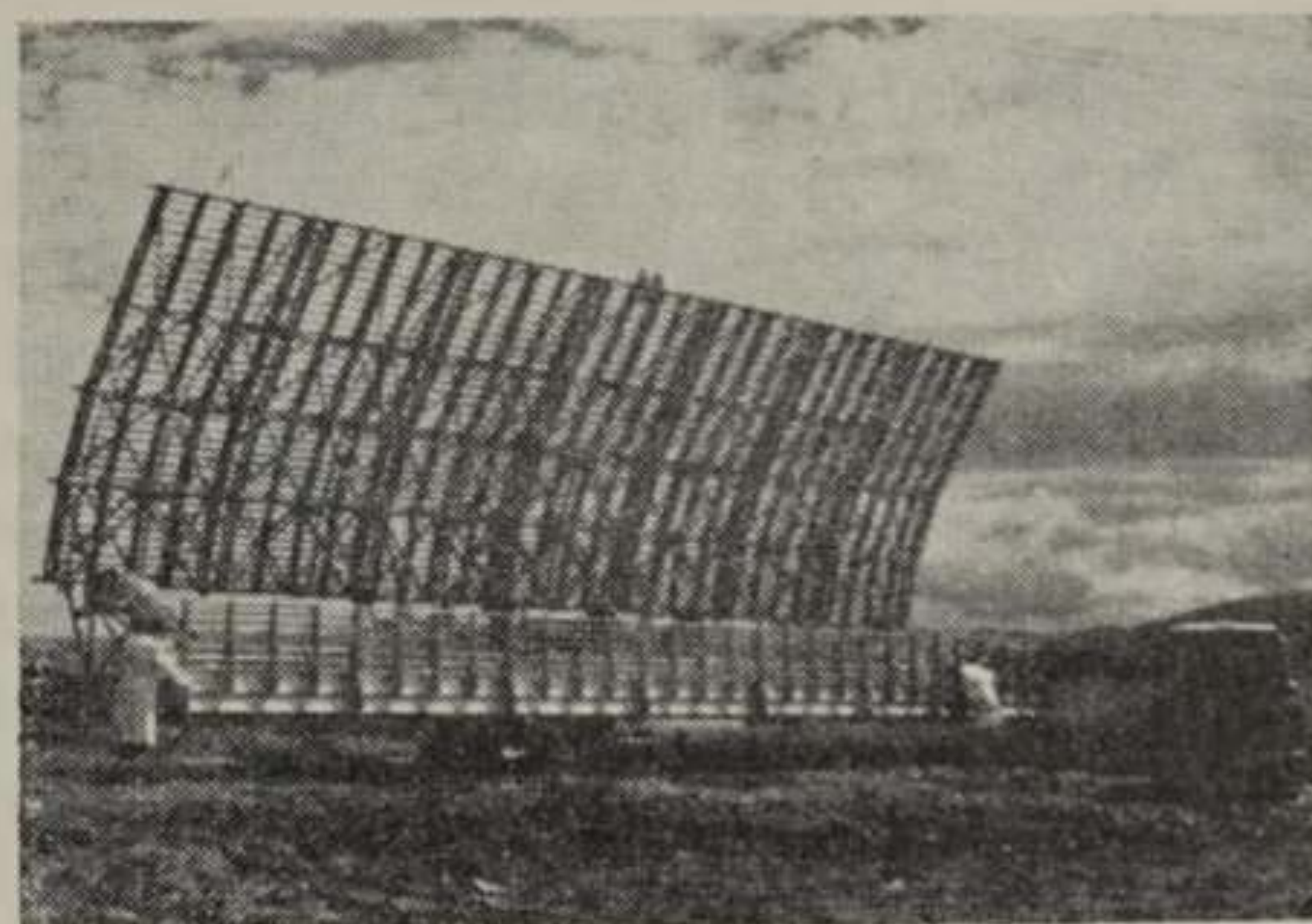
Vol. 17, No. 6

AUGUST 1, 1962

Contents:

	Page
Editorial — A Rose by Any Other Name	7
Frontispiece — Giant Marconi Dish Reflector	9
General Electronics	
Quicker Colour Matches	34-35
Industrial Electronics	
Adjustable Power Supplies	19-24
Digital Instrumentation	35
TV	
A TV Antenna for Channel Two <i>Irving Spackman</i>	13-15
Looking at Bonded-Shield TV Picture Tube	26-27
Radio	
40th Anniversary — Formation of the BBC	10-13
A Grid Dip Oscillator with Magic Eye Indicator <i>Irving Spackman</i>	16-18
Departments	
Letters from Readers	3
Book Reviews	29
Shortwave Survey	30-31
New Products	32
Overseas Notebook	36
Technical Journal Contents List	38-39
Record Reviews	40

On Our Cover



Advanced Radar For Dunedin

After the war, Marconi's fore-
saw that with the anticipated
rapid increase in aircraft speeds
and traffic densities, there would
be an urgent need for surveillance
radar of the highest efficiency for
air traffic control.

It was realised that the "con-
ventional" radar wavelength of
10 cms, 3 cms, and below — then
much in favour — possessed
serious shortcomings for the pur-
pose of airways surveillance, be-
cause on such very short wave-
lengths a radar beam tends to
behave like a light beam, notably
in that it is reflected back from
raindrops, hail, snow, and even
cloud concentrations. This "pre-
cipitation clutter" is a serious
handicap to keeping aircraft ob-
servation on the radar screen.

In seeking a solution to this
problem, Marconi's took what was
then a bold step in adopting a
wavelength of 50 cms. It was
found that precipitation clutter
at this frequency was virtually
nil, the radar beam giving rise
only to very weak echoes from
rain, hail, snow, and heavy cloud
masses. Consequently, the aircraft

(continued on page 33)

Featured Next Month

- ☆ Looking at Long Range TV Reception.
- ☆ Space Rendezvous Systems.
- ☆ Construction — SSB Exciter.
- ☆ Relays For Industry.
- ☆ Stereo Amplifiers.

OVERSEAS NOTEBOOK : NEW PRODUCTS : SHORTWAVE SURVEY : TECHNICAL JOURNALS CONTENTS



• • • • • *a rose by any other name*

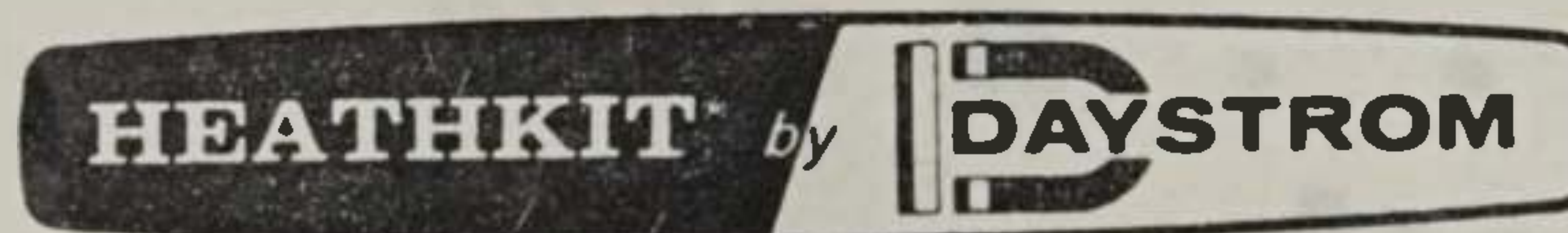
Two announcements in Overseas technical journals bearing August publishing dates are worthy of a little thought on our part. That revered, and to some rather awesome, English monthly "Electronic Technology" will soon be appearing under the title "Industrial Electronics". This is not the first change of title made by its publishers and many of our own readers will recall it first as Wireless Engineer, as long ago as the 1920's, then as "Electronic and Radio Engineer" and more lately as "Electronic Technology." A change of titles in a new journal, say, over three or four years in an endeavour to find a name with sales appeal, either in search of readers or advertisers, is not uncommon but the shedding of titles by a journal as stable and sound as "Electronic Technology" calls for more than a brief note of welcome to the new title. For many years "Wireless Engineer" (and its later titles) held pride of place as the top non-Institutional electronic periodical with a definite lean towards theoretical aspects. The slow change from wireless — radio broadcasting today — to broader scope brought the title change to include Electronics and Radio and the advances of the past 10 years or so reduced the title to the all-embracing "Electronic Technology". These changes were movements with the time. The leap to "Industrial Electronics" is almost a changing of horses in mid-stream until one stops to consider that in most overseas countries industrial electronic equipment calls for over 50% of all electronic components manufactured and in Britain and the U.S.A., for more than 65% of the professional and technical manpower. 12 years ago these figures were approximately half their present percentages. This increasing demand calls for similar increase in technical information of a kind suited to the bulk of readers, or potential readers, and the proprietors of the new "Industrial Electronics" are to be complimented on filling the gap in one such bold move. We have no doubt that the change of name, and swing of editorial content, will only enhance the good name of our departed friend "Wireless Engineer".

An announcement that the British Institution of Radio Engineers has applied for membership of the Part 1 examination

Committee of the Home Engineering Institutions will at present only be of direct interest to student members of the British Institution of Radio Engineers but, like the new "Industrial Electronics", does deserve more thought. The student radio engineer who started in his profession as a member of a Radio Institution has long suffered a disadvantage in being specialised at too early a stage of examinations. Whilst adequate basic training in electrical and radio science was required it has only been lately that any knowledge of, for instance, applied mechanics has been called for. Thus the joining of the British I.R.E. in with the Home examining bodies, together with our own New Zealand Institution of Engineers — a subscribing body to the joint Part 1 — will provide basic engineering subjects common to all branches of engineering. To those rash enough to suggest that applied mechanics are of no use to electronic engineers we would suggest that one day they may well be asked to design an amplifier for strain gauges and it will be of some help to know that Poisson's Ratio is not some fish canned at Gisborne.

It has been the aim of this journal to give its readers editorial material over as broad a field as possible. Because the industry in this country is small, and we are the only magazine dealing solely with radio and electronics in New Zealand, we cannot, nor do we want to, change our editorial emphasis as in the case of the new "Industrial Electronics". Nevertheless, the specialist interests deserve attention and, even more, they deserve publicity. Our special "Communications" issue earlier this year showed the benefit of occasional concentrations on one particular field. Because we feel that there is no place in industry where electronics cannot be wisely used, if we can be said to be changing our emphasis at all it is towards widening the interest of our readers beyond their own currently narrow field. Because of this we can see the sense in the British I.R.E. examination move. For our own part we will follow up our convictions by supporting, where necessary, our editorial matter with basic theoretical text.

C.W.S.



A MERRY CHRISTMAS TO YOU ALL FROM *Heathkit*

FIRST OF ALL THANK YOU FOR YOUR SUPPORT
DURING THE PAST YEAR AND ALSO FOR BEING
SO CONSIDERATE IN THESE DIFFICULT TIMES
WITH IMPORT LICENSES BEING WHAT THEY ARE.

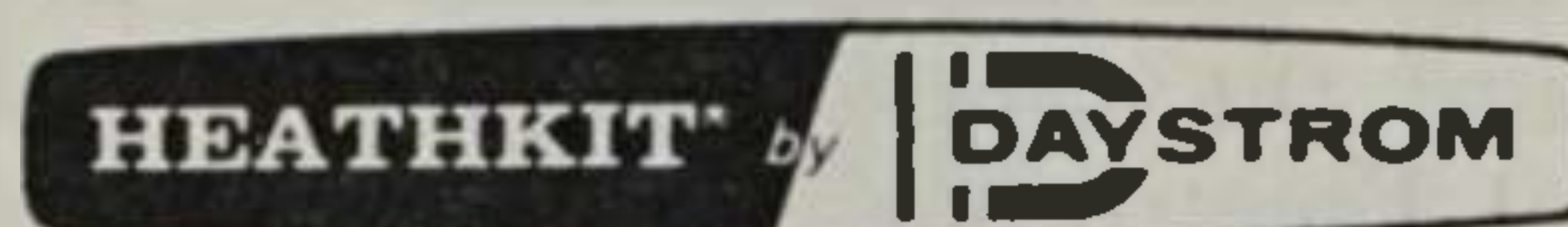
 IS WORTH WAITING FOR
AND ITS WELL WORTH OWNING ONE BECAUSE
AS MOST OF YOU KNOW IT'S THE BEST IN IT'S
CLASS.

PROVED OVER THE YEARS BY STRINGENT TESTS,
ACCEPTED BY GOVERNMENT DEPARTMENTS
HEATHKIT IS THE EQUIPMENT FOR YOU WHICH-
EVER WAY YOU LOOK AT IT.

MAKE YOUR NEW YEAR RESOLUTION NOW
AND MAKE THIS CHRISTMAS A **HEATHGIFT**
CHRISTMAS.

NEW STYLING — NEW MODELS

NEW **LOW** PRICES — NEW ALL OVER



FROM

TRICITY HOUSE, CHRISTCHURCH

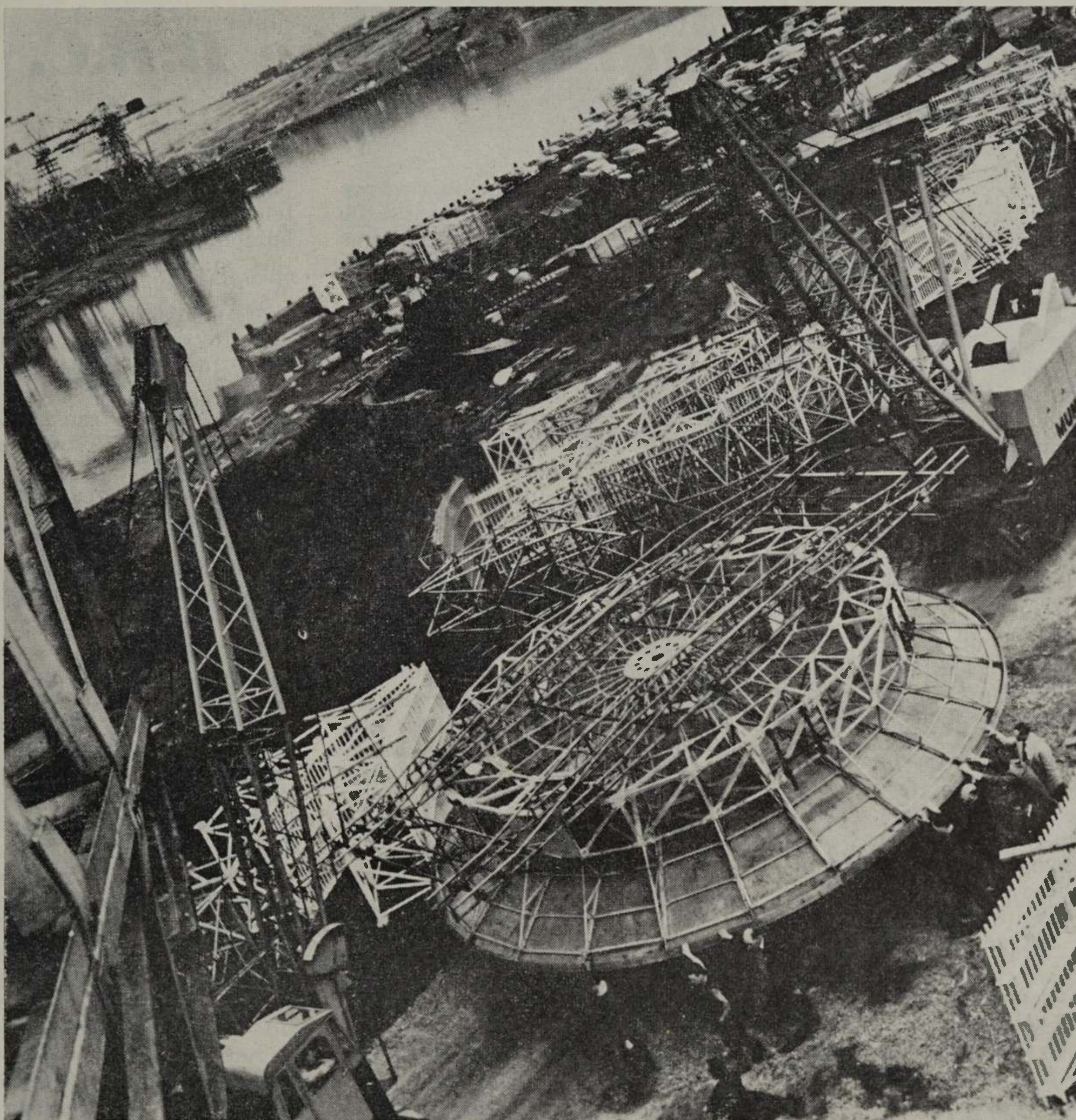


CAMPBELL'S RADIO, HASTINGS

OR

P. H. ROTHSCILD & CO. LTD.

83 Pretoria Street, Lower Hutt. P.O. Box 170. Telegrams: "FRANDS"



30ft. DIAMETER EXPERIMENTAL DISH REFLECTOR

“Rolled out” recently at Marconi’s mechanical engineering works at Felling was this 30 foot diameter experimental dish reflector, believed to be the first produced in Great Britain, designed to operate at wavelengths down to 3 cm. It is shown here on its way to the test site for an intensive programme of load and deflection tests.

Several completely new production techniques had to be devised in order to ensure a sufficiently high degree of precision and this very large dish has been manufactured with a measured surface accuracy of better than 20 thousandths of an inch standard deviation. Accurate reflectors of this type working at these high frequencies are likely to find increasing use in the field of satellite tracking.

40th ANNIVERSARY — *formation of the B.B.C.*

Forty years ago, on 14th November 1922, the Marconi Company formally handed over its London sound broadcasting station, 2LO, (with which the Company had been transmitting programmes since the previous May), to the newly-formed British Broadcasting Company Ltd., an organisation formed by six large radio manufacturers* with a share capital of £100,000.

Today, the British Broadcasting Corporation has an annual income of over £40 millions, possesses nearly 400 transmitters and employs a staff of over 17,500. A daily audience of 25 millions is claimed for its sound programmes and 20 millions for BBC television.

The seed sown by the Marconi Company in the years 1919-22, when techniques developed during the Great War were used to originate entertainment broadcasting in this country, have thus borne remarkable fruit. The story behind those pioneering years is a curious one in terms of evolution and one not generally known to the public.

To a Canadian must go the honour of being the first to broadcast speech and music. This was as long ago as 1906, when Professor R. A. Fessenden, working in the U.S.A. transmitted a short programme on Christmas Eve of that year from Brant Rock, Massachusetts. His transmitter was a 50 kc/s alternator, modulated by a watercooled microphone.

Others followed suit, notably Dr. Lee de Forest in 1907, 1908 and 1910, the 1908 experiments being carried out from the Eiffel tower. Another American, E. W. Alexanderson, succeeded in building a 100 kc/s alternator with a power of $1\frac{1}{2}$ kW and made a decisive step forward in 1912, when he devised a means of coupling the microphone indirectly to the alternator.

De Forest used a modulated arc for his tests and both this and the alternator systems had serious practical disadvantages. Nevertheless, it must have been a puzzling experience for the few ships' operators who chanced to tune their receivers to the transmissions, to hear distorted music and speech instead of morse. As for the experimenters, they were carrying out serious tests and there was no thought of mass-entertainment in their minds at the time.

Oddly enough, de Forest had the key to successful radio-telephony transmission right to hand in his own invention which he called the 'Audion'. This was the triode thermionic valve; but unfortunately the early Audions were very inefficient as amplifiers and it was not until after Dr. Langmuir's introduction of high-vacuum triodes in 1912 that they were found to be capable of generating oscillations.

Thereafter, events moved swiftly; the high vacuum gave the thermionic valve a significant amplification factor and the almost simultaneous discovery in 1913 by Meissner (Germany), Armstrong, Langmuir and de Forest (America) and Round (Britain) of the valve's ability to generate oscillations opened the door to practical radio-telephony.

The 1914-18 war gave great impetus to the triode's development in the military field, and in particular the work of Round and Prince of Marconi's established radio-telephony's value as a means of controlling fighter aircraft. The coming of peace found the thermionic valve vastly improved both as an amplifier and a generator, and designs for radio-telephony transmitters and receivers were by that time well established.

But with the war ended, civil uses for such equipment had to be found and evaluated. As one aspect of this, the Marconi Com-

pany in 1919 installed a radio-telephony transmitter at Ballybunion, Ireland, and it was via this station that the voice of W. T. Ditcham, a Company engineer, made history as being the first to span the Atlantic from East to West, being received clearly in Louisberg (Nova Scotia).. The transmission was carried out on a wavelength of 3,300 metres.

Later in the year a 6 kW experimental radio-telephony station was built at Marconi's Chelmsford works but this was replaced early in 1920 by a 15 kW transmitter with which a series of public telephony range tests were carried out by Round and Ditcham. Purely to offset the monotony of reading 'railway time-table' material at the microphone for test purposes, the engineers introduced the occasional musical item. To their surprise, reports and letters of appreciation came in from all over Britain and the Continent, and it was obvious that the amateurs wanted more.

Thus the real beginning of broadcasting entertainment in this country was accidental; a mere side-effect to the main business of range-testing.

On February 23rd 1920 the Chelmsford transmitter again made history by broadcasting the world's first telephony news service. The further interest shown by listeners was another straw in the wind to indicate that there might be possibilities in the broadcasting of speech and music for entertainment purposes alone, and plans were laid for an ambitious essay — no less than the transmission of a recital by Dame Nellie Melba herself.

This, the world's first advertised programme of broadcast entertainment, took place on June 15th 1920, when Melba, under the sponsorship of the 'Daily Mail', visited the Marconi works. At 7.10

p.m. on that summer evening the golden notes of the famous prima donna thrilled amateurs all over Europe — the privileged few hundreds who owned receiving equipment at that time.

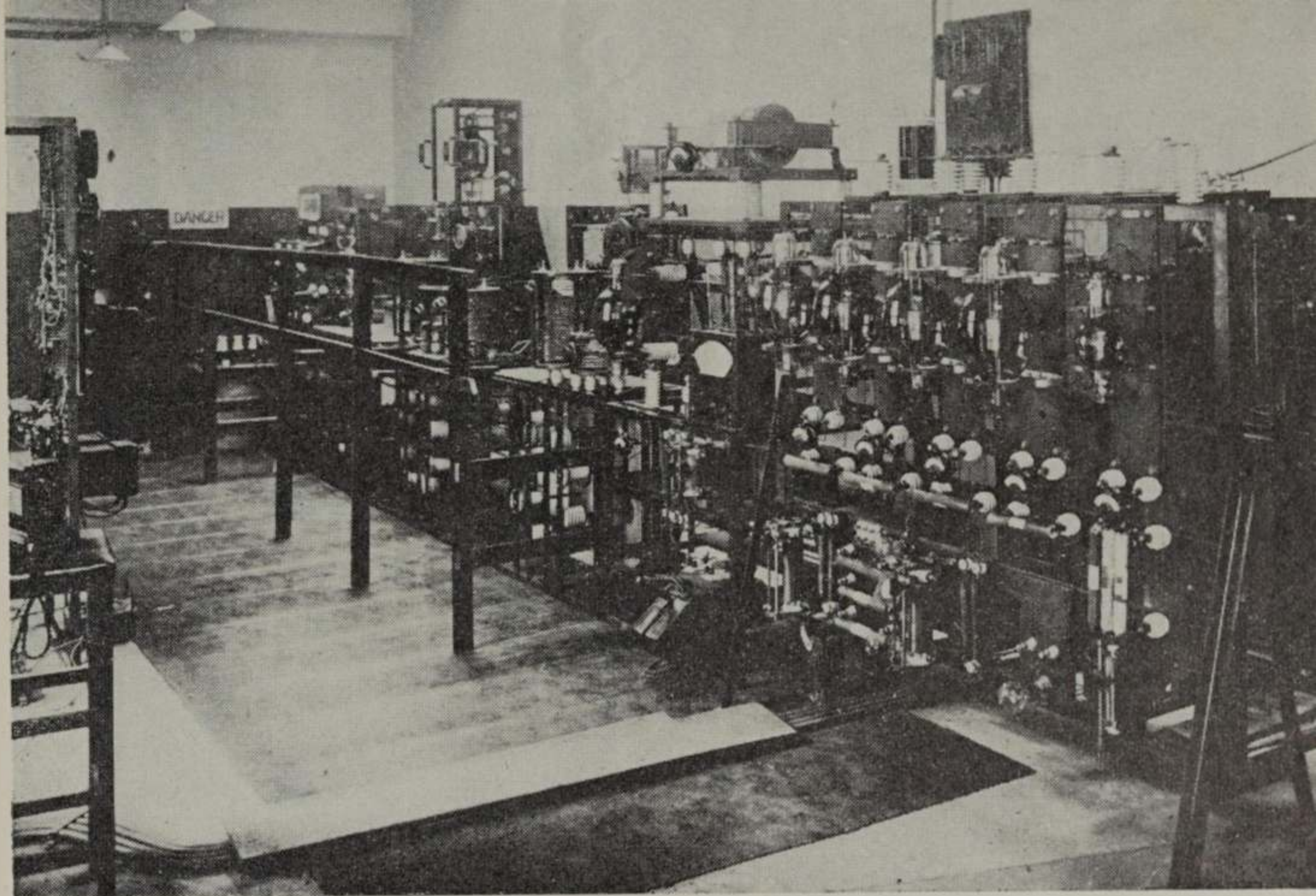
The spate of congratulatory messages which came in as a result convinced the Marconi Company that here was a vast potential civil market in transmitting equipment, domestic receivers and components, if only the public at large could be made aware of the fascination and the entertainment value inherent in broadcasting.

There was, unfortunately, a snag, and a big one at that. The Marconi transmissions were licensed by the Postmaster General for experimental purposes only, and although the occasional special demonstration was tolerated, a regular entertainment service would most certainly be vetoed. Nevertheless, some further broadcasts were carried out.

The blow, when it fell, was none the less heavy for being anticipated. The worst happened; The PMG withdrew the Company's license to transmit items of entertainment on the ground of interference with legitimate services. The situation was crucial because although the Company had a clear lead at that moment, there was every indication that American business interests were hot on the trail and were shortly about to make a big drive to popularize broadcasting and to go all-out for world receiver markets.

The situation in America, in fact, paralleled British experience. In 1919, Dr. Frank Conrad of the Westinghouse Company had built an experimental radio-telephony station, and, like Round and Ditcham, transmitted music to avoid the tedium of continuous speech. He, too, was inundated with requests for more and more gramophone record transmissions and soon, largely as a result of newspaper publicity, the number of listeners multiplied, and Dr. Conrad's Company experienced a minor boom in the demand for receiver components.

There was, however, one important difference between England and the U.S.A. in that in America there was comparatively little re-



The Original 2LO Transmitter at Marconi House, London.

striction in the matter of licensing radio stations. As a consequence, when Westinghouse decided to build a station in Pittsburg and operate it on an advertised entertainment basis, their way was clear. Their station KDKA went on the air officially on November 2nd 1920, causing an immediate sensation by broadcasting the results of an American Presidential Election.

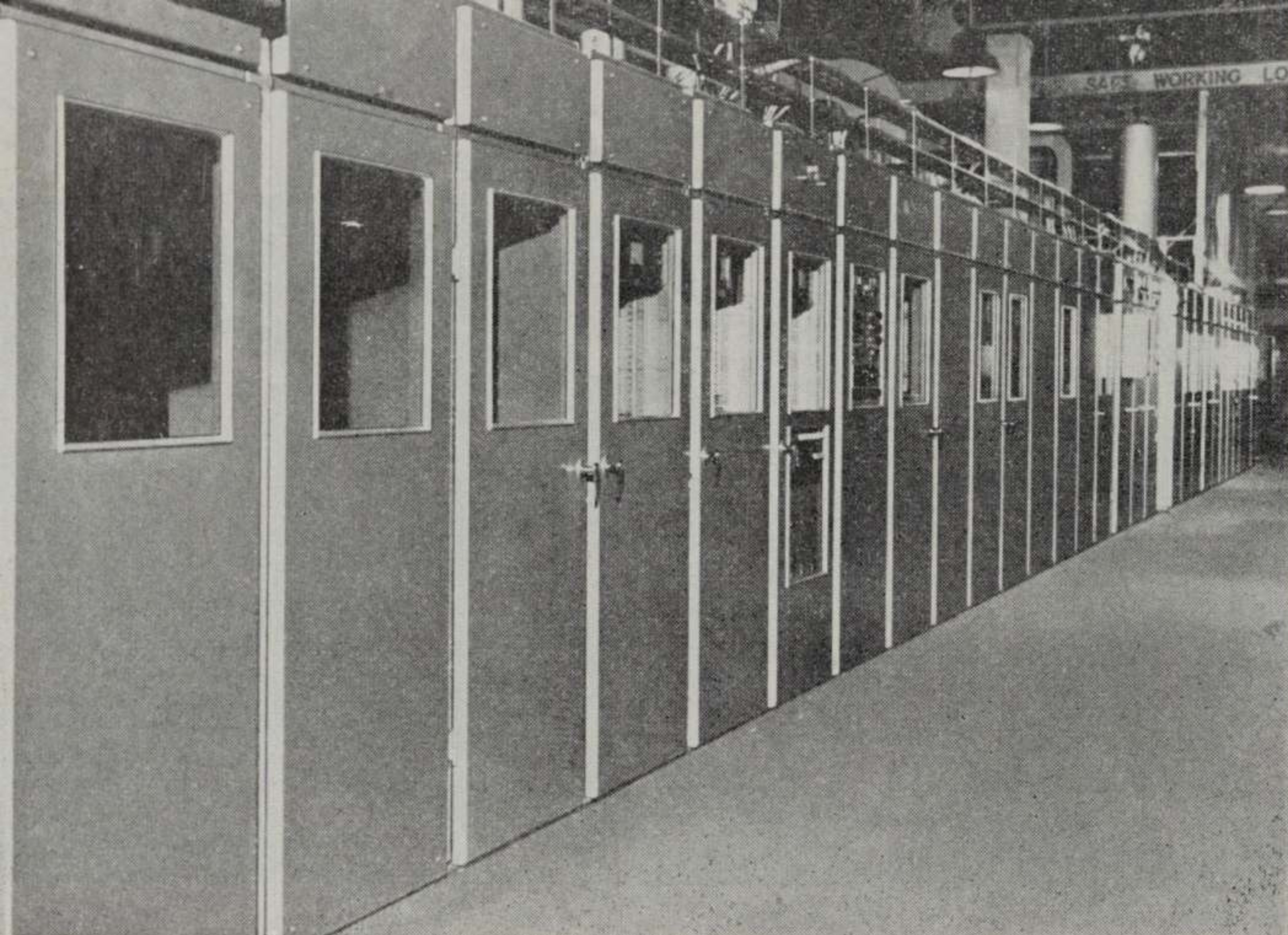
In the meantime, in Britain, Marconi's had to endure the chagrin of having established a lead and being unable to follow it up officially. Westinghouse, on the other hand, were reaping a rich harvest in terms of domestic receiver and component sales. It was not until 63 Wireless Societies in the country petitioned the PMG asking for official permission to have the Chelmsford transmissions resumed, that the ban was lifted. By that time nearly two precious years had gone by.

It was not until January 13th 1922 that Marconi's were authorized to establish another station. Even at that, there were restrictions. The power must not exceed 250 watts and transmission time must not extend beyond one half-hour per week; the station was to shut down for three minutes in every ten to listen for instructions to stop, should interference be experienced by other services. It was the man with the red flag in front of the motor car all over again.

The task of building the transmitter was undertaken by the Development Section of Marconi's Aircraft Division, who also undertook to provide the weekly half-hour transmission each Tuesday evening between 8.00 and 8.30 p.m. Captain P. P. Eckersley who was in charge of the project, acted as compere, singer and actor-manager in addition to his technical responsibilities.

That station, 2MT, Writtle, or 'Two Emma-Tock' as it was soon affectionately known, rapidly endeared itself to all amateurs within listening range. Capt. Eckersley proved himself a master of spontaneous humour and the programmes, mostly consisting of items by Marconi employees, ran with a joyous abandon that has never again been recaptured. At the same time much valuable data accrued.

First on 700 metres wavelength but soon changing to 400 meters. Two Emma-Tock continued for almost a year, making an ever-increasing army of friends throughout its career. It is of interest to note that among the young engineers who ran it, P. P. Eckersley became the first Chief Engineer of the BBC, N. Ashbridge (now Sir Noel) was the BBC's Technical Director when he retired in 1952 and is now on the Marconi Board of Directors, R. T. B. Wynn became the Chief Engineer of the Corporation, H. L. Kirke, an As-



A Modern Medium Frequency Broadcasting Transmitter.

sistant Chief Engineer and B. N. MacLarty became Head of the BBC's Design and Installation Department before returning to Marconi's in 1947. He is now the Company's Engineer-in-Chief.

Soon after Writtle began operation, the Marconi Company received another permit — this time for the establishment of an experimental station at Marconi House, London. Again there were restrictions; a power of only 100 watts was permitted; music was to be transmitted, and broadcasting was allowed only between 11.00 a.m. and 12 noon and from 2.00 p.m. to 5.00 p.m. daily. The weekly half-hour from Writtle had been a few crumbs; the new permit constituted half a loaf, and the Company set to work without delay. After a while the 'no music' restriction was removed and approval given to increase the power to $1\frac{1}{2}$ kW.

This was the original station '2LO' which began operations on May 11th 1922, the first broadcast being the Lewis-Carpentier fight. At the start, transmissions were not advertised, but concerts were arranged for the benefit of special audiences at some institution, hospital, private garden party, fete or wireless society at which the receiving apparatus was installed and operated by the Company's own engineers. Each concert was

the subject of a special G.P.O. authorization, and listeners who were registered on a Marconi mailing list were notified by post of forthcoming broadcasts. Later, newspapers began to announce some of the programmes editorially, but mention of the Marconi House station was forbidden.

The 2LO station transmitter was designed by Captain H. J. Round and installed, together with the aerial system, by C. S. Franklin of short wave beam fame. It operated on a wavelength of 360 metres. In charge of activities was the late A. R. Burrows who eventually became the well-loved 'Uncle Arthur' of the BBC. He it was who introduced the concept of a professional announcer (they were called Masters of Ceremonies in those days) and who laid the foundations of today's studio management techniques.

In contrast to 2MT, the London station was self-conscious to a degree. As befitted its responsibility it was careful to give offence to none and its programmes were typical of the 'musical evenings at home' which were still in vogue everywhere. The 2MT Writtle engineers were quick to seize upon this and lost no opportunity in lampooning 2LO's sobriety. It added nothing to the London station's self-confidence to receive requests not to transmit on Tues-

day evenings so that listeners could give the Writtle boys' parodies their undivided attention!

Nevertheless, many notable broadcasts were carried out. In addition to the Lewis-Carpentier fight mentioned, Carpentier himself spoke on behalf of the British Legion; reports on the King's Cup Air Race were given; and the Prince of Wales broadcast to the Boy Scouts — all before the Marconi Company relinquished the station.

The radio broadcasting boom was on with a vengeance; aerials with varying degrees of aesthetic appeal were rapidly becoming a feature of the London landscape and a nightly hush fell on the suburban living-room as father fiddled with the cat's whisker. Marconi's were experiencing a healthy demand for their domestic receivers (manufacture of these ceased in 1926) and other manufacturers were pressing their claims to stimulate interest for their products by installing stations of their own.

Over-cautious as the G.P.O. undoubtedly was at the onset of the experimental work, its attitude was to some extent justified in the light of conditions across the Atlantic, where no right of refusal to establish stations existed, and as a consequence the wavebands were choked with the outpourings of rival transmitters, each interfering unmercifully with its neighbours. The G.P.O. having granted a licence to the Marconi Company, could not in fairness refuse other manufacturers, yet to follow the American example unreservedly would be to create chaos in Britain also.

In April 1922, the matter was considered by the Wireless Subcommittee of the Imperial Communications Committee, which made certain recommendations to the Postmaster General. As a result of these, the P.M.G. called a conference of radio manufacturers and it was decided that they should consolidate their interests by forming a single Company which, subject to certain conditions, should have complete control of broadcasting in this country.

In this fashion the British Broadcasting Company Ltd. was born, with a capital of £100,000 in £1 shares subscribed by the six radio manufacturers mentioned earlier. Any bona-fide radio manufacturer was eligible to join the Company by depositing £50 and taking up one or more shares. On November 14th a Broadcasting Committee of the founder members took over responsibility for transmissions from 2LO (although official registration of the British Broadcasting Company did not take place until December 15th) and the Marconi Company was officially freed from the onus of providing programmes.

While the two-year lag in obtaining authorization to broadcast entertainment programmes was

regrettable, there was satisfaction in knowing that, in spite of it, the situation had been contained and the British radio industry was well able to supply all home requirements in the boom years of the 1920's. Overseas too, the Marconi Company was able to safeguard its interest in the capital goods field (transmitting stations, etc.), thanks to the extensive amount of technical know-how acquired in the war and immediate post-war years. The U.S.A. did, however, capture a considerable slice of the world market in domestic receivers and components.

In the intervening forty years Marconi's have been in close association with the BBC as a major supplier of transmitting and

studio equipment, both sound and television, on a competitive basis with other manufacturers. As two instances — in 1936 Marconi-EMI television equipment was selected to carry the first public television service in the world, and, when, twenty years later, the BBC's Crystal Palace station came into service, Marconi transmitters were chosen to carry the service. In 1954 Marconi's gave the first public demonstration of compatible colour television in this country; the Company's colour cameras have been used by the BBC for their subsequent experimental transmissions.

* The Marconi Company; the Metropolitan-Vickers Co.; the Western Electric Co.; the British Thomson-Houston Co.; the Radio Communication Co. and the General Electric Co.

TELEVISION ANTENNAE FOR CHANNEL 2

With the opening of the Dunedin Station, there are now two stations operating on Channel 2. At this stage it is felt that we can deal with some antennae systems for this band, particularly as there now appear to be some problems which have arisen.

With the transition to the high powered station on the Waitakere (see R. & E. March 1962) Auckland viewers are now receiving interference-free transmissions over much larger areas than was possible from the small experimental station. In areas close to the Waitakere however, ghosting problems due to multipath transmissions have become evident.

Whilst the field strength is such that, to the initial jubilation of the residents, indoor antenna systems seem to be practical, preliminary results show that the signal strengths of many of the "phantom" signals almost equal the direct signal from the transmitter.

This is not a new problem, being commonly found in other countries, and in certain other areas of this country. The only cure is to utilise a directional aerial to reject the ghosts, and to reduce the

now excessive signal at the receiver to a suitable level by inserting an attenuating "pad" in the feedline.

With the improved locality, the transmissions from the Waitakere station are being well received at distances up to 100 miles depending on the particular locality. For this reason we feel that there is need to describe an antenna for more distant use, in addition to giving details of dimensions suitable for Channel 2 which can be applied to the two and three element antennae described in an earlier issue (R. & E. May, 1961).

This higher gain antenna will also be suitable for use in the Dunedin Area where the lower powered transmitter, originally operating in Auckland, is now temporarily established.

We will deal first with the problems of ghosts, and their elimination. In many cases, a simple directive antenna will give sufficient reduction in ghosts. This is accomplished in three ways.

(1) The increased directivity reduces signals picked up from reflecting areas, situated at an angle to the main transmitter. This is coupled with

(2) The increased signal

strength available from the transmitter when an aerial possessing some "gain" is utilised. This increased signal strength increases the A.V.C. voltage in the receiver, thereby reducing its sensitivity.

(3) The additional signal voltage available at the aerial terminals of the receiver, enables an attenuating pad to be included. This reduces by the same amount, the strength of the direct signal, which is now stronger; and the ghosts, which should be weaker in strength, due to the aerial directivity.

When designing and constructing such an attenuating network, it is still necessary to maintain an impedance match so that the characteristics of the aerial system and tuner are maintained.

The design of an attenuator is shown in Fig. 3.

If the signal voltage attenuation ratio is designated A, then the values of R1 and R2 for this attenuator can be calculated from the formulae A—1

$$R1 = 150 \times \frac{A + 1}{A} \text{ ohms}$$

$$R2 = 600 \times (A + 1) (A - 1) \text{ ohms}$$

2 Element Array — Folded Dipole and Reflector — Channel 2.					
(Refer to Fig. 2a for details of dimensions as shown).					
Driven dipole length l	---	---	---	---	94 inches
Reflector length L	---	---	---	---	103½ "
Spacing between driven dipole and reflector S	---	---	---	---	35 "
Centre to Centre spacing of sections of folded Dipole H	---	---	---	---	¾ "
3 Element Array — Folded Dipole with Reflector and Director.					
(Refer to Fig. 2 b. for details of dimensions as shown).					
Driven dipole length l	---	---	---	---	93½ inches
Reflector length L	---	---	---	---	105 "
Director length D	---	---	---	---	90 "
Spacing between Driven dipole and reflector SR	---	---	---	---	41 "
Spacing between driven dipole and director SD	---	---	---	---	38 "
Centre to Centre spacing of sections of folded dipole H	---	---	---	---	¾ "
4 Element Array — Folded Dipole with Reflector and 2 Directors.					
(Refer to Fig. 2 c. for details of dimensions as shown).					
Driven dipole length l	---	---	---	---	94 inches
Reflector length L	---	---	---	---	105 "
1st Director length D1	---	---	---	---	91½ "
2nd Director length D2	---	---	---	---	90 "
Spacing between Driven Dipole and reflector SR	---	---	---	---	41 "
Spacing between Driven dipole and 1st Director SD1	---	---	---	---	38 "
Spacing between 1st and 2nd Director SD1D2	---	---	---	---	40 "
Centre to Centre Spacing of sections of folded dipole H	---	---	---	---	¾ "

Fig. 1

Some practical values for suitable attenuation ratios are listed below.

Voltage Attenuation Ratio A	Loss db	R1	R2
(Input to Output)			
10:1	20	120	68
3:1	10	82	220
2:1	6	47	390
7:5	3	24	910

These are exact values, but in most cases the nearest preferred value of carbon resistor to the figure stated, can be used—for example 22 ohms can be used for 24 ohms. Combination of preferred values can be used to make up the higher values, for example 910 can be made from 680 and 220 ohms. The only type of resistor which should be used is the composition carbon type, preferably of at least 10% tolerance. Wire wound resistors are not suitable. As there is no power being dissipated, ¼ or ½ watt resistors are quite suitable. They should be assembled, with short leads, soldered together, in a mechanical replica of the electrical ladder configuration.

Although many factors are involved, some indications of the type of attenuator needed, compared with the antenna used, can be given as a guide. With a two element antenna, an attenuator giving 3 or 6db. attenuation can be selected as a starting point; with a 3 element antenna, a pad giving 6 or 10 db. of attenuation may be selected, whilst a 4 element beam will probably also re-

quire a 10 db. attenuator. This is a direct comparison with a dipole aerial at the same height. However, the increase of signal strength over a previously selected indoor antenna, which may have provided adequate signal strength, except for the ghost problem, could be considerably more than the stated figures. For this reason, a 20 db. attenuator has been included, which may be required for a high gain antenna, such as a 4 element, used to reduce severe ghosting.

Now we will deal with antenna design for Channel 2.

In the case of two and three element arrays, there is no need to do other than alter the figures of the antenna, designed for Channel 1 or 3, which was described previously. For the convenience of our readers, we have tabulated the design details for two, three and four element yagi type TV antenna. We have also printed diagrammatic sketches of the three aerials, showing all the details needed to construct these antenna, in Fig. 2.

The four element antenna has been designed, to ensure maximum gain whilst still maintaining a satisfactory match to a 300 ohm feedline. Whilst this is a compromise, the centre impedance of the antenna still lies within the values to maintain a standing wave ratio of 1.5 to 1, which is an acceptable standard for TV antenna design. This figure was

determined using instruments with the antenna at a height of 25 feet above ground, mounted on a chimney and situated about 12 feet above a galvanised iron roof, with half the system lying over the roof; probably a typical installation.

Here are a few notes regarding the construction of these antennae.

The length of the boom should be selected to be at least 2 inches longer at each end, i.e., 4 inches total, than the total of the various element spacings, depending on the design selected. This is to ensure that there is sufficient material at each end of the boom to maintain a secure support. As was previously suggested either a piece of 1½ x 1½ inch straight grained timber or a piece of 1½ or 1½ inch dowelling can be used as a boom, if aluminium is not available. In either case, holes can be drilled through the boom, making sure that they all lie parallel to each other, and the elements pushed through the holes and secured by a P.K. through the bottom of the boom.

The dimensions should be held within ½ an inch of the values shown in Fig. 1 for optimum results, as long as the diameter of the elements is kept at ½ an inch. For tubing diameters greater than ½ inch, the dimensions should be reduced ¼ to ½ inch, whilst for tubing less than ½ inch, the figures should be increased by ½ an inch. Tubing diameters of less than ½ inch are not recommended however, as there is insufficient strength available in the element to withstand continuous buffeting by winds, birds, etc., particularly in coastal regions. A seagull alighting on a piece of ¾th. tubing can bend it double. This is particularly the case if some of the cheaper seamed tubing is used. Preference should be given to the seamless extruded tubing, if possible, although it is more costly.

We often hear complaints from TV viewers that their antenna systems vibrate or drum in the wind. This is usually due to structural resonance in one or more elements of an array. The easiest way to alleviate this problem is to observe the element closely whilst

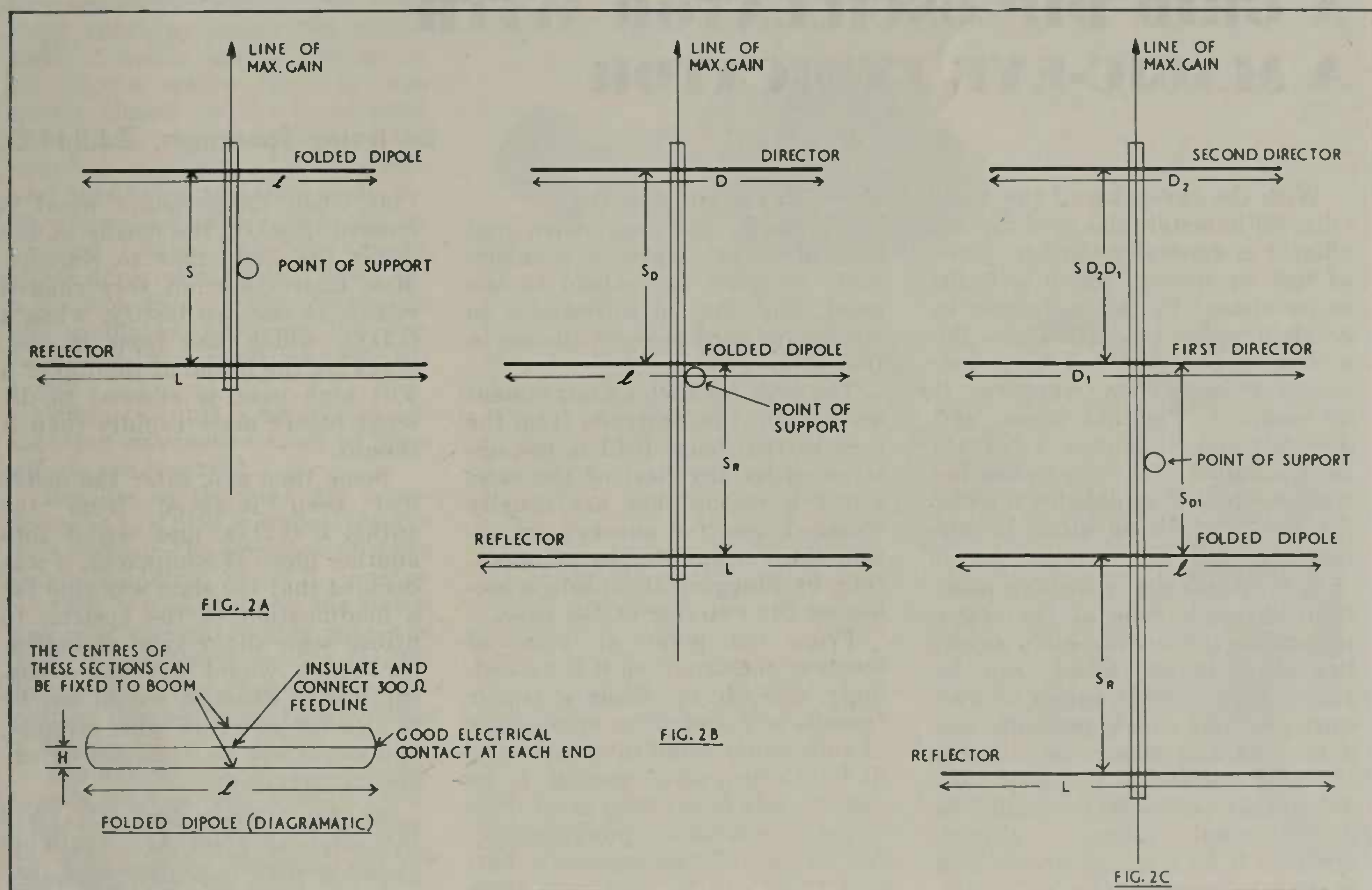


Fig. 2

it is humming, and to note the point of maximum movement. This may be in the centre of each side, or at the end. A simple and effective cure is to load the resonant point with a little weight; even a rubber gromet from an automobile parts distributor is often sufficient to effect a cure. If all other measures fail, the resonant points can be tied together, or to the boom, or supporting mast, with mono-filament nylon. This is strong, and a good electrical insulator.

With regard to insulators for the centre section of the folded dipole, offcuts of plastic material such as perspex, styrene and formica are suitable. It is recommended that the junction of the feedline and the folded dipole be made with the feedline soldered to solder lugs, clamped tightly to the element with cadmium plated aluminium or stainless steel hardware. All the joints are best made by compressing the ends of the tubing in a vice and bolting them

tightly together with similar hardware. When finally assembled, all the joints should be given several coats of clear plastic spray, or clear varnish to weatherproof the joint. If a wooden dowel boom is used, this can be given one or two coats of aluminium paint, and it will look almost like the real thing.

The feedline should be supported away from the mast, if it is metal, the roof, gutters, and any other part of the house which is metal, or is of such a nature to abrade the insulation from the wire. In most cases, commercial stand-off insulators suitable for mounting on masts, and gutters are available at reasonable prices.

A certain amount of ingenuity will no doubt be displayed in supporting these aerial systems. Some suggested methods are the use of an additional length of dowelling, similar to that used for the boom, or a stray length of water pipe or electrical conduit. Pipe flanges, clamps made from

steel rod formed into U section bolts, bolts and steel straps, and clamps used for fabricating pipe rails and fences, are suggested. Any lashings such as those to be placed around a chimney, should be made from hard drawn stranded galvanised steel wire, commonly used for clothes lines, suitably protected at the sharp corners with galvanised steel right angle plates.

This completes our coverage of television antennae suitable for all these three low frequency channels. It is hoped that this article will provide the answers for all those who have written requiring information on Channel 2 aerial systems.

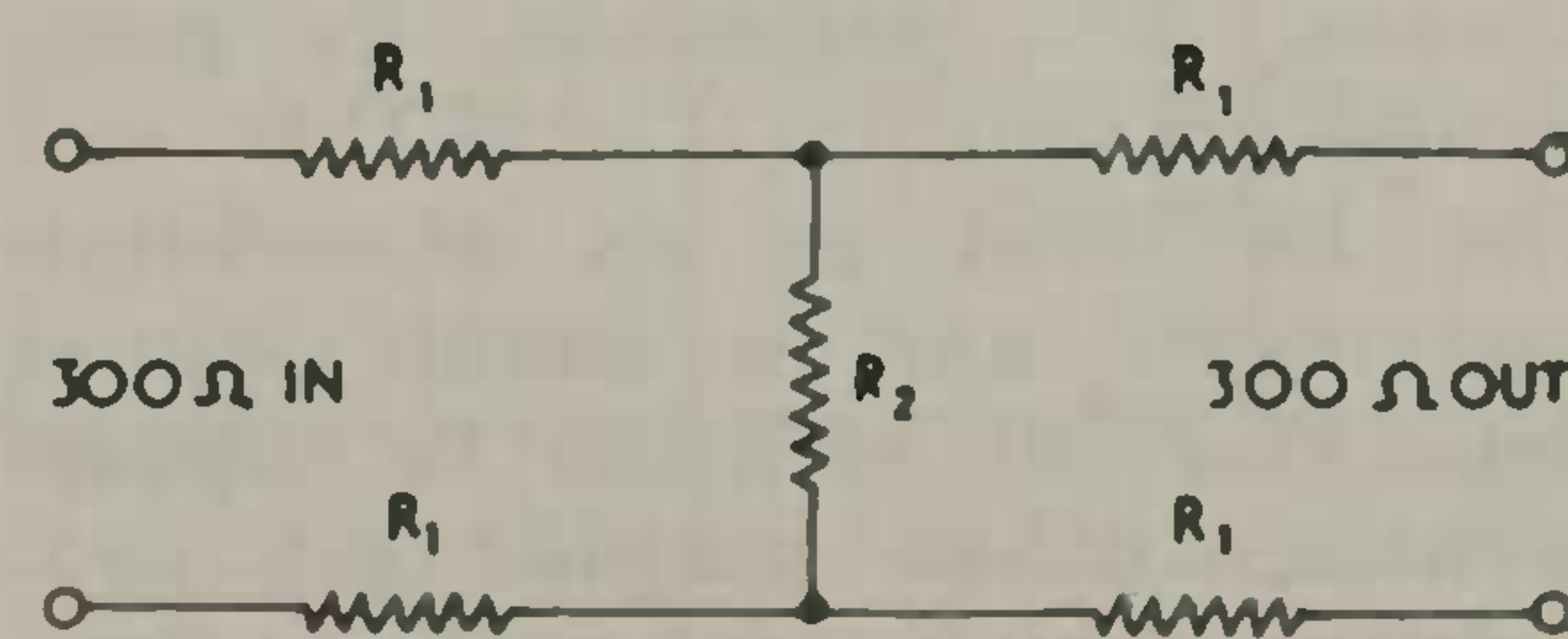


Fig. 3

A GRID DIP OSCILLATOR WITH A MAGIC-EYE INDICATOR

by Irving Spackman, Z.L.I.M.O.

With the exception of the Volt-Ohm-Milliammeter, the grid-dip oscillator is generally the first piece of test equipment which is built, or purchased by the newcomer to amateur radio. Up to this time the article in question has been borrowed from friends, whenever it is required. The old timer will also tell you, that once a G.D.O., as it is called, has been in use for a short while, it establishes a niche for itself which no other instrument can fill.

Why is this? It is nothing more than a simple type of frequency measuring device — merely a calibrated oscillator which can be tuned over a wide range of frequencies, and which generally has a moving coil meter, to indicate the grid current to the oscillator. When this oscillator is coupled to an external resonant circuit, whether it be a tuned circuit or a resonant antenna, the grid current will drop when the G.D.O. is tuned to the same frequency as that, to which the circuit, or antenna, is tuned. This is because the resonant circuit absorbs a certain amount of energy from the oscillator and there is less feedback available to maintain the oscillation, with a resultant loss of grid voltage. This shows itself by reduced current through the grid leak of the oscillator — a grid current dip.

The dip in grid current is quite sharp when the circuit to which the oscillator is coupled has reasonably high Q.

Since the G.D.O. provides its own R.F. energy, it does not require the circuit being checked, to be energised. It is therefore useful for checking tuned circuits in receivers, transmitters, R.F. chokes, and antennas, as mentioned previously. The G.D.O. can also be used as an absorption wavemeter and a simple signal generator, in addition to supplementing other simple test procedures which make themselves known, as the user gains experi-

ence with the equipment.

Generally, such an instrument is most useful, when it is sufficiently compact to be held in one hand, and can be introduced to circuits in hard-to-reach places, in the equipment.

The coils for such an instrument are designed to protrude from the case so that their field is not obstructed by any part of the case. For this reason they are usually changed, one for another, to obtain the various ranges of operation, by plugging them into a socket on the exterior of the case.

From the point of view of amateur construction, it is exceedingly difficult to obtain a power transformer and filter condensers of sufficiently small dimensions, to fit into a unit small enough to be comfortably held in the hand. This indicates a separate power supply for the unit, or alternatively battery tubes can be used with their associated expensive H.T. batteries. As a second alternative, transistors can be used. Although several transistor G.D.O.'s have been built, the author's has as yet, not been able to duplicate the performance of "Old Faithful" which has worn out one set of tubes, and has been rebuilt and recalibrated several times.

It has always been felt that an indicating instrument such as a moving coil meter is unnecessary for the purpose of indicating a dip in grid current. A certain value of grid current is established and the resonant point is noted by a change in current, generally of no particular value. For the most accurate readings of frequency, the coupling to the resonant circuit should be reduced to the point where the dip is only just detectable. If the coupling is too tight, the oscillator frequency is pulled, as the resonant point is approached, and the correct frequency can be considerably displaced from the point at which the dip is observed. A meter movement also has a certain amount of inertia, so

that when the resonant point is crossed quickly, the needle of the meter has little time to respond. Most meters are not very rugged either, as one can testify, when a G.D.O. which has been in use, checking the beam, at the top of a 30ft high pole, is allowed to descent rather more rapidly than it should.

Some time ago, after the meter had been removed from the author's G.D.O. and wired into another piece of equipment, it was decided that the time was ripe for a modification to the system, to utilise some other type of indicator which would not be so susceptible to damage, would not be needed for metering other circuits, and could not be damaged by excessive overload.

As we already had 200 volts D.C. and 6.3 volts A.C. available at the oscillator, we reasoned that a magic eye tube might be a suitable indicator. Checking the grid current through the grid leak of the oscillator produced the information that there was up to 40 volts of grid bias produced on most of the lower frequency ranges. This appeared to be more than sufficient to fully cut off the anode current of the triode section of an EM84 thereby reducing the shadow length of the indicator section to zero, whilst even at the highest frequency in use, half deflection of the tube's shadow was possible. This is partly because of the tube's characteristic, a curved voltage versus length of deflection, graph. Some details of this are outlined below.

Vg	Deflection
0	20mm (fully open shadow)
—1	17.5mm
—2	15mm
—5	10.0mm ($\frac{1}{2}$ closed shadow)
—10	5.0mm ($\frac{3}{4}$ closed)
—22	0.0mm (closed)

The oscillator circuit was set up, so that, at the lowest frequencies, where the coils and tubes were most efficient, and losses were the lowest; the grid and anode coup-

ling condensers were of just sufficient value to permit the amplitude of oscillation to rise up to the figure where the eye was nearly closed. As the frequencies are raised, the reactance of the coupling condensers becomes less, and this helps to compensate for the decreased efficiencies and increased losses. For this reason, there never seemed any need, for a control, to carry the voltage on the oscillator, although this can be added, if desired, at little expense.

When the unit is used as an absorption wavemeter, some of these effects are reversed.

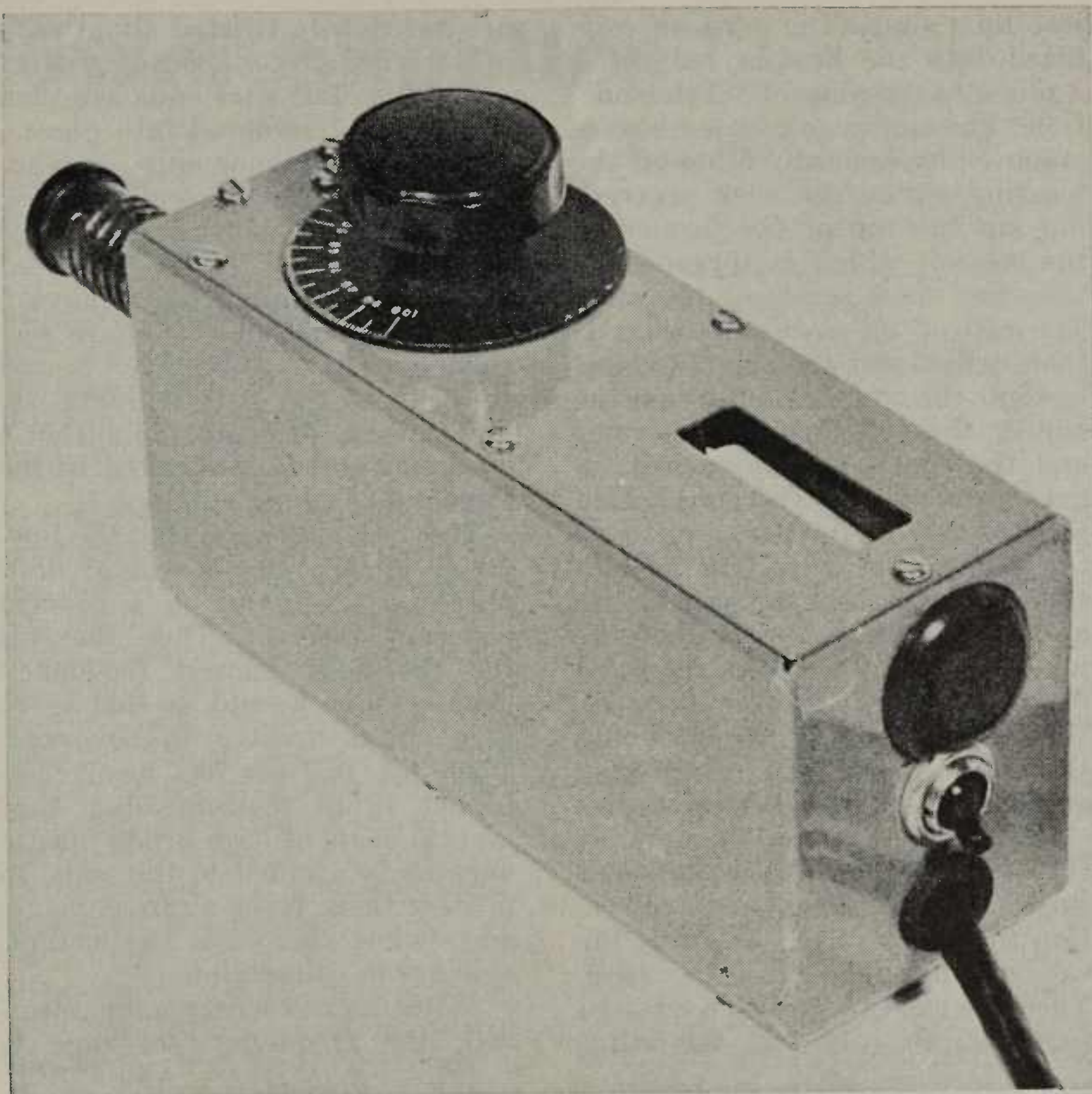
Because of the high eye sensitivity at low grid voltages, the eye will indicate the presence of quite small amounts of R.F. energy when it is picked up by the resonant grid circuit. In this case, the H.T. is removed from the oscillator, so that the grid-cathode circuit of the oscillator tube acts as a diode.

The author did not include any means for inserting a set of headphones into the unit, as a monitor was already available. In the particular layout, such a system was rather difficult. Any reader who desires monitoring facilities however, could include a closed circuit jack at the bottom of the grid leak, suitably by-passed to ground for R.F., with say a 500 pf. condenser.

The EF95 or 6AK5 was chosen over the more commonly used 6C4 9002, EC92, etc., because of the tube's higher transconductance, small physical size, also there are two cathode returns for the tube. All these factors are important at the high frequency end of the range.

POWER SUPPLY:

The power supply for the unit is quite conventional. It uses a small power transformer, a silicon rectifier and resistance capacitance smoothing. At the low current drain of this G.D.O. this supply produces about 150 volts which is quite adequate. If the voltage is allowed to rise much above 250v. a certain amount of marking of the illuminated area of the EM84 occurs after a period of use. If another power supply is available with an output not in



excess of 250v. this can be used, as both the filament and H.T. drain are very light.

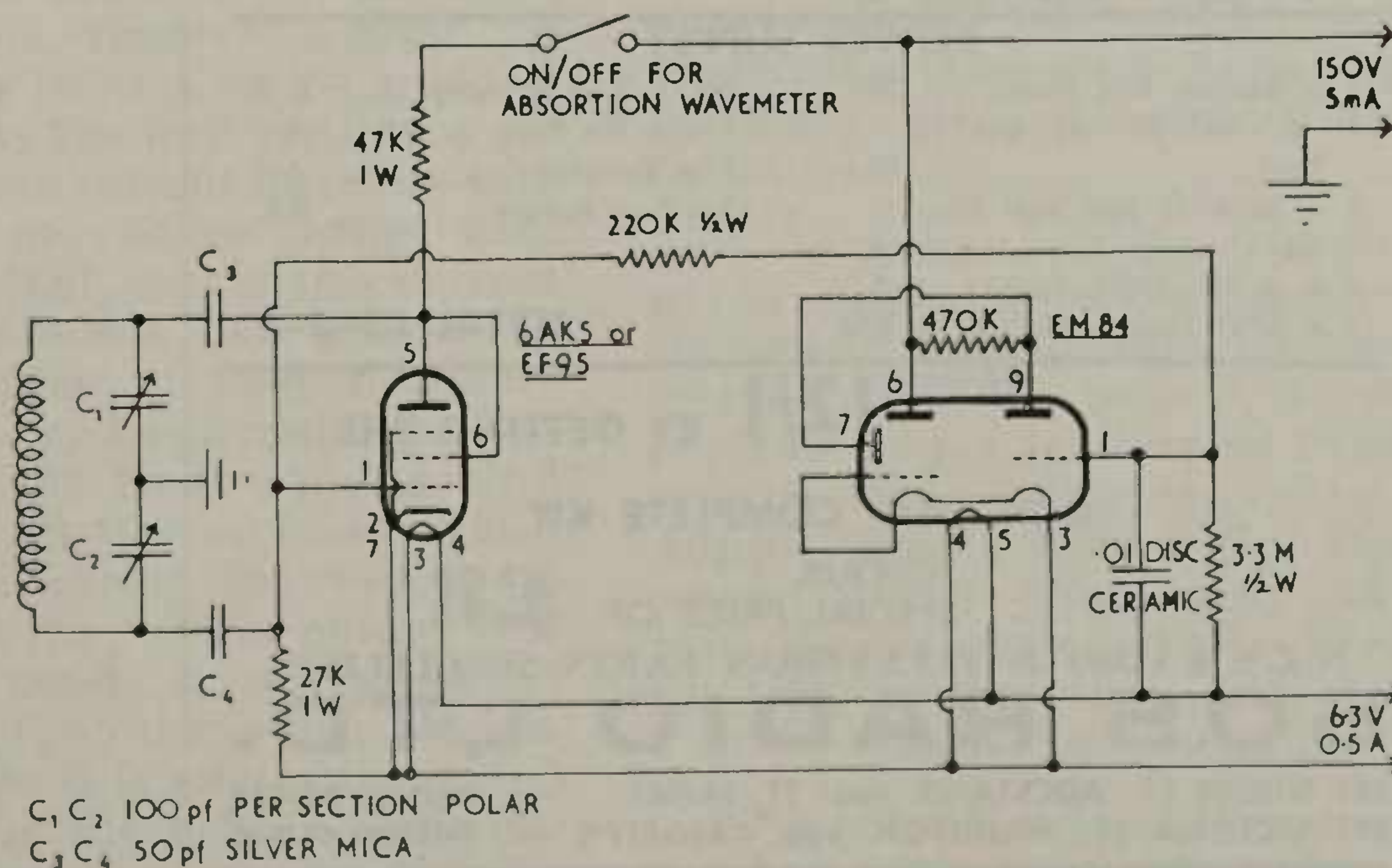
This power supply can be used also for other test equipment which may be built at a later date.

COILS.

The author was rather lucky to come by a set of coils which had been made commercially during the war for some piece

of monitoring equipment. However, the plug in bases did not fit any locally available socket, so new sockets had to be made for them. Also the range was not complete, and did not extend above 10 meters. Consequently the remainder of the coils were assembled in the following way.

Half inch Aladin coil formers were used without their associated



Adjustable Power Supplies

This month we publish a resume of American practice applied to Regulated Power Supplies. In view of our earlier articles on Silicon Rectifiers, and promises to keep readers up to date on such matters, we are indebted to Harrison Laboratories of New Jersey for providing us with this information through their Associates, Hewlett-Packard.

SOPHISTICATION in laboratory power supply design is bringing more flexibility to these instruments and new conveniences to the user. Remote programming, remote sensing, and the ability to operate with one-knob control either in series or in parallel with other supplies are some of the features presently being designed into power supplies. Power supply performance now includes full overload protection through adjustable current limiting, low output impedance over a wide band of frequencies, short recovery time to instantaneous changes in line voltage or load current and no overshoot on turn-on, turn-off or power failures. At the same time, better use of components results in compact units of high efficiency and low heat dissipation.

Considerable engineering effort has been expended on making modern power supplies immune to most laboratory mishaps, such as accidental shorts, open-circuits or sudden line transients caused by spot welders, electric ovens and the like. Some of these design features, as embodied in a broad variety of power supplies manufactured by Harrison Laboratories, are described here.

Constant-Voltage/Constant Current Supplies

A recent innovation in laboratory instruments is represented by the constant voltage/constant current (CV/CC) power supply. These supplies operate in the conventional constant voltage mode

when the load draws less than some chosen maximum current. If the load should increase and attempt to draw more than the selected current, the CV/CC supply then behaves as a constant current source, adjusting its output voltage to constrain the current to the chosen level.

Besides safely limiting the maximum current when used as a constant-voltage source, the CV/CC supply also limits the maximum open-circuit voltage when operating as a constant-current source. As a battery charger, for instance, the CV/CC supply charges a battery at a constant selected rate and then abruptly reduces the current to a trickle charge when the preselected voltage level is reached.

In the constant current mode, CV/CC supplies are well suited for supplying fixed currents to focusing coils or other magnetic circuits, the current remaining constant despite temperature induced changes in coil resistance. Having both constant voltage and constant current modes of operation in one supply in no way degrades performance in either mode.

Under light or no load conditions, the CV/CC supply operates in the constant voltage mode, maintaining the output voltage at the value selected by the front panel (or remote) control, as shown by point A on the graph of Fig. 1. As the load resistance decreases, the current increases with little or no voltage change until the selected maximum current limit is reached. This is the "critical" value of load resistance (point B) and represents the V/I ratio of the front panel control settings. Further decrease in load resistance causes the voltage to drop but the current output now remains constant, as represented by point C on the graph. The critical value B is arbitrarily moved around by the independent voltage and current controls.

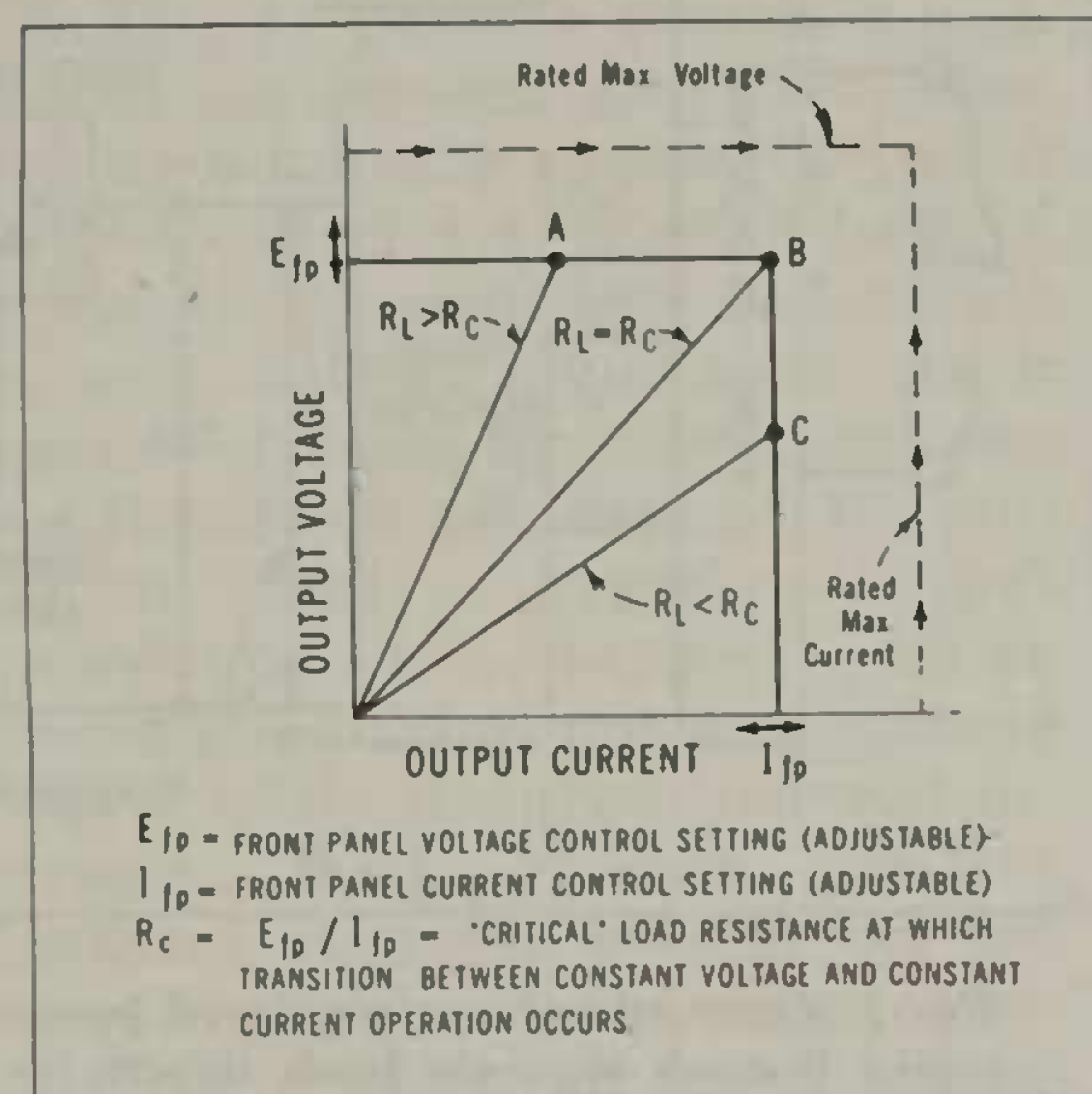


Fig. 1. Voltage/current characteristics of CV/CC power supply. No switching is required for transition from constant voltage to constant current operation or vice versa.

How The CV/CC Supply Works

A preliminary look at the constant voltage regulator, Fig. 2, will help to introduce the operation of the constant current regulator. As is common practice, the voltage comparison amplifier and regulator comprise a feedback control system which adjusts the output voltage to bring the voltage difference between the inputs of the comparison amplifier to zero. While this is the basic principle of a voltage regulator, it is of interest to note that in terms of feedback theory, the regulated supply may be considered as a d-c power amplifier in which the "input" is the reference voltage, B is the divider ratio, and line voltage and load changes are disturbances in the μ circuit. The feedback acts to suppress these disturbances by the factor $1/(1-\mu B)$, where μB is the loop gain.*

As shown here, one amplifier input is connected to the negative output bus. The other input is connected to summing point P, which is shown at the junction of fixed resistor R_r and Output Voltage Adjust variable resistor R_p . The control action continuously adjusts the voltage on the positive bus to bring the voltage at point P to the negative bus potential.

With point P held at the negative bus voltage, the voltage drop

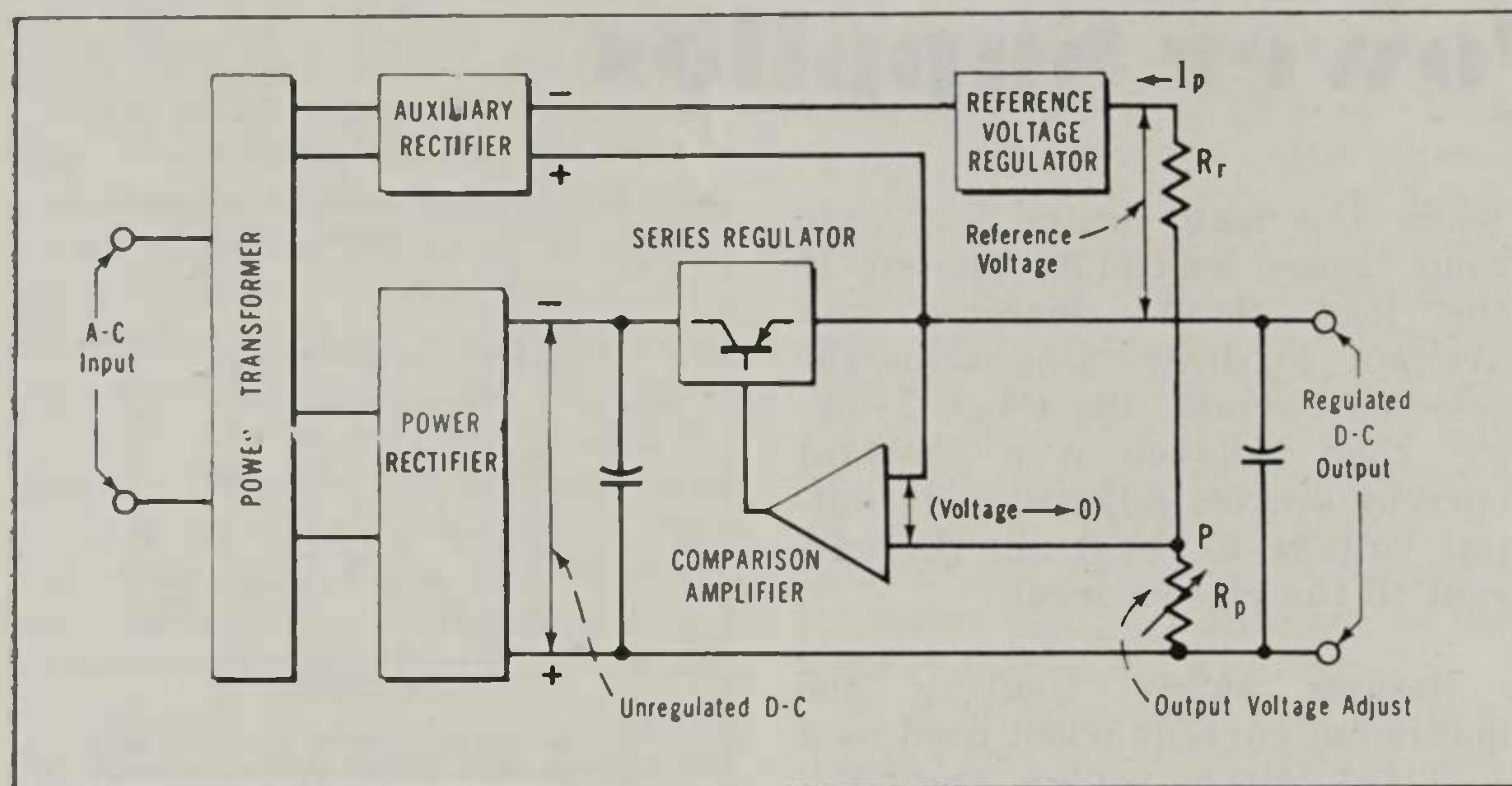


Fig. 2. Constant voltage regulated power supply. Voltage sensing circuit may be connected through separate leads directly to load, achieving optimum regulation at load terminals.

across fixed resistor R_r is the same as the reference voltage, and this voltage drop remains constant during operation. The current I_p through resistor R_r , and thus through R_p , likewise is held constant so that the IR voltage drop across R_p is determined solely by the resistance value of R_p . The power supply output voltage then is a linear function of the resistance of R_p .

As will be discussed later, there are several advantages to deriving a control voltage in this manner. For one, the arrangement makes it possible to program the power supply remotely by disconnecting R_p and substituting an external resistance. The remote programming resistor may be fixed, variable, or switched to discrete values, switching external resistors enabling the power supply to be reset to precise voltages.

Connections to R_p are brought to a terminal strip at the rear of H-Lab supplies for convenient changeover to remote programming. The output voltage then is specified in terms of volts per ohm of programming resistor. In addition, the comparison amplifier input connected to point P may be disconnected from the internal reference and reconnected to any external voltage, thus converting the power supply into a unipolar d-c power amplifier. The terminal strip connections also permit remote error sensing to be used if heavy currents in the leads connecting the load cause trouble-

some voltage drops.

A constant current regulator circuit is shown in Fig. 3. The same series regulator and constant voltage reference source of the CV regulator are employed here, but the current programming resistor R_{pi} is returned to the negative bus. Also, a low value current monitoring resistor R_i (typically 3 ohms in a 0.5 amp supply) is inserted in series with the negative bus. The action of the control circuit now is to bring the comparison amplifier inputs to the same potential by matching the voltage drop across R_i to the voltage drop across R_{pi} . The output current thus becomes a function of the Current Adjust resistor R_{pi} . Here again the Current Adjust resistor

R_{pi} may be disconnected and an external resistance used for remote programming, or an external reference voltage may be substituted.

The combination of constant voltage and constant current regulators in one power supply is shown in Fig. 4. The amplifiers described previously are simply connected in parallel to a common series regulator. In practice, the outputs of the comparison amplifiers are taken from the collectors of transistors, each one of which cuts off and is ineffective when the other has control of the output. Either or both of the regulating functions may be programmed remotely and they are adjustable separately.

A popular CC/CV power supply using these techniques is the Harrison Lab model 865B. This compact unit supplies up to 0.5 amps at any voltage between 0 and 40 volts. High gain in the regulator chain holds the output voltage within 0.01% or 1 mv (whichever is greater) for a 0.5 amp change in load, or holds the output current within 250 microamps during constant current operation.

Auto-Series and Auto-parallel Operation

For higher voltages, power supplies simply may be stacked with the positive bus of one tied to the negative bus of the next but control of all supplies by a single Voltage Adjust control is enabled by

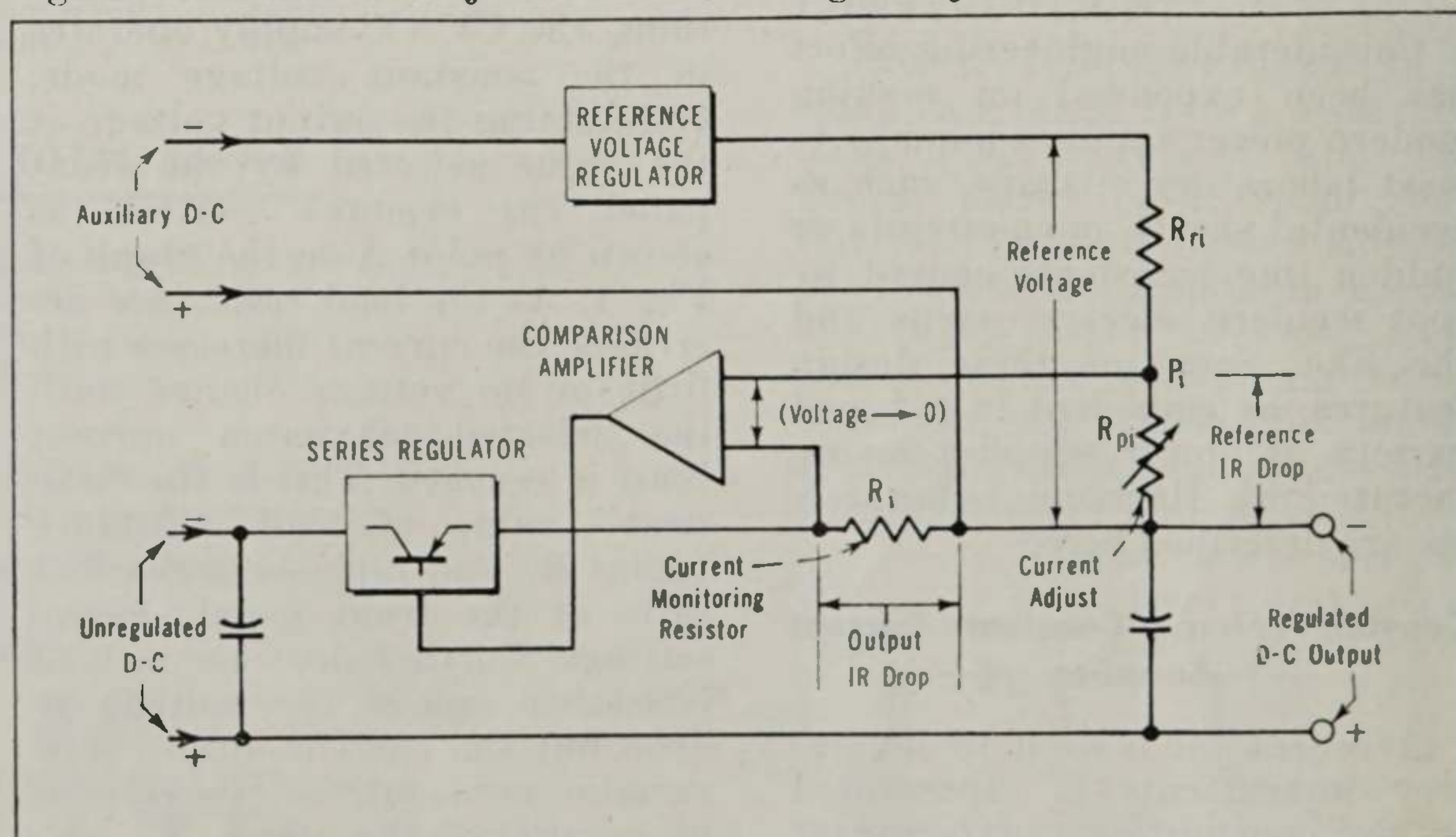


Fig. 3. Constant current regulated supply. Reference voltage source and high gain amplifiers achieve constant current operation, in contrast with current limiting which only prevents current from exceeding selected maximum.

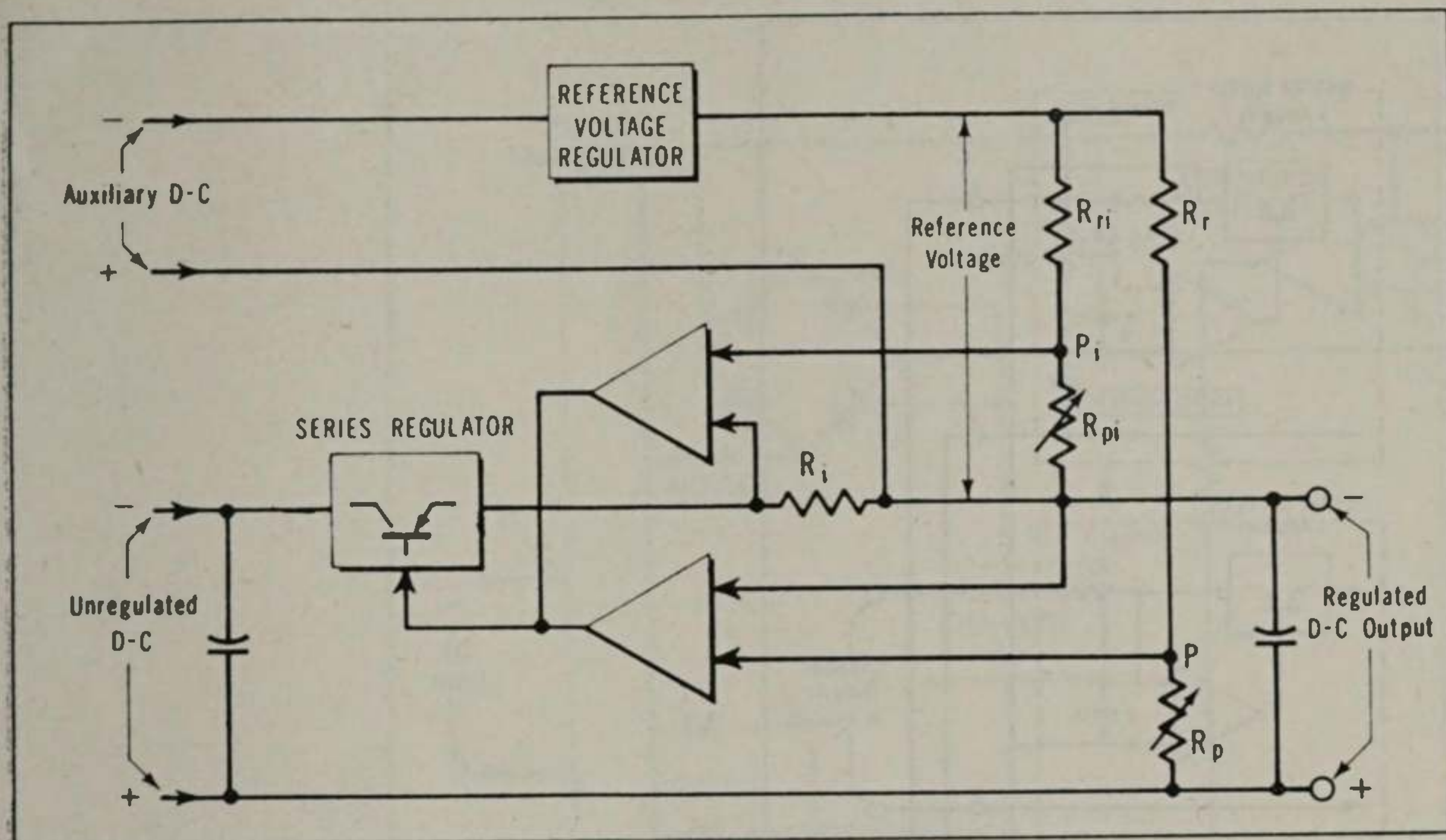


Fig. 4. Constant voltage/constant current (CV/CC) regulated supply. In heavy duty H-Lab CV/CC supplies, disconnect diodes in series with comparison amplifier outputs sharpen transition from constant voltage to constant current operation.

the addition of one control lead, as shown in Fig. 5. With this connection, the "Master" supply becomes the reference voltage for the others, which have had their internal voltage references disconnected (a new fixed resistor R_r is added). The slave supplies, set individually to any voltage, will track the Master Voltage proportionally.

The CV/CC supplies may be interconnected for parallel operation, as shown in Fig. 6, without the large circulating currents that usually arise from slight inequalities in the output voltages of any two low impedance sources. Here, the voltage regulators of the slave supplies are disconnected from their own references and reconnected as shown. Each slave regulator adjusts its current output so that the voltage drop across its current monitoring resistor matches that across the current monitoring resistor in the master supply. This action is effective throughout both the constant voltage and constant current operating ranges, with all control coming from the master supply. Any number of these power supplies (of the same model) may be connected for Auto-Parallel operation.

Zero Output Impedance

For tighter voltage regulation, and also to prevent mutual coupling between parallel loads, the effective output impedance of a

power supply ideally should be zero. Formerly, the impedance of regulated supplies never quite reached zero, for reasons explained here.

The output impedance Z of a regulated power supply (or any feedback amplifier) can be expressed by the equation:

$$Z = Z_o \frac{(1 - \mu B_{sc})}{(1 - \mu B_{oc})}$$

where Z_o is the impedance looking back into the supply with the amplifier disconnected, μB_{sc} is the loop gain with the output short circuited, and μB_{oc} is the loop gain with the output open circuited. In the constant voltage mode, $\mu B_{sc} = 0$ and μB_{oc} is very large. In the constant current mode, $\mu B_{oc} = 0$ and μB_{sc} is very large and negative. It is evident that in the CV mode, the output impedance decreases as regulator gain increases, the impedance approaching but never quite reaching zero.

If positive feedback is added to the amplifier of gain μ in the expression above, totally within the negative feedback loop, there results a new value of feedback amplifier gain μ' , expressed by the relation:

$$\mu' = \mu / (1 - \mu B')$$

where B' is the locally introduced positive feedback factor. Now, B' may be chosen to make the product $\mu B' = 1$, in which case the denominator vanishes and μ' goes

to infinity. This value of μ' may be substituted for μ in the original expression for output impedance, in which case Z becomes zero.

Adding a positive feedback loop to the comparison amplifier, simply by adding a resistor between output collector and input base of a two-stage amplifier, can result in zero output impedance. As a matter of fact, by increasing the positive feedback beyond the optimum point, a negative output impedance is obtained which means that the output voltage rises slightly if output current increases. With enough positive feedback to make $\mu = \text{infinity}$, the circuit could be on the verge of oscillating were it not stabilised by the overall negative feedback loop.

The 865B, as adjusted at the factory, has less than 0.01 ohms internal impedance from d-c to 100 cps. Above 100 cps, the gain of the positive feedback loop falls off but the internal impedance is no more than 0.02 ohms at 1 kc, rising to 0.1 ohms, typically, at 100 kc. At higher frequencies, the in-

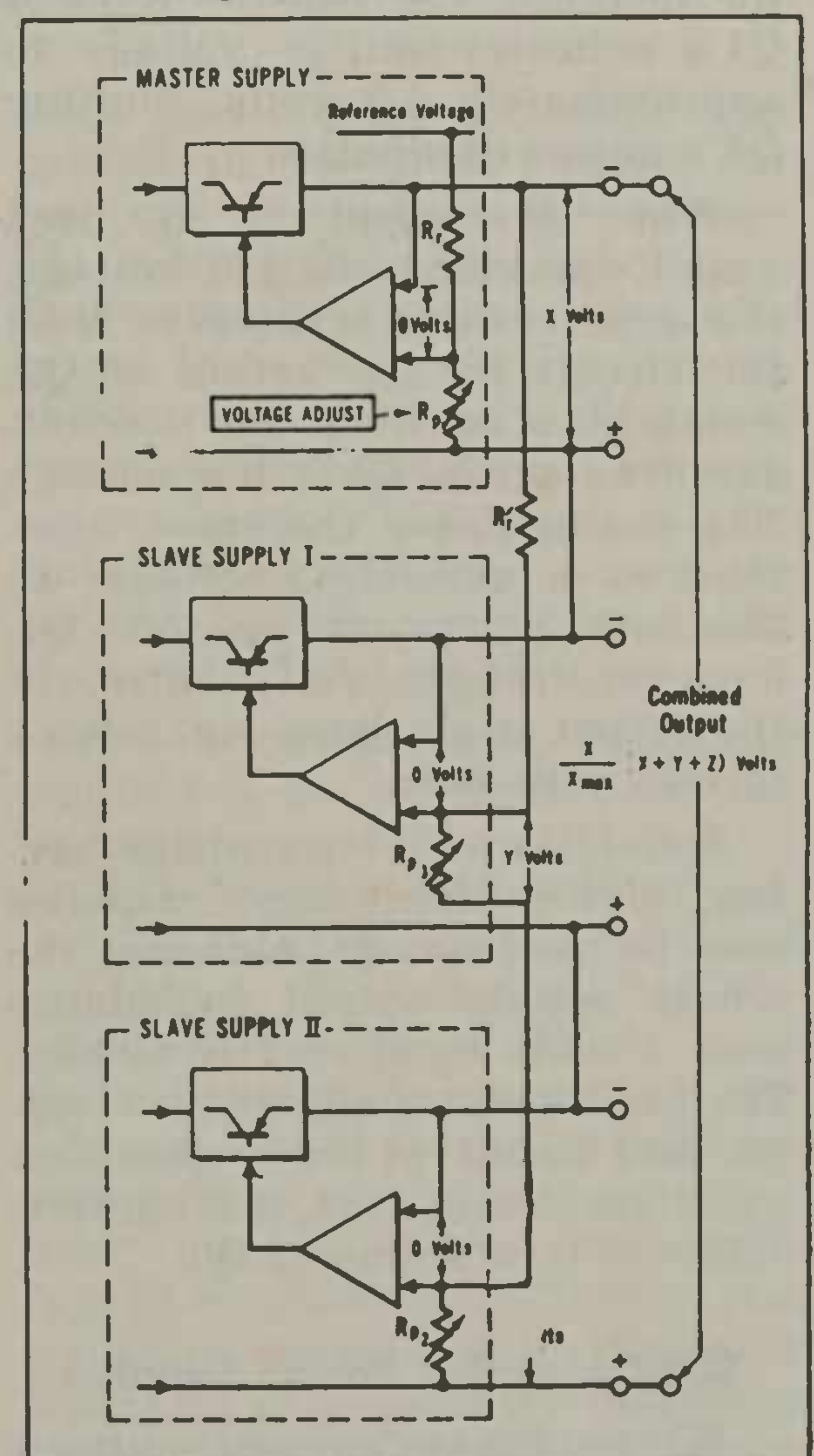


Fig. 5. Series connection (Auto-series) of power supplies for one-knob control. Master supply becomes reference source for slave supplies so that slave voltages track master voltage proportionally.

ductance of the output capacitor ($0.3 \mu\text{h}$) determines the output impedance. Computer-grade low-inductance electrolytic capacitors are used in all these supplies.

Conserving the Series Regulator

The series regulator of a simple regulated power supply with fixed rectifier voltage is often called upon to dissipate considerable amounts of power. This power reaches a maximum when full current is drawn at a low output voltage since the regulator is required to drop the rectifier voltage to the desired output level. In such "brute force" designs, excess power handling capacity must be built into the series regulator to meet this condition.

A more efficient regulator design makes advantageous use of a "pre-regulator," as shown in Fig. 7. Here, resistor R_s in series with the main regulator dissipates most of the power when the supply is used for low output voltages at high currents. In a 40 volt supply, for instance, the resistor reduces Q_1 's collector-emitter voltage to approximately 1.5 volts, limiting Q_1 's power dissipation.

When the supply is to be used near its maximum output voltage, the series resistor is removed from the circuit by the action of Q_2 , which turns on whenever the voltage drop across Q_1 is low enough. The preregulator therefore functions as a variable resistance to dissipate power as needed. Q_1 , however, retains full control of the output at all times, right down to zero volts out.

A smaller power transistor having higher frequency response may be used for Q_1 , reducing the power supply output impedance over a wide band of frequencies. The pre-regulator also reduces ripple and improves line voltage regulation because of the emitter-follower type action of Q_2 .

SCR-Controlled Power Supplies

Where heavy current outputs are required, some form of control device often is added to the rectifier circuit to further limit power loss in the regulators. The control limits the rectifier output voltage

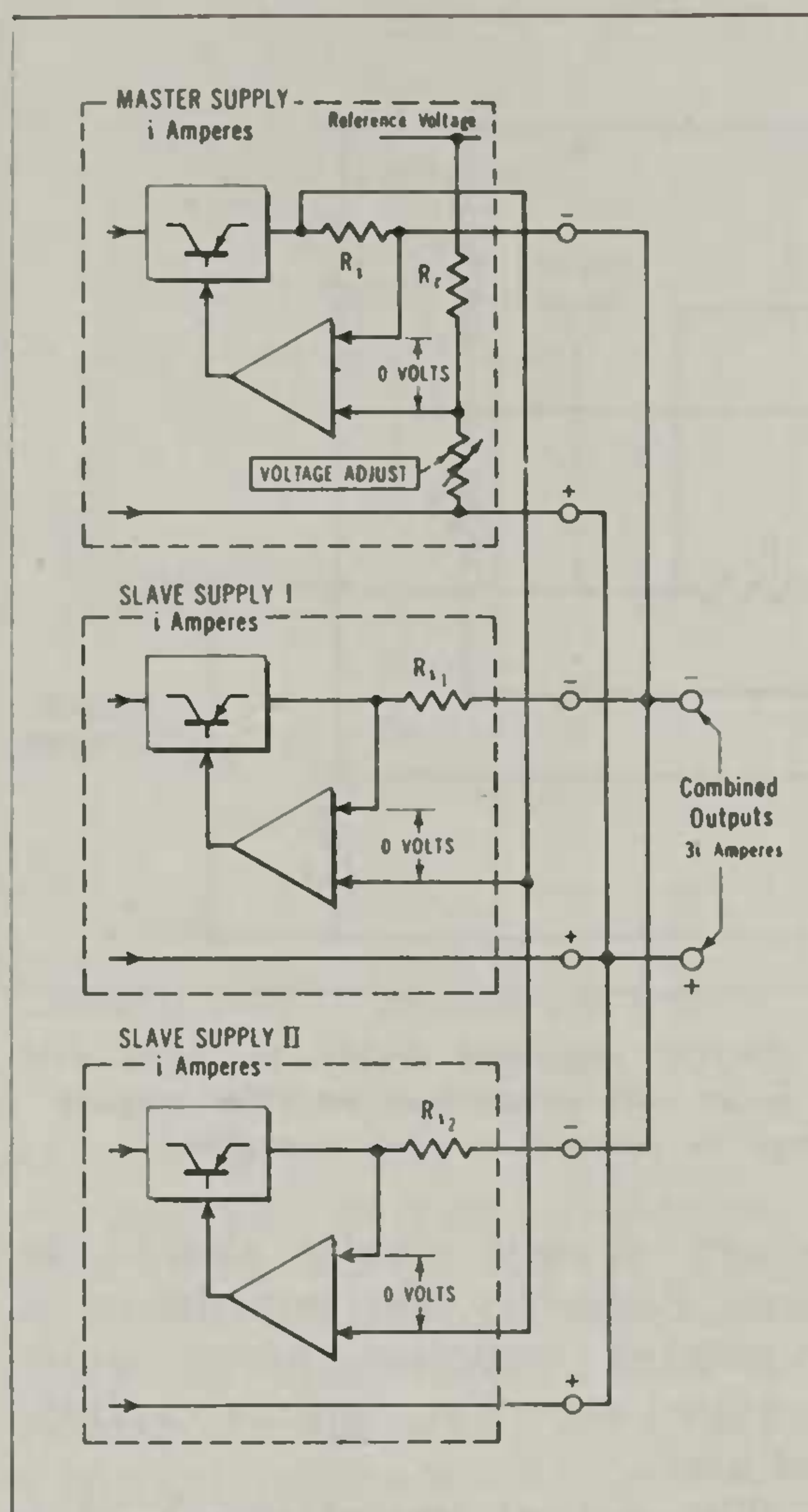


Fig. 6. Parallel connection (Auto-parallel) of power supplies. One-knob control is retained in either constant voltage or constant current operation.

to some level suitably higher than the output terminal voltage.

The rectifier voltage control may be simply an autotransformer mechanically coupled to the output voltage control to make the rectifier voltage track the output voltage. This method, though, is not adapted readily to remote programming and has the further disadvantage of not protecting the regulating elements in the event of a short-circuit on the output terminals.

More recent techniques use thyristors or silicon controlled-rectifiers (SCR's) as rectifying elements. The firing angles of these devices are controlled to keep the input capacitor charged to a level only a few volts higher than the output voltage. With this method, the rectifier voltage can be made to track the output voltage automatically. Sophisticated control circuits with SCR's as the only power controlling element are able to maintain 0.5% regulation.

A simplified diagram of a typical SCR regulated power supply is shown in Fig. 8. The same refer-

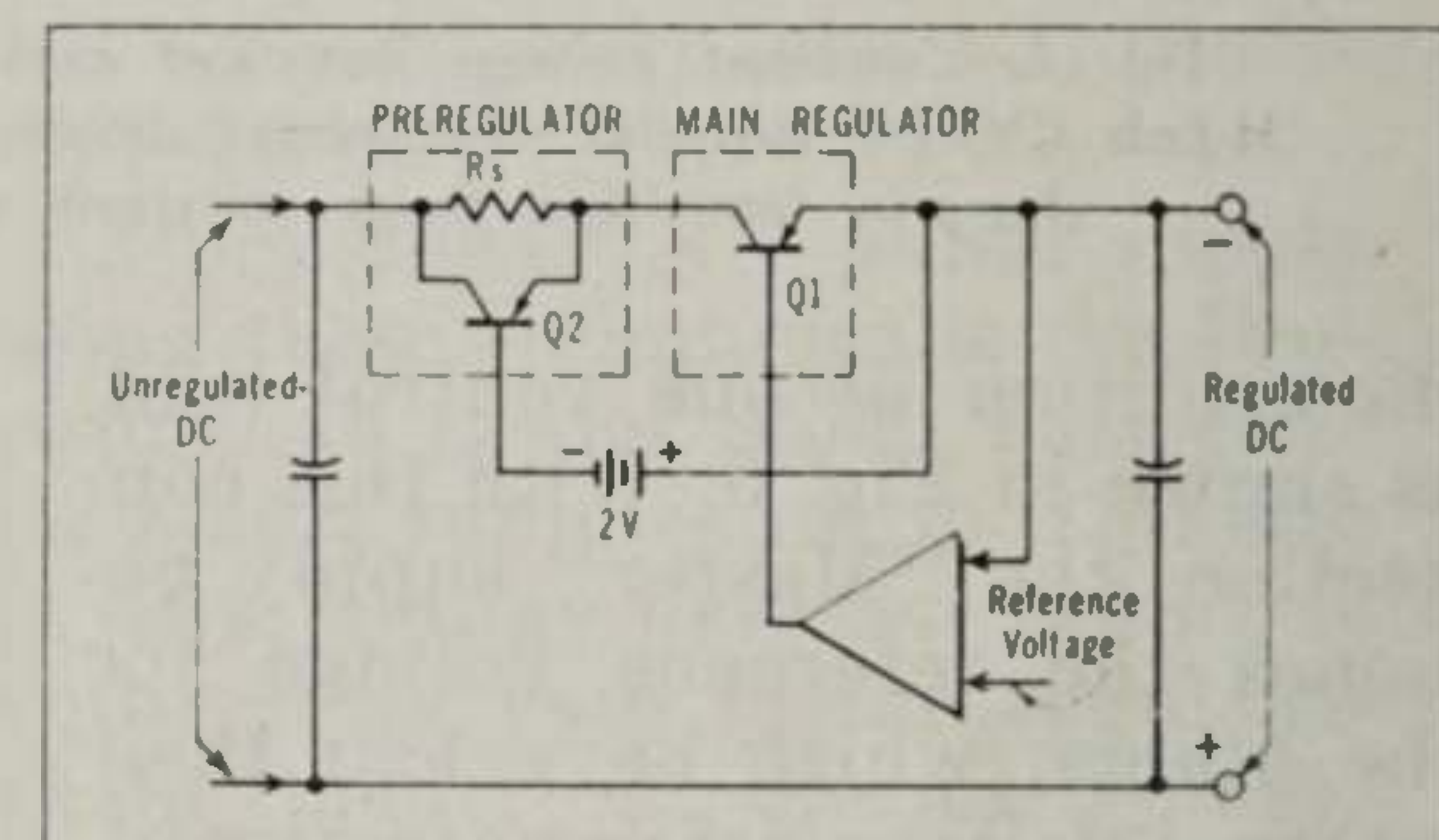


Fig. 7. Power supply with preregulator. For higher power, additional preregulators may be added either in series or parallel.

ence voltage, summing point and voltage comparator circuitry discussed previously are used but there is no series regulating element. Instead, silicon controlled-rectifiers are placed in two of the rectifier bridge arms.

The rectifiers pump up the relatively large input capacitor to the required voltage. This capacitor feeds the large output capacitor through the small series filter resistor (typical 0.04 ohms in a 25 amp supply). The comparison amplifier then monitors the voltage on the output capacitor and controls the firing angle of the SCR's to maintain this voltage at the desired level.

The output of the comparison amplifier is a constant current which charges ramp capacitor C_r . The ramp, shown in Fig. 9A, starts at the beginning of each half cycle of the input a-c waveform and terminates when C_r is discharged at the end of the half cycle. When the ramp voltage reaches the turn-on level of blocking oscillator transistor Q_3 , this transistor, previously cut-off, con-

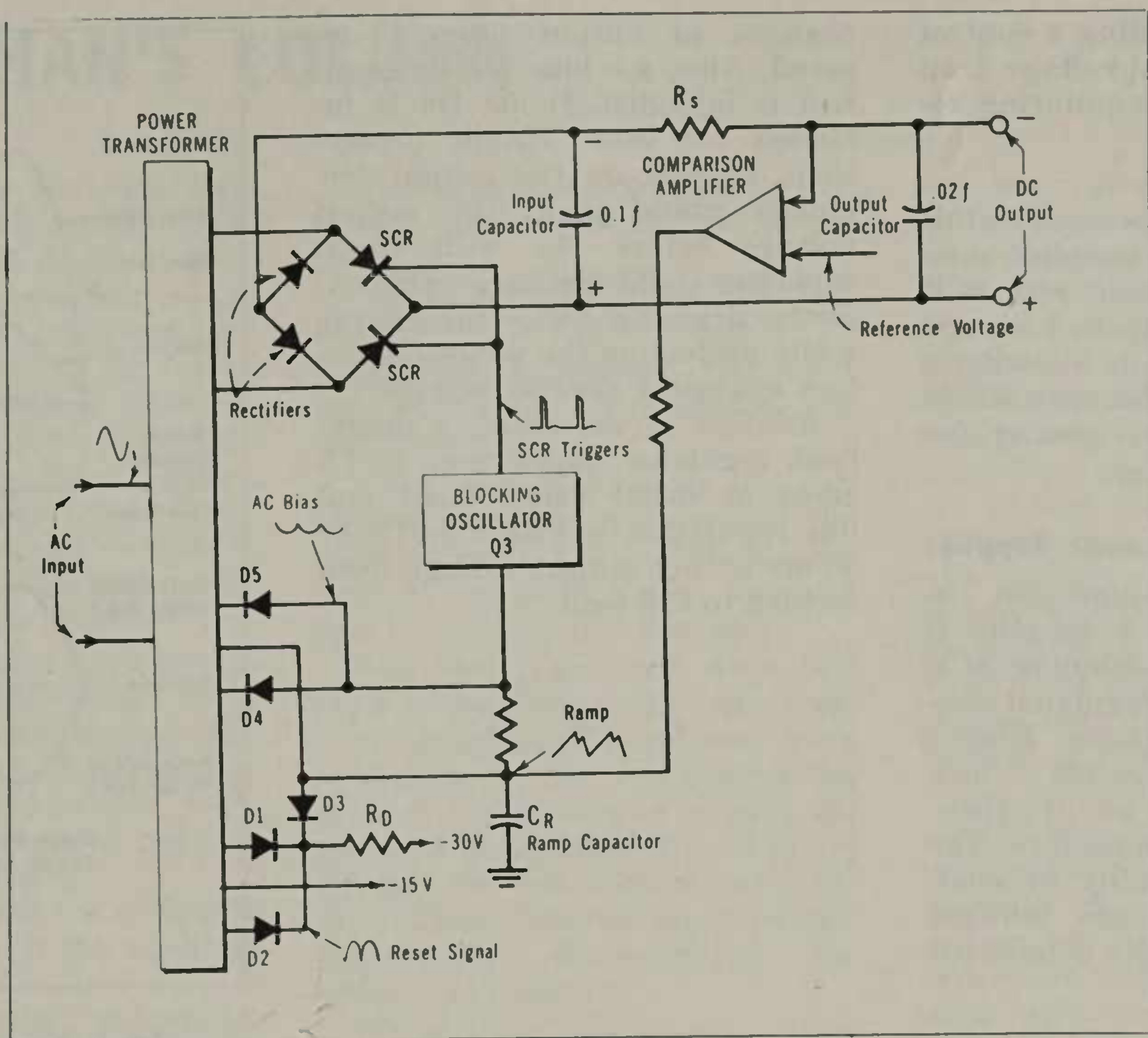


Fig. 8. Regulated supply with SCR control. These supplies may be connected for remote programming, remote sensing, Auto-series, and Auto-parallel operation.

ducts and generates an output pulse. The SCR which is fired by the blocking oscillator continues to conduct, of course, during the remainder of the half cycle. Conduction time is just long enough to bring the charge on the input capacitor up to the desired level.

The steepness of the ramp slope, determined by the current supplied by the voltage comparator, therefore controls the firing angle of the SCR's. A slight drop in the output voltage as a result of increased current demand, for example, increases the ramp current. The SCR's then fire earlier during the a-c cycle, supplying more energy to the input capacitor.

An important feature of these SCR regulated high current supplies is their immediate response to changes in the input line voltage. This fast response is the result of a-c bias, added to the ramp, which alters the firing angle of the blocking oscillator to make this angle responsive to the amplitude of the a-c input. For instance, if the input voltage were to increase, the resulting increase in a-c bias

would delay the firing angle of the blocking oscillator. Conduction time of the SCR's is then reduced, compensating for the increased line voltage. This compensation occurs within one cycle of a change in input line voltage before the output voltage is affected by the change. This half cycle speed has a far faster response than that found in magnetic amplifier power supplies, and produces remarkable immunity to line transients.

The series filter resistor is also used as a monitoring resistor for current limiting in the SCR regulated supply. A typical SCR unit supplies up to 25 amperes at 0 to 36 volts. Combined line and load regulation is within 0.5% for a load change from no load to full load accompanied by an input line change from 125 to 105 volts a-c. Ripple and noise are less than 1%.

SCR Supplies with Series Regulation

For extremely tight output voltage regulation and ripple requirements, SCR regulated supplies are combined with series regulators similar to those discussed previously. The SCR control circuit

itself does not use a voltage comparator in the usual manner but responds instead to the voltage drop across the series regulators. This maintains a fixed voltage drop across the series regulators nominally two to three volts. The main regulator controls the output voltage while the SCR circuit merely maintains the voltage across the series regulating transistor just above its saturating voltage.

The preregulator normally would not be required since the voltage across the regulators is limited, but it is included to protect the regulator during transient conditions. For example, if the output of the power supply were shorted suddenly, most of the original output voltage would appear across the regulators for a brief interval while the input capacitor discharges. During this transition period, the preregulator functions as previously described to limit the voltage drop across the main regulator.

These power supplies react immediately to sudden changes in output current. This is accom-

lished simply by adding a control link which senses the voltage drop across the current monitoring resistor.

The Harrison Labs model 810B is typical of power supplies combining series regulation with SCR control, supplying up to 7.5 amps at 0-60 volts and while allowing a voltage change of less than 0.02% or 10 mv, whichever is greater, for a 7.5 amp load change.

SCR High Voltage Power Supplies

A significant innovation in semi-conductor power supplies is made possible by combining SCR control with series regulated control in another manner. Higher voltage outputs (up to 320 v) now are possible without use of expensive high-voltage transistors. The efficiency and reliability of semi-conductor circuitry are brought here to a field formerly dominated by vacuum tubes.

The diagram of such a supply is shown in Fig. 10. The series regulator known as a "piggy-back" regulator, rides on top of the main SCR supply. As shown on the diagram of Fig. 10, the piggy-back regulator is a CV/CC control of the type described earlier but it has its own d-c source and functions independently of the main SCR supply. Its positive bus, however, is tied in series with the negative bus of the main SCR supply while the voltage programming resistor is extended out to the positive bus of the SCR supply.

The SCR control monitors the voltage drop across the series regulators and adjusts the SCR voltage to maintain the desired voltage drop. This means that the SCR control in an effort to adjust the series regulator voltage drop, brings the summing point within the operating range of the comparison amplifier. In this way, the Voltage Adjust resistor controls the combined output voltage from zero all the way to 320 volts.

Current monitoring is included with this type of supply so that the SCR's respond immediately to

changes in output current demand. Also, a-c bias for line control is included. Diode D6 is included for short circuit protection; a short on the output terminals would drop the output voltage before the SCR input capacitor could discharge. D6 conducts, draining away the charge while protecting the series regulators against a reverse voltage.

Another model using a piggy-back regulator, supplies up to 1.5 amps at 0-320 volts. Load and line regulation is within 0.01% or 30 mv at any output voltage from no load to full load.

* * *

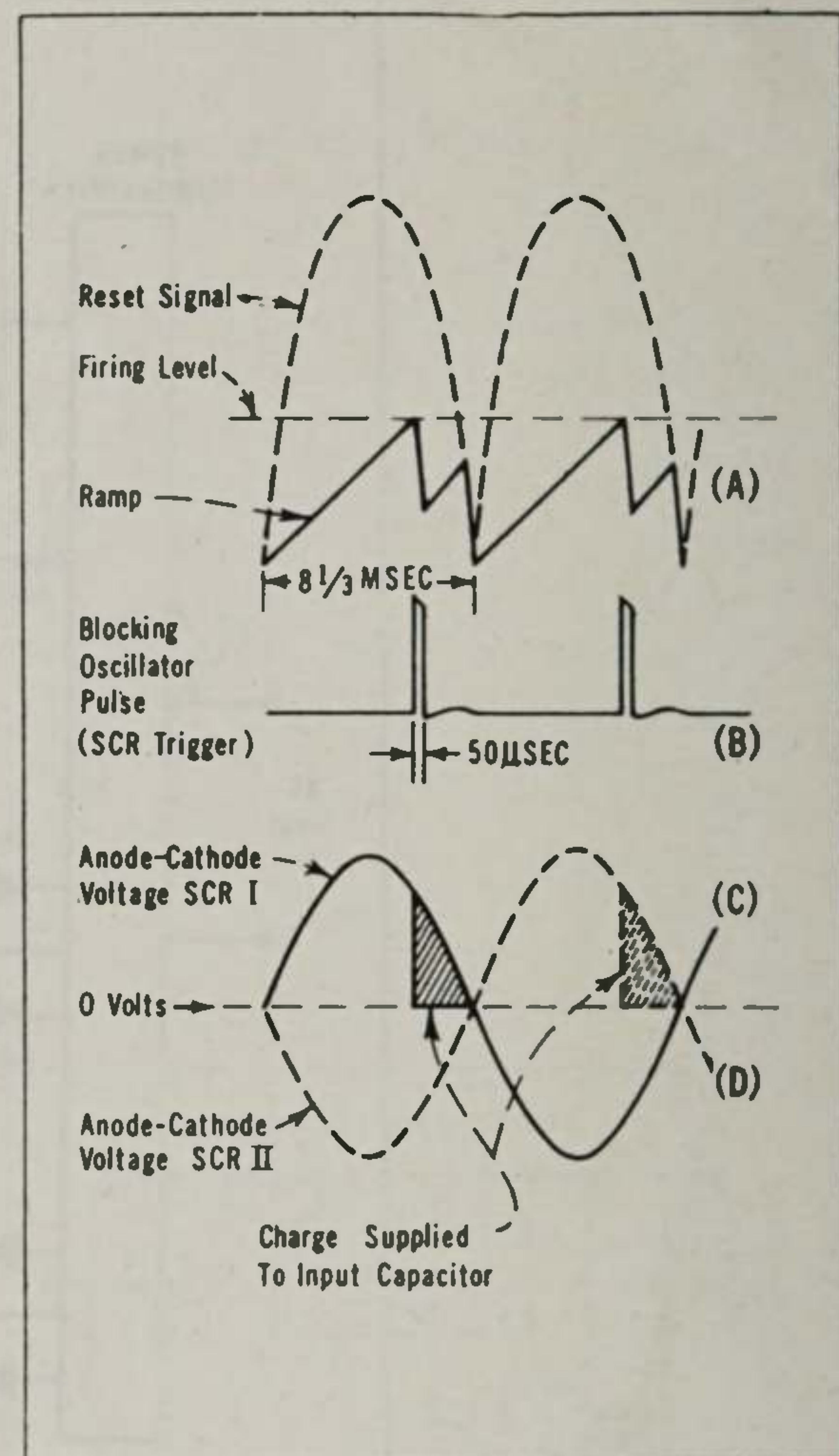


Fig. 9. SCR control waveforms.

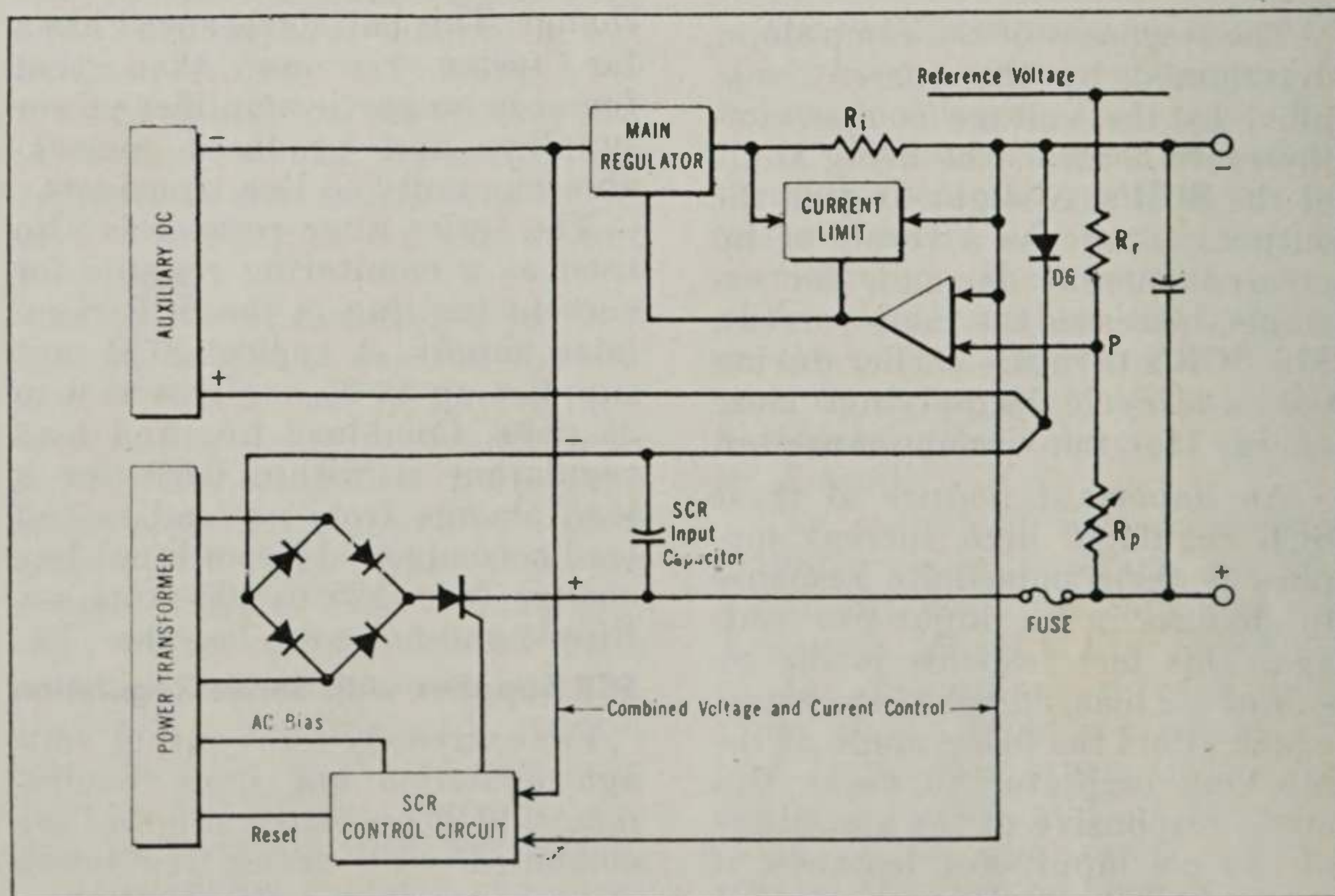


Fig. 10. Solid-state high voltage supply with "piggy-back" regulator. Piggy-back regulator supply itself delivers no more than 20 volts to combined output.

SERVICEMAN'S COLUMN

by J. Whitley Stokes

Over the 'phone the lady had said it was a built-in radio which had suddenly gone dead. On arrival I was met by said lady wearing matador pants. Just how useful those pants were to be I was to find out later. Seven children under the age of four were distributed on the front steps. "Don't worry they're not all mine", she said as she cleared a pathway through the mob, and conducted me to the lounge.

The set appeared ordinary enough, the chassis being built into the wall between lounge and kitchen. There was no sign of a speaker anywhere however so I had to call the owner and ask her to explain the mystery.

"Oh, it's up above the ceiling".

"Yes, but where's the opening through?"

"My husband hasn't got round to that part yet, but we found it sounded so good with the speaker just resting on the plaster that we left it there."

Well as the trouble was in the speaker I had to get it out somehow.

"Could you show me where the manhole is?" was my next question.

Without replying she grabbed a stool from the kitchen, stood on it and pushed open the manhole cover. Then, chinning herself, disappeared through the opening. Quite frankly I would have preferred to use a step-ladder but after all I couldn't very well let myself be outdone by a woman. Fortunately there was a convenient doorway adjacent and I was able to secure a toe hold on the architrave and thus gain access to the manhole. I had remembered to bring my torch and my next step was to locate the athletic lady now squatting alongside the speaker. The speaker was simply facing flat down on the plaster ceiling.

"Do you mean to say you could actually hear this quite clearly in the lounge?" I asked incredulously.

"Oh! not just in the lounge but anywhere in the house."

"But surely you must have had to turn the volume full on all the time".

"Well, yes we did, but it didn't sound over loud in the room".

Pity the neighbours, I thought and as though I had spoken she commented.

"The chap next door did ask us once why we always had the radio so loud, but it didn't seem loud to us, in fact my husband said it sounded just like hi-fi."

Just then the front door bell rang necessitating the lady's descent. It couldn't have been more opportune as she was spared the sight of my having to wrench the wires off the speaker when I found I'd left the side-cutters down below. (The owner had made no provision for disconnecting the speaker of course.)

When I got the speaker down into daylight I found the voice coil was O/C which wasn't surprising considering the pounding it must have taken. Anyway a new speaker was supplied and hooked up beside the set with firm instructions that it was not to be used "upstairs" until a suitable opening had been made in the ceiling.

I've sometimes wondered how poor a TV picture has to become before some people will call a serviceman or even realise that the picture has deteriorated noticeably. It seems that the American serviceman's slogan "As long as it moves they're happy" may be applicable here too.

The above comments were brought on by a recent call to attend a set that was reported as going "perfectly" until it was moved to another room.

The set in question was a 2lin. model of Australian origin and apparently had had considerable use. The complaint "Sound O.K. — no pix". Guessing the fault to lie in the line output or E.H.T. circuit, I proceeded to check same but everything appeared O.K. though there was no sign of a raster. Then it struck me that the ion trap magnet might have shifted

and sure enough it was found to be quite loose. Re-positioning it immediately restored the picture. But what a picture! It was about 1in. up from the bottom with both the horizontal and vertical linearity the worst I'd ever seen. On the test pattern it would not resolve more than about 200 lines, and on top of that the picture was fairly crawling with noise due to the use of a rabbit's ear aerial. The owner seemed quite satisfied with things as they were however so it was with some diffidence that I suggested that I could improve the picture if I took the set into the shop. He did agree however.

The line voltage tapping was set for 215 volts and I imagined it might have been done to boost an ageing picture tube or to obtain more height or width. However with the line voltage topping set correctly there was still plenty of brightness and it was possible to obtain sufficient height and to considerably improve the linearity after juggling with the various preset controls. That only left the poor definition to contend with, a check with the 'scope' revealed the need for re-alignment of the I.F. strip, particularly in regard to the setting of the traps. After this was done a noticeable improvement in the response was apparent.

This left only the rabbit's ear aerial to deal with but as the owner was unwilling to go to the expense of an outside aerial things had to be left as they were. Under the circumstances I am still wondering if my efforts in improving the picture were warranted!

FOR SALE

Lampkin Micrometer Frequency Meter type 105/B. Built in Crystal Calibrator. Range 100 Kc/s to 400 mc/s.

Accuracy: Better than .0025%.
Price £130.

Also: Heathkit Audio Frequency Meter type AF-1. 0-200 Kc/s.
Price £40.

Both units in first-class condition.

Apply to:—

RADIO ENGINEERING LTD.,

P.O. Box 764 - DUNEDIN.

LOOKING AT

Bonded Shield TV Picture Tubes

Since the introduction of the first TV Receiver, it has been customary, and in many cases mandatory, to provide a plate-glass safety shield built into the front of the cabinet. The only deviation from this practice, until recently, has been the use of moulded-plastic shields in the smaller portable sets for the purposes of weight reduction. Although this fact is widely known, there may be some of our readers who are not fully aware of the reason for this safety shield.

The envelope of a conventional cathode ray tube is a glass bulb from which the air has been exhausted as thoroughly as is economically possible, in a mass production process. Every square inch of the outer surface is therefore subjected, by the atmosphere, to a force of about 15 lbs, which results in a large area such as the face of a 23 inch tube, sustaining a pressure of about one and three quarter tons. Although the bulb is designed to have an adequate safety margin of strength, for normal handling and use, there is always the danger of an accidental blow or shock causing a violent collapse of the bulb. This is called an 'implosion'. When this happens, pieces of glass are often ejected outwards with great force.

For this reason, the need for a safety panel in front of the tube has always been recognised. Additionally, the receiver cabinet has to be strengthened to contain the violence of such a happening.

Quite recently, a new series of tubes has been introduced which, as one of the many desirable features, eliminates the necessity for providing the plate-glass safety shield. These are the new 19 and 23 inch, square cornered, rectangular, picture tubes, with

matching implosion shields laminated to the tube face with a layer of thermosetting epoxy resin, especially developed for this application. Since their introduction, these tubes have already gained wide acceptance in the industry, because of their increased strength, and associated safety factor, and also improved picture performance.

From the point of view of safety, not only do these new Twin-Panel or bonded panel tubes, have a stronger face, but if it is subjected to a blow which is heavy enough to break the bulb, there will be no violent implosion. In particular, no glass will be projected forward through the sandwich face to injure a viewer. Thus cabinets can be lighter, since they no longer have to be strong enough to contain the implosion, and the separate safety panel may be omitted.

Basically, there are two types of "bonded-shield" tubes. One employs a pressed-glass implosion shield formed in such a way as to curve around the face of the picture tube, thus providing a natural pocket for the introduction of the resin adhesive. This is shown in Fig. 1. A second approach is also used in which a flat sheet of

plate glass, similar to that normally fitted in the front of the TV Receiver, is cut and moulded to match the contour of the tube face. In this case, the glass does not curve around the side of the tube, therefore a plastic band is used to hold the implosion plate at the proper distance from the tube face to allow for the resin layer. Both types have been made commercially, but, at present, the first version has been the most popular.

These new designs have resulted in the first major viewing improvement for some time. Part of this has been due to the fact that the faceplates have tended to become much more 'square'. This was brought about by public demand. The average viewer is accustomed to rectangular shapes for mirrors, windows, picture theatre projection screens, and picture frames.

The trend then to square off the corners also resulted in additional viewing areas, so that the part of the picture in the corners which was formerly lost or distorted in shape, can now be seen. In the case of the 23 inch tube, this has recovered 20 additional square inches of usable viewing surface, compared with the more conventional shaped 21 inch tube. The amount of transmitted picture information that is not reproduced is now negligible.

The reduction of the overscan of the raster, which was required by the older style of tube, has also brought with it an improvement in available contrast. Why this is so, is not immediately obvious, but is quite significant.

When the electrons in the over-scanned beam strike the bulb walls instead of the face plate, some of them are reflected back

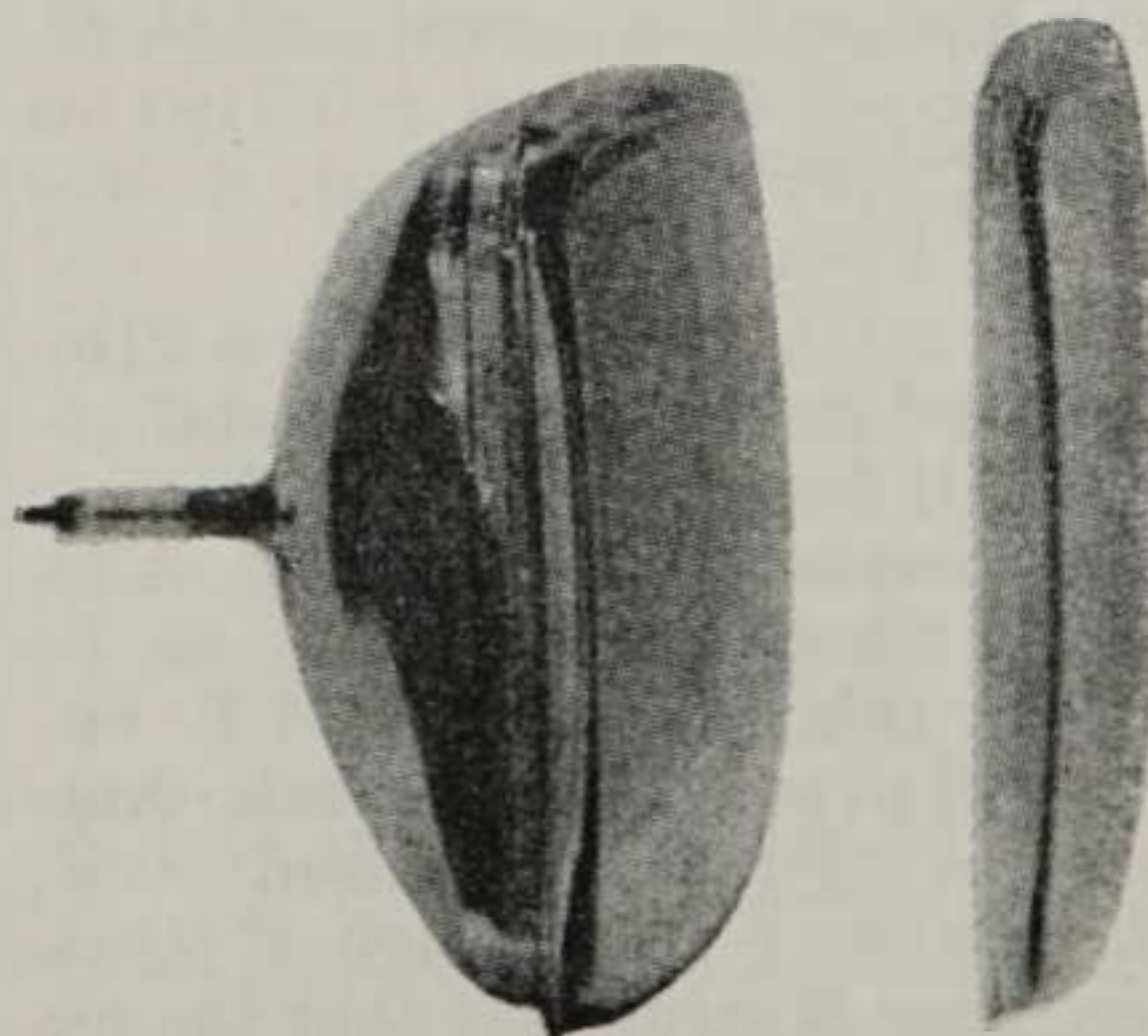


Fig. 1

on to the phosphor screen, producing low level excitation of certain areas, in addition to the desired excitation by the main beam. This contamination, particularly in areas which should remain black, tends to decrease the contrast ratio. With overscan reduced to an insignificant level, a more correct tonal quality is maintained in the picture, in addition to the better contrast ratio. This is shown graphically in Fig. 2.

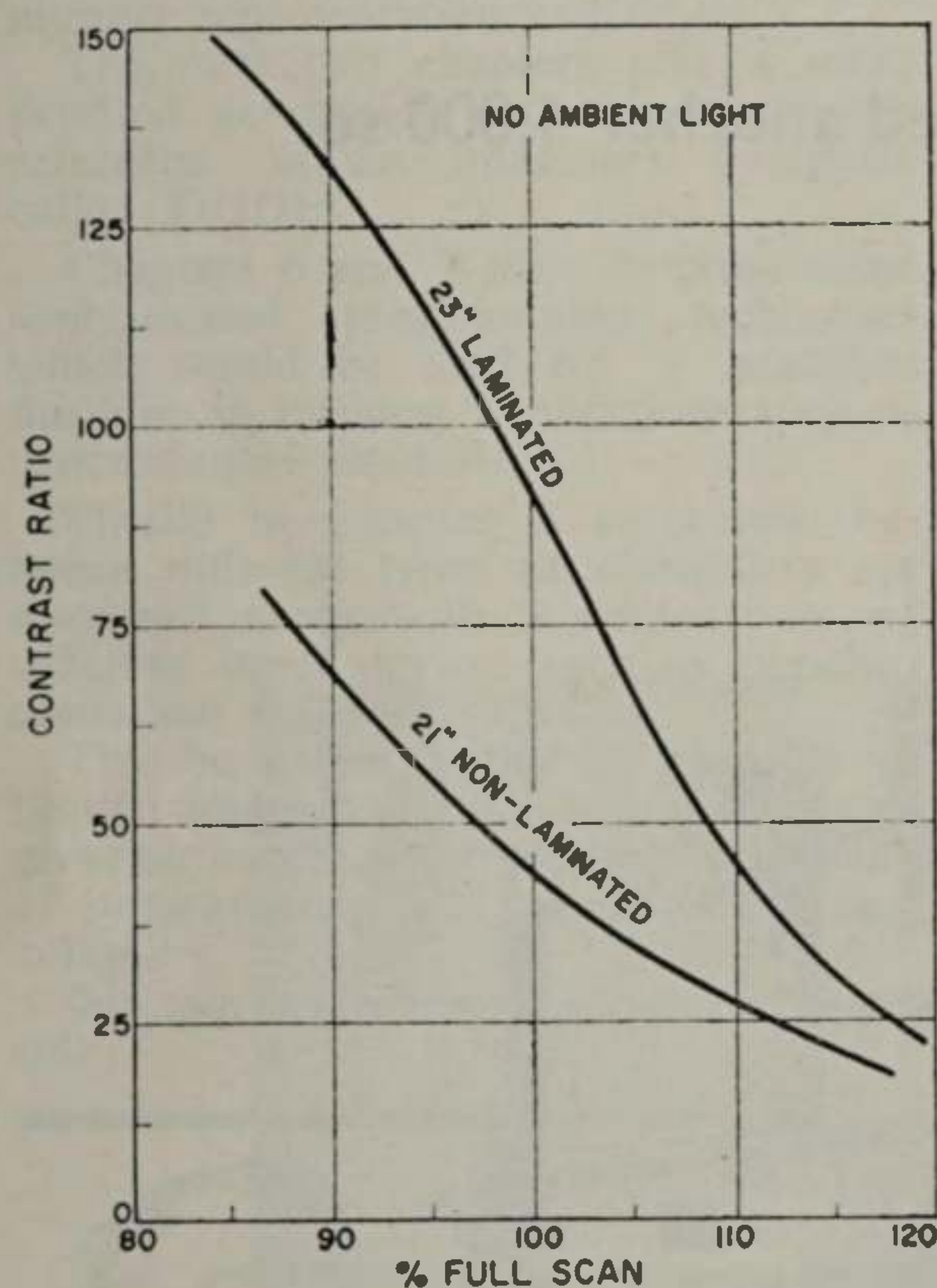


Fig. 2

Another bonus of the new tube is the flatter face. Curvature of the screen restricts the angle over which the viewing audience may be distributed and tends to distort the image for those who are not facing the screen head on. This curvature has been made necessary by the physical requirements of the tube. The addition of another element, the laminated implosion shield, in front of the faceplate, has made it possible to flatten out the surface considerably. This can be noted in Fig. 1.

Elimination of a separate glass plate has also eliminated two reflecting surfaces. This is due to the fact that the transparent resin developed for making the bond has approximately the same index of refraction as the glass used, so

that light passes through glass-resin-glass with no internal reflections from the two glass surfaces that are in contact with the resin layer. Fig. 3 shows that, with a separate plate, there are four reflecting surfaces; the inner and outer surfaces of the faceplate and the inner and outer surfaces of the safety plate. The laminated tube, on the other hand, has only two reflecting elements; the inner surface of the faceplate and the outer surface of the attached shield. Thus the reflection of ambient light is greatly reduced.

This reduction results in another substantial increase in available brightness. A further improvement in contrast is achieved by tinting the safety shield. The latter is often a grey filter having a 50 per cent transmission characteristic. The filtering improves contrast by reducing the amount of ambient light that passes through the safety shield and reflects back from the tube.

As a result of the high voltage employed, parts of the TV tube become statically charged to quite a high voltage even though there is a ground strap connecting the tube to the chassis. This high voltage tends to attract dust particles and moisture. With a separately mounted safety panel these are deposited on the picture tube faceplate and the inner surface of the safety panel.

The film that is formed reduces picture brightness, contrast and resolution. While cleaning the two surfaces involved, will restore the picture quality, this seemingly simple job necessitates the removal of the picture tube. The bonding of the safety panel to the faceplate eliminates this problem, as the compound panel can be easily wiped to free it from dust, without fear of scratching the surface.

How the Laminated Front is Assembled

The significant improvements realised with use of a bonded-shield tube, have been made possible by the development of epoxy-resin lamination method for attaching the shield. The prepared tube and its separate shield are first cleaned and then mounted in a special designed jig. The two elements are carefully spaced so that, after the resin is introduced, a minimum thickness will be maintained over the entire tube face. This jigged assembly is then heated to 200°-250°F and the epoxy resin is then dispensed into the predetermined cavity between the tube and the panel.

The epoxy resin, like other similar materials, requires the addition of a hardener to effect a thermosetting cure. Since the resin begins to cure immediately after the hardener is added, this

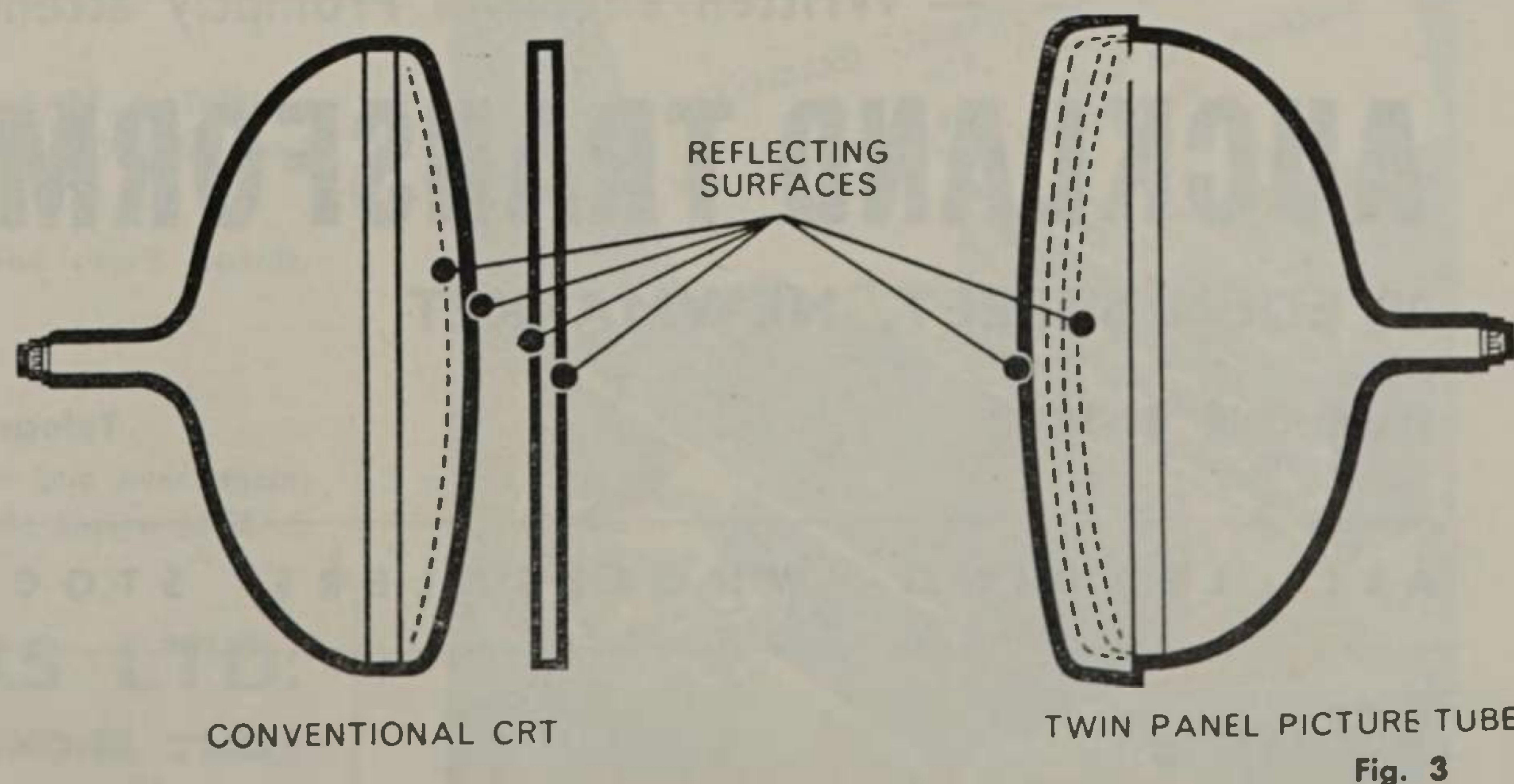
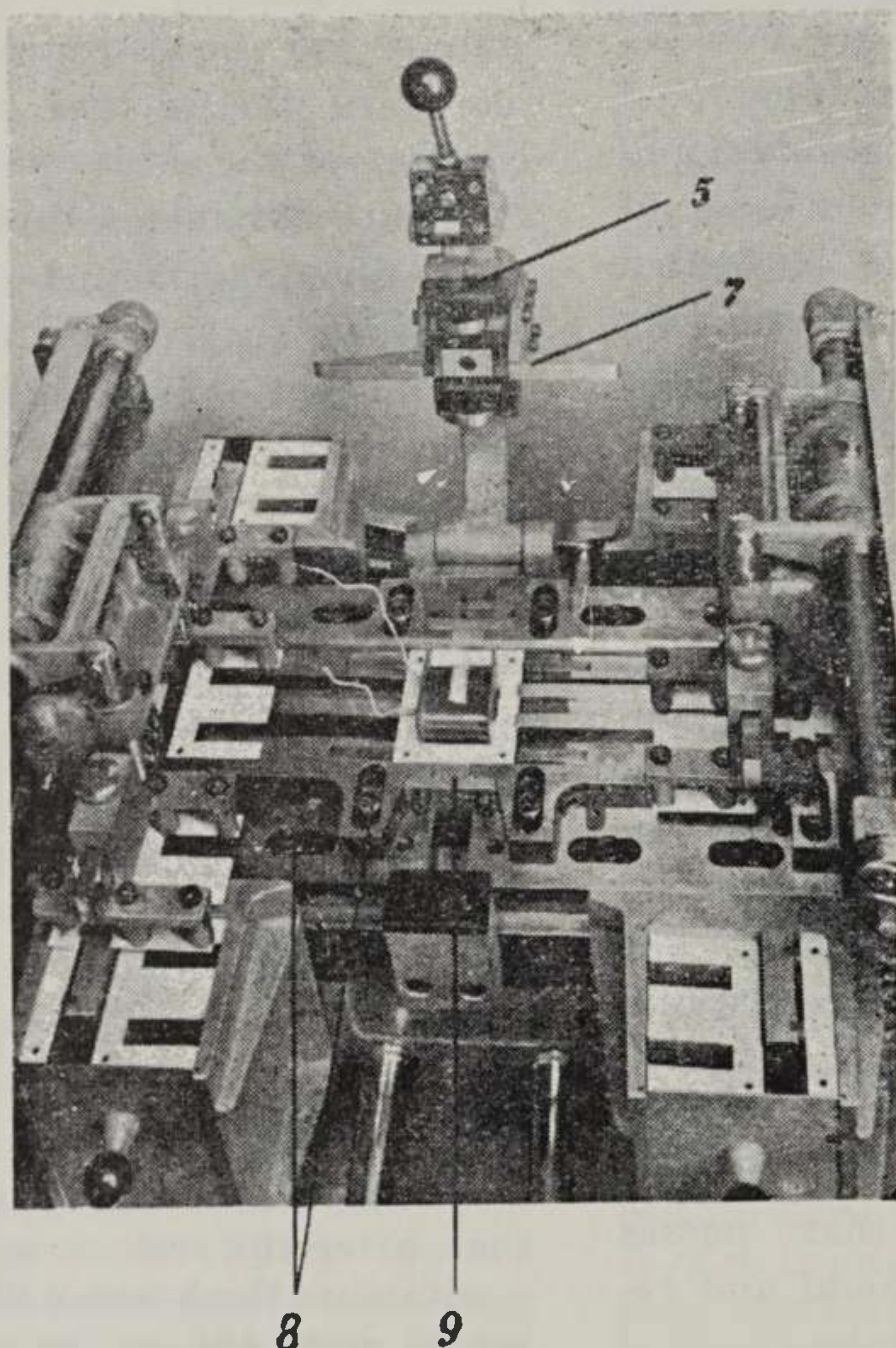


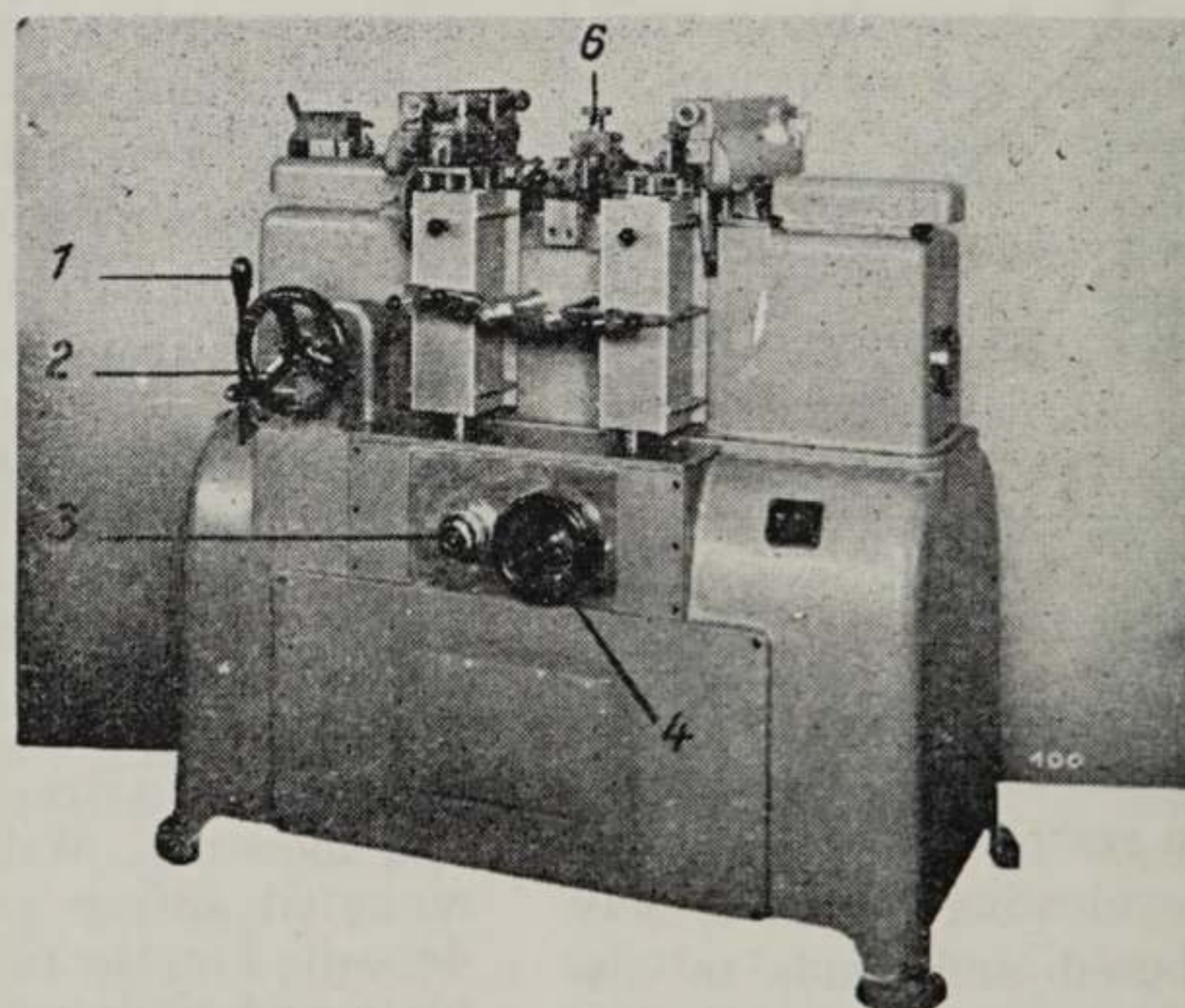
Fig. 3

The Auckland Transformer Company



See the PACKING MACHINES in action and discuss any problems you may have with one of the four Hams on the Staff.

extends to all Hams in or visiting Auckland, a cordial invitation to visit their factory in Newmarket, to which they have just added another 4,000 sq. feet floor Space.



— Written enquiries Promptly attended to —

AUCKLAND TRANSFORMER CO. LTD.

20 EDEN STREET, NEWMARKET

— — — AUCKLAND

TELEPHONE 51-307

Telegrams: "TRANSFORMA," Auckland

ALL LEADING WHOLESALE STOCK A.T.C. PRODUCTS

Book Reviews . . .

Programming for Digital Computers: By J. F. Davidson, published by "Business Publications," in association with B. T. Batford Ltd.

This book is an introduction to programming for digital computers and is of definite interest to those wishing to learn something about the use of digital computers from the non-technical point of view.

The first three chapters give a brief introduction to computers, along with some basic techniques, and explain the task of the programmer without going into any great detail on order-codes, number representation and so on.

The next two chapters give a more detailed description of this task with reference to an imaginary computer called TRIDEC.

Chapters 6 and 7 then describe some sophisticated programming techniques which would be used for a practical machine in business applications such as processing of pay-rolls.

Finally in Chapter 8 variations between different types of computers are discussed along with a comparison of different input devices such as punched cards and magnetic tapes.

This book then, although probably of limited interest, is very informative and gives an excellent introduction to the art of programming and use of the digital computer.

Our copy by courtesy of Technical Books Ltd.

Transistors — Theory and Practice: By L. Brock-Nannestad, published by World Publications, Hellerup, Denmark.

This small handbook of some 60 pages is intended as an introduction to some of the transistor techniques. It is suitable for those readers who wish to commence work with these modern components and who would like to have both the theory and a little practical work as an introduction.

The first section of the book introduces the theory of semi-conductors, followed by a relatively simple explanation of transistor characteristics, parameters, and equivalent circuits. Next, a chapter follows on the choice of working points and their stabilisation, followed again by a section on the design of resistance—capacity, coupled amplifiers and output stages. In the second part of the book several practical transistor circuits are described together with indications of suitable components. Some of these circuits are audio amplifiers, different oscillator circuits, simple regenerative receivers and some pulse circuits. The final section of the book contains a brief summary of many of the transistors existing at the date of writing.

Our copy by courtesy of Technical Books Ltd.

The third book this month is entitled **Printed Circuits:** By Morris Moses, published by the Gernsback Library Inc., New York.

This is a collection of information and photographs from a number of the prominent American firms specialising in the use and design of printed circuits. It is a book on the "How to do it" of printed circuits and associated miniature equipment and has been written more especially for the American Amateur, TV and Radio Serviceman, and experimenter. Practical techniques and methods have been presented wherever possible.

Chapter 1 deals with the development of the art of printing electronic circuits, whilst the second and third chapters cover many of the techniques and the selections of the various types of materials and also the various types of components which are more suitable for utilisation with printed circuitry. Chapter 4, perhaps rather a foreigner in this particular publication, deals with batteries and power sources but undoubtedly these have a great deal to do with the ultimate utilisation of printed circuits. The fifth chapter deals with the repair and fault tracing of printed circuits and other sub-miniature assemblies. It also covers certain more specialised instruments which are a necessary adjunct to the servicing of such circuitry. The sixth and seventh chapters deal with practical assemblies and demonstrate the means of laying out a number of various types of printed circuit boards starting with a simple one-transistor radio, passing through instruments, and ending up with high-frequency crystal control transmitters, radio control equipment, etc. As these techniques are only coming to the fore in this country at the present time, such a publication makes interesting and instructive reading.

Our copy by courtesy of Technical Books Ltd.



NEW

THE NEW TRANSISTOR RADIO SERVICE MANUAL

- ★ Contains data for CROWN, GLOBAL, HITACHI, LARK, NATIONAL, NIVICO, SHARP, SONY, SANYO, STANDARD, TOSHIBA and TELEFUNKEN.
 - ★ 200 Circuits plus 200 pages showing printed circuit boards, chassis layouts, alignment data, etc.
 - ★ Transistor Interchangeability Charts.
 - ★ Heavy-duty binder—expandable.
- This Serviceman's BIBLE will repay you over and over again.
Price £10/10/- (Annual Sub. for additional Data Sheets, £2/2/-).

NOW AVAILABLE From:—

TECHNICAL BOOKS LTD.

31-33 VICTORIA ST. W. — PHONE 22-385



Shortwave Survey

by MIKE BUTLER

In this decade, when the conflict of ideologies has reached an unprecedented level, we re-discover that Shortwave Radio is the only ready means whereby one nation can speak to the individuals in another without censorship (if one discounts jamming) by the controlling faction of that country. This assumes, of course, that the people the broadcaster wants to reach, want to hear. And for this reason radio is the most democratic arrangement in the world. It is the listener's vote by his use of the tuning knob or on/off switch that determines the success of any broadcast.

With the distance between most of us and the missile makers measured in minutes it would appear vital for each of us to know what everyone else is saying and doing about it. Shortwave Radio allows us to determine this, free from local colouring and delay.

News in English

- 1800 BBC (12095) China (7330, 9785) U.S.S.R. (9775).
 1820 Italy (9575).
 1830 Canada (11720) Portugal (11920, 17895) U.S.S.R. (9775) Yugoslavia (6100).
 1845 Fiji (3980, 4755) Pakistan.
 1900 A F R T S (15410, 17780, 21645) China (7080) Fiji - BBC relay (4755).
 1915 Indonesia (9865) Liberia-ELWA.
 1930 Poland, WRUL 17760, (17760, 17845).
 1945 Fiji (4755) India (7235, 9635) Pakistan (9740) Sweden.
 2000 AFRTS (17780) Australia (11840, 15315) and Australian Regionals, not Sundays (4920, 6090, 11880, 15220) BBC (9410, 11750, 11820, 11860, 12095) Ghana, Hungary, Japan (9525, U.S.S.R. (9500) VOA (6135, 6185, 7205, 9525, 9765, 15235, 15330, 17710, 17795).
 2005 Bulgaria.
 2015 BBC (refer 2000) Denmark, Israel (9009).
 2030 China (7080).
 2045 Australian Regionals (refer 2000) Canada, Ghana.
 2100 AFRTS, Australia (11840, 15240, 15315) U.S.S.R. (17740) VOA (6015, 9530, 11900, 15435, 17710, 17765, 21610).
 2115 Australian Regionals, Sunday at 2130, (6090, 6150, 9660, 15220).
 2130 China (7480, 11980) WRUL (17845).
 2145 Australia (11840, 15240, 15315) Australian Regionals except Sunday (Refer 2115) BBC (9410, 11820, 11860).
 2200 AFRTS (11905) Hungary (9833) U.S.S.R. (9775, 11715) VOA (15130, 15170, 17710, 21610).
 2230 U.S.S.R. (refer 2200).
 2245 Australia (11840, 15220, 15240) Australian Regionals, Sunday only (9660, 9680).
 2300 BBC (9410, 9510, 15070) U.S.S.R. (12020) VOA (15405, 17765, 21745).
 2330 Australia (11840, 15240) Japan (15135, 15390).
 0000 AFRTS (15310, 17815) Australian Regionals except Sat./Sun. (15230, 15425) BBC (9510, 11750, 11820, 12040) VOA (15155, 15360, 17745).
 0015 Australia (17870).
 0030 A F R T S (15310) Japan (15135).
 0100 A F R T S (15310, 17815) Japan (15195) U.S.S.R. (9690, 9720, 11690, 11870) V O A (15155, 15210, 15360, 17735, 17745, 17775, 21745).
 0110 Formosa.
 0130 Australia (17840, 17870, 21540).
 0200 A F R T S (15210, 15310, 17815) BBC (7230, 9510, 12040) Ceylon — BBC relay (15265) Japan (15195) VOA (9650, 15325, 15405).
 0230 Australia (refer 0130, add. 15315, 15240) Australian Regionals (15230, 15425) India (15105, 15310).
 0300 A F R T S (11870, 15210, 17825) China (15060, 17745) Czechoslovakia, Japan (15105, 15325) U.S.S.R. (7150, 7290, 7320, 9665, 9690) VOA (9650, 11835, 11875, 15325).
 0305 Italy (9575).
 0315 Japan (17895) Spain (9360).
 0330 Australian Regionals (15230) Hungary (7220, 9833) U.S.S.R. (refer 0300).
 0400 AFRTS (refer 0300), Australia (17870), BBC (9410, 12095) Bulgaria (9700) China (15060, 17745) Japan (15105), 15195) VOA (7220).
 0415 Spain (6130, 9360).
 0430 India, Rumania (11810, 11900) U.S.S.R. (9665, 9690).
 0500 AFRTS (15210) Australia (15240, 17870, 21540) BBC (6110, 7140, 9140, 9580, 12095) Canada, Czechoslovakia (9550) West Germany, Japan (15195) U.S.S.R. (9665, 9690,) VOA (5960, 9545, 9740, 9770, 11805).
 0515 Australia (refer 0500) Congo-Brazzaville, Spain (6130, 9360).
 0525 West Germany (9735).
 0530 Japan (15235, 17725) South Korea (15125) Philippines (17805).
 0600 A F R T S (6040, 11930, 15210) Australia (9570, 11710, 15240, 17870) Australian Regionals except Sunday (4920, 15425) BBC (6110, 7120, 9510, 9580, 9640, 11945) Canada (6070, 6120) Japan (15195, 15325, 17725) N.Z. (6080) VOA (6025, 6080 interferes with N.Z., 9720, 9740, 9755, 9770, 11805, 15270).
 0630 Canada — CFRX (6070) Egypt (11915) U.S.S.R. (9540, 9730, 11850, 11980, 17740).
 0700 AFRTS (6040, 11930) Australia (refer 0600) BBC (6110, 9510, 11750, 11930, 11955, 15070) Canada — CFRX (6070, Fiji — BBC relay (3980, 4755) Holland (9590, 11730) Liberia — ELWA, BBC relay (11975) U.S.S.R. (9540, 17740).
 0730 South Korea (15125) N.Z. (6080, 11780) Poland, U.S.S.R. (15360).
 0745 Japan (15135, 15235).
 0800 AFRTS (6040, 9700, 11930) Czechoslovakia, Japan (11725, 15135) Pakistan.
 0815 West Germany (17815).
 0830 Canada (5970, 9630) China (9945, 11650, 15060, 17830).
 0845 Australia (7190, 9570, 11710, 11810,) West Germany (15270).

0900 AFRTS (5965, 6040, 9700, 11930, 15370) Australia (refer 0845) Australian Regionals (4920, 6090, 6130, 9680) Fiji — ABC relay (3290, 3980, 4755) Italy (15325) Japan (11725, 15325) VOA (5985, 6075, 6145, 7155, 9545, 9650, 15205).
 0915 BBC (9725, 11750, 11955, 15070, 15435, 21470, 21550).
 0930 China (11650, 15060) Japan (11875, 15235) N.Z. (6080) Pakistan (21590).
 1000 AFRTS (5965, 6040, 9700) Australia (7190, 9570) India (11715, 17855) Japan (9505, 9605, 11875, 15235) South Korea (9640).
 1010 Formosa (6095, 7130, 9685, 11860).
 1025 West Germany.
 1030 Thailand (11910) U.S.S.R.
 1045 Italy (17800) United (9545).

Where no frequencies are given it is implied that we have had no recent reception from that source at the time of the newscast. However, signals are expected with a change of season.

Besides being one of the most important features in a S.W. Station's programme a typical news

session is often the listener's quickest and easiest means of identifying a station. If the speaker's accent and the facts given do not immediately betray the origin of the broadcast, the frequent reiteration of call sign or station slogan certainly will.

The well received outlet of RADIO AUSTRALIA on 11840 which has been heard for years between 2000 and 2200 now re-opens at 2215 and is followed at excellent strength until closing at 0015, in parallel with the transmitters on 15220 and 15240. Also between 0115 and 0330 an additional session is heard on 15315 and 17840. Both frequencies carry an excellent signal.

The special broadcast for Australasian listeners by RADIO CANADA from 0830 to 0905 daily, usually received very well on 9630, is now heard on an additional frequency in the 49 metre band, 5970. At present the new outlet is slightly better than the 31 metre signal.

FIJI is again in the news with a bright new signal on the little-used 90 metre band. Reception here between 0800 and 1000 on

3290 was a vast improvement on their 4755 transmissions which have recently encountered severe interference, a natural corollary perhaps to better conditions at these frequencies. The 60 metre band transmitter on 3980 appears to be still functioning although it is not a spectacular performer at this distance.

The new Voice of America station at Greenville, North Carolina is reported to be testing prior to commencing its transmissions to Africa, Latin America, Europe and the East. U.S. listeners have heard tests with recorded music and announcements on the half-hour on 5965, 9770 and 11770 between 0100 and 0400 although no reception has been had at our listening post. The transmitters planned for the new relay station are: six 500kw, six 250kw and six 50kw, and this massive line-up when fully operational, should make a deep impression here even if all their beams are aimed in the opposite direction!

We remind readers to add 12 hours to the above times to obtain N.Z. time or add 10 hours for Australian Eastern Standard Time.

THE NATIONAL ELECTRICAL AND ENGINEERING COMPANY LTD.

Executive Staff Changes

The beginning of September saw many changes amongst the Executive staff, of The National Electrical and Engineering Company Ltd. At the September Board Meeting, it was announced that Mr. J.



Mr. T. G. Ritchie

G. Ritchie has been appointed General Manager of the company. Mr. Ritchie joined National Electric in Christchurch as branch accountant in 1930, after being associated with the subsidiary company N.Z. Insulators Ltd., at Temuka since 1924. In 1933 he was transferred to Wellington as Wellington and South Island accountant and in 1935 was promoted to secretary of the Company. In 1960 he was given a seat on the board as an executive director. Mr. Ritchie is by professional training a registered accountant. He brings to his new task an experience of the company's operations over a period of more than 30 years.

Other appointments included Mr. C. J. Peard, A.R.A.N.Z., as company secretary; Mr. I. L. Malcolm, A.M.I.E.E., as branch manager, Hamilton; Alan D. Harland, as merchandise sales manager at head office; Mr. Rowan Doreen, as assistant to the Auckland manager; Ken Lee Richards, B.Sc. (London) as manager of Christchurch branch; and Mr. A. T. Anderson, as branch manager of Hastings.

Reorganisation of Telecommunications Ltd. and Wiseman's Electrical Co. Ltd. Departments

On September 17, 1962, Telecommunications Ltd. opened a new factory at 112-114 Nelson Street, Petone. The factory at 13 Tory Street, Wellington, will be closed but an office and design laboratory will be open at Magnus Motors Building, Wakefield Street, Wellington, for the convenience of clients. This office will also be the Head Office and Accounts section for both companies.

The new set-up will be as follows:—
WISEMAN ELECTRIC CO. LTD.—

Head Office, Accounts,
TELE-COMMUNICATIONS LTD. —
 Design Laboratory,
 2nd Floor, Magnus Motors Building,
 160 Wakefield Street, Wellington, C.1.
 Telephone 54-691.

TELE-COMMUNICATIONS LTD. —
 Factory
 112-114 Nelson Street, Petone, Telephone 69-173.

WISEMAN ELECTRIC CO. LTD. —
 Warehouse
 98 Vivian Street, Wellington, C.3. Telephone 55-777.

Postal Address for both Companies—
 P.O. Box 2020, Wellington.

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 1365, Auckland.

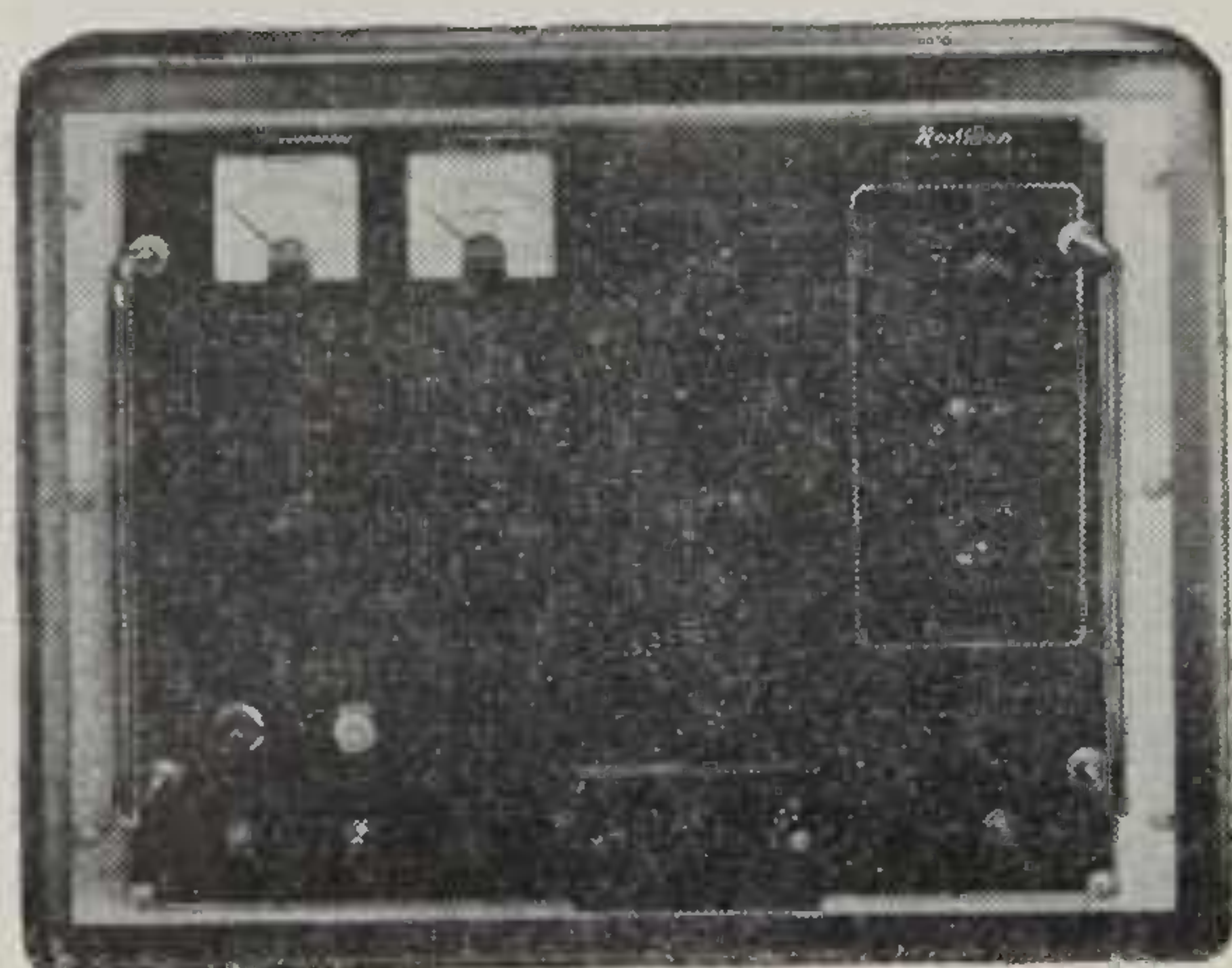
A Compact 500/750 Watt Linear Amplifier

Automatic Channel Selection on Redifon's GA.406

A compact and economical 500/750 watt linear amplifier, Type GA.406, has been introduced by Redifon Limited for use with their h.f. SSB radiotelephones, Rediplex systems, or any suitable drive unit.

The new amplifier covers the frequency range 2 - 18 Mc/s, and a unique feature is the provision of four pre-set frequencies which can be selected manually (from the front panel) or automatically by the associated transmitter/receiver drive unit or separate control unit. Three of the channels are pre-set internally by readily accessible links, and the fourth may be pre-set or continuously tuned from the front panel.

Automatic transmitter/receiver switching eliminates the need for additional control circuitry between the GA.406 and driver, only a single co-axial connection being required. One control on the front panel switches the amplifier out of circuit when full power is not required; and comprehensive metering enables the equipment to be set up quickly on different operational frequencies. An indication of standing wave ratio is provided when the optional directional coupler is used.



The GA.406 is supplied with dust covers for fitting into standard 19-inch racks or in a fully enclosed housing. It is completely self-contained, with a built-in power supply unit operating on 115 or 230 volts 50/60 cycles single-phase a.c. The amplifier circuit uses two grounded-grid QY4-400 valves, conservatively operated and fan cooled. Maximum reliability and minimum heat generation are achieved by complete elimination of valve rectifiers — silicon diodes being employed for anode and screen supplies. Semi-conductors are used in the control circuits. An r.f. input of only 50 watts p.e.p. at 50 ohms is required for full output.

An optional remote control unit provides channel selection facilities over a multicore cable up to 300 feet in length.

* * *

Portable A.C. Millivoltmeter VF 1040.

The VF 1040 is a compact, transistor-operated a.c. millivoltmeter, recently developed by Solartron Laboratory Instruments Ltd. Electrically isolated from power lines and ground, and free from internally generated hum, it has the exceptionally high common-mode rejection essential for the accurate measurement of differential voltages. The instrument has full-scale sensitivities of 1 mV to 316 V in 12 ranges, and an operational frequency range of 10 c/s to 1 Mc/s. Measurements may be made to an accuracy of plus/minus 1% of f.s.d. from 10 c/s to 100 kc/s. and to plus/minus 2% of f.s.d. from 100 kc/s up to 1 Mc/s. The meter is scaled in dB's to provide level measurement facilities from -72 dB to +52 dB relative to 1 mW in 600 ohms.

The input impedance on the mV and V ranges are not less than 1 Mohm/ 45 pF and 1 mohm/10 pF respectively. The instrument is powered by a 6V battery provided by four universally obtainable U2 dry-cells, and has a current drain of approximately 10 mA. The meter is usable down to a battery e.m.f. of 4 V, and a "check battery" position is provided on the function selector. Self contained and weighing only 5 lb., it is truly portable and equally suitable for laboratory, mobile or field application.

* * *

X-Ray Diagnostic Apparatus Ordered for Dunedin Hospital

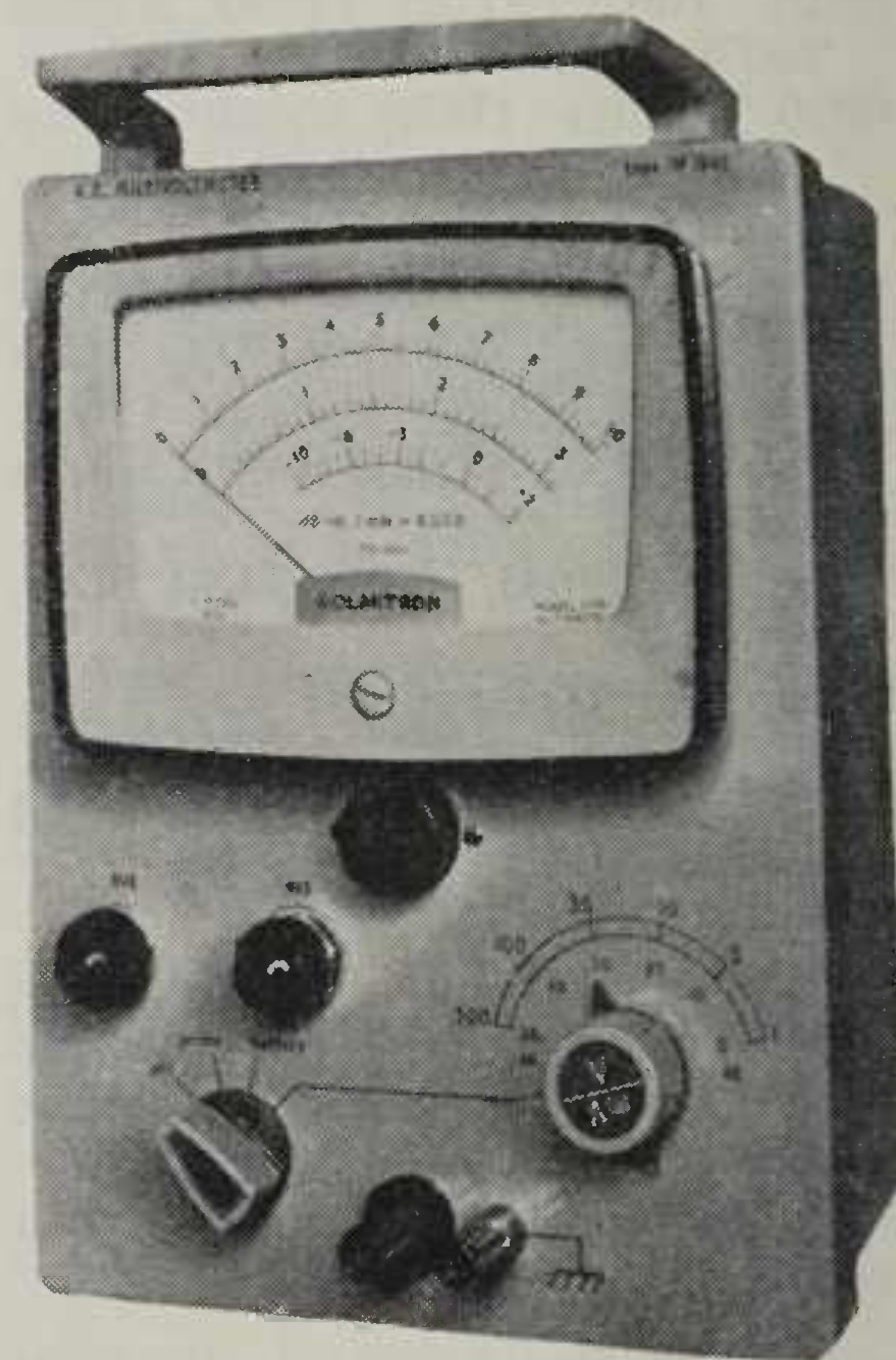
An order was placed with Amalgamated Wireless (Australasia) N.Z. Limited by the Otago Hospital Board for an Image Intensifier using Closed Circuit Television for display purposes. The equipment, which will be the first to be installed in New Zealand using Closed Circuit Television, will be installed in the Dunedin Public Hospital. The Closed Circuit Television equipment will be manufactured by Marconi's of England.

* * *

New 500 Watt Triode Valve

A new 500 watt radiation cooled triode for audio frequency vibratory amplifiers and single sideband transmitters is being produced by Associated Electrical Industries, London.

The valve employs a generously rated, directly heated thoriated tungsten cathode. Its linear grid characteristic makes it suitable for use in single sideband



The New Solartron Millivoltmeter.

transmitters, the large anode will withstand a 100 per cent overload for up to 60 seconds without damage to the valve. A special feature of the valve is that the exhaust tube is completely protected from accidental damage or breakage.

The valve is of the plug-in vertically mounted type, using a conventional valve holder.

* * *

Micro-Switch in Printed Circuit

A new method of including micro-switches in printed circuits has been developed by Burgess Products Co. Ltd., Gateshead, England.

Snap action make-and-break micro switches are used for the first time, the company believe, as an integral part of a printed circuit board. The technique is ideally suited for printed circuits needing a multiplicity of switches, particularly those with key board operation.

The metal components of the micro-switches are mounted on the opposite side of the printed circuit board to the copper laminate, to which electrical connection is made by brass mounting rivets. The rivets are made to bite deep into the laminate so that good conductivity is assured without solder.

ADVANCED RADAR FOR DUNEDIN AIRPORT

(continued from page 5)

echoes can still be seen on the screen, even when the aircraft are passing through areas of heavy precipitation.

A small amount of energy is scattered back from turbulent storms. This is just an aircraft round the centre of turbulence sufficient to show up on the radar screen, enabling the area controller to reroute.

There are other important advantages of 50 cms. For example this frequency provides a longer range for a given power; and it permits the use of crystal control, making possible a fully coherent Moving Target Indicator.

Today, at many busy airports and government research airfields on four continents, Marconi 50 cm radars are keeping a watchful eye day and night, in fair weather and foul, on the traffic that crosses the skies.

The first Marconi Surveillance Radar installation to be commissioned in New Zealand was that for Wellington airport. The demands made on this installation are probably the toughest ever. Formidable engineering problems were involved in the installation of this radar because of the hilly nature of the terrain, the pre-

valence of high winds, and the possibility of earth tremors in the area.

Work is now completed on the Mombasa Surveillance Radar System where a Marconi S264 is being installed by the Marconi/A.W.A. Radar Engineering Group. The huge aerial is 52 feet long, 16 feet high, and weighs 7½ tons. It is designed to rotate in winds of 90 knots and to survive a 120 knot gale. This rotating giant has already become a familiar sight at Dunedin Airport.

There are four basic sections to this Surveillance Radar System; the Aerial Head (the rotating element); the Transmitter and Receiver equipment (located in a building sunk into the ground adjoining the aerial); the Display Consoles (situated in the control tower); and the Radar Distribution Unit also in the Control Tower building. The transmitting equipment is unattended and remotely controlled.

The transmitter peak power is 50 Kw with pulse length 2 or 4 micro-seconds and a PRF of 500 to 800 p.p.s. The horizontal beam width is 2.1° and the vertical aperture makes possible a solid cover of aircraft up to 40,000 feet at ranges approaching 100 miles.

EMITAPE

THE TAPE BY WHICH ALL OTHERS ARE JUDGED

Emitape is the universal Magnetic Recording tape suitable for all types of tape recorders whether they are single or twin track machines.

THREE DIFFERENT GRADES

Emitape "88" — General Purpose

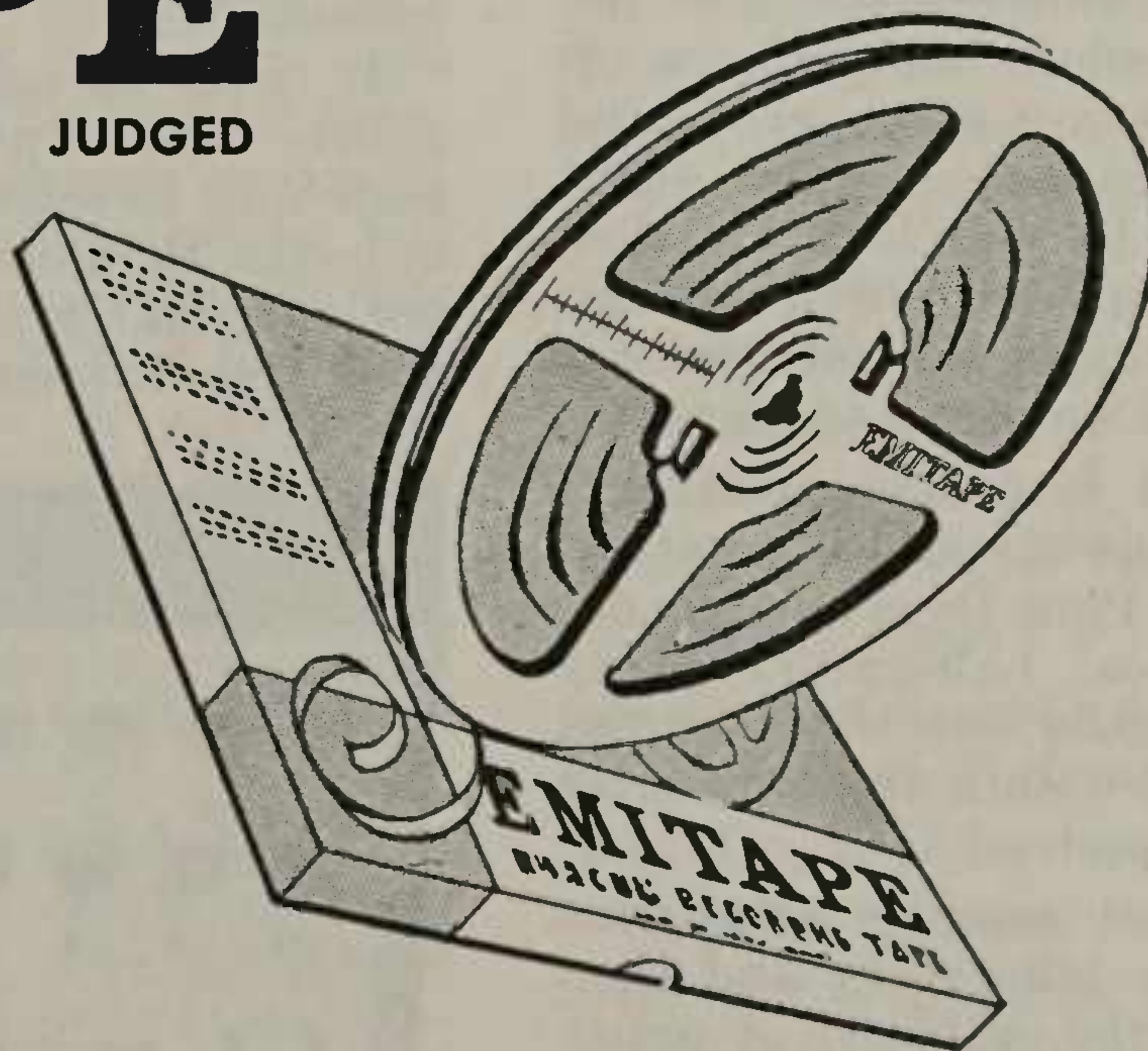
Emitape "99" — Long Play

Emitape "77" — Professional Grade

Full range of Emitape accessories, including jointing compound and empty plastic spools also available.

Suitable for all tape recorders.

Available wholesale in New Zealand only from —



HIS MASTER'S VOICE (N.Z.) Ltd.

Head Office : P.O. Box 296, WELLINGTON.

QUICKER COLOUR MATCHES

Reproduced by arrangement Du Pont magazine—Published by E. J. Du Pont de Nemours & Co. Inc., Wilmington, Delaware.

a new computer should speed shade-matching for dye and paint manufacturers

The business of a COMIC—written with capital letters—is serious indeed. It's an electronic instrument designed to speed the matching of colours by determining rapidly and accurately the combination of dyes needed to produce a given shade.

Colourant Mixture Computer is its full name and it was developed by Davidson and Hemmendinger, Easton, Pennsylvania. About 50 are in use in such places as textile mills and paint and plastic resins plants.

Du Pont entered the dye business during World War I, when supplies of European colourants were cut off. Now, as then, the matching of shades for customers is a large part of dye service work. A highly trained shade matcher looks at a colour sample — a bit of cloth, a scrap of paper — and makes an educated guess about how it can be matched. He then mixes several dyes in a beaker, colours a sample and compares it with the one he wants to match.

So expert can shade matchers become at this dye-and-try method that the Du Pont Dyes and Chemicals Technical Laboratory today generally mails out the required dye formula within 48 hours after a query is received.

But mailed samples take time to reach the laboratory and then get back to the customer. A paper mill, say, that needs to know a dye formula to bid for an order wants answers fast. Moreover, there always are stubborn samples that might require several days or a week to duplicate. Here, especially, is where the COMIC fits in.

It usually can find suitable formulae in one-half to one-quarter as many trials as purely visual methods commonly require. Dye

specialists emphasize, however, that it is not a cure-all for shade matching problems. Certain dyes that fluoresce, for example, present particular difficulties.

Colour can be analyzed by an instrument called a spectrophotometer, which measures the fraction of light reflected at each wave length of the visible spectrum. Each shade, then, has its peculiar profile, called a "spectrophotometric curve".

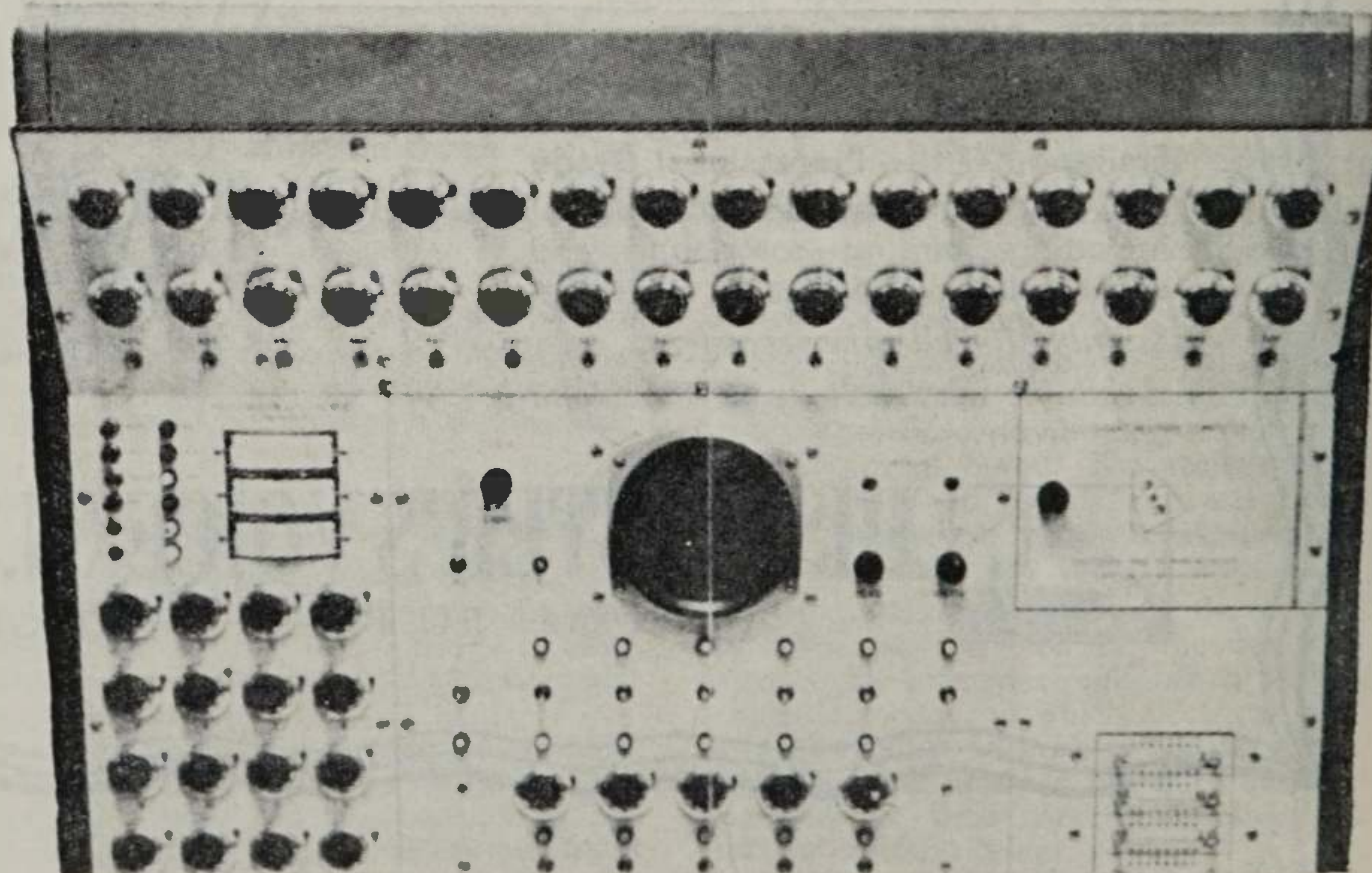
Before it can function, the COMIC needs values derived from these curves, not only for the shade it seeks to match but also for several dyes that, it seems likely, would combine to produce it. This information is fed through "plug-in" boxes, one for each colourant.

It takes an operator with both ability and experience at shade matching to select the right plug-in boxes. He must choose dyes that not only match the shade but also meet the customer's requirements

in such properties as bleed- and light-fastness and that are in an acceptable price range.

When measured values for both the sample and the trial match are placed in the computer, their differences appear as a curve of dots on the oscilloscope. The operator then adjusts concentration dials to make his trial formula match the straight zero line. If no combination of dial settings will do this, he switches to other dyes by replacing one or more of his plug-in boxes and tries again. His goal is to achieve a match that is spectrophotometric — that is, one that looks the same as the sample under all lights.

This COMIC model is equipped with a Tristimulus Difference Computer (TDC) for use when such a perfect match is impossible. With it, an operator can quickly obtain the best metameric match — a shade that looks the same as the sample in some lights although not in all.



Generally, Tech Lab makes a test dyeing to compare the COMIC'S first approximation with the given sample. In some cases, the match is acceptable; more often, however, adjustments are necessary. Experience to date suggests that most COMIC matches are successful on the second or third try.

Precious time is lost — and the value of the COMIC lessened — if Tech Lab must prepare the spectrophotometric profile of the sample it seeks to match. Ideally, a customer would plot this curve on his own equipment — a recording spectrophotometer or equivalent instrument equipped to make reflectance measurements. He could then relay the spectrophotometric points to the lab and quickly get back the formula for a match.

Such an ideal system is on the horizon. Dye specialists want to be certain first, though, that they have as thorough an understanding as possible of how the COMIC can perform. Applications that will develop with experience, they say, will make it an even more valuable tool in handling colour problems.

BACK NUMBERS OF RADIO & ELECTRICAL REVIEW

Periodically inquiries are received for back numbers of "Radio & Electrical". A few copies of the issues since the publication changed hands (i.e. April 1961) are available from the publishers, The Magazine Press Ltd., Lumley House, 10 High St., Auckland. (P.O. Box 1365).

Correction:

In the circuit on page 14, of the June issue, in the Article entitled, "A Single Sideband Linear Amplifier," the junction of RL and the condenser should be earthed. Also the value of the condenser should be .01 mfd. The inductance of the R.F. choke associated with these two components should be 2.5 mh. This can be an Inductance Specialists No. 33 choke whilst the 1.0 mH choke in the anode circuit can be a No. 23 choke made by the same manufacturer. In the third column in page 18, third line from top, tap 2 x 6 should read 2 and 6.

THE CASE FOR DIGITAL INSTRUMENTATION

— continued from last month

Some of the Advantages and Disadvantages of Digital Instruments

The growing popularity of such instruments indicates that they offer numerous benefits over moving coil pointer meters. But they do have some drawbacks.

A summary of the advantages would include the following:

Speed: 20 or more readings per minute can be made easily with a digital instrument, because of the fast response time and displays of numbers which can be read at a glance in bright sunlight or total darkness from across a room. There is very little chance of misinterpretation.

Completely Automatic: There are generally no knobs to use to change ranges, or to rebalance. In most models placement of the decimal point and indication of the proper polarity, where required, is automatic.

Ease of Operation: Operation of most digital instruments is so simple that it can be taught to semi-skilled personnel in a short time.

Accuracy: This depends on design features and requirements but typical Digital Voltmeters provide accuracy of $\pm 0.01\%$ of full scale for each range — for example in a four digit instrument, resolution is 1 part in 10,000.

Ruggedness: Generally these instruments are less temperamental than the normal moving coil instruments they replace. They will retain their full accuracy under such adverse conditions as tilting, motion or vibration, whilst spirit levels and temperature compensations are not required.

The disadvantages of digital voltmeters can be summarized as follows:

Initial Cost: The initial cost of most digital instruments is at present considerably higher than the conventional indicating instruments they replace.

Maintenance: These instruments are more complex than usual in-

dicating instruments and therefore may require more regular servicing under maintenance. This is not necessarily a disadvantage, in the respect that considerable time is saved when the instrument is used.

Grounding, Shielding and Filtering: Adequate grounding and shielding must be used to avoid problems caused by spurious voltages. Because of the high speed of operation, input signals which are associated with other intermittent and unneeded signals can often be measured however. Extraneous consistent noise cannot be tolerated and this must be filtered out for successful measurements.

One point which must obviously crop up is the accuracy of digital equipment. Some of the questions have been solved by one or other manufacturer. Short term accuracy can be defined in a number of ways. An error of 1 digit, often called the 'least count' or '1 count' means an error, the size of the smallest increment displayable by the instrument.

An error which is detailed as "so many per cent of reading" indicates that the error has an absolute value governed by the value of the measurement, whereas an error described as "so many per cent of full scale" is usually indicated for each range and the error is generally of fixed amplitude over the range.

Another factor which must arise is the possible shift in the value of the reference source or sources. This is often described as long term drift. Provided that compensation is easily made and adjustment can be carried out, this is not a problem provided there is a standard reference of higher stability available or some laboratory or industry is able to effect such adjustments.

Overseas Notebook . . .

Radio Telephone Assistance

Twelve vehicles, each fitted with a radio telephone, will patrol a stretch of more than 760 miles across the Nullarbor Plain to assist motorists on their way to and from the Empire and Commonwealth Games in Perth next month. The patrol, which will be in five stages, will operate along the Eyre Highway between Ceduna in South Australia and Norseman in Western Australia. Each vehicle has a "Seafarer 20" radio telephone, designed, manufactured and installed by Amalgamated Wireless (Australasia) Ltd. Using this equipment, the patrols will maintain contact with the Royal Flying Doctor Service, (Kalgoorlie), the Flying Medical Service, (Ceduna), units of the South Australian Police and with each other. In addition, two supervisor's vehicles, similarly equipped will take part in the operation.

* * *

Compact New Photo-Electric Control:

A compact, low-cost photo-electric control with applications in manufacturing processes, materials handling in general printing, packaging and bottling, for door and gate control, and in security systems at premises, has been introduced by a U.K. firm. It is intended for application to machines of various kinds as an alternative to electro-mechanical or larger photo-electric devices.

The new detector will operate off ordinary indoor lighting, but a special light source can be supplied if desired.

With the lighting of the level mentioned, the detector will monitor 3-4 interruptions of the light beam per second. With more light, as would be provided by a special light source, maximum speed of operation, 6 cycles/second, is obtainable.

Machine Automatic Division of Elcontrol Ltd., Wilbury Way, Hitchin, Hertfordshire, England.

* * *

Marconi Cameras Used for First Live Colour TV Sent via Telstar:

During the 587th orbit of the Telstar satellite, another milestone in the history of telecommunication was passed. Marconi colour television cameras at Cul-

A private automatic branch telephone exchange and a centralised automatic dictation system, which work in conjunction with each other, have been installed by Associated Electrical Industries Ltd. and Assmann Dictating Systems Ltd., in a new annexe to London County Council Headquarters. The system, which has just come into full operation, is one of the first to work on PABX dictation—that is through an internal telephone exchange which is also connected to the G.P.O. telephone system.



This picture shows the audio typing section supervisor noting down, on a "cueing" slip, instructions relating to a particular dictation.

drose, almost within shouting distance of the birthplace of transatlantic telecommunications at Poldhu, sent the first live colour television signals across the Atlantic to America.

This transmission was more than a technical experiment, forming a highlight of the American Medical Association's 12th Annual Congress on Dermatology, held at the Shoreham Hotel in Washington, D.C. Shortly after 3.45 p.m. B.S.T. on 12 September, five leading experts on dermatology in this country demonstrated chronic skin conditions in four-patients at the Royal Naval Air Station, at Culdrose in Cornwall. The demonstration was televised by a mobile colour television unit.

In the Shoreham Hotel, Washington, D.C., an audience of 3,000 doctors from 50 countries saw the demonstration projected on to a 9ft. x 12ft. screen.

Reports from the American end of the space link at Andover state that an excellent colour picture was received. In Washington, the demonstration was received with acclaim and although the colour saturation deteriorated at times the picture definition was good. One eye witness stated that the general colour seen in Washington approached that of a medical atlas.

New Wireless Equipment for Light Planes and Gliders:

A new transmitter-receiver to give economical ground-to-air communications for light planes and gliders was shown at the Farnborough Air Show. It has 11 channel selections among the 400 channels available in the 116-136 Mc/s VHF at 50 Kc/s spacings.

Its main economy advantage is lower power drainage resulting from part-transistorisation; it is also suitable for use with stations still equipped with transmitters employing 100 Kc/s-spaced channels.

The "transceiver" consists of two units — transmitter-receiver and modulator-power supply. As the main transmitter-receiver unit is intended for mounting on the instrument panel, its face area has been limited so that it should blend with modern panel presentations. The modulator-power supply unit can be mounted up to 15-ft. (4.5m) from the main unit in several alternative positions.

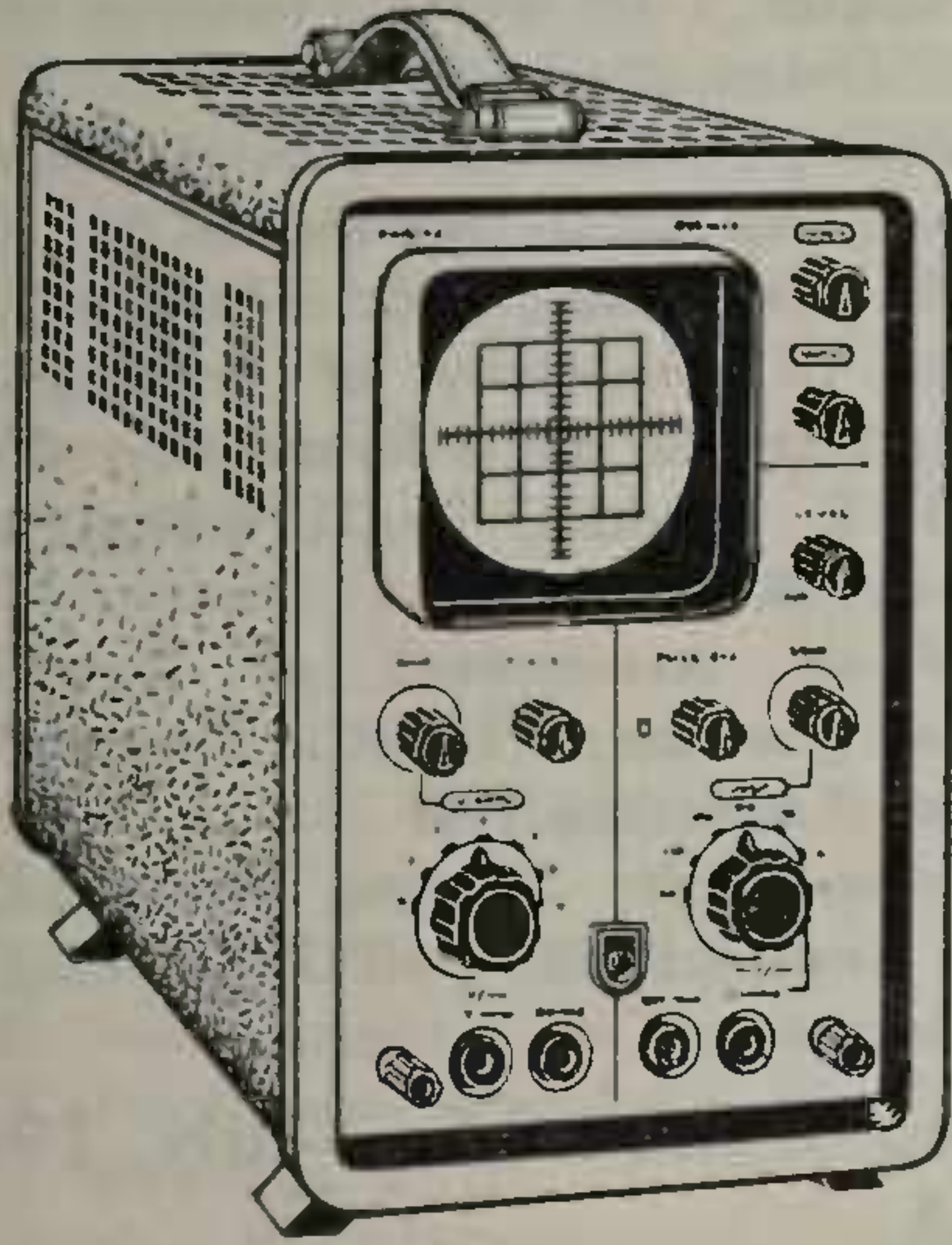
The set is crystal-controlled on both "transmit" and "receive" with the crystals being easily changed. Input voltage is either 12v or 24v according to the setting of a subminiature multi-way plug on the power unit.

Burndep Ltd., West Street, Erith, Kent.



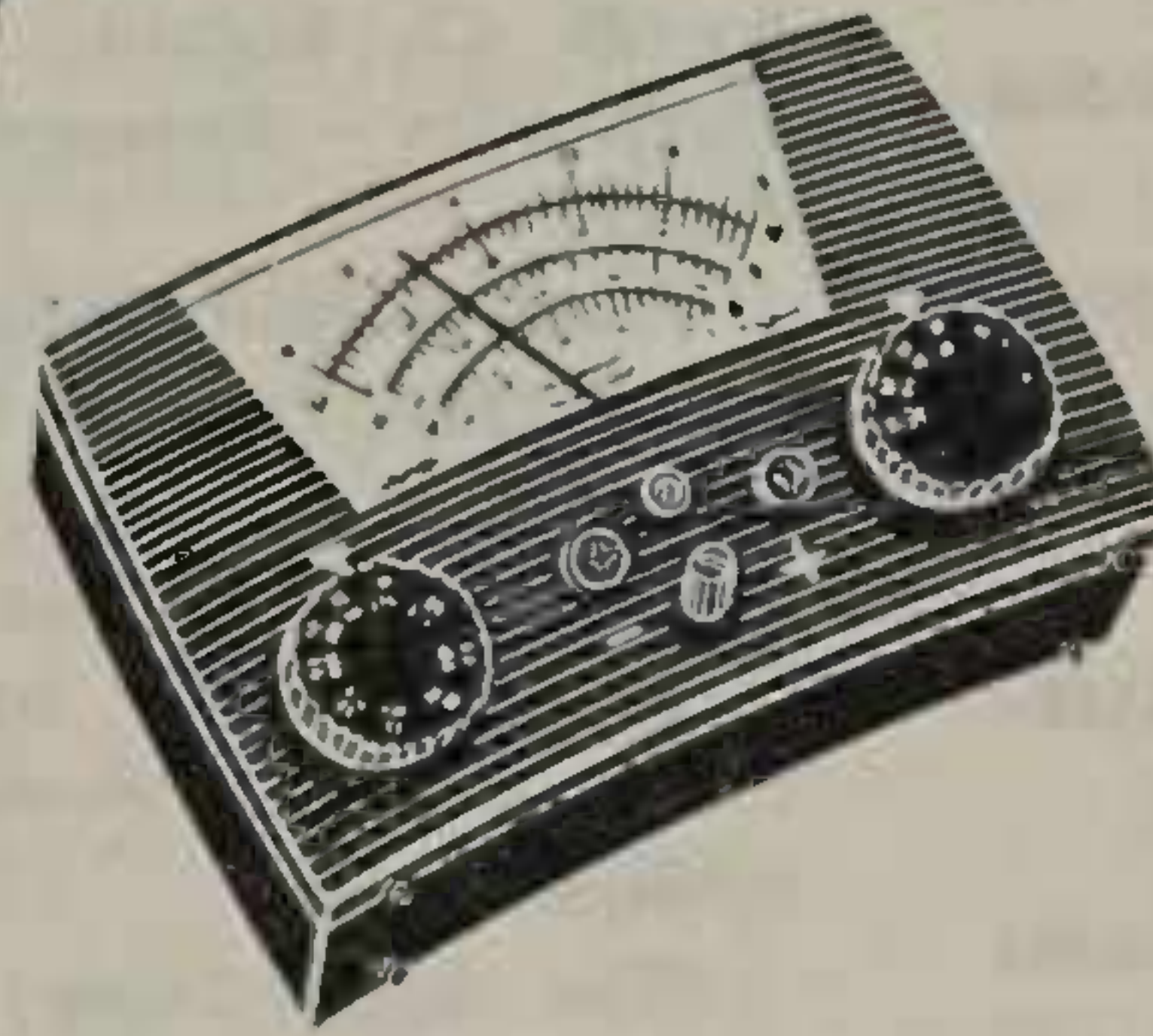
TV SERVICE INSTRUMENTS

the right tools for the job!



OSCILLOSCOPE GM5600:

An outstanding oscilloscope for TV service work. With a frequency range from d.c. to 5 Mc/s it gives accurate display of band pass curves and pulse shapes.



MULTIMETER P.817.00:

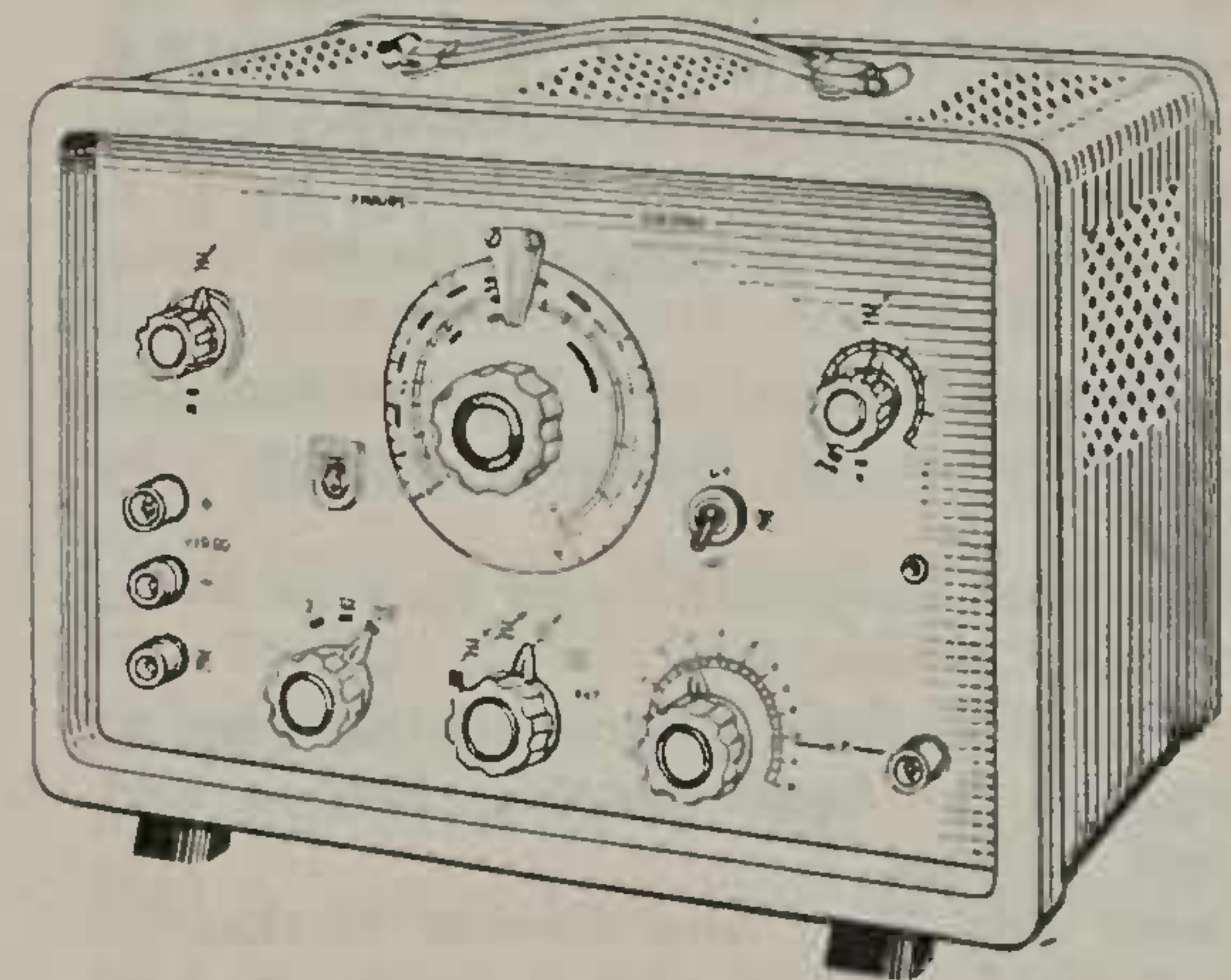
An excellent 28 range test meter of robust construction yet with a sensitivity of 40,000 ohms/volt. Voltages a.c. and d.c., currents a.c. and d.c. and resistances can all be measured.

PRICES:

GM5600	£82.18.0
P.817.00	£21. 0.0
GM2892	£82. 5.0
GM2877	£92. 6.0

PATTERN GENERATOR GM2892:

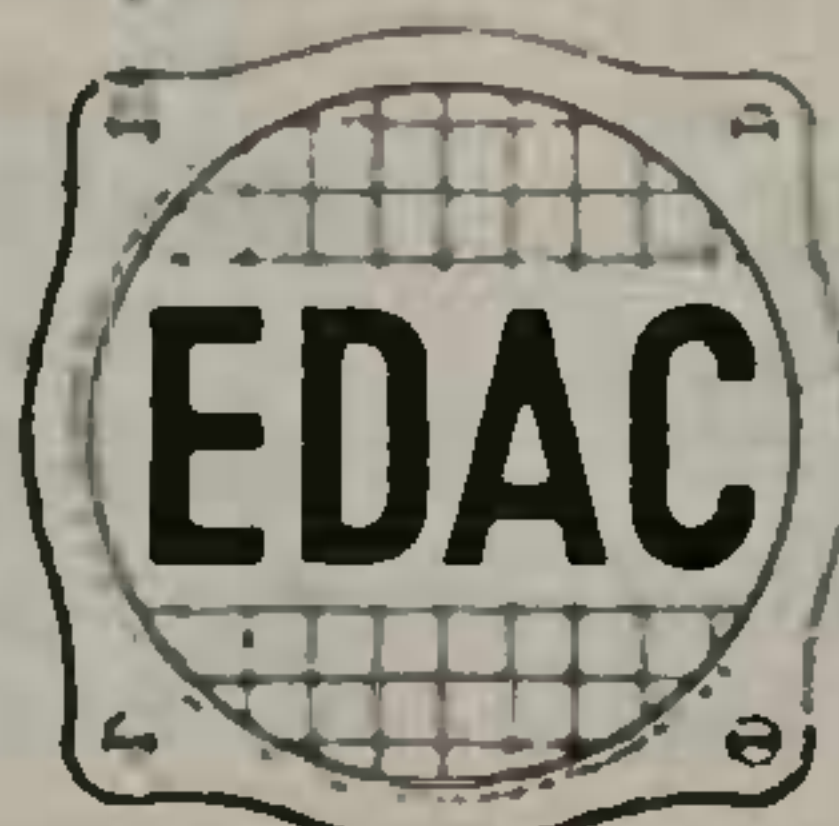
A "must" for TV servicing outside telecasting hours, this generator produces a pattern of inter-laced vertical and horizontal bars whose spacing can be varied. All channels from 1 to 5 are included.



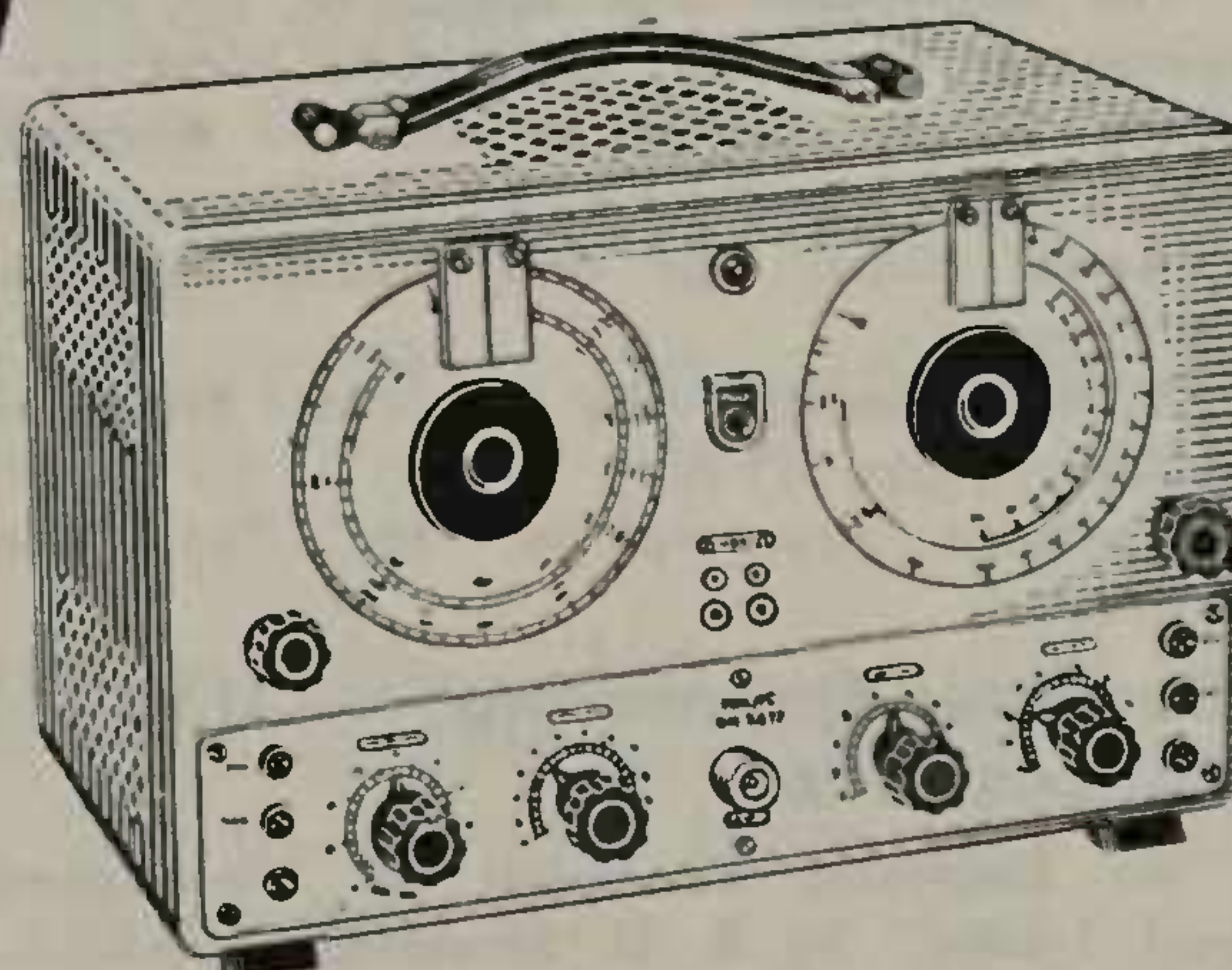
ALSO AVAILABLE:

Universal Bridge GM4144	£37.16.0
V.T.V.M. GM6000	£38.10.0
Signal Tracer GM7600	£38.3.0
H.F. Oscilloscope GM5601	£137.0.0
H.F. Oscilloscope GM5602	£261.0.0

Full Technical Information on all these instruments is available upon request from:



ELECTRONIC DEVELOPMENT AND APPLICATIONS CO. LTD.



WOBBULATOR GM2877:

This instrument enables the response curves of TV receivers to be displayed on an oscilloscope and provides the fastest method of aligning the I.F. strips.

TECHNICAL JOURNALS — Contents List

"Radio-Television and Hobbies" — Australia — August 1962

"T.V." Remote Control Part 3—A Novel Contrast Control Circuit," by Philip Watson.

"A Magnetic Pickup Preamp with N.P.N. Transistors," by Jamieson Rowe.

"Transistor Converter Design—Part 3," by Jamieson Rowe.

"An R.F. Preamp Stage for H.F. Receivers," by Keith Jeffcoat.

"A Transistorised Crystal Microphone 'Transformer'."

"A Two Unit Monitor-Intercom System," by Ian Pogson.

"The Playmaster 101," by John Davidson and Neville Williams.

"Radiotronics" — Australia — Australia — August 1962

"The Economy Five," a Low Cost Mains Operated Transistorised Stereo.

"Nuvisor Two-metre Transmitter," by R. M. Mendelson, W20KO.

"A Reassessment of Stereo," by B. J. Simpson.

Wireless World—July, 1962—U.K.

"The 'Stenode'—An Old Principle Reviewed," by L. A. Moxon, B.Sc., A.M.I.E.E.

"Bootstrap Follower Characteristics"—Frequency Response and D.C. Stability, by T. K. Hemingway, B.Sc., of English Electric Aviation Ltd.

"Transistor Inverters," by Thomas Roddam.

"Fundamentals of Feedback Design," by G. Edwin.

"Differential Equations—And How to Avoid Them," by 'Cathode Ray.'

"Plotting Transistor Characteristics," by A. T. Ferguson—of South Shields, Marine and Technical College.

"Nands and Nors and Sheffer Strokes"—Static Switching Circuits, by J. F. Young, C.G.I.A., A.M.I.E.E., A.M. Brit. I.R.E.

"Wireless World" — U.K. — August 1962

"The Classification and Retrieval of Technical Information," by A. E. Cawtell.

"Complementary Multivibrator" — High Mark Space Ratios with a Single Timing Circuit, by J. C. Rudge, B.Sc. of E.M.I. Electronics.

"Electroluminescent Devices," by L. H. Brace, of Static Devices Co., Texas, U.S.A.

"Filternics," by T. Roddam—Active Filters with Negative Impedance Converters.

"Fundamentals of Feedback Design," Part 8, by G. Edwin.

"Excitations and Responses," by Cathode Ray.

"Portable Test Oscillator," by Sqn. Ldr. D. R. Bowman.

"The Bowcherot Effect," by J. F. Young, C.G.I.A., A.M.I.E.E., A.M. Brit. I.R.E.

"British Communications and Electronics" — U.K. — August 1962

"The Post Office Satellite System Ground Station at Goonhilly Downs," by W. J. Bray, M.Sc. (Eng.), M.I.E.E., and F. J. D. Taylor, O.B.E., B.Sc., M.I.E.E., Staff Engineers G.P.O. London.

"The Andover Ground Station for Project Telstar."

"Project Relay," by R. E. Warren and J.

R. Burke—both of the N.A.S.A.

"The 85 Ft. Steerable Dish Aerial at Goonhilly Downs," by H. C. Husband, B.Eng., M.I.C.E., M.I.Mech.E., of Husband & Co., Sheffield.

"The 1700 Mc/s Transmitter," by E. A. Mattue, A.I.E.E., and D. L. Cooper-Jones, B.Sc. (Eng.), A.M.I.E.E., of S. & C. Ltd., London.

"The Five-Kilowatt Travelling-Wave Tube," by M. O. Bryant, B.Sc., Ph. D., of Services Electronics Research Laboratory, Harlow, Essex.

"The Output Stage for the Ground Transmitter for Project Telstar," by A. R. Petheram, B.Sc., of A.E.I. Ltd.

"Plymouth to Goonhilly"—Linked by Surface Microwave, by J. R. Brinkley, M.Brit. I.R.E., of Pye Telecommunications Ltd., Cambridge.

"The Solid State Maser in Satellite Communication Systems," by J. C. Walling, B.Sc., Ph.D., A.Inst.P., and F. W. Smith, B.Sc., both of Mullard Research Laboratories, Salfords, Surrey.

"A Woven Memory Matrix with Cylindrical Electroplated Film Elements," by D. F. A. MacLachlan, B.Sc., A.R.C.S., of G. V. Planer Ltd.

The Short Wave Magazine — July, 1962 — U.K.

"Two-Metre Sideband with the K.W. 'Viceroy,' Using the Transverter Principle.

"Aerial Tuning for Top Band" (160 metres).

"Modern Receiver for the Amateur Bands," Part 2, by J. D. Heys (G3BDQ).

"Pre-selection on Twenty Metres."

"Field Strength Readings and SWR Checks," by J. K. Fidler (G30YP).

"Capacity Measuring Box," by F. G. Rayer (G30GR).

"Building a Lattice Mast—and Raising It!" by N. E. Read (G6US).

"The Short Wave Magazine" — U.K. August 1962

"An Effective Noise Silencer Using Separate Noise Receiver," by G. T. Sassoon, G3JZK.

"The Minitopper"—A Miniature 160-metre Transmitter for Bench or Mobile Working—by W. Farrar, G3ESP/M and J. Arundel, G3HCX.

"Aerial Hints, Tips and Ideas," by The Old Timer.

"R.T.T.Y. Topics," by W. M. Brennan, G3CQE.

"Nuvisor Pre-Amplifier for Ten and Fifteen."

"Electronic Engineering" — U.K. — August 1962

"An Electronic Controller for High-Speed Road Traffic," by B. D. Simmons, A.M.I.E.E., A.M. Brit. I.R.E., and R. J. Todd, both of A.E.I.

"Maximum Pulse-Packing Densities on Magnetic Tape," by G. C. Zimon, M.A., A.M.I.E.E., A.Inst.P. of Ampex, Gt. Britain Ltd.

"Transistor Power Supplies with Limited Overload Current," by F. J. U. Ritson and R. C. Foss, both of University of Durham.

"An Admittance Display System," by A. B. Shone, B.Eng., A.M.I.E.E.

"A Rapid Response Ratemeter with Protection Against Random Trigger," by J. B. Cornwall, Grad.I.E.E., and A. W. Melville, A.M.I.E.E., both of D.S.I.R., New Zealand.

"The Use of Direct Coupled Logic in the Design of an Arithmetic Unit," by P. L. Owen, B.A., T. R. H. Sizer, A.M.I.E.E., and M. F. Partridge, M.A.

"Amplitude and Phase Measurement in the V.H.F. Region," by MacA. Thomas, B.E., Eng. Sc., of University of Melbourne.

"Binary Multiplication and Division Using Ferrite Cores," by D. J. Morris, M.Sc., Dip. Eng., and W. Alexander, M.Sc. (Eng.), Ph.D., M.I.E.E., both of University of Nottingham.

"The Tunnel Diode as a Relaxation Oscillator," by J. E. Houldin, Ph.D., B.Eng., and R. A. Whitney, B.Sc.

"A Simplified Assessment of Transistor Amplifier Performance," by C. Yorker, of English Electric Aviation Ltd.

"High Current Pulse Shaping Using S.C.R. and Delay Lines," by E. Dell'Oro, Ph.D., of Transistor Electronic Ltd.

Proceeding of the I.R.E.—July, 1962 —U.S.A.

"The Fundamental Noise Limit of Linear Amplifiers," by H. Heffner, Fellow, I.R.E., of Stanford Electronic Laboratories, Stanford University.

"Negative L. & C. in Solid-State Masers," by R. L. Kyhl, M.I.R.E., R. A. McFarlane, M.I.R.E., and M. Strandberg, Fellow I.R.E.

"Introduction to the Theory of V.L.F. Propagation," by J. R. Wait, Fellow I.R.E., of the National Bureau of Standards.

"Composite Characteristics of Negative Resistance Devices and Their Application in Digital Circuits," by C. A. Renton, M.I.R.E., and B. Rabinovici, Senior Member I.R.E. of R.C.A. Surface Communications System Laboratory.

"Phase-Stable Oscillators for Space Communications"—with reference to Phase Noise, the Spectrum, the Short-term Stability and the Q of the Oscillator, by L. R. Malling, M.I.R.E., of the Jet Propulsion Laboratory, California Institute of Technology.

"Harmonic Generation, Rectification and Lifetime Evaluation with the Step Recovery Diode," by S. M. Krakauer, M.I.R.E.

"Frequency, Sounding Techniques for H.F. Communications Over Auroral Zone Paths," by G. W. Jull, D. J. Doyle, G. W. Irvine, M.I.R.E., and J. P. Murray, of Defence Research Communications Establishment, Ottawa.

"The Proceedings of the I.R.E. — U.S.A. — August 1962

"Radio Telegraphy," by Senatore Guglielmo Marconi, by G.C.V.O., D.Sc., LL.D. — a Reprint from Prov.I.R.E., August 1922.

"Group Theory and the Energy Band Structure of Semiconductors," by Allen Nussbaum, Assoc. I.R.E.

"Injection Currents in Insulators," by Murray A. Lampert, of R.C.A. Laboratories.

"Theoretical Considerations on Millimeter Wave Generation by Optical Frequency Mixing," by J. R. Fontana, M.I.R.E., and R. H. Pantell, M.I.R.E.

"Electron Guns for Forming Solid Beams of High Perveance and High Convergence," by R. D. Frost, M.I.R.E., O. T. Purl, Senior

Member I.R.E., and H. R. Johnson, Fellow I.R.E.

"Thermal Noise in Field-Effect Transistors," by A. Van Der Ziel, Fellow I.R.E.

"Higher-Order Temperature Coefficients of the Elastic Stiffnesses and Compliances of Alpha-Quartz," by R. Bechmann, Fellow I.R.E., A. D. Ballato, M.I.R.E., and T. J. Lukaszek, M.I.R.E.

"Q.S.T." — U.S.A. — August 1962

"Complete Transmitter from an S.B.10 Adapter," by K. L. Mengle, W3CT.

"Handy 12 Volt D.C. to 110 Volt A.C. Inverter," by H. M. Neber, W9YVZ.

"Three Band Crystal-Controlled Converter," by L. G. McCoy, W1ICP, Tech. Assistant Q.S.T.

"Four Watts for Six Metres," by W. W. Deane, W6RET.

"Retrievable Antennas," by T. G. Griner, W3DEA.

"Some Tips on Neutralising R.F. Stages," by E. P. Tilton, W1HDQ, V.H.F. Editor Q.S.T.

"A Novel Key for Use with Electronic Keyers," by R. M. Brouger, W5HPB, of Shell Development Co., Texas.

"A Two-Meter Transistor Preamplifier," by J. A. Mayhew, J.

"A 'Solid' Look at 'Little Oskey,'" by C. D. Warner, WV2ROA.

Radio, Television and Hobbies — July 1962 — Australia

"TV Remote Control"—Part 2, by Alan Nutt.

"Transistor Converter Design," Part 2, by Jamieson Rowe.

"A Transistor-Converter Powered Geiger Counter."

"A Simple One Transistor Set," by John Davidson.

"Economy Receiver Design for the Amateur Bands," by Keith Jeffcoat.

Electronic Technology — U.K. — August 1962

"Frequency Modulation of an R.C. Oscillator," by J. B. Izatt B.B.C.).

Electrical Review — U.K. — 13th July 1962

"Electronic Methods of Motor Control," by L. Babad (A.E.I. Ltd.).

Electrical Review — U.K. — 20th July 1962

"Transistor Instrumentation in Rockets," by G. G. Haigh (Royal Aircraft Establishment).

Journal of the British Institution of Radio Engineers — July 1962

"Television Line Time Base Output Stages Using Transistors," by K. E. Martin (Mullard).

"Propagation Influences in Microwave Link Operation," by M. W. Gough (Marconi W.T. Co. Ltd.).

"Some Recent Developments in Marine Navigational Aids," by J. W. Nichols (formerly Trinity House), and A. C. MacKellar (Trinity House).

Journal of the Institution of Electrical Engineers — U.K. — August 1962

"Distortion Problems in F.M. Multichannel Communication," by R. G. Medhurst (G.E.C. Ltd.).

A GRID-DIP OSCILLATOR WITH A MAGIC-EYE INDICATOR

(continued from page 18)

The materials can be joined with P.K. screws or pop rivets.

The tuning condenser and coil socket should be mounted as close together as it is possible to manage, with regard to soldering, etc. Similarly the oscillator tube should be mounted as close to the condenser gang as it is possible, to ensure short leads to the tuned circuit. The socket for the EM84 should be oriented so that the luminous band is uppermost, lying close to the top plate. The cable for the power supply can be any light 3 core cable of sufficient insulation rating and current carrying ability.

The box holding the unit can be dressed up by giving it a coat of a suitable enamel, applied from an aerosol type spray. If well constructed and carefully calibrated this unit will give many years of accurate and faithful service.

Range 1. 1.5 — 3.1 mc/s 215 uH
180 turns No. 36 SWG Enamel or close wound in 2 layers.

Range 2. 3.0 — 6.2 mc/s 50 uH
90 turns No. 36 SWG Enamel or close wound.

Range 3. 6.0 — 12.5 mc/s 12.5 uH
40 turns No. 30 SWG Enamel close wound.

Range 4. 12.0 — 23.5 mc/s 3.3 uH
19 turns No. 24 SWG Enamel close wound.

Range 5. 23 — 55 mc/s 0.88 uH
8 turns No. 24 SWG spaced over 1 inch.

Range 6 50 — 110 mc/s 0.24 uH
3 turns No. 24 SWG spaced 3/8 inch.

Range 7 95 — 180 mc/s 0.05 uH
U turn of 18G wire 1½ in. long, 3/8 in. between limbs of U outside pins.

Discard top of plug for this coil.

Note: All the coils which do not fill the coil formers should be wound on the end away from the base plug. Clip off the brass lugs sticking out of the shoulder of the formers with side cutters and file smooth.

LOOKING AT BONDED-SHIELD TV PICTURE TUBES

(continued from page 27)

intermixture cannot be accomplished too far in advance. A special dispenser is used which accurately meters the proper proportions of resin and hardener, and also mixes them intimately just prior to their introduction into the tube assembly. In addition, the resin is maintained at 200°F. This substantially increases the rate of cure, minimizing processing time.

After the resin has been added, the assembly is held in the jig for 20 to 30 minutes. While this is not sufficient time for complete curing, the tube may be removed safely from the jig and handled. In a few hours, the tube itself is cool, but the curing process continues. Approximately 24 hours are required for complete curing.

Aside from maintaining correct temperature and correct proportions of resin and hardener, there are other precautions observed. Poorly mixed materials may result in resin defects. Care must be taken to prevent the inclusion of air bubbles or small foreign particles, since the over-all quality of the screen area must be just as good as that of a non-laminated tube. In addition, special testing and control procedures have been developed to insure that the resin will cure with the proper elongation and tensile-strength characteristics.

In addition to advantages already noted, the tube offers new styling possibilities, to the set manufacturer. Free of the need for adding a separate safety plate, the designer has more flexibility in developing methods of mounting the tube. He can also achieve a further reduction in the depth of the set. Advantages to the viewer in terms of improved picture quality, have already been noted. The bonus to the service technician, in terms of a safer tube to handle in the workshop, completes the circle of benefits. Thus this simple development has something important to offer to all who are concerned with the set, from manufacturer to user.

Record Review

by Professor C. G. F. Simkin

KEY:

- Not recommended because of poor performance or recording.
- ★ Recommended although the performance or recording has faults.
- ★★ Strongly recommended because both performance and recording are excellent.

★★SHOSTAKOVITCH Symphony No. 10 in E minor, Op. 93; played by the Philharmonia Orchestra, conducted by Efram Kurtz. The Record Society, RZ6026.

This is a magnificent disc, offering the best symphony of the greatest living Russian composer, an extremely good orchestral performance and recorded sound of the highest quality.

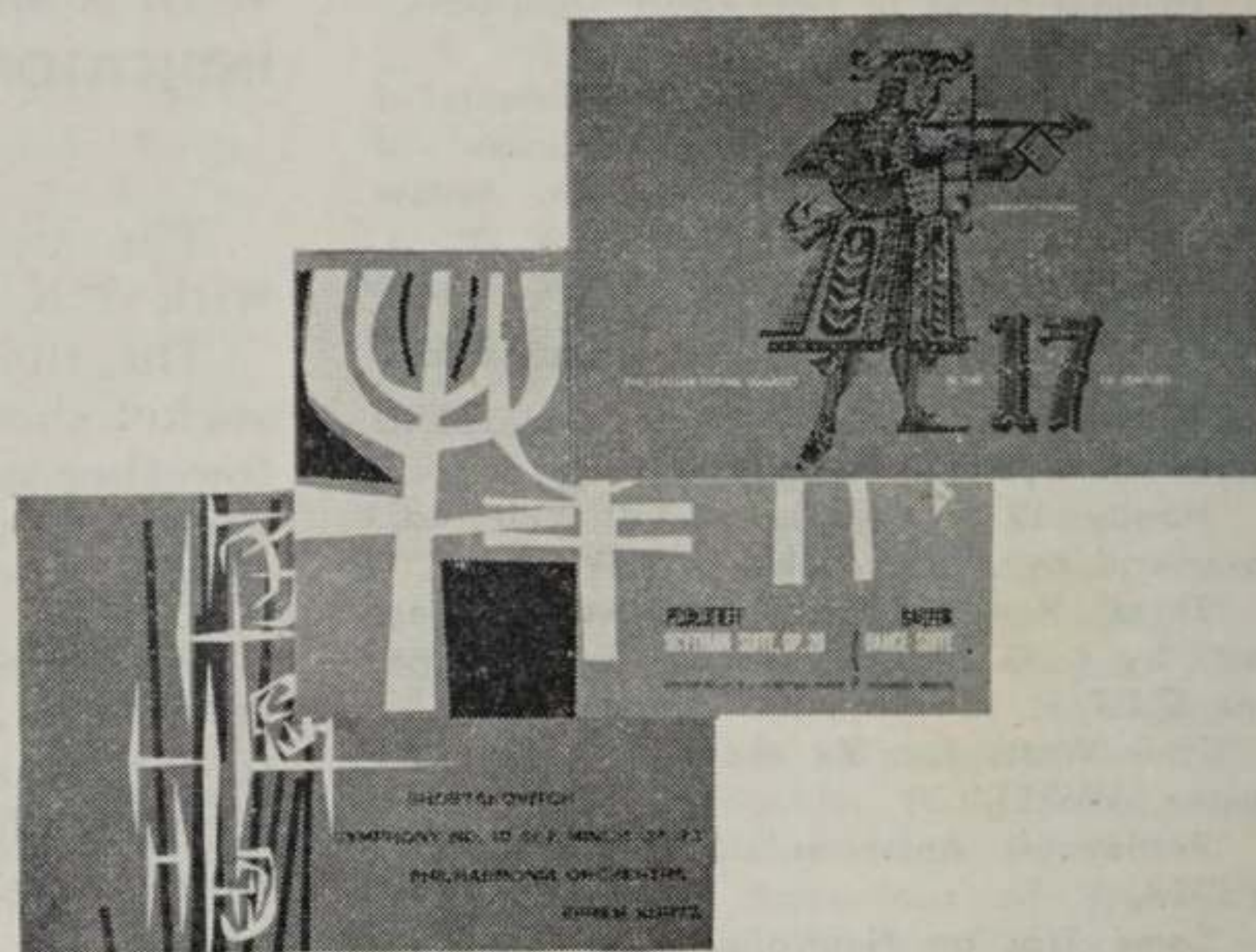
The symphony is a work of force and beauty. True, the first movement, as Shostakovitch confessed, failed to realize his aim of a dramatic and tragic allegro because he was seduced by lyrical themes and slow tempi. But the themes are lyrical, if sombre, and monotony is avoided, in the middle of the movement, by a long climax of loud dissonance and agitated rhythm. The brief, dry, energetic scherzo is also a successful astringent between the long first movement and the resumption of lyrical, if less sombre, themes in the third and fourth movements. These are very appealing. The third has beautiful writing for winds, broken by a brisk jazzy interlude. The fourth movement has fine passages for both winds and strings in attractively contrasting tempi.

The Philharmonia, under Kurtz, gives an inspired interpretation. Its woodwinds, horns and strings all play beautifully, and the full orchestral passages are splendid. The recording makes each solo instrument live, natural and in fine tonal balance with the orchestra, the percussion sounds perfect, and the loud tutti also emerge clear and warm.

* * *

★PROKOFIEFF: Scythian Suite, played by L'Orchestre National de la Radio-diffusion Francaise; and BARTOK: Dance suite, played by the Philharmonia Orchestra; both conducted by Igor Markevitch. The Record Society, RZ6029.

Prokofieff's suite for a projected Diaghilev ballet is barbaric music for a barbaric theme—the trials of a legendary hero of the Scythians with demoniac forces for the Sun God's daughter. Dissonant, polytonic, angular and daringly orchestral, it has a quality of physical exhilaration. But too little of such exhilaration comes through the altogether too refined interpretation of the Orchestre National under Markevitch. The first movement gets inadequate orchestral weight, and the last movement fails to build up the dazzlingly powerful climax the music demands. The quiet second and third movements, however,



are very well done, and the sinister beauty of the "night" section comes across very satisfactorily.

Bartok's suite, the apex of his first period, was contributed to a national festival in 1923. It fully reflects his interest in folk music, not only Hungarian in the second and third dances, but also Arabian in the first and fourth dances. The Philharmonia gives a dazzling performance of this brilliant suite, fully catching the spirit of the music and triumphantly meeting all its demands, whether the heavy, hard texture of the first dance, or the remarkable accumulation, then decumulation of winds in the fourth dance.

The recording is excellent. It convincingly reproduces all instruments from strings to the peculiar percussion devices of Prokofieff's suite, and is remarkably successful in handling the powerful dynamics of Bartok's dances.

* * *

★★THE ITALIAN STRING QUARTET IN THE 17th CENTURY; played by the Quartetto Italiano. The Record Society, RZ6028.

This concert will appeal, not only to those who are interested in the development of chamber music, but to all who find early baroque music attractive—with or without its historical connotations. It ranges from Gabrielli's two songs for four strings composed at the beginning of the century, through a balleto by Marini, a sonata by Neri, a capriccio by Vitali and a suite by Scarlatti, to a quartet sonata by Vivaldi at the end of the century. It shows most strikingly the development of the string quartet from a sonorous polyphonic style, full of the flavour of the organ, to the completely instrumental and plastic style of Vivaldi.

The archaic organ flavour is strong in the three compositions of Gabrielli, Marini and Neri on the first side of the disc, but they have considerable charm and make pleasant listening. Vitali's capriccio is obviously a real step towards an instrumental style, and both energetic and lyrical. Scarlatti's sonata is a fascinating blend of the new, in the allegri, and of the old, in the slow movement. Vivaldi gives the string quartet distinctive quality in a sonata that has all the charm and musical interest to be expected of him.

The Quartetto Italiano play this music understangingly and well, and are splendidly recorded:



We're calling all our friends in the trade to thank them for their custom and co-operation during nineteen sixty two and to wish them all a . . .

MERRY CHRISTMAS and a HAPPY New Year...

from

BEACON RADIO LIMITED

Corner Brown and Fitzroy Sts., Ponsonby, Auckland. P.O. Box 2757. Telephone 16-164 (3 lines).



"the choice of critics"

BULGIN

**PRECISION ELECTRONIC
COMPONENTS OF
THE HIGHEST QUALITY**

The largest and most varied range of electronic components made by any one company in the world

As supplied to—

ADMIRALTY
WAR OFFICE
AIR MINISTRY
HOME OFFICE

MINISTRY OF WORKS
MINISTRY OF AVIATION
MINISTRY OF SUPPLY
RESEARCH ESTABLISHMENTS

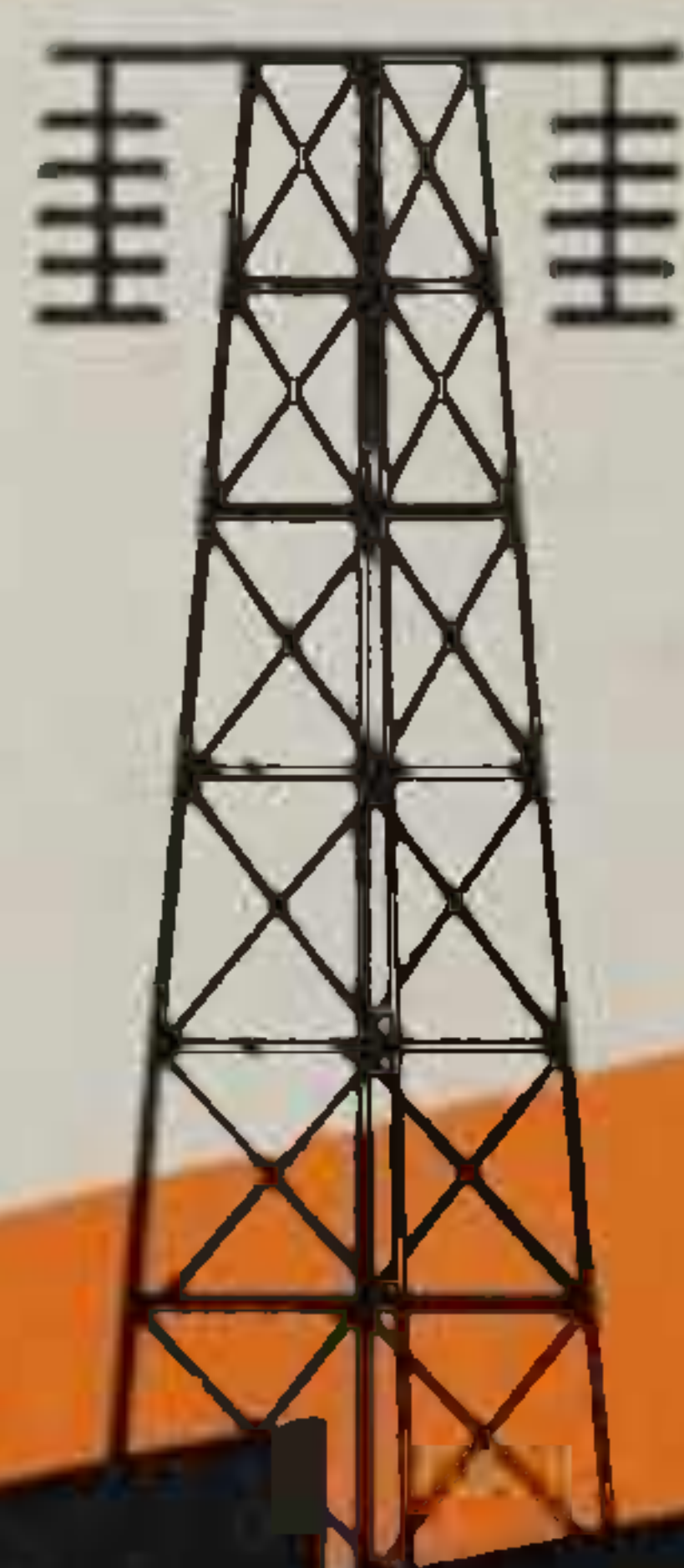
B.B.C.
G.P.O.
I.T.A.
N.P.L.

AND TO LEADING:—AIRCRAFT, AUTOMOBILE, INSTRUMENT,
ELECTRICAL APPLIANCE AND RADIO AND TV MANUFACTURERS

Products of

A. F. BULGIN & CO. LTD.

BYE-PASS ROAD, BARKING, ESSEX, ENGLAND



Represented in New Zealand by

TURNBULL & JONES LTD.

Auckland, Wellington, Christchurch, Dunedin, Whangarei,
Hamilton, Tauranga, Rotorua, Hastings, Palmerston North,
New Plymouth Lower Hutt, Nelson and Invercargill.