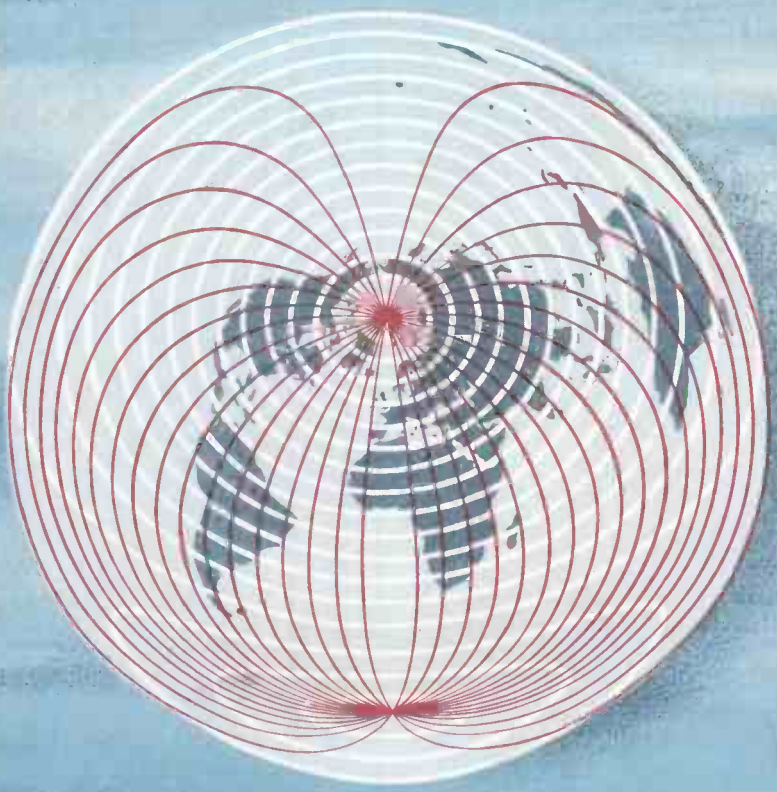
SEPTEMBER 1955 · TWO SHILLINGS

Show Guide

Wireless World

Radio · Electronics · Television



FORTY-FIFTH YEAR OF PUBLICATION

Wireless World

RADIO, ELECTRONICS, TELEVISION

Managing Editor:
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Editor:
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SEPTEMBER 1955

In This Issue

VOLUME 61 NO. 9
PRICE: TWO SHILLINGS

FORTY-FIFTH YEAR OF PUBLICATION

PUBLISHED MONTHLY (4th Tuesday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London." *Annual Subscription:* Home and Overseas, £1 7s. 0d. U.S.A. $4.50. Canada $4.00. BRANCH OFFICES: *Birmingham:* King Edward House, New Street, 2. *Coventry:* 8-10, Corporation Street. *Glasgow:* 26B, Renfield Street, C.2. *Manchester:* 260, Deansgate, 3.

VALVES, TUBES & CIRCUITS

33. MW53-80: A 90° TELEVISION PICTURE TUBE

REASONS FOR 90° SCANNING

The screen size of direct-viewing picture tubes has grown rapidly since the television service was re-started after the war. The 9-inch circular tube of 1946 has been supplanted by progressively larger tubes, the latest of which has a rectangular face with a 21-inch diagonal. If these larger tubes had been merely expanded versions of the 9-inch tube, the problem of cabinet depth, which was present even in 1946, would have been very much aggravated. Tube lengths, however, have been kept within reasonable limits by the introduction of greater scanning angles. If, for a given screen size, the scanning angle of the electron beam is increased, it follows that the gun and the deflection coils will be moved in towards the screen, and the overall length of the tube will be reduced. The effectiveness of this solution to the problem is shown by the fact that a 21-inch tube with the same scanning angle as a 9-inch tube would be half as long again as it actually is. The new Mullard 21-inch, 90° tube type MW53-80, which is shown in the photograph, is, in fact, about three inches shorter than a 70° tube of the same screen size.

CIRCUIT AND TUBE PROBLEMS

Wide angle scanning eases cabinet design, but it brings problems of its own. The most serious is the disproportionate increase in the deflection coil power requirements. If the scanning angle is changed from 70° to 90°, the power which must be supplied by the line timebase output transformer is increased by 50 per cent. A second complication is that the beam at maximum deflection is liable to be intercepted by the envelope of the tube, producing corner cutting of the picture. Thirdly, in tubes with approximately flat faces, the deflected beam strikes the screen at increasingly acute angles, and the spot may be markedly defocused at the edges of the screen.

These difficulties have been countered by improving the efficiency of the scanning system and its associated circuits, so that the increase in power drain is not out of proportion to the gain in useful picture size. A practical line scanning circuit, in which the efficiency is improved by the use of the full h.t. line potential in conjunction with tuning of the leakage inductance of the output transformer, will be described in a further advertisement in this series.

Deflection defocusing and corner cutting are overcome by careful tube and deflection unit design. In particular, the scanning coils and the front of the yoke are shaped to fit the cone of the picture tube—giving optimum sensitivity.

A NEW PICTURE TUBE

The Mullard MW53-80 is an indirectly heated direct-viewing tube with a 90° deflection angle and a rectangular screen with a 21-inch diagonal. The metal-backed grey glass screen, with white fluorescence, has a useful area of 378mm by 482mm. The tube incorporates an ion trap, and the electron gun is designed to give uniform focus over the whole screen. Magnetic focusing and double magnetic deflection are used. The capacitance formed by the external conductive coating and the final anode may be used to provide smoothing for the e.h.t. supply. The 6.3V, 300mA heater is suitable for parallel or series connection. The overall length of the tube is 507 ± 10mm.

Operating data for the MW53-80 will be included in the reprint of this advertisement.

Reprints of all the advertisements in the "Valves, Tubes, and Circuits" series, with additional notes, are available without charge from the address given below.

Mullard

MULLARD LTD · TECHNICAL SERVICE DEPT., CENTURY HOUSE . SHAFTESBURY AVENUE · LONDON W.C.2

MVM 333

Wireless World

SEPTEMBER 1955 VOL. 61 No. 9

B.B.C. Report

THE past year has been one of great technical development in British broadcasting, and so it is not surprising that the engineering section of the B.B.C.'s Annual Report for 1954-55* provides some interesting sidelights on the Corporation's activities. Only in one place is gloom apparent; that is in dealing with the present position on the medium waveband. Here, it is evident that things are likely to become worse rather than better, in spite of many efforts to improve the service. "It would appear that the point is now being approached at which little or no improvement in medium-wave reception can be gained by means of additional stations, so long as they must share a wavelength with an existing station."

An enterprising piece of research into v.h.f. propagation at long range over water has been undertaken by installing at Scheveningen in Holland a Band II transmitter which works in conjunction with five receiving stations on the East coast. Apparently the main purpose of this experiment is to collect data on the possibilities of long-distance interference.

A commendably realistic approach is disclosed towards the allied problems of studio acoustics and monitoring control. The Report says: "Improvements in correlating acoustic quality, as assessed by experienced listeners, with the results of laboratory measurements helped towards the improvement of studio acoustics generally. A study was also made of the effect of the acoustics of listeners' living rooms upon the quality given by a particular studio. This study led to a comparison between the conditions under which programmes are heard by listeners and the conditions under which they are heard by the B.B.C. staff in the control cubicles attached to the studios; as a result, further attention will be given to the improvement of the listening conditions in the cubicles."

That last sentence gives food for thought and may well provoke controversy. It might even be argued that the conditions in the control cubicles should be degraded rather than improved. In these matters there are two schools of thought. One contends that the monitoring loudspeaker should match the average listener's mediocre receiving equipment, so that he may be given a signal that "sounds nice" to him. The other point of view, of course, is that the output should allow full justice to be done to it by the best receiver and loudspeaker used under the best conditions.

* Cmd. 9533; H.M.S.O., 4s 6d.

Velvet Glove or Mailed Fist?

FOR well over a quarter-century there has been talk of compulsory interference suppression. As long ago as 1949 the Postmaster was given the necessary legal powers but, so far, has done little to put them into effect. Up to the present, no *user* of interfering electrical equipment has been bound to fit suppressors; compulsion has so far been applied only to *makers* of internal combustion engines.

A big change takes place on September 1st. On that day the P.M.G.'s regulation†, laid before Parliament in March, comes into force. The new order imposes an obligation on all users of small electric motors to keep radiated and conducted interference within specified limits on the bands of frequencies used for television Band I and for medium- and long-wave sound broadcasting. A second regulation (No. 292) imposes similar obligations on manufacturers and sellers of refrigerators. It should be noted that manufacturers of motors are not yet affected; this matter is still under review.

What will be the effect of the regulations just coming into force? Much depends, we believe, on the way they are administered. When they were first issued, an official statement said the Post Office would not use its new powers except when it is necessary "to insist on an appliance being put right because it causes interference and the owner will not voluntarily have a suppressor fitted." A policy of too much velvet glove and not enough mailed fist would, we believe, fail to achieve a significant reduction in the present intolerably high level of interference.

† Statutory Instrument No. 291:1955. H.M.S.O., 6d.

Rocket Sounding in the Upper Air

Confirmation of Results Inferred from Radio Measurements

By SIR EDWARD APPLETON, F.R.S.

RECENT official announcements have made clear that rocket investigations of the upper atmosphere will be conducted by at least four countries during the International Geophysical Year 1957-58. Indeed it is evident that rocket work will provide the main new technique to be used during this year of intensive geophysical investigation, just as the radio sounding of the ionosphere was the novel technical feature introduced in the work of its predecessor, the International Polar Year of 1932-33.

American workers, with their ten years of experience with rockets, have already amply demonstrated their great value for upper air measurements *in situ* —measurements which have confirmed and extended results previously inferred from atmospheric soundings by sound and radio waves. For example, the study of the propagation of sound waves to great distances led to the conclusion that there must be a warm layer of air in the middle atmosphere; while all readers of *Wireless World* are aware that the ionosphere was discovered by experiments on radio wave reflection. Both the layer of warm air at medium levels, and the ionosphere at still higher levels have been detected in rocket soundings; and in this article I propose to deal with the underlying theory of the types of measurements in the two cases.

We naturally wonder how it is possible to measure any atmospheric characteristic during a rocket flight, since the projectile is only at rest at the top of its trajectory. The most obvious air characteristics of interest are the temperatures and pressures at various heights. But clearly the rocket compresses and heats the air through which it hurtles. However, careful experiments have shown that, just ahead of the tail fin of the rocket, there is a place where the pressure is the same as that of the undisturbed air. The recording barometer to measure air pressure can thus be placed there. The first, and basic, relation which has been the object of study by rocket sounding is, therefore, the *air pressure as a function of height* above sea level. Work of this kind has given a precision to this relationship which could not be expected from previous theoretical speculation about atmospheric characteristics. Fortunately, from the pressure-height curve, it is possible also to make a fairly accurate estimate of the temperature-height relationship in the atmosphere. By contrast, direct measurements of air temperature are difficult, if not impossible, because of the heating up of the rocket skin by air friction.

The deduction of air temperature must be made from the values of the pressures observed at two heights which are fairly close together. For example, if Δp is the pressure change over a small range of Δh, then it can be shown that

$$\frac{1}{p}\frac{\Delta p}{\Delta h} = -\frac{1}{H} \qquad (1)$$

where p is the average pressure and H is the scale height of the atmosphere at the average level in question. It is the quantity H which leads to a determination of atmospheric temperature, since, by definition,

$$H = \frac{kT}{\bar{m}g} \qquad (2)$$

where k is Boltzmann's constant, T the absolute temperature, $\bar{m}$ the mean molecular mass of the atmospheric constituents and g the acceleration due to gravity at the height in question. It will therefore be seen that to determine the temperature by this method, we have to make assumptions concerning the nature of the atmospheric gas constituents and their relative proportions.

As mentioned above, rocket soundings, made by American scientists since 1946, have confirmed the existence of the warm belt in the atmosphere, immediately above the stratosphere, the enhanced temperature of which is due to the absorption of solar ultra-violet light by atmospheric ozone. The atmospheric temperature has been shown to start to rise at a level of 30 km above the ground, reaching a maximum at a level of 50 km, thereafter falling to a minimum at 80 to 85 km, above which it rises again.

I now turn to the subject of the rocket exploration of the ionosphere, which is undoubtedly the most spectacular aspect of this fascinating field of enquiry. The ionosphere was discovered in 1924 by the method of radio sounding. One advantage of such a technique is, of course, that the phenomena investigated by radio means are not appreciably altered by the sounding mechanism. There are, it is true, two effects of such a nature, but they are trifling in practice. The beam of exploring radio waves exerts a small pressure—the pressure of radiation—on the ionosphere and pushes it upwards; also, when the radio waves travel into the ionosphere itself, they tend to warm the ionosphere (as in the Luxembourg effect). The magnitude of radio power used normally in ionospheric radio sounding is, however, so small that these two effects are inappreciable. We can therefore claim to measure things in the ionosphere by radio without changing sensibly the things we measure!

I now turn to consider the nature of the ionospheric quantities which can be measured in rocket sounding. The American method of measuring the electron density at a given height, which is, of course, the basic quantity of ionospheric interest, depends on a very elegant application of the Doppler effect. Let us assume that a radio set in the rocket is emitting a constant frequency f as the rocket climbs upwards. Then it is easy to show that the radio frequency received at ground level will be less than f by the quantity Δf, where

$$\Delta f = \frac{fv}{V} \qquad (3)$$

where v is the mechanical upward velocity of the rocket and V is the phase velocity of the radio waves *in the*

vicinity of the rocket-emitter. Now, in un-ionized air, the phase velocity of the radio waves is c_0, the normal velocity of light in the same medium. But, when the ionization is substantial, V differs appreciably from c_0. It is, of course, the enhancement of V due to ionization which is the origin of the reflecting power of the ionosphere for radio waves.

If a very high radio frequency is employed the relation between V and the electron density N is given by

$$\frac{c^2_0}{V^2} = \left(1 - \frac{Ne^2}{\pi m f^2}\right) \quad .. \quad .. \quad .. \quad (4)$$

(here e and m are, respectively, the charge and mass of the electron) so that, when V is found, using (3), N may be deduced, using (4). I am here neglecting, for simplicity, the effect of the earth's magnetic field; but equation (4) can be modified to allow for such an influence if desired.

Various elegant methods of measuring the Doppler effect from a rocket radio source travelling through the ionosphere have been developed by American scientists, by means of which the relation between electron density N, and height h, has been estimated. The N values so obtained are of the same order of magnitude as previously measured by radio sounding; but it is already clear that the new technique can supplement, in various important ways, the older radio technique. For example, in the case of the rocket experiments, it is possible to measure directly the value of N in the upper part of an ionospheric layer, whereas this quantity can only be inferred in the case of radio sounding.

A word of caution should, however, be added concerning the effect of the rocket itself on measurements of ionization density in the ionosphere. These are based on the assumption that neither the rocket nor the exuded gases affect the ionosphere over a range of one radio wavelength in the ionospheric medium. American rocket scientists feel that this condition is likely to be fulfilled in the lower part of the ionosphere—for example, below 140 km—but, at high levels, it is considered likely that gaseous products may spread out to a considerable distance from the rocket itself and so vitiate the accuracy of N determinations.

It is now known that rocket explorations of the upper air will be conducted by the United States, France, Russia, Great Britain and possibly Australia, during the International Geophysical Year. So far such exploration has been pursued mainly at one site, White Sands in New Mexico, and it is therefore most gratifying to learn of its extension to other latitudes and longitudes. Meanwhile the hourly sounding of the ionosphere by the relatively cheaper method of radio goes on constantly at many stations all over the globe, and will indeed be greatly extended in world coverage during the year 1957-58.

DIFFERENTIATING SPEECH AND MUSIC

American Design for a "Commercial Killer"

ALTHOUGH it is to be hoped that commercial announcements in I.T.A. programmes will not initiate the violent urge to get at the "off" switch that such interpolations are said to provoke in America, it is nevertheless interesting to speculate on how the differentiation between wanted and unwanted programmes might be made automatically—and, of couse, electronically.

One method, described on page 50 *et seq.* of the August 1955 issue of *Radio-Electronics*, has already reached the stage of commercial production by the Vocatrol Corporation of Cambridge, Mass., and is based on the difference in the rates of decay of the sounds in speech and music. The vowel sounds of speech are said to cut off at a rate of 400 db/sec, whereas decay rates in music are much lower.

In the "Vocatrol" a capacitance-resistance filter of suitable time constant converts the changes of level into pulses, and a diode is used to suppress those arising from rapid *rises* of level, which can occur in both speech and music. The wanted pulses pass through a potentiometer (sensitivity control) to an amplifier and thence to a parallel CR storage circuit of long time constant. A mono-stable multivibrator controlled by the voltage built up in this circuit is used to switch a large negative potential to the control grid of one of the audio stages in the receiver. A bandpass input filter and a logarithmic amplifier precede the differentiating circuit to remove hum and sibilants and to ensure that changes in general level of the programme do not affect the control.

Borderline transmissions, described in the report as "singing commercials," "patter songs" with light orchestral accompaniment, and announcers who slur their speech, may call for adjustment of the sensitivity control according to the listener's preference.

No mention is made of studio acoustics and the fact that talks and music studios have widely different reverberation times. It seems likely that most spoken "commercials" are recordings made in a damped studio or commentary cubicle, and that this would account for the difference in decay times. Would the method of control described be proof against a "live commercial" declaimed in an orchestral studio at the end of a concert?

BROADCASTING STATIONS OF THE WORLD

MANY hundreds of additions and amendments have been included in the operating details of the 2700 broadcasting stations of the world given in the latest edition of our book "Guide to Broadcasting Stations." To ensure as high a degree of accuracy as possible the tabulated information, secured from many sources, was checked against frequency measurements made at the B.B.C. receiving station at Tatsfield.

Short-wave broadcasting stations throughout the world are listed both geographically and in order of frequency (with power and call sign). The long- and medium-wave lists include only stations operating in Europe.

Details of European v.h.f. broadcasting stations and television transmitters are again included. The growth in both these spheres is shown by the fact that there are now over 300 and 130 stations respectively, compared with 160 and 40 when the last edition was prepared two years ago. Completely revised and in a new format, the 8th edition is obtainable from booksellers, price 2s 6d, or by post from this office, price 2s 8d.

WORLD OF WIRELESS

Marine V.H.F. Modulation • Import-Export Ratio • The T.A.C.

F.M. at Sea

TUCKED AWAY in a written reply in *Hansard* of July 28th is the announcement by the Postmaster-General that "it is the Government's intention that the United Kingdom should adopt frequency modulaion for these [v.h.f. international maritime radio] services."

Dr. Hill stated that other maritime countries in Europe and in the Commonwealth had agreed that in the interest of world-wide standardization f.m. should be used as is already done in North and South America. He added that the majority of the interested parties in this country, including all the shipping interests, are prepared to accept the change which will be made gradually.

Balance of Trade

IT WILL be seen from the following table of radio equipment exported and imported during the first six months of this year and last year that the balance of trade is becoming less favourable. Whereas exports increased by about £0.5M, imports increased by well over £2M, bringing the total imports to nearly 40% of the value of our present exports. Although these figures, extracted from the Board of Trade accounts, do not agree entirely with those issued by the Radio Industry Council, they do give a general picture of the Industry's overseas trade.

	Exports (Jan.-June) 1954	Exports (Jan.-June) 1955	Imports (Jan.-June) 1954	Imports (Jan.-June) 1955
Valves and c.r. tubes	1,040,860	1,247,740	1,776,353	1,664,494
Transmitters and nav. aids	6,373,705	6,322,315	919,792	801,483
Broadcast receivers:				
(sound)	1,376,410	1,393,147		
(radiograms) ...	216,648	283,401		
(television) ...	101,019	53,773		
Sound reproducing gear	489,351	610,263	1,161,643	3,553,258
Components ...	3,398,610	3,490,348		
Batteries	879,867	1,010,371		
	13,876,470	14,411,358	3,857,788	6,019,235

Television Advisory Committee

THERE have been a number of changes recently in the membership of the technical sub-committee of the Television Advisory Committee. The chair is occupied by the Post Office engineer-in-chief, now Brigadier L. H. Harris. The Post Office representative is Captain C. F. Booth (assistant engineer-in-chief), in place of H. Faulkner, and A. B. Howe, assistant head of the B.B.C. research department, now represents the Corporation in place of R. T. B. Wynn. Dr. Willis Jackson has resigned.

Three additional members have been appointed, they are L. H. Bedford (Marconi's), T. M. C. Lance (Cinema-Television) and E. P. Wethey (Kolster-Brandes).

The inclusion of Mr. Lance may be a pointer to the subject at present being studied; the terms of reference of the T.A.C. included the phrase "television for public showing in cinemas and elsewhere."

Germanium from Coal

AT THE present time one of the main sources of germanium is the flue dust from coal-fired furnaces. Only a small proportion of the available germanium is deposited and the remainder is lost to the atmosphere as fine dust.

A programme has been initiated by the Fuel Research Station of the Department of Scientific and Industrial Research to survey all possible sources and to investigate the distribution of germanium in the coke, tar and liquor by-products of coal carbonization processes. This, according to the "Report of the Fuel Research Board" (published by H.M. Stationery Office, price three shillings), will lead to the discovery of ways of modifying these processes to increase the proportion of germanium recovered.

PERSONALITIES

Sir George Nelson, Bart., is to be president of the I.E.E. for the 1955-56 session. Sir George is chairman and managing director of the English Electric group of companies, which includes Marconi's W.T., Marconi Marine, Marconi Instruments, English Electric Valve and Scanners. He was recently appointed a governor of the Imperial College of Science and Technology.

H. Stanesby, the new chairman of the Radio and Telecommunication Section of the I.E.E., has been closely associated with radio work in the Post Office since he entered the Dollis Hill laboratory as a "youth in training" in 1924. For two years he was responsible for the direction of the radio laboratory at Dollis Hill. Now staff engineer in the Radio Planning and Provision Branch, he has specialized in the development of crystal filters and cable and radio links for television. He has frequently represented this country at international conferences and is chairman of the C.C.I.R. Study Group IX concerned with general technical questions.

SIR GEORGE NELSON

H. STANESBY

Sir Gordon Radley, a deputy director general of the Post Office since last October and before that engineer-in-chief for three years, has been appointed director general and so becomes the first engineer to fill the post. Sir Gordon, who is 57, joined the Post Office as a temporary inspector in the research branch in 1920. He received his Ph.D. from London University in 1934 for a thesis on radio interference from power lines and a knighthood in 1954.

The position of deputy director general, vacated by Sir Gordon Radley, is to be filled by **R. J. P. Harvey,** who has been director of radio and accommodation for the past 18 months. Mr. Harvey, who is 50, is chairman of the Mobile Radio Committee set up by the P.M.G. to investigate the problems of clearing mobile radio users from Band III.

Captain K. H. T. Peard, who was captain of H.M.S. *Collingwood,* the naval electrical school, from 1953 until a few months ago, has been promoted Rear-Admiral and appointed director of the Naval Electrical Department at the Admiralty. He is 53. He succeeds **Rear-Admiral Sir Philip Clarke** who had held the position from 1951. Sir Philip has been president of the British Institution of Radio Engineers since last October.

Captain G. C. Turner has been appointed assistant Captain Superintendent, Admiralty Signal and Radar Establishment. He was fleet radar officer, British Pacific Fleet, at one time during the war and has since served in the radio equipment and electrical departments of the Admiralty and as executive officer at the electrical school (H.M.S. *Collingwood*).

Commander J. Forrest, who has recently been appointed to the radio equipment department of the Admiralty, has specialized in air radio matters during his naval career and it is in this field that he will be mainly concerned in his new post.

P. L. Taylor, M.A., A.M.I.E.E., who has been head of the electrical section of the College of Aeronautics, Cranfield, Bucks., since its foundation in 1946, has left the College to join the research department of Metropolitan-Vickers, at Trafford Park, Manchester. His article on servo-mechanisms appeared in our January 1952 issue.

M. R. Gavin, M.A., D.Sc., F.Inst.P., M.I.E.E., vice-principal and head of the department of physics and mathematics in the College of Technology, Birmingham, for the past five years, has been appointed professor of applied electricity at the University College of North Wales. Before going to Birmingham, Dr. Gavin, who received his doctorate from Glasgow University for work on valves for decimetre waves, was for eleven years at the G.E.C. research laboratories, Wembley. Dr. Gavin, who has contributed several articles to our sister journal, *Wireless Engineer,* was appointed an M.B.E. in 1946.

E. Lawrenson, M.A., has been appointed chief engineer of the Wireless Telephone Company, Limited, of Sheffield, a member of the Plessey group. He joined the company last year, having previously been senior engineer in the advanced development laboratory of Standard Telephones & Cables.

A. V. Krause, Grad.I.E.E. recently appointed by 20th Century Electronics, Limited, head of cathode-ray tube development, was formerly senior engineer in the vacuum tube development section of Cinema-Television, Limited. He had previously been on the staffs of Standard Telephones & Cables and Mullards.

A. V. KRAUSE

OUR AUTHORS

Professor G. H. Burchill, contributor of the article on the design of Tchebycheff filters, was a designer of synchronous machinery with the Canadian General Electric Company for five years before joining the staff of the Nova Scotia Technical College. He has been teaching for twenty-six years and since 1953 has been professor of electrical engineering at the college.

H. G. Manfield, who describes methods of making printed circuits on page 436, has been at T.R.E. (now R.R.E.), Malvern, since 1946 where for the major part of his service he has been working on printed and potted circuits. During the war he was for some time resident maintenance engineer at several radar stations.

T. K. Cowell, development engineer in the recently formed electronic development division of R. B. Pullin and Company, instrument makers of Brentford, Middlesex, describes in this issue a multi-purpose chassis for experimental work. After six years at the G.P.O. Radio Branch at Dollis Hill, which he entered as a trainee in 1948, he was with Furzehill Laboratories for a few months before joining Pullin in January this year.

S. Kannan, who discusses aerial circuit magnification on page 461, graduated from the University of Madras (India) in 1943 and joined National Ekco Radio and Engineering Company, of Bombay, as development engineer in 1948. Five years later he joined E. K. Cole, Ltd. (Southend), where he is now concerned with the design and development of broadcast receivers.

OBITUARY

Richards W. Cotton, who died recently in Portland, Maine, U.S.A., was well known in the British radio industry, having been controller of signals (communications) at the Ministry of Aircraft Production for some time during his residence in this country from 1934 to 1946. He was at one time chairman of British Rola and was a director of Philco (Overseas), Ltd. In 1952 he was appointed director of the electronics division of the American Defence Production Administration.

IN BRIEF

Television licences in the United Kingdom increased by 52,505 during June (the latest figures available). The total number of **Broadcast Receiving Licences** current in Great Britain and Northern Ireland at the end of June was 14,035,567, including 4,676,422 for television and 275,910 for car radio.

Extended Band III Tests.—Since August 2nd the transmission times of the Belling-Lee Band III experimental transmitter (G9AED) at Croydon have been extended by 17 hours a week. The times are now Monday to Friday, 9.30 to 12.30, 2.0 to 5.30 and 7.30 to 8.30; Saturday 10.0 to 1.0. Transmissions from G9AED will cease at one o'clock on September 3rd when test transmissions from the temporary I.T.A. transmitter at Croydon (opening on September 22nd) are due to start.

The **Monopolies Commission** has now appointed nine investigators to consider and report on the supply of valves and cathode-ray tubes, which was referred to the Commission last December. Written and oral evidence is now being taken and any offers to give assistance should be addressed to the Monopolies and Restrictive Practices Commission at 8, Cornwall Terrace, Regents Park, London, N.W.1.

"Inexpensive Wave Analyser." In Fig. 2 of this article (p. 361, August issue) the value of R7 should be 75kΩ, not 33kΩ.

I.E.E. Council.—Among those elected to fill the vacancies on the council of the I.E.E. at the end of September are: Sir George Nelson, president (see "Personalities"), T. E. Goldup, director of Mullards, a vice-president for the second time, Sir Hamish MacLaren, Director of Electrical Engineering, Admiralty, a vice-

president, and Professors H. E. M. Barlow (University College, London) and J. Greig (King's College, London) ordinary members.

The new committee of the **I.E.E. Radio and Telecommunication Section** (note the new title), which takes office at the end of September, will be under the chairmanship of H. Stanesby (see "Personalities") with Dr. H. S. McPetrie, who is head of the Radio Department at R.A.E., Farnborough, as vice-chairman. The five vacancies among the ordinary members of the committee will be filled by F. S. Barton (principal director, electronics research and development, M.o.S.), Dr. A. J. Biggs (G.E.C. research laboratories), W. Ross (R.A.E., Farnborough), T. B. D Terroni (manager and chief engineer, transmission division, A. T. & E.) and F. Williams (senior superintendent engineer, B.B.C.).

An **Exhibition of Electrical Standards** has been opened at the Science Museum, South Kensington, and will remain open until October 31st. One of the objects is to show the origin and derivation of the various electrical units. The complete set of the original B.A. Units of Resistance, which were made in 1864 for the British Association and constitutes the oldest set of accurate electrical standards now in existence, are to be seen. The Museum is open on week-days from 10.0 to 6.0 and on Sundays from 2.30 to 6.0.

A new observatory, to be known as the **Mullard Radio-Astronomy Observatory,** is to be set up by the University of Cambridge as a result of an offer from the Mullard Company to provide £100,000 over a period of ten years for radio-astronomy research.

Brit. I.R.E.—The first meeting of the session will be held at 6.30 on September 28th, at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1, when G. I. Hitchcox will deliver a paper on "Extending the limits of resistance measurement using electronic techniques."

F.M. Tuner.—Constructional details of a tuner for the v.h.f. service of the B.B.C., which will be available to 83% of the population by the end of 1956, are given in a new *Wireless World* booklet. In it are reprinted the articles by Amos and Johnstone in the April and May issues. It is obtainable from this office price 2s. (plus 2d. postage).

We regret that there is an error in the terms quoted in the bottom left hand panel of the advertisement offering complete equipment by **Stern Radio, Limited,** on page 144 of this issue. That page had gone to press before the error was discovered; the correct figures are:—

	Cash Price	Deposit	Monthly (12)
(a)	£22 19 0	£7 13 0	£1 8 1
(b)	£23 19 0	£8 0 0	£1 9 3
(c)	£28 16 6	£9 12 6	£1 15 2
(d)	£35 7 6	£11 16 0	£2 3 3
(a)	£24 9 0	£8 3 0	£1 9 11
(b)	£25 9 0	£8 10 0	£1 11 1
(c)	£30 17 0	£10 6 0	£1 17 8
(d)	£36 18 0	£12 6 0	£2 5 1

Since publishing the note in our last issue on the **Sound Reproduction Demonstration** to be given in New York, G. A. Briggs has advised us that Columbia Records Inc., and not Capitol Records Inc., will now be making the comparative recordings.

BUSINESS NOTES

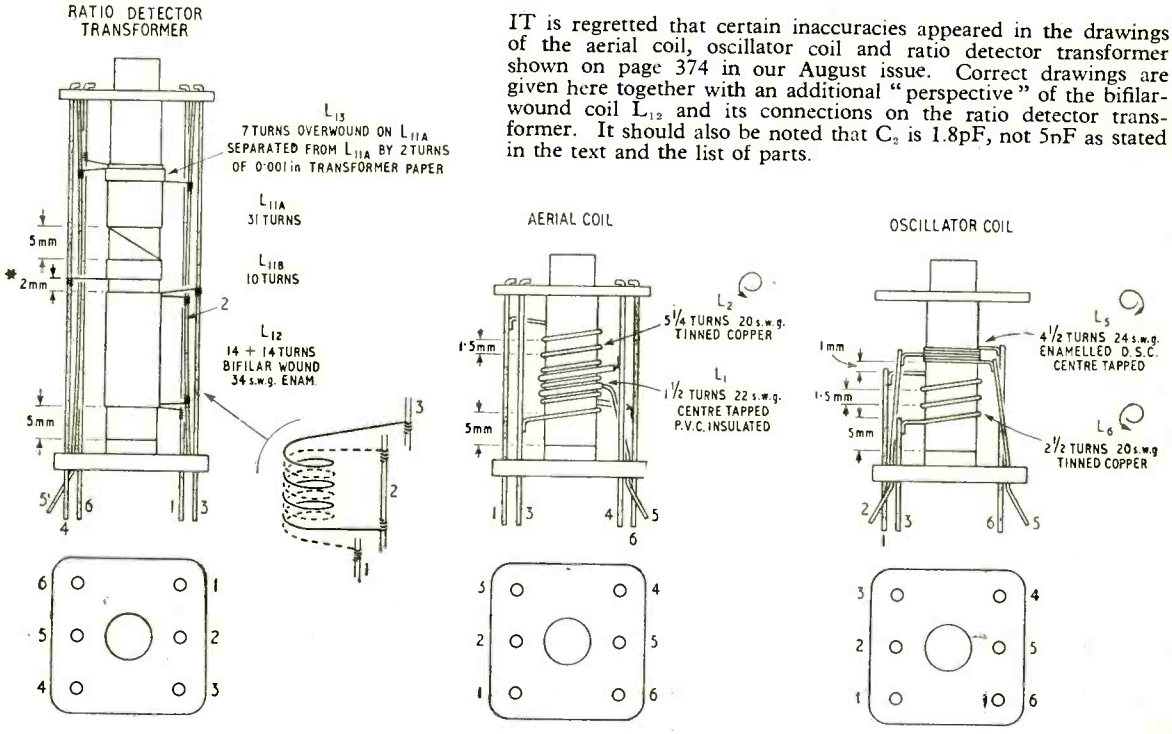
An order for the supply of twenty-three 30-kW short-wave transmitters has been placed with **Standard Telephones and Cables** by the Post Office. They are for installation at three stations and will be used for overseas point-to-point telephony and telegraphy services.

Ace Radio, Limited, receiver manufacturers of Tower Road, London, N.W.10, have opened the first of a series of new factories being built at Basildon New Town, Essex.

(*Continued on next page*)

F.M. TUNER UNIT: CORRECTIONS

IT is regretted that certain inaccuracies appeared in the drawings of the aerial coil, oscillator coil and ratio detector transformer shown on page 374 in our August issue. Correct drawings are given here together with an additional "perspective" of the bifilar-wound coil L_{12} and its connections on the ratio detector transformer. It should also be noted that C_2 is 1.8pF, not 5nF as stated in the text and the list of parts.



An acoustical advisory service has been established by **Tannoy**, of West Norwood, London, S.E.27, to deal with problems of excessive noise in factories. Acoustical treatment of existing buildings and collaboration with architects in planning new premises are the main functions of this department.

The design and manufacture of filters with Ferroxcube pot cores to customers' specifications is now undertaken by **Mullard's** Components Division.

Magnetic and Electrical Alloys, Ltd., of Burnbank, Hamilton, Scotland, producers of laminations, cores and stampings, have been acquired by the **Telegraph Construction and Maintenance Co.** J. Ancel Holden is continuing as chairman and W. Randall, a director of Telcon, has been appointed as vice-chairman and managing director. Telcon have recently formed a metals group which embraces Telcon-Magnetic Cores, Ltd., at Chapelhall, Lanarkshire, Temco, Ltd., at Lydbrook, Gloucestershire, Sankey-Telcon, Ltd., at Crawley, and Magnetic and Electrical Alloys.

Bakelite, Ltd., is to market polyethylene under an agreement with Union Carbide, Ltd., who are setting up a plant at Grangemouth, Scotland. Until the new factory comes into operation in 1957, polyethylene imported from the Union Carbide and Carbon Corporation, of America, will be available from Bakelite.

The merchandizing division of the **Solartron Electronic Group, Ltd.,** of Thames Ditton, Surrey (new telephone number Emberbrook 5522), has been appointed agent for the United Kingdom, Eire and certain parts of the British Commonwealth for the Consolidated Engineering Corporation, of Pasadena, California, and its associated companies. The Corporation manufactures a wide range of electronic and other industrial equipment.

To enable the audience to see both the live and televised performance of "The Barber of Seville" from Glyndebourne recently, 17 **H.M.V.** and **Marconiphone** receivers were installed in various parts of the theatre. The signal was taken from the B.B.C. at video frequency, passed through an amplifier and then distributed to the receivers on the vision frequency of Channel 4.

Kelvin and Hughes, Ltd., announce that they have entered the component market. Among the components listed are a magnetic record/reproduce head and sine-cosine potentiometers.

The sound reproduction equipment in the new liner *Empress of Britain* is being supplied by **Pye Marine**. In addition to the 150 loudspeakers used for the entertainment of passengers and crew, there are 35 loudspeakers associated with an emergency system with "talk-back" facilities at each speaker position.

For the demonstration of **Pye** underwater television at the recent international trade fair in Toronto, a microwave link was used to convey the underwater scenes from the ship stationed some two miles outside Toronto harbour to the receivers in the fair.

Reproducers and Amplifiers, Ltd., the well-known loudspeaker manufacturers of Wolverhampton, celebrated their silver jubilee in July. To mark the occasion a presentation was made to the founder and managing director, H. C. Willson.

Telerection, Ltd., aerial manufacturers, of Cheltenham, Glos., announce the formation of Telerection Developments, Ltd., "to co-ordinate and develop the large expansion plan on hand by the group of nine companies" which includes installation companies in six provincial centres.

Raymond E. Cooke, B.Sc. (Eng.), Grad. I.E.E., joined **Wharfedale Wireless Works, Ltd.,** of Idle, Bradford, at the beginning of August as technical manager and head of the research department.

Edwards High Vacuum, Ltd., announce the formation of an Italian subsidiary, Edwards Alto Vuoto S.p.A., with offices in Milan.

Telcon Africa (Pty.), Ltd., a subsidiary of the Telegraph Construction and Maintenance Company, Greenwich, has opened a new factory at Wadeville, Germiston, Transvaal.

Hivac Limited, manufacturers of sub-miniature valves, have transferred their registered office from Harrow to their new factory in Stonefield Way, Victoria Road, South Ruislip, Middlesex (Tel.: Ruislip 3366).

Permanoid, Ltd., formerly Associated Technical Manufacturers, Ltd., cable manufacturers, of New Islington, Manchester, have opened a Midlands branch at 558, Wolverhampton Road East, Fighting Cocks, Wolverhampton, Staffs. (Tel.: Wolverhampton 38367).

The telephone number of the **British Electric Resistance Co., Ltd.,** and the **British Power Transformer Co., Ltd.,** of Queensway, Enfield, Middlesex, is now Howard 2411.

The new telephone number of **Erie's** Great Yarmouth factories is Great Yarmouth 4911.

OVERSEAS TRADE

A further substantial order for equipment for transmitting and receiving stations of the Canadian Overseas Telecommunications Corporation has been received by **Marconi's W.T. Company** through its Canadian associate. The contract provides for the supply of six Marconi-Siemens R/T terminal equipments and ancillary gear.

Decca airfield control radar (Type 424) is being installed at Dum Dum civil airport, Calcutta, where there is already a Type 41 long-range storm warning radar.

A new overseas radio-telephone and telegraph centre for Burma is to be equipped by **Standard Telephones and Cables, Limited,** with single-sideband transmitters (4 to 40 kW), receivers, terminal equipment and beam aerials.

Another contract has been placed with **Marconi's** by the Gold Coast Posts and Telecommunications Department for the supply of radio-telephone equipment for the country's internal communication system. It provides for the installation of a twin-path, 24-channel (per path) radio communications service from Kumasi to Takoradi, via Mpraeso, Koforidua, Mampong (Akwapim), Accra, Winneba and Cape Coast. The new circuit will eventually link with one already being installed by Marconi's between Kumasi and Tamale in the north.

The New Zealand Post and Telegraph Department is calling for tenders for the supply of some **3,500 valves** and cathode-ray tubes of various types. Particulars are obtainable from the Export Services Branch, B.o.T., Lacon House, Theobalds Road, London, W.C.1 (Ref. ESB 15177/55). Closing date for tenders is September 15th.

Television in Uruguay.—The commercial department of the British Embassy in Montevideo draws the attention of U.K. manufacturers to the potential market for British receivers which will exist when the first television station in Uruguay opens shortly. It is understood that the Servicio Oficial de Difusion Radio-electrica is contemplating calling for tenders for the supply of 10,000 receivers to introduce the television service to the public. Interested manufacturers not already represented in Uruguay are invited to write to the Embassy in Montevideo.

South African Representatives.—Joseph Teer and Son (Pty.), Ltd., 5 Ulster House, Kruis Street, Johannesburg (P.O. Box 1630), wish to represent United Kingdom manufacturers of trimmer capacitors.

Saudi Arabian Market.—The firm of Suleiman Bakshwin, of Medina, have informed the British Embassy at Jidda that they are interested in receiving offers from United Kingdom suppliers of battery receivers and batteries.

National Radio Show

Stand-to-Stand Preview of Technical Exhibits

On Wednesday, August 24th, Dr. Charles Hill, the Postmaster-General, will open the 22nd National Radio Exhibition at Earls Court; overseas visitors and invited guests are having a preview the day before.

In the following pages we give a brief stand-to-stand survey of the technical exhibits prepared from information given to us by the 121 exhibitors. Although there are bound to be some last-minute releases by manufacturers, we feel that this preview will provide visitors with a useful guide to the show and readers unable to visit Earls Court will, we hope, find the survey valuable.

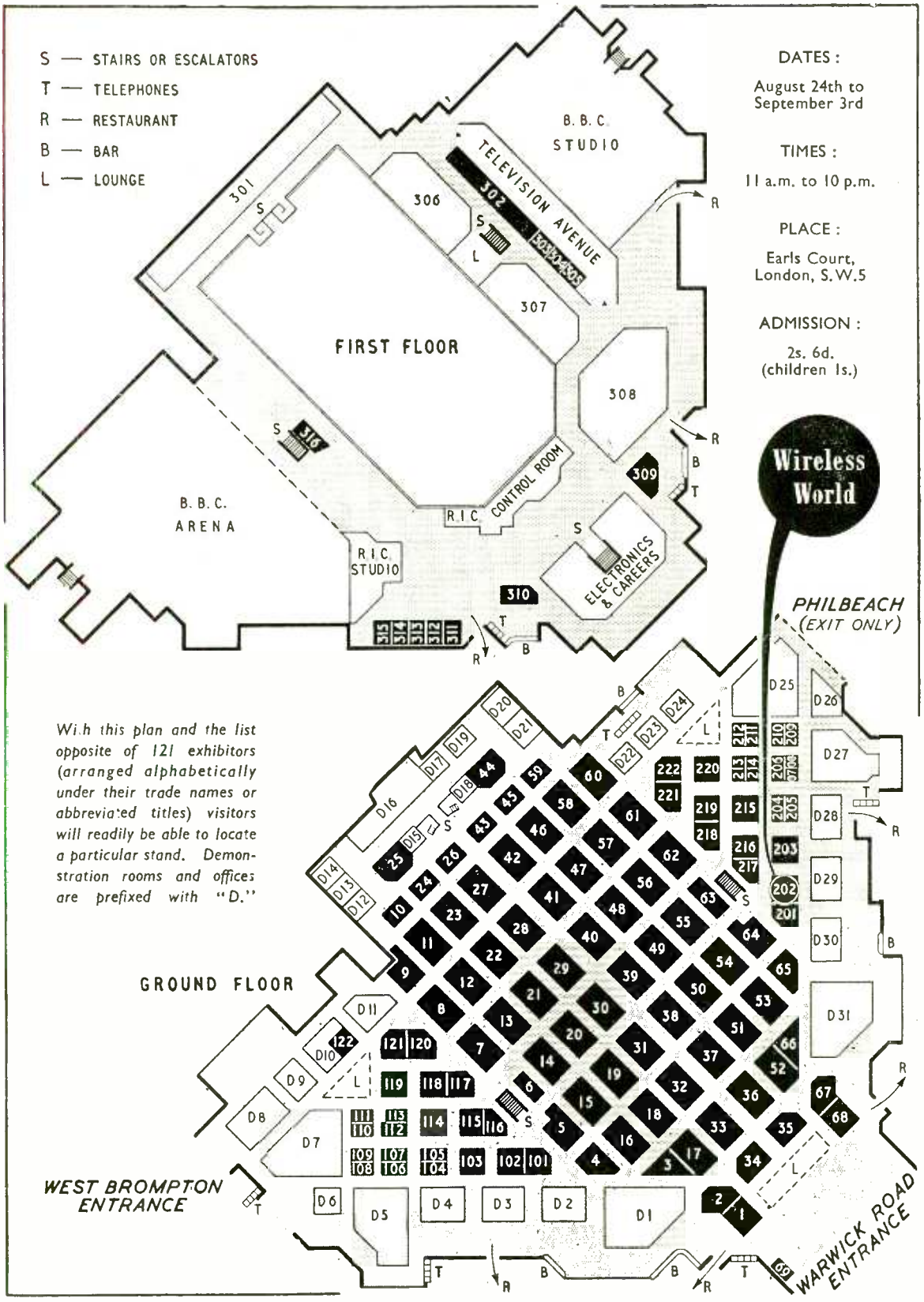
Visitors will have a foretaste of commercial television for the Radio Industry Council has offered time for short films backed by advertisements to be distributed on the network for the demonstration of Band III receivers. In Television Avenue on the first floor 28 manufacturers will be demonstrating 82 receivers, but they will operate on Band I only; Band III demonstrations are confined to the exhibitors' stands and demonstration rooms.

Instead of the collective displays of electronic equipment being set up in various odd corners of the show, as happened last year, they are this year being combined with the training display to form a large "electronics and careers" section on the first floor. It will comprise "Electronics of To-day," including examples of electronics in air and sea transport, medicine, communications, industry, etc., "Electronics of the Future" and a section devoted to careers in which visitors will have the opportunity of seeing the new I.E.E. training film "The Inquiring Mind."

ALPHABETICAL LIST OF EXHIBITORS

	Stand
Acos	201
Aerialite	33
Airmec	108
Alba	21
Antiference	64
Argosy	35
Army	308
Arrell	111
Assimil	312
Avo	116
B.B.C.	301
B.C.C.	217
Baird	52
Barclays Bank	3
Belling-Lee	46
Bernards	314
Bowmaker	106
Brimar	1
British Radio & Television	109
British Railways	2
Brown Bros.	9
Bulgin	59
Bush	22, 57 (D24)*
Champion	62
Channel	212
Collaro	39 (D29)
Cossor	23 (D8)
Cossor Instruments	114
Decca	32 (D2)
Defiant	60 (D9)
De La Rue	214
Domain	305
Dubilier	221
Dynatron	24
E.A.P.	303
E.A.R.	216
E.M.I.	215 (D26, D28)
E.M.I. Institutes	311
Econasign	113
Ediswan	58 (D21)
Ekco	12, 121 (D7)
Electrical & Radio Trading	102
English Electric	31 (D23)
Evening News	67
Ever Ready	54
Ferguson	14, 103 (D4)
Ferranti	13, 120 (D11)
G.E.C.	37 (D31)
Garrard	47
Gibbs	209
Goodmans	20
H.M.V.	48, 49 (D25)
Hart	210
Hobday	220
Hunt	8
Invicta	53
J.B. Cabinets	219
J-Beam Aerials	104
K.B.	16
Keith Prowse	69
Kerry's	203
Labgear	204
Linguaphone	207
Lloyds Bank	115
McMichael	40
Marconiphone	50 (D27)
Masteradio	36
Midland Bank	44
Mullard	18 (D1, D30)
Multicore	63 (D18)
Murphy	29 (D3)
National Provincial Bank	68
Navy	307
Pam	61 (D22)
Pamphonic	34
Permanoid	111
Peto Scott	55
Philco	15
Philips	27, 42, 43 (D16, D17)
Pilot	56
Plessey	122 (D10)
Portogram	65
Practical Wireless	107
Pye	30 (D5)
R.A.F.	306
RCA Photophone	110 (D6)
R.G.D.	11 (D13)
R.S.G.B.	310
R.T.R.A.	302
Reflectograph	208
Regentone	38
Roberts	117
Rola Celestion	17
S.T.C.	119
Sapphire Bearings	304
Simon	10
Slingsby	112
Sobell	19
Specto	206
Spencer-West	211
Star	309
Stella	51
T.C.C.	45 (D20)
Tape Recorders	66
Taylor	6
Telequipment	105
Telerection	7
Television Society	315
Thompson, Diamond & Butcher	4
Trix	26
Ultra	41
United Appeal for the Blind	316
Valradio	118
Vidor	28 (D19)
Wearite	218
Westinghouse	101
Westminster Bank	222
Whiteley Electrical	25 (D12, D15)
Wireless & Electrical Trader	205
Wireless World and *Wireless Engineer*	202
Wolsey	5

* Demonstration rooms and offices are prefixed with "D."



National Radio Show

Guide to the Stands

ACOS (201)

Piezoelectric (crystal) pickups and microphones for every purpose are made by this firm, and attention is directed to the recently developed GP59 series of pickups for high-quality radio-gramophones and record players.

The GP59-1 is a turnover cartridge of wide frequency range and medium output, and the GP59-3 has a high output for use with amplifiers having a low overall gain. Both types are fitted with an easily replaceable cantilever stylus.

Microphones range from inexpensive hand and desk types to models suitable for studio work.

Cosmocord Ltd., 700 Great Cambridge Road, Enfield, Middlesex.

AERIALITE (33)

Folded dipoles are used in all the Band III aerials shown by this firm; they include indoor and outdoor types with from three elements upwards. Metal strip is used in many of the indoor models. There is a selection of adaptors for converting Band I aerials into dual-band systems and provision is made for orientating the Band III parasitic element, or elements, to meet the requirements where the B.B.C. and I.T.A. stations are differently sited.

There is also a good choice of f.m. aerials, aerial fittings and a range of Band III convertors.

Aerialite Ltd., Castle Works, Stalybridge, Cheshire.

AIRMEC (108)

The Televet Type 877 is a comprehensive television test set in portable form, but mains operated. It enables alignment adjustment of receivers to be carried out in the absence of a "live" broadcast on Bands I and III; a built-in wobbulator and oscilloscope ($2\frac{3}{4}$-in tube) facilitate visual adjustment.

The coverage is 8 to 70 Mc/s and 168 to 230 Mc/s in two ranges with a crystal-check oscillator for ensuring accuracy. The wobbulator gives a variable sweep at 50 c/s and up to 12 Mc/s bandwidth.

Airmec Ltd., High Wycombe, Bucks.

ALBA (21)

In addition to a range of 14in, 17in and 21in table model and console television receivers with multi-band turret tuners, a Band III tuning adaptor is available for users of the older Alba models.

Two new sound broadcast receivers have been developed, both with provision for v.h.f. reception. The table Model 3211AC covers short, medium and long waves in addition to the v.h.f. range, for which a built-in aerial is provided. A high-quality output stage feeds an 8in × 5in elliptical loudspeaker. Model 6221 is a radio-gramophone version with a 10-in loudspeaker and 3-speed record changer.

A. J. Balcombe Ltd., 52-58 Tabernacle Street, London, E.C.2.

ANTIFERENCE (64)

The "Snapacitor" principle of fixing the various elements or rods of a television aerial is one of the principal features of all this firm's Bands I, II and III aerials. It eliminates actual metallic connection between the elements and the feeder, or elements and structure, and is said to eliminate most of the troubles that arise from corrosion. Greatest prominence is given to Band III aerials, both as separate items and as adaptors for existing Band I systems. The range includes indoor and outdoor types. The "Exstat" anti-interference aerial now employs high-efficiency ferrite-cored transformers.

Antiference Ltd., Bicester Road, Aylesbury, Bucks.

ARGOSY (35)

The present range of sound and vision broadcast receivers includes two recently introduced radio-gramophones with 6-watt push-pull output stages which cover four wavebands, including v.h.f. Built-in compressed dipoles are provided, but provision for external aerials for both a.m. and f.m. reception is made. There is also a table-model broadcast set covering the same ranges, with a ferrite rod aerial for long- and medium-wave reception. A new 17in table-model television receiver is being introduced.

Argosy Radiovision Ltd., Hertford Road, Barking, Essex.

ARMY (308)

Both the Royal Corps of Signals, which operates the Army communication network, and the Royal Electrical and Mechanical Engineers, responsible for the maintenance of the equipment, are participating in the Army's exhibit. Examples of the latest telecommunications equipment, test gear and electronic devices used by the Army are to be seen.

The War Office, Whitehall, London, S.W.1.

ARRELL (111)

This firm specialize in the production of television aerials and associated fittings. They have no fewer than 15 different models of Band I aerials for indoor and outdoor use and a dozen Band III models. A feature of the designs is the use of low-loss polythene insulators on all aerials.

Arrell Electrical Accessories Ltd., New Islington, Manchester, 4.

ASSIMIL (312)

This company—a division of E.M.I. Institutes—has introduced a system of language instruction by gramophone records, based on a method which was originated on the Continent many years ago. For English-speaking people, courses are offered in French, German, Italian and Russian.

Assimil (England) Ltd, 10 Pembridge Square, London, W.2.

AVO (116)

Two new signal generators covering Bands I, II and III make their debut this year. One, the "Mark III," is a moderately priced instrument covering 150 kc/s to 220 Mc/s in six bands; while the "Wide-Band AM/FM" model provides amplitude modulated signals over the band 5 to 225 Mc/s, and a frequency modulated output over 60 to 120 Mc/s. The modulating frequency is 400 c/s and the deviation ±150 kc/s. Other features include high accuracy of adjustment of the oscillator and provision for either sine-wave or square-wave modulation.

Another interesting Avo product is the Type 160 valve tester. A full range of Avometers is shown also.

Automatic Coil Winder and Electrical Equipment Co. Ltd., Winder House, Douglas Street, London, S.W.1.

B.B.C. (301)

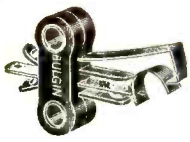
The advantages of v.h.f. broadcasting is the theme of the B.B.C. stand which incorporates a demonstration theatre, seating about a hundred people. In the theatre comparative tape recordings of reception on a v.h.f. receiver and a medium-wave set, made under varying conditions of interference, will be played over. At each demonstration an engineer will be present to answer questions.

B.B.C., Broadcasting House, London, W.1.

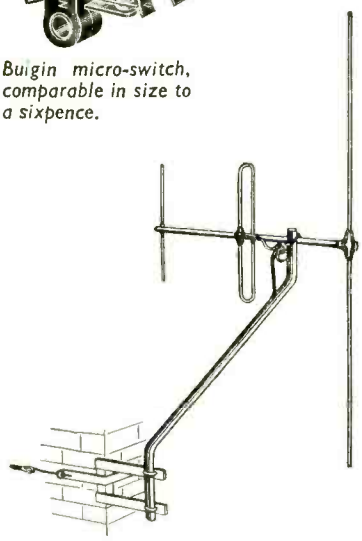
B.C.C. (217)

This firm manufacture v.h.f. radio-telephone equipment for mobile, portable and fixed-station uses. Mobile equipments are generally of 5 watts r.f. output; fixed station sets are of 5 watts and 25 watts output while portable, or pack sets, give about 120 mW output. The latest addition is a motor-cycle installation with selective calling facilities.

British Communications Corporation Ltd., Second Way, Exhibition Grounds, Wembley, Middlesex.



Bulgin micro-switch, comparable in size to a sixpence.



Aerialite Model 800 twin-band aerial.

BAIRD (52)

Television receivers with 14in and 17in tubes are shown in both table models and consoles. An unusual feature is the use of electromagnetic focus. A 12-channel tuner is included in which two channels only are initially operative.

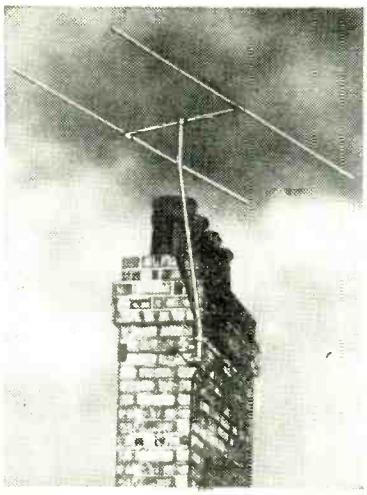
As a console model there is a new set with a 21in tube.

Hartley Baird, Ltd., Princess Works, Brighouse, Yorks.

BELLING-LEE (46)

Combined aerials, separate aerials and adaptors for existing aerials are shown in profusion on this stand. An unusual combination is a Band I-Band II aerial (t.v./f.m.) which should be very satisfactory in areas of relatively high signal strength. It consists of one vertical and one horizontal dipole fitted to a single insulator and sharing a common downlead.

They have a diplexer combining unit for coupling two different (i.e. Band I and Band III) aerials into a single feeder without measurable loss in efficiency of either, or it could be used to split the output from a dual-band aerial designed for a common feeder into two output channels for separate Band I and Band III inputs at the receiver.



Belling-Lee Junior "H" FM aerial.

Their display of aerials, while physically overshadowing their other items, should not be allowed to attract all the visitors' attention. The firm make a wide range of plugs and sockets, fuse holders, connectors and interference suppressors. They are specialists in the latter business.

Belling and Lee Ltd., Cambridge Arterial Road, Enfield, Middlesex.

BRIMAR (1)

So far as valves for domestic applications are concerned, this year's exhibit concentrates attention on types introduced to meet present-day demands in the design of sets for broadcast reception in Bands II and III. Brimar television tubes are now fitted with an improved tetrode gun. A special display of transistors is to be made.

"Special quality" valves figure more prominently than in previous years. The cost of these valves has been considerably reduced, thus attracting designers to their use in wider fields of application.

New "Brimistors" include special types for insertion in valve-heater chains and for the suppression of switching surges. A miniature pattern is made for the protection of filaments in mains/battery portables.

Standard Telephones and Cables, Ltd., Footscray, Sidcup, Kent.

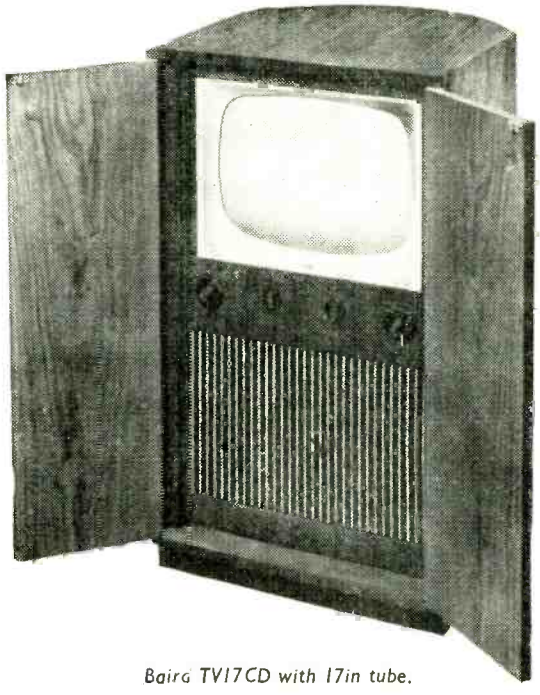
BULGIN (59)

The design and manufacture of micro-switches have been an important activity of this firm in recent years; one of the newest additions to their range takes the form of a sub-micro-switch comparable in size to a sixpence, yet which will handle 1.5 A peak current at up to 250 V a.c. or 50 V d.c. Micro-switches can be used either singly or banked for operation by a single multi-cam spindle.

The present range of miniature and standard toggle switches is very wide and most of the numerous types are available with or without insulated operating dollies.

Another important activity is the

Airmec "Televet" television receiver alignment and test equipment.



Baird TV17CD with 17in tube.

production of signal lamps; these are made in single or multiple types, large, small and Lilliputian. Sharing the same stand will be a wide range of knobs and dials, terminals, test prods and chassis fittings, including twin and multi-way connectors with floating contacts.

A. F. Bulgin and Co. Ltd., Bye Pass Road, Barking, Essex.

BUSH (22, 57)

Television sets with 12in, 14in, 17in and 21in tubes are made by this firm and all cover Bands I and III. Except in the 12in models, the tuning system comprises cam-operated slug-tuned coils, with band-switching, controlled by a multi-position knob and a clicker mechanism. A fine tuning control is provided. These sets also have a.g.c. on sound and vision, the control voltage for the latter being derived from the sync separator.

Several sound broadcast receivers equipped for f.m. reception will be on view, including a radio-gramophone. One model, the VHF54, has a magic-eye tuning indicator.

Bush Radio Ltd., Power Road, London, W.4.

CHAMPION (62)

Four new sound broadcast receivers with v.h.f. ranges form the basis of this season's programme. Another set, the Model 836 "Fidelo," is for 88-95 Mc/s only, works from a.c. or d.c. mains, gives 3 watts output into a 6in elliptical loudspeaker and costs £19 19s (including tax).

In the Model 840 console and 841 table model, two electrostatic loudspeakers are used in conjunction with a moving coil unit. Internal dipoles for v.h.f. and ferrite rod aerials for other wavebands are provided in addition to sockets for external aerials. These sets are for a.c. mains only and have three wavebands—88-95 Mc/s, 200-550 metres and 800-2,000 metres.

An additional short-wave range (15-50 metres) is included in the Model 880 table model and Model 856 radio-gramophone.

Champion Electric Corporation Ltd., Drove Road, Newhaven, Sussex.

CHANNEL (212)

A recent addition to this firm's products is a 9-channel television convertor providing one channel in Band I and eight in Band III; coils for all are included and aligned.

Other items of interest include a Band III pre-amplifier giving a gain of 24dB and a dual-band waveform generator giving a composite bar pattern and all sync pulses for alignment of a receiver in the absence of a "live" transmission.

Channel Electronic Industries Ltd., Princess St., Burnham-on-Sea, Somerset.

COLLARO (39)

The mechanical techniques of high-grade gramophone turntable design have been applied in the "Tape Transcriptor" mechanism with which Collaro have entered the magnetic tape recording field. A heavy flywheel with a ground and lapped spindle and single-ball thrust bearing ensures speed constancy, while a retractable drive to both capstan and take-up spool prevents the formation of flats on the intermediate friction wheels when the machine is switched off. The tape transport system is symmetrical with two motors and four heads (two to each track). Track changing is effected by switching heads and reversing the functions of capstan and take-up spool motors.

Items concerned with disc reproduction will include the "Studio" range of pickups, the 2010 transcription turntable, the RC54 record changer and the AC3/554 gramophone unit.

Collaro Ltd., Ripple Works, Bye-Pass Road, Barking, Essex.

COSSOR (23)

All this season's television receivers are tunable for alternative programmes: a typical specification is that of the 17in Model 937 with 21 valves. Features include turret tuning, flywheel sync, and automatic contrast control. There is also a "three-in-one" equipment embodying television, all-wave sound broadcasting and an automatic record changer.

Emphasis is placed on a.m./f.m. sound sets, of which there are three models, including a radio-gramophone.

A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5.

COSSOR INSTRUMENTS (AND EXPORT) (114)

This year's exhibit is concentrated largely on equipment for test and alignment of sound and vision broadcast receivers, both for use in production and maintenance. A typical instrument is the "Telecheck and Marker Generator" which, connected to a standard oscilloscope, will present the overall response curve of a television receiver. There is also an alignment generator for f.m. receivers which will be demonstrated at work.

There is also to be a comprehensive display of oscilloscopes ranging from a miniature single-beam instrument to specialized double-beam wide-band models.

A range of export receivers is to be shown.

Cossor Instruments, Ltd., Cossor House, Highbury Grove, London, N.5.

DECCA (32)

The combination of a pre-tuned three-programme f.m. receiver and a multi-channel 17in television receiver in the Model DMC/D18 gives a choice of all forms of entertainment broadcast in this country. Five Band I, three Band II and two Band III channels are provided and there are two blank positions.

In the new Models RG100 and RG103 radio-gramophones the normal short-, medium- and long-wave ranges are retained as an alternative to v.h.f. with continuous tuning over Band II. Internal resonant dipoles are provided for v.h.f. and a ferrite rod aerial for the a.m. stations. External aerials can also be used on all ranges where necessary. The RG100 has a Garrard RC111 record changer and a single pentode output valve, while the RG103 has a push-pull output stage and uses the Garrard RC80 record changer.

These new models will be supplemented by a choice of four other television receivers, four radio-gramophones and two portable record reproducers.

The Decca Record Co. Ltd., 1-3 Brixton Road, London, S.W.9.

DEFIANT (60)

A feature of the 17in television set is an electrical shift control; the 14in retains the more usual mechanical arrangement. In other respects the sets are similar. Bands I and III are covered with switch selection and trimmer; separate aerial feeders are used for the two bands.

A radio-gramophone, the RGSH-756, has a push-pull output stage and covers Band II as well as short, medium and long waves. There is a built-in Band II aerial and an internal ferrite-rod aerial for medium and long waves. This can be rotated by a panel control.

Co-operative Wholesale Society Ltd., 1, Balloon St., Manchester.

DE LA RUE (214)

The many plastic materials shown by this firm will include a range of improved insulating boards, and "Delaron Copper Clad," a composite board specially produced for the making of "printed" circuits by offset litho, silk-screen or photographic processes. This laminate is made to withstand the etching process and subsequent dip soldering and also has good characteristics for the punching of holes.

Thomas De La Rue and Co. Ltd., 84-86 Regent Street, London, W.1.

DOMAIN (305)

This exhibit comprises display stands, tables and trucks. There are 10 models of tables for television sets. They are of tubular metal construction with a shelf.

Domain Products Ltd., Domain Works, Barnby Street, London, N.W.1.

DUBILIER (221)

The wide range of capacitors and resistors required by the radio and electronics industries today is well exemplified by the many different types displayed on this stand. Prominence is given to two types of high-voltage capacitors for use in fly-back e.h.t. circuits. Alternative types with screw terminals or soldering

lugs are available. The maximum working d.c. voltage is 20 kV for a ceramic- and 30 kV for a plastic-tube type.

For v.h.f. circuitry Dubilier have a range of miniature silvered ceramic capacitors in normal, feed-through and bushing patterns.

Resistors also cover a wide field of application; one of their latest additions is a dual "Q" type with concentric spindles and mains switch.

Interference suppression is a speciality of this firm and they now have a wide range of suppressors for domestic and industrial apparatus.

Dubilier Condenser Co. (1925) Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

DYNATRON (24)

One example of the range of elaborate apparatus being shown on this stand is the Ether Pathfinder a.m./f.m. chassis. It is a tuner covering two s.w. bands, medium and long waves and the v.h.f. band. It has an r.f. stage, frequency-changer and two i.f. stages on all bands. The output is 0.2 V r.m.s. for 40 per cent modulation and the tuner is intended for use with the (separate) LF10 a.f. amplifier. This is a four-valve amplifier with push-pull output giving 12 W for under 0.1 per cent distortion.

A television set, the Condor, has a 21in tube and a 13-channel tuner. Flywheel sync is fitted and a.g.c. is provided on both sound and vision.

Dynatron Radio Ltd., The Firs, Castle Hill, Maidenhead, Berks.

E.A.P. (303)

The portable "Elizabethan" magnetic tape recorder has a response on playback which conforms to C.C.I.R. standards and can be used for the reproduction of E.M.I. and other tape records made to these standards. The amplifier may be used independently for other purposes with a level response from 30 c/s to 15 kc/s.

A new console model and two new portable versions will also be shown.

E.A.P. (Tape Recorders) Ltd., 546 Kingsland Road, London, E.8.

E.A.R. (216)

Record reproducing equipment is the principal concern of this firm. Portable and console models range from the "Mascot Miniature" to a "High Fidelity F.M.-Gram." The "Armchair Consolette" is provided with a special stand, or it can be used as a table model.

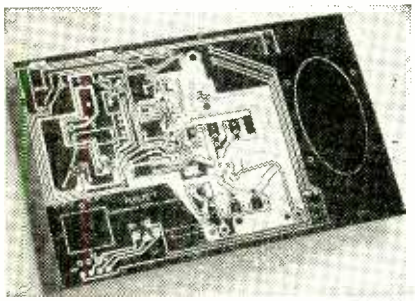
Equipment for the demonstration of gramophone records will also be exhibited.

Electric Audio Reproducers Ltd., 17, Little St. Leonards, London, S.W.14.

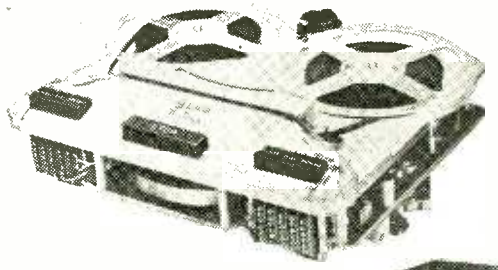
E.M.I. (215)

Equipment for tape recording at a "professional" level is to be a prominent feature of the E.M.I. exhibit. In this category is the high-quality recorder Type BTR/2, designed for record-making companies and broadcasting organizations. Different models provide for choice of tape speeds up to 30in/sec. Other recorders include a portable battery-operated model weighing only 14½lb.

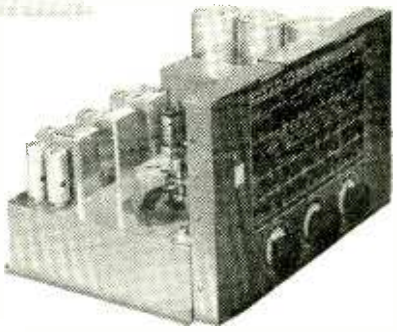
Other E.M.I. activities are also represented in the exhibit. The design and installation of relay distribution systems for both sound and vision broadcasting is undertaken, while another department deals with sound amplification for public build-



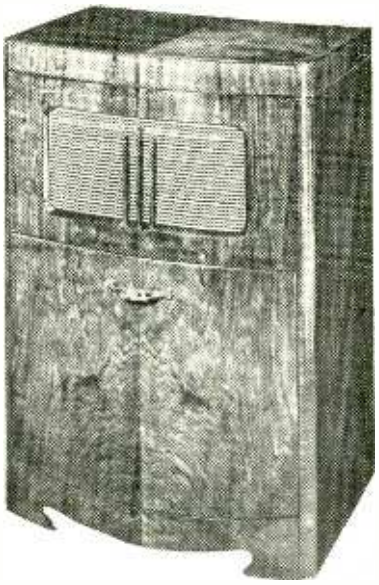
Printed circuit on De la Rue copper laminate.



Left: Collaro "Tape Transcriptor."



Right: Dynatron a.m./f.m. tuner of Ether Pathfinder.



Decca RG100 radio-gramophone with v.h.f. range.

Above: Cossor Instruments f.m. signal generator.

Left: Bush VHF54 covering long, medium and v.h.f. bands.

ings, hotels, factories and similar places.

E.M.I. Sales & Service, Ltd., Hayes, Middx.

E.M.I. INSTITUTES (311)

This institute offers home training in the various branches of applied electronics. Emphasis is on the practical side, and students are provided with experimental outfits on which to work. However, there are also courses on theoretical principles.

E.M.I. Institutes, Ltd., 10 Pembridge Square, London, W.2.

EDISWAN (58)

Broadcast receiver valves include recently introduced types for Bands II and III; among the latest productions are earthed grid triodes for both parallel and series connection. A new 12in cathode-ray tube, Type CRM124, has an ion trap tetrode gun fitted as standard. Industrial transmitting and special-purpose valves include the "Vapotron" with a novel cooling system; the valve is cooled by water vapour. Air cooling is used in a new 1-kW valve for r.f. heaters.

Among the many components and accessories shown by Ediswan will be a 12-channel turret turner for television receivers. A new co-axial television feeder has cellular polythene insulation; attenuation at 200 Mc/s is given as 3 and 3.2dB per 100ft for the rigid and flexible types respectively. Components include a number of parts moulded in high-performance fluorocarbon resins.

Edison Swan Electric Company, Ltd., 155 Charing Cross Road, London, W.C.2.

EKCO (12, 121)

Tube sizes in the television sets shown on this stand are 14in, 17in and 21in. Turret tuning is used for the two bands and some models also include provision for f.m. reception on Band II. One of these, the TC267, with a 17in tube, has spot wobble, flywheel sync and a.g.c. The 21in model (TC220) also has these features.

Quite a large number of the sound broadcast sets are now provided with facilities for Band II reception. The smallest is the U243 for a.c./d.c. operation; it has built-in aerials and a tuning indicator. The largest is a radio-gramophone, ARG256, which covers long, medium and short waves as well as Band II. There are a push-pull output stage feeding a pair of loudspeakers, a three-speed automatic record changer, bass and treble tone controls, while provision is made for feeding the radio output to a tape recorder.

Car radio sets are also on view, on stand 121.

E. K. Cole Ltd., Southend-on-Sea, Essex.

ENGLISH ELECTRIC (31)

The television sets shown on this stand are available in two forms—with and without provision for the reception of the three f.m. Band II stations. The vision side is switched off in the Band II positions of the selector switch. All sets cover Bands I and III. There are 17in table and console models and a 21in console in which the tube operates at 15 kV. Permanent-magnet focusing is used with electromagnetic deflection and flyback e.h.t. The set is designed for a.c./d.c. operation and a control barretter is fitted. The power consumption is 170 W.

The English Electric Co. Ltd., Marconi House, Strand, London, W.C.2.

EVER READY (54)

Though dry batteries for every conceivable application in the radio and allied field comprise the main Ever Ready exhibit, there is also a range of six battery-operated broadcast receivers. These comprise light- and medium-weight portables and transportables and two table models.

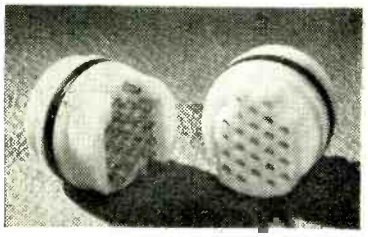
The Ever Ready Company (Great Britain) Ltd., Hercules Place, Holloway, London, N.7.

FERGUSON (14, 103)

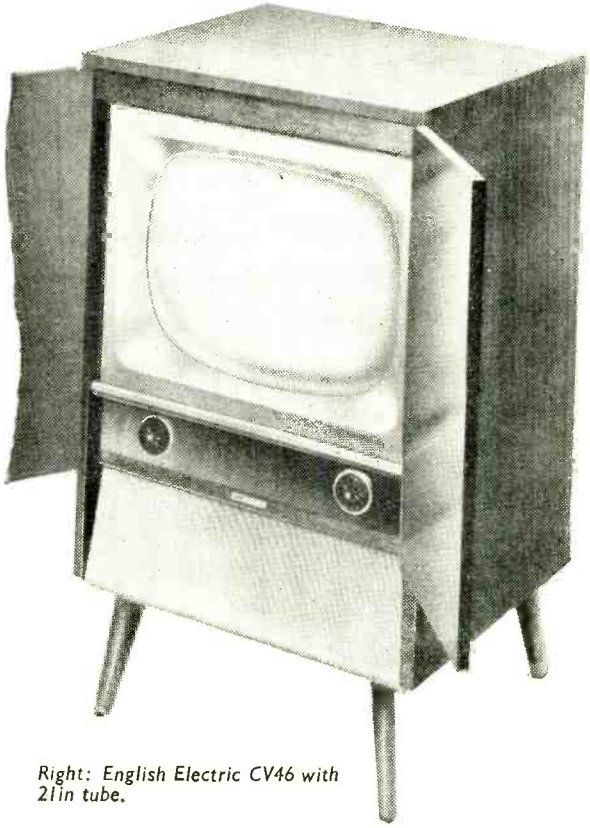
A large range of television and sound broadcast receivers is being shown. The "nine-star" television sets are fringe-area models and include an a.g.c. circuit in which the user has a choice of two time constants. The "new standard" sets are for normal

(*Continued on page* 419)

Ekco TC220 with 21in tube.

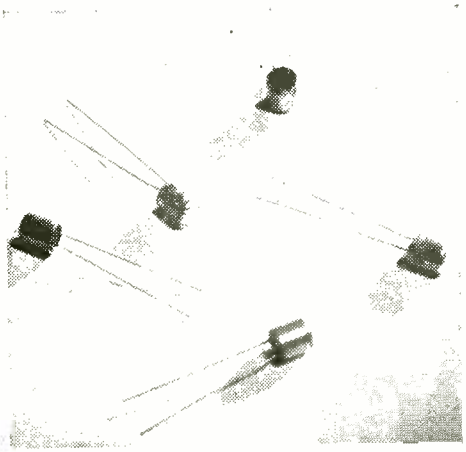


Left: Ediswan multi-way plug and socket in PTFE.

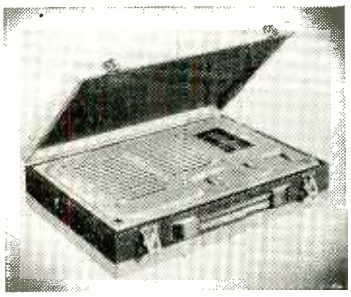


Right: English Electric CV46 with 21in tube.

G.E.C. 25-watt general-purpose amplifier.



Ferranti silicon junction diodes.



Ever Ready "Brief Case" portable.

Ferguson 352U a.c./d.c. transportable.

reception conditions. In each range there are 14-in, 17-in and 21-in tube models, and an earlier 12-in design is retained in table-model form.

The sound receivers include the model 329A, for a.c. operation, which includes Band II f.m. reception. There is a range of radio-gramophones, some of which cover Band II. An adaptor to enable f.m. to be received with any existing Ferguson set having pick-up sockets is shown.

Ferguson Radio Corp. Ltd., 105-109 Judd Street, London, W.C.1.

FERRANTI (13 & 120)

Broadcast receiving valves specially designed for operating at around 200 Mc/s have recently been added to the Ferranti range. Cathode-ray tubes up to 21in will also be shown.

A series of silicon junction diodes have recently been introduced. These are of the hermetically sealed type with very low reverse current, designed to withstand high operating temperatures. An important part of the exhibit comprises industrial valves such as trigger tubes, miniature stabilizers, thyratrons and high-voltage rectifiers. Specialized c.r. tubes for industrial use include flying spot scanners.

A demonstration unit will present a picture on a long-afterglow c.r. tube by means of a flying spot scanner system.

Ferranti, Ltd., Hollinwood, Lancs.

G.E.C. (37)

Among the latest Osram valves is the KT55, a relatively high-power output valve for a.c./d.c. operation on restricted h.t. voltages. A range of recently introduced miniature receiver valves has been designed for operation at around 200 Mc/s. There is a new 21-in cathode-ray tube with a 90° scan angle.

Three new p-n-p junction transistors, Types EW53, EW58 and EW59 cover many different applications, including use in r.f. circuits up to about 0.5 Mc/s. Both germanium and silicon diodes are to be shown, as well as photo-electric devices and cold-cathode trigger tubes.

The present G.E.C. range of television receivers is very wide; all have switch selection of alternative programmes and fully automatic gain control. Fringe-area models are produced. Sound receivers for the present season include a table model and a radio-gramophone with provision for v.h.f. reception.

An interesting 25-watt general-purpose amplifier just produced has a wide range of application. Flexibility of control is a feature.

General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2.

GARRARD (47)

Principal interest centres on the 3-speed record changers and record players which form the foundation of many proprietary radio-gramophones. For the connoisseur there is the Model 301 "transcription" motor with minimum "wow" and flutter, and a wide range of alternative pickups and record-playing accessories.

Garrard Engineering and Manufacturing Co. Ltd., Swindon, Wilts.

GIBBS (209)

Television and radio tables and other furniture are exhibited here. Record cabinets are shown in sizes up to the U568, holding 340 records.

Herbert E. Gibbs Ltd., First Avenue, Montague Road, Edmonton, N.18.

GOODMANS (20)

Once again this stand will take the form of a demonstration theatre—this year with a seating capacity of eighty. The "Axiom" and "Audiom" high-quality loudspeakers will be shown working in a new range of enclosures (types Axiom 180, 280, 480 and 172) which have been designed to give good transient response and a smooth bass in cabinets of comparatively small size.

The Axiom 80 loudspeaker unit, which has hitherto been made for export, is now available in this country, and will be demonstrated. It has a free-edged cone with cantilever suspension, and has a fundamental resonance of 20 c/s.

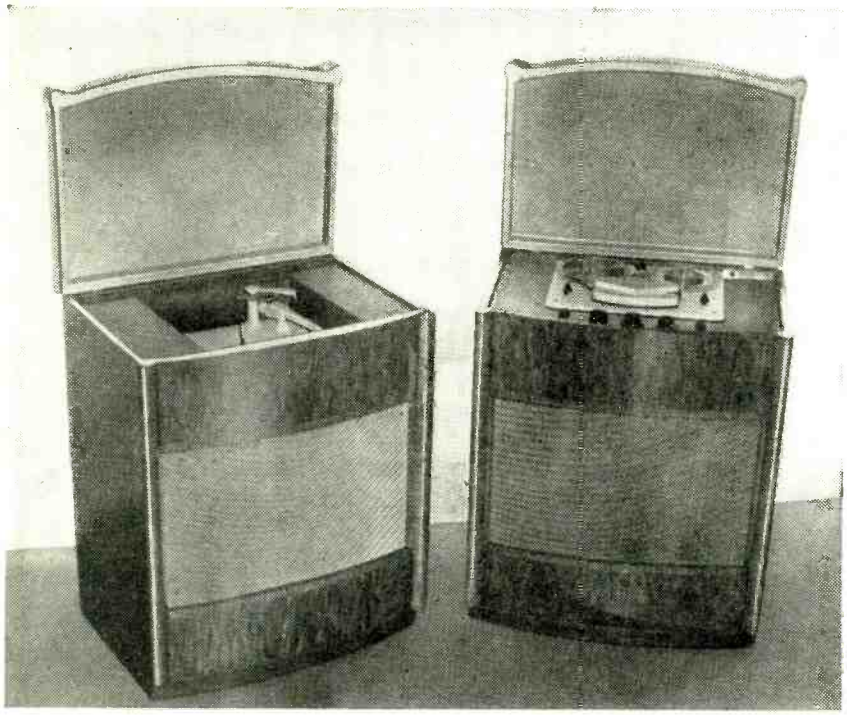
Goodmans Industries Ltd., Axiom Works, Wembley, Middlesex.

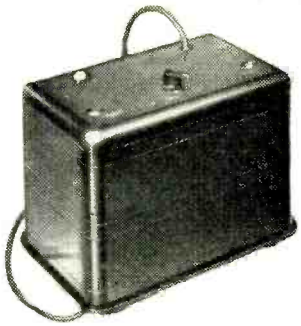
H.M.V. (48, 49)

High sensitivity and ease of tuning are design features of the new H.M.V. television receivers, which have all main controls at the front. Electrostatic focusing is used; the line scan and e.h.t. unit is completely sealed.

There is a range of sound receivers covering the long, medium and v.h.f. broadcasting bands. The Model 1252 tuner for connection to the pick-up terminals of a receiver provides reception of v.h.f. transmissions; the unit is self-contained, with its own power supply.

Equipment for the "Stereosonic" twin-channel sound reproduction system, described in *Wireless World* last May, can be heard working in the H.M.V. demonstration room. This equipment can also be used as a





Invicta Band III convertor.

Left: Twin-channel reproducers for H.M.V. "Stereosonic" system.

single-channel high-quality reproducer of tape records or discs of all characteristics.

E.M.I. Sales & Service Ltd., Hayes, Middx.

HART (210)

On this stand is to be found a wide range of record cabinets and television tables. The last are of wood construction and have shelves and castors.

Alfred Hart & Co. Ltd., 249 Upper Street, Highbury Corner, Islington, London, N.1.

HUNT (8)

With the addition of ceramics and capacitors designed especially for use in printed circuits, the range of capacitors now produced by Hunt is most comprehensive. It includes electrolytics in a wide variety of types, metallized paper, of which the W97 (Thermetic) midget has a nominal working temperature range of $-100°C$ to $+100°C$, metal foil and paper types, silvered mica, stacked foil and mica and ceramics.

A capacitor test set is also produced; it covers resistance measurements as well.

Printed circuits is another activity of this firm.

A. H. Hunt (Capacitors) Ltd., Bendon Valley, Garratt Lane, London, S.W.18.

INVICTA (53)

The new Type 126 television receiver with a 14-in tube, like all this year's Invicta models, has a 13-channel tuner. There is also a convertor unit for adapting Band I sets for reception of Band III.

A range of table model sound receivers and radio-gramophones providing both a.m. and f.m. reception will also be shown.

Invicta Radio, Ltd., 100 Great Portland Street, London, W.1.

J.B. CABINETS (219)

The production of radio and radio-gramophone cabinets for the trade comprises the main activities of this firm and their exhibit consists of a selection of the more interesting models produced recently.

J.B. Manufacturing Co. (Cabinets) Ltd., 86 Palmerston Road, Walthamstow, London, E.17.

J-BEAM AERIALS (104)

The television aerials made by J-Beam have always followed a very distinctive pattern, the feeder being joined, *via* a suitable matching section, to the end of the dipole in place of the more general centre connection. They have recently evolved an even more novel aerial for Band III fringe areas. It consists of a skeleton slot combined with twin yagis.

J-Beam Aerials Ltd., Cleveland Works, Weedon Road Industrial Estate, Northampton.

K.B. (16)

Although there are several 14-in tube television sets shown on this stand, in the main the new models have 17-in or 21-in tubes. They all have turret tuners for Bands I and III. Among the 17-in models there is one specially designed for fringe areas.

Many of the broadcast sets now include v.h.f., the sets in general covering medium and long waves and Band II. Radio-gramophones are also shown. The MG.30 has three loudspeakers mounted in angular planes.

Kolster-Brandes Ltd., Footscray, Sidcup, Kent.

LABGEAR (204)

The production of television aerials is a new departure for Labgear; the models shown include indoor and outdoor types and a novel design is a dual-band system comprising a single dipole for Band I and a two-element system with a fork-like attachment to the Band I dipole for Band III. A single feeder is used.

One of the Band III 4-element outdoor aerials intended for areas of poor reception (not necessarily fringe) has wide spacing between elements and it is claimed this provides a somewhat better signal than usual. A broadside array consisting of two wide-spaced 4-element yagis is said to serve for most fringe areas.

Labgear (Cambridge) Ltd., Willow Place, Cambridge.

LINGUAPHONE (207)

This company provides courses of instruction in a great number of languages; teaching is through the medium of gramophone records. Various kinds of reproducing equipment are available, including a headphone attachment enabling the student to listen without disturbance.

Linguaphone Institute, Ltd., 207-209 Regent Street, London, W.1.

MCMICHAEL (40)

Particular attention is paid in this season's television receivers to inter-

lace so as to ensure high-quality definition under all conditions of reception. Another feature of the new sets is the omission of a line output transformer; one reason is to eliminate one potential cause of breakdown, another is to restrict temperature rise in the set. In the absence of an output transformer e.h.t. is derived from a separate generator.

Table and console television sets with from 14-in to 17-in tubes are shown and are available with or without a radio chassis. Twelve-channel turret tuners are used throughout the McMichael range. Sound radio sets include a standard chassis for fitting to television sets and several table models, consoles and radio-gramophones.

McMichael Radio Ltd., 190 Strand, London, W.C.2.

MARCONIPHONE (50)

Four new television receivers have been introduced; these give the choice between 14-in and 17-in tubes, and table or console cabinets. All are for a.c./d.c. supplies and embody switched coil tuning for 13 channels. Automatic vision gain control is fitted and a wide-range tunable filter is provided for mitigating the effects of diathermy or similar kinds of interference. An 8-channel Band III converter unit for fitting to earlier Marconiphone sets is to be shown.

Most of the new sound receivers provide for v.h.f. reception as well as for medium and long waves, and are also available as radio-gramophones.

There will be a comprehensive display of cathode-ray tubes and valves.

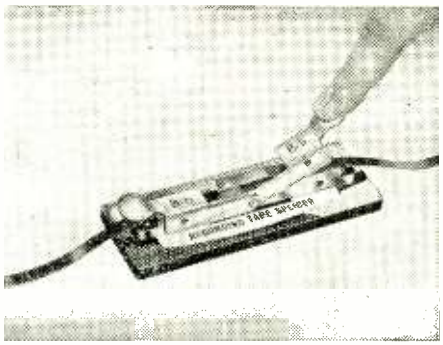
The Marconiphone Company, Ltd., Hayes, Middx.

MASTERADIO (36)

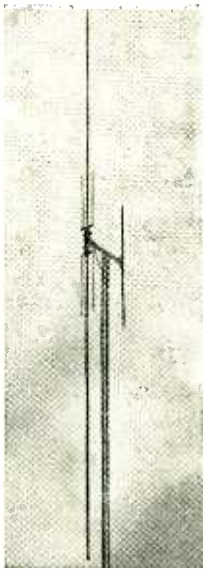
Without exception all Masteradio television receivers provide 13-channel tuning, embody an ion trap and are housed in cabinets designed especially for wide-angle viewing. All are superhets and, with the exception of Model TE21C, which is for a.c. mains, they operate on either a.c. or d.c. supplies. Tube sizes range from 14in to 21in.

One of this season's sound broadcast sets is an a.m./f.m. model covering four wavebands; it is known as the "Elstree" and is a table model.

Masteradio Ltd., Fitzroy Place, London, N.W.1.



New "Bib" (Multicore) tape splicer.



Two-band television aerial made by Labgear.

MULLARD (18)

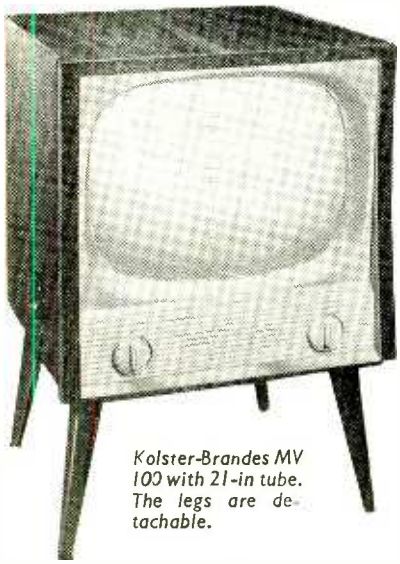
This year's exhibit aims at providing visitors with easily assimilated explanations of the functioning of various electronic devices, particularly of valves, cathode-ray tubes and transistors. There will also be a demonstration showing the advantages of f.m. broadcasting.

In one of the demonstration rooms a specimen 20-W amplifier built around the new EL34 pentode valve will be working. The design of this amplifier was discussed in detail in *Wireless World* for May and June this year. Another demonstration room will show the uses of devices intended primarily for the equipment manufactured, including picture tubes and components for 90° scanning, transistors for hearing aids, Ferroxcube ferro-magnetic cores and a new grade of Ticonal permanent magnets for loudspeakers. Some of the newer applications of transistors are also demonstrated.

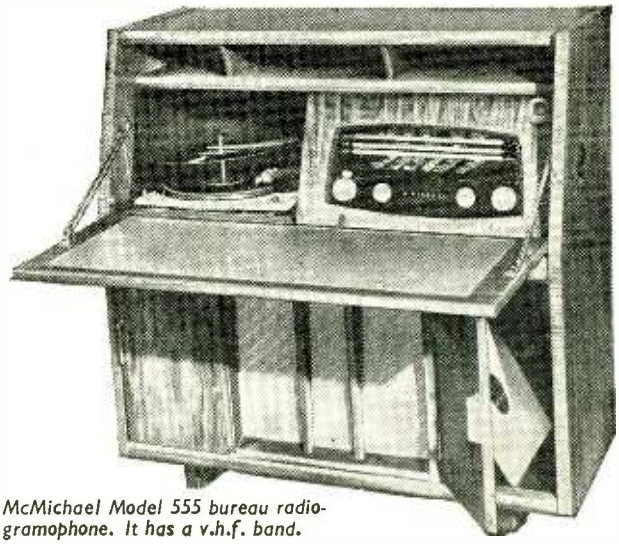
Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

MULTICORE (63)

The main exhibit here will show by practical demonstration how Ersin Multicore wire solder is used in the manufacture of radio receivers.



Kolster-Brandes MV 100 with 21-in tube. The legs are detachable.



McMichael Model 555 bureau radio-gramophone. It has a v.h.f. band.

Though most radio needs are met by six different tin-lead alloys in nine gauges, it is interesting to know that as many as 400 different specifications are available with, for example, melting points ranging from 145°C to 296°C. Another Multicore exhibit shows a complete soldering process that has been developed for printed circuit techniques of manufacture.

The Bib splicer for magnetic recording tape is now being produced in the modified form described in our February issue.

Multicore Solders, Ltd., Maylands Avenue, Hemel Hempstead, Herts.

MURPHY (29)

One of the features of this exhibit is a range of broadcast receivers which include Band II in their frequency ranges. The sets all cover medium and long waves and one short waveband and have a double-triode v.h.f. tuner in which one section acts as an earthed-grid r.f. amplifier and the other as a mixer-oscillator. There is an internal dipole for Band II and this also functions as a plate aerial on the other bands. One model, the A242R, is a radio-gramophone.

Television sets are of 14-in and 17-in types and have turret tuners with a cascode r.f. stage to cover Bands I and III. A direct-drive scanning circuit is used and the sets are available both as table models and as consoles.

Band III convertors for older Murphy sets are available.

Murphy Radio Ltd., Welwyn Garden City, Herts.

NAVY (307)

Among the examples of marine radio-communication equipment and electronic aids to navigation to be seen on this stand are the transmitter-receiver supplied to members of the Royal Naval Volunteer (Wireless) Reserve for use in their own homes and equipment for the facsimile transmission of weather maps.

The trend of progress in marine radio equipment is exemplified by replicas of the W/T office in a small ship of the 1920's and in its modern counterpart.

The Admiralty, Whitehall, London, S.W.1.

PAM (61)

Three table-models and one console comprise the television receiver range. The 17in Model 752DL is notable for its use of twin loudspeakers. All models are for a.c./d.c. operation with provision for 13 channels on Bands I and III.

The new a.m./f.m. sound receivers will be shown: Model 701 with c.r. tuning indicator in a table cabinet and Model 702RG, a radio-gramophone in a bureau cabinet.

The Pam "Pixie" portable is made by the printed circuit technique.

Pam (Radio and Television) Ltd., 295 Regent Street, London, W.1.

PAMPHONIC (34)

High-quality amplifiers, loudspeakers and microphones for both p.a. work and domestic sound reproduction will be shown, as well as magnetic tape sound delay mechanisms for sound reinforcement in large auditoriums.

One of the principal items is the "1002" 25-watt amplifier for which only 0·05% distortion at 15 watts (1 kc/s) is claimed. The pre-amplifier, in addition to a wide range of variable tone controls, gives compensation for the main groups of recording characteristics and has provision also for radio, microphone and magnetic tape inputs. The frequency range of the equipment is 2 c/s to 100 kc/s with 28 dB of negative feedback.

Among the p.a. equipment an all-weather "Loud Hailer" with self-contained rotary converter designed to run from 12-volt accumulators is well worth close inspection.

Pamphonic Reproducers Ltd., 17 Stratton Street, London, W.1.

PERMANOID (111)

Two low-loss coaxial cables suitable for use in Bands I and II fringe areas and in most areas of Band III are now manufactured by Permanoid. One, the Type 308, is largely air-spaced with a spiral of polythene cord surrounding the centre conductor. It has a loss 3.5 dB at 200 Mc/s. An even better performance is exhibited by the Type 308EP with an attenuation of only 3.3 dB at 200 Mc/s; for 100ft in every case.

Permanoid Ltd., New Islington, Manchester, 4.

PETO SCOTT (55)

Television receivers are shown on this stand in both 14-in and 17-in models, the sets being otherwise substantially the same. A turret-tuner is fitted and a form of a.g.c. is used on both sound and vision. The video amplifier has a cathode-follower output stage. The c.r. tube is operated at 14 kV.

The sets are for a.c. only and both table and console models are listed.

Peto Scott Electrical Instruments Ltd., Addlestone Road, Weybridge, Surrey.

PHILCO (15)

The range of Philco receivers for this season is wide, including as it does a.m. two- and three-band sets, portables and transportables and a.m./f.m. models. All the Philco television receivers have 13-channel tuners. Car radio receivers with push-button control are also produced.

Emphasis is placed on the comprehensive series of fully tropicalized sound receivers and car radio sets for export.

Electronic training units are also to be shown.

Philco (Overseas) Ltd., Romford Road, Chigwell, Essex.

PHILIPS (27, 42, 43)

Broadcast and sound-reproducing equipment to be shown for the first time includes a car radio receiver, a table model television set, a portable record player with built-in amplifier and automatic changer and a new record changer unit. There is also a new range of high-quality sound reproducing units.

The new television receiver has a 17-in tube and is fitted with an all-channel turret tuner. Flywheel sync and a.g.c. are included.

Among the sound receivers is an a.m./f.m. model embodying a rotatable ferrite rod aerial for long and medium wave reception and a dipole for v.h.f. Push-button controls are provided.

The new Philips car set is a two-unit model with separate speaker and is permeability tuned.

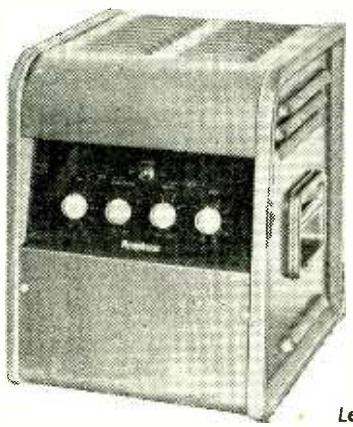
Philips Electrical, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

PILOT (56)

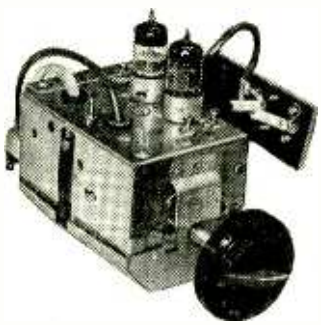
This exhibit includes a new range of television receivers with 13-channel turret tuners to which coils are ready fitted for four channels in Band I and three in Band III. Automatic gain control and flywheel sync are embodied in all sets.

The range of sound receivers

(*Continued on page* 423)



Left: Pamphonic 10-watt amplifier, type 600V.



Pilot turret tuner adaptor kit.

includes a mains portable with ferrite rod built-in aerial and a battery-mains set. There are also two new receivers and one radio-gramophone which cover the v.h.f. band.

Pilot Radio, Ltd., Park Royal Road, London, N.W.10.

PLESSEY (122)

This firm manufacture a very wide range of components and accessories exclusively for the radio and electronics industries. Their exhibit consists of a selection of components and parts illustrating the vast scope of their activities. Many new items are in evidence and particular attention has been given to meeting the requirements of overseas visitors.

The Plessey Co. Ltd., Vicarage Lane, Ilford, Essex.

PORTOGRAM (65)

Record reproducers of the portable type have for many years been the speciality of this firm, and a wide choice of specifications is offered.

In addition, two interesting new console reproducers have been developed. The HF65 is for record reproduction and incorporates a high quality amplifier and twin loudspeakers arranged to radiate from the sides of the cabinet to give wide sound diffusion. There is ample record storage space and provision for the addition of an f.m. feeder unit. Model TR100 is primarily a console tape recorder and reproducer with space for the inclusion of a gramophone turntable or record changer and an f.m. feeder unit. In this model a large bass-reflex enclosure is associated with the loudspeaker.

Portogram Radio Electrical Industries Ltd., Preil Works, St. Rule Street, London, S.W.8.

PYE (30)

Details of the Pye exhibit were not available at the time of going to press. In addition to the normal range of television and sound broadcast receivers a special display of high-quality sound reproducing equipment is to be staged.

Pye, Ltd, Radio Works, Cambridge.

R.A.F. (306)

Amongst the equipment being shown by the R.A.F. is the "sonobuoy" used by aircraft for the detection of submarines. The cylindrical buoy, 6 inches in diameter, houses a transmitter which is automatically switched on when dropped into the sea. All underwater noises in the vicinity of the buoy are picked up by a microphone and radiated by the aerial which is automatically erected when the transmitter is switched on.

Examples of air traffic control equipment, ground and air-borne transmitters and a pictorial display of telemetry as used in guided missiles will also be seen on this first-floor stand.

Air Ministry, Whitehall Gardens, London, S.W.1.

RCA PHOTOPHONE (110)

Inputs for magnetic and crystal pickups, radio, tape and microphone are provided in the control stages of the RCA "High Fidelity" 12-watt amplifier. The microphone input can be mixed with the radio/tape input.

Disc playback characteristics conform to the 1955 R.I.A.A. recommendations, and are supplemented by a high-pass filter (cut-off 20 c/s) and optional low-pass cut-offs at 10, 7 and 5 kc/s with slopes variable up to 35 dB/octave. Variable bass and treble controls give up to ±15 dB at 30 c/s and 15 kc/s.

The main amplifier is stated to be flat within 0.2 dB between 20 and 25,000 c/s, to have total harmonic distortion less than 0.1 per cent at 10 W, 700 c/s, and a noise level 85 dB below the rated output of 12 watts.

RCA Photophone Ltd., 36 Woodstock Grove, London, W.12.

R.G.D. (11)

Two new television receivers (1756T and 1756C) employ "Synchrolock" circuits for line timebase stability under adverse conditions of reception.

The new "Three-Fifteen" radiogramophone includes a v.h.f. band, and this feature is also provided in the "One-Twelve" table-model receiver.

Other new models to be seen are the "Three-Twelve" console automatic radio-gramophone with 2½-watt output, and the "Five-O-Five" automatic record reproducer.

Radio Gramophone Development Co. Ltd., Eastern Avenue West, Mawneys, Romford, Essex.

R.S.G.B. (310)

Amateur television transmission, demonstrated on a closed circuit, a low-power portable transmitter, typical of those used for field days, and an automatic morse sender are features of the Society's stand.

The "R.S.G.B. Amateur Radio Call Book" and "A Guide to Amateur Radio" are among the Society's publications available on this stand.

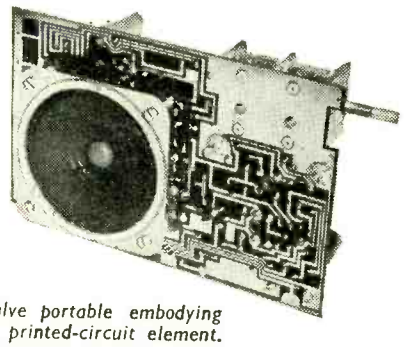
Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.1.

R.T.R.A. (302)

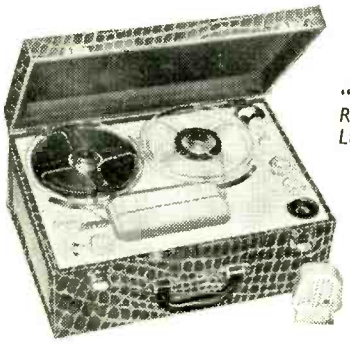
As would be expected this stand is devoted exclusively to the requirements of the dealer. On it will be found details of the various services offered by the Association to its members; in particular the receiver maintenance-insurance scheme oper-

Portogram HF65 record reproducer incorporating twin loud-speakers.

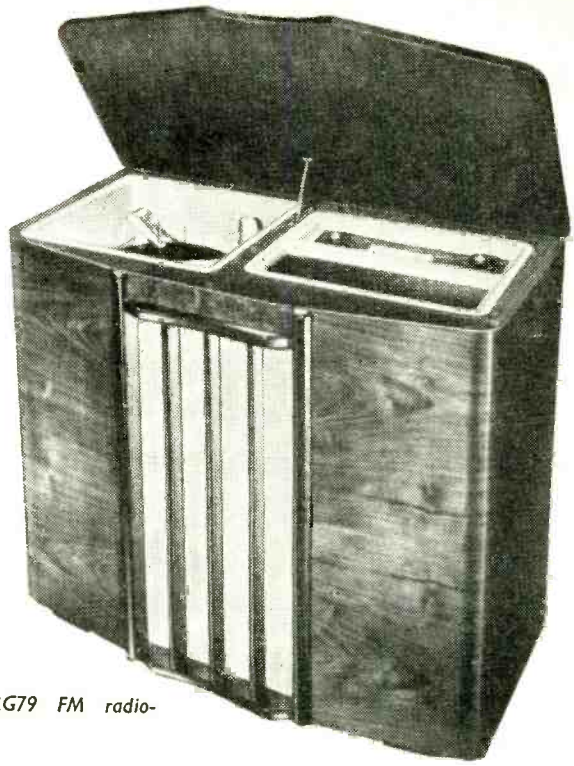
R.C.A. Photophone 12-watt "High-Fidelity" amplifier.



Four-valve portable embodying T.C.C. printed-circuit element.



"Editor Super" (Tape Recorders (Electronics) Ltd.



Regentone ARG79 FM radio-gramophone.

ated by Telesurance through R.T.R.A. dealers.

Radio and Television Retailers' Association Ltd., 26 Fitzroy Square, London, W.1.

REFLECTOGRAPH (203)

In the tape mechanisms which form the basis of this firm's magnetic recorders and reproducers, a unique continuously variable speed control is employed. Models are available for industrial and scientific applications as well as for domestic high-quality sound reproduction.

The latest development is the Model RR100 which has separate amplifiers with facilities for monitoring during recording. Four transistors are employed in the playback amplifier with the object of reducing residual hum below the level possible with valves.

Rudman, Darlington (Electronics) Ltd., Wednesfield, Staffs.

REGENTONE (38)

A new table-model sound receiver (A155FM) and two radio-gramophones (ARG79FM and ARG89FM) provide facilities for v.h.f. as well as long, medium and short waves. These will be supported by a wide choice of popular models, including the ARG77 and the Multi 99 table radio-gramophone.

The established television range of five models, two table, two console and a combined television-radio-gramophone, continues unchanged.

Regentone Radio and Television Ltd., Eastern Avenue West, Romford, Essex.

ROBERTS (117)

Efficient circuitry and meticulous attention to finish and external appearance characterize the portable sound receivers made by this firm. There is a choice of types for battery, mains or mains/battery operation and more recent models are fitted with "Ferroxcube" aerials.

Roberts' Radio Co. Ltd., Creek Road, East Molesey, Surrey.

ROLA CELESTION (17)

In addition to representative examples of loudspeakers for set manufacturers, a number of special types will be shown to illustrate the versatility of the company's manufacturing resources. P.A. units for covering large areas, sources for underwater communication and flame-proof types for use in mines and oil refineries will be included in the display.

Rola Celestion Ltd., Ferry Works, Summer Road, Thames Ditton, Surrey.

S.T.C. (119)

A range of selenium rectifiers, including h.f. types, is to be shown. There will also be a series of rectifiers for sound and vision broadcast receivers as well as e.h.t. tubular rectifiers and "Q" type unistors. Three groups of high-voltage lightweight aluminium rectifiers, including types for aircraft and other uses, will also be shown, as will germanium junction power rectifiers and photo-electric cells.

A demonstration is to show the manufacture of tubular rectifiers, including electronic counting of the components used in assembly. Other displays will illustrate the use of germanium power rectifiers and servo-motor control through a photo-electric cell.

Standard Telephones & Cables, Ltd., Connaught House, 63 Aldwych, London, W.C.2.

SAPPHIRE BEARINGS (304)

As one of the industry's principal manufacturers of gramophone reproducing styli, this firm will be showing examples of "flame-fashioned" surface finish under the microscope. A modern type of shadowgraph will also demonstrate the method of checking the radius of the point to 0.0001in.

Sapphire Bearings Ltd., 96a Mount Street, London, W.1.

SIMON (10)

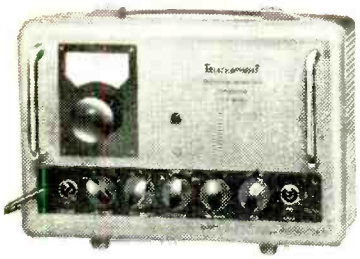
Magnetic tape recorders for domestic and professional use are represented by the recently introduced portable Model SP/2 and by a replica of the long-duration tape monitoring equipment installed in the control tower at the Royal Aircraft Establishment, Farnborough.

The Model SP/2 is notable, among other things, for the ready accessibility provided by the redesigned case, and for the fact that it includes an independently available 10-watt reproducing amplifier.

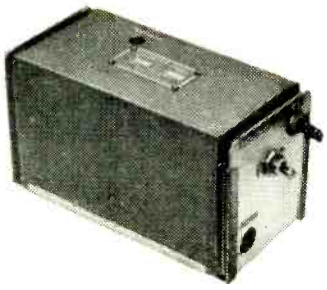
Simon Equipment Ltd., 48-50 George Street, London, W.1.

SOBELL (19)

The range of sound broadcast sets includes models covering the f.m. Band II and radio-gramophones.

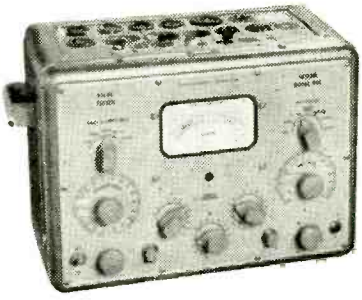


Telequipment 2-band television pattern generator, Model WG44.



Spencer-West Band III convertor.

Reflectograph Series RR100 tape recorder.



Taylor Model 45C valve test set.

Television models include 14-in and 17-in types and are for a.c./d.c. operation covering Bands I and III with turret tuning.

Radio & Allied Industries Ltd., Langley Park, Slough, Bucks.

SPECTO (206)

This firm is showing a magnetic tape reproducer for tape records having the C.C.I.R. characteristic. The output has 15 W output with a response within ±0.5 dB from 10 c/s to 20 kc/s. The harmonic distortion at 10-W output is claimed to be under 0.4% at 40 c/s and less at higher frequencies. Treble and bass tone controls are provided.

The reproducer and amplifier are available together or separately.

Specto Ltd., Vale Road, Windsor, Berks.

SPENCER-WEST (211)

In addition to pre-amplifiers for television and distribution amplifiers for Bands I, II and III, this firm is showing a range of convertors. The Type 30 is a simple model to permit reception of one station in Band I and one in Band III, while the Type 33 provides two channels in Band III. This has a neutralized-triode r.f. stage with a pentode mixer and triode oscillator. A feature of the unit is that remote switching for station selection is provided.

The "Adder" is a more elaborate convertor for 13 channels and provides an output at intermediate frequency.

Spencer-West Ltd., Quay Works, Great Yarmouth.

STELLA (51)

Models making their first appearance include a portable mains/battery broadcast receivers in a plastics case; a ferrite rod aerial is fitted. A new console radio-gramophone includes provision for v.h.f. reception, for which a built-in dipole is provided.

A new table-model television receiver, fitted with a 17in tube, is designed for use within the service areas. It embodies a.g.c. on both sound and vision and is fitted with a turret tuner.

A record player with a built-in three-valve amplifier has been introduced; this is additional to the model ST50A portable record player for use with existing amplifiers.

Stella Radio and Television Company, Ltd., Oxford House, 9-15, Oxford Street, London, W.1.

T.C.C. (45)

A special feature is made this year of capacitors designed especially for television receivers covering Band III and, with an eye to the future, Band IV also (470-585 Mc/s). These are all ceramics and consist of lead-through and stand-off bypass capacitors constructed from "Hi-k" (high dielectric constant) ceramic and small pre-set trimmers made from "Low-k" ceramic.

For circuits where high capacitance couplings are wanted in a reasonably small physical size T.C.C. have a range of "Superlitics"; these are electrolytics with leakage resistances comparable to many paper types.

A new development is a sub-miniature electrolytic of high capacitance and low-voltage rating for use in transistor circuits.

Printed circuits are becoming an important activity of T.C.C. and the many different specimens shown exemplify the various applications now found for these assemblies in radio and electronic equipments.

Telegraph Condenser Co. Ltd., Wales Farm Road, North Acton, London, W.3.

TAPE RECORDERS (66)

The "Editor" and "Playtime" series of tape recorders have been augmented by the "Editor Super Hi-Fi" and the "Playtime Plus." In the former a large-diameter loudspeaker is mounted in the detachable lid, and in the "Playtime Plus" a playback amplifier has been included. The new "Playtime Plus" weighs only 20lb.

Tape Recorders (Electronics) Ltd., 3 Fitzroy Street, London, W.1.

TAYLOR (6)

Prominent among the new pieces of test equipment introduced this year is a versatile valve tester known as the Model 45C. Valveholders to accommodate all valves in current use, English, Continental and American, are disposed about the top with the controls on the front. Charts give test conditions for over 4,000 valves.

Other items of particular interest at the present time are a signal generator covering Band III television wavelengths, a 20-kΩ/V test meter and a television/f.m. receiver alignment frequency-modulated oscillator; the range is 5 to 250 Mc/s.

Taylor Electrical Instruments Ltd., 419-424 Montrose Avenue, Slough, Bucks.

TELEQUIPMENT (105)

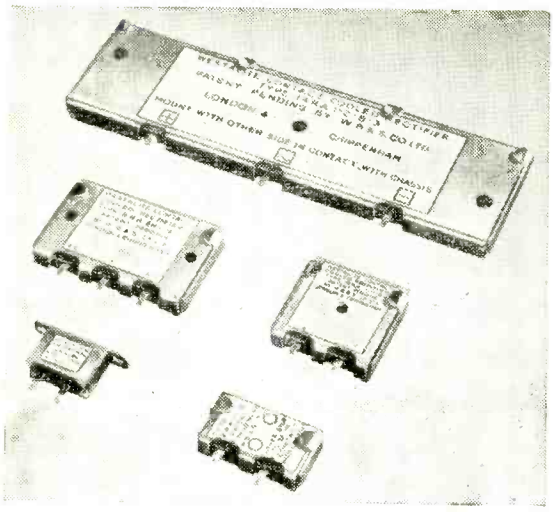
The WG44 television pattern generator made by this firm covers both the Band I and Band III television frequencies and gives the choice of several combinations of horizontal and vertical bars for testing a receiver in the absence of a "live" broadcast. They make, also, factory-type test equipment and a high-grade oscilloscope.

Telequipment Ltd., 1319a High Road, Whetstone, London, N.20.

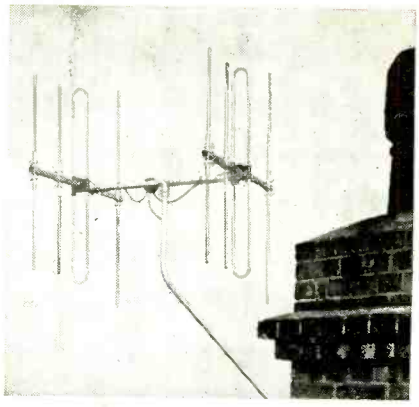
TELERECTION (7)

A distinctive feature of this firm's multi-element Band I television and f.m. aerials is that a "delta" matching system is employed for the feeder. Some aerials are also given a slight upward tilt; this is particularly noticeable in the "Multimus" series of 4-element fringe area types; which incidentally now includes one for f.m. broadcasting.

Between the fringe area types and single dipoles comes a considerable number of intermediate patterns for all three v.h.f. bands for use at various distances from the transmitters Indoor and outdoor types types are included. Fringe area



Westinghouse contact-cooled rectifiers.



Wolsey Model BAY4 Band III fringe-area television aerial.

Band III aerials are now available with six or more elements, and in general folded dipoles are used.

Telerection Ltd., Antenna Works, St. Paul's, Cheltenham, Gloucester.

TELEVISION SOCIETY (315)

In addition to providing a rendezvous for members and visitors, the stand of the Television Society also serves as an information bureau. Reprints of some of the papers read before the Society during the past year or so, including Gouriet's "Introduction to Colour Television," will be available.

Television Society, 164 Shaftesbury Avenue, London, W.C.2.

TRIX (26)

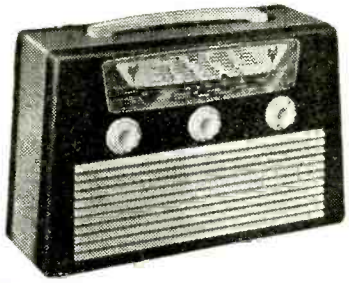
A wide variety of sound reproducing equipment for high-quality domestic and public address applications is made by this firm. The "Recital" console gramophone, which incorporates the Model T41 amplifier, has been improved in detail finish, and a new series of cases and improved amplifier performance are to be found in the "Trixette" range of portable gramophones.

For p.a. work a new 150-watt amplifier (Model T152) has been developed which can be duplicated and operated from a single drive unit (Model T152ID) to give 300 watts for large installations. A new moving-coil microphone (Model G7871) and general-purpose p.a. loudspeaker (Model G7073) are available, and for motor coaches a small, simplified battery-operated amplifier (Model B65/MX) provides an output of 5 watts.

Trix Electrical Co. Ltd., 1-5 Maple Place, London, W.1.

ULTRA (41)

Television receivers with tubes of 14in, 15in and 17in are shown by this firm and all provide for reception in Bands I and III. The



Vidor "Marquisa" all-purpose mains portable.

VT9-17 is for a.c./d.c. operation and has a.g.c. on both sound and vision.

Broadcast sets covering the f.m. Band II as well as medium and long waves are also shown. One such model forms part of a radio-gramophone in which the automatic changer can deal with 33⅓, 45 and 78 r.p.m. type records.

The "Ultra Twin," an a.c./d.c./battery portable, is now available in a cabinet with sliding doors.

Ultra Electric Ltd., Western Avenue, Acton, London, W.3.

UNITED APPEAL FOR THE BLIND (316)

At the invitation of the Radio Industry Council, the "United Appeal," which acts on behalf of a number of associations for the blind, is again staging a live demonstration to show how blind people can take their place in the radio industry side-by-side with their sighted colleagues. The equipment for the demonstration is provided by Philips Electrical.

United Appeal for the Blind, 28 Manchester Street, London, W.1.

VALRADIO (118)

The tuner produced by this firm, and used in their television receivers, provides for sound reception in Band II as well as for television in Bands I and III. It covers the range 40-100 Mc/s in four steps and 170-225 Mc/s in two steps. Continuous tuning between the steps is effected by the permeability method.

Valradio, Ltd., New Chapel Road, High Street, Feltham, Middx.

VIDOR (28)

Two new 12-channel table-model television receivers have been introduced this year; they are the Models CN4230 and CN4231; both embody the same receiver chassis, but the former has a 14-in tube and the latter a 17-in. A small but important point is that the tube protecting glass is easily removable for cleaning.

Among the many portables is a new 4-valve, 2-waveband model, the CN432. It is a very small "upright" style, all-dry battery operated with low-consumption valves, a 5-in loudspeaker and a ferrite rod aerial.

The display of receivers is supported by a full range of dry batteries, including hearing-aid types.

Vidor Ltd., Erith, Kent.

WEARITE (218)

One of the pioneers in this country in the design of tape mechanisms for magnetic recording, this firm will be showing the versatility of their "Tape Deck" as applied in industrial and Service equipment as well as in the "Ferrograph" portables for sound recording and reproduction.

The Wearite range of audio and radio components is supplemented by new coils and transformers for v.h.f./f.m. receivers.

Wright and Weaire Ltd., 131 Sloane Street, London, S.W.1.

WESTINGHOUSE (101)

Contact-cooled rectifier units in a wide choice of ratings have recently been introduced for use in television and sound broadcast receivers. These units are designed for mounting in close contact with a metal chassis, and, by dissipating their heat through it, allow a reduction in bulk, cooling fins being no longer

equired. The emphasis of the Westinghouse exhibit will be on the nore specialized types of rectifiers uch as germanium crystal, copper-oxide units for measuring instruments, "Westectors" and some niniature high-voltage units.

Sealed tubular rectifiers with quadruple-voltage elements are shown for providing e.h.t. for cathode-ray tubes.

Westinghouse Brake & Signal Co., Ltd., 82, York Way, London, N.1.

WHITELEY ELECTRICAL (25)

The new WB12 high-quality amplifier and feeder unit makes use of the "ultra-linear" method of connection in the output stage and has switched selection of pickup matching. A new f.m. tuner has also been developed.

A 15-in concentric duplex unit and a ready-to-assemble corner reflex cabinet kit for 10-in and 12-in units have been added to the loudspeaker range, which includes cambric cone types from 2½in to 18in in diameter.

Representative examples of the wide range of components supplied to industry and the Government departments will be shown.

Whiteley Electrical Radio Co. Ltd., Victoria Street, Mansfield, Notts.

WOLSEY (5)

This year a special feature of Wolsey Band-III television aerials is that the insulators on the aerials are made of polythene specially moulded to provide a good waterproof junction between the dipoles and the insulator.

The range of aerials has been greatly extended and, while the main emphasis is on Band-III types, both existing television requirements and v.h.f. sound are fully provided for. Pre-assembly in the factory is still one of the main features of this firm's products.

Wolsey Television Ltd., 43-45, Knight's Hill, West Norwood, London, S.E.27.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

"Tape Bookmark"

A METHOD I have been using for "finding the place" on magnetic tapes is to impose a large amplitude subsonic on the tape—about 2c/s from a dippy oscillator for 30 sec. I find about 20V into the recording amplifier, which normally requires 50mV mean, is ample. Where the recording head is fed from an output pentode via a high resistance, shunting the resistance with a 4μF paper capacitor should be effective.

On fast wind or rewind, although the tape is about ¼in from the playback head, a loud note is heard in the 100-400c/s range, according to the tape speed. By counting these markers, which are placed between each item, I can find the right place on the tape.

A simple switching circuit could be made to operate a device like the selector shown in the article by Price and Frewer in your April, 1955, issue.

The only drawback is that the indexing can only be done on one track, as, although it does not affect the adjacent track in any way, it comes through on fast rewind whichever track is in use. If difficulty is found with erasure, a permanent magnet can be used to remove the last traces of the subsonic.

Coventry. R. G. WICKER.

FOR office dictation and telephone recording, where it is only necessary to mark the interval between messages, I have found it useful to inject into the head for a second or two a small voltage at 50c/s, derived from the filament circuit, which gives a recognizable signal on fast wind.

Manchester. E. S. RUSHTON.

Magnetic Tape Characteristics

IT is refreshing to read the article "Does the tape characteristic matter?" in your March issue and still more to note the conclusions you reach. The fact that "it depends on the machine" is only too well known to tape manufacturers but not all machine manufacturers realize it as yet and very few of the users.

It is perhaps going too far to suggest that, if a tape has, in its own right, a characteristic, then so has a mu-metal stamping but the underlying idea is quite logical. There are one or two factors, in addition to those mentioned in the article, which may possibly have influenced some of the characteristics shown, such as optimum bias current (query: were all the runs on any one machine carried out with a fixed bias current?), surface smoothness and tape thickness, although this last factor is perhaps implied at the end of the first paragraph. Differences in top response between machines could, of course, be due in part to different air-gap width of the playback head.

As regards the one specific anomaly you mention, tape No. 4 may be of lower coercivity than tapes 5 and 7 and the bias field strength may be lower on machine (C) than on the other two. As a result the bias value may be nearer the optimum on machine (C) for tape 4 but too low for tapes 5 and 7. At the same time tapes 5 and 7 show good top response on machine (C) as might be expected if they were of higher coercivity and under-biased.

What is puzzling is the pair of curves on machine (C) for tape 6. Were they taken with the tape running in opposite directions or—horrible thought—with the coating in contact and remote from the head?

Slough, Bucks. H. G. M. SPRATT.

The Cascode

"CATHODE RAY'S" statement on page 399 of your August issue that a.g.c. would be ineffective if applied to Fig. 1 is incorrect. In fact, the required voltage for any given control is roughly one half that required by Fig. 2. When the valve is used as in Fig. 1, the characteristics approach that of a "straight-mu" type and in Fig. 2 that of a "variable-mu" type.

The circuit shown in Fig. 2 is usually preferred since its cross-modulation characteristic is superior. This point is fully discussed in *RCA Review*, March, 1951, in an article "Use of new low-noise twin triode in television tuners." G. R. WOODVILLE.

M.O. Valve Company.

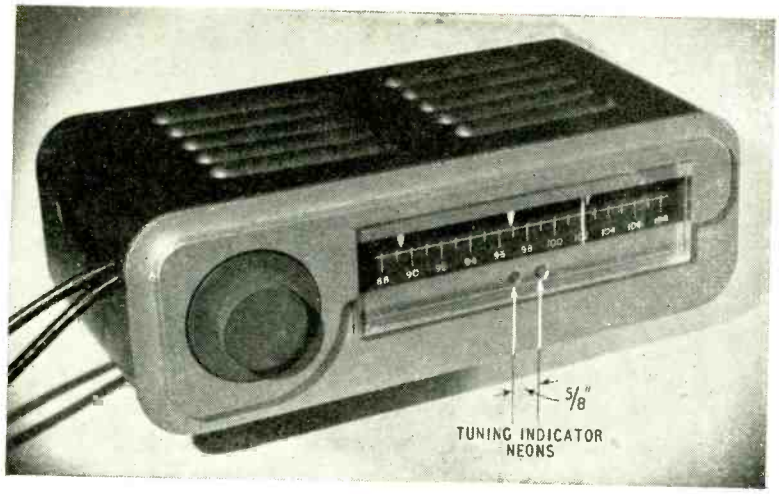
Cathode Ray writes:—My apology to readers for my misstatement about the cascode, and thanks to Mr. Woodville for correcting it.

Battery-mains Short-circuits

I HAVE had in for repair many battery-mains receivers, and in several cases filament and/or dropping resistor breakdowns have been the result of partial short-circuits due to the battery leads, where batteries are not *in situ* and mains operation is used, contacting with the metal chassis or components underneath.

Surely it would be a simple matter for manufacturers of these sets to provide dummy sockets in the cabinet material to take these leads, and thereby prevent many unnecessary breakdowns and other complaints?

Stowe, Buckingham. W. H. JARVIS.



NEON F.M. TUNING INDICATOR

By
JOHN D. COLLINSON*

High Sensitivity with Indication of + or −

To the listener interested in high-quality sound reproduction a frequency-modulated v.h.f. broadcast system approaches the ideal. In contrast to the medium-wave a.m. service, it is difficult to design an f.m. receiver with a poor audio-frequency response. A wide frequency response in itself, however, is of little value if impulse noise is allowed to obtrude on the programme, or if non-linearity distortion in the receiver mangles the signal before application to a "$D_{tot} \leqslant 0.01\%$" high-fidelity amplifier.

Both noise and distortion can be kept to low values in well designed and aligned receivers, but the user must play his part in getting the best performance from any given set by tuning it in correctly.

If a receiver is correctly designed and aligned so that the i.f. passband and the discriminator characteristic are symmetrical, and the i.f. signal produced by the received unmodulated carrier is exactly in the middle of the passband, impulse noise will be fully rejected.

The phase-modulated components of the noise, being evenly distributed throughout the passband, correspond to a signal whose mean frequency is that of the midpoint of the passband, so that the discriminator output is zero. If the carrier is mistuned a standing d.c. will appear at the discriminator output which reduces to zero for the duration of the noise. Thus an audio signal will appear proportional to the amount of standing d.c., which in turn is proportional to the amount by which the carrier is mistuned.

Sources of Distortion

Non-linearity distortion can arise both in the i.f. amplifier and the discriminator. If the carrier is mistuned, large deviations can swing the signal past one side of the flat top of the i.f. amplifier passband. Amplitude variations are removed in the limiter stage, but phase changes occur at the same time. When demodulated the audio signal will be asymmetrical, showing the presence of added even harmonics. The discriminator will add its quota of distortion as it is only linear over a limited range on either side of zero output, so that if the carrier is mistuned it must deviate more into the non-linear region.

From the foregoing we may conclude that in the absence of a tuning indicator, the user may resort to two stratagems:— (a) await the passage of an unsuppressed motor-car, then hurriedly tune out its ignition noise, or, (b) tune for minimum intermodulation during loud passages in the programme. With either method, the correct tuning point tends to be elusive, and some form of indicator is essential, if only to stop doubt gnawing at the mind of the technical purist.

As the negative voltage at the limiter grid is proportional to the signal strength, it would appear that it might be applied to a "Magic Eye" in the same manner as the a.g.c. voltage in an amplitude modulation receiver. Tuning for minimum shadow angle should then give the correct tuning point. However, the main requirement of an i.f. amplifier in a

* The Acoustical Manufacturing Co., Ltd.

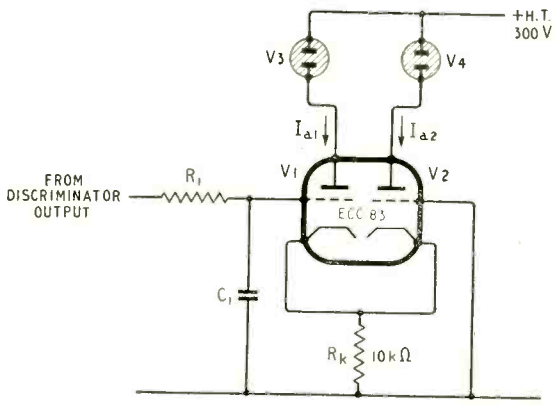


Fig. 1. Complete circuit diagram of neon tuning indicator. V3 and V4 are miniature uncapped neons (Hivac, type CC11L). These are also available with M.E.S. cap and designated CC10L.

frequency-modulation receiver is that it shall have a flat frequency response over some 200 kc/s bandwidth; thus the mid-point is indeterminate. Any attempt to get a well-defined peak at the limiter grid will degrade the phase response of the i.f. amplifier, which introduces odd-order distortion in the audio signal. It is therefore necessary to provide a separate high-Q circuit, tuned exactly to the middle of the i.f. passband, to rectify the resultant signal and to feed that to the indicator. This throws a heavy responsibility on the stability of the auxiliary tuned circuit, and such an indirect approach seems unwise.

A better method is to indicate zero d.c. output from the discriminator. Indicating nothing, however, presents its own problems. One of the best solutions is to use a centre-zero meter. This not only shows the correct tuning point, but whether the set is off-tune, and the direction in which it is off-tune, without having to alter the tuning control. It has the disadvantage that as the demodulator currents are small, a valve voltmeter circuit has to be used, which together with the cost of the meter movement itself is uneconomical, not to speak of the difficulties of finding a meter which "blends with the *décor* of one's home."

A simple and reliable circuit has been developed (Fig. 1) that gives a visual indication of the correct tuning point which may be interpreted in the same manner as a meter. It consists basically of a cathode-coupled amplifier in which one grid is taken to a reference potential, in this case zero d.c. or earth. The other grid is taken to the output of a Foster-Seeley discriminator. If both potentials are equal, then equal currents flow in both valves. If the potentials are not equal, e.g. V1 grid is positive to earth, then I_{a1} increases, making the common cathodes more positive. The negative potential between V2 grid and its cathode is increased, and I_{a2} decreases. The current flowing in each valve is indicated by the brilliance of the two miniature neon lamps in series with each anode. With the type of neon specified, the light output is approximately 0.25 lumens per mA.

The human eye is not particularly good at estimating absolute light output, but it is very much better at estimating the relative output between two lights closely spaced. This ability is aided in the circuit arrangement used, as the eye has not merely to compare the brilliance of a light against a fixed reference, but against one varying in the opposite direction (Fig. 2). Thus, by tuning the receiver until both neons are of equal brilliance, a very sensitive indication is given of zero output from the discriminator. In practice the sensitivity of the system can be such that provided *both* neons are obviously alight, the tuning error has negligible effect on the receiver performance.

The indication given by the plain neon lamps is not ideal as the glow surrounds only one of the parallel electrodes on d.c., and when viewed from the side, the random change of glow position is distracting. For this reason it has been found better to view the neons end-on via a low-loss diffusing screen. A suitable material is $\frac{1}{16}$in opal Perspex (I.C.I. Colour No. 030). When mounted close together the glow from one neon may be screened from the other by a light-coloured opaque sleeve over the body of the bulbs, the light colour helps to reflect the light forward through the diffusing screen.

The performance is determined by the choice of valve, the common cathode resistor, and the h.t. supply. The standing bias on the valve grids must be chosen so that the current through the neon is limited to about 0.7 mA in the unbalanced condition. The cathode load resistor determines the see-saw action which takes place when the receiver is mistuned. With finite values of μ and R_k the anode current changes will not be equal and opposite, but unbalance is immaterial as it reduces to zero at the working point. In practice the small current demand allows a high value of R_k to be used and this performs the dual function of bias and cathode load resistor.

The components C_1R_1, whose time constant is comparable to the period of the lowest frequency likely to be encountered, are used to filter the audio signal from the discriminator output. Without this filtering both neons will appear to brighten simultaneously with a heavily modulated signal, thus obscuring the d.c. component.

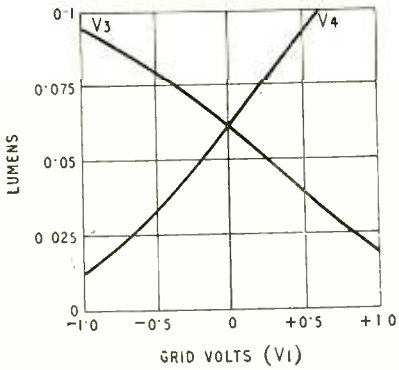


Fig. 2. Light output of neons plotted against discriminator output voltage for circuit of Fig. 1.

With the typical circuit shown in Fig. 1 connected to the output of a Foster-Seeley discriminator, there is a clear indication of the correct tuning point within ±3 kc/s. The only difficulty anticipated was the fact that as the indicators show equal brilliance in the absence of a carrier, it was thought that steps would have to be taken to suppress the indicators when the limiter grid current was low. However, this proved unnecessary as one or other indicator is extinguished before the wanted carrier is heard.

There is no reason why this indicator should not be used with a ratio detector *provided that it is of the balanced type*, but the d.c. output per kc/s of deviation will be considerably less than that of a Foster-Seeley discriminator.

"Band II F.M. Tuner Unit"

ALL the coils specified on p. 374 of this article in last month's issue can also be supplied by Wright and Weaire Ltd. The "Wearite" type numbers are:—

Aerial coil L_1, L_2	757
R.F. choke L_3	758
R.F. coil L_4	756
Oscillator coil L_5, L_6	755
Ist i.f. coil L_7, L_8	751
2nd i.f. coil L_9, L_{10}	752
Ratio detector transformer L_{11}, L_{12}, L_{13}	753
I.F. traps L_{14}, L_{15}	759

The escutcheon for the EM80 tuning indicator can be supplied by McMichael Radio Ltd.

Toronto Audio Show

Some Personal Impressions

By P. G. A. H. VOIGT,* B.Sc., A.M.I.E.E.

ON the North American continent, audio fairs tend to run to a pattern. The recipe appears to be quite simple. Take one or more floors of a suitable hotel. Give the inmates of any of the rooms accommodation elsewhere. Remove the beds and some of the other furniture. Collect several dozen manufacturers, agents, importers, distributors, wholesalers, retailers and others commercially interested in "hi-fi," and persuade them that taking space would be to their advantage. Prepare a catalogue with all appropriate information you can lay hands on, including information which the above manufacturers' agents, etc., will supply. Have a few tons printed and on hand. Advertise on the radio (including television), in the Press and by every other publicity method you can think of, and then, by opening day, you will find that you have an Audio Show on your hands.

It is a fairly safe bet that something unexpected is sure to happen, so it is well to have all routine matters under control well in advance. The Toronto Audio Show was no exception to the general rule.

That part of Canada which includes Toronto looks like the foot of Italy and sticks down into the U.S., is supplied with "the Hydro"—a rather special type of alternating-current at 25 c/s which was adopted when the hydraulic power stations were built at Niagara Falls in the early days of electricity. New sources at 60 c/s are being built rapidly, but are claimed for new outlets in an expanding economy, with the result that many parts of Toronto, including the Prince George Hotel, where the Show was held, are still on 25 cycles.

The problem was tackled by disconnecting the wiring of the two floors used for the Show at the distributing box, and connecting temporary leads to a large frequency converter hired for the purpose. Excellent, all set and the Show ready to open.

Naturally each exhibitor had to be rationed as regards the power he could draw, for every converter has its limits. For some unknown reason, however, the total demand exceeded the safe loading of the converter. Perhaps it was that some exhibitors did not count their illumination as part of the load, or their equipment took more watts than it should, according to its specification. We shall never know exactly what the cause was, but it did not take that converter long to become very hot. The result was that after running for a while, the power would shut off, stay off for five minutes or so and then come on again. The matter was coped with by the second day, but on the first one's most vivid recollection was of waiting in the dark for the power to come on again and give the equipment a chance to continue its performance!

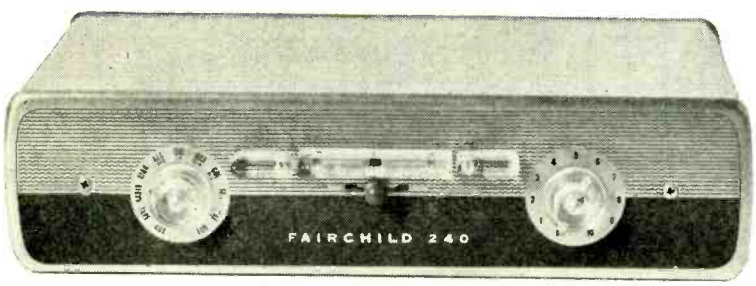
The test of the value and success of an exhibition is measured in terms of how many paid for admission, and even if some of the approximately 4,700 paid admissions represent repeat visits, it seems that on average over 1,000 new visitors came to the Show each day. For many, there can be little question but that this was the first occasion on which they heard reproduced sound of vastly better quality than that from the average radio. From this point of view alone, namely educating the public, the show must be counted a success. What the balance sheet worked out at is none of our business, what matters is that at the *first* such show in Toronto the public showed a lively interest.

Canadian "Hi-Fi"

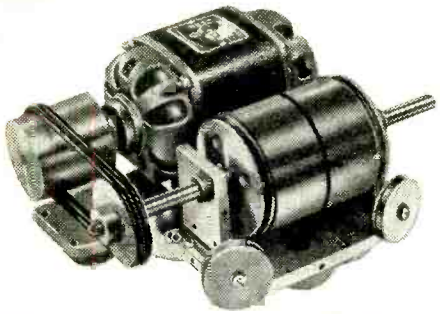
Canada, with its population of less than 1/10th that of the U.S., has, by comparison, only a small market without crossing frontiers and getting tangled up in customs complications, etc. The number of truly Canadian firms on the manufacturing side of the "hi-fi" game is consequently very small. McCurdy Radio Industries do custom work, manufacturing and installing broadcast studio control equipment, etc. Microlab Devices make transcription-type turntables for 25 and 60 c/s supplies, originally for broadcast stations, and now increasingly for "hi-fi" addicts. Dominion Electrohome Industries and the Kelton Company are attacking the domesic "hi-fi" market.

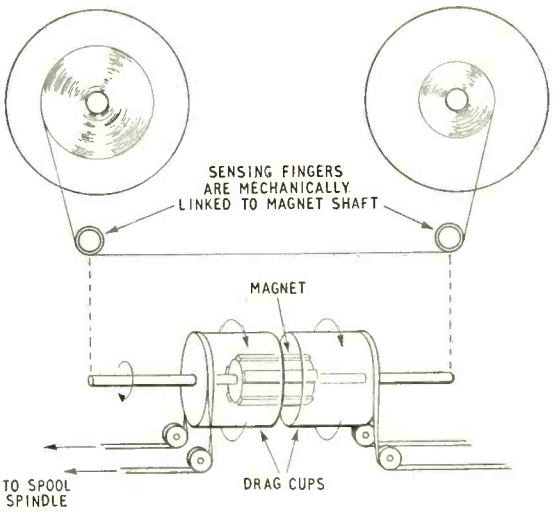
The Kelton speaker system is out of the usual rut and is described as using an acoustic bandpass at low frequencies. The low-frequency speaker has a completely enclosed cavity behind, and another cavity in front from which the sound is radiated via a number of spaced holes. The design is based on a development of the method described by J. J. Baruch and H. C. Lang of the Massachusetts Institute of Technology at a meeting of the Radio Club of America on May 22nd, 1952, and reported on page 30 of the Radio-Electronic Engineering section of *Radio and Television News* for

* Voigt Patents, Ltd., London, England, and Sonograph Engineering and Manufacturing Co., Ltd., Toronto, Canada.



Fairchild Model 240 pre-amplifier showing "balanced bar" tone controls.





"Isimetric" tape drive mechanism in the magnetic recorder designed by the International Scientific Industries Corporation. The sketch on the right indicates the principle of operation.

July 1952. Both the front cavity and the speaker are tuned to the same resonant frequency, and are over-coupled so as to obtain a bandpass effect. Quite a surprising amount of bass was obtained from a small volume, but it is noteworthy that in their best reproducer two of these were used together, two more speakers were used for the middle and also a tweeter, making five in all.

There is no need to discuss the many British components displayed, for *W.W.* readers will know about these already. Practically all the "hi-fi" household names, Goodmans, Wharfedale, Acoustical (Quad), Leak, Ferranti, Garrard, Connoiseur, etc., are effectively represented here. Williamson-type amplifiers, too, either according to the original circuit, or with the Hafler & Keroes† "Ultra Linear" modification are very popular.

Those readers familiar with U.S. magazines would also recognize the many U.S. "hi-fi" products which were being demonstrated. There are in Canada no currency exchange regulations which make the purchase of U.S. goods difficult; all you need is money!

The majority of U.S. manufacturers still tackle the problem of quality speakers for home use on the same basis as one tackles it for high-power p.a., namely to use different speakers for different frequency ranges. The various possible combinations of "tweeters," "woofers" and mid-range speakers that can now be put together could only be calculated with an electronic computing machine. Since, in most of the 50 or so rooms used for demonstrations, there was a variety of combinations to listen to, it will be understood that the writer came away with no very clear picture. He still remains convinced that there is more in loudspeaker design than just getting the widest possible frequency reponse.

The biggest speaker at the show was undoubtedly the U.S. Electro-Voice "Patrician IV." The writer cannot really quarrel with the idea that a speaker should be 62in high, for he designed one of exactly that height two decades ago, but this "Patrician" is 39in wide across the front! It uses one "woofer" driving a folded horn, two speakers for the next range, one for the next, and then a "tweeter," i.e., a total of five, all horn loaded. There is much that can be done with about 35 cu ft in hand. The writer can vouch for the floor-shaking ability of this speaker with suitable organ music, for he was on duty in the room set at the disposal of the Society of Music Enthusiasts, while a firm demonstrating a tape machine with organ music had one of these speakers operating in the room immediately below! Incidentally the price here, allowing for customs duties, 10 per cent sales tax, etc., is just over $1,000 or about £364 at the present rate of exchange.

† Audio Engineering, Nov. 1951.

There were speakers in all kinds of cabinets and enclosures. In some cases panel resonances were killed by damping and in some by rigidity of construction. In one case, this rigidity was achieved in a very simple manner indeed, by using a barrel with the speaker set in the side, and some internal damping material to diminish air resonances. The fact that the name of the distributor of this item is Mr. Bier is purely coincidental!

Amplifiers and pre-amps. of all kinds and with varying numbers of knobs were to be seen. In some cases, notably Quad (British), Philips (Dutch, branch plant in Toronto), National, and Fairchild (U.S.), considerable trouble had been taken to make their product look attractive and not like some piece of experimental equipment out of the lab. The Fairchild pre-amp. used an exceedingly neat way of disguising two of the knobs. Part of the decorative trim is a transparent horizontal strip divided into three parts. The two ends are attached to the bass and treble tone control spindles and the recommended procedure is to find by experiment the preferred setting for these controls, then to withdraw the levers and replace them so that they are in line with the horizontal strip. If for any reason the controls are altered, this is obvious, for they are then no longer in line, and in fact indicate the change in the response curve.

On the Philips amplifier there was also an indicator of response. It consisted of a horizontal white line behind a transparent panel. As the bass and treble control knobs were turned, the appropriate end of the line curved up or down to show how the response had changed.

New Tape Drive

Tape machines were there in great variety. With but one exception, they seemed to be along the orthodox lines. The exception, by International Scientific Industries Corporation, a U.S. organization, was not then in commercial production. The designer of this machine must, at some time, have said to himself, "I don't like the mechanics of ordinary tape machines, let us throw the book away and start again."

Most tape machines also have something which slips

in the drive to the take-up reel though when this "slip" occurs in an electric motor it may not be obvious. Fundamentally the take-up reel needs a low torque, higher speed drive when empty and a higher torque, lower speed drive when full, with a smooth automatic transition from one to the other as the reel fills up. At the time when the take-up reel is empty, and the supply reel is full, the pull of the tape there acts well away from the reel axis and so exerts maximum torque. The brake also has to be stronger at this stage than later on when the reel is not so full. As the supply reel unwinds its speed increases, while the torque due to the tape tension drops. The ideal brake should adjust itself to suit these continuously varying conditions.

The "Isimetric" drive provides both the varying torque and the varying brake action in an elegantly simple way. The primary drive is a toothed permanent magnet rotor, driven from the main capstan motor. The magnet is enclosed by two "drag cups" which are coupled to the spool turntables by driving belts. Eddy currents induced in the cups tend to make them follow the rotation of the magnet, and the torque exerted depends upon the degree of overlap between cup and magnet. The position of the magnet relative to the two cups is controlled by "sensing fingers" which take up positions depending on the angle at which the tape leaves and enters the supply and take-up spools.

An additional manual control puts in extra motional "bias" of the magnet position, so that when both reels are half full one reel, the take-up reel, has more torque than that on the braked reel. To reverse the tape direction the bias is applied in the opposite direction. Torque is thus maintained all the time on both reels, but superiority of torque can be transferred from one reel to the other by moving the control. Very rapid reversals of tape direction are therefore possible without "spilling" tape all over the place; this should please those who need this facility for editing work. They will also appreciate the control over the tape by operating with the bias knob in a nearly balanced position when the tape can be made to move very slowly, the instant reversal feature still being retained.

A separate motor is used to drive the capstan, and is of "inside out" construction, in that the inner part is stationary while the outer part rotates. The motor thus acts as its own flywheel. These are the main features, but other minor ones have been worked on with equal care, in fact the writer was told that the last year has been spent on simplifying the machine. It is most certainly out of the rut, and we may wish those responsible the best of luck, for there are not enough enterprising people in this world.

"Second Thoughts on Radio Theory"

OUR contributor "Cathode Ray" needs no introduction to regular readers of *Wireless World*, for he has been writing in the journal now for over twenty years. To others it should be explained that he is an author who adopts a sympathetic and informal approach to radio theory, expounding in his own way the sort of things the textbooks either miss out altogether or deal with in a dry and stereotyped manner.

A book has now been produced containing a selection of over forty of "Cathode Ray's" articles—and many of our readers will say it has been long overdue. It constitutes an entertaining textbook for the beginner in radio and a first-class refresher course for others. The selected articles are mostly on elementary topics dealing with basic electrical ideas, circuit elements and techniques and circuit calculations; but, as the author himself says, the more elementary the subjects are, the more important it is to get clear ideas on them. Any errors or obscurities in the original articles have been removed and there are additional summaries, diagrams, cross-references, questions to work out and, of course, an index—making in all a total of 409 pages and 266 illustrations.

"Second Thoughts on Radio Theory" can be obtained from any bookseller at 25s or direct from our publishers at 25s 8d by post.

CLUB NEWS

Birmingham.—"High Fidelity Sound Equipment" is the subject of the talk to be given by C. H. Young (G2AK) to members of the Slade Radio Society on September 2nd. At the next meeting (16th), which will be held at the Aston Technical College, Ettington Road, Birmingham, 6, and for which tickets must be obtained from the secretary, the Osram 912 amplifier will be demonstrated. On September 30th Dr. P. D. Whitaker, of Birmingham University, will speak on "The Application of Electronics to Research in Nuclear Physics." Except where otherwise stated the meetings are held at 7.45 at Church House, High Street, Erdington. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

Bradford.—A joint meeting of the Bradford, Leeds and Spen Valley clubs will be held on September 27th at Cambridge House, Bradford, when Dr. M. J. Heavyside (G2QM) will speak on aerials for short spaces and short-waves.

Coventry.—The annual general meeting of the Coventry Amateur Radio Society will be held at 7.30 on September 26th at the Society's H.Q. at 9, Queens Road, Coventry. Sec.: J. H. Whitby (G3HDB), 24, Thornby Avenue, Kenilworth, Warwicks.

Edgware.—Meetings of the Edgware and District Radio Society are held on Wednesdays at 8 o'clock at 22, Goodwyn Avenue, Mill Hill. The next session's programme includes talks on a variety of subjects and practical evenings especially for beginners. Sec.: E. W. Taylor (G3GRT), 99, Portland Crescent, Stanmore, Middlesex.

Edinburgh.—The opening meeting of the 1955/1956 session of the Lothians Radio Society will be held at 7.30 on September 8th at 25, Charlotte Square, Edinburgh, 2. Meetings are held on alternate Thursdays. Sec.: J. Good (GM3EWL), 24, Mansionhouse Road, Edinburgh, 9.

Glasgow.—An effort is being made to start a group of the British Amateur Television Club in Glasgow. Interested readers should communicate with J. W. Bruce, 15, Dowanhill Street, Partick, Glasgow, W.1.

B.A.T.C.—As already announced, the British Amateur Television Club is holding a convention at the Bedford Corner Hotel, Tottenham Court Road, London, W.1, on October 1st. Admission is 5s. Particulars are obtainable from D. Reid, 4, Bishops Road, Chelmsford, Essex.

QRP.—The closing date for entries for the portable equipment contest, organized by the QRP Society, is September 30th. Details of the contest, which is open to non-members, are obtainable from John Whitehead, 92, Rydens Avenue, Walton-on-Thames, Surrey.

Language Translation by Electronics

Novel Application of Digital Computing Machines

By J. P. CLEAVE,* B.Sc., Grad. Brit. I.R.E., and B. ZACHAROV,* B.Sc., Grad. Inst.P.

The idea of using digital computing machines for the translation of languages was first suggested by Dr. A. D. Booth of Birkbeck College in 1946. An automatic translation project is now under way at the college research laboratory, and this article discusses the problem in the light of the experience gained so far. It illustrates the present trend towards the use of computers more for processing information than for straightforward calculation alone.

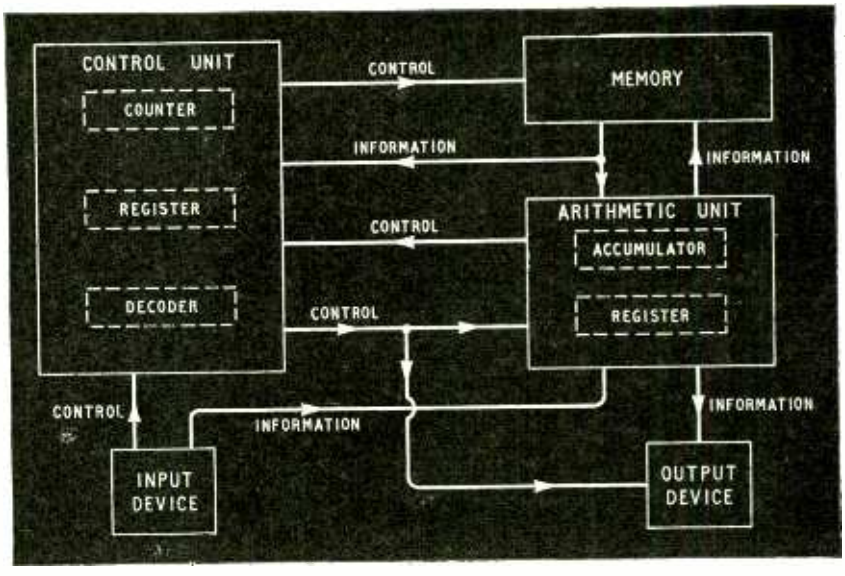
WITH the advent of mechanical calculating machines it became possible to obtain solutions of problems other than mathematical in an automatic fashion. One such problem was the automatic translation of language—the general idea being to code the words into numerical form and cause the machine to operate on these numbers in a certain routine to which the translation process can be reduced. It was only with the development of electronic digital computers, however, that results could be obtained in a reasonably short time and without excessive reference to data stored externally to the machine. In principle a computing machine is capable of automatically translating languages to any required degree of refinement, although at present there are severe limitations owing to the small amount of internal storage space for information that is generally available in the machine. The obstacles that limit the scope and refinement of electronic translation are not, however, insuperable. We can, for example, by employing a human agent to edit the material passing into and out of the machine, obtain results which could only have been obtained automatically with a more complex mode of operation or on a computer of more advanced kind than exists at the present time.

The aim of electronic translation is not to produce a literary masterpiece (though this is theoretically possible with a large enough machine) but to give a more or less semantically and syntactically correct translation of the input text, and in particular to render the vast amount of foreign scientific literature now available intelligible to the scientist. Even very rough translations can be of value here, since they allow the specialist to examine briefly the documents in his particular field of study and to pick out those of special interest. These can then be submitted to a human translator for a more exact rendering.

Restricting the aim of electronic translation to the provision of scientific information simplifies the process by removing questions of style (and so reducing the difficulties of idiom) and by limiting the size of vocabulary. The practicability of the scheme depends, first, on the extent to which the process of translation can be formalized, and secondly, on whether the formalized translation process can be adequately expressed in terms of the "orders" available for controlling the computing machine. It is necessary, in fact, to compile a complete "program" of machine instructions that will carry out sentence analysis and selection of words.

To translate a foreign language it is necessary to have a knowledge of the syntax of the foreign language, a dictionary, and a knowledge of the syntax of the "target" language (meaning, of course, English in this country). The dictionary is a list of foreign

* Birkbeck College Electronic Computer Laboratory.



Essential features of the Birkbeck College computer to be used for translation. Containing some 400 valves, it works on the serial principle and has a basic p.r.f. of 80 kc/s. Operations equivalent to addition and subtraction are done in about 400 microseconds.

language words and their "target" language equivalents, together with grammatical notes indicating possible syntactical functions of the foreign language words. It should also contain a list of contexts in which the foreign language word has a special meaning; for example, the German "unter" is entered in a standard German-English dictionary as follows:

unter (1) preposition: under, below.
~*uns:* among ourselves.
nicht ~ein Pfund: not less than one pound.
(2) adjective: lower, under, inferior.
(3) prefix: under, among.

A knowledge of the foreign language syntax enables one to decide what are the grammatical functions of the foreign words (whether nouns, verbs, prepositions or what) and hence which blocks of words function as subject, direct object, indirect object, etc. in a sentence or clause. The knowledge of the "target" language syntax permits the rearrangement of the translated foreign words blocks into the appropriate "target" language order and the appending of necessary syntactical word endings.

Mechanized Translation Procedure

With these basic sources of information, then, it is possible to lay down in outline a definite procedure for the translation in terms of mechanical operations. First, it is necessary to determine the grammatical functions of the foreign language words. This is done by reference to the dictionary and is easy to systematize in a computer. The dictionary information about the possible grammatical functions of the word under consideration can be made to initiate an examination of a small context, say one word on either side, to resolve the ambiguity. For example, suppose "unter" (see above) occurs in a German sentence and we wish to decide whether it is an adjective or a preposition, then the words immediately following will settle the point. Thus, if following "unter" there is a group comprising an article or possessive adjective, an adjective, and a noun, with accusative or dative case endings, the "unter" is used here as a preposition.

The second part of the translation procedure is to determine the meanings of the words. Here we meet the problem of ambiguity in its largest form. It is closely connected with the problem of idiomatic usage, but this narrower difficulty is more easily disposed of, for a note in the dictionary can indicate that there is an idiomatic use of the word and thus lead to a set of operations for searching the context to see whether the conditions for the idiomatic use are present.

The next step is to identify groups of words which behave as one unit in a sentence. For instance, a noun together with its modifiers behaves as one unit. To determine these blocks of words the context of each word of the foreign language must be examined for grammatical patterns, and two blocks in juxtaposition will have to be distinguished by considering case endings. Then, with the word blocks found it is relatively simple to decide which are the clauses of the sentence on the basis of the occurrence of punctuation marks, conjunctions, etc. and also by the order of the word blocks.

Finally, the last stage of the procedure is to give the "target" language equivalents of the foreign language words in accordance with the analysis described above. This involves two things. First, adding the correct word-endings. This is a simple procedure according to the rules of the "target" language since the sentence structure and grammatical function of each foreign language word have already been determined. Secondly, arranging the "target" language word equivalents in the conventional word order of that language. This is an entirely mechanical operation once the clauses of the sentences have been identified.

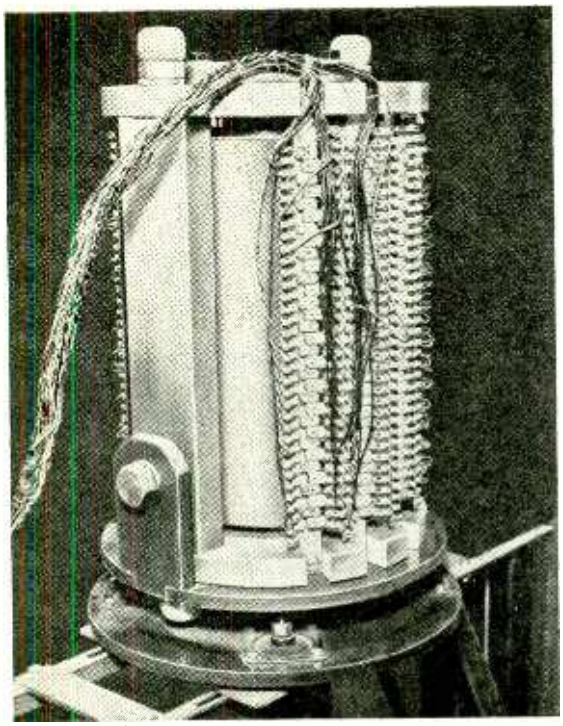
Computer Facilities

To summarize all this briefly, the basic operation involved in translation can be reduced to: (a) comparing incoming words with the dictionary entries, (b) recognizing patterns of words or characters (as in idioms, word blocks, etc.) and (c) transferring information to and from a store (as required in the operation of searching the context of a word to find the presence of the other words used in the idiom). The next question to consider is how these operations can be achieved with the facilities available in a computing machine.

Despite variations in detail, all electronic computers have the following three main types of facility: (1) information manipulation (such as the ability to shift information to and from the various storage systems), (2) arithmetic operations (such as addition and subtraction) and (3) what is known as "conditional transfer" (to be described below). These facilities are quite adequate to perform the basic operations of translation. In terms of actual "hardware," the digital computer has, in general, four distinct sections: a "memory" in which information can be stored; an arithmetic section in which operations are performed on the stored information; a control section which specifies what operation is to be performed (and, just as important, when); and terminal devices which enable data to be fed into the machine and by which the machine can display the results of its operations.

The first problem is how to code the words to be translated into numerical form and feed them into the machine. One convenient way is to deal with each letter of the words separately. It is then possible to use a teleprinter as the input device, for as each letter key is depressed it produces a pattern of holes and spaces in a paper tape corresponding to the "0" and "1" digits of a number in binary notation. The paper tape can then be fed through a "reading" device which converts the holes and spaces into corresponding sequences of pulses and blank periods suitable for use in the computer. Decoding the translated text from the output of the machine is simply the reverse of this process, and here it is possible for a "receiving" teleprinter to be operated directly from the emerging sequences of pulses.

Once having decided how the words are to be coded in numerical form it is easy to see that they can be stored as groups of binary digits in the computer "memory" system, for example as states of magnetization on oxide media or as states of operation in flip-flop devices. This "memory" can be a magnetic drum, a system of acoustic delay lines, an electrostatic store or any other device, but the major requirement is large capacity; very quick access to any word is not necessary. At the moment only one type of store, bearing in mind the question of cost, fulfils these requirements. It is the magnetic drum, and this is in fact used on the digital computer in Birkbeck College Electronic Computer Laboratory. Here approximately 8,000 words may be stored, and clearly several such



This magnetic drum storage system of the computer will contain the dictionary information necessary for translation.

drums could be used. It is this "memory" system of the computer which contains the dictionary used in translation. All the foreign language words likely to be required are stored in one set of positions on the drum while their "target" language (or English) equivalents are stored in another related set of positions. The "memory" also contains the complete set of instructions (known as the "program") for the translation process, each instruction being represented by a group of 32 digits recorded on the drum.

"Arithmetic" Operations

To see how the arithmetic unit operates in the translation process we can examine how an incoming word is compared with words stored in the dictionary incorporated in the "memory." The stored words can be fed out sequentially from the "memory" and subtracted from the incoming word. When zero is sensed from the result the incoming word is clearly coincident with the word just subtracted, and the signal so produced can be used for initiating the next part of the program, which in the simplest case is the selection of the appropriate "target" language word from the "memory" dictionary. This operation is a very easy and rapid one for a computer. Another way in which the arithmetic unit may be used is in either separating "stems" from "endings" (subtraction) or joining them. This process would be particularly useful when dealing with highly inflected languages, such as Russian and Latin, where it would be convenient to store stems and endings in the mechanized dictionary.

A very useful facility is the "conditional transfer" mentioned above. This is a control method which allows the program sequence to proceed in one of two channels, depending on whether the most significant binary digit of an incoming number is a "0" or a "1." This can be very usefully applied in translation processes in which the sequence of operations depends on recognizing any given configuration of digits in the number representing a word or part of a word. Many machines have other conditional control facilities which are similar in that they allow the sequence of operations to proceed in either of two channels provided a given condition is satisfied or not. Such a system could recognize, for example, whether a certain storage device had all "0s" or all "1s" filling it.

Specialized Dictionaries

The size of store necessary to contain the total vocabulary for a non-technical translation would be extremely large. The number of terms used in specialized branches of science, however, is considerably smaller than that required for general literature. Consequently, by limiting the automatic translation to a particular branch of science, the dictionary can be reduced to a size manageable by present techniques of storage. Besides reducing the size of vocabulary, concentration on technical literature reduces the problem of ambiguity. And by further specialization on, say, a particular branch of mathematics, ambiguity of technical terms within that branch is lessened. For technical translation, then, a mechanized dictionary must be compiled in two stages: first by collecting together the general language of mathematics, that is, the language common to all or most branches of mathematics, and secondly by assembling a glossary of all the technical words in the particular branches of mathematics. The translation of a paper, on, say group theory would thus be preceded by feeding into a computer a dictionary of the general language of mathematics and a glossary of group-theory terms.

Not every case of ambiguity with a word can be resolved simply by reducing the vocabulary or referring to a small context. For instance "Ableitung" in German means "derivative" or "deduction." The first translation occurs so frequently in many branches of mathematics that it would be safe to consider it a general mathematical term along with the second meaning. And it will not always be possible to decide by reference to the immediately preceding word which meaning is intended, for example, "zweite Ableitung" can mean "second derivative" or "second deduction" and both these phrases could occur in mathematical literature. Resolving this type of ambiguity is difficult and could possibly be done by reference to the context of the complete sentence. Failing resolution of ambiguity, all possible meanings could be printed, leaving the specialist in that particular branch of mathematics to decide the issue.

Enough has been said now to show the nature of the problem. Various projects are under way in America and in England, notably at Birkbeck College. On the engineering side research is directed towards the construction of "memories" which are large and also permit quick access to the stored data. At the same time, devices for the automatic recognition of printed and spoken material are being developed. On the linguistic side, the problems are to construct a "program" for each language to be translated into English and to build glossaries of suitable technical terms for the various interested branches of science.

Etched Foil Printed Circuits

With Particular Reference to Photomechanical Methods of Production

By H. G. MANFIELD*

FOR the production of identical circuit patterns in large quantities, printed wiring is becoming increasingly popular. At the time of writing, only wiring is being attempted; the printing of component parts, with the exception of r.f. coils and low-value capacitors, is still a long way off.

The etched foil method appears to offer more advantages than other methods, and is more easily scaled down for use in laboratories and in pilot plant production. Basically, this system uses a thin copper foil, usually between 0.001 and 0.002in thick, bonded to an insulating material; this may be practically any type of laminate but, as it needs to be machined, cut and punched, synthetic resin bonded paper (s.r.b.p.) is almost universally used. Special circuits may need either a base material suitable for use at higher temperatures than s.r.b.p. or one possessing better dielectric properties (lower permittivity and power factor). The printed circuit pattern is impressed on to the copper in acid-resisting ink (the resist) and all the unwanted copper is removed by etching in a weak acid.

Methods of Printing.—The word "printing" is used in a loose way when discussing "printed" circuits. Sometimes real printing methods are used, such as the offset-litho or the silk-screen, but photography is often used to produce the same result, and, although this is hardly "printing," the method is very similar to that used in making printing plates of the "line" or "half-tone" variety.

A few words about the non-photographic methods will show the relative merits of each.

Offset-Litho Methods.—When a large quantity of printed circuits is required, the offset-litho method is probably the most suitable way of producing them. The work is done by specialist printers using a flat-bed machine over which a roller travels from end to end. The printing plate is made by a method very similar to the one to be described in detail, but it is made on an aluminium sheet which has been lightly roughened or "grained." The prepared plate is placed on the bed of the press where it is first inked and then traversed by a blanket roller, usually of rubber, which transfers its inky pattern to the copper-clad laminate. The layer of ink transferred from the printing plate to the laminate is very thin and would not in itself stand up to the acid which is later used to remove all the unwanted copper, leaving the pattern alone on the insulated base. A layer of powdered bitumen or resin is brushed or blown on to the inky pattern and adheres to it. This is fused by heat to form a reinforced layer that will resist the acid etchant.

This process is carried out by skilled printers using standard methods and equipment, as used in the quantity production of nameplates, etc. It is not possible to scale it down to laboratory proportions.

Silk-Screen Methods.—The silk-screen method of printing is extensively used for the production of large-sized prints, e.g., posters. It is attractive for printing circuits because of its general use in the radio and electronic industry for the printing of dials, scales, etc. Circuit and nameplate printing both use non-absorbent base materials—an essential difference to printing on paper. The method of production may be scaled down for use in the laboratory and it is quite economical for the making of a few prints, but several hundred may also be made in the same way.

The silk-screen consists of a fine woven material either of silk or fine wire, which is stretched tightly over a wooden or metal frame. The pattern is made into a stencil by photographic means and this is attached to the silk, leaving holes only where the pattern is required, all the rest being blanked out. The laminate is placed under the screen, ink is poured on one end and transferred to the other by means of a square-cut rubber squeegee. In this way the ink is forced through the holes in the stencil and forms a pattern on the laminate. The inks used for silk-screen work are very viscous and, as a thick layer can be applied, they are, when dry, good acid resists.

Limitations of Offset-Litho and Silk-Screen Methods.—Apart from difficulties in production which have already been mentioned, there are technical reasons why both the methods discussed are unsuitable for certain electronic circuits. The most serious limitation is in the degree of fine detail that can be obtained by their use.

In a large number of circuits, fine detail is not necessary and it should be part of the design to eliminate unduly narrow lines and spaces, but when these cannot be avoided, or when coils must be printed, photographic printing methods must be used.

Photomechanical Methods.—Printing on metals is not done by the same means as is used in portrait or landscape photography, neither are emulsions stripped from plates and transferred to metal surfaces. The process is to deposit a photo-sensitive material on to the plate, then expose and develop it.

When making printing plates or blocks, the base material is metal and is able to withstand heating, which hardens the coating material and greatly improves its acid resistance. In addition, the etching is only carried on for a fraction of a mil (thousandth of an inch)—in the trade a "deep etch" is 0.0005in. For circuit printing, the copper must be etched right through and, as it is usually about 0.0015in thick, this may take 10-15 minutes or more, according to the density of the etchant and its temperature, and on the degree of agitation.

* Radar Research Establishment, Ministry of Supply

Numerous ways are available for producing the image. Some are wrapped in trade secrecy, others use proprietary methods—often called "cold-tops" to distinguish them from the processes where heat is required. Many of these have been tested over a period of several years and some have proved unsatisfactory; others are temperamental and require rigid control of room humidity. Two methods will be described; neither uses proprietary materials, and both have given consistently good results over a period of time.

Preparation of Drawings and Negatives.—Before printing on the laminate a negative is required, and this is made from a drawing of the circuit pattern which is to be produced. A drawing in Indian ink on white cardboard has been found reasonably satisfactory. It is made four times the size as this allows the draughtsman to draw thick lines and when working to his normal tolerance of ±0.005in, the final result will be within ±0.00125in, which is sufficiently accurate for all but the most intricate designs.

To avoid work in the drawing office a novel method of producing master prints has been developed, which is only applicable when the circuit is to be printed on a standard-sized board with terminations in fixed places. When used it enables the circuit designer to lay up a master in a short time, knowing that when photographed it will be precisely to size and that the terminations will be correctly placed. With the double-sided board, registration between opposite sides is very important and is quite difficult when using drawings, as paper and cardboards are dimensionally unstable.

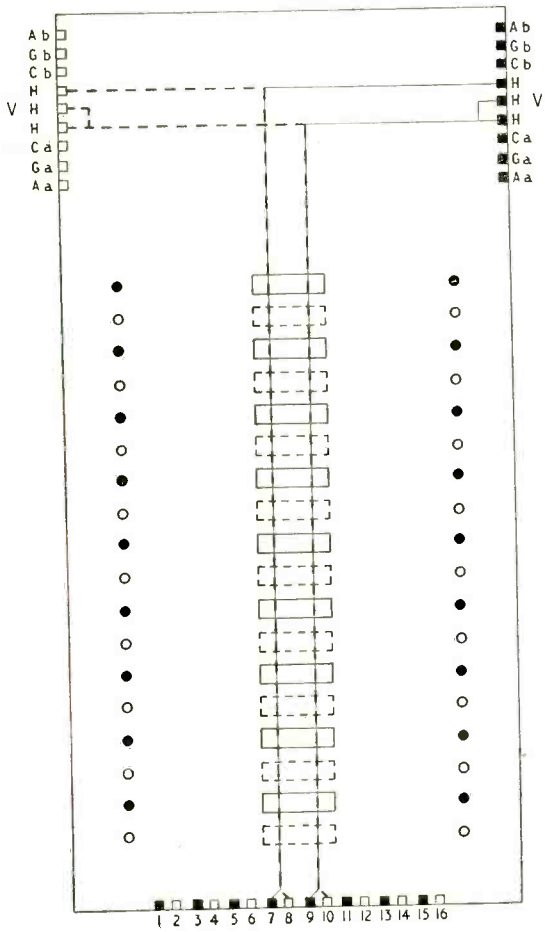


Fig. 1. Typical foundation pattern for use with white-on-black laminated paper for producing master circuits by engraving.

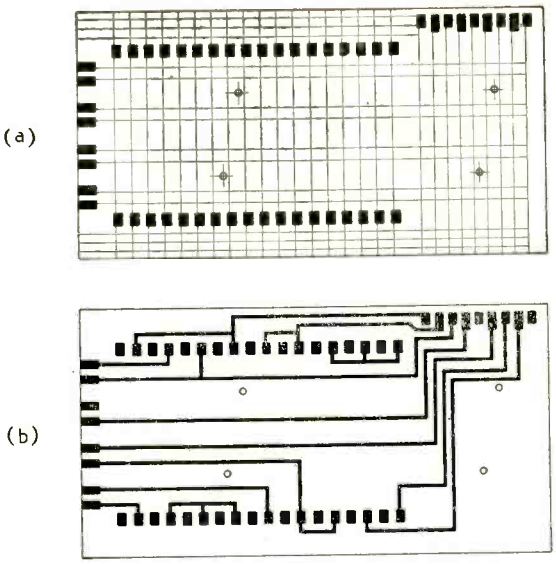


Fig. 2. Engraving sheet (a) with terminations and grid pattern cut to receive "wiring" in the form of tape strips,(b).

The circuit layout is made on a sheet of paper on which a standard basic pattern is printed by a duplicator. The lines are pencilled in, either in different colours for each side or in solid and broken lines (Fig. 1).

The system is to use engraving sheet, a three-ply laminate of a black sheet between two white or a white sheet between two blacks. The former is generally used and the standard terminations are engraved out, leaving dense black squares or circles on a white background. Surface shine is eliminated by rubbing down with fine glass paper to a matt finish. A grid pattern is marked on the surface to guide the tapes which are used to produce the wiring pattern (see Fig. 2 (a)). The whole sheet is marked out and engraved on a milling machine; the work can be done very accurately. The pattern is four times full size.

When completed, the pattern is transferred to the engraved sheet by means of adhesive cotton tape, known as photographic masking tape. This has a dull, unglazed finish that prevents shine on the photograph. It is obtained one inch wide and slit to 0.2in as the wiring is of 0.05in width, four times up in size. This tape adheres well to the engraving sheet and can be used over and over again as it retains its adhesive properties. The engraved sheet complete with its pattern of wiring is shown in Fig. 2 (b).

A circuit made by the method described is shown in Fig. 3. It consists of a double-sided laminate on which the standard components are assembled and held in turret lugs. Two double-triode wire-ended valves are fixed to the board with special clips. The whole sub-unit has been designed especially so that it can be made by semi-automatic means, and all the

joints are made by dip soldering. Only the edges of the board are immersed in the solder, joining the copper foil and the components to the tags.

Photography.—The drawing on engraved sheet, when completed and checked, is mounted on an easel and photographed to correct size. This is easily done with a process or studio camera as the image is projected on to the ground glass focusing screen and measured with a ruler. If a special process camera is not available and a studio type is used, it will be important to ensure that the drawing, lens and focusing screen are all perfectly square and parallel to each other or the pattern will be distorted.

The choice of negative is limited by the need of a very "contrasty" picture giving complete transparency of the pattern on a completely opaque background. Two photographic suppliers have recently introduced a range of extremely contrasty negatives which are available in various sizes both on film and on glass. These negatives (Kodak "Kodalith" and Ilford "Formalith") are developed in special developers (known by the same name as the plates). They require a long exposure as the emulsion is very slow, but the result is ideal for photomechanical purposes as the whites are transparent and the black very dense, needing no reduction or intensifying as do most process plates and films.

The choice of plates or films is governed by the final requirements and the available equipment. For maximum stability and the maintenance of close tolerances, glass plates are preferred, but these often fail to make intimate contact with the laminate, when making the contact print. Films can be backed up close to the base and if a vacuum printing frame is available, intimate contact is made, giving the finest reproduction of the original pattern.

We will assume that the plate or film negative has been made and has been retouched where necessary to fill in any pinholes.

Printing on the Laminate.—The copper-clad laminate is usually made of paper impregnated and bonded with phenol-formaldehyde (s.r.b.p.) but it may be of glass cloth impregnated with polyester, epoxy or silicone resins. In any case, the copper foil is bonded to one or both faces by various proprietary methods, some patented by the laminators.

The poorness of the bond was largely responsible for the long delay in realizing the initial basic ideas behind etched foil. Modern materials have the copper foil bonded well enough to withstand a peel test on a 1-in strip of up to 25lb at room temperature, and stable enough to withstand dipping for 3 or 4 seconds in a bath of solder heated to 250°C.

When received from the manufacturers the copper faces are greasy and oxidized. They are cleaned either by wet abrasion with a brush, water and pumice powder or, if the surface is not pitted or porous, by chemical means with or without the passage of current (cathodic etching). The surface must be clean enough to maintain an unbroken film of water when wetted. When thoroughly clean and degreased, the board is ready for the application of the photo-sensitive coating.

Coating Solutions.—Two types of photo-sensitive coatings will be discussed. One, a single coating, requires reinforcing with ink before it becomes a sufficiently strong acid resist. The other, a double coating, stands up to the etching bath without reinforcement. Each has its advantages and disadvantages, which will be discussed later.

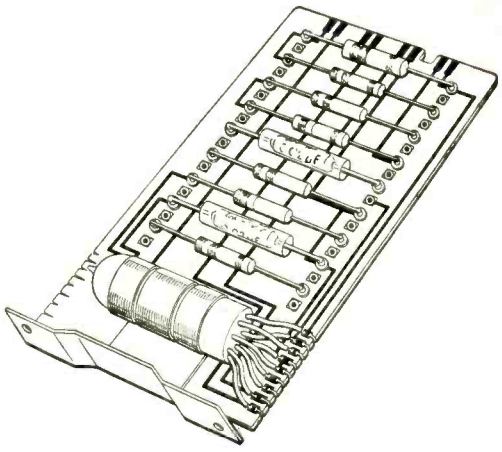


Fig. 3. Sub-unit using printed wiring and dip soldering, made from the master diagram of Fig. 2.

Single Coating Method.—The solution, which is water soluble, is made as follows: Take 70 grams of egg albumen and dissolve in 250 c.c. of warm, distilled water at about 35°C. When dissolved, add 111.5 grams of ammonium dichromate followed by 7 grams of ammonia, 0.88 specific gravity. Make up mixture with distilled water to 560 c.c. Filter through a No. 41 filter paper to remove particles.

The filtered solution is poured on to the clean copper face of the laminate and whirled until dry. The whirling may be done with a hand-operated tool like a hand drill with a rubber suction cup instead of a chuck, or on a modified gramophone motor and turntable, rotating at about 100-120 r.p.m. Commercial whirling machines are available for production quantities. The motor-driven types are best as the rotation is at a controlled and repeatable speed. If it is required to speed up the process, slightly warmed air may be applied from a hair-dryer or by other means, but it is important that the coating should not be overheated at this stage.

As there is a build-up of the coating at the edges of the plate an oversized plate is used; in other words, the pattern is smaller in size than that of the board which is being coated.

When dry the coating presents the appearance of a glossy yellow film that is even and non-tacky. It is not sensitive to any normal lighting except strong sunlight and to ultra-violet light, so the coating may be made in a well-lit room excluding sunlight.

The plate is placed in contact with the negative, emulsion to coating. Both are put in a printing frame —preferably of the vacuum type, but good work has been done with the ordinary type used to make contact prints. The exposure is made to ultra-violet light from either an arc-lamp or a high pressure mercury vapour lamp. If the negative is really opaque it is impossible to over-expose it, but as lamps produce heat, it is possible to overheat it. Four to six minutes with an arc lamp and 10 to 12 with a mercury vapour lamp are generally correct. Under-exposure must be avoided or the image will peel off during development.

On removal from the frame, the image will be seen as a dark pattern where the light has hardened the coating in those places not covered by the lines in the negative. The laminate is placed face upwards

on a flat surface and a small pool of lithographic developer ink (a black, oily liquid) is poured on its centre. The ink is swabbed over the surface as quickly as possible with cotton-wool several pieces of which could be used in order to get a very thin film of ink remaining on the copper surface. The object is to remove as much ink as possible in the shortest time as it is quick-drying, and too thick a film will make the subsequent development very difficult.

The inky film is dried with warm air and thoroughly wetted under running water. Those parts of the image that were covered by the opaque parts of the negative will wash away leaving the pattern showing in the copper base. Sometimes, parts of the coating require light rubbing with cotton wool to clean up the surface, but when the process has been carried out satisfactorily the running water will suffice to develop out the image. When fully developed, the plate is dried by hot air; this time the heat is beneficial as it hardens the ink layer and so increases its acid-resisting properties.

As described, the ink layer will stand up to the etching solution long enough to remove all the unwanted copper, but as it never really dries and if both sides of a board are to be prepared for etching further initial treatment of the first side is necessary. This is quite simple, merely being the pouring over its surface of a powdered bitumin or resin (the latter known as Dragon's Blood). The powder adheres only to the sticky ink and by tapping smoothly on the side of a bench or by washing in water, all the surplus is removed from the copper. This layer of powder must be fused by heating. The resin requires about 2-5 minutes' treatment at 100°C, either in an oven or by the application of infra-red heat; the bitumen fuses at a higher temperature, which is found by experiment.

When the process is complete, the resist pattern is very hard and practically scratch-proof so the reverse side of the board may be coated and processed exactly as for the first side. When finished, the placing of the board edgewise into the etchant will remove the unwanted copper from both sides at once.

Circuits treated as described have withstood 4-5 hours in a bath of ferric chloride of 1.38 s.g. at 25°C.

Double Coating Method.—In the method already described, the single coating must be light-sensitive and also acid-resistant; this limits the choice of materials that can be used—most of them are based on a colloid such as albumen, fish glue, gelatin or gum arabic.

The separation of the light-sensitivity and acid-resistant properties allows a stronger base to be used, whilst the light-sensitive material has only to resist the solvent for attacking the base—in other words, the first layer is acid-resisting and the second is made into a stencil through which a solvent removes the underlayer where required. The process is carried out as follows:—

A cellulose nitrate lacquer is coated on the cleaned copper face of the laminate. Whirling is unnecessary as the solution, thinned to double its volume with acetone, is poured on to the centre of the plate and allowed to flow over its entire surface. It dries quickly and as it is dyed red, the smoothness of the coating is easily checked.

When dry, the plate is coated with the albumen solution exactly as used in the single-coating method. It is exposed to the arc or ultra-violet mercury vapour lamp through the negative and is developed in water after exposure, instead of being inked up as described previously. As the albumen solution is almost colourless, it is difficult to see it on the surface of the lacquer, but as it is dried with hot air the image appears, only to disappear when it is completely dry. The albumen coating solution could be dyed but the need for this has not occurred in the experience of the author.

The lacquered plate is now covered by a stencil of albumen in the circuit pattern. If a solvent is now poured on its face, all the lacquer will be removed except where it is covered by the albumen coating. Many solvents may be used—propyl alcohol is effective but most are too quick in action and some attack the stencil. A slow acting and very effective solvent is polyethylene glycol—a liquid rather like glycerine in appearance and consistency. A small quantity of this is poured on to the plate and lightly swabbed with cotton wool. All the unwanted coating comes away, leaving the image ready for acid etching. No heating is required or is desirable, as the lacquer is easily crazed by overheating.

This method is satisfactory for single-sided circuits but it is impracticable to coat one side of the laminate without getting any of the lacquer on the reverse. It provides a stable image that is non-tacky and quite tough and so able to withstand handling without being easily damaged.

Etching the Copper.—Although nitric acid has

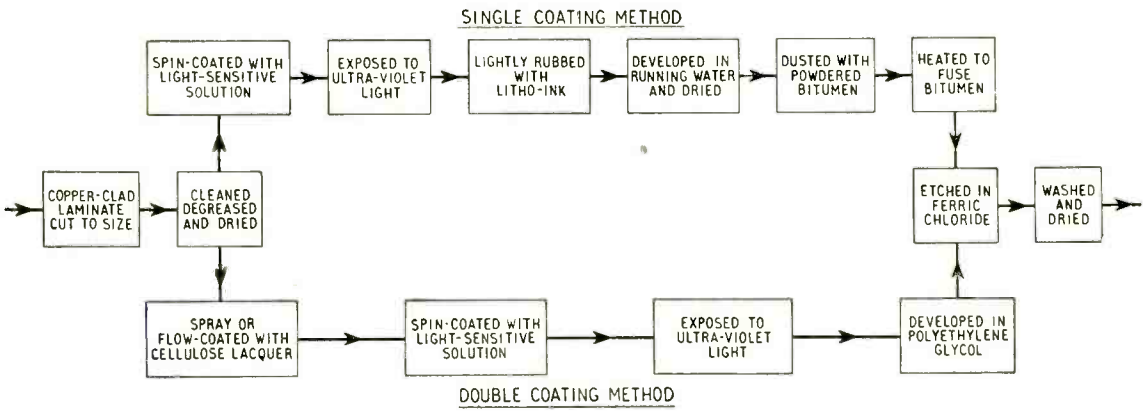


Fig. 4. Comparison of single- and double-coating photographic methods.

been used by a few people, most use ferric chloride as an etchant. Practically all workers in the printing trade use it because it gives a slower, more easily controlled etch without bubbling. When copper is attacked by nitric acid, hydrogen is liberated; this bubbling through the liquid can lift the acid-resistant pattern.

The ferric chloride may be obtained as lumps which are dissolved in water by the user or, more conveniently, as a liquid of about 1.38 s.g. When making a new bath, some 5 per cent or so of old etching fluid should be added to it as this increases its cutting speed.

Etching machines are available for large-scale work, but for laboratory purposes a photographic developing dish made of china is adequate. The single-sided board is immersed face downwards so that the copper silt which is cut away by the etchant falls to the bottom of the bath. Double-sided boards are, as already stated, placed edgewise in the bath and in each case the dish is agitated in a similar way to that used in developing a normal photographic plate.

Warming the bath to about 30-35°C speeds up the process, which can often be completed in about 7-10 minutes. Some machines will etch through 0.001in of copper in three minutes, but the resists that have been discussed are extremely durable and, when necessary, the boards may be left untouched, if the bath is at room temperature and unagitated, until the final cleaning of copper which may take about an hour.

After etching, the board is thoroughly washed in warm water to remove all traces of acid and then the resist pattern may be removed with a solvent—turpentine or white spirit for the bitumen or resin, acetone for the cellulose lacquers. Where the bitumen or resin has been well fused, abrasion of its surface, with water and scouring powder, may be necessary to clean up the exposed copper circuit. It is advisable to dry the laminate in an oven for about half an hour at 100°C to remove any water that has been absorbed during processing. This is particularly important when low-grade punching materials have been used as a base for the copper foil.

Comparison of Single- and Double-coated Methods.—It has already been stated that the double coating would be difficult to apply to double-sided boards, but apart from this fact, the following points should enable a choice to be made between the two methods.

There are more operations when using the single than when using the double coating (see Fig. 4) and it requires less manipulative skill to carry out the latter. The application of the cellulose lacquer is very simple and the albumen coating is applied in each case, so the process is common to both methods. A certain dexterity is required when inking up the albumen-coated plate; too thin a layer makes a poor acid resist and too thick a layer makes the development of the image difficult. Following up with powdered bitumen or resin is probably best done by dipping the board into the powder and washing away the surplus under a tap which, although simple, requires practice to perfect it.

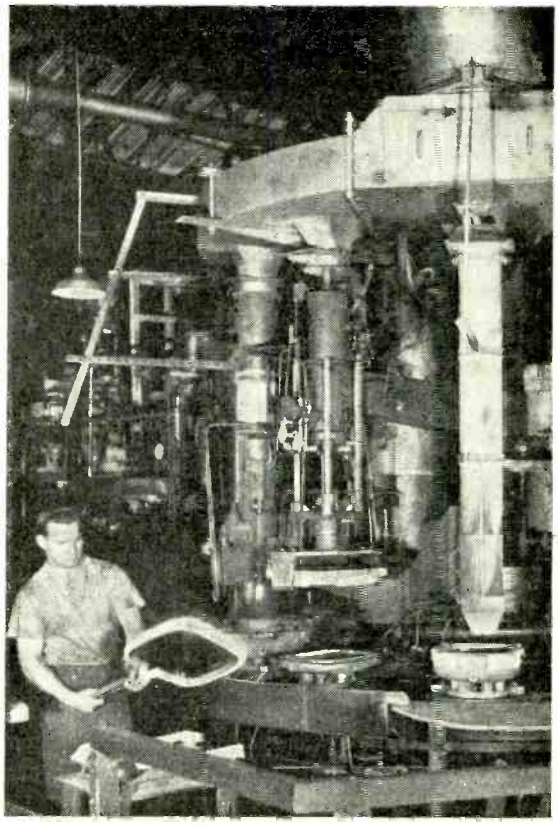
On the other hand, the thinners and solvents for the ink—white spirit or turpentine—are pleasant to use, whereas acetone as the solvent for the cellulose lacquer is unpleasant, also the red cellulose is much more difficult to remove from the skin and from clothing than the simple oily liquids.

With a little practice, the single coating with its reinforcing materials gives consistently good results under all conditions of temperature and humidity. It produces a resist pattern which is very much more durable than most cold top enamels, it is made up by the user from harmless chemicals, easily obtained. The solution, when kept in a well-stoppered coloured bottle (so that it is unaffected by light) has been used over a period of three months without deterioration.

Given a good negative, thorough cleaning of the copper, adequate exposure followed by development in cold, running water, and careful inking up of the image, very satisfactory results can be achieved with a definition that is good enough for the finest detail such as is needed on miniature circuits and coils.

Acknowledgement is made to the Printing and Allied Trades Research Association, Leatherhead, and to Kodak, Ltd., Kingsway, London, for help and advice on circuit printing over a period of five years.

Glassware for C.R. Tubes



Cathode-ray tube glass parts (cones and face-plates) are turned out at the rate of one every six seconds by a new automatic plant put into operation by Pilkington Brothers at St. Helens this year. The firm came into the business at the Government's request in 1948 and now, with the new equipment, are able to produce at least two million components a year. In this machine, large blobs of molten glass from a furnace are fed into moulds on a rotating table, and this passes under a plunger which descends and presses out the glass to the required shape. Annealing follows, then inspection, and grinding and polishing where necessary.

American Oscilloscope Technique

With Some Remarks on Anglo-American Divergencies

By A. J. REYNOLDS*

THOSE readers who were in the radio industry in pre-war days will remember the very high regard in which instruments by such American companies as General Radio, Boonton, Ferris and Measurements Corporation were held. In the early and mid 'thirties the British Instrument as we know it today hardly existed. We had, of course, famous companies such as Cambridge, Muirhead, Sullivan and Tinsley, but they were fully occupied making what can be regarded as laboratory standards, bridges of extreme precision, potentiometers and variable air capacitors of exquisite workmanship. Little was then available, British made, for those awkward characters who required to generate few microvolts at many megacycles or who cherish a notion to measure the Q of the Litz-wound glass-former inductors in their super short-waver.

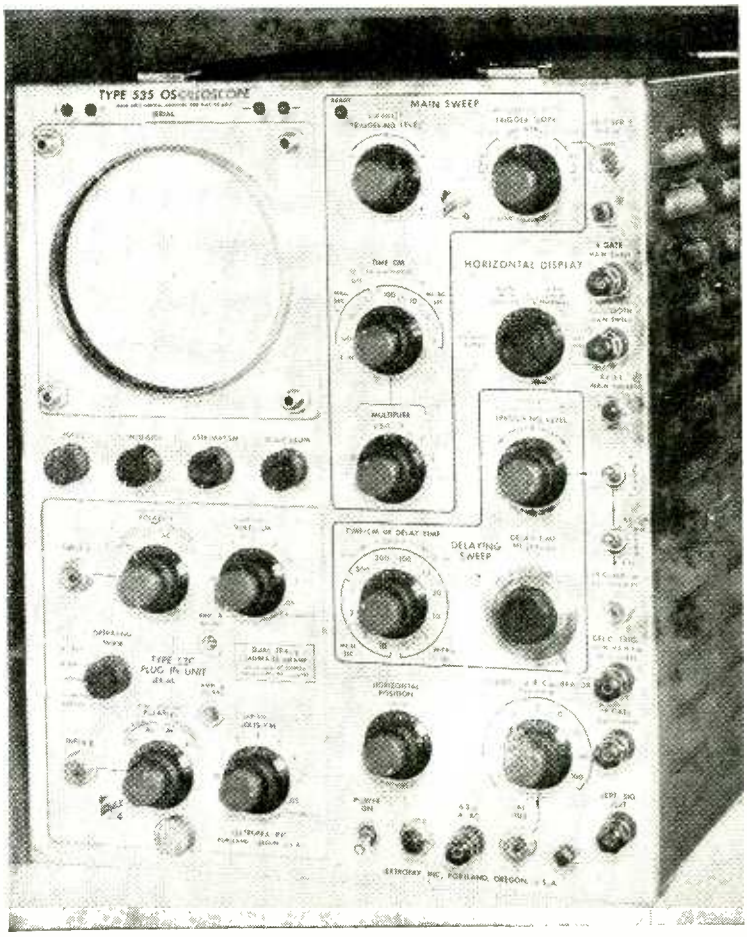
The founder member of the new brigade of instrument firms was undoubtedly Marconi-Ekco who, in the late 'thirties, began to make American-style instruments in this country. Having a relatively clear field they expanded rapidly, but when war broke out most of the serious work in British laboratories was still being done with instruments of American manufacture. During the war few American instruments found their way into the country and the small British industry expanded enormously. It had to: in pre-war days the Standard Signal Generator was an object of awe and veneration enshrined amongst the polished teak and lacquered brass binding-posts of the standards room, one per factory being about the number required. In the Services thousands were necessary, and such old favourites as the Marconi TF144 were bounced across the desert in 15-cwt trucks and dragged across the gooey mud of forward airstrips by sodden "erks."

After the war Britain found herself with a new industry—electronic instruments. New names appeared: Advance, Airmec, Cintel, Dawe, Solartron, Wayne Kerr and a whole host of others. The well-publicized dollar shortage precluded the entry of American instruments and as a result the styling, electrical and mechanical design of the products of the two countries have moved steadily apart. A somewhat similar state of affairs exists to that in the motor industries of the two countries.

Across in the States conditions were very similar to those at home. The war gave the instrument industry a tremendous fillip and while the old-established companies grew enormously, and along lines that could have been fairly easily predicted, a horde of new companies shot up overnight. (Some of them also shot down again pretty quickly.) Amongst these were two destined to become the giants of the industry. They are Hewlett-Packard, born in the garage of one Dave Packard just before the war and now the largest instrument company in the world in terms of turnover, and our heroes on this occasion Tektronix.

Company Organization

Tektronix Inc. was organized as an Oregon corporation in January, 1946, for the purpose of developing



Front panel of Tektronix oscilloscope Type 535, giving some idea of the facilities available.

* Livingston Laboratories.

and manufacturing cathode-ray oscilloscopes. The owners all had extensive wartime electronic experience in either military or civilian capacities. The president, Howard Vollum, actually worked in this country on radar development during the war.

The company and its products form a useful guinea pig for a miniature study of current American thought in light current engineering. It is a successful company; from small beginnings as late as 1946 it now dominates the American wide-band oscilloscope market and is by far the largest producer of these instruments in the world. Before going on to the instruments let us look at a few points concerning the general organization and see how they tie up with your own conception of an American company and normal British practice.

First, the president, Howard Vollum, is a distinguished engineer, completely *au fait* with the performance of his company's oscilloscopes and the designer of some of them. This is a theme constantly reiterated in the new generation of U.S. instrument companies. Bill Hewlett and Dave Packard designed all of their company's original products. Rarely is the accountant-cum-financier type of director found over there. On enquiry you will be told " You can always take an engineer and train him as a business man, but rarely does the converse apply."

Secondly, at Tektronix they are more nearly self-sufficient than any other comparable company in the world. The only bought-out components are those such as valves and resistors. When the commercially available article is not good enough there is no hesitation in setting up a department to improve on current practice. Commercial capacitors could not be bought that were sufficiently good for use in their time bases, so they wind their own to ±0.25%. Bought-out c.r. tubes were insufficiently linear for the sort of accuracy sought—so they made their own, incidentally solving a major tube manufacturing problem in the process. The new Tektronix tube uses a helical post-deflection accelerator ring that starts at the top of the tube neck and runs helically right up the flare to the screen. This, of course, is an old idea and obviously the right way to make a p.d.a. tube, but up till now no manufacturer has succeeded in holding the resistivity of his material sufficiently constant to achieve a uniform potential gradient down the tube. Hating the conventional tag-strips and group-boards, they developed and manufacture their own ceramic group-boards that contribute greatly to the internal appearance of the instruments. This may surprise those who thought, as I tended to, that the American manufacturer produced a set of drawings that were effectively a stock list enumerating the bought-out parts that merely had to be assembled in the parent works. This philosophy, once prevalent, is now regarded with disfavour by the most progressive companies.

A third feature is the generosity of the electrical performance compared with the specification. Many experienced observers in this country have been forced to apply a "transatlantic factor" to written specifications emanating from the U.S.A. It has sometimes even appeared that in the Great Democracy the output watts were larger than ours and input watts smaller. (Something to do with the size of the U.S. gallon no doubt.) Here, however, is a conservatism of claim at least equal to the best of the British firms. On the type 535 oscilloscope, for example, the claimed Y amplifier bandwidth of 10 Mc/s measures as 3 dB down at 13.5 Mc/s.

The last point, which I am sure has a sizeable bearing on the company's success, is its method of payment. Every month 22½% of the company profit is divided amongst the employees in the ratio of their salaries and a further 7½% added to the pension fund. A simple enough payment by results system, but one which ties an individual's earnings to the performance of the company as a whole. Under this system what matters to each employee is that the customer is satisfied. Surely all men should be working to please the customer rather than to put one over on an inspector three benches away!

Two Outstanding Models

As examples of the instruments themselves we have space to deal with but two, the fabulous type 517 and the latest of the line, the type 535.

The 517 is a wide-band high-voltage oscilloscope designed primarily for the observation and photographic recording of very fast rising waveforms having a low duty cycle. The use of 24 kV accelerating potential on a metallized cathode-ray tube permits photographic recording of single sweeps at the maximum writing speed allowed by the Y amplifier and sweep circuits. Distributed-type Y amplifiers provide a rise time of 7 millimicroseconds with a maximum sensitivity of 0.1 V/cm. Both amplitude and time calibrators are provided. Sufficient time delay is incorporated in the Y amplifier to permit viewing the leading edge of the waveform which triggers the sweep.

In order to provide sufficient vertical deflection voltage with a rise time as short as 7 millimicroseconds for a cathode-ray tube using 24 kV accelerating potential, a distributed amplifier is employed. This amplifier consists of five distributed stages plus a phase inverter and trigger valve. The first two stages use six 6AK5 valves each, next a stage of seven 6CB6 valves and a phase inverter of three 6CB6s. The signal then goes to a push-pull driver stage having six 6CB6s each side and finally to the output stage with twelve 6CB6s on each side.

The performance on the X axis is just as impressive. Since many fast-rising pulses are either non-repetitive or non-uniformly spaced, it is essential to have a sweep which can be triggered by the observed pulse itself. To enable the type 517 to trigger from fast rising signals of small amplitude, a wide-band, distributed amplifier is incorporated. Signals of 0.3 V amplitude with a rise time of 1 millimicrosecond will easily trigger the sweep. When using the observed signal as a trigger, any signal giving a deflection of 2 mm is adequate.

The time base on its fastest speed runs at 10 mμ sec/cm, that is, a complete sweep of 8 cm in 80 mμ sec. Although their invariable practice, and one well suited to the method of calibration, this style of specifying time base speed strikes me as slightly ludricrous. It is rather like saying "Poor old Charlie was nicked for failing to exceed 0.033 hours per mile in a built-up area." Come to think of it, they are in effect quoting the time base slowness rather than time base speed.

That then is type 517, a slightly fabulous beast in that few of us could live up to it. Owning a 517 must be rather like owning a 4½ Ferrari or being married to Marilyn Monroe. Let us examine another model, just as outstanding in its own sphere but more applicable to everyday problems, the type 535.

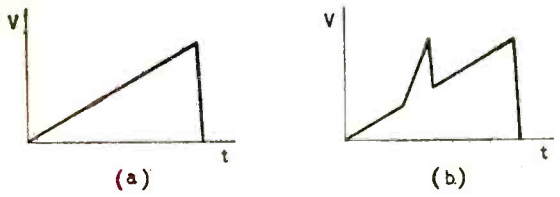


Fig. 1. Waveform of a conventional time base sweep (a) and with a second sweep superimposed on it (b).

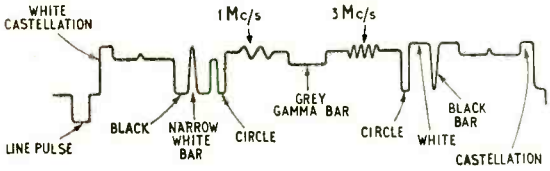


Fig. 2. Television waveform from one line of Test Card "C."

The 535 is a most unusual instrument for two reasons. First, it is the best example to date of that oft-attempted oscilloscope, the Y amplifier characteristics of which can be varied by means of a series of plug-in pre-amplifiers. The main ones of these are the 53B, with a frequency response of d.c. to 10 Mc/s and a sensitivity of 5 mV/cm, and the 53C, with a response of d.c. to 8.5 Mc/s and a sensitivity of 50 mV/cm. A double beam facility is provided by means of an electronic switching system. This beam switch can be triggered by alternate sweeps or allowed to run free at 100 kc/s. A d.c. and low frequency pre-amplifier is available, giving deflection sensitivities of 50 μV/cm. When these are allied to a time base having continuous coverage from 0.02 μsec/cm to 12 sec/cm, it will be seen that even without any other features the 535 would still be an outstanding instrument.

The second unusual facility is one that obviously springs from the firm's association with radar, as it is a well-established radar technique applied for the first time to oscilloscopes. This is the use of two time bases, one of which strobes the other. For those not familiar with this trick a word of explanation. Consider the two time bases in Fig. 1, one of which, at (a), is pictorially quite familiar. It can be so arranged that the linear rise of voltage in (a) will trigger a second time base, running much faster, at a predetermined voltage level, as shown in (b). It will be obvious that if the first sweep is triggered by a pulse, then varying the voltage at which the second sweep fires will slide this sweep up and down the slope of the first one and so provide a variable delay between the trigger pulse and the start of the second sweep. In practice no such waveform as (b) appears in the instrument, this having been simplified to establish the general principle.

Selective Observation

Let us take a practical example. We will feed into the type 535 oscilloscope a television waveform, Test Card "C" in fact, and arrange for the first sweep to be triggered by the line pulses and to have a duration of some 100μsec. The resultant display will then consist of a jumble of all 405 lines. If, however, a rudimentary sync separator, consisting of a CR network with the correct time-constant, is included in the trigger circuit, then the time base will trigger from the frame group and permit a display on one line which looks something like Fig. 2.

Now supposing it is arranged that when the second sweep fires it applies a "bright-up" to the beam, then a portion of this display will appear brighter than the rest. The length of the bright patch can be varied by adjusting the duration of the second sweep and its position along the picture by varying the delay (point on the first sweep at which the second sweep fires). In our example we could arrange the bright portion of the trace to coincide with the 3-Mc/s bars. This done, by switching the input of the X amplifier the second sweep can be applied to the plates of the tube and a picture of the 3-Mc/s portion of one line made to occupy the whole screen, permitting detailed examination. The beauty of this system is that a complex waveform can be displayed *in toto* on the screen, a portion of it selected for detailed observation and that portion viewed on a greatly increased time scale with absolute certainty that it is the desired part of the waveform.*

This has perforce had to be a rather sketchy treatment of a complete range of instruments, but I hope it has at least shown that, during the years when American instruments have been absent from this country, oscilloscope design at any rate has been progressing along lines rather different from our own.

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Since this article was written a further development of the 535 oscilloscope has taken place, bearing the type number 545. It is based on a new cathode-ray tube developed by Tektronix which has the fantastic deflection sensitivity of 7V/cm with 10kV on the p.d.a. ring. Use of this tube gives the new oscilloscope the following Y amplifier performance: frequency response, d.c. to 30 Mc/s; rise time, 12mμsec; sensitivity at full bandwidth, 50mV/cm. The amplifier is 6dB down at 45 Mc/s and 12dB down at 60 Mc/s.

* Although this example deals with the use of the type 535 as a line selecting monitor, this function is performed equally well by the simpler type 524, an oscilloscope that has been a standard instrument in American television circles for over four years.

AMATEUR COURSES

IN preparation for next year's radio amateur examination, to be held by the City & Guilds in May, a large number of educational establishments up and down the country are arranging evening courses of instruction. Among those from which we have received specific details are:—

Bradford Technical College; classes are being arranged by the Bradford Amateur Radio Society (Sec. F. J. Davies, 39, Pullan Avenue, Eccleshill, Bradford, 2).

Brentford (Middlesex) Evening Institute; Wednesdays (fee 10s).

Glasgow, Allan Glen's School; theory will be taken on Tuesdays and morse on Thursdays (fee 10s.)

Huddersfield Technical College, where the lecturer will be C. W. Oakley (G3IPD).

Holloway, Grafton School; theory on Mondays and practice on Wednesdays with morse instruction after each evening's class (fee 10s).

Ilford (Essex) Literary Institute; both theory and practical courses on Wednesdays (fees 10s per course).

South-East London Technical College; theory Wednesdays.

Wembley Evening Institute; Mondays, morse 7 to 8, theory 8 to 10.

Transistor Equivalent Circuits

3.—*Earthed-Base Transistors*

By W. T. COCKING, M.I.E.E.

SUMMARY:—Equivalent circuits for the earthed-base transistor are derived from the earthed emitter circuits of Part 2. The different forms of transistor constants are discussed and the relations between the more common ones are tabulated for easy reference.

So far, transistors have been considered only in the earthed-emitter form of connection. The published characteristics of transistors, however, are usually for the earthed-base connection rather than for the earthed-emitter. The constants of transistors are also usually quoted for the earthed-base connection.

It might be thought, therefore, that it would have been better to start in Part 2 with this arrangement and so to follow the customary practice in transistor literature. We have here deliberately avoided this, however, in order to bring out the basic similarity of the transistor and the thermionic valve, so far as external matters are concerned. If it were not for certain difficulties with the point-contact transistor, we might even take the view that the earthed-emitter circuit should be regarded as the fundamental one, just as the earthed-cathode circuit is so regarded for the valve.

A difficulty arises with the point-contact transistor, however, for it can have negative input and output resistances when its emitter is earthed. These negative resistances cause certain difficulties of measurement which can make it awkward to obtain the characteristic curves and constants. Because of this, it is much more convenient to make measurements on the point-contact transistor in the earthed-base condition than in the earthed-emitter and, for uniformity, it is

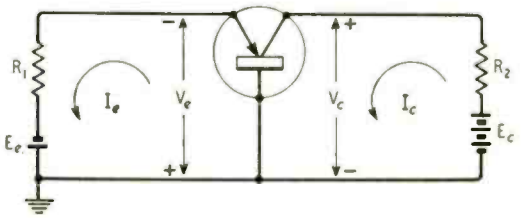


Fig. 1. Amplifier stage using an earthed-base n-p-n transistor.

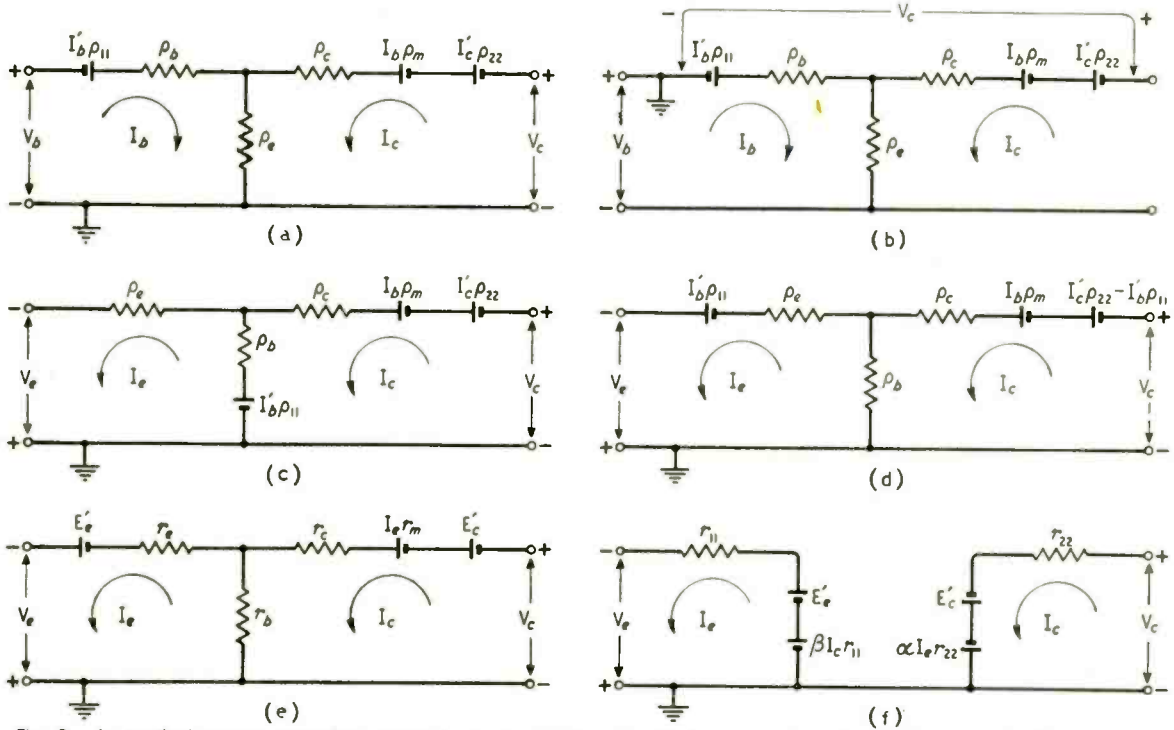


Fig. 2. An earthed-emitter equivalent circuit is shown at (a) and, with its connections altered for an earthed base, at (b). The successive transformations to an earthed-base equivalent circuit are shown at (c), (d) and (e). A two-generator form appears at (f).

customary to measure junction transistors in the same way. It seems desirable, therefore, that our final transistor constants should be ones based on this circuit.

It should not be thought that the earthed-emitter equivalent circuit developed in Part 2 has been wasted, however. So far from that, we regard it as an essential stepping-stone from the valve to the earthed-base transistor. Further, the earthed-emitter circuit is being increasingly used with junction transistors and all that is necessary to employ the equivalent circuits of Part 2 with transistor constants for the earthed-base connection is to have some conversion formulae so that ρ_b, ρ_e, ρ_c, and ρ_m or r_{11}, r_{22}, a and b can be derived from them.

Our next step must be to develop an equivalent circuit for the earthed-based transistor. The circuit has the form shown in Fig. 1 for an *n-p-n* transistor. Let us first of all derive an equivalent circuit from the one for the earthed-emitter circuit Fig. 5(b) of Part 2. This is repeated in Fig. 2(a). For the earthed-base connection it becomes Fig. 2(b) which can be re-drawn as in (c). The essential change is that the collector voltage is measured between collector and base instead of between collector and emitter. There is, therefore, a change in the meaning of V_c between (a) and the other diagrams.

Fig. 2(c) can be changed to (d) by removing $I'_b\rho_{11}$ from the ρ_b arm and inserting it in both the ρ_e and ρ_c arms. In (b), (c) and (d), V_b has become V_e. The two are numerically equal but of opposite polarity, when measured from earth. In (c) and (d), too, I_b has disappeared and the path of I_c has been changed. It is plain from (a) that $I_e = I_b + I_c$, so that the currents in all the resistances are unchanged by this re-distribution and re-naming.

We now require this equivalent circuit to be brought to the form of Fig. 2(e) in which the quantities are derived from the earthed-base characteristics instead of the earthed-emitter. The relations between (d) and (e) are easily established by comparing their mesh equations. For the emitter loop

$$\begin{aligned} V_e &= I_e(\rho_e + \rho_b) - I_c\rho_b - I'_b\rho_{11} \\ &= I_e(r_e + r_b) - I_c r_b - E'_e \end{aligned}$$

which gives us $r_e = \rho_e$, $r_b = \rho_b$ and $E'_e = I'_b\rho_{11}$.

For the collector loop we have

$$\begin{aligned} V_c &= I_c(\rho_c + \rho_b) - I_e\rho_b - I'_c\rho_{22} + I'_b\rho_{11} - I_b\rho_m \\ &= I_c(r_c + r_b) - I_e r_b - E'_c - I_e r_m. \end{aligned}$$

Substituting $I_e = I_b + I_c$ for the coefficient of r_m in the second part

$$V_c = I_e(r_c + r_b - r_m) - I_e r_b - E'_c - I_b\rho_m.$$

TABLE 1

Given $r_{11}, r_{22}, \alpha, \beta$		
$r_b = \beta r_{11}$	$\rho_b = \beta r_{11}$	$\rho_{11} = r_{11}$
$r_c = r_{22} - \beta r_{11}$	$\rho_c = r_{22}(1-\alpha)$	$\rho_{22} = r_{22}(1-\alpha) + r_{11}(1-\beta)$
$r_e = r_{11}(1-\beta)$	$\rho_e = r_{11}(1-\beta)$	$a = \dfrac{\alpha r_{22} - r_{11}}{r_{22}(1-\alpha) + r_{11}(1-\beta)}$
$r_m = \alpha r_{22} - \beta r_{11}$	$\rho_m = \alpha r_{22} - \beta r_{11}$	$b = 1 - \beta$
Given r_b, r_c, r_e, r_m		
$r_{11} = r_b + r_e$	$\rho_{11} = r_b + r_e$	$\rho_b = r_b$
$r_{22} = r_b + r_c$	$\rho_{22} = r_e + r_c - r_m$	$\rho_c = \dfrac{r_e - r_m}{r_b + r_e}(r_e + r_c - r_m)$
$\alpha = \dfrac{r_b + r_m}{r_b + r_e}$	$a = \dfrac{r_m - r_e}{\rho_{22}}$	$\rho_e = r_e$
$\beta = \dfrac{r_b}{r_b + r_e}$	$b = \dfrac{r_e}{r_b + r_e}$	$\rho_m = r_m$

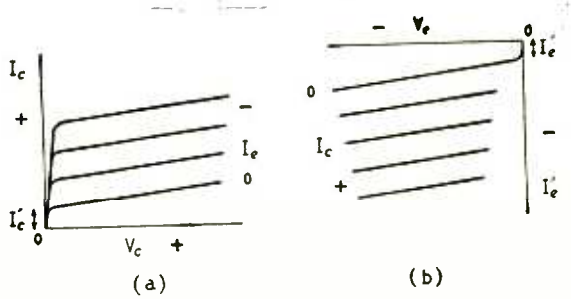


Fig. 3. General form of n-p-n transistor characteristics for the earthed-base connection.

Comparing the first and last equations for V_c, we have $r_c = \rho_c + \rho_m$, $r_m = \rho_m$ and $E'_c = I'_e r_{22} - I'_b\rho_{11}$.

We can now go a stage further and transform Fig. 2(e) to the form (f), which is like the equivalent circuit that we first derived for the earthed-emitter transistor. For this we have

$$V_e = I_e r_{11} - \beta I_c r_{11} - E'_e$$
$$V_c = I_c r_{22} - \alpha I_e r_{22} - E'_c$$

Comparing these with the ones for Fig. 2(e) we get $r_{11} = r_e + r_b$, $\beta r_{11} = r_b$, $r_{22} = r_c + r_b$, $\alpha r_{22} = r_b + r_m$, so $\alpha = \dfrac{r_b + r_m}{r_b + r_c}$ and $\beta = \dfrac{r_b}{r_b + r_e}$. If we remember how we derived the corresponding terms of the earthed-emitter circuit from the transistor characteristic, it is now plain that these terms have similar meanings for the earthed-base characteristics. We can say therefore, that r_{11} is the emitter a.c. resistance

$$r_{11} = \delta V_e/\delta I_e$$

for I_c constant. Also r_{22} is the collector a.c. resistance

$$r_{22} = \delta V_c/\delta I_c$$

for I_e constant.

The other terms are the current amplification factors α and β, and

$$\alpha = \delta I_c/\delta I_e$$

for V_c constant while

$$\beta = \delta I_e/\delta I_c$$

for V_e constant.

The characteristics for the earthed-base connection are shown in Fig. 3. We could have started with these and derived r_{11}, r_{22}, α and β from them in accordance with the above definitions and in exactly the same way as we did for the earthed-emitter transistor in Part 2. We should then have obtained Fig. 2(b) directly and found $E'_e = I'_e r_{11}$ and $E'_e = I'_e r_{22}$ where I'_e and I'_e are the zero-current intercepts as in Fig. 3. Following the same argument as in Part 2 we could have found Fig. 2(e) and then established the relations with the earthed-emitter circuit (d).

The relations between the values for the equivalent circuits are summarized in Table 1.

The complete equivalent circuit can be reduced to its a.c. form by omitting the d.c. parts as we did before. The result is Fig. 4. One great advantage of this form of circuit is that three of the elements r_e, r_b and r_m have the same values as their earthed - emitter

counterparts ρ_e, ρ_b and ρ_m. It is only r_c that differs from ρ_c.

At this stage it is desirable to consider what four constants should be used to represent the transistor. So far, we have based everything upon a pair of a.c. resistances and a pair of current amplification factors because they are somewhat analogous to valve constants and are easily determined from the transistor characteristics. There are quite a lot of alternatives, however. We have already met a, b, ρ_{11} and ρ_{22} with the derived quantities ρ_b, ρ_c, ρ_e and ρ_m for the earthed-emitter connection and α, β, r_{11} and r_{22} with the derived quantities r_b, r_c, r_e and r_m for the earthed-base.

Choice of Constants

The thermionic valve operating with a negative grid requires only one family of curves to describe its characteristics and two constants, derivable from these characteristics, to describe it in an a.c. equivalent circuit. Because the transistor passes current at all its three electrodes, two families of curves are needed to describe it and four constants are needed for an equivalent circuit. This raises difficulties, because neither the two families of curves nor the four constants are unique. There are four possible families of curves and twelve possible constants!

This applies to the earthed-emitter connection and there are the same number again for the earthed-base arrangement. We need only four constants out of twenty-four possible ones! In the valve we have only three—amplification factor μ, a.c. resistance r_a, and mutual conductance g_m; they are related since $\mu = g_m r_a$ so we need two only out of a possible three and, if we ever want the third, the relation is a very simple one.

In the case of the transistor, the relations between the twenty-four possible constants are much more complex and are not readily performed mentally. It is rather important, therefore, to choose the best four constants. Unfortunately, opinions differ about which are the best and different writers use different ones. This accounts for much of the difficulty of transistor literature.

We regard it as essential that whatever four constants are chosen they should be determinable from the transistor characteristics which are most readily available. This at once rules out earthed-emitter constants, for the usual characteristics are the earthed-base type. We have, therefore, to choose four out of twelve possible ones.

There are three groups of four which are particularly common in the literature and which are

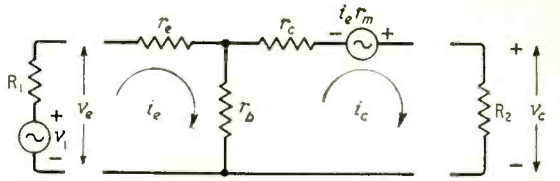


Fig. 4. A.C. equivalent circuit corresponding to Fig. 2 (e).

defined in Table 2. The symbols following the square brackets indicate which voltage or current is to be regarded as constant. The twelve constants listed are not all distinct; for example, $y_{11} = 1/h_{11}$, $r_{22} = 1/h_{22}$, $h_{12} = r_{12}/r_{22}$, $h_{21} = y_{21}/y_{11}$. There are more possibilities than are shown in Table 2, therefore.

According to Shea[1] the h group is the most suitable, because the constants are the easiest to measure and vary less with temperature and operating point than the others. However, h_{11} and h_{12} are not obtainable readily from the ordinary characteristic curves. In fact, no single group is!

There is one serious objection to the nomenclature of the h group, which is that the same letter serves sometimes for a resistance, sometimes for a conductance and sometimes for a ratio. This is very bad practice, because it prevents the ready dimensional checking of equations It is likely to cause errors. In this respect, both the r and y groups are satisfactory, because all the r constants are resistances and all the y constants are conductances.

Measurement of Constants

When the constants are obtained by measurements on an actual transistor, some are easier to measure than others. The output resistance of a junction transistor is usually rather high, 1–2 MΩ, and it is difficult to employ a high enough external impedance to obtain constant-current conditions. It is much easier to make the impedance low and so to operate under constant-voltage conditions. It is, therefore, easier to measure quantities which need V_c kept constant than those which require I_c to be constant. At the input, the reverse applies. If the input resistance is very low, it is difficult to obtain a voltage supply of low enough internal resistance to operate under constant-voltage conditions, but it is quite easy to operate at constant current. Thus it is easier to measure quantities which need I_e kept constant than those which must have constant V_e.

The h group constants of Table 2 are thus admirably suited to the requirements of measurement.

When one wants to derive the constants from the characteristic curves, however, the h group is quite unsuitable. The most convenient ones are r_{11}, r_{22}, α and β, that we have used hitherto. They are all easily determined from the characteristic curves, which is why we selected them in the first place.

It does not seem practicable, therefore, to have a single set of primary constants which is suitable both for evaluation by measurement and from the characteristic curves. It seems best, therefore, to adopt one set for measurement purposes and another for derivation from the valve

TABLE 2

$r_{11} = \delta V_e/\delta I_e]I_c$	$y_{11} = \delta I_e/\delta V_e]V_c$	$h_{11} = \delta V_e/\delta I_e]V_c$
$r_{22} = \delta V_c/\delta I_c]I_e$	$y_{22} = \delta I_c/\delta V_c]V_e$	$h_{22} = \delta I_c/\delta V_c]I_e$
$r_{12} = \delta V_e/\delta I_c]I_e$	$y_{12} = \delta I_e/\delta V_c]V_e$	$h_{12} = \delta V_e/\delta V_c]I_e$
$r_{21} = \delta V_c/\delta I_e]I_c$	$y_{21} = \delta I_c/\delta V_e]V_c$	$h_{21} = \delta I_c/\delta I_e]V_c$
$r_b = \dfrac{h_{12}}{h_{22}}$	$= \beta r_{11}$	$= r_{12}$
$r_e = \dfrac{1 - h_{12}}{h_{22}}$	$= r_{22} - \beta r_{11}$	$= r_{22} - r_{12}$
$r_e = h_{11} - (1 + h_{21})\dfrac{h_{12}}{h_{22}}$	$= r_{11}(1 - \beta)$	$= r_{11} - r_{12}$
$r_m = -\dfrac{h_{12} + h_{21}}{h_{22}}$	$= \alpha r_{22} - \beta r_{11}$	$= r_{21} - r_{12}$

[1] "Transistor Audio Amplifiers," by Richard F. Shea. (Chapman & Hall).

characteristics. The h group seems best for the first and, for the second, the r_{11}, r_{22}, α and β groups that we have used hitherto.

Whichever is adopted, it can be transformed to the other or to the r_e, r_b, r_c and r_m group if it is desired to use this type of equivalent circuit. This circuit is very commonly used in the literature and its outstanding advantage is that three of the four resistances are the same for both the earthed-base and the earthed-emitter connection. Only one needs to have its value altered.

Transformation of Constants

For general use in circuit work, no single equivalent circuit is necessarily always the best. Often, a particular form best suits a given problem. It is, therefore, very necessary to be able to pass readily from one form to another and Table 1 enables this to be done. Sometimes, the transistor constants are quoted somewhat differently; instead of having r_{11}, r_{22}, α, β or r_b, r_c, r_e and r_m, for instance, one might have r_b, r_c, r_e and α. The quickest way of finding r_m is then to find r_{11}, r_{22} and β from the relations in the first column of the second group of transformations in Table 1 and then to compute r_m from the equation in the first group. It works out at $r_m = \alpha\ (r_b + r_c) - r_b$.

Table 2 gives the definitions of the r, y (or g) and h groups of constants which are found in the literature. In addition, it gives a transformation from the h group to the r_b, r_c, r_e and r_m form so that, with the aid of Table 1, a transformation to any other group can be effected. The transformation from the r group to the r_b, r_c, r_e and r_m form is also included, since this is also commonly found in the literature. The derivation of the r group is treated in the Appendix.

One or two comments on the relations of Table 1 may be helpful. In the first place, some of the relations can be simplified in practice with negligible error; for example, r_b is often very small compared with r_c and can be neglected in comparison. Secondly, the relation for a, the current amplification factor for the earthed-emitter transistor, is different from the one usually quoted, which is $a = \alpha/(1 - \alpha)$. The equation given reduces to this simple form when $r_{11} \ll \alpha r_{22}$ and $r_{11}\ (1 - \beta) \ll r_{22}\ (1 - \alpha)$, which is usually the case.

Before we conclude this part, it may be helpful to quote some actual figures for transistors to get an idea of the order of magnitude of the quantities involved and how the transformations are effected. Turning to the *Wireless World* "Radio Valve Data", we find the Mullard OC70 listed as having $r_b = 750\,\Omega$, $r_c = 1.5\,\text{M}\Omega$, $r_e = 35\ \Omega$ and $\alpha = 0.97$, so

$$r_m = 0.97 \times 1.5 = 1.455\,\text{M}\Omega$$

since r_b is negligibly small in comparison with r_c. For the earthed-base connection we have (see Table 1):— $\rho_b = 750\ \Omega$, $\rho_e = 35\ \Omega$, $\rho_m = 1.455\,\text{M}\Omega$ and

$$\rho_c = \frac{1.5 - 1.455}{1.5} = \frac{0.045}{1.5} = 0.03\,\text{M}\Omega = 30\,\text{k}\Omega.$$

For the two-generator earthed-base equivalent circuit we have:—

$$r_{11} = 750 + 35 = 785\ \Omega$$
$$r_{22} = 1.5\,\text{M}\Omega$$
$$\alpha = 0.97$$
$$\beta = \frac{750}{785} = 0.956$$

while for the two-generator earthed-emitter circuit we get:—

$$\rho_{11} = 785\ \Omega$$
$$\rho_{22} = 1.5 - 1.455 = 0.03\,\text{M}\Omega = 30\,\text{k}\Omega$$
$$a = \frac{1.455}{0.03} = 48.5$$
$$b = \frac{35}{785} = 0.0446$$

Using Table 2, we can evaluate the quantities in terms of the r and h group and we get:—

$$r_{11} = 785\ \Omega$$
$$r_{12} = 750\ \Omega$$
$$r_{21} = 1.455\,\text{M}\Omega$$
$$r_{22} = 1.5\,\text{M}\Omega$$

and $$h_{11} = r_e + r_b\frac{r_c - r_m}{r_c + r_b} = 35 + 750\frac{1.5 - 1.455}{1.5}$$
$$= 35 + 750\,\frac{0.045}{1.5}$$
$$= 35 + 750 \times 0.03 = 35 + 22.5 = 57.5\ \Omega$$

$$h_{12} = \frac{r_b}{r_b + r_c} = \frac{750}{1{,}500{,}000} = 0.0005$$

$$h_{21} = -\frac{r_m}{r_c} = -\frac{1.455}{1.5} = -0.97$$

$$h_{22} = \frac{1}{r_c} = \frac{1}{1.5 \times 10^6} = 0.66 \times 10^{-6}\ \text{mhos}$$

Point-contact Transistor

For a point-contact transistor, the values are quite different. Krugman[2] quotes:— $r_{11} = 250\,\Omega$, $r_{12} = 100\,\Omega$, $r_{21} = 24\,\text{k}\Omega$, $r_{22} = 12\,\text{k}\Omega$. From Table 2 we then have:—

$$r_b = 100\ \Omega$$
$$r_c = 11.9\,\text{k}\Omega$$
$$r_e = 150\ \Omega$$
$$r_m = 23.9\,\text{k}\Omega$$

From Table 1, $r_{11} = 250\,\Omega$, $r_{22} = 12\,\text{k}\Omega$, $\alpha = 24/12 = 2$ and $\beta = 100/250 = 0.4$. Notice particularly that α is greater than unity. This is typical of a point-contact transistor; with the junction type, α is always less than unity. Proceeding, we have $\rho_{11} = 250\ \Omega$, $\rho_{22} = 0.15 + 11.9 - 23.9 = -10.85\,\text{k}\Omega$, $a = (23.9 - 0.15)/(-10.85) = -21.8$, $b = 150/250 = 0.4$. Notice that ρ_{22} and a are both negative for the point-contact transistor in the earthed-emitter circuit. Taking the remaining form we have,

$$\rho_b = 100\ \Omega,\ \rho_e = 150\ \Omega,\ \rho_m = 23.9\,\text{k}\Omega,$$
$$\rho_c = \frac{11.9 - 23.9}{12}(12.05 - 23.9) = -10.85\,\text{k}\Omega.$$

What is the meaning of α greater than unity? In terms of a.c., we have defined it as i_c/i_e and we have $i_e = i_b + i_c$. If α is greater than unity, it means that the collector current is greater than the sum of the base and collector currents and, in turn, this means that the base current must be in the opposite direction to the collector current. We derived our equivalent circuit for the junction transistor and took the positive directions of current flow as the actual directions. With the point-contact transistor, however, one of these is reversed. We cannot yet say which.

However, we find ρ_{22} is negative and this means that i_e is reversed compared with the junction transistor.

[2] "Fundamentals of Transistors," by Leonard M. Krugman. (Chapman & Hall).

We can say, therefore, that in the two types i_b flows in the same direction but i_c in the opposite and we have the curious result that the emitter current of a point-contact transistor is smaller than the collector current.

(To be concluded)

APPENDIX

IN American literature, the equivalent circuit of a transistor is usually derived from the arrangement of Fig. 5. The transistor is represented as a box with four terminals 1, 1 and 2, 2, two of which are internally joined. The voltages v_1 and v_2 are applied externally and, as a result, the currents i_1 and i_2 flow with the directions shown. Four resistances are named arbitrarily r_{11}, r_{12}, r_{21}, r_{22} and the following equations are written:—

$$\begin{aligned} v_1 &= i_1 r_{11} + i_2 r_{12} \\ v_2 &= i_2 r_{22} + i_1 r_{21} \end{aligned} \qquad \text{(A1)}$$

The meaning of the four resistances is then determined by putting the currents each in turn equal to zero. Thus,

$$\begin{aligned} r_{11} &= v_1/i_1 \text{ for } i_2 = 0 \\ r_{21} &= v_2/i_1 \text{ for } i_2 = 0 \\ r_{12} &= v_1/i_2 \text{ for } i_1 = 0 \\ r_{22} &= v_2/i_2 \text{ for } i_1 = 0 \end{aligned} \qquad \text{(A2)}$$

The equivalent circuit of Fig. 6 is then drawn with $v_e = v_1$, $i_e = i_1$, $v_c = v_2$, $i_c = i_1$ for the earthed-base transistor and the same current directions as for Fig. 5. The equations for Fig. 6 are:—

$$\begin{aligned} v_e &= i_e(r_e + r_b) + i_c r_b \\ v_c &= i_c(r_c + r_b) + i_e(r_b + r_m) \end{aligned} \qquad \text{(A3)}$$

Comparing these with (A1), we have

$$\begin{aligned} r_{11} &= r_e + r_b \\ r_{12} &= r_b \\ r_{21} &= r_b + r_m \\ r_{22} &= r_c + r_b \end{aligned} \qquad \text{(A4)}$$

If we write $v_c = 0$ in (A3) any current in the collector circuit flows as a result of v_e. Then

$$i_c = -\, i_b \frac{r_b + r_m}{r_b + r_c}$$

and the minus sign indicates that the current i_c flows in the opposite direction to that shown in Figs. 5 and 6. In our derivation in the text, we assumed this opposite direction of current flow from the start and our v_c was a voltage developed by i_c in a load resistance even if this was not always specifically shown. Here v_c is an externally applied voltage.

The current amplification factor is

$$\alpha = \frac{r_b + r_m}{r_b + r_c}$$

$= -\, i_c/i_e$ in the American convention.

We defined α in relation to the static characteristics of the valve as $\delta I_c/\delta I_e$, which is equivalent to i_c/i_e in terms of alternating current. The minus sign arises in the American definition because they have assumed i_e to flow the other way round. There is no real difference in the meaning of α.

The backward current amplification factor, which we are calling β, is defined in American literature as

$$\beta = -\, i_e/i_c \text{ for } v_e = 0$$

$$= \frac{r_b}{r_e + r_b}$$

from (A3).

We originally defined b as $-\, \delta I_b/\delta I_e$ and later obtained β as $1 - b$ or $1 + \delta I_b/\delta I_e = (\delta I_b + \delta I_e)/\delta I_e = \delta I_c/\delta I_e$ which is i_c/i_e in terms of alternating current. Again, there is a difference of sign in the definition which is again brought about by the different direction of current flow assumed initially. Again, there is no difference in the real meaning of β.

The American derivation of the equivalent circuit is simpler than ours and leads to the same result, but it is intellectually less satisfying, because the initial constants r_{11}, r_{12}, r_{21}, r_{22} are obtained in an apparently arbitrary manner. Our constants r_{11}, r_{22}, α, β are derived directly from the characteristic curves and have an obvious physical meaning.

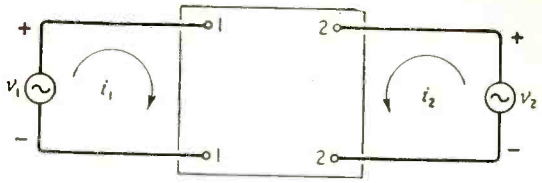


Fig. 5

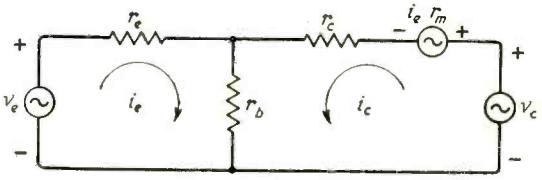


Fig. 6

BOOKS RECEIVED

Linear Feedback Analysis by J. G. Thomason, B.Sc. Treatise covering basic principles and their application in electronic circuits and servo-mechanisms, with special reference to the causes of instability and methods of stabilization, with practical illustrative examples. Pp. 355+x; Figs. 236. Price 55s. Pergamon Press, Ltd., 4-5, Fitzroy Square, London, S.W.1.

Powder Metallurgy. Report of Technical Assistance Mission No. 141 on European and American manufacturing techniques. Pp. 309; Figs. 15. Price 20s. Organization for European Economic Co-operation, 2 rue André-Pascal, Paris, 16.

Thermionic Valves, 1904-1954. Souvenir reprint of the lectures and photographs of the exhibits at the celebrations to mark the jubilee of the thermionic valve (16th November, 1954). Pp. 69. Price 9s. The Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Practical Wireless Servicing Manual by F. J. Camm. Revised tenth edition, including additional chapters on the construction of test instruments. Pp. 284; Figs. 221. Price 17s 6d. George Newnes, Ltd., Southampton Street, London, W.C.2.

Points on Pickups by F. Wilson. Replacement guide to stylus types and cartridges, illustrated for ready identification. Pp. 34. Price 3s. A. C. Farnell, Ltd., 15, Park Place, Leeds, 1.

Théorie des Réseaux de Kirchhoff by M. Bayard. Analysis and synthesis of linear networks under sinusoidal conditions. Pp. 414+xv; Figs. 315. Price F.fr. 3,200. Editions de la Revue d'Optique, 3 et 5, Boulevard Pasteur, Paris, 15.

Cours de Radioélectricité Générale. Volume 4 Propagation des Ondes by Pierre David. General survey of radio wave propagation. The influence of the ground, the troposphere and the ionosphere. Applications to the selection of wavelengths for long-distance communication. Pp. 223. Editions Eyrolles, 61, Boulevard Saint-Germain, Paris, 5.

A Guide to Electricity by J. H. M. Sykes, Assoc.I.E.E. Elementary treatise on everyday electrical engineering practice for the general reader. Pp. 275; Figs. 90. Price 21s. Hutchinson's Scientific and Technical Publications, Stratford Place, London, W.1.

Design of Tchebycheff Filters

Experimental Verification of the Basic Formulæ

By G. H. BURCHILL,* B.Sc.

THE following notes are offered as a corollary to the series of articles on filter design by Thomas Roddam (*Wireless World*, Aug., Sept., Nov., Dec. 1954). Filters of the third order will be discussed and the results given of measurements on experimental filters.

Data for constructing Tchebycheff third-order (π-section) filters are given by Fig. 1, and the configurations and characteristics of these filters are shown by Fig. 2. Curves are plotted for the case where source and load resistances R_1 and R_2 are equal, and for the case where R_2 is infinite. The curves were calculated on the assumption that losses in the filter components could be neglected.

These filters have relatively high insertion loss beyond cut-off, but they also have appreciable loss at certain frequencies in the pass band. The loss is to some extent under the control of the designer, and depends on the value chosen for the factor "t" in the Tchebycheff polynomial which describes the insertion loss characteristic. As indicated by Fig. 1, the greater the value of t the greater the loss beyond cut-off; but also the greater the loss at some frequencies in the pass band. Thus with reference to Fig. 2, the greater the value of t the greater the slope of the insertion loss curve beyond cut-off, and also the more pronounced the "ripple" in the pass band.

To design a filter it is first necessary to choose a value of t. The choice may be made either by consideration of the allowable loss in the pass band, or of the desirable loss beyond cut-off. The lower "db"

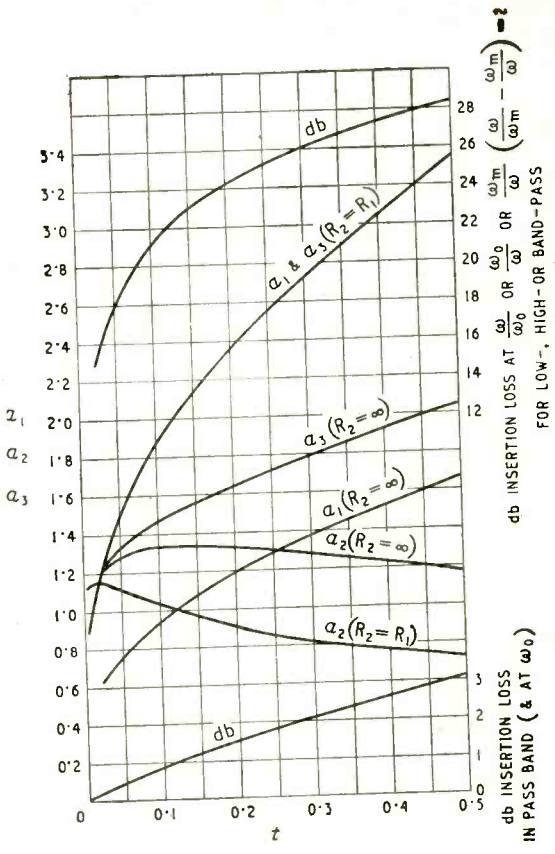
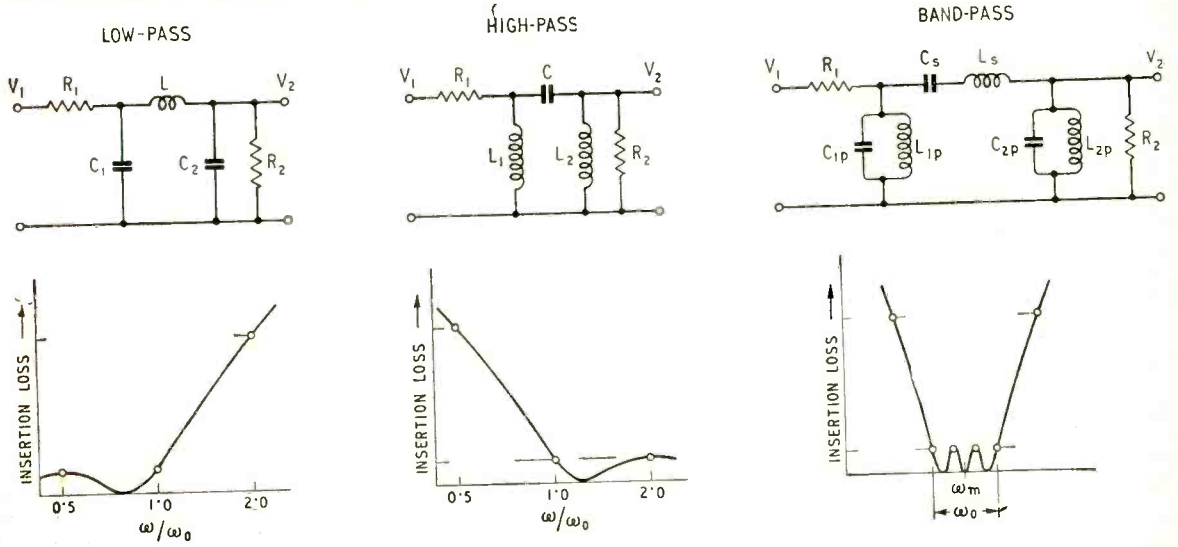


Fig. 1. Basic data for use in design formulæ.

Below: Fig. 2. Third-order (π-section) Tchebycheff filters and their characteristics.



* Professor of Electrical Engineering, Nova Scotia Technical College.

curve is used in the first case, the upper " db " curve in the second. When a value of t has been chosen the corresponding values of a_1, a_2 and a_3 are read from their respective curves for the specified termination, $R_2 = R_1$ or $R_2 = \infty$. The filter components are then calculated as follows:

For a low-pass filter with cut-off angular frequency ω_0

$$C_1 = a_1/\omega_0 R_1 \qquad L = a_2 R_1/\omega_0 \qquad C_2 = a_3/\omega_0 R_1$$

For a high-pass filter with cut-off angular frequency ω_0

$$L_1 = R_1/a_1\omega_0 \qquad C = 1/a_2\omega_0 R_1 \qquad L_2 = R_1/a_3\omega_0.$$

For a band-pass filter of band width ω_0 and mean angular frequency ω_m

$$C_{1p} = a_1/\omega_0 R_1 \qquad L_s = a_2 R_1/\omega_0 \qquad C_{2p} = a_3/\omega_0 R_1$$

$$L_{1p} = 1/\omega_m^2 C_{1p} \qquad C_s = 1/\omega_m^2 L_s \qquad L_{2p} = 1/\omega_m^2 C_{2p}$$

The curves were plotted after a number of filters had been designed and tested. The method of design was based on the articles " Filters without Fears " by Thomas Roddam in the August and September 1954 issues of *Wireless World*. The filter components were determined from cut-and-try solutions of the Tchebycheff filter equations, for which Mr. Roddam did not give a solution. Following Mr. Roddam's method, but in more general form, the desired insertion loss characteristic for the low-pass case, based on the appropriate Tchebycheff polynomial, is: $db = 10 \log [1 + 18t(\omega/\omega_0)^2 - 48t(\omega/\omega_0)^4 + 32t(\omega/\omega_0)^6]$ The expression in brackets may also be derived in terms of the filter components, as explained by Roddam. When $R_1 = R_2$ it is:

$$1 + \omega^2\left\{\left[(C_1 + C_2)\frac{R_1}{2} + \frac{L}{2R_1}\right]^2 - L(C_1 + C_2)\right\}$$

$$+ \omega^4\left\{\frac{L^2(C_1 + C_2)^2}{4} - 2LC_1C_2\left[(C_1 + C_2)R_1 + \frac{L}{R_1}\right]\frac{R_1}{4}\right\}$$

$$+ \omega^6 L^2 C_1^2 C_2^2 \frac{R_1^2}{4}$$

Writing $C_1 = a_1/\omega_0 R_1$ $L = a_2 R_1/\omega_0$ $C_2 = a_3/\omega_0 R_1$ and equating the two expressions term by term gives:

$$\frac{(a_1 + a_2 + a_3)^2}{4} - a_2(a_1 + a_3) = 18t$$

$$\frac{a_1 a_2 a_3}{2}(a_1 + a_2 + a_3) - \frac{a_2^2(a_1 + a_3)^2}{4} = 48t$$

$$a_1^2 a_2^2 a_3^2 = 128t$$

The first equation may be simplified to $a_1 + a_3 = \sqrt{72t} + a_2$ and the third to $a_1 a_2 a_3 = \sqrt{128t}$ If these are substituted in the second equation there results $a_2^3 + 2\sqrt{72t}\,a_2^2 + 72ta_2 - 8\sqrt{32t} = 0$ Values of a_2 for particular values of t were obtained from this equation. The corresponding values of a_1 and a_3 were then obtained from the simplified forms of the first and third equations.

When $R_2 = \infty$ the filter equations become:

$$\omega^2(C_1 + C_2)^2 R_1^2 - 2\omega^2 LC_2 = 18t(\omega/\omega_0)^2$$

$$2\omega^4 LC_1C_2(C_1 + C_2)R_1^2 - \omega^4 L^2 C_2^2 = 48t(\omega/\omega_0)^4$$

$$\omega^6 L^2 C_1^2 C_2^2 R_1^2 = 32t(\omega/\omega_0)^6$$

Substitution of a_1 etc. gives.

$$(a_1 + a_3)^2 - 2a_2a_3 = 18t$$

$$2a_1a_2a_3(a_1 + a_3) - a_2^2a_3^2 = 48t$$

$$a_1^2a_2^2a_3^2 = 32t$$

further manipulation leads to:

$$a_3 = \frac{\sqrt{32t}}{2a_1^2} + \frac{48t}{2\sqrt{32t}} - a_1$$

$$a_2 = \frac{(a_1 + a_3)^2 - 18t}{2a_3}$$

$$a_1a_2a_3 = \sqrt{32t}$$

These were solved for particular values of t, using a slide-rule and systematic computing form, by trying values of a_1, finding the resulting values of a_3 and a_2, and comparing $a_1a_2a_3$ with $\sqrt{32t}$. About six trials usually gave the solution.

In *Wireless World*, December 1954, Mr. Roddam explained the transformations which give high-pass and band-pass filter designs from low-pass calculations. The examples he gave were second-order filters, but the expressions he derived were general, and apply also to third-order filters. The high-pass and band-pass design formulæ given above were obtained by writing these expressions in terms of R_1, a_1, a_2 and a_3.

A comparison with other types of filter is interesting. Mr. Roddam gives the solution for Butterworth response, low-pass, with $R_2 = \infty$. For our purpose it may be written $C_1 = 1/2\omega_0 R_1$, $L = 4R_1/3\omega_0$, $C_2 = 3/2\omega_0 R_1$. Evidently in this case $a_1 = 0.5$, $a_2 = 1.33$, $a_3 = 1.5$. The insertion loss at $\omega = \omega_0$, 3 db, is the same as that of a Tchebycheff filter having $t = 0.5$, but the Butterworth filter does not have the 3-db loss at $\omega = 0.5\omega_0$ and it has about 10 db less insertion loss at $\omega = 2\omega_0$. If $R_2 = R_1$ a Butterworth filter has $a_1 = 1$, $a_2 = 2$, and $a_3 = 1$, giving the same component values as the conventional image-impedance method.

When $R_2 = R_1$, $a_3 = a_1$, and $C_2 = C_1$, there is no obvious difference between the proportions of Tchebycheff and Butterworth filters. It is therefore instructive to determine the conditions that lead to these different types of response. If the low-pass design equations are multiplied together, there results:

$$LC = \frac{a_2 R_1}{\omega_0} \cdot \frac{a_1}{\omega_0 R_1} = \frac{a_1 a_2}{\omega_0^2}; \text{ or } \omega_0^2 = \frac{a_1 a_2}{LC}$$

and if they are divided:

$$\frac{L}{C} = \frac{a_2 R_1}{\omega_0} \cdot \frac{\omega_0 R_1}{a_1} = \frac{a_2}{a_1} R_1^2; \text{ or } R_1^2 = \frac{a_1}{a_2} \cdot \frac{L}{C}$$

Evidently it is possible to operate a given filter, having fixed values of L and C, at any value of the Tchebycheff factor t, and the corresponding values of a_1 and a_2, if the resulting values of ω_0 and R_1 are acceptable. Further, it is possible to operate with $a_1 = 1$ and $a_2 = 2$ to obtain Butterworth response. As an example, a filter made up of a 46-millihenry inductor and two 0.1-microfarad capacitors operates

(a) Butterworth, with $f_0 = 3320$ c/s, if $R_1 = R_2 = 480$ ohms.

(b) Tchebycheff, $t = 0.125$, with $f_0 = 3320$ c/s, if $R_1 = R_2 = 960$ ohms.

(c) Tchebycheff, $t = 0.5$, with $f_0 = 3650$ c/s, if $R_1 = R_2 = 1460$ ohms.

There is another mode of operation which is useful at radio frequencies. If t is chosen as 0.0185, $a_1 = a_2 = a_3 = 1.15$. If a filter having these proportions is operated at the frequency $\omega = 0.866\omega_0$, so that $a_1\omega/\omega_0 = 1$ (etc.) the reactances of all its components be-

come numerically equal to R_1. Then if it is terminated with an arbitrary load resistance R_L the rather complicated general expression for the input impedance becomes simply R_1^2/R_L. The value of R_1 may be chosen to make this input resistance any desired value, so the circuit can act as an impedance-matching network, as well as reducing harmonic radiation. The low-frequency filter of the previous example operates in this fashion if $R_1 = 680$ ohms. When tested between a 340-ohm source and a 1360-ohm load (or vice versa) it showed a response resembling the Tchebycheff, but with insertion gain in the region near $0.866\omega_0$ (2350 c/s). The measured gain was slightly less than 1.9 db, the theoretical value for perfect matching.

Measurements have been made on a number of experimental filters, of the three types, some designed for $R_2 = R_1$ and some for $R_2 = \infty$. Two r.f. filters were also set up and tested in the equivalent lattice form for matching balanced to unbalanced lines. In general the agreement between measurements and calculations was close. The greatest discrepancy occurred in the pass band where the calculated insertion loss was zero or very small. In this region typical high- and low-pass filters showed 1- or 2-db loss, and band-pass filters (with three coils) as much as 5-db loss. The discrepancy is presumably due to the neglect of component losses in calculations. The loss has the effect of reducing the ripple in the pass band, and several band-pass filters designed with $t = 0.5$ showed only 1- or 2-db variation over the pass band, instead of the expected 3-db. One filter, designed for $R_2 = \infty$ and with $t = 0.41$ was tested with a value of $R_2 = 5000$ ohms ($R_2 = 10R_1$). It showed about 0.6 db more insertion loss in the pass band than it had without the resistor, and no measurable difference in loss outside the pass band. Evidently R_2 need not be extremely high to be considered "infinite."

Simplified GCA

A NEW precision approach radar known as SPAR has been developed in the U.S.A. which provides all the facilities of a full-scale ground controlled approach (GCA) system for landing aircraft in poor visibility and at the same time is simple to operate and can if required be moved quickly from one site to another. The total weight is under one ton and the various parts break down into conveniently sized units for handling and for transport by aircraft if necessary. The whole equipment can be dismantled in six man-hours and re-erected in the same time.

The illustration shows the type and arrangement of the aerials; each measures 8ft × 2ft and they scan mechanically in azimuth and in elevation respectively, the former over an arc of 30° and the latter 10° (−1° to +9°).

What is thought to be a unique feature of this GCA is that both glide and approach paths (elevation and azimuth information) are displayed on a single 17in extra-long-persistence c.r. tube. "B" scans are used in both cases with glide path information shown on the top half of the tube and approach path information below. A logarithmic scale of range is employed, which is appropriate since it gives the greatest expansion of the trace at the most critical stage of the talk-down descent; just before the actual touch-down.

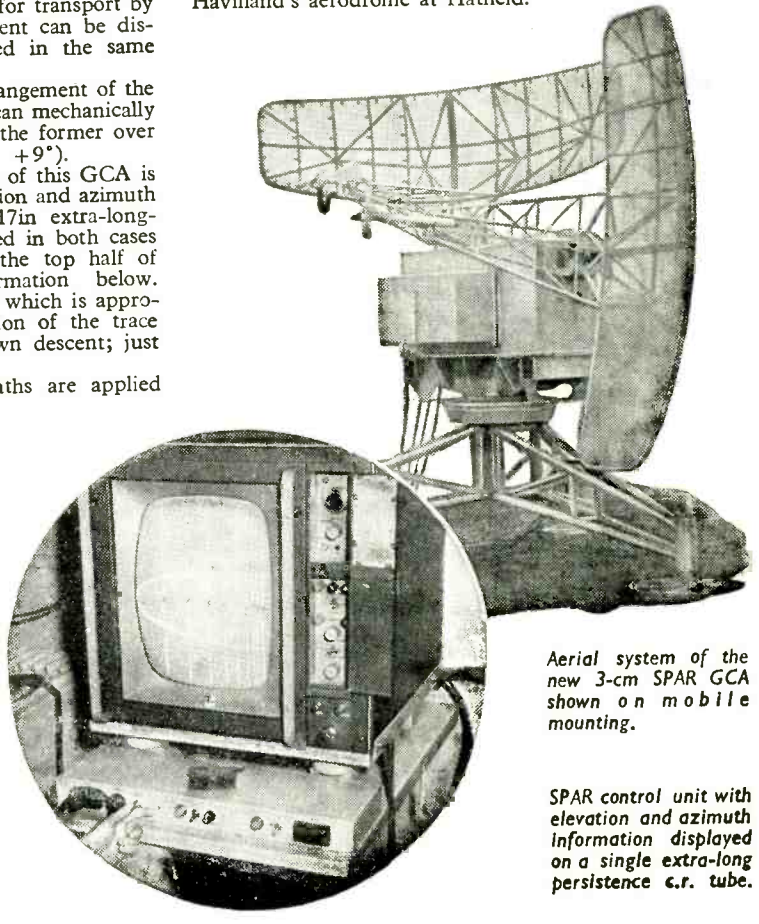
Predetermined glide and approach paths are applied electronically to the screen of the tube and it is only necessary for the controller to keep the two elongated echoes astride these displayed paths to bring the aircraft down safely. Relevant flying instructions are passed by v.h.f. radio-telephone.

A high degree of accuracy is claimed for this system; ±20ft at touch-down, just before which the pilot takes over for a visual landing, and 0.5% of the range are the figures given.

The aerial unit can be positioned either on the centre line of the runway or to one side of it, the maximum displacement off centre being 1,000ft.

Brief technical details of the installation are as follows: operating frequency, 9,080 Mc/s ±1%; pulse width, 0.5 μsec; peak power 50 kW; range, 10 nautical miles; aerial scan rate, 2 per sec azimuth and elevation. Provision is made for optional circular polarization to combat any clutter or degradation of the system by rain droplets. The power input required is 3.5 kVA at 115/230 V a.c. 50/60 c/s single phase.

The equipment is a Bendix product and is handled in the U.K. by Elliott Bros., Century Works, Lewisham, London, S.E.13, who recently demonstrated it on De Havilland's aerodrome at Hatfield.



Aerial system of the new 3-cm SPAR GCA shown on mobile mounting.

SPAR control unit with elevation and azimuth information displayed on a single extra-long persistence c.r. tube.

Vertical Pattern of V.H.F. Aerials

New Method of Measurement Dispensing with the Need for High Towers

By E. G. HAMER,* B.Sc.(Eng.) Hons., A.M.I.E.E.

THE increasing use of v.h.f. equipment for mobile services, both of the business radio and public utility types, has called for intensive development to improve the performance of all the various units involved. In the case of the transmitter the maximum power output is restricted by regulations laid down by the local licencing authorities, and to some extent by the economic maximum power consumption of the mobile equipment. The output signal-to-noise ratio of modern receivers is controlled mainly by the noise factor of the input circuits when the thermal noise is predominant. The noise factor varies between individual designs but is usually as low as 4 db up to 100 Mc/s, and 6 db up to 180 Mc/s. The main items which remain, and which could possibly give improved performance are the aerial systems and feeders. A small improvement say 1 to 2 db could be made by using low-loss air-spaced feeders, but this improvement would be outweighed by the large increase in initial cost of the improved feeder cable.

Many types of aerials have been used in the past both for the fixed and mobile stations, and each system designer has had his own particular favourite. The performance of several types of aerials has been suspect in the past, their failings becoming apparent during the course of trials or demonstrations. This in many cases has led to conflicting opinions on the suitability of various types of aerials for different uses, and it has not been possible to recommend on technical grounds the best aerial for various types of service. It has been thought for some time that the vertical polar diagram of the various types of aerial varied considerably, and it is possible that the diagram changes rapidly with small changes of frequency, this being of importance where double frequency working, or common aerials are in use (Ref. [1,2]). The lack of information in the past has been due to the practical difficulties involved in the measurement of the true vertical polar diagram of an aerial, as even with the use of a high tower only part of the diagram can be measured. To some extent the vertical polar diagram of an aerial will depend upon its location and method of mounting, so that any measurements made will only apply to the particular equipment used, or some idealized case, say that of free space. In most aerials used for mobile services the desirable factor of a low standing-wave ratio, and lack of energy fed back down the outside of the feeder are sacrificed in the interests of low initial cost; and a "live feeder can have a pronounced effect on a vertical polar diagram, or on the symmetry of both the horizontal and vertical diagram, usually giving a degradation of performance in the required directions.

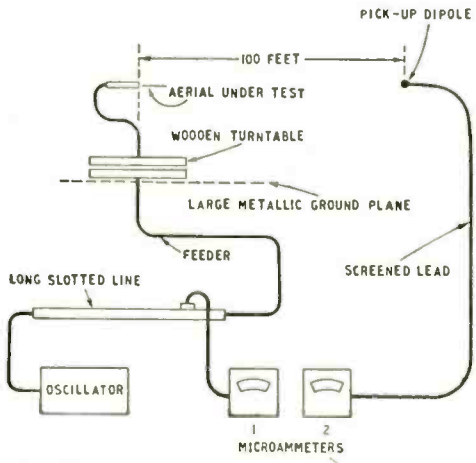


Fig. 1. Block schematic diagram of the equipment used for the measurements described in the text.

With a view to checking this last unknown factor of system performance (i.e. the aerial) it was decided to measure the approximate vertical polar diagram of various types of aerial. It has been shown in the past that the vertical polar diagram of simple aerials comprised only of vertical elements could be obtained by laying the aerial horizontally above a large ground plane and either rotating the aerial itself, or moving the receiving test aerial around at a fixed radial distance from the aerial being measured. But this method has not been justified in the past for more complex aerials consisting of mixtures of horizontal and vertical elements. The techniques used have been discussed in a previous paper (Ref. [5]) and provided certain precautions are taken reasonably accurate results will be obtained. The results obtained compare favourably with part diagrams taken when using a high tower to move the receiving aerial in a vertical direction. This to some extent may be fortuitous as the measured true vertical diagram will vary according to the height at which the aerial under test is mounted and also to the surrounding terrain.

Fig. 1 shows a block schematic diagram of the equipment used; the aerial under test was mounted on a wooden turntable which itself was set on a large metallic ground plane laid on the roof of a wooden hut. The aerial was connected by a suitable feeder to an oscillator through a long slotted line. The pick-up dipole was mounted 100 feet away and connected to a bridge rectifier, the resulting direct current being fed by a screened lead to microammeter 2. When measurements were made the radio frequency power into the aerial from the oscillator was adjusted to give a constant field strength at the pick-up dipole as measured by microammeter 2, and the power fed to the aerial measured by use of the long slotted line and microammeter 1. Fig. 2 is a sketch of the pick-up dipole head, a resonant circuit with the centre earthed was

* Research Laboratories, General Electric Company, Wembley.

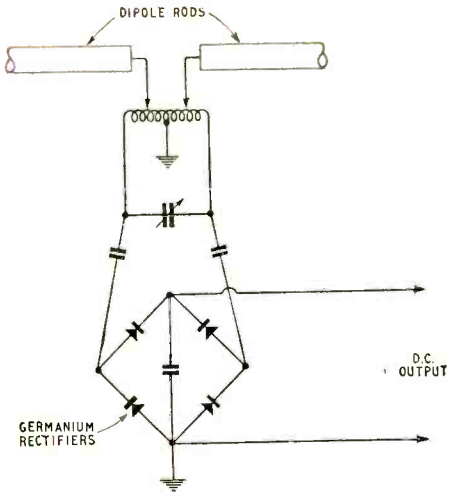


Fig. 2. Pick-up dipole head.

used to eliminate stray and unwanted pick up from powerful medium wave stations. A bridge formed of four germanium rectifiers was tapped on to the coil *via* isolating capacitors. A pick-up circuit of this kind, although insensitive, has the advantage of long-term stability, and requires no returning or power supplies; it was mounted at the top of a plywood telescopic mast on a level with the aerial under test. By plotting the inverse of the power fed into the aerial under test to give a constant field strength at the pick-up aerial the polar diagram of the aerial was obtained.

The product of the maximum and minimum relative voltages as measured by the long slotted line is directly proportional to the power being fed into the aerial (Ref. [3]), and by obtaining this product at various positions the polar diagram is obtained. For any given aerial setting as the standing-wave ratio is constant the aerial power is proportional to V_{max}^2 and the field strength at the pick-up aerial to V_{max} where V_{max} is the relative voltage at a maximum position along the slotted line. It is convenient only to measure V_{max} and V_{min} at a few positions to obtain the standing-wave ratio, and at all other positions only to measure V_{max}. This obviates the need to keep moving the probe of the slotted line, thus reducing the time taken to make a series of measurements, which in itself tends to increase the accuracy as the effect of drift of measuring equipment is minimized.

The average time to take a complete polar diagram of an aerial with a mechanically driven turntable, and with 10-deg intervals is thus reduced to 10 to 15 min. These individual diagrams are rescaled to a basis of equal radiated power, and hence direct comparisons of the performance of various types of aerials tested may be made (Ref. [5]).

Figs. 3, 4 and 5 are photographs of some of the aerials tested and Fig. 6 shows a comparison of the performance of various types of aerial when radiating the same power, and plotted on a basis of relative field strength. The Aerial Table shows the relative gain of the various types of aerial in a horizontal direction when compared with the equivalent omni-directional source.

It will be noted that in the case of asymmetric

AERIAL TABLE

Type of Aerial	Gain over Omni-directional Source
Standard Dipole	2.2 db (theoretical 2.15 db)
Sleeve Dipole	1.5 db
Ground Plane	−0.5 db
Wide band Ground Plane	−0.4 db
Simple " J "	2.6 to 2.9 db depending on direction
Ground Plane " J " $\lambda/4$ rods)	0.5 to 1.5 db depending on direction
Ground Plane " J " $\lambda/2$ rods)	1 to 2.5 db depending on direction

Gain of various types of aerial in the horizontal plane.

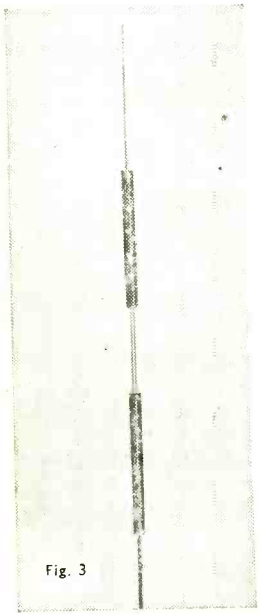


Fig. 3

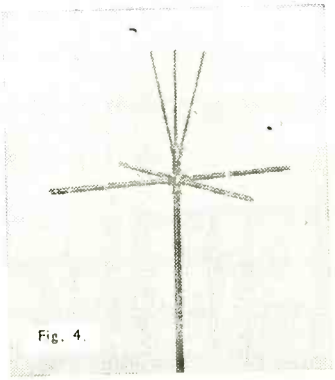


Fig. 4.

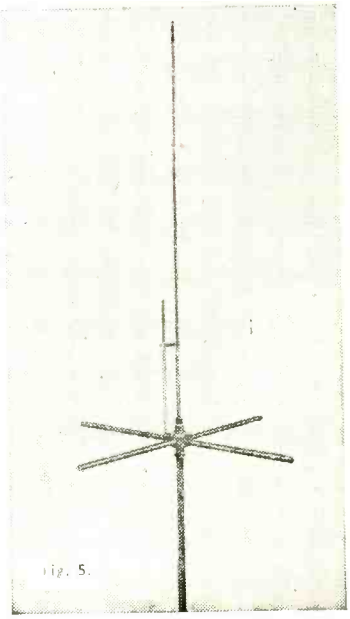


Fig. 5.

Fig. 3. Type of standard dipole used.

Fig. 4. Details of the wide-band ground-plane aerial.

Fig. 5. The ground-plane "J" aerial employed in the tests.

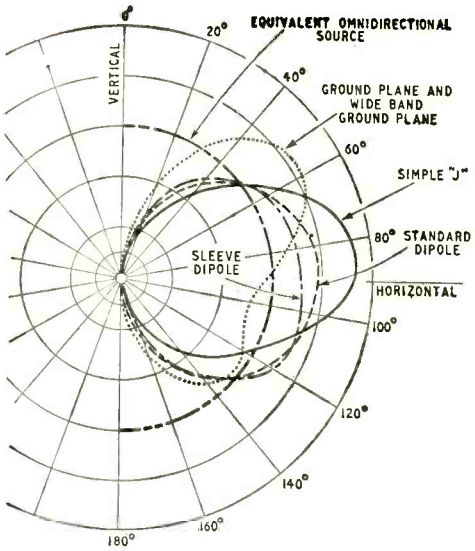


Fig. 6. Comparison of various aerials.

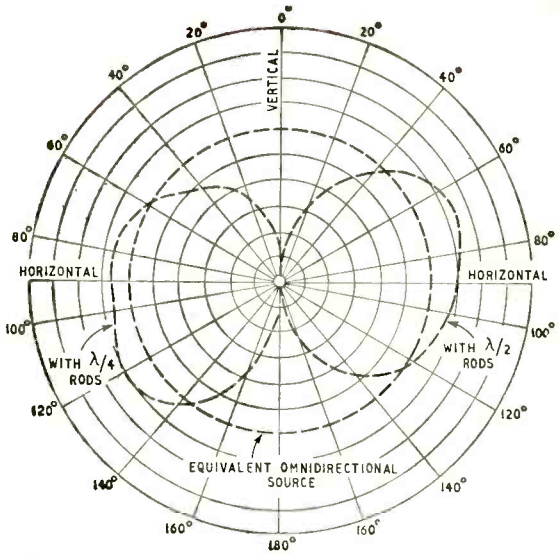


Fig. 7. Average polar diagrams of ground-plane "J" aerials.

aerials the gain varies according to the actual direction in the horizontal plane; also although in Fig. 6 the ground-plane aerial and wide-band ground plane are shown as having the same diagram small differences do exist and these account for the variation of horizontal gain as shown in the Aerial Table. Fig. 7 shows the average vertical polar diagram of the ground plane "J" aerials. These aerials are asymmetric and the polar diagram depends upon the actual direction of measurement. These average figures are taken by combining the diagrams taken in various planes so as to give a representative answer. This effect is also shown in the Table where the horizontal gain is seen to vary according to the direction of measurement.

In the case of aerials which are asymmetric in both horizontal and vertical planes, the average of the "Rousseau" diagram (Ref. [4]) in several directions should be taken. By applying this construction to the results obtained for the different aerials under test, they may all be scaled to have the same mean spherical intensity, and hence directly compared. This is probably the most accurate method but in the case of complex aerials where the mean of many "Rousseau" diagrams would have to be taken; the actual relative power fed to an aerial can be quickly obtained by dividing the V_{max}^2 reading by the standing-wave ratio as measured at the slotted line. For any given aerial the standing-wave ratio will be constant and hence need only be measured once.

This is seen to be true as

$$\text{Relative Power to aerial} = V_{max} \times V_{min} = V_{max}^2 \times \frac{V_{min}}{V_{max}} = \frac{V_{max}^2}{\text{S.W.R.}}$$

The reciprocal of this value is plotted, as the pick-up voltage has been kept constant.

The comparative power at the pick-up dipole if the radiated power is kept constant is proportional to

$$\frac{\text{S.W.R.}}{V_{max}^2}$$

and the field strength at the pick-up dipole if the radiated power is kept constant is proportional to

$$\frac{\sqrt{\text{S.W.R.}}}{V_{max}}$$

This method is of course subject to errors due to drift of the measuring equipment, and other errors of measurement.

For normal communication services it would appear that the best aerial to use is the simple "J" aerial, or dipole aerial with or without sleeve suppressor. The ground-plane "J" aerials offer little if no technical advantage despite their additional complications. Ground-plane aerials would appear definitely unsuitable for land mobile services, although they would have an advantage if used in mobile services to aircraft. These conclusions are based on tests conducted at a single frequency and where the aerials are to be used for multiple frequency working this may not be true. It is possible that an aerial which at a single frequency gives a slightly inferior performance, may hold this performance over a wide band of frequencies; whilst another initially superior aerial may have its performance seriously degraded by slight changes of frequency. This will probably be shown very markedly in special types of stacked aerials used to give omnidirectional gain in the horizontal plane.

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[2] E. G. Hamer, "V.H.F. Common Aerial Working," *Electronic Engineering*, XXIII, No. 281, July 1951, pp. 244-249.

[3] E. G. Hamer, "Slotted Line Techniques," *Electronic Engineering*, Dec. 1951.

[4] B. W. Golding, "Electrical Measurements and Measuring Instruments" (Sir Isaac Pitman & Sons, Ltd., Third Edition, 1948), page 406.

[5] E. G. Hamer, "V.H.F. Aerial Radiation Pattern Measurements." *Electronic Engineering*, October 1953, Vol. 25, pp. 427-431.

FOURIER—Fact or Fiction?

Why Sine Waves?

By "CATHODE RAY"

YEARS ago—around 1930 if I remember rightly—there arose a great public controversy, the like of which, regrettably, never emerges nowadays to gladden our dull lives. Everybody has become too sophisticated to proclaim, with any show of authority, that mathematicians are wrong, or that the earth is flat, or television is a hallucination. But at the time I mentioned there were a number of persons well known in the radio world, including no less an authority than the late Sir Ambrose (Valve) Fleming, who said—and stuck to it—that sidebands were imaginary; a mere mathematical fiction. The dispute reached such a pitch that actually a Government-sponsored Committee was appointed to go into the thing, and the result was Special Report No. 12 of the Radio Research Board, published by H.M.

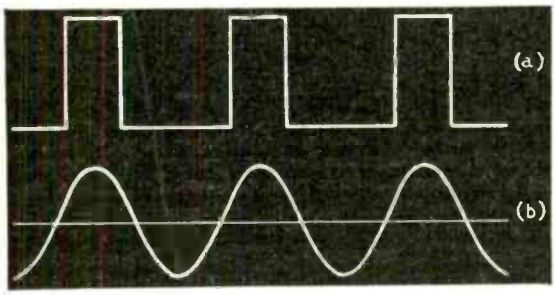


Fig. 1. Is it true that waveforms such as (a) are really and inevitably made up waveform (b) at various frequencies?

Stationery Office in 1932. But by then the subject had gone cold.

The same kind of doubts about the reality of what is represented by mathematical processes must often visit the minds of students faced with the Fourier theorem—the one that says that periodic waves of any and every shape can be regarded as made up exclusively of pure sine waves having frequencies that are whole-number multiples of the fundamental frequency of the wave. It certainly is difficult to believe that waveform (a) in Fig. 1 can be constructed entirely from smooth waves of form (b). There is some excuse for the feeling that this can be no more than a "mathematical fiction"—an ingenious device to help with calculations, but not a physical reality.

Other questions may well be asked. What is it about waves of the particular shape (b) that they and they alone have only one frequency? How did they come to have the special privilege of being the sole ingredients of all other waveforms? Did Fourier confer it, or is it an immutable law of Nature? Is there any other waveform that could be substituted?

When I started looking up a few books to see what they said on such questions, I found that they didn't even ask, much less answer them. They just took for granted that a single-frequency wave must be a sine wave*, and that Fourier has no competitors. A more thorough search revealed some clues, but not much that could be considered to be crisp answers. Perhaps you would like to try answering the above questions yourself before reading on.

Fundamental Frequency

To clear the ground, I would remind you that the Fourier theorem applies only to *periodic* waveforms; i.e., those that repeat exactly and for ever. In practice, "for ever" can be interpreted rather freely, without making a great deal of difference, as "a considerable number of periods" (or cycles, as they are more often called). One period is the shortest time required for a showing of the complete programme, before it starts to repeat. Fig. 1 shows three identical copies of each waveform; and if what it shows occurred during one-thousandth of a second the fundamental frequency would be 3kc/s. In (a) there would be (according to Fourier) other frequencies, whole-number multiples of 3 kc/s; but (b) being a sine waveform has (it is generally assumed) no other frequency.

Look now at Fig. 2, which is the kind of thing

* Throughout here, "sine wave" includes the cosine wave, which is the same thing advanced quarter of a cycle in phase.

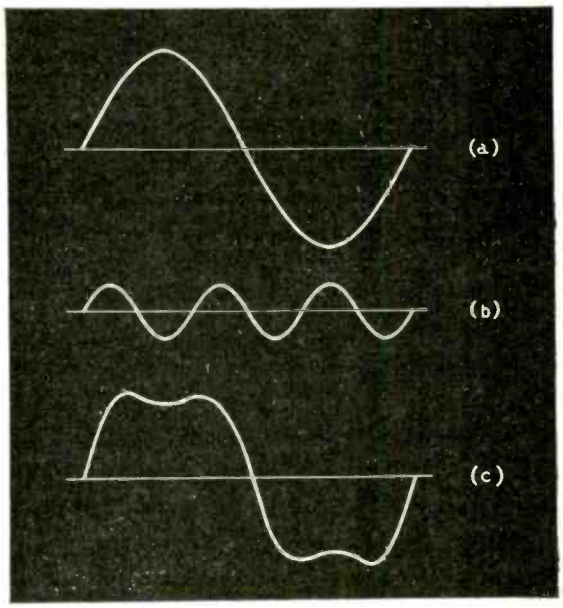


Fig. 2. Example of how a fundamental sine wave (a) and a harmonic (b) add up to a different waveform (c).

commonly used to demonstrate Fourier. First, at (a), is one cycle of sine waveform. Next (b), three cycles of the same form in the same time and therefore three times the frequency. If (b) is added to (a), its first and second positive half-cycles augment the lower slopes of the positive half-cycle of (a), and its first negative half-cycle flattens the positive peak of (a), so the result is something like (c). Among other things, this demonstration is supposed to convince everybody that (c) is necessarily a composite wave, made up of a fundamental (a) and third harmonic (b), both of these of course being of sine form.

But what if somebody, just to be awkward, comes along and draws Fig. 3 showing that adding together the non-sine waves (a) and (b) gives a sine wave (c), so (c) must be a composite wave, made up of a fundamental and third harmonic? Would you be able to explain why Fig. 2 must be accepted rather than Fig. 3?

Credentials in Doubt ?

Of course, if some mathematician should chip in with a neat proof that a perfect sine wave cannot in fact be constructed in this way from any one other waveform, it would give us some ground for believing that the sine waveform had a special claim. (I have failed to find any such proof, and would be glad to receive offers.) Still more would the prestige of the sine wave be boosted if a Fourier series (of sine waves) could be shown to be the *only* one that can be used for constructing other wave forms. There, at least, I have authoritative mathematical guidance, and it is to the effect that waveforms *can* be constructed from series other than sine. So the sine wave is still, as it were, confined in our mental guardroom, unable so far to produce complete evidence of its intitlement to the very special status commonly granted to it.

Thinking over the thing, I eventually arrived at several reasons why the sine should be selected in preference to all others, but nothing to rule all other forms completely out on principle. The further book search I mentioned tended to support these reasons, so here they are.

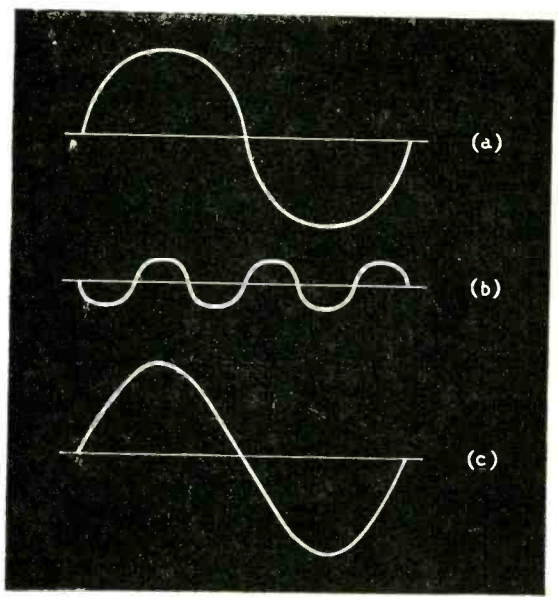


Fig. 3. Here, a non-sine waveform (a) and its harmonic (b) add up to a sine wave (c).

They can be divided into two lots: mathematical and physical. Suppose we were to start absolutely from scratch to choose some function of time that would make the most suitable basis for expressing repetitive events. The simplest for this purpose would be something that goes on continuously at a steady rate and yet repeats itself identically in definite periods. Nothing that I—or apparently anybody else—can think of fits this description so simply and well as what in the physical world appears as steady rotation. Mathematically, it is change of angle at a constant rate. Suppose OA in Fig. 4 is a fixed line to mark the start of an angle, and the angle between it and OB (labelled θ) increases at a constant rate. When the angle has changed by one whole revolution, or 360°, or 2π radians (all of which are the same thing), the position is exactly the same as at the start, and what happens during the next 2π radians is exactly the same as during the last. So it fits perfectly with the definition of "periodic." Call the number of periods or cycles or revolutions per second f. The angle traced out per cycle is 2π radians, so the angle traced out per second is $2\pi f$, written ω for short; and consequently the angle between OA and OB (i.e., θ) at t seconds from the start (when $t=0$) is ωt. So we have

$$\theta = \omega t$$

Now for many purposes (as we shall see) the significant thing about this circular motion is the height of B above the horizontal (OA). That height, in relation to the maximum it can attain—obviously equal to the length OB—has been named the sine of the angle AOB, abbreviated to $\sin\theta$. It is what the length OB has to be multiplied by to give the height of B above OA. When $\theta=0$ (or 180°), $\sin\theta$ is obviously 0; when θ is 90° it is 1, and when θ is 270° it is -1. Plotting $\sin\theta$ against θ from 0 to 360° (or 2π radians) we get the familiar curve of Fig. 2(a). Suppose the maximum height, equal to the length of OB, is denoted by H. Then the height at any time t must be $H\sin\omega t$. So if we plotted height against time we would get a curve just the same shape as Fig. 2(a), of maximum or peak height H, and with f complete waves per second. Mathematically, there is nothing to equal this for simplicity and clearness in expressing uniform periodic motion or change. But from our point of view the more important thing is that it ties up perfectly with so many of the technicalities to which *Wireless World* is devoted.

Elementary A.C.

Take, for example, the generation of alternating current by the most elementary arrangement we can think of—a loop of wire rotated at constant rate in a uniform magnetic field. The vertical lines in Fig. 5 represent the direction of the field, and B is an end view of one of the two horizontal parts of a square loop of wire rotated about O. When the loop is horizontal, the wire is all moving along the field, so has no e.m.f. generated in it. When vertical, the wire B is cutting directly across the field, so e.m.f. is a maximum. At all positions, the e.m.f. is proportional to the sine of the angle, so the waveform of the e.m.f. is a sine waveform.

A still more significant thing is what happens when

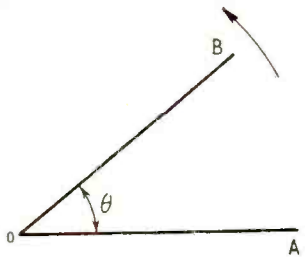


Fig. 4. How a sine wave is derived from a steadily increasing angle.

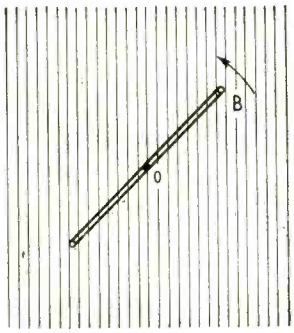


Fig. 5. Side view of an elementary a.c. generator consisting of a square loop of wire rotating about O in a uniform magnetic field.

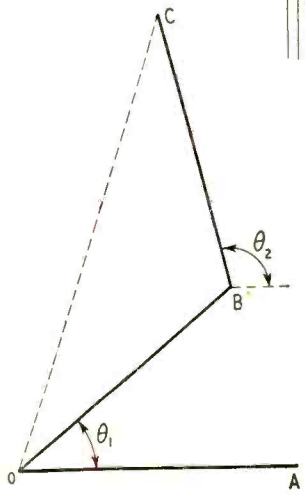


Fig. 6. If to B rotating steadily around O is added C rotating at the same speed around B, then the angle CBO remains constant, so C also rotates steadily in a circle around O. This shows that if two sine waves of equal frequency are added together the total is also a sine wave.

we use this sine-wave e.m.f. to drive current through a circuit. No matter how complicated the circuit—provided only that it is linear—the waveform of the current is the same. It may be shifted backwards or forwards relative to the voltage wave, but the shape is identical. This is not true of any other waveform. Lord Rayleigh put it rather nicely in his *Theory of Sound*: he said that a simple tone (by which he meant one having sine waveform) "is the only one capable of preserving its integrity among the vicissitudes it may have to undergo. Any other kind is liable to a sort of physical analysis, one part being differently affected from another."

This is bound up closely with the very significant and important fact that electrical and mechanical arrangements that give rise to periodical or to-and-fro or wave motion, called oscillation or vibration, tend, when conditions are reduced to the simplest or ideal, to cause the waveform to be of the sine pattern. The "arrangements" referred to include, as the essential minimum, capacitance and inductance in the electrical systems, and their analogues, compliance and inertia, in the mechanical systems. Now our electrical theory teaches us that while the current through a linear resistance is proportional to the e.m.f. across it (Ohm's law), the current through a capacitance is proportional to the rate of change or "differential" (nothing to do with engine drivers or motor cars) of the e.m.f., and the current through an inductance is proportional to the opposite of the differential—the "integral"—of the e.m.f. The differential of a curve on a graph is represented by the slope of the curve, and if you draw a graph of the slope of a sine wave you find that it has exactly the same waveform as the sine wave, subject to a phase advance of quarter of a cycle. So obviously if you perform the reverse operation—draw the integral curve, the graph of whose slope is a sine wave—you get another sine wave, shifted quarter of a cycle the other way. The sine waveform is the only one of which that is true, and it accounts for the fact that the current waveform in capacitive and inductive circuits, as well as resistive, is only the same as the voltage waveform when that has the sine shape. It accounts for a lot of other things, too, such as the tendency for oscillation to have a sine waveform, the more nearly the conditions that cause it are reduced to simple inductance-and-capacitance.

Another interesting point is that the wave formed by adding together any number of sine-wave variables of equal frequency but different phase has itself a sine form. So if there are two or more sine-wave currents flowing in the same circuit, even if they are out of phase with one another, the total current has sine waveform. This may not be obvious if you draw the separate waveforms, and it is laborious to add them up point-by-point on a graph; one can much more easily see it by slightly elaborating Fig. 4—adding another "vector" line like OB, but at a different angle (Fig. 6), and then noting that the tip of it (C) performs a circular motion around O, just as if it were the tip of a single vector OC representing the total of the other two. But if you try adding together any other out-of-phase waveforms you will find that the total has a different form. So if electrical engineering (for example) were based on any other waveform, the whole thing would be unbearably complicated and difficult.

A Tricky Question

Even without detailing all the significant consequences of the foregoing significant facts about sine waves (which could easily take up thousands of pages) the most sceptical reader may be willing by now to concede that the sine wave has the best claim to its proud position in science. But besides the question of the realities of harmonics (which we shall have to leave till next month), we still have the question of why only sine waves have a single frequency. It would not do, however, to start a murder trial by asking the accused *why* he murdered his wife. His lawyer would be very quick to object that it had not been established that he *had* murdered his wife. We have not yet established as a fact that the waveform of a single-frequency oscillation is necessarily sine.

Your first reaction may be that this is a frivolous question—of *course* a sine wave has only a single frequency and is the only single-frequency waveform; if it weren't the Fourier theorem would be complete nonsense, and so would most—anyway, a lot—of our basic theory. Yes; we may be quite sure it is true, but can we prove it? Obviously if it can be proved that a single-frequency waveform is

necessarily a sine waveform, it will be a still more decisive fact with which to justify our enthronement of the sine wave. But let me point out that the Fourier theorem doesn't prove it; it only shows that any waveform can be regarded as made up of sine waves having frequencies that are 1, 2, 3, 4, etc., times the fundamental frequency. It doesn't prove that there is no other waveform of which this is true.

Of course, all hinges on what we mean by "frequency." Are we not—perhaps unconsciously—relying on the admittedly strong status of the sine wave to define the frequency of any waveform as the frequency of the sine waves into which Fourier analyses it? Are we not, in fact, committing the logical fallacy called (don't ask me why) "begging the question," i.e., basing a "proof" of something on the assumption of that something? Have we any absolutely independent scientific ground for saying that if an oscillation occurs at only one frequency its waveform must be sine? Is "frequency" a basic characteristic of Nature that we are bound to accept, or is it one of those things, like "offside," that could mean different things, and can only be made to mean one thing alone by people agreeing to accept an arbitrary definition? If we define frequency as (for example) the rate at which identical events occur, can we show why Fig. 1 (b) has been chosen, rather than (a)—or any other of a variety of waveforms—as having only a single frequency?

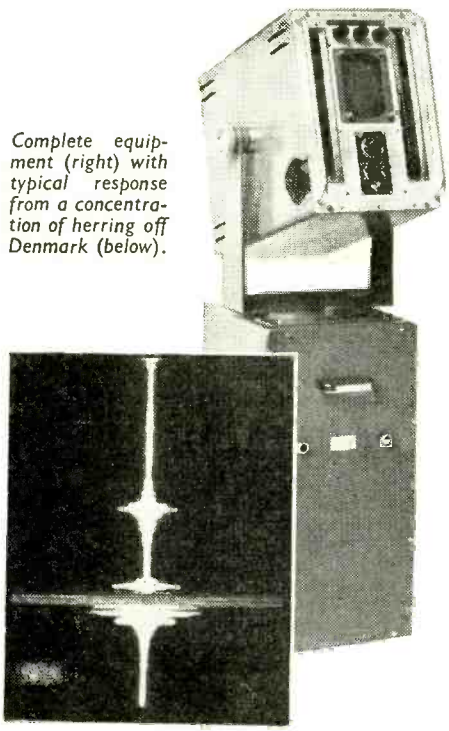
I suppose you will say at once that it can be perfectly easily demonstrated; if a transmitter puts out a pure sine waveform it can be picked up on only one frequency—the fundamental—but if it has any other waveform it can be tuned in on harmonic frequencies. What more proof could one want?

Well, I may be a bit awkward, but I must point out that the tuning-in is done by an arrangement that by its nature responds to sine waves. But in a single cycle of a pure sine wave, the variable attains 70.7% of its peak value four times, at evenly spaced intervals, and if some device responded to this condition it would respond four times per cycle and would reckon the frequency accordingly. It might be that a system could be devised that would respond to square waves only at their fundamental frequency, and would interpret sine waves as composed of an infinite series of harmonic square waves. That may sound rather fantastic, and anyway, I am not proposing that in practice our usual concept of frequency based on sine waves should be abandoned; but it is an interesting thing to consider whether we can prove that frequency is necessarily and inevitably based on sine waves, or whether that is merely a matter of convenience, because it fits in with the way tuning circuits and ears happen to work.

Next month we shall consider whether all non-sine waves are really composed of sine waves, or only mathematically; and how square waves, sawteeth, etc., are analysed, and what they contain.

Ultrasonic Fish Detection

Depth Sounding Equipment Based on Radar Technique



Complete equipment (right) with typical response from a concentration of herring off Denmark (below).

A NEW echo-sounding device recently introduced by Pye Marine as an aid to trawler fishing is notable for being all-electronic in operation and is claimed to be more sensitive than previous equipments of this kind. The transmitter consists of a 30-kc/s oscillator working into a magnetostriction transducer which sends pulses of ultrasonic energy from the bottom of the fishing vessel towards the sea bed. Reflections from shoals of fish and the sea bed are received by another transducer and, after amplification, are applied to the deflection plates of a c.r.t. display system. They appear on the screen as horizontal deflections on either side of a vertical timebase which represents the depth to which the equipment is sounding (see picture).

The speed of the timebase can be varied by a control knob which also moves a pointer on a calibrated scale showing the depth corresponding to the finish of the trace. (Depth, of course, determining the transit time of the ultrasonic pulse.) This ensures that as the sounded depth is decreased the trace is expanded to increase its scale. The variable timebase actually provides the means of triggering the transmitted pulse. Thus, as the timebase speed is increased for decreased sounding depth so also is the p.r.f. of the transmission, to the maximum possible for that depth. Successive echoes combine to form a steady picture as soon as the p.r.f. is high enough and in practice this occurs at depths less than 100 fathoms.

Another control knob calibrated in depth enables a marker to be moved up and down the trace. This actually deflects a portion of the trace, equivalent to a depth of seven fathoms, bodily to the right, and it can be placed over any echo that one wishes to investigate. By means of a secondary timebase the selected seven fathoms can then be expanded to fill the whole screen for examination in detail. In the circuit this secondary time base and the marker are both triggered from the start of the main timebase through a variable delay circuit, the control knob of which carries the depth calibration.

The design has taken into account the variations present in ships' power supplies, and a 10% voltage change is permissible.

Standard Chassis

Versatile System for the Experimenter and the Development Laboratory

By T. K. COWELL*

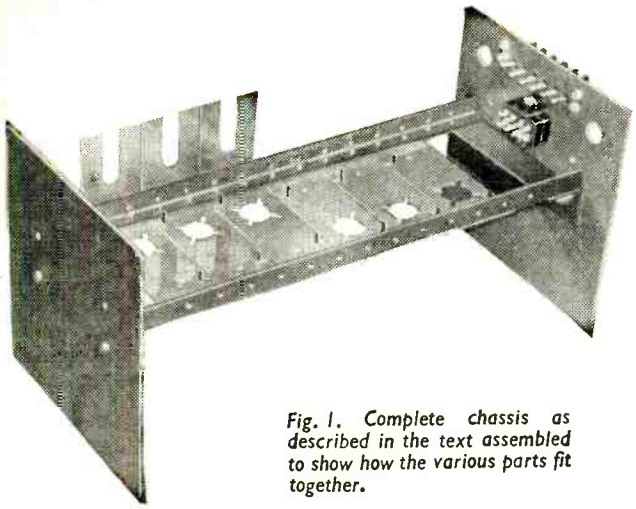


Fig. 1. Complete chassis as described in the text assembled to show how the various parts fit together.

FOR some years, the author has been concerned with the construction and development of various small experimental units up to the prototype stage. The units usually embodied not more than half a dozen valves and their associated components and in general, the chassis, panels, etc, used for one job were not suitable for further use. Accordingly, they were either scrapped, or put in a cupboard and forgotten until the next "open day" when they would be hastily stripped of components and crushed into a bulging scrap metal bin.

It was with a view to reducing this wastage of time and material that the author set about devising a chassis that would possess the often conflicting features of simplicity and versatility.

It was felt that the chassis should provide the following facilities:—

(1) Be capable of assembly for a particular need from a small number of "standard parts."

(2) Be capable of accepting a circuit containing up to six valves of B7G or B9A type, a lesser number of valves with somewhat larger bases, or a mixture of any such types in any order.

(3) Positions of valves, potentiometers, switches, etc, should be capable of alteration without difficulty.

(4) Assembly should be capable of standing upright (i.e., with the valves base downwards) or inverted to facilitate wiring, alterations, voltage checking, etc.

(5) Be possible to join one chassis to another for larger layouts, without reducing the flexibility of the system.

Dimensions of Parts

As bench supplies of h.t. and l.t. are usually available in development and research establishments, it was felt that a plug and socket connection would suffice together with simple facilities for switching and metering. The chassis described here fulfils the requirements outlined and the dimensions given in the sketches have been found to be satisfactory in practice.

* R. B. Pullin and Co., Ltd.

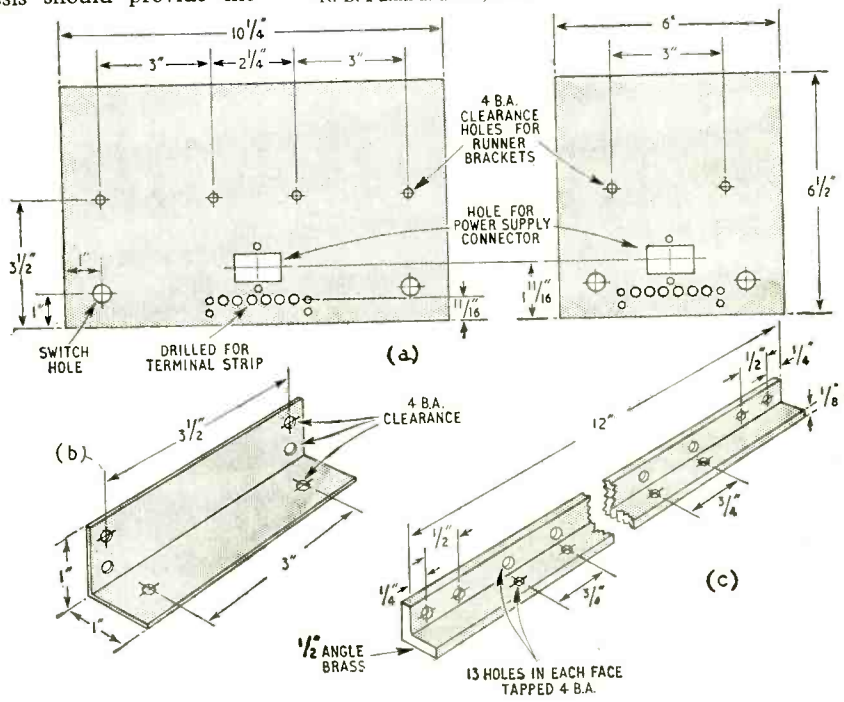


Fig. 2. Details of two alternative end plate are given in (a) while (b) shows the end-plate bracket and (c) one of the long runners.

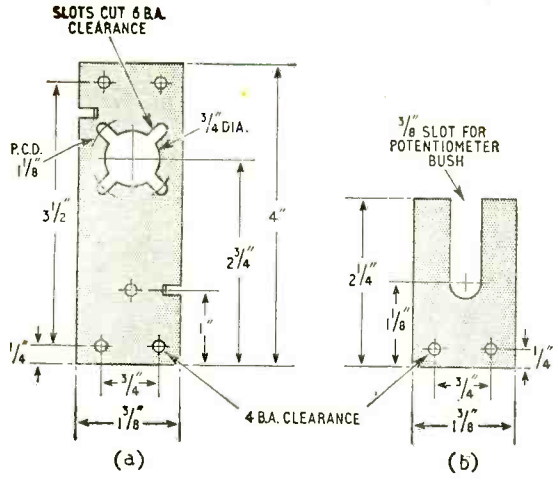


Fig. 3. Details of (a) the valveholder plate and (b) the potentiometer plate.

Reference to Fig. 1 will show that the chassis is made up of component plates (for valveholders, potentiometers, etc.) mounted on two rails, or runners. The runners are supported by a pair of end plates. One of the end plates carries a power supply connector, switches and a terminal strip to facilitate supply metering and control. The runners are fixed to the end plates by a simple bracket, Fig. 2 (b), which ensures adequate rigidity.

As illustrated in Fig. 2 (a) the end plates are made in two sizes, so that a simple doubling of chassis width is possible, using the standard runners and component plates.

One of each pair of end plates is drilled and cut to accept two small toggle switches, an eight-way chassis mounting plug, and a terminal strip. The other plate of each pair is left plain, except for the fixing holes for the runner bracket.

Only one runner is shown in Fig. 2 (c) as the two are identical. By making the component plate fixing hole spacing equal to $\frac{3}{4}$in, it is possible to mount long tag-strips of either the miniature type ($\frac{1}{4}$in spacing), or the larger type with $\frac{3}{8}$in spacing, along the runners.

Component Plates

The plates illustrated in Fig. 3 are those found to have been most generally useful, and may be very easily fabricated. The valveholder plate, Fig. 3 (a), is capable of accepting either B7G or B9A holders in any one of four positions. Also, as the hole is positioned towards one end of the plate, the latter may be fitted to the runners in two ways.

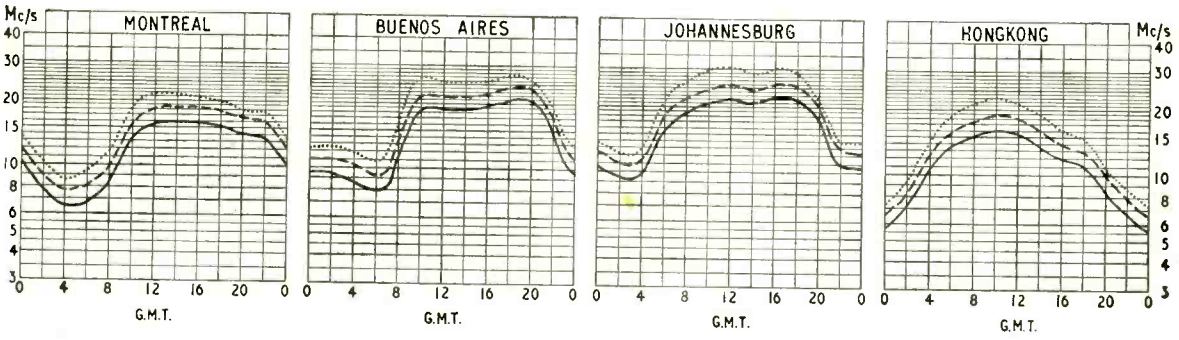
To save time and trouble in fitting earthing tags, a pair of saw-slots are made in either side of the plate, leaving a tag that may be bent up. One 4-BA clear hole is drilled in the plate to facilitate fitting a small tag-strip, or stand-off terminal, if required.

The potentiometer plate, Fig. 3 (b) needs little explanation beyond the fact that it is slotted for easy removal of potentiometers, rotary switches, etc. The distance between adjacent shaft centres is normally $1\frac{1}{2}$in, but the slot permits the vertical staggering of components whose diameter somewhat exceeds this figure.

Input and output terminations may be made on small, single screw fixing stand-off terminals, but tag-strip would do equally well. In cases where screened input and/or output leads are necessary, suitable sockets could be mounted on the appropriate component plate.

The valveholder plates are made of brass to facilitate soldering, but aluminium alloy is satisfactory for the other parts, provided that earthing points on individual valve plates are bonded together. For work usually involving large components it would probably be convenient to scale-up the whole system, but the author has found that a chassis of the size illustrated is a fair compromise for the majority of experimental applications.

SHORT-WAVE CONDITIONS *Predictions for September*



THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during September.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

..... FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY

——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

Aerial Circuit Magnification

Notes on Capacitive Bottom Coupling for Medium- and Long-wave Receivers

By S. KANNAN,* B.Sc., Assoc.Brit.I.R.E.

INPUT circuits with bottom capacitive coupling are commonly encountered in commercial broadcast receivers. A typical arrangement is that shown in Fig. 1, in which C represents the lumped capacitance (including any trimmer, gang or fixed capacitor, valve input capacitance and all strays); C_c is the coupling capacitor shunted by R whose value is chosen to be much greater than the reactance of C_c at the lowest radio frequency to which the receiver tunes and much smaller than the reactance of C_c at supply mains frequency so as to minimize any hum pick-up by the aerial; and L is the aerial coil. For medium and long waves, the equivalent circuit of Fig. 1 is given in

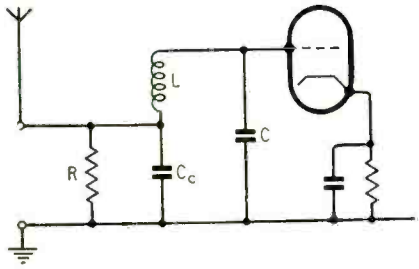


Fig. 1. Typical aerial input circuit with capacitive bottom coupling.

Fig. 2, where, for simplicity, R and the valve input resistance have been neglected, C_a represents the internal impedance of the aerial (mainly capacitive) and $r = \frac{\omega L}{Q}$.

Fig. 2 is transformed, by Thévenin's theorem, into Fig. 3, where at any resonant frequency $f\left(=\frac{\omega}{2\pi}\right)$ of the aerial input circuit, the total circuit impedance $= r$.

$$\therefore E_o = E_a \cdot \frac{C_a}{C_a + C_c} \cdot \frac{1}{\omega C r} \quad .. \quad .. \quad (1)$$

Since the Q of the circuit

$$= \frac{\omega L}{r} = \frac{C + C_a + C_c}{\omega C r (C_a + C_c)}$$

equation (1) can be rewritten:

$$E_o = E_a \cdot \frac{Q\,C_a}{C + C_a + C_c} \quad .. \quad .. \quad .. \quad (2)$$

$$\therefore \text{Aerial circuit gain}\dagger = \frac{Q\,C_a}{C + C_a + C_c} \quad .. \quad (3)$$

This generalized equation (3) can now be applied to the two commonly encountered types of aerial tuned circuits:

(a) *Variable Capacitor Tuned Circuit:* as shown in Fig. 4, where C_s denotes the sum of all strays and valve input capacity, C_t = trimmer capacity, C_v = aerial tuning capacitance and $C_t + C_v + C_s = C$ of Fig. 1.

Due to C_v (usually one section of a ganged condenser), the value of C varies over the band, and hence, as shown in equation (3), the aerial gain also varies over the band. However, in order that the disturbance of the tuning by changes in aerial capacitance (C_a) be kept at a minimum (and in some cases in order also that the aerial circuit frequency coverage be not unduly restricted), C_c is usually much greater than C_a. In a typical medium-wave circuit, with $C_a = 200$pF, $C_c = 4{,}700$ pF, R = 10 kΩ, $C_t + C_s = 70$ pF, $C_v = 13$ to 528 pF, the aerial gain at the l.f. end of the band will be $= \frac{200.Q}{5498}$, while the gain at the h.f. end will be $= \frac{200.Q}{4983}$.

Hence, if the Q of the circuit remains fairly constant

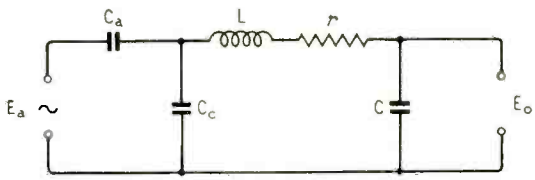


Fig. 2. Equivalent circuit of Fig. 1.

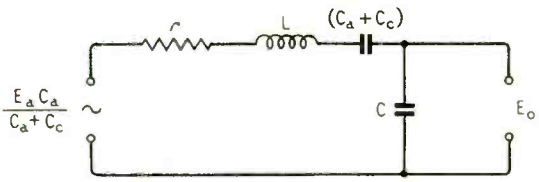


Fig. 3. Thévenin transformation of the equivalent circuit of Fig. 2.

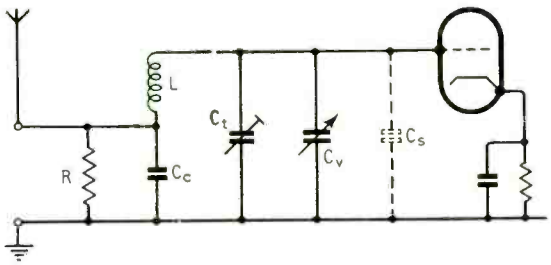


Fig. 4. Variable capacitance tuning.

*Development and Engineering Dep'., E. K. Cole Ltd.

†The terms "input circuit magnification", "aerial circuit gain" and "aerial step-up" are used synonymously to mean the ratio of E_o to E_a.

over the band, the gain at one end of the band will be $\frac{5498}{4983} = 1.1$ times that at the other end, the gains at intermediate frequencies falling between these limits. Thus, with such a coupling, one desired feature of aerial circuit design is achieved, viz., fairly constant aerial gain over the band. Another desired feature, viz., a high enough aerial gain, will not be achieved with this method of aerial coupling unless the Q of the circuit is fairly high. Perhaps this explains why this method of coupling was not popular with designers in the days before ferrite-cored aerial coils, when the Q of air-cored and dust-cored aerial coils of normal dimensions rarely exceeded 50 and consequently more aerial gain could be obtained with other forms of aerial coupling. With the advent of ferrite cores, however, Q's of the order of 180 are easily held fairly constant over the band and, even allowing for a reduction of this Q by 50% due to valve input and other circuit damping, adequate gains are still obtainable.

Equation (3) also shows that, provided the circuit Q is constant over the band, the r.f. input sensitivity at aerial input must needs vary over the band by not more than the ratio indicated, viz.

$$(C_a + C_c + C_t + C_s + C_{v-max}) \text{ to } (C_a + C_c + C_t + C_s + C_{v-min}).$$

Hence, if in a receiver where circuit Q is nearly constant over the band, the aerial sensitivity figures vary by an abnormal ratio (e.g., 100 μV, to 10μV, over the band, which is not borne out by equation (3), the designer would do well to look elsewhere for the trouble, e.g., inconstant oscillator performance, wide tracking or ganging errors, etc.

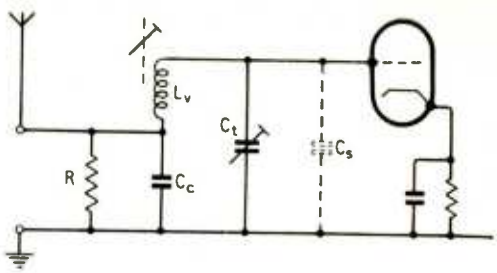


Fig. 5. Permeability-tuned aerial circuit.

(b) *Permeability-tuned Circuits.* Equation (3) also shows why this coupling system is especially suited for many applications of permeability-tuned aerial input circuits. One example is a car-radio design where an efficient coupling of the rather inefficient car-aerial was carried out by this method (see Fig. 5). With $C_a = 68$ pF, $C_c = 90$ pF, $C_t + C_s = C = 100$ pF, and the circuit Q varying between 20 and 40 over the band, the aerial step-up over the band was between 5.35 and 7.9. Thus with permeability-tuned circuits, and especially in applications (e.g., car-aerial installations) where the designer need not provide for much possible variation in C_a, a low value of C_c can be used to obtain good aerial gains even with low-Q aerial coils. It should be noted, however, that in mobile installations the equivalent series resistance of the aerial can, in some cases, become an important limiting factor in the determination of maximum obtainable aerial circuit gain.

COMMERCIAL LITERATURE

Colloidal Graphite Dispersions; a list of technical data, including solids content, density, flash point, diluent and typical applications, on 23 "dag" products arranged in convenient tabular form, from Acheson Colloids, 18, Pall Mall, London, S.W.1.

Silver Brazing Paste consisting of finely divided metal powder and flux in a liquid medium, which can be painted on the work, described in a leaflet "Easy-flo Paint" from Johnson, Matthey & Co., 73-83, Hatton Garden, London, E.C.1.

Books on Radio, television, electronics and other engineering subjects. A classified catalogue with descriptive notes from Cleaver-Hume Press, 31 Wright's Lane, Kensington, London, W.8.

Equipment Cases, racks, consoles, chassis, panels, etc. listed in an illustrated catalogue giving dimensions and enclosing a price list, from Alfred Imhof, 112-116 New Oxford Street, London, W.C.1.

Continuous Terminal Strip (to be cut up into pieces as required); cable cleating and strapping; sleeving; mouldings; grommets and other products described in an illustrated catalogue with tables of dimensions from Creators, Plansel Works, Sheerwater, Woking, Surrey.

Harmonic Distortion Meter Kit for an instrument covering 20 c/s-20 kc/s with an accuracy of ± 5 per cent of f.s. reading plus 0.1 per cent distortion. Specification of this "Heathkit" from Rocke International Corporation, 13 East 40th Street, New York 16, N.Y., U.S.A.

Tantalum Electrolytic Capacitors claimed to have greater reliability and longer shelf-life than conventional aluminium types. Technical bulletin giving capacitances, sizes, etc. from The Telegraph Condenser Co., North Acton, London, W.3.

Vibration Generators and power oscillators for driving them. Concise descriptions and specifications of a complete range of equipment on a leaflet from Goodmans Industries, Axiom Works, Wembley, Middlesex.

Switches and Signal Lamps. An illustrated catalogue containing ten new products and notable for its "blueprint" drawings of constructions and mechanisms (with dimensions). From Arcolectric Switches, Central Avenue, West Molesey, Surrey.

High Stability Resistors (wire-wound) ranging from 0.1Ω to 1MΩ with resistance tolerance of 0.1 per cent and temperature coefficient of only 0.002 per cent per degree C. Leaflet from Electrothermal Engineering, 270 Neville Road, London, N.7.

Small Electrolytic Capacitors by T.C.C. referred to in our June issue do not, of course, have a "paper dielectric construction" but the electrical advantages associated with such a construction, combined with the high capacitance values given by electrolytic operation. Apologies to the makers.

Oscilloscopes, oscillators, amplifiers, pulse generators and other test equipment. A short leaflet catalogue from the Solartron Electronic Group, Solartron Works, Thames Ditton, Surrey. Also a leaflet on a transfer function analyser, comprising l.f. decade oscillator and phase sensitive voltmeter, for testing servo systems.

Amateur Transmitter Valves. A valve line-up chart, "Headliners for Hams," giving operating conditions for class C amplifier and oscillator, modulator and frequency-multiplier service and also s.s.b. valve data. From the Radio Corporation of America, Tube Division, Harrison, New Jersey, U.S.A.

"V.H.F. Broadcasting Starts"

An error occurred on page 252, of our June, 1955, issue, where it was said that a transmitter fault could produce merely a 3-dB drop in signal strength. The figure should be 6dB, since if one transmitter fails one half of the aerial is also inoperative and the aerial gain is halved.

Rugby Radio Extension

Control and Supervision from a Central Point

TWENTY-EIGHT modern 30-kW transmitters have been installed in a new building on a 700-acre extension of the long-range Post Office radio station at Rugby. Eventually the new building will be surrounded by about 100 aerials of one kind or another radiating telephony and telegraphy signals to all parts of the world on frequencies between 4 and 27.5 Mc/s. About 60 aerials, mostly rhombics, are at present in use; these are multi-wire types and being non-resonant work over a wide range of frequencies. Were resonant aerials employed far more than the 100 legislated for would be needed to maintain the service envisaged for the new extension.

The aerials are connected by open-wire transmission lines to switching units inside the building; these are twin coaxial systems providing complete interchange of connections between transmitters and aerials. There are two such switching units installed, each serving 14 transmitters and giving each transmitter the choice of any one of six different aerials by remote control. On the roof of the transmitting building the twin coaxial feeders are transformer-matched, by four open-wire lines, to the main twin-wire outdoor transmission line systems.

For telephony each transmitter accepts an input on about 3 Mc/s and, by mixing with an internal crystal-controlled oscillator, converts this to the required output frequency. Linear amplifiers are employed throughout with considerable negative feedback and suppression of harmonic and intermodulation components.

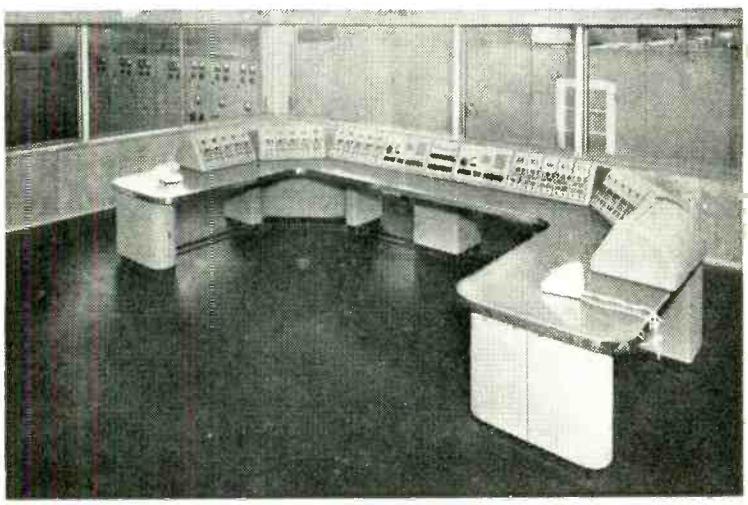
When supplied with two separate telephony (or audio) inputs between 100 and 6,000 c/s, the drive equipment provides two independent sideband outputs or, if required, a double sideband output. It is also capable of providing an output of four telephony speech channels 300 to 3,000 c/s wide for operating the main transmitter as a four-channel independent sideband system.

The frequency-shift system is generally favoured for telegraphy whenever suitable facilities exist at the receiving end. The output of this drive unit is on a fixed frequency between 4 and 27.5 Mc/s and can be normal single-channel FSK, single-channel FSK with frequency modulation, two-channel FSK or on-off keying.

Control of all the 28 transmitters is effected from a central operating position taking the form of a curved control desk as shown in the illustration. On it are assembled separate control panels for each transmitter with switches for on-off, monitor, local or distant operation of the transmitters and indicating lamps to give warning of a fault in any of the transmitters.

The transmitters, drive units, aerial switching system and much of the associated equipment were supplied by Marconi's Wireless Telegraph Company and installation was carried out in co-operation with the Post Office.

The heart of the new extension to the G.P.O.'s station at Rugby is shown here. From it the engineers in charge can start up or close down any one of 28 transmitters, monitor their operation and change frequency and aerials by remote control. The transmitting hall is visible in the background.



RANDOM RADIATIONS

By "DIALLIST"

Penny Plain, Tuppence Coloured

A GOOD MANY readers living in the service area of the Alexandra Palace transmitter will probably take the opportunity of seeing something of the B.B.C.'s experimental transmissions of colour television in the autumn. The vast majority of them, I imagine, will have to content themselves with the penny plain version and will only be able to make guesses about the tuppence coloured pictures. But even that is well worth while: for they will be able to discover whether or not the system being tested is genuinely compatible; whether, in other words, the colour transmission gives an acceptable monochrome picture. That's going to be a very important point. We're not far from the time when there'll be 5,000,000 monochrome sets in use in this country and, whatever happens about colour, a good service for them has to be provided for years to come. There'd be an outcry if their owners thought that they were being sacrificed on the altar of colour television.

Making the Change

The number of black-and-white television sets in the homes of this country may well be doubled by the time a completely satisfactory colour system has been developed. And that, I believe, is one of the reasons why neither the B.B.C. nor the I.T.A. are likely to be in any particular hurry to develop it. It's highly improbable that it will be feasible to convert or adapt existing sets for colour; those who want the tuppenny version will have to buy new receivers, which seem likely to be a good deal more costly than those of to-day. Unless, in fact revolutionary new processes of transmission and reception are developed, the stage seems hardly to be set for a boom in colour television. It's much more probable that when good compatible transmissions are regularly on the air a gradual, rather than a spectacular, increase in the number of domestic colour receivers will take place. People will buy them when the time comes to replace their existing sets.

Festina Lente

Hasten slowly is a sound watchword in such matters as the development of colour TV. It's no use, as our good friends on the other side of the Pond have found, going off at half-cock. And I don't think we're in danger of doing that. The P.M.G. won't sanction the adoption of any system until his advisers are completely satisfied that it's the goods; and I'm sure that the B.B.C. and the I.T.A. will be just as hard to please. The radio industry itself provides another staunch safeguard. It certainly wouldn't support the kind of colour television system that could be guaranteed to give passable pictures only if users were prepared to pay £300 for a receiver and to employ a whole-time resident serviceman! Please don't imagine that I want the development of colour TV to be delayed: I certainly don't. But there must be no ifs or buts about the system we launch.

Divis Starts Well

AS I write, there are splendid reports of the coverage disclosed by the initial transmissions from the new Belfast television station at Divis. Reception has been good over a larger area of Northern Ireland than was forecast by the B.B.C., and excellent pictures have been obtained much farther afield than that. In fact, they've left little to be desired in much of the area round Dublin as well as in other parts of Southern Ireland. It's unlikely that Southern Ireland will be able, at all events in the near future, to finance a television service of its own. I don't think, though, that we need worry if some of its folk can pull in the Divis programmes free, gratis and for nothing so far as licence fees are concerned. To do so they'll have to buy receivers made in this country, and that's good business for us. Actually there are already quite a few enthusiasts in that part of the world who have been eager to spend money on rather chancy reception of Wenvoe and Holme Moss. Divis has also been well received in many parts of N.W. England and S.W. Scotland, in which it has hitherto not been possible to rely on getting good, steady pictures from stations on the mainland. Altogether a very satisfactory show, on which all concerned deserve warm congratulations.

A Spot of Bother

RATHER an interesting fault cropped up recently in my television receiver. It had been right up to the mark when previously used; but now, after the usual warming-up period, the brightness of the picture was a good deal below its normal level. As the sound was unaffected and the height and width of the picture were as they should be, it seemed that the h.t. line was beyond suspicion. The picture was clear and steady enough; just dim. Tests dis-

closed a weak signal at the video amplifier, and, moving forward, the trouble was eventually found to be at the input to the second vision i.f. stage. The cause was, in fact, a defective i.f. transformer. When a new one had been obtained and connected up reception was again as good as ever. The reason why I describe this fault is that the symptoms were rather misleading. More often perhaps than not a poor signal from the video amplifier means an unsteady picture; with maybe line break-up and vertical rolling, the reason being that the sync pulses aren't good enough to take proper charge of the time bases.

Present Help in Time of Trouble

IT'S a bit surprising, I think, that dealers and service technicians don't make more general use of the oscilloscope. Many of them, of course, are fully cognisant of its virtues as an aid both to fault-finding and to correct alignment; but there are lots who never give it a thought. Simple oscilloscopes suitable for the jobs in question aren't all that expensive. It certainly takes a bit of practice and of common sense to use them effectively; but this instrument does so speed up the work, once its use has become familiar, that I'm sure it must quickly pay for itself in a busy repair shop. Myself, I wouldn't care to undertake the job of lining up the superhet stages of a high-quality sound or television receiver without being able to see what's going on by means of the oscilloscope screen. Perhaps the coming of v.h.f. sound broadcasting with frequency modulation will give the oscilloscope a boost, for it's the most reliable of all means of checking up f.m. receivers.

Lining 'em Up

THE South Wales Electricity Board is to spend a tidy bit of money during the next 18 months on getting rid of d.c. supplies and standardizing those that are already a.c. but with some odd voltage or frequency. I only hope that other Boards will take a leaf out of their book. It's a job that should be pressed forward, for the different forms of mains power supply now still often to be found in the same town—or even on different sides of the same street—are more than a nuisance to domestic and other users. If, for instance, you come to move house, you may well find that quite a number of your existing appliances won't be of any use in the new abode.

UNBIASED

By FREE GRID

A New Menace

WE are, I hope, all trying hard nowadays to avoid causing interference to radio reception and to that end have fitted suppressors to all electrical apparatus under our control. I have long ago put my own house in order in this respect but Mrs. Free Grid arrived home recently from one of her infernal shopping expeditions with an entirely new piece of electrical apparatus which has so far defied all my efforts to suppress it. I am wondering, therefore, if any of you with specialized technical knowledge in the matter of suppression can let me have a word of advice.

The apparatus calls itself a magnetic broom and claims quite rightly that unlike ordinary brooms it does not raise a cloud of dust when you use it, as the polystyrene bristles become electrified by friction with the carpet or floor. All dust particles thus cling to the bristles. Its very virtues are its greatest drawback from the point of view of listeners and lookers as the friction between bristles and carpet, which brings into being the static charge, causes an inferno of crackles and snowstorms. I have tried earthing the bristles but this merely converts the sweeper into an ordinary broom. Is there any solution at all?—beyond the obvious one, of course.

Communal TV Aerials

ANYONE taking a train from any of the great London termini cannot help being struck by the large and ever-increasing number of TV aerials that adorn the chimney pots. As the train gets farther afield and passes through country towns the number of elements on each aerial steadily increases until the skyline of distant towns seems ornamented with a lot of elevated xylophones.

When taking such a journey the other day I could not help wondering whether some of the xylophone owners would not have laid out their money to better advantage if they had invested in a really tall mast instead of in a family of directors. Here and there I did notice that somebody had been thinking on somewhat the same lines as myself and had put their ideas into practice; I'll warrant that such people get better reception than do their xylophonic neighbours.

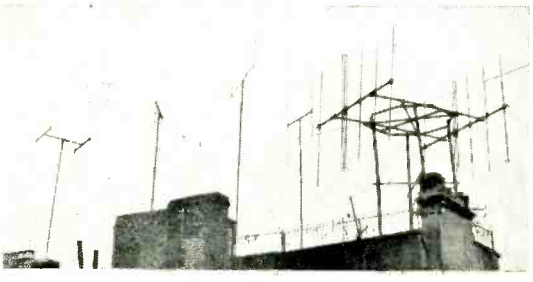
However, a tall mast needs careful staying and if everybody erected one the general effect would be far from beautiful. At the same time, if TV aerials continue to grow at their present rate the skyline of a densely populated district will look even uglier than it does to-day.

I have been wondering, therefore, if it would not be possible for streets to co-operate as they did for fire-watching during the war and contribute to the erection of a really high and well-stayed mast to carry a communal aerial which would feed signals to subscribing houses by means of a coaxial cable.

An aerial pre-amplifier would, of course, be needed and possibly others at intervals along the distribution cable.

The mast could carry aerial arrays for B.B.C. and I.T.A. television and also for f.m. The advantage of such an arrangement would be increased signal strength, greater freedom from interference and greater beauty of skyline. Also the cost of maintaining the mast and aerial arrays would work out less per subscriber than the present cost of keeping individual aerials up to the mark.

I quite expect to be told that this is already done in some areas; in fact, the other day I noticed a TV mast towering above a building outside Wandsworth Town station which was such a fine piece of work that I suspect it to be a communal effort.



Could anything be uglier?

Hi-Fi-Li

A CORRESPONDENT has sent me a copy of the Toronto *Telegram* in which appears an advertisement for what is called Hi-Fi make-up. I can only suppose that the vendors of this cosmetic or the composers of their advertisement have no knowledge of feminine psychology.

Hi-Fi in radio, or anything else, virtually means "the same as the original" or at any rate a close approach to the original. Therefore the girl who uses this cosmetic may expect to look as Nature made her; a thought which would send a shudder through even the most tempting torso. Surely, the whole object of using cosmetics is to make some improvement upon Nature's handiwork, or in other words to obtain a result which is as lo-fi as possible.

Improving upon Nature!

Have the people responsible for this advertisement never heard that—

"A little touch of powder,
A little dab of paint,
Can make the female features
Look like what they ain't"?

As Others See Us

DURING May I took the opportunity of visiting the "Photo Fair" not so much because of an interest in photography as to see how another great industry went to work in putting itself over to its customers, and to find out if we radio people could pick up a few valuable ideas.

I took Mrs. Free Grid along as she and people like her with their "snaps" of repulsive-looking people on the beach or in the garden and of babies in their baths are the very backbone of the photographic industry. Their cameras are only in the crystal-set class and yet they use more films and paper and so bring more grist to the mills of the big photographic manufacturers than do the owners of the lordly Leica and such-like instruments.

To my astonishment this numerically great class of prosperity-bringers was almost totally ignored by the exhibition. It made me wonder if we are making a similar mistake at the annual radio show. Honestly I don't think we are, for at Earls Court is to be found the true democratic spirit with something for all the listening and looking public. Nobody is ignored, but all the same I should like to read a photographer's criticism of the Radio Show.

E180F

wide-band low-noise pentode

16mA/V

c_{in}=8pF c_{out}=3pF

PRINCIPAL CHARACTERISTICS			
V_a	190V	g_m	16.5mA/V
V_{g2}	160V	r_a	35kΩ
V_{g1}	−1V	μ_{g1-g2}	50
I_a	13mA	Heater	6.3V,0.3A
I_{g2}	3mA	Base	B9A

Input damping = 6kΩ (at f = 50 Mc/s and with cathode connections strapped).

The unusually high slope/capacitance ratio of this new Mullard pentode has been achieved by using very fine grid wire, the latest type of frame grid and the smallest cathode-grid clearance yet employed in large scale production.

Gold plating of the base pins ensures that, when mounted in a suitable socket, the E180F makes one of the best base connections obtainable.

This new valve is eminently suitable for wide-band amplifier applications such as radar i.f. amplifiers, camera and transmission equipment for high definition television, and telephone line and transmission equipment.

For low-noise input stages the valve may be triode-connected and very favourably employed in pre-amplifiers in radar i.f. and camera equipment.

Your enquiries on the E180F will be welcomed at the address below.

Mullard

Mullard Limited, Communications & Industrial Valve Dept., Century House, Shaftesbury Avenue, London, W.C.2.

MVT 174

TAILORED FOR THE JOB

It is by no means accidental that the Ferrograph has achieved so high a reputation in every country to which exportation is possible, and at a price no greater than that of an ordinary home recorder.

One of the main contributory factors is that practically all component parts used in the Ferrograph are made in our own works at South Shields, **having been expressly designed for the function they are to perform.**

Thus, by purposeful design, adequate control during manufacture, and strict inspection, standards have been established to which all Wearite/ Ferrograph components conform.

After assembly from such parts each Ferrograph is subjected to a multiplicity of tests, culminating in a pen-recorder trace of its response and wow.

Only thus has the **Ferrograph** set and maintained **the standard by which all other recorders are judged.**

Dealerships in several of the principal towns are still open and applications are invited.

Ferrograph

BRIEF SPECIFICATION

Twin Track (to International standards)
Playing British and American pre-recorded tapes

Playing Time with 1,750 ft. Reel
45 minutes per track at $7\frac{1}{2}$ i.p.s. (other speeds pro rata)

Quick Rewind
in less than 60 seconds

Signal Level Meter
giving positive reading

Frequency Response
±3 db 50/10,000 c.p.s. at $7\frac{1}{2}$ i.p.s.

"Wow" and Flutter
Less than 0.2% at $7\frac{1}{2}$ i.p.s.

Signal to Noise Ratio
Better than 50 db, 200/12,000 c.p.s. Unweighted, including hum, 45 db.

Longterm Speed Stability
Less than .5% variation

Output Power
$2\frac{1}{2}$ watts into 15 ohms

MODEL 2A/N
$3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s.
76 gns.

MODEL 2A/NH
$7\frac{1}{2}$ and 15 i.p.s.
86 gns.

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To meet this demand, the English Electric Valve Company have developed two new valves for R.F. generators of 10 kW and upwards. These new products are not modifications of valves used for communications, but are designed expressly for operation under the less favourable conditions imposed by factory use. They are rugged and will withstand severe overloads; they are low in first cost and have a long service life. Both types are available in air-cooled or water-cooled versions and a suitable range of rectifying valves for use in conjunction with them is also available.

'ENGLISH ELECTRIC'

Type	Maximum Operating Frequency at Full Rating (Mc/s)	Cathode	Dimensions (*maximum*)		Filament		Maximum Anode Voltage kV.(D.C.)	Maximum Anode Dissipation (Kilowatts)	Useable Emission (Amperes)	Amplification Factor	Mutual Conductance (mA/V)
			Length mm.	Diameter mm.	Volts	Amperes					
BR. 1102	50	Th.	483	241	8·2	230	12·0	20·0	45	42	20·0
BW.1102	50	Th.	473	152	8·2	230	12·0	20·0	45	42	20·0
BR. 1103	100	Th.	356	203	6·0	120	8·5	10.0	16	25	8·3
BW.1103	100	Th.	343	116	6·0	120	8·5	10·0	16	25	8·3

NOTE: CATHODE:—Th. *denotes* THORIATED TUNGSTEN. BR. *denotes* AIR-COOLED. BW. *denotes* WATER-COOLED.

Technical data sheets are available on request.

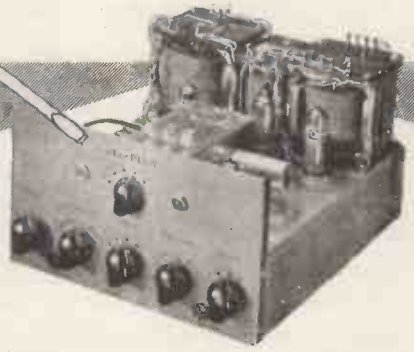
ENGLISH ELECTRIC VALVE CO. LTD. *Waterhouse Lane, Chelmsford*
Telephone: Chelmsford 3491

AP 300-20

Home Constructors

MAKE A SOUND JOB OF IT WITH . . .

HUNTS CAPACITORS



APPROVED CAPACITOR KITS FOR CONVERSION TO THE OSRAM "912 PLUS"

PASSIVE INPUT UNIT (NO VALVE)

Ref.	Capacitance	Volts D.C. Wkg.	List No.	List Price s. d.
C 24	470pF±10%	350	L 433	1 4½
C 25	0.002μF	1500	A 77	1 6
C 26	0·005μF	1000	A 71	1 3
C 27	0·005μF	1000	A 71	1 3
C 28	0·01μF	600	A 60	1 0
C 29	220pF±10%	350	L 433	1 4½
C 30	100pF±10%	350	L 431	1 4½
C 31	100pF±10%	350	L 431	1 4½
C 32	33pF±10%	350	L 430	1 4½

Price for complete kit 11.10½d.

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Ref.	Capacitance	Volts D.C. Wkg.	List No.	List Price s. d.
C 33	0·1μF	350	B 406	2 3
C 34	25μF	12	JD 26T	2 3
C 35	0.05μF	350	B 405	2 3
C 36	330pF±10%	350	L 433	1 4½
C 37	150pF±10%	350	L 433	1 4½
C 38	68pF±10%	350	L 430	1 4½
C 39	33pF±10%	350	L 430	1 4½
C 40	1000pF±10%	350	L 433	1 9
C 41	8μF	450	JF 553TS	3 6

Price for complete kit 17.6d.

APPROVED CAPACITOR KIT FOR THE OSRAM 912 High Quality Amplifier

Ref.	Capacitance	Volts D.C. Wkg.	List No.	List Price s. d.
C 1	0·005μF	1000	B 402	2 0
C 2	25μF	25	JD 52T	2 6
C 3	0·1μF	350	B 406	2 3
C 4	0·05μF	500	B 405	2 3
C 5	8+16μF	450	JE 561	7 6
C 6	470pF±5%	350	L 433	1 6
C 7	1000pF±5%	350	L 435	1 9
C 8	2000pF±5%	350	L 435	2 4½
C 9	0·02μF	750	B 404	2 1½
C 10	22pF±5%	350	L 430	1 6
C 11	220pF±5%	350	L 433	1 6
C 12	470pF±5%	350	L 433	1 6
C 13	25μF	25	JD 52T	2 6
C 14	0·1μF	150	B 500	2 0
C 15	2μF	150	B 504	5 6
C 16	0·01μF	350	B 810	1 6
C 17	0·05μF	500	B 405	2 3
C 18	0·05μF	500	B 405	2 3
C 19	50μF	25	JD 53T	2 9
C 20	50μF	25	JD 53T	2 9
C 21	0·001μF	600	B 847	1 3
C 22	0·001μF	600	B 847	1 3
C 23	8+16μF	450	JE 561	7 6
	2 Horizontal Mounting clips H 1			8

Special price for complete kit £2.15.0

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THE TRADE MARK OF RELIABILITY
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The Invisible link with the Isolated Community

V.H.F.

RADIO TELEPHONE

Subscriber pole-mounted battery operated unit

- ★ **No Change in Normal Telephone Operating Procedure**
- ★ **Mains or Battery Operation**
- ★ **Signalling Units for All Types of Circuit**

The V.H.F. link provides the most practical means of direct communication between isolated communities in all areas where the nature of the terrain or distance involved preclude the use of open wires for junction or subscribers' lines. Dialling facilities can be employed, and the radio equipment can be interposed in a standard line circuit in any part of a telephone system without modification to switching equipment.

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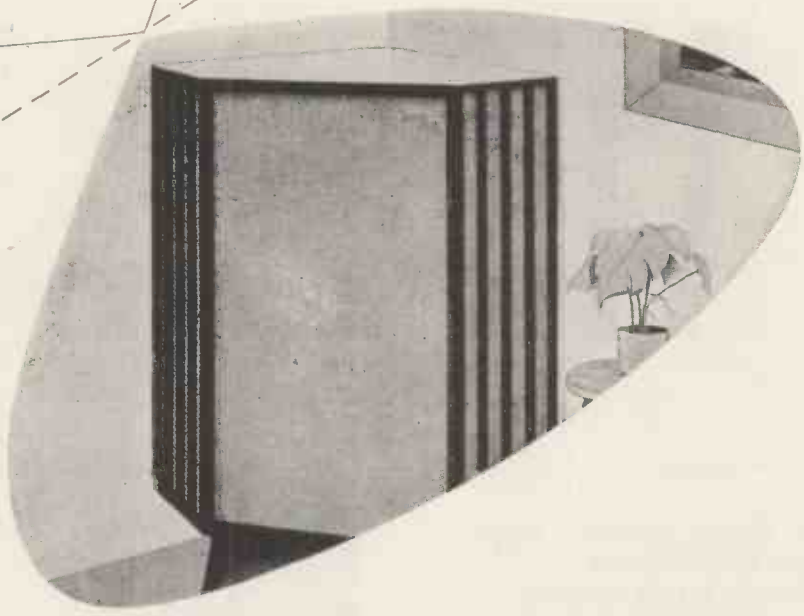
AT14511-Bx107

What's in an Enclosure ?



For those to whom acoustics is a mystery, the mounting of such a fine high fidelity instrument as the Tannoy Dual Concentric Speaker is inevitably something of a hit-and-miss procedure. And it is difficult subsequently to subdue the nagging thought that perhaps a more knowledgeable approach might have produced even finer results.

It is for such people . . . people who cannot be happy with anything short of the best . . . that the GRF Enclosure has been produced.

Based on the larger and more costly ' Autograph ' enclosure, it has an elaborate interior system of sound source expansion, incorporating all the advantages of horn loading for bass reproduction. Mid-range frequencies are covered by direct frontal radiation via an entirely new acoustic coupling device, and the high frequency end of the spectrum is amply catered for by the normal non-directional horn loaded source of the 15" Tannoy Dual Concentric unit.

. . . . And if technicalities are of little more than passing interest, the point that really counts is that, obviously, Tannoy would never release an enclosure that did not extract the last possible degree of realism from their own Speaker unit.

DIMENSIONS

Max. front to rear 29"
Max. width 38"
Overall length 48"
Floor clearance, on standard legs 6½"

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- ★ Heats up from cold in 6 seconds—by a light thumb pressure on the switch ring.
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- ★ Can be used from a car battery.
- ★ It is by far the most efficient and economical soldering iron ever designed for test bench and maintenance work.

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Designed on an entirely new principle, this light-weight, versatile iron is eminently suitable for soldering operations in the RADIO, TELEVISION, ELECTRONIC and TELECOMMUNICATION industries, particularly for all SERVICE work. For general purpose work the Superspeed Iron is the ideal stand-by soldering tool.

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Ponton

WE CAN DELIVER FROM STOCK

these popular Tape Recorders

Editor

HI-FI RECORDERS

These superb British made Dual Track recorders, rich in range and tonal qualities, incorporate an additional High Fidelity 10 in. GOODMANS Loudspeaker in the lid, which can be detached and used in any position desired for public meetings, concerts, dances, etc. They are powerful enough to meet any volume requirements, yet maintain crystal clear quality reproduction at all volume levels. IDEAL FOR PRE-RECORDED TAPES.

- ★ *Two speeds—3¾ in. and 7½ in. per sec.*
- ★ *Two hours recording.*
- ★ *Instantaneous braking.*
- ★ *Instantly ready to record or playback.*
- ★ *Built-in speaker is additional to 10 in. high flux speaker in detachable lid, giving greater versatility.*
- ★ *Easily removable chassis built on unique steel frame, ensuring ease of inspection.*
- ★ *Size overall 11½ in. × 16¾ in. × 12 in. Weight 37 lb.*
- ★ *Magic eye level indicator.*
- ★ *Independent BASS and TREBLE controls.*
- ★ *For A.C. mains 200-250v.*

EDITOR HI-FI

Fitted in elegant leathercloth suitcase with gilt fittings. Complete with High Fidelity desk microphone and 1200 ft. spool of tape. **49 gns.**

EDITOR SUPER HI-FI (Illustrated above)

Fitted in padded simulated crocodile case with continental gilt fittings and locks, with elegantly styled super tape deck. Completely automatic simple interlocked control; MIXING and MONITORING facilities. Complete with microphone and tape. **60 gns.**

Also available from stock . . .

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Easy to carry—easy to look at! Two hours recording and two speeds—3¾ in. and 7½ in. per sec. Fitted in leathercloth suitcase. Complete with microphone and 1200 ft. tape **45 gns.**

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De Luxe version of the Editor, with elegantly styled super tape deck and MIXING and MONITORING facilities. Complete with microphone and 1200 ft. tape **55 gns.**

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is used by all discerning and careful buyers—it provides easy repayment terms coupled with very low deposits and low service charges. We are authorised Distributors for most high grade Electronic Equipments, and if you will let us know your requirements we will quote details by return. Or send your deposit with your order, allowing sufficient for carriage and packing extra, in order to secure your needs. Please specify over what period, up to a maximum of 18 months, you wish to repay, and the necessary forms will be sent to you immediately.

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85 gns.
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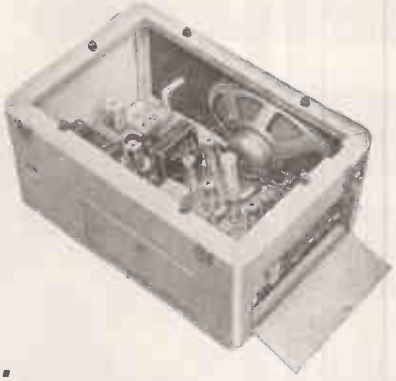
SP/2 TAPE RECORDER

- ★ **Frequency Response**
  50 - 12,000 c.p.s. ± 3db. at 7½ i.p.s.
  50 - 7,000 c.p.s. ± 3db. at 3¾ i.p.s.
- ★ **Ten-inch Loudspeaker**
- ★ **Autostop**
- ★ **Two-stage Capstan**
- ★ **'Fingertip' Control**
- ★ **Three Motor Drive**
- ★ **10 watts p.p. output**
- ★ **Independent Bass & Treble**
- ★ **Twin-track recording**
- ★ **High Fidelity Amplifier**
  can be used independently of the recorder for P.A., Radio or Record Reproduction.

The NEW SIMON Model SP/2 Tape Recorder is designed and built to top standards. Years of specialist experience in the field of sound-recording engineering and techniques have been combined to produce an entirely new equipment which is faultless in performance and appearance. The SP/2 provides superb recording and reproduction facilities. Ask your dealer to show you the new SP/2 now. . .



WE SHALL BE AT THE
RADIO SHOW
EARLS COURT
Aug 24-Sept 3
STAND 10

The inside story . . .

Ask for a copy of the new booklet — "Affairs of Tape", free of course. Brings you up to date on Tape Recording — gives you the inside story of the SP/2.

Simon is *Sound* recording

SIMON SOUND SERVICE LTD.
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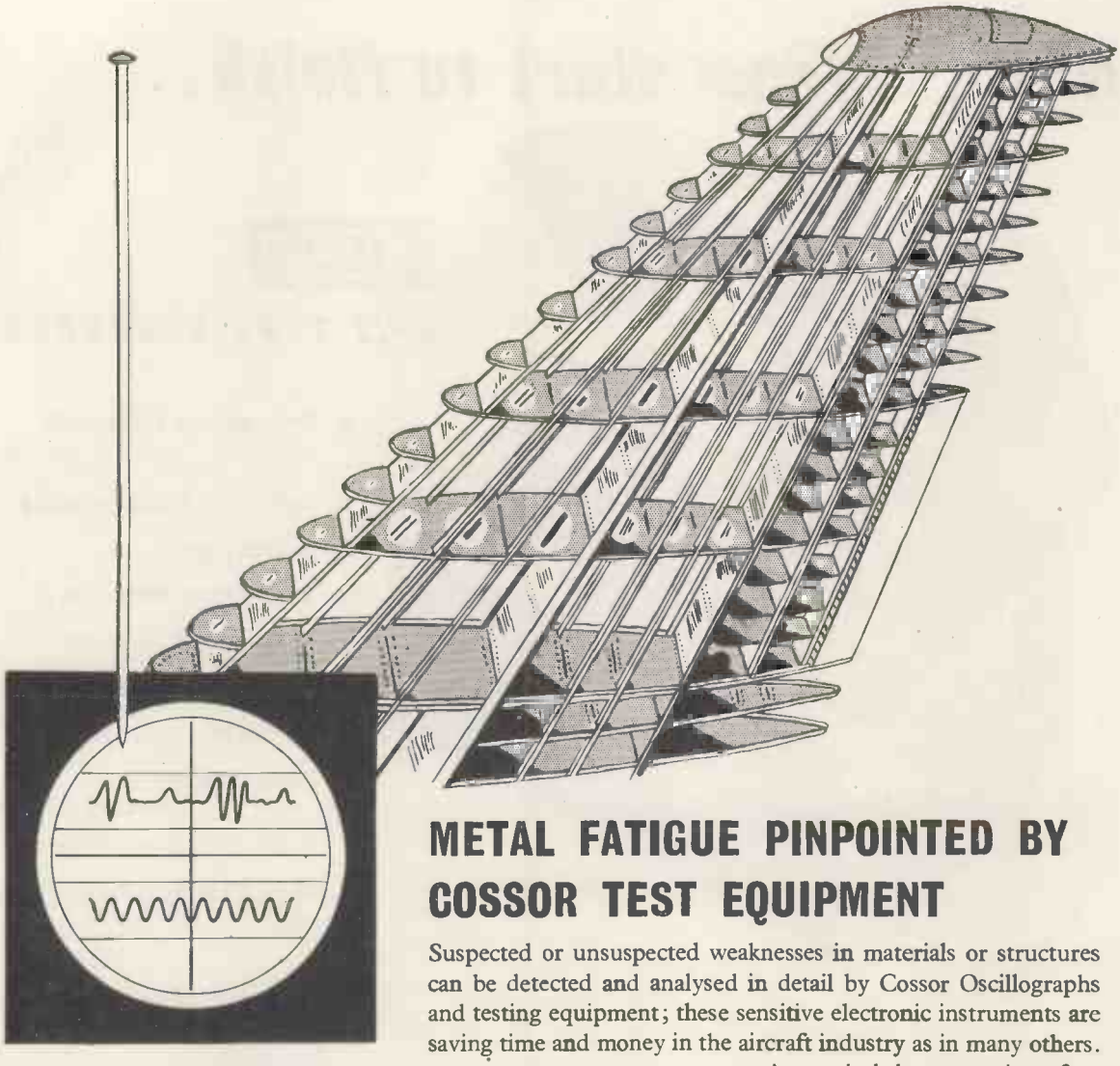
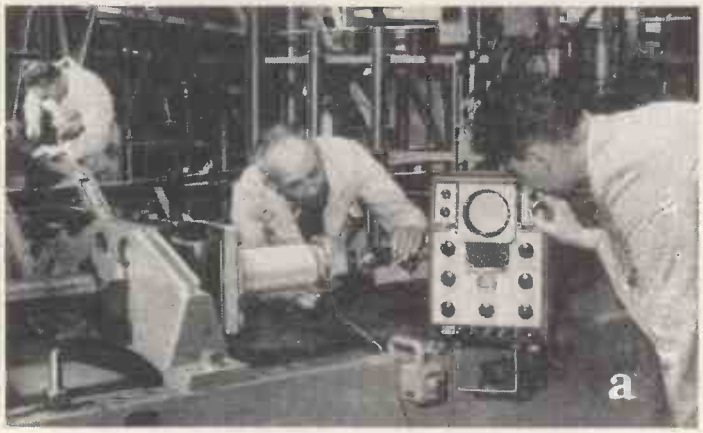


METAL FATIGUE PINPOINTED BY COSSOR TEST EQUIPMENT

Suspected or unsuspected weaknesses in materials or structures can be detected and analysed in detail by Cossor Oscillographs and testing equipment; these sensitive electronic instruments are saving time and money in the aircraft industry as in many others.

A practical demonstration of an oscillograph in conjunction with a dynamic model of the Vickers Supermarine "Swift" can be seen on the Cossor Stand (No. 63) at the Farnborough Air Display.

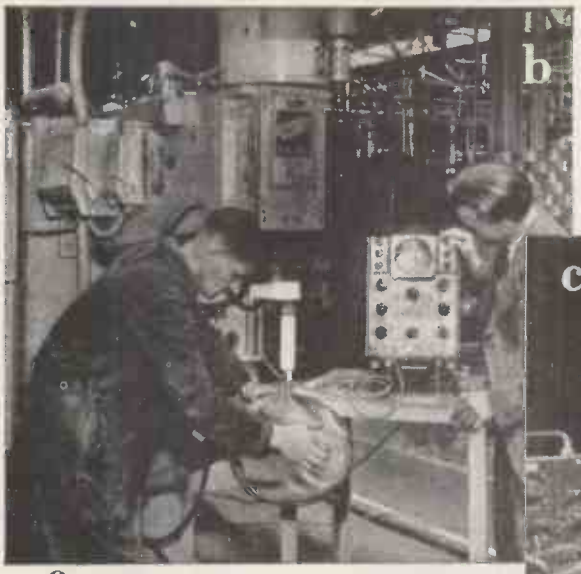


a *Investigation of fatigue behaviour in aircraft structural components is carried out with this pulsator. Steady tensile loads of up to 20 tons/per sq. in. may be applied to which can be added oscillatory stresses of up to 10 tons/per sq. in. The Cossor Oscillograph displays the output of the exploring strain gauges. Photograph by courtesy of* **Saunders-Roe, Ltd.**

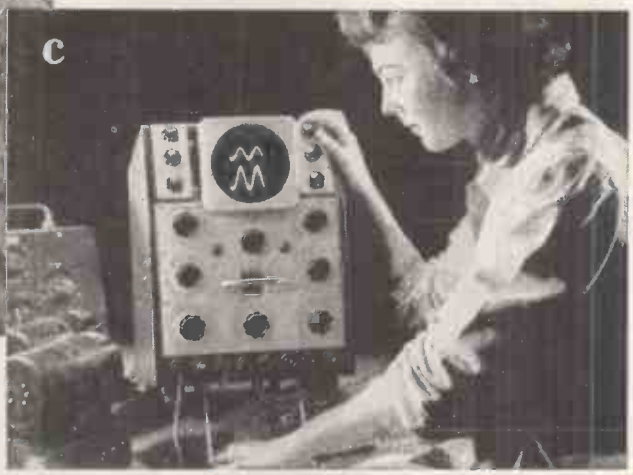
SEE THE COSSOR TEST EQUIPMENT IN OPERATION ON STAND No. 63

THE COSSOR GROUP OF COMPANIES · HIGHBURY GROVE · LONDON · N.5

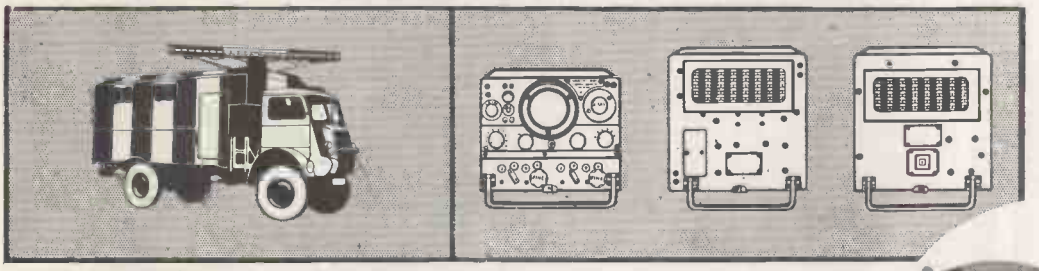
A. C. COSSOR LTD · COSSOR RADAR LTD · COSSOR INSTRUMENTS LTD · STERLING CABLE CO. LTD
BEST PRODUCTS LTD · COSSOR (CANADA) LTD · BEAM INSTRUMENTS CORPORATION (U.S.A.)



b *The Cossor Model 1049 Double Beam Oscillograph is displaying the onload waveform of the welding current through a starter fairing of a Rolls-Royce "Avon" engine. Photograph by courtesy of* **Rolls-Royce Ltd.**



c *The Cossor Model 1049 Double Beam Oscillograph displays the output of the twin inverters under test at the works of Sir W. G. Armstrong-Whitworth Aircraft Ltd. Photograph by courtesy of* **Sir W. G. Armstrong-Whitworth Aircraft Ltd.**



Transponder Surveillance Radar is a Secondary Radar system. This new Cossor development employs a ground interrogator pulse transmitter with an airborne transponder and gives greatly increased operational range.

The latest airborne equipment for reliable navigation is the Gee Mk. III produced by Cossor for use in the Gee system of hyperbolic navigation. It is used extensively by the R.A.F. and continental air forces and by Aer Lingus.

Now installed at London Airport, Zurich Airport and on Royal Dutch Air Force aerodromes, Cossor Airfield Surveillance Radar (ACR Mk. VI) gives permanent-echo cancellation, C.R.D.F. superimposition, 60 miles' range and video mapping. A full scale A.C.R. rotating Scanner, in conjunction with a Secondary Radar aerial, will be on show in the Equipment Park at the Air Display.

COSSOR

AT THE S.B.A.C. DISPLAY FARNBOROUGH

5th - 11th SEPTEMBER

Reflectograph

present the new R.R. (Record/Reproducer) Series 100 Magnetic Tape Recorder—an instrument of advanced circuit design and flexibility, with the following outstanding features :—

FULLY TRANSISTORIZED PLAYBACK AMPLIFIER

Two Frequency Ranges :—
60—12,000 cycles ± 3dB.
D.C. Levels to 100 cycles (−3dB)

Separate Record and Playback Amplifiers.

Full Monitoring facilities during Recording.

Continuously Variable Tape Speed from 3.75″ to 8.50″ per sec.

New type Carrying Case with hinged bottom, permitting immediate access to interior of instrument for the storage of accessories and for inspection of electrical and mechanical units.

IN THIS RECORDER no output stage is fitted; instead, a separate record and playback amplifier are provided delivering an equalized output of 300mV (Peak). During recording, the instrument operates from the mains supply in the conventional manner. On playback, however, all power supplies are switched off with the exception of the mains to the tape drive mechanism. The playback amplifier then operates from a small dry battery and so permits the full advantage of low noise and "hum" to be obtained from this unit during the playback function.

The record level meter is switched to read "Transistor D.C. volts," "Record head bias volts," and "Record level," while, due to the unique design of the carrying case, all preset controls, mechanical and electrical units, are immediately accessible by unlocking and swinging down the hinged bottom.

The tape rewind is electrically interlocked with the record/playback switch to avoid accidental erasure during rewind, and coloured signal lamps indicate the record and playback functions.

In the home, when recording from an F.M. transmission, this instrument permits a playback quality virtually indistinguishable from the original signal, while in industry and research with the addition of the Model "T" sub-unit which plugs into the input and output sockets of the recorder, signals of D.C. levels and up to 100 cycles (−3dB) may be recorded.

The new R.R. Series 100 may be seen, heard and demonstrated with other models in the Reflectograph range on **Stand No. 208** *at the National Radio Show, Earls Court.*

RUDMAN DARLINGTON (ELECTRONICS) LTD

Wednesfield, Staffs. *Tel: Wolverhampton 31704*

good magnetic characteristics *demand* PRECISE ELECTRICAL INSPECTION

Standard **maintains its established leadership in the manufacture of high permeability magnetic alloys by constant vigilance in the control of each and every production process, one of which is illustrated here. Produced by a Company which has the unique advantage of being a large-scale user of its own magnetic materials, a long experience of the applications of these materials gives full appreciation of the properties essential for uniform electrical characteristics and stable performance.**

It will pay you to investigate the capabilities of *Standard* magnetic alloys with relation to your specific requirements.

- PERMALLOY 'C' for highest initial permeability, useful for wide-band frequency transformers, current transformers, chokes, relays and magnetic shielding.
- PERMALLOY 'B' has lower initial permeability than Permalloy 'C' but higher values of flux density. Suitable where high permeability to alternating field is required superimposed upon a steady polarising field.
- PERMALLOY 'D' for very high resistivity without undue lowering of the maximum flux density. Variation of permeability with frequency is small. Ideal for H.F. applications.
- PERMALLOY 'F' for high flux density, very rectangular hysteresis loop, with a retentivity of at least 95% of its saturation value and low coercive force. Ideal for saturable reactors, magnetic amplifiers, digital computors, memory devices, etc.
- V-PERMENDUR for high permeability with a very high value of maximum flux density. Finds special application for use as high quality receiver diaphragms, also motor generators and servo-mechanisms in aircraft where weight and volume are important factors.

"Straightforward & Logical System of Control"

VOLUME CONTROL AND ON/OFF SWITCH

BASS AND TREBLE CONTROLS
Compensation for the environment in which the equipment is used

FILTER SLOPE
Adjusting the filter characteristic for the finest performance inherent in the programme

FILTER SWITCH
Setting the filtering range

PUSH BUTTONS
Selecting radio, microphone or tape inputs

PUSH BUTTONS
Selecting playback characteristic

QUAD II CONTROL UNIT — SPECIFICATION

FREQUENCY RESPONSE :
Cancel position.
Radio & Tape inputs: 20-20,000 c/s within 0.3db.
Microphone input: 20-18,000 c/s within 1db.
Pickup Input (R.2): Within 0.5db of stated characteristics.
Other plugs, no significant change.
Bass and Treble controls: Within 1db of published curves.
Filter frequencies (ff): 5Kc/s, 7Kc/s 10Kc/s ± 250 c/s.
Filter slope: Level to 50 db/Octave.

INPUT SENSITIVITIES (for 1.4 V.rms output):

Radio and Tape:	Internal Impedance	100 KΩ:	100mV.
Microphone:	" "	100 KΩ:	1.5mV.
Pickup:	to suit pickup in use, adapted by plug-in unit.		

DISTORTION (1.4 V output):
All controls 'level', Radio input or R.2 pickup input: 0.02% approx.
Least favourable arrangement of plugs and controls: less than 0.1%

POWER SUPPLY : The unit takes its power from the main amplifier.
330 V 2 mA, 6.3 V 1 A } Plus currents taken by tuner units which may be connected to sockets provided.
Maximum power available from tuner sockets:
330 V 30 mA (each tuner)
6.3 V 2.5 A (total) The heater supply is C.T. to chassis.

VALVES : 1 x EF.86 (Z.729 or 6267), 1 x ECC.83 (12AX7) (ECC.81, B309 or 12AT7 with changed bias resistor).

BACKGROUND :
—70 db or where applicable, approximately 6 db above equivalent thermal noise of input impedance.

MECHANICAL :
Front panel: Die-cast, stove finished silvered fawn, machine engraved.
Knobs: Aluminium, stoved matt brown, machine engraved.
Chassis and Cover: Steel, rust-proof processed, stoved steel grey. The complete unit, electrically and mechanically is fully tropical and suitable for all climatic conditions.

DIMENSIONS : 10½" x 3½" x 6½".

WEIGHT : 7 lbs. nett. (3.15 Kg.).

ACOUSTICAL

Send for illustrated brochure giving full details of the QUAD II Amplifier.

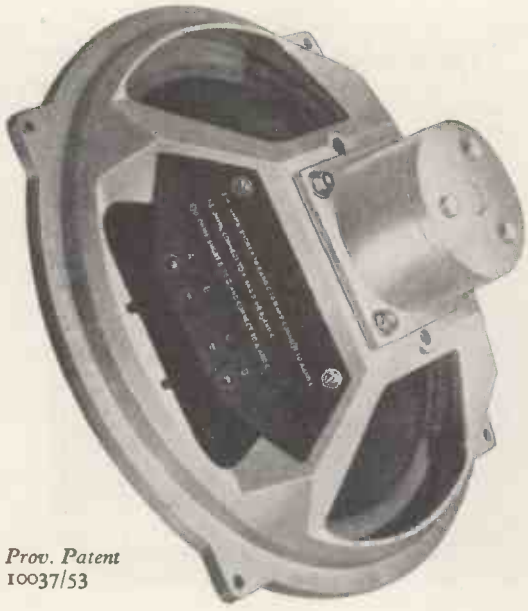
QUAD II

. . . for the closest approach to the original sound.

ACOUSTICAL MANUFACTURING CO. LTD. HUNTINGDON, HUNTS. Tel: Huntingdon 361

★ HIGH FIDELITY AT

acclaimed by leading experts



Prov. Patent 10037/53

Stentorian HI-FI UNITS

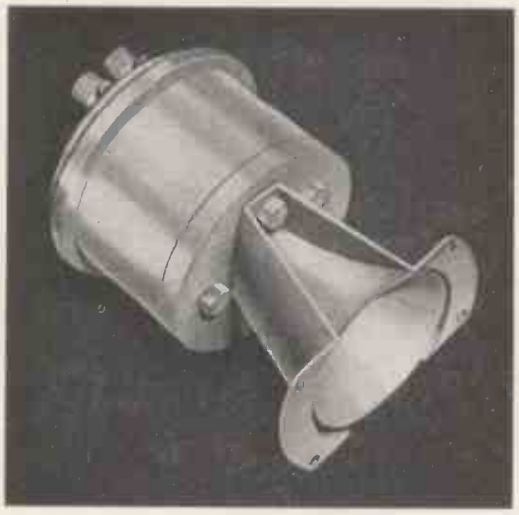
INCORPORATING THE PATENTED CAMBRIC CONE & UNIVERSAL IMPEDANCE SPEECH COIL AT 3, 7.5 AND 15 OHMS

H.F. 1012 10″ Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity, 10 watts. Frequency response, 30 c.p.s.—14,000 c.p.s. Bass resonance, 35 c.p.s. **£4.17.6 TAX PAID**

H.F. 812 Die-cast 8″ unit, incorporating 12,000 gauss magnet. Handling capacity, 5 watts. Frequency response, 50 c.p.s.—12,000 c.p.s. Bass resonance, 65 c.p.s. **£4.2.9 TAX PAID**

H.F. 912 9″ Die-cast unit, incorporating 12,000 gauss magnet. Handling capacity, 7 watts. Frequency response, 40 c.p.s.—13,000 c.p.s. Bass resonance, 45 c.p.s. **£4.7.3 TAX PAID**

H.F. 1214 (15 ohms only) 12″ unit, Incorporating 14,000 gauss magnet. Handling capacity, 15 watts. Frequency response, 25 c.p.s.—14,000 c.p.s. Bass resonance, 39 c.p.s. Diecast chassis. **£9.15.6 TAX FREE**



Stentorian PRESSURE TYPE TWEETER UNITS

Provide outstanding quality of reproduction when used with Stentorian 10″ or 12″ Hi-fi units. Speech coil of aluminium wire, wound on aluminium former which is rigidly fixed to an aluminium diaphragm. Speech coil and diaphragm situated at the rear of magnet centre pole hollowed out to form the commencement of the Horn, in the centre of which is the phase equalizer.

T.10 Speech coil impedance: 15 or 30 ohms. Response: 2,000/14,000 c.p.s. Flux density: 14,000 gauss. Power handling capacity: 5 watts. Dispersion angle 90°. Dimensions: $4\frac{1}{4}$″ long (exclusive of terminals). Distance between fixing holes: $2\frac{1}{2}$″ and $1\frac{1}{2}$″.
PRICE £4.4.0

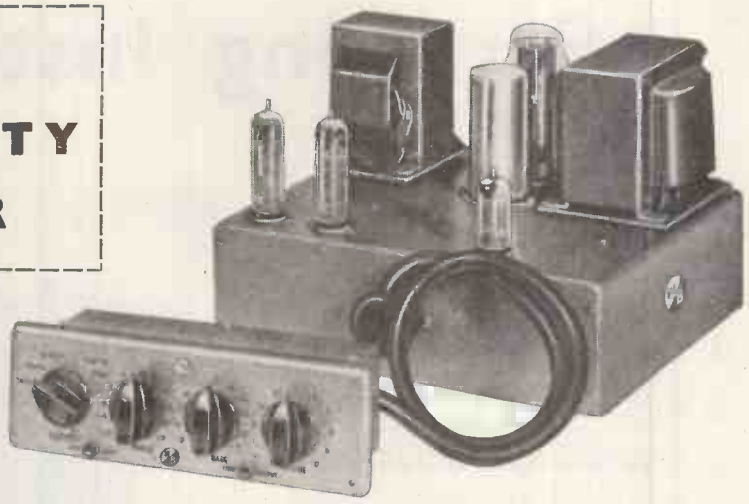
T.12 Speech coil impedance: 15 ohms. Response: 3,000/17,000 c.p.s. Flux density: 16,000 gauss. Power handling capacity: 15 watts. Dispersion Angle 90°. Dimensions: $6\frac{7}{8}$″ long (exclusive of terminals). Distance between fixing holes: 4″ and $2\frac{1}{4}$″.
PRICE £12.12.0

A suitable cross-over network at 30/- is available.

WHITELEY ELECTRICAL RADIO CO. LTD

REALISTIC COST ★

THE WB12 HIGH FIDELITY AMPLIFIER



Price £25 complete

Thirty years' manufacturing experience of sound reproduction equipment is embodied in the development of this amplifier — the technical details will satisfy the most critical user. Employing the most recently developed valves, it has a low noise input circuit, feeding the double triode phase splitter, and a push-pull output stage, ultra-linear connected, using a specially designed Whiteley Output Transformer. 25 db negative feed back is applied over the main amplifier. Switched pick-up matching is incorporated in an extremely flexible, compact and easily mounted pre-amplifier tone control unit. Both units are attractively styled and finished in hammered gold.

This equipment, when used in conjunction with Stentorian Speakers, provides most oustanding reproduction.

MAIN AMPLIFIER

Power Output	12 watts
Distortion	400 c/s 0.2% 1,000 c/s 0.12%
Frequency Response	+ .15 db 20-20,000 c/s
Negative Feedback	25 db
Hum and Noise	—80 db relative to 10W
Output Tappings	3-4 ohms and 15 ohms

VALVES

GZ.32 2 X EL.84 2 X ECC.83

Power Supply for feeder available 6.3V, 1.5A, 50mA at 300V

SPECIFICATION

CONTROL UNIT

Input Sensitivity for 10W	50mV
Hum and Noise relative to 10W	—72 db
Bass Control	Continuously variable from +11 db to —11 db at 30 c/s
Treble Control	Continuously variable from +10 db to —10 db at 10 Kc/s
Switched Input for Radio Feeder, Pickup and Tape	

NEW! An outstanding addition to the Whiteley range of High Fidelity equipment is the new F.M. Tuner, designed to take full advantage of the V.H.F. transmissions with their extended frequency range and absence of background and noise.

Attractively styled, it is tunable to cover present and proposed frequencies, and will operate efficiently with any good quality audio amplifier — particularly the W.B.12, which was designed with ample spare power for this purpose.

Maximum freedom from frequency drift has been ensured by the use of temperature-compensated circuits, while tuning is simple and positive, aided by the tuning indicator.

EASILY ASSEMBLED BASS REFLEX CONSOLE CABINET

This very attractive cabinet in highly polished walnut veneer is specially designed for use with Stentorian 10" or 12" units. Takes only a few minutes to assemble, the only tool required being a screwdriver. The sub-baffle has additional provision for Tweeter Unit if required. Size: 32 in. x 22 in. x 16 in. Supplied packed flat, complete with screws.

£10.10.0

CORNER CONSOLE CABINET for use with 8" HI-FI Cambric Cone Unit.

£5.10.0

★ *See and hear them on Stand 25 at the Radio Show: alternatively, they may be heard at our London Office (109 Kingsway, W.C.2) any Saturday from 9 a.m. to noon.*

MANSFIELD · NOTTS

W B

A COMPLETE Television Servicing Instrument

Incorporating :—

- ★ WOBBULATOR
- ★ PATTERN GENERATOR
- ★ A.M. SIGNAL GENERATOR
- ★ C.W. SIGNAL GENERATOR
- ★ L.F. OSCILLATOR
- ★ OSCILLOSCOPE
- ★ E.H.T. VOLTMETER
- ★ A.C. & D.C. VALVE VOLTMETER

THE AIRMEC *TELEVET TYPE 877* illustrated above, provides every facility needed for completely CHECKING, REPAIRING, OVERHAULING and ALIGNING Television Sets. It has the following :—

- *CRYSTAL CALIBRATION*
- *COVERS BANDS I & III*
- *CAN BE USED WITH BOTH A.C. & A.C./D.C. TYPE SETS*
- *COMPLETELY PORTABLE — WEIGHT 25 LBS.*

Come and use this instrument at our Stand No. 108 at the NATIONAL RADIO and TELEVISION EXHIBITION, August 24th to September 3rd

£66-10-0
LIST PRICE

Write now for full details to

AIRMEC
LIMITED

HIGH WYCOMBE — BUCKINGHAMSHIRE

Telephone : High Wycombe 2060 *Cables :* Airmec, High Wycombe

ADVANCE COMPONENTS LTD., MARLOWE ROAD, WALTHAMSTOW, LONDON, E.17 Telephone : LARkswood 4366/7/8

7·5 to 250 Mc/s
ON FUNDAMENTALS
IN FIVE RANGES
SINE AND SQUARE WAVE MODULATION
R.F. OUTPUT 1 μV to 100 mV

Advance

MODEL Q1
V.H.F. SIGNAL GENERATOR

£45
(List price in U.K.)

This " Advance " V.H.F. Signal Generator covers 7.5 to 250 Mc/s, a range that embraces Bands 1 and 2 *and also the impending Very High Frequency Television Transmissions on Band* 3. Moreover, this instrument is available at a price well within the reach of every service man. In the traditional " Advance " manner, this instrument is designed for simple operation and with a versatility that not only fulfils present needs, but anticipates the even more exacting requirements to deal with the television test problems of tomorrow.

Below are some outstanding features :-

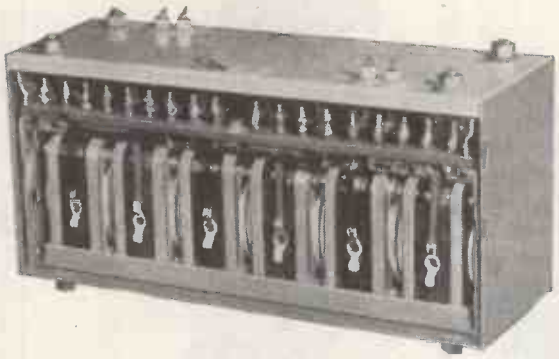
- WIDE RANGE—7.5 to 250 Mc/s
- SINE AND SQUARE WAVE MODULATION
- RELIABLE ATTENUATION
- LOW LEAKAGE—*less than* 3 *microvolts*
- TRULY PORTABLE—*weighs only* 17 *lbs.*
- COMPETITIVE PRICE

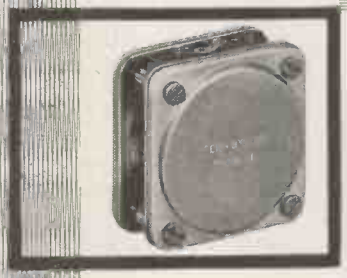
The Q1 provides the ideal complement to the Model E2. These together give complete coverage from 100 *kc/s to* 250 *Mc/s.*

Full technical details available in Folder W23 on request.

ADVANCE COMPONENTS LTD., MARLOWE ROAD, WALTHAMSTOW, LONDON, E.17 Telephone : LARkswood 4366/7/8
GD

Improved filter units





with Ferroxcube pot cores

1 *High performance combined with small size and light weight.*

2 *Designed and built to customers' individual requirements.*

3 *Long term stability, even under conditions of temperature variation.*

High quality electrical filter units built around Ferroxcube cores can now be supplied to communications equipment designers' individual specifications. These filter units have significant advantages over comparable types designed without the use of Ferroxcube, particularly in the frequency range 300 c/s to 500 kc/s. For audio frequencies the use of Ferroxcube cores permits the winding of compact coils with very high inductances. This results in a considerable reduction in the size and cost of the associated condensers and hence of the filter unit as a whole. The high Q values obtained for a given volume, especially above 10 kc/s, enable sharp cut off characteristics and low pass-band losses to be achieved, while negligible stray flux facilitates the production of compact and mechanically robust filters. Electrical filter units are among a number of high quality components now being made available by Mullard. Full details of the complete series of components will be gladly supplied upon request.

Mullard

'Ticonal' permanent magnets
Magnadur ceramic magnets
Ferroxcube magnetic cores.

MULLARD LTD · COMPONENTS DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · WC2
(M1463)

20 Mc/s FREQUENCY MONITOR

The Automatic Frequency Monitor (20 Mc/s) is but one of a series of high grade monitors now in course of manufacture for the accurate measurement of frequency.

Employing hard valve techniques throughout, it will measure any frequency in the range 10 c/s to 20 Mc/s to an accuracy within ± 1 part in 10^6.

The result, in decimal notation, is presented on eight panel mounted meters each scaled from 0 to 9 and the unknown frequency is automatically remeasured every few seconds.

This new equipment presents a considerable advance in frequency measuring techniques and apart from normal laboratory applications, is ideally suited for incorporation in production testing routines.

Full technical information on this and other frequency measuring equipment is available on request.

CINEMA TELEVISION LTD

A COMPANY WITHIN THE J. ARTHUR RANK ORGANISATION

WORSLEY BRIDGE ROAD · LONDON · S.E.26

HITHER GREEN 4600

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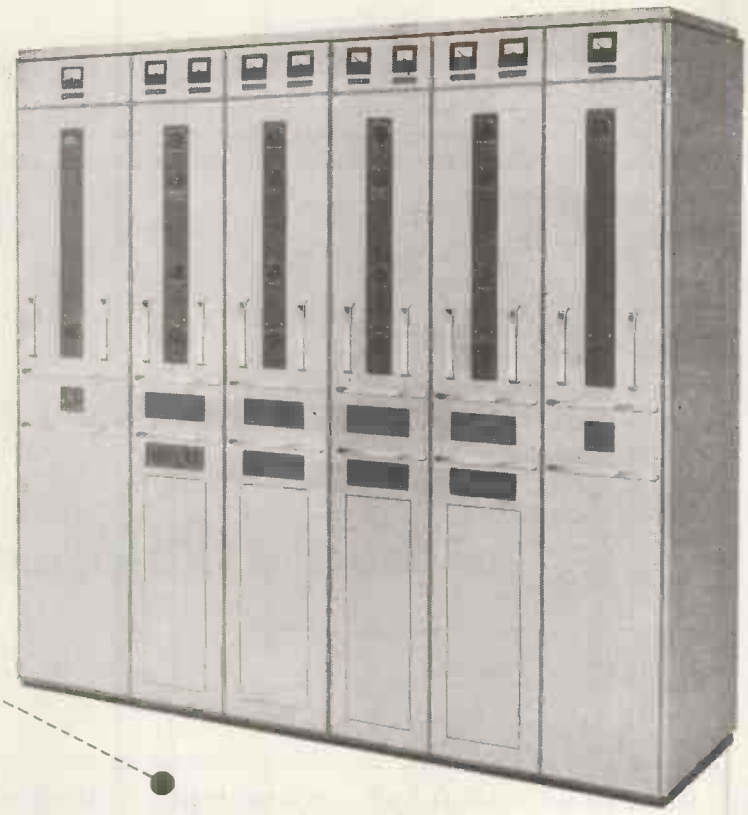


2-3 kW Channelised Transmitter

The GFT.560/2 is a 2-3 kW channelised transmitter with a frequency range of 1.5-30 Mc/s. It consists of three basic cabinets—r.f. unit, modulator unit, and power supply unit—combinations of which can be used to provide multi-frequency working as well as a number of different types of emission. The wave change facilities of the transmitter are both rapid and reliable—a valuable asset when the operating frequency is changed many times each day. The GFT.560/2 is fully tropicalised, and its unit construction facilitates future expansion of the initial installation, should the need arise.

For use in conjunction with the GFT.560/2 there are ancillary units that enable the transmitter to be remotely controlled over a two wire telephone circuit: operational adjustments are dialled to the transmitter.

The versatility and reliability of this new Mullard transmitter make it particularly suitable for h.f. en-route, ground-to-air services and point-to-point communication networks. A team of Mullard communication engineers is available to advise on the use of the GFT.560/2 in such applications.

ABRIDGED DATA *Frequency Range* 1.5—30 Mc/s *Frequency Stability* To Atlantic City 1947 standards *Power Output* 3kW. c.w., 2kW m.c.w. or r/t *Types of Emission* c.w., m.c.w., telephony, frequency shift A1, A2, A3, F1 *Output Impedance* 600 ohms balanced twin feeder *Power Supply* 400V, 50-60 c/s, 3-phase.

Mullard

SPECIALISED ELECTRONIC EQUIPMENT

MULLARD LIMITED · EQUIPMENT DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · WC2
(MI469)

D

SPECTONE

MULLARD 5-10 AMPLIFIER

This remarkable development will meet the most exacting high fidelity requirements at an extremely low price.
Meticulous inspection at each stage ensures that the Spectone Mullard 5-10 Amplifier fully meets Mullards specification.

TWO INPUTS One for radio tuner, microphone, etc., and one for pickup. The pickup input has two switch positions for equalisation—L.P. and Standard. Plug-in equalisers are available to suit various pickups.

CONTROLS Besides the input and equalisation selection switch, volume, treble and bass controls are provided. The treble control is continuously variable from +10db to −10db and the bass +11db to −5db.

MAXIMUM OUTPUT
15 watts

POWER OUTLET for pre-amplifier
300 volts at 12 milli-amps. 6.3 volts at 2 amps.

HUM & NOISE
−73db referred to 10 watts.

OUTPUT IMPEDANCE
15 ohms

FREQUENCY RESPONSE
± 0.5db 10 c/s to 20,000 c/s.

TOTAL HARMONIC DISTORTION at 10 watts.
Less than 0.4% at 40 c/s.
Less than 0.2% at 400 c/s.
Less than 0.3% at 2,000 c/s.

OPERATING VOLTAGE
200/250 volts A.C. 110/115 volt model available to special order.

OUTPUT RESISTANCE
at 1,000 c/s is 0.9 ohm.

DAMPING FACTOR
approximately 17.

WE SHALL BE AT THE
RADIO SHOW
EARLS COURT
Aug 24-Sept 3
STAND 206

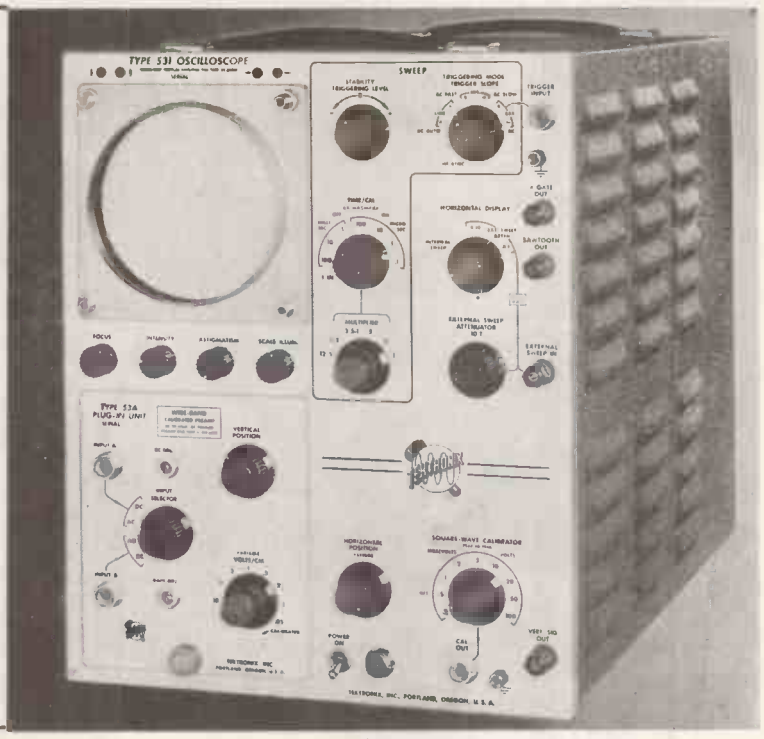
PRICE
£18-18-0
Pick-up Equaliser Plug 12/6

Manufacturers of the
SPECTONE

Magnetic Tape Reproducers for playing Tape Records to the C.C.I.R. characteristic with the highest fidelity. The modern method of hearing good music faithfully reproduced.
Leaflets on request.

SPECTO LTD. Vale Rd Windsor

5 BIG REASONS why you should own this oscilloscope



The Tektronix Type 531 Oscilloscope is far ahead in performance characteristics, and is capable of a much wider range of applications than the ordinary general-purpose laboratory oscilloscope.

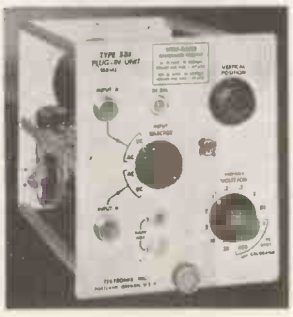
1 TYPE 531 EXCELS *in vertical-amplifier characteristics* — with the Type 53B Plug-In Preamplifier it offers accurately calibrated sensitivity to 0.05 v/cm from dc to 10 mc, 0.035-μsec risetime... to 0.005 v/cm from 5 cycles to 9 mc, 0.04-μsec risetime.

2 TYPE 531 EXCELS *in sweep characteristics* —Miller-runup circuitry generates linear sweeps in the extremely wide range of 0.02 μsec/cm to 12 sec/cm (600,000,000-to-1 ratio), with 24 accurately calibrated sweeps from 0.1 μsec/cm to 5 sec/cm. 5x magnifier is accurate on all ranges.

3 TYPE 531 EXCELS *in triggering facilities* —offering amplitude-level selection, automatic triggering, and 30-mc sync in addition to all standard triggering modes.

4 TYPE 531 EXCELS *in writing characteristics* — new Tektronix precision metallized crt with 10-kv accelerating potential provides high brightness, improved focus, and excellent linearity. (Recorded writing rate exceds 175 cm/μsec).

5 TYPE 531 EXCELS *in versatility* — Quick change plug-in preamplifiers and inherent oscilloscope capabilities combine to convert the Type 531 to applications normally requiring separate highly-specialized instruments. Available plug-in units provide for dual-trace ... low-level differential ... wide-band differntial ... and micro-sensitive applications in addition to wide-band high-gain applications. Current development work promises greatly-extended capabilities through new designs in plug-in units.



Type 531 Oscilloscope
$995, £ 384

Type 53B Plug-In Unit
$125, £ 49

plus duty if applicable

f.o.b. Portland (Beaverton), Oregon, U.S.A.

Write for 16-page booklet.

Represented in Great Britain by
LIVINGSTON LABORATORIES LTD.
Retcar Street, London N. 19
Archway 6251

Tektronix, Inc.

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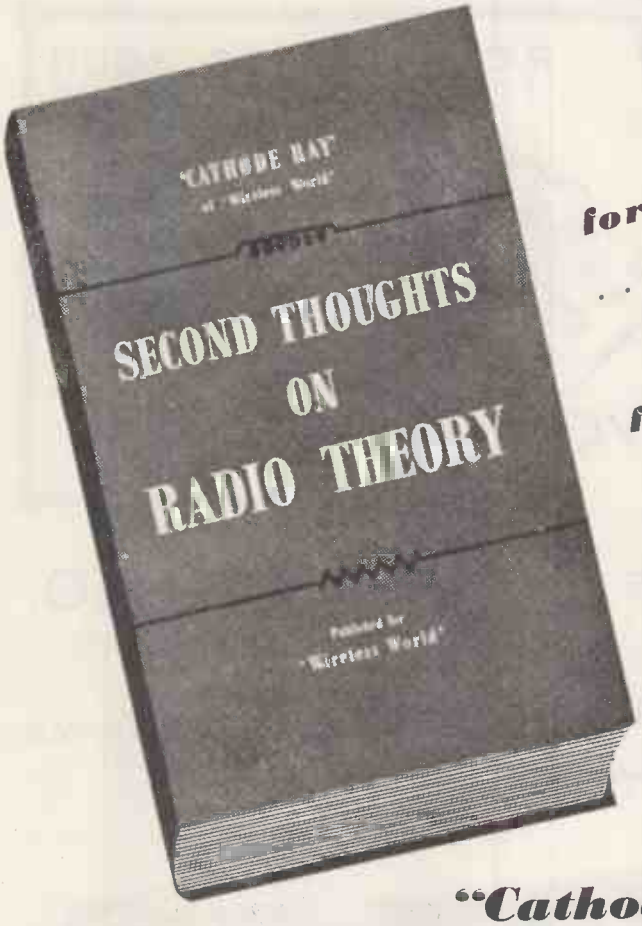

for the student
. . . a helpful textbook

for the engineer
. . . a useful refresher course

for all enthusiasts
. . . an invaluable source of reference

"Cathode Ray" explains . . .

CONTENTS INCLUDE:

Basic Ideas
Harmonics
Modulation
Resonance Curves
The Coupling Capacitor
The Cathode Follower
Negative Feedback and Hum
Attenuators
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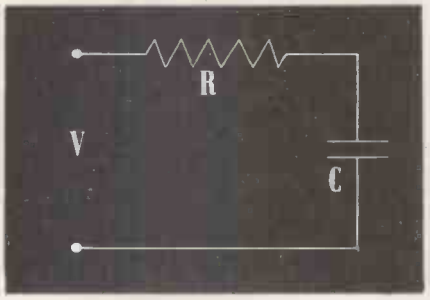

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- **High insulation resistance**
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A quality component which may be economically used in commercial equipment

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LONDON

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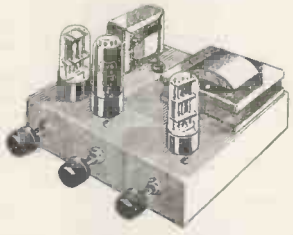
PREMIER RADIO COMPANY

4-WATT AMPLIFIER



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Valve line-up 6SL7, 6V6 and 6X5, FOR A.C. MAINS 200/250 VOLTS. Output Transformer suitable for either 3 ohm or 15 ohm Speakers. Negative feed-back is applied from the secondary of the output Transformer over the whole Amplifier to the input stage giving an excellent frequency response. Due to the high gain and wide range tone controls any type of pick-up may be used. Overall size 9×7×5in. Price of Amplifier complete, tested and ready for use, £5/5/-, plus 3/6 pkg. and carr. Steel case finished black crackle with engraved panel. 21/- extra.

INSTRUCTION BOOK, 1/- (Post Free) which includes Assembly and wiring diagram, also a detailed Stock List of priced components.

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Electrostatic H.F. Speaker type LSH75 Gain of 20 db over the range of 7-18 kcs., inherent capacity 800 pf., maximum polarising voltage 300 D.C., operative A.C. voltage 60, suitable for outputs of up to 5 watts, size 2½in. x 2½in. x ¼in., price 12/6. Type LS100, details as above, inherent capacity 1100 pf., suitable for outputs of up to 20 watts, size 5in. x 3in. x ¼in., price 21/-.

Will add sparkle to the top response of any equipment.

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,, N3/160	12 kV.	1 mA.	21/6
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12 v. 1 amp.	8/-
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A RANGE OF BAND 3 AND F.M. AERIALS IS NOW AVAILABLE

Teletron Ferrite Rod Aerials. Medium Wave 8/9. Medium/Long Wave 12/9.

Illustrated list available giving full details of Bureau type Cabinets.

ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium with four sides:

7×5½×2in. ..	4/-	10×9×3in.	7/-
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10×8×2½in. ..	5/6	16×10×3in. ..	8/3
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14×9×2½in. ..	7/6		

ALUMINIUM PANELS 18 s.w.g.

7×6in.	1/3	7×4in.	1/-
9½×6in.	1/8	9½×4in.	1/5
10×9in.	2/2	10×7in.	1/11
12×9in.	2/8	12×7in.	2/5
14×9in.	3/2	14×7in.	2/11
16×9in.	3/8	16×7in.	3/5
20×9in.	4/8	20×7in.	4/5
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Model PC/1
Brown Rexine covered 15/11
Overall dimensions 15in. × 13½in. × 5in.
Clearance under lid when closed 2½in.

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Grey Lizard Rexine covered 45/-
Overall dimensions 15in. × 13in. × 6in.
Clearance under lid when closed 3in.

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Overall dimensions 16½in. × 14½in. × 10½in.
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All the above Cabinets are supplied with Panel. Carrying Handle and Clips.

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V.H.F. Tuning Unit type UT340 permeability tuned, coverage 86-103 mcs. stage gain Aerial to output of 1st I.F. (contained in Unit) approximately 350. Maximum frequency drift 0-70 degrees centigrade 30 kcs. Radiation less than 26 microvolts per metre price 59/5, (including tax). Valve UCC85.

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Ratio Filter type URF377 Q1-75, Q2-105, price 10/6

Overall bandwidth of the above Units 200 kcs.

Complete Handbook containing full details of construction and point-to-point wiring diagrams including also details of F.M. Aerials 2/6 post free.

★QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 26/-. Plus 1/6 Pkg. and Carr.

★ SPECIAL OFFER ★
LIMITED PERIOD

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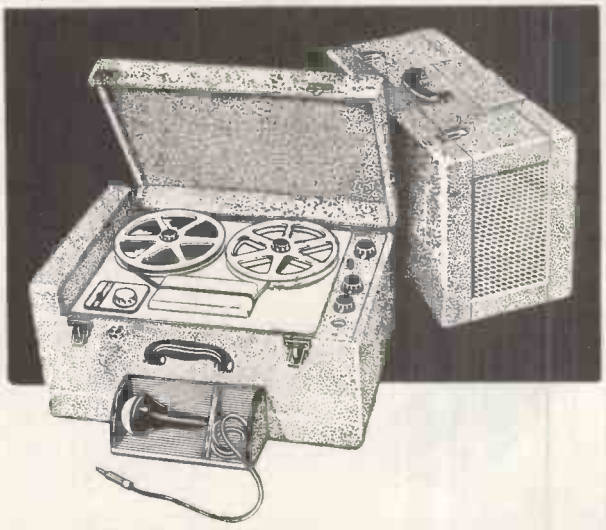
TAPE RECORDER

USING THE NEW LANE 2-SPEED TAPE UNIT MARK 6

COMPLETE £36 CASH

Packing & Carriage 1 gn.
(Including Reel of Scotch Boy Tape and Microphone)

H.P. Terms: Deposit £10/8/- and 12 monthly payments of £2/16/-.



SPECIFICATION

- ★ TWO SPEEDS 7½in. AND 3¾in. PER SECOND.
- ★ THREE SPECIALLY DESIGNED RECORDING MOTORS.
- ★ 1,200FT. TAPE REELS PROVIDING PLAYING TIMES OF 1 HR. AND 2 HRS.
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- ★ 7-VALVE HIGH QUALITY AMPLIFIER.
- ★ INDEPENDENT TREBLE AND BASS CONTROLS.
- ★ MAGIC EYE RECORD LEVEL INDICATOR.
- ★ AMPLIFIER MAY BE USED FOR RECORD REPRODUCTION OF HIGH QUALITY.
- ★ COMPARTMENT FOR HOUSING MICROPHONE.
- ★ SPECIALLY DESIGNED MICROPHONE BY A LEADING MANUFACTURER.

SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW:—

Amplifier (built, wired and tested with Speaker). £14/15/-, plus postage and carriage 7/6.

Hire Purchase Terms, Deposit £3/15/- and 11 monthly payments of £1/2/-.

New Lane 2-speed Tape Unit Mark 6. £18/10/- plus packing and carriage 7/6.

Hire Purchase terms, Deposit £4/11/9 and 12 monthly payments of £1/5/6.

Portable Cabinet (rexine covered). £4/19/6, plus postage and carriage 5/-.

Microphone, £2/15/-, plus postage and carriage 1/-.

Reel Scotch Boy Tape MC2-111 (1,200ft.), £1/15/-, plus packing and carriage 1/-.

Instruction Booklet. 2/6. Post free.

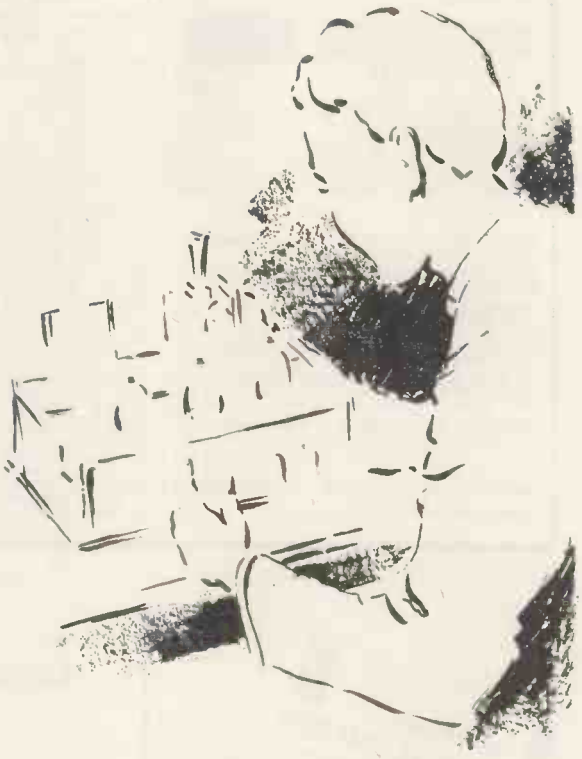
The answer to set designers' headache

Who ever heard of a set designer with no headaches ? We haven't. But we do know of many with considerably fewer headaches since they discovered the Monarch Automatic Record Changer.

Many manufacturers have, in fact, found the Monarch to be so completely reliable they have eliminated their own tests !

Any designer with more than his fair share of headaches would do well to examine the Monarch carefully. His critical appraisal will reveal a changer with many virtues, no vices—and no headaches.

The Monarch is now fitted as standard equipment by the majority of the world's leading set makers.



special features

- ★ Exclusive 'Magidisk' automatically selects 7 in., 10 in. and 12 in. records, intermixed.
- ★ Plays up to 10 records at 33⅓, 45 or 78 r.p.m.
- ★ High compliance crystal cartridge fitted with dual sapphire styli.
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- ★ Independently tested Monarchs have completed equivalent of over 90 years' faultless performance.

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Wireless World

RADIO, ELECTRONICS, TELEVISION

Managing Editor:
HUGH S. POCOCK, M.I.E.E.

Editor:
H. F. SMITH

SEPTEMBER 1955

In This Issue

VOLUME 61 NO. 9
PRICE: TWO SHILLINGS

FORTY-FIFTH YEAR OF PUBLICATION

PUBLISHED MONTHLY (4th Tuesday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (60 lines). *Telegrams:* "Ethaworld, Sedist, London." *Annual Subscription:* Home and Overseas, £1 7s. 0d. U.S.A. $4.50. Canada $4.00. BRANCH OFFICES: *Birmingham:* King Edward House, New Street, 2. *Coventry:* 8-10, Corporation Street. *Glasgow:* 26B, Renfield Street, C.2. *Manchester:* 260, Deansgate, 3.

VALVES, TUBES & CIRCUITS

33. MW53-80: A 90° TELEVISION PICTURE TUBE

REASONS FOR 90° SCANNING

The screen size of direct-viewing picture tubes has grown rapidly since the television service was re-started after the war. The 9-inch circular tube of 1946 has been supplanted by progressively larger tubes, the latest of which has a rectangular face with a 21-inch diagonal. If these larger tubes had been merely expanded versions of the 9-inch tube, the problem of cabinet depth, which was present even in 1946, would have been very much aggravated. Tube lengths, however, have been kept within reasonable limits by the introduction of greater scanning angles. If, for a given screen size, the scanning angle of the electron beam is increased, it follows that the gun and the deflection coils will be moved in towards the screen, and the overall length of the tube will be reduced. The effectiveness of this solution to the problem is shown by the fact that a 21-inch tube with the same scanning angle as a 9-inch tube would be half as long again as it actually is. The new Mullard 21-inch, 90° tube type MW53-80, which is shown in the photograph, is, in fact, about three inches shorter than a 70° tube of the same screen size.

CIRCUIT AND TUBE PROBLEMS

Wide angle scanning eases cabinet design, but it brings problems of its own. The most serious is the disproportionate increase in the deflection coil power requirements. If the scanning angle is changed from 70° to 90°, the power which must be supplied by the line timebase output transformer is increased by 50 per cent. A second complication is that the beam at maximum deflection is liable to be intercepted by the envelope of the tube, producing corner cutting of the picture. Thirdly, in tubes with approximately flat faces, the deflected beam strikes the screen at increasingly acute angles, and the spot may be markedly defocused at the edges of the screen.

These difficulties have been countered by improving the efficiency of the scanning system and its associated circuits, so that the increase in power drain is not out of proportion to the gain in useful picture size. A practical line scanning circuit, in which the efficiency is improved by the use of the full h.t. line potential in conjunction with tuning of the leakage inductance of the output transformer, will be described in a further advertisement in this series.

Deflection defocusing and corner cutting are overcome by careful tube and deflection unit design. In particular, the scanning coils and the front of the yoke are shaped to fit the cone of the picture tube—giving optimum sensitivity.

A NEW PICTURE TUBE

The Mullard MW53-80 is an indirectly heated direct-viewing tube with a 90° deflection angle and a rectangular screen with a 21-inch diagonal. The metal-backed grey glass screen, with white fluorescence, has a useful area of 378mm by 482mm. The tube incorporates an ion trap, and the electron gun is designed to give uniform focus over the whole screen. Magnetic focusing and double magnetic deflection are used. The capacitance formed by the external conductive coating and the final anode may be used to provide smoothing for the e.h.t. supply. The 6.3V, 300mA heater is suitable for parallel or series connection. The overall length of the tube is 507 ± 10mm.

Operating data for the MW53-80 will be included in the reprint of this advertisement.

Reprints of all the advertisements in the "Valves, Tubes, and Circuits" series, with additional notes, are available without charge from the address given below.

Mullard

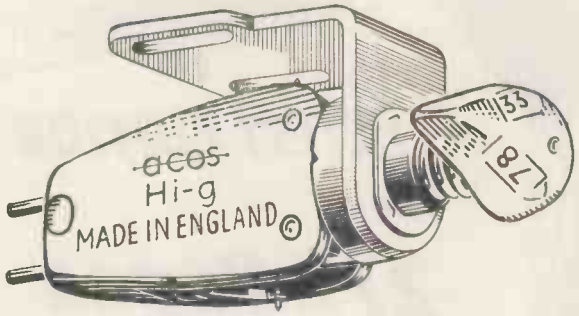
MULLARD LTD · TECHNICAL SERVICE DEPT., CENTURY HOUSE . SHAFTESBURY AVENUE · LONDON W.C.2

MVM 333

NEW- QUITE EXCEPTIONAL IN DEFINITION AND QUALITY OF REPRODUCTION

The ACOS HGP 59 Series

High Definition **Turnover Pick-up Cartridges**



This new ACOS "High Definition" Series represents a most important advance in "turnover" pick-up cartridge design. There are two versions — the *HGP 59-1* with a normal output which will give superb wide-range reproduction in the highest grade radiogram, and the *HGP 59-3* which will load a single valve amplifier in a portable player. Both have all the features listed on the left.

Salient Features

Extremely smooth response with no peaks to colour or mar reproduction.

*

New type stylus mounting reduces all Pick-up distortion to an absolute minimum.

*

Extremely light stylus pressure.

*

Very compliant stylus—superb transient response, low record and sapphire wear.

*

Sapphire styli replaced very simply without any tools whatsoever.

*

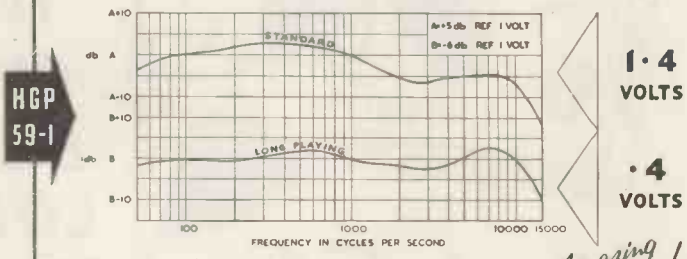
Positive turnover mechanism with a neutral position.

*

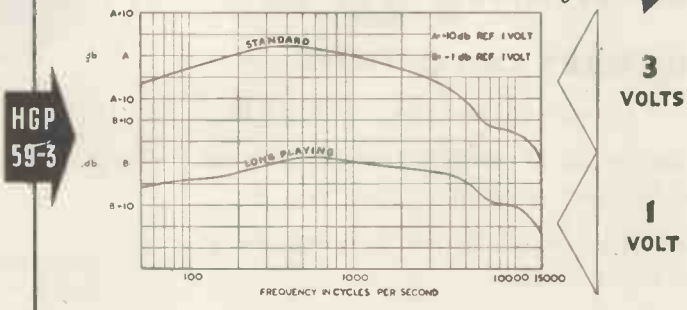
Precision sapphires made by the finest precious stone lapidiaries. Individually inspected under 500x magnification.

*

Each unit very carefully checked for sensitivity and response and finally subjected to a critical listening test before being despatched from the factory.



Amazing Outputs!



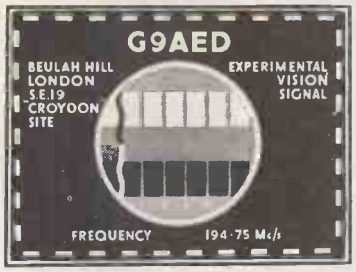
THE RADIO SHOW
EARLS COURT
STAND No. 201

... always well ahead

"BELLING-LEE" NOTES

G9AED
CROYDON

Within a week of publication of this issue of the "Wireless World," the "Belling-Lee" band III experimental transmitter at Croydon will have closed down. We would like to thank all those readers who have assisted us by sending in reception reports. We have also been very pleased to receive letters of appreciation from so many dealers and others in the Trade. So far as we are concerned, we are grateful to those members of our staff who have carried out the duties of station operators. Up to the time of writing the station has kept to schedule with only a one minute breakdown from the starting date of April 1st. The only other times the station has been "off the air" during scheduled hours has been due to co-operation with I.T.A. engineers testing on dummy load etc. G9AED Croydon now closing down.



NOW CLOSING DOWN!

●

SEAMED v. EXTRUDED TUBES for TELEVISION and V.H.F. AERIAL ELEMENTS

Some people are rather inclined to look upon the use of all forms of seamed tube as a means to achieve cheapness, but it is significant that one prominent maker of television aerials is changing over from extruded to seamed tube as quickly as possible, and perusal of the findings of the research project into this question removes all doubt as to reasons why.

In the manufacture of extruded tube, the alloy in a "semi-plastic" condition is forced through a die, and the resulting grain structure is short. Any flaw in the element may result in fracture, and such a flaw may appear anywhere along its length.

In the manufacture of a close seamed rolled tube, a strip is cut along the grain from a sheet of the correct alloy; this strip is rolled to form a tube. The grain is along the length of the tube which is work hardened during the process.

The tables showing tensile tests show the seamed tubes to be superior under all headings; tons per sq. inch, 0.1% proof stress, ultimate tensile stress, elongation and Young's modulus.

Deflection tests also favour the seamed tube.

The table showing Fatigue tests show the most astonishing figures. Here the elements in their normal housings were subjected to vibration tests. Both types of element being tested horizontally and vertically until fatigue cracks appeared. The advantage of the seamed tube over the extruded tube is in the region of 4 : 1.

Authorities are satisfied that in general it is not high wind that causes aerial elements to snap, but fatigue.

These tests were carried out on elements manufactured from standard alloy specifications commonly used in good practice.

Drawn tube B.S.1471 HT.10WP.
and
Seamed tube B.S.1470 HS.10.

It is important to note that manganese is generally omitted from billets used for extrusion, as it slows down the rate, but the presence of this metal in significant quantities in the sheet from which the seamed tubes are rolled, has the effect of retarding corrosion.

There is insufficient capacity in the country to supply the requirements of the one manufacturer using this method of construction.

Finally, no claims are made for the use of seamed tube under conditions of tortional stress, as in crossarms, booms or masts. This would definitely be a wrong application.

From careful consideration of the facts it would appear that there is quite a lot in favour of rolled seamed elements correctly manufactured.

Belling & Lee Ltd.,
Great Cambridge Road,
Enfield.
Middlesex.

NDB/EFW
15.7.55.

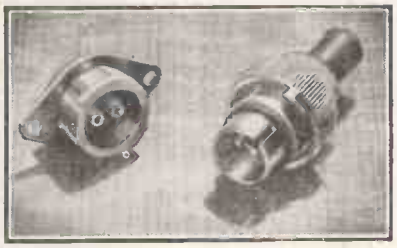
A NEW HIGH-GAIN 3-ELEMENT

This further addition to the "Belling-Lee" band III range was designed specifically as an inexpensive high gain aerial to cover channel 9 only. Available with various mounting arrangements and listed under **L923**.

A range of lightweight plugs & sockets

"SCREENECTOR"

for instrumentation, etc.



These non-reversible, screened connectors accommodate cables up to 0.24 in. overall diameter and are available for 1 to 3 ways. Points to note:—A spring-loaded locking ring is now incorporated giving vibration-proof locking; resilient skirt maintains screen contact even if locking ring is left undone; contacts assembled on moisture resistant, nylon-filled, phenolic moulded insulant; rubber cable support to minimise wear at clamping point; housing designed so that the moulded inserts can be interposed, i.e. fixed or free plug, etc.; flange permits use on panels of any thickness.

New type plugs (L.788, L.789 or L.790 range) will mate with old type sockets (L.722, L.625 or L.715 range) locking as formerly, and old type plugs will mate with new type sockets but will not lock in as the ring is not spring-loaded. Apart from this both ranges are interchangeable mechanically and electrically.

Contact Resistance:—less than 2 milliohms per pole.

Working Voltage: 150 v. d.c. or a.c. peak.

Insulation Resistance:—60,000 megohms at 500 v. d.c. between contacts and from contacts to housing.

BELLING & LEE LTD
GREAT CAMBRIDGE ROAD, ENFIELD, MIDDX., ENGLAND

NEW! THE PRACTICAL WAY of learning RADIO • TELEVISION • ELECTRONICS

COMPLETE EXPERIMENTAL COURSE in RADIO ENGINEERING and SERVICING

An entirely new series of courses designed to teach Radio, Television and Electronics more quickly and thoroughly than any other method. Specially prepared sets of radio parts are supplied and with these we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio receivers, etc.

Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business — these Practical Courses are ideal and may be yours at very moderate cost.

With these outfits, which you receive upon enrolment and which remain your property, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to designing, testing and servicing of complete Radio and Television Receivers.

NEW TELEVISION COURSE including a complete set of equipment dealing with the design, construction and servicing of a high quality television receiver.

Courses (with equipment) also available in *many other engineering subjects*.

COURSES FROM 15/- PER MONTH

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An educational organisation serving the E.M.I. Group of Companies which include "HIS MASTER'S VOICE," MARCONIPHONE, COLUMBIA, ETC.

To E.M.I. INSTITUTES,
Dept. 127X, Grove Park Road, London, W.4.

Please send me your FREE book on Practical Courses.

Subject(s) of interest.....

NAME .....

ADDRESS.....

.....

SEPTEMBER/55 IC.68A

Why Ediswan Clix P.T.F.E. Valveholders are widely used in B.B.C. Television equipment

Large quantities of Ediswan Clix P.T.F.E. Valveholders are used in B.B.C. Television equipment. Only the combination of the finest insulation—P.T.F.E., the most efficient contact material—Berylium copper—and Ediswan Clix design and manufacture can match the requirements of efficiency and reliability in this and all other stringent valveholder applications.

Ediswan Clix P.T.F.E. Valveholders are fully type approved for Services Grade 1, Class 1 conditions. Full details of these valveholders and other components in the Ediswan range are given in catalogue CR. 1681. Manufacturers and Development Groups may have a copy on request.

EDISWAN

CLIX

RADIO, TELEVISION & ELECTRONIC COMPONENTS

THE EDISON SWAN ELECTRIC COMPANY LIMITED, *Member of the A.E.I. Group of Companies*

155 Charing Cross Road, London, W.C.2 and Branches. *Telephone: Gerrard 8660. Telegrams: Ediswan, Westcent, London*

CR3

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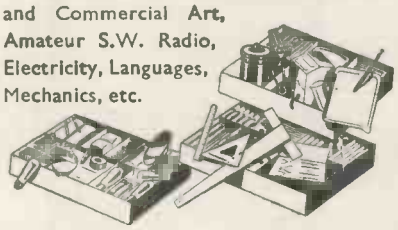
- ★ We offer training in all subjects which provide lucrative jobs or interesting hobbies.
- ★ The student is taken carefully and thoroughly through his chosen subject.
- ★ A tutor is personally allotted by name to ensure private and individual tuition.
- ★ Free advice covering all aspects of training is given to students before and after enrolment with us.

NEW

LEARN THE PRACTICAL WAY — COURSES WITH EQUIPMENT

With many courses we supply actual equipment thus combining theory and practice in the correct educational sequence. The equipment, specially prepared and designed, remains your property. Courses include: Radio, Television, Electronics, Draughtsmanship, Carpentry, Photography and Commercial Art, Amateur S.W. Radio, Electricity, Languages, Mechanics, etc.



Equipment supplied upon enrolment and remains your property.

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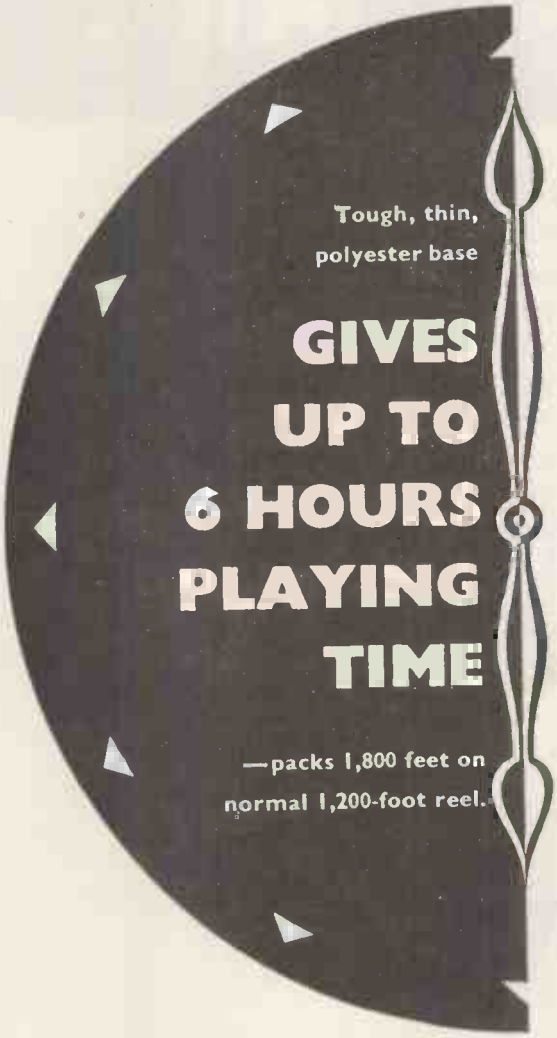
(We shall not worry you with personal visits) SEPTEMBER IC38a

new world-beating 'SCOTCH BOY' extra-play magnetic recording tape 190m

Regd. Trade Mark



THE FINEST BASE-FILM EVER MADE

The astonishing new polyester base-film for 'Scotch Boy 190M,' is so much stronger than other tape bases that it can be made 33⅓% thinner—*and still be stronger.* This means you get 50% more length—and 50% EXTRA PLAYING TIME—on the same-sized reel.

Polyester film is a naturally limp and flexible material, and is little affected by temperature and humidity changes. 'Scotch Boy 190M' tape conforms snugly to recorder heads, is easy to handle, winds trimly, and tracks smoothly. It has an indefinite life in storage, and is an ideal tape for archive purposes.

NEW THIN COATING

The new and potent oxide coating of 'Scotch Boy 190M' tape gives clear, crisp reproduction of every frequency in the audible range. High-frequency response shows a specially notable improvement. Output variations from reel to reel and within each reel are remarkably small and, as with all Scotch Boy tapes, background noise is negligible.

THE WORLD'S FINEST TAPE

'Scotch Boy 190M' has been developed and produced in Britain by the 3M Company. Its appearance in Britain is its first appearance in the world. This is a landmark in the development of tape recording.

'SCOTCH BOY' 190m

MAGNETIC RECORDING TAPE

with polyester base

ANOTHER 3M COMPANY PRODUCT

MINNESOTA MINING & MANUFACTURING CO. LTD.
LONDON, BIRMINGHAM, MANCHESTER AND GLASGOW.

a new STABILISED POWER SUPPLY UNIT FOR PHOTO-MULTIPLIERS

Ediswan now have available a new stabilised power supply unit which has been specially designed to feed Photo-Multipliers. It is particularly suitable as a supply unit for Ediswan Mazda Photo-Multipliers type 27.M1, 27.M2 and 27.M3.

BRIEF SPECIFICATION TYPE R1184

INPUT	OUTPUT	STABILITY	OUTPUT RESISTANCE	RIPPLE
200–250 v., 40–100 c.p.s.	High stability low ripple D.C. supply variable between 300 and 1,100 volts. Max. current 2 mA. Pos. or neg. may be earthed.	A 10% change in mains input voltage results in a change of less than 0.1% between 1,100 volts and 600 volts output.	Approximately 1,500 ohms.	Less than 0.01% R.M.S.

MOUNTING The Unit is suitable for standard rack mounting or for bench use. Bench Stands are available.

PRICE — £48

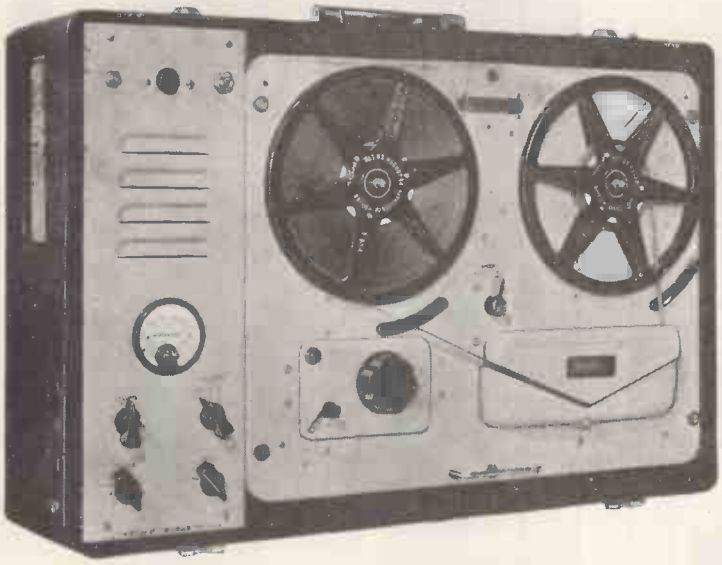
Further information is available on request

EDISWAN

RADIO DIVISION · THE EDISON SWAN ELECTRIC COMPANY LIMITED
155 Charing Cross Road, London, W.C.2. *Telephone:* Gerrard 8660. *Telegrams:* Ediswan, Westcent, London
Member of the A.E.I. Group of Companies

SP115

VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8¼in. x 22½in. x 15¾in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The total hum and noise at 7½ inches per second 50-12,000 c.p.s. unweighted is better than 50 dbs.

★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.

★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.
★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

POWER SUPPLY UNIT

to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE £18 0 0.**

We supply and recommend the Jason F.M. Feeder Unit. **PRICE £15 17 0,** including Purchase Tax.

3-WAY MIXER AND PEAK PROGRAMME METER

FOR RECORDING AND LARGE SOUND INSTALLATIONS, ETC.

One milliwatt output on 600 ohm line (.775V) for an input of 30 micro-volts on 7.5-30 ohm balanced input.

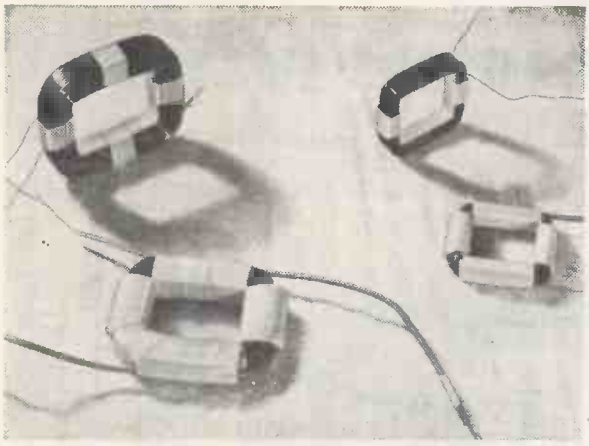
Output balanced or unbalanced by internal switch. The meter reading is obtained by a valve voltmeter with 1 second time constant, which reads programme level, and responds to transient peaks.

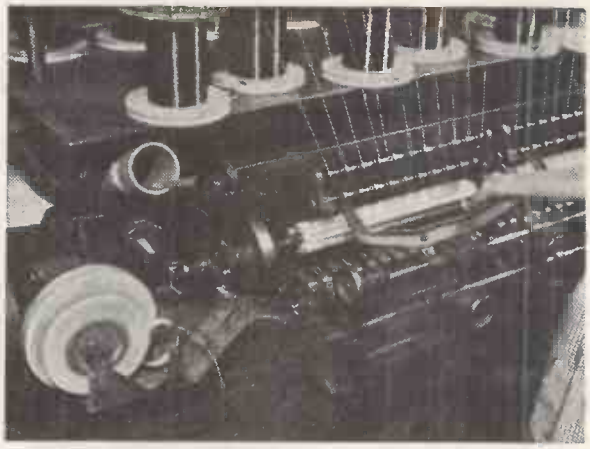
Calibration in 2 db steps, to plus 12 db and minus 20 db referred to zero level. Special low field internal power pack supplies 8 valves including stabilising and selenium rectifier, consumption 23 watts.

Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London."





'SCOTCH BOY'

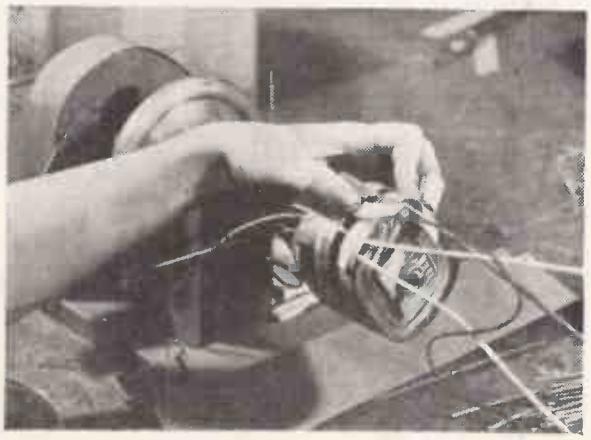
Electrical Tapes

NOW with Thermosetting Adhesive

In the field of component assembly, 'Scotch Boy' electrical tapes have long been unrivalled for strength, ease of application, and excellent dielectric properties.

Now a new range of 'Scotch Boy' electrical tapes, with thermosetting adhesive, has been introduced. These remarkable new paper, glass cloth, and acetate cloth tapes have the same ability to stick at a touch, but the adhesive cures firm when components are subjected to the normal drying cycles.

The cured adhesive has greatly increased solvent resistance, and soft spots are eliminated. The new tapes are, therefore, ideal for use with solventless varnishes and casting resins.



HERE ARE TYPICAL APPLICATIONS:

CENTRE RIGHT	*No. 27 Glass Cloth Tape holds the leads and insulates the lead wire splice of a lighting transformer*
TOP RIGHT	*No. 38 Paper Tape is used to anchor, start, and finish wires*
TOP LEFT	*No. 38 Paper Tape binds and insulates motor field coils*
BOTTOM RIGHT	*No. 28 Acetate Cloth Tape anchors leads in secondary windings, and No. 38 Paper Tape holds fibre lead pads of a transformer*

FOR SPEED AND ECONOMY IN COIL ASSEMBLY

'SCOTCH BOY'

(Regd. Trade Mark)

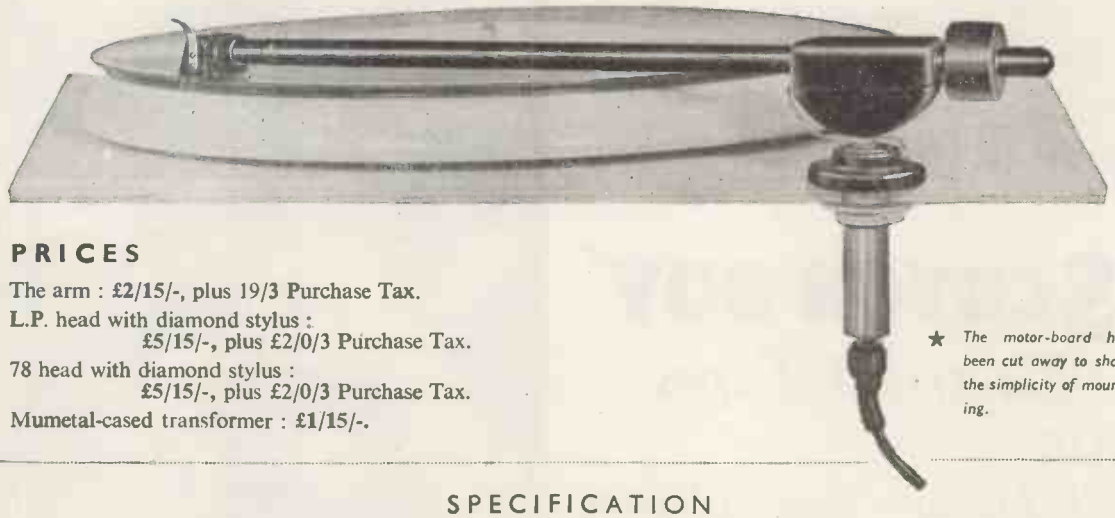
Electrical Tapes

ANOTHER 3M COMPANY PRODUCT

MINNESOTA MINING AND MANUFACTURING COMPANY LIMITED · LONDON · BIRMINGHAM · MANCHESTER · GLASGOW

THE LEAK DYNAMIC PICKUP

This new pickup results from five years continuous development of our first moving coil design. Reports from users during the first few months of its sales have justified our earlier belief that the pickup might earn recognition as the best in the world.



★ *The motor-board has been cut away to show the simplicity of mounting.*

PRICES

The arm : £2/15/-, plus 19/3 Purchase Tax.

L.P. head with diamond stylus :
£5/15/-, plus £2/0/3 Purchase Tax.

78 head with diamond stylus :
£5/15/-, plus £2/0/3 Purchase Tax.

Mumetal-cased transformer : £1/15/-.

SPECIFICATION

★ THE ARM

This is of advanced design having very low inertia. Friction is kept to a minimum by using a single pivot bearing. The arm is counter-weighted and has provision for plug-in interchangeable heads. An arm-rest is provided.

★ GENERATING SYSTEM

Dynamic (moving-coil). Coil impedance approximately 6 ohms, 1,000 c/s. No magnetic material is embodied in the moving parts, and the pickup is free from the inherent distortion of moving iron (magnetic variable reluctance) types. These distortions are also inherent in those dynamic pickups in which the moving coil is wound on a magnetic core.

★ STYLUS

Material : Diamond, guaranteed unconditionally not to chip or break.
Stylus sizes : L.P. 0.001 in. radius + nothing —0.0001 in.
78, 0.0025 in. radius ± 0.0001 in.

★ PLAYING WEIGHTS

Between 2 and 3 grammes for L.P.
Between 5 and 6 grammes for 78.
Automatically adjusted by the weight of the head.

★ RECORD AND STYLUS WEAR

These are lower than on any pickup of which we have cognisance. Diamond has a playing life of approx. 100 times longer than sapphire, and because it will take a higher polish than any other material it therefore causes less record wear.

★ OUTPUT

The shielded step-up transformer delivers an output of 8 mV for each cm/sec. r.m.s. recorded velocity. This means that an amplifier with a sensitivity of 40 mV at 1,000 c/s will be easily loaded by the pickup from commercial records.

★ FREQUENCY RESPONSE

Total variation ± 1 db 20,000 c/s to 40 c/s with the LP head, including transformer (recorded velocity 1.2 cms/sec. r.m.s. above turnover).
Low frequency resonance :
20 c/s ± 5 c/s with our very lightweight arm.
High frequency resonance :
0.001 in. radius on Vynil, 21,000 c/s ± 2,000 c/s.
0.0025 in. radius on shellac, above 27,000 c/s.
The frequency response does not change with temperature.

★ SIGNAL-TO-HUM-RATIO

It is not possible to specify this important ratio without stipulating the strength of the interfering fields. These fields will, of course, vary according to the installation. However, for the purpose of comparison measurements have been taken under working conditions, i.e. with various pickups mounted normally within inches of the electric turntable motor and within two feet of a power transformer in an amplifier. The results show that the Leak Dynamic Pickup has a lower hum content than any variable reluctance (moving-iron, magnetic) pickup and a very much lower hum content than a single turn moving coil (i.e. "ribbon") pickup. This confirms what would be expected from theoretical considerations.

★ DIMENSIONS

From the centre of the fixing stem to the front of the pickup head, 9¼ in. From the centre of the fixing stem to the rear of the arm, 2 in. The height of the pickup is adjustable and it can be used with any turntable.

★ MOUNTING

A template of original Leak design is supplied, enabling the pickup to be accurately located on the turntable mounting board. There is a single fixing hole and the stem contains a miniature socket which accepts the plug leading to the transformer (see illustration).

★ TRANSFORMER

The transformer has a step-up ratio of 1.80 and is heavily shielded in mu-metal. The primary lead is terminated in a plug and a shielded secondary lead is supplied.

★ *Write for illustrated leaflet 'W'.*

ELECTROSTATIC LOUDSPEAKERS

Reprints of "The Gramophone" article (May, 1955), by H. J. Leak, summarising his work and findings on Electrostatic and Dynamic Loudspeakers, are available on request, free of charge

Sole distributors for H. J. LEAK & CO. LTD.

AUDIO TRANSDUCERS LTD., PICCADILLY HOUSE, 33-37 REGENT STREET, LONDON, S.W.1

Telephone: REGent 5659 *Telegrams: HIFI, PHONE, LONDON* *Cables: HIFI. LONDON*

The first 21 years . . .

On Monday, September 14th, 1934, Mr. H. J. Leak left his employment as a sound-film engineer and founded our company. The beginning was modest. The aim of the founder was to earn a living in the way which appeared to hold the best promise of a happy life; by making sound-reproducing equipment better, if possible, than anyone else. To-day, twenty-one years later, the objective is exactly the same and is approached with the same enthusiasm, but the circumstances have vastly altered. The company is known throughout the world, and owns a fine post-war factory and office buildings, designed for the most efficient production of audio products, with ample spare land for periodic expansion. The company's steady growth has been achieved without any surrender of independence, for the final direction and control, both engineering and commercial, remains with the founder, who is assisted and advised by an efficient and enthusiastic nucleus of executives each having fourteen or more years of service.

During the first eleven years of the company's life the main products were audio amplifiers of many types, the company remaining somewhat anonymous because these amplifiers, though they were of Leak design, were supplied to large organisations for sale under their own names, or to government departments. Wider recognition came in 1945 when, as the result of war-time research in our laboratories, we were able to offer audio amplifiers with a distortion content as low as 0.1%. A survey of engineering literature will confirm that we were the first manufacturers in the world to design and market amplifiers with such a small distortion content, and the magnitude of this advance can be gauged when it is remembered that the then accepted standard for laboratory amplifiers was 2% distortion. Our figure of 0.1% was received with incredulity, but it was subsequently confirmed by the National Physical Laboratory, and this criterion is still an accepted world-wide standard.

With this clear lead on low-distortion amplifiers we were able to build up an export market much greater than the domestic one, and the increased volume of manufacture resulted in lower prices which, in turn, brought real high-fidelity amplifiers within the reach of the music lover at home. We also further popularized high-fidelity by lecturing throughout the country and giving demonstrations of comparisons between live and recorded voices and music.

During all these years we have carried out constant research and development on transducers, and our first moving-coil pickup (1948) was widely greeted as a distinct advance over the available magnetic and crystal types. This pickup is still in use all over the world in many recording studios for dubbing and play-back work. Our latest "Dynamic" pickup is a development of the earlier model and has found a ready market throughout the world among those who demand the highest quality of record reproduction.

Until very recently all our work on loudspeakers had not enabled us to offer products markedly superior and cheaper than those obtainable elsewhere, and we therefore refrained from entering this market. However, final designs are in the process of tooling, and within the next few months we shall market loudspeaker transducers giving very obvious improvements in listening quality. These loudspeaker motors will initially comprise a 15" moving-coil bass reproducer employing novel constructions and materials, resulting in an enhanced steady state and transient performance as compared with conventional loudspeakers. There will also be a balanced-push-pull electrostatic loudspeaker having astonishingly low harmonic and transient distortions. In combination these motors give an advance in listening quality comparable with the advance made by the advent of the Rice-Kellogg moving-coil loudspeaker in 1925, and with the advance made by our introduction of low-distortion amplifiers ten years ago.

Within a month or so details of the Leak "Trough-Line" FM tuner will be announced. Most of the conventional bases of present-day FM tuners have been abandoned for solutions resting on firmer engineering grounds, and many features of the tuner may well become standard practices of the future, just as happened with the original "Point One" amplifier.

Our grateful thanks are due to very many people. To our suppliers for giving us the high-quality materials and finishes on which we insist; to our agents and dealers overseas and at home for their service to our customers and ourselves; and to our customers for their support and recommendation—the basis on which the company has grown. Finally, a special word of thanks to fellow engineers for the knowledge which they spread by the written and spoken word.

It has been an exciting and happy twenty-one years. The founder, who is in his forties, is the oldest executive, so we are still a *young* company in outlook, with the enthusiasm of youth tempered by the experience of survival and achievement. We therefore look forward exuberantly to the future and we hope that you will share with us the pleasures resulting from the undoubted advances yet to come in the art and science of sound reproduction.

H. J. LEAK & COMPANY LIMITED

T.V. E.H.T. GENERATOR

Gives 6 to 9 k.v. output—draws its power supplies (6.3 volt .8 amp. 250 volts 59 mA.) from the set. 69/6 plus 2/6 post.

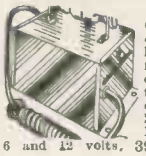
1in. MICROMETER

Exceptional purchase enables us to offer a 1in. precision micrometer at the very low price of 10/-. A micrometer is an essential part of an engineer's equipment. You will have found the need for one on many occasions in the past for measuring wire gauge, etc. Price 10/-, post free. Note.—We now have a waiting list for this: orders in rotation.

INSTANT HEAT CONVECTOR

The heater with the lowest possible thermal capacity, 4ft. long: made from heavy gauge sheet steel (galvanised), 1 kW., suitable A.C. or D.C. Price only 50/- or with thermostat, £3/15/-. Note.—The thermostat mounts separately and will control up to three heaters.

CLEVELAND CAR BATTERY CHARGER



Gives 1½ amp. charge—uses everlasting metal rectifier and robust double wound mains transformer in metal carrying case with leads and croc. clips. Price, 6 volt, 29/6; 6 and 12 volts, 39/6, post 2/6.

TRANSFORMER PRIMARIES

These are transformers with wound primaries tapped 200, 220 and 240 but with no secondaries. There is ample window space, however, for the hand winding of secondary to suit your own requirements. Size required depends upon amps. taken out and the voltage: e.g. if 10 amps. at 10 volts is required then a 100-watt primary is needed. 50 amps. at 5 volts requires 250 watt, etc., etc. Transformers are complete with clamps and feet.

Watts	Price	Post & Pkg.
80	7/6	1/6
100	10/-	2/-
120	12/6	2/6
250	12/6	2/6
500	25/-	4/6
1,000	40/-	6/6
2,000	60/-	8/6

CHANCE OF A LIFETIME

Corner Console. A massive cabinet but being corner fitted is not out of place even in a modern small living-room. Overall dimensions of this cabinet are 47in. wide x 31in. (deep to corner) x 50in. high. Made to house "15" Televisor. Radio Unit, Amplifier, Tape Deck, etc. Originally £18—our price £10, plus 30/- carriage.

ADDITA—BAND III CONVERTOR

Our convertor has given very satisfactory results from the experimental Beulah Hill station, and we have had many satisfying reports regarding its performance.

It is a very neat-looking unit and fits to the side or the back of the televisor. It is designed to convert any T.V. superhet or T.R.F. and no internal modifications of any kind are required. Simply plug in the aerials, connect to the mains, and you have Band I or Band III at the flick of a switch. Standard models are set for London working but the unit is completely tunable for any combination of stations.

Build it Yourself

You can save at least £2 on the above if you build the convertor yourself. Price of all components including stove enamelled case and even transfers for the front, is £3/10/-, plus 2/6 post, or £4/10/- if mains components also required. Data is included free with the parts or available separately price 2/6.

BAND 3 AERIAL KIT

An interesting aerial, "The Folded V," was described in the July number of a T.V. magazine. We tried this and found it to be most efficient, both for interference reducing and increasing reception strength. It is simple to make. We, therefore, offer this aerial as a constructor's kit. The kit comprises alloy elements and connectors, neat plastic centre piece with polythene insulators and saddle for mounting on existing mast or in loft, window frame, drain pipe, etc., etc. 8/6. Construction data free with parts or available separately, price 1/-.

W.W. (May 1954 Band III Kit)

One of the most successful circuits for Band III conversion was published in the "Wireless World," May 1954. The results we have received in our Eastbourne laboratory have been more than satisfactory and we consequently offer a complete kit of parts including the specified EF80 valves, wound coils, drilled chassis In fact, everything including a copy of the circuit diagram. Price only 42/6, post 2/6 extra. Mains components if required 25/- extra.

AERIALS

3 element array with swan neck mast with "U" bolt clamp for fitting to existing masts from ¾in. to 2in dia.	41/6
3 element array with cranked mast and wall mounting bracket	42/6
3-element array with cranked mast and chimney lashing equipment	65/-
5-element array with swan-neck mast and "U" bolt clamp for fitting existing mast from ¾in. to 2in. dia.	52/6
5-element array with cranked mast and wall mounting bracket	53/6
5-element array with cranked mast and chimney lashing equipment	67/-
8-element array with swan neck mast and "U" bolt clamp for fitting to ¾in. to 2in. dia. mast	69/-
8-element array with cranked mast and chimney lashing equipment	83/6
8-element array with 1¼in. mast cap, 10ft. mast and heavy duty single chimney lashing equipment	134/-
10-element array with cranked mast and chimney equipment	94/6
10-element array with 1¼in. mast cap, 10ft. mast and heavy duty single chimney lashing equipment	145/-
10-element array with 2in. mast cap, 12ft. mast and heavy duty double chimney lashing equipment	178/6

BAND III Aerials—These aerials have quick fitting alloy elements and polythene low-loss insulators.

BAND III DOWN-LEAD. 8¾d. per yard, or super low loss 1/4 per yard.

Ready Built for Band III—59/6

We have a very limited quantity of a ready built convertors intended for Band I to Band III conversion at aerial frequency. This is a two-valve circuit and it's frequency can be set anywhere within the 186–196 mc/s Band. It will convert to any frequency between 40–48 mc/s. Input arranged for standard coaxial feeders. It uses two valves, EF80 as R.F. input and ECC81 double triode as local oscillator and mixer. It draws its power supplies from the receiver (requires approx. 200 volts at 25 m.a. and 6.3 at .6 a.). Efficient input filter and very simple to adjust. Pre-aligned so no instruments required for aligning. Size approximately 4¼ × 2½ × 2. 59/6 post and packing 2/6.

WHAT IS IT?

It is the indicator that you would make to check that the "Elpreq Band III Signal Generator" is working properly. When the loop is brought up to the output circuit the lamp lights brightly.

THE "ELPREQ" Band III SIGNAL GENERATOR is most useful. It:—

1. Will provide the signal for tuning to any Band III station.
2. Can be used as a grid-dip meter for checking the frequency of Band III T.V. aerials, Coils, etc.
3. Can be made to give a pattern on T.V. Receiver screen.
4. Can be accurately calibrated with included equipment.

All the parts including valves, tuning condenser and metal chassis are available as a Kit at 25/- post free. Construction data free with Kit or available separately price 2/6.

DEMONSTRATIONS OF BAND III EQUIPMENT AT ALL BRANCHES

CABINETS FOR ALL

We confidently believe we carry the best stock of cabinets in London. The one illustrated is the Bureau, a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board is revealed when the front is dropped. Both radio board and motor board are left uncut to suit your own equipment. Price is 16 guineas, carriage 12/6. We have many other types in stock. Pay us a visit or send for Cabinet List.

THE CLEVELAND ORGANTONE

Five valve 3 waveband superhet covering Long, Medium and Short waves—built to attain highest performance of sensitivity, fidelity and output—Osram miniature valves—low loss iron coils—permeability tuned I.F.S.—full A.V.C.—variable negative feedback—gram, position on wave change switch—4 watts output—particularly fine tone especially on gram. Chassis size:7 × 7 × 7 approx. scale size 4½ × 4½ approx. Tested in difficult areas where exceptional results have been obtained. Price £11/10/-, or £3/16/- deposit, Carr., etc., 7/6.

THE CLEVELAND "TREMENDO"

The Cleveland Organtone was good, but this one is really superb. It has a 7-valve circuit with 6-watt output, fitted with independent bass and treble controls. It is really an efficient R.F. circuit coupled to a high fidelity amplifier. The chassis size is the same as the Organtone, namely 12 × 7 × 7 with the 10½ × 4½ multi-coloured scale, and it is built to the same exacting specification as the Organtone. Price £15/10/-, carriage and packing 7/6. Terms £2/5/- deposit.

AUTO-CHANGER BARGAIN

3-SPEED BY MOST FAMOUS MAKER

Plays all records 7in., 10in. and 12in.
Records may be mixed. 7in., 10in. and 12in.
Uses famous Acos, Hi-G turnover Sapphire c'dge.
Brand new, in maker's carton Free 12 months' guarantee Normal price £16/10/-. Huge purchase enables us to offer these at £9/17/6 or £4 deposit and seven monthly payments of £1 each. Non-callers please add 7/6 for carriage and insurance.

CHASSIS ASSEMBLY

Three-colour 3-waveband scale covering standard, Long, Medium, and Short wavebands, scale pan, chassis, punched for standard 5-valve superhet, pulley driving head, springs, etc., to suit. Scale size 14½ × 3½in. Chassis size 15 × 5in. × 2 deep. Price 15/- plus 1/6 post. Note.—This is the one that fits our 37/6 table cabinet.

Old customers please note our post order and inquiry department is now being run from Eastbourne and we can promise a much better service than of late.

MULLARD AMPLIFIER "510"
A High Quality Amplifier designed by Mullard engineers. Robust high fidelity with a power output exceeding 10 watts and a harmonic distortion less than .4% at 10 watts. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 C.P.S.—three controls are provided and the whole unit is very suitable for use with the Collaro Studio and most other good pick-ups. The price of the unit completely made up and ready to work is £12/10/- plus 10/- carriage and insurance. Alternatively, if you wish to make up the unit yourself we shall be glad to supply the components separately. Send for the Mullard amplifier shopping list.

OCTAGONAL SPEAKER CABINET
Conforming exactly to the designer's specification—for G.E.C. metal cone speaker: also suitable any good 8in. speaker. Price £12/10/- or 37/6 deposit, carriage and insurance 7/6 extra. G.E.C. metal cone (extra octave) speaker £8/15/-.

SPEAKERS
The latest W.B. cambric cone speaker units all in die-cast frames with universal impedance speech coils 3 ohm., 7.5 ohms., and 15 ohms.

Model H.F. 812 8in.	£3 5 6
Model H.F. 912 9in.	£3 9 6
Model H.F. 1012 10in.	£3 17 6

Also in die-cast frames but with 3 ohm. or 15 ohms. speech coils.

Model H.F. 510 5in.	£1 19 6
Model H.F. 610 6in.	£2 12 6
Model H.P. 1214 12in.	£9 15 6

We also carry a range of G.E.C. Wharfedale and Goodmans Hi-Fi speakers.

PICKUPS
ACOS HI-G HEADS for use with Garrard or Collaro plug-in units in brown or ivory, 42/- each.
THE B.J. ARM, new type to give correct tracking over the whole recording. Extra lightweight, suitable for Decca, Garrard and Chancery heads. £2/19/6.
ACOS GP20 HI-G with the new HI-G plug-in heads, all designed to obtain the nearest to perfect reproduction—pressure only 8 grammes. Complete with either head. £3/7/6. Extra head £2/2/-.
THE NEW LEAK TL-10 AMPLIFIER WITH "POINT-ONE" PRE-AMP. In the amplifier world the name Leak probably stands highest. It is symbolic of precision sound engineering. The TL-10 has an output of 10 watts and with its pre-amplifier will operate from any good pick-up. A continuously variable input attentuator in the pre-amp. permits the use of crystal, moving iron or moving coil pick-up. Provision is made for tape recording and play-back as an exclusive feature. Easy accessible jacks being provided on the front panel for speedy hook-up. The complete amplifier with pre-amp. £28/7/-. Or TL-10 amplifier only 17 gns. Or "Point-One" amp., only 10 gns.

THE CLEVELAND F.M. TUNER

This tuner is based upon the very successful circuit in the booklet published by Data Publications, sometimes incorrectly known as "Jason" circuit. We have made up models at all branches and will be glad to demonstrate.

Four valves and two crystals are used. Two crystals are used in the ratio detector to avoid heater-cathode hum so often encountered with valve ratio detectors. Stability is extremely good and tuning most simple. The tuner draws its power supply from the set or amplifier, its valve heaters are not connected to earth With only a simple indoor aerial made by parting the ends of ordinary flexible cable this tuner works very well at Eastbourne (over 60 miles from London) and we await reports from even greater distances. Cost of all parts including valves, prepared metal chassis, wound coils and stove enamelled scale, slow motion drive, pointer, tuning knob, in fact everything needed to make the complete unit, is £6/12/6. Data is included free with the parts or is available separately price 2/-. Extra parts for fringe area model 20/-.

THIS MONTH'S SNIP

THREE-SPEED GRAM MOTOR
200–240 A.C. mains-operated, complete with turntable—plays 33, 45 and 78 r.p.m. records. Post and insurance 3/6.

59/6

COMMUNICATIONS RECEIVER R1155

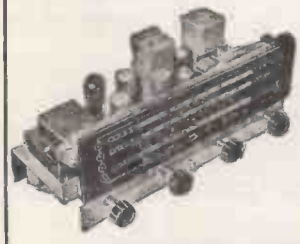
This set, as most will know, is considered to be one of the finest communications receivers available today. The frequency range is 75 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case. Made for the R.A.F., so obviously a robust receiver which will give years of service Slightly used but completely overhauled and guaranteed in perfect working order. PRICES; Grade 2 £7/19/6. Grade 1 £9/19/6. Or will be sent against deposit of 30/-. If you cannot call to collect please include an additional 15/- to cover cost of transit and case carriage. This partly returnable to you if and when you return the transit case.

MAINS POWER PACK FOR R1155
With Pentode output stage. Plugs into socket on receiver so no internal modifications are required. Price £5/10/- complete with speaker ready to work, carriage 3/6. Or in cabinet £6/15/-. Carriage 5/-.

ENTIRELY NEW CIRCUIT

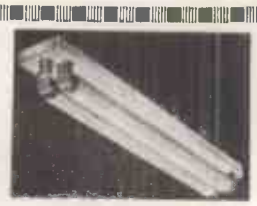
Redesigned and developed and built by the Cleveland Company—very good reports received.

THE "WINDSOR 5"



This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15 x 6 x 6in. Price £9/19/6 complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms if required.

TABLE RADIO CABINET
Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15½ x 14 x 6½in. Walnut veneered and satin finished, 37/6, carriage and packing 3/6. Note—This cabinet is the correct one for the Windsor chassis above with 6½in. speaker.



THE TWIN 20
This is a complete fluorescent lighting fitting. It has built-in ballast and starter, —stove enamelled white and ready to work. It is an ideal unit for the kitchen over the work-bench, and in similar locations. It uses two 20-watt lamps. Price, complete less tubes, 29/6, or with two tubes, 39/6. Post and insurance 2/6. Extra 20-watt tubes 7/6 each.

Complete kit comprises 40-watt control unit, starter lamp, lamp holders, clips and wiring diagrams. Price, less tubes, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 carr.

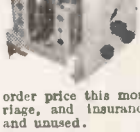
AMAZING MINI-RADIO
Uses high-efficiency coils—covers long and medium wavebands and fits into the neat white or brown bakelite cabinet —limited quantity only. All the parts, including cabinet, valves, in fact, everything, £3/19/6, plus 2/- post. Constructional data free with the parts, or available separately 1/6.

A.C./D.C. MULTI-METER KIT
The Multi-Meter illustrated measures A.C./D.C. volts and D.C. m/amps. and ohms. It has a sensitivity of 200 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector calibrated scale, stick-on range indicator and full instructions for making are available as a kit, price 19/6 plus 9d. post and packing.

VALVE HOLDER PLUGS

Each is fitted with a rubber shroud. For B7G button base and type 2 for B9A Price 2/- each discounts for quantities.

BEETHOVEN CHASSIS



Chassis size approx. 9½ x 7½ x 8½. First class components. A.C. mains operation. Three-wave (medium and two shorts). Complete with five valves, ready to work. Special cash-with-order price this month. £5/19/6, carriage, and insurance 7/6. Brand new and unused.

ELECTRONIC PRECISION EQUIPMENT LTD.

249 Kilburn High Road, Kilburn
Phone: MAI 4921
Half-day Thursday

42–46 Windmill Hill, Ruislip, Middlesex
Phone: RUISLIP 5780
Half-day Wednesday

152–153 Fleet St., E.C.4
Phone: FLEET 2833
Half-day Saturday

29 Stroud Green Road, Finsbury Park, N.4
Phone: ARCHWAY 1049
Half-day Thursday

Post orders should be marked "Dept. 2" and addressed to E.P.E. LTD., 123, TERMINUS ROAD, EASTBOURNE.
All enquiries to Eastbourne address and please enclose S.A.E., terms are cash with order.

MAINLY FOR THE INDUSTRIAL USER

POTTED MAINS TRANSFORMERS

These are of really superior construction fitted in cast metal cases and compound filled. Terminals come to ebonite baseboard. All are upright mounting and have 220/230 normal 50 cycle mains input and fully screened primary.

Type 5F1. 265-0-265 at 300 mA.: 6.3 v. at 7 amp.; 4.4 v. at 2.5 amp.; Price 35/- plus 3/6 carriage.

Type 5F2. 365-0-365 at 150 mA.; 4 v. at 2.5 a.; 6.9 v. at 4.2 a. Price 32/6, carriage and packing 3/6.

Type 5F3. 1540 v. 2 v. at 2 a.; 4 v. at 1 a.; This is an ideal transformer for televisors and scopes using V.C.R. 97, etc. Price 25/-, carriage 2/6.

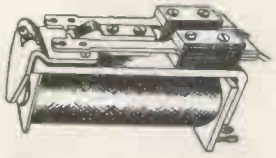
POTTED CHOKES

These chokes are in similar type cases and therefore match the above transformers.

Type 5F4. 5 H. at 300 mA. Price 10/-, carriage and packing 2/6.

Type 5F5. 10 H. at 150 mA. Price 12/6. Post and packing 2/6.

RELAYS P.O. 3000 TYPE



Ref. 5A1. 2,000 ohm, slow close coil plat. contacts, one break, two make. Price 12/6 each.

Ref. 5A2. 2,000 ohm. standard coil, plat. contacts, change over make before break, two make, 1 break. Price 15/-.

Ref. 5A3. 200 ohms. standard coil plat. contacts, two make. Price 7/6 each.

Ref. 5A4. 10 ohm. standard coil, one pair plat. contacts, also mounted but not operated by the relay, are thermal change-over contacts, make before break. Price 8/6 each.

WELD TYPE WIRE JOINTER

This jointer melts the wires and causes the metal of each to run together, thus making a strong and permanent weld. It obviously is not intended to replace the soldering iron but nevertheless is ideal for making joints that have, for instance, to withstand heat, vibration, chemical action, etc.

In many cases also this method is faster than soldering and there can be a considerable saving of current. Price 9/6. Or complete with enclosed mains transformer, 29/6.

AUTO TRANSFORMERS

For working American equipment off our mains etc., etc., Input tapped 200-240 v. Output 115 v. In addition to those listed below we have special this month 150/200 watt totally enclosed in metal box with input and output leads. Price 47/6, plus 2/- post and packing.

Totally enclosed and screened.

	Price	Carr.
50 watt	£1/2/6	1/6
100 watt	£1/16/-	1/6
150 watt	£3	2/-
250 watt	£4/10/-	2/6
500 watt	£5/10/-	2/6
Unscreened		
1 KVA (1,000 w.)	£6/10/-	5/-
1.5 KVA (1,500 w.)	£7/17/6	5/-
2 KVA (2,000 w.)	£10/17/6	7/6
3 KVA (3,000 w.)	£12/7/6	10/-
5 KVA (5,000 w.)	£19/5/-	12/6

VARIABLE RESISTORS

Heavy Duty Type.

Ohms	Amps.	Price
*.5	30—40	35/-
*1	20—25	35/-
1.2	10—15	15/-
3	7—10	15/-
11	3—5	22/-
*50	2½—4	45/-
*100	2—3	45/-

*These are screw adjust types

UNITS FOR CONTROLLED AUTOMATIC ROTATION

We have brand new, still in original unopened packing cases as shipped from America two items of equipment which form part of the radar system RC84. These two units work together to form a Tower rotating device, with remote control.

Item 1, known as Tower 24A, is in fact the geared driving motor which rotates the mast. This is quite a heavy construction and would rotate a heavy scanner, reflector, Beam array, etc., etc.

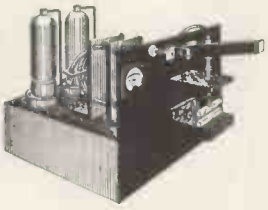
Item 2, known as Indicator 1-221-A is the remote controller which enables the azimuth position of Tower 24A to be controlled from a remote point. Conversely, it enables the azimuth position of the tower to be known at any time. Both the Tower and the Indicator contain selsyn transmitter/receivers and it is these that provide the impulses which cause the aerial to rotate backwards or forwards. The equipment intended for 117 volt A.C. mains but will operate from our mains if connected through step down transformer of 1 K.W. rating.

Prices 1-221-A £25 plus carriage. TR24A £35 plus carriage.

Special discount of £5 for cash with order or C.O.D. if both units purchased together.

R.F. HEATERS CONSTRUCTOR'S KIT

THE ELPREQ R.F. HEATER



The Elpreq R.F. Heater has been planned to fill the need in industry for a reasonably priced unit to be used in the works or for development.

The heater is supplied in kit form, mainly to keep the cost low but also as it is thought that many users will wish to assemble the units within special casings to be close to the production line.

As it is not possible to have one frequency which is equally efficient for both dielectric and inductive heating a frequency efficient for dielectric work has been chosen. It being felt that this fills the greater need

THE POWER PACK

The Power Pack used is the " Elpreq Variable 500 " which is fully described in another section, this gives ten variations of power to a maximum of 500 mA. at 1,000 V.—continuous rating.

THE R.F. UNIT

Two carbon anode, high power triodes working into a push-pull circuit act as R.F. generators. The R.F. output to the " work " is taken from the tank coil.

Two meters are provided. The one in the main H.T. line shows the total milliamps being drawn by the R.F. unit. The other in the R.F. output stage indicates the R.F. current into that circuit.

The output frequency is approximately 15 megacycles but this will vary with the work and can be deliberately changed by tuning or by altering the size of the tank coil.

Connection to the work is through two substantial pillar terminals brought out to the front panel.

Size is approximately 16½in. × 13in. × 14in. and weight is approximately 25 lb.

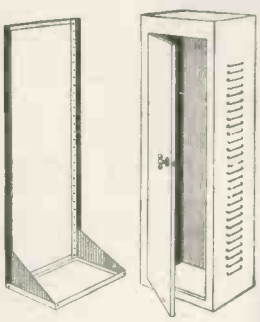
Price of all components including metal chassis to make power pack and R.F. units is £40

Or wired up ready to work £55.

All prices are ex our Eastbourne works and terms are cash with order

RACKS AND RACKING EQUIPMENT

ALL EX-MINISTRY EQUIPMENT



STANDARD RACK

6ft. high and 19in. wide, heavy steel construction. Holes drilled and tapped at the standardized spacings. Price £4/15/- plus carriage.

ENCLOSED RACK

As above but rectangular and with sheet metal enclosed sides (vented), fitted handle and closing bars. Price £7/15/- or £6/15/- depending on condition, plus carriage.

MOUNTING PLATES

to fit above racks. Heavy ¼in. steel plates (drilled at standard intervals and 19in. centres) with chassis mounting brackets.

Ref. 5A5—19 × 14 front plate with chassis brackets, 17/6.

Ref. 5A6—19 × 12 front plate with chassis brackets, 16/6.

Ref. 5A7—19 × 10½ front plate with chassis brackets but drilled for meters and other items, 8/6.

SAFETY SWITCH

When fitted this switch will cut off the mains as rack door is opened. 5/6.

CHARGING SWITCHBOARD

Feed this Switchboard through a Mains Transformer and Rectifier giving 24 volt D.C. up to 50 amps, and you have an excellent multi-circuit charger for simultaneously charging several batteries at different currents. This is an ex-Government switchboard rated at 550 watts 18 volts fitted into steel cases with doors. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are brand new, in original cases Price £4/10/-, carriage 10/-.

We can supply a 12 volt, 50 amp. Mains Transformer at £4/5/- plus 5/- carriage.

HIGH POWER TRANSFORMERS

For R.F. Heaters, transmitters, etc., etc. These are open wound type for maximum cooling and have the normal 200-250 primary fully screened.

Type 5F6. 1,000 v. at ½ amp., e.g., 5 K.V.A. Price £8/10/-, carriage and packing 5/-.

Type 5F7A. 2,200 v. at 1 amp., e.g., 2 K.V.A. Price £15, carriage and packing 7/6.

Type 5M1. 1000-1000 v. at 1.5 amps., e.g., 1½ K.V.A. Price £12/10/-, carriage and packing 7/6.

Type 5M2. 1000-0-1000 v. at 500 mA. and 4 v. at 4 a. Price £7/10/-, carriage and packing 4/6.

Type 5M3. 375-0-375 v. at 250 mA. and 4 v. at 4 a. Price 37/6, carriage and packing 3/6.

Type 5J1. 500-0-500 v. at 500 mA., 6.3 v at 6 a., 45/-, carriage and packing 3/6

POWER FILAMENT TRANSFORMERS

Type 5M4. 4 v. at 4 a. 2-0-2 v. at 10 a Price 18/6, carriage and packing 3/6

Type 5M5. 3.15-0-3.15 at 10 a., 4-0-4 at 10 a. 4-0-4 at 2 a. 4 at 4 a. 2.5-0-2.5 at 3 a. Price 27/6, plus carriage and packing 3/6.

Type 5M6. 34 v. at 2 a. tapped 32 v., 30 v. and 28 v., for relays, etc., 22/6, plus 3/6 carriage and packing.

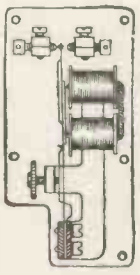
Type 5J2. This has four 4 v. 10 amp. centre tapped secondaries 35/-. Plus 3/6 packing and post.

POWER CHOKES. Open wound type and feet with clamps.

Type 5M7 30 Henry at 500 mA., 35/-
Type 5M8 20 Henry at 500 mA., 32/6
Type 5M9 15 Henry at 500 mA., 27/6
Type 5M10 10 Henry at 500 mA., 22/6
Type 5M11 25 Henry at 250 mA., 18/6
Type 5M12 3 Henry at 10 amps., 18/6
Type 5M13 200 Henry at 5 mA., 15/-

PORCELAIN STAND-OFF INSULATORS

threaded each end. Price 1/6



RELAYS

Extra light weight, extra sensitive for high speed or radio control work, weight only 1½ oz., closes on 2 mA., solid platinum change-over contacts, adjustable pressure. Price 12/6.

TELEPHONE JACK PLUGS

As illustrated 7d. each. Sockets to suit, 10d. each.

AUTOMATIC MOTOR STARTER

For remote control of D.C. motor between 1 and 3 kw., adjustment for 100v. or 230v. Unused and in first-class condition, complete with metal and wired glass cover. Price £10. carriage 5/-.

EX-ROYAL NAVY SOUND POWERED TELEPHONE

These require no batteries, and will go for long periods without attention. Complete with generator and sounder which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations can be used instead of the sounder, or where several telephones are used together will indicate which one is being called. Size 7¾in. × 9in. × 7¾in., wall mounting, designed for ships' use but equally suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

BLOCK CONDENSERS

All unused. .5 mfd. at 2,500 v., 3/6; 4 mfd. at 750 v., 3/6; 8 mfd. at 500 v. 5/-. 4 mfd. at 500 v. 2/6; 4 mfd. at 1,500 v. 6/6.

SENSITIVE ALTIMETER

These contain aneroid barometer movement and useful gears. Price 7/6 each. Post 1/-.

Note.—Also a few in good working order, available at 22/6.

SCRAMBLER—TELEPHONE EQUIPMENT

As used by Ministries and Forces for holding secret conversations. Works in conjunction with normal telephone equipment.
Items available, all new and unused, are:—Frequency Changer, Type 6AC, Ref. No. YBO2700, price £5. Standard G.P.O. desk type instrument with scrambler switch, complete with lead and junction box, price £2/10/-. Hand-ringing generator in wooden box, 15/-. Junction box with three multiple relays and cable strips, 35/-. Bank of three drop indicators in box, 15/-. Instruction book £1 refunded if returned within 14 days.

GREATLY REDUCED CATHODE RAY TUBES

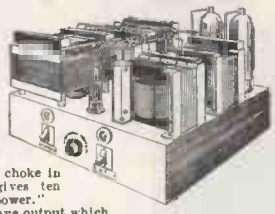
VCR97. Brand new and unused, "cut-off type," ideal for 'scope, etc. Price 12/6. Carriage and insurance 5/- extra.

VCR517. 6¼in. guaranteed full picture, 29/6, plus 5/- carriage and insurance.
VCR139A. 2¼in., 32/6, plus 2/6 carriage, etc.
VCR138. 3½in. electrostatic short persistence, suitable for T.V. and ideal for 'scope work, 37/6 plus 3/6 carriage, etc.
VCR112. 5in. electrostatic, persistence not known, 15/- each, plus 5/- carriage, etc.
CV996. 6in. electrostatic, persistence not known, 15/- each, plus 5/- carriage, etc.
CV1140, CV1500, CV1546. All 12in. magnetic, long persistence, £4/10/-, plus 10/- carriage.

10-CORE CABLE

10 flexible copper conductors well insulated suitable for mains work. Covered Overall with hard rubber, 1/6 per yard.

HEAVY DUTY POWER PACKS



500 WATT 1,000 v. (VARIABLE)
The conventional circuitry is employed throughout and all components are amply proportioned to permit substantial overloading. A master switch controls the whole unit and whenever this is on current is supplied to the rectifier filaments, thus keeping them always in the emissive state. The H.T. transformer is supplied from the primary of the filament transformer, connection being via an on/off switch and a tapped choke. The on/off switch controls the H.T. and the tapped choke in conjunction with its selector switch gives ten variations from "low power" to "high power."
Two directly heated rectifiers give a full wave output which is smoothed by a 10 Henry choke and 4 mfd. condenser. A bleeder resistor connected across the output serves as a dummy load and also discharges the smoothing condenser which otherwise would be a source of danger to users.
The continuous rating of the power pack is 1,000 volts at 500 milliamp (500 watts). But the proportions of the various components are such that 100 per cent. overloading can be allowed for pulse work or other intermittent operations. The size of the power pack is approximately 16½in. × 13in. × 13in. and its weight is approximately 87 lb. Price; Kit of parts £27/10/-, or made up ready £37/10/-.

500 WATT 2,000 v. (VARIABLE)
The maximum continuous rating of this is 250 milliamps at 2,000 volts. Rectification is half wave. Specification otherwise as for the variable 500/1,000 v.

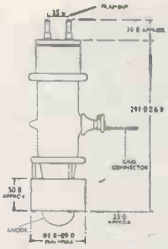
1,000 WATT 2,000 v. (VARIABLE)
The continuous power rating of this is 500 milliamps at 2,000 volts. But the tapped choke and selector switch enables this to be reduced in ten steps. Weight approximately 120 lb., size 16½in. × 13in. × 13in. Price £37/10/- in kit form, or made up ready to use £47/10/-.

1,000 WATT 1,000 v. (VARIABLE)
The maximum continuous rating of this is 1 amp. at 1,000 volts. Rectification is full wave, output is variable. Weight approximately 120 lb., size 16½in. × 13in. × 13in. Price £37/10/- in kit form, or £47/10/- made up ready to work.

FIXED MODELS
Any of the models mentioned above can be supplied without the tapped choke and selector switch. The prices are as follows:—
Fixed 500/1,000 v. £22/10/- in kit form, or £30 made up.
Fixed 250/2,000 v £22/10/- in kit form, or £30 made up
Fixed 500/2,000 v. £32/10/- in kit form, or £40 made up
Fixed 1,000/1,000 v. £32/10/- in kit form, or £40 made up
All prices quoted are ex Works.

CEILING FAN

This model, made by Revo, incorporates a series-wound totally enclosed ball-bearing motor of robust construction and noiseless operation. The fan has a blade diameter of 36in. and is supplied with 20in. suspension tube and ceiling canopy. All finished white cellulose enamel. The voltage working is 230-250 v. D.C. Revo catalogue number D12288
Price £10/10/-



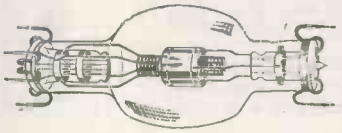
SPECIAL PURPOSE VALVES

Triode Type CV 1098—this is a high-power air-cooled triode. Specification of which is as follows; Filament voltage 8.2 v., filament current 35 amps., anode dissipation 750 watts. Maximum anode voltage 23 kV

This valve is very suitable for R.F. heating at high frequencies and two of these in push-pull under Class C conditions would have an output of approximately 2 kilowatts. Brand new, still in original shockproof packing, price £15 each.

TETRODE TYPE VT31

This is a high-powered air-cooled tetrode. Specification of which is as follows:— Heater volts 11.25, heater current 8 amp., maximum anode voltage 5 kV., anode dissipation 250 watts, size approximately 14½in. long and 6½in. across the bulb.
Limited quantity only at £4 each, still in original packing.



WATCH THESE COLUMNS FOR DETAILS OF VARIOUS OTHER INDUSTRIAL TYPE VALVES. ALTERNATIVELY SEND US YOUR ENQUIRIES.

HIGH CYCLE MOTOR ALTERNATOR

TYPE 1. Has a motor 230 v., 50 cycle single phase 2,800 r.p.m., coupled to a generator output 250 v., 1,728 cycles at .24 amps. Good condition, with wiring diagram, £3/10/-, plus 7/6 carriage.
TYPE 2. Has a motor 230 v. 50 cycle single phase, coupled to an alternator output 250 v. 625 cycles .24 amps. Price £3/10/-, plus 7/6 carriage.

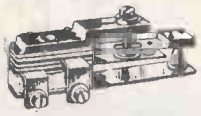
SPECIAL EQUIPMENT SALES

IMPORTANT NOTE

Owing to the bulkiness of many of the items listed on these two pages it may not be possible to keep stocks at branches, therefore please telephone confirmation that the item is actually at the branch before journeying specially to see it.

SPECIAL SALES DEPT., E.P.E. LTD., 123, TERMINUS ROAD, EASTBOURNE. Phone: Eastbourne 5055

NEW 5 AMP. THERMOSTAT (MINIATURE)



2¼" × 1" × 1½" high.
Useful for the control of appliances such as convectors, gluepots vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F., fitted with heavy (5 amp. A.C.) silver contacts size 1½in. long × ¼in. wide, price 8/6. post 6d.: 1 amp. type 3/6. 2 amp type 5/6.

METERS

2½in. Flush mounting	
0-30 mA. moving coil	10 6
0-300 mA. moving coil	10/6
0-500 mA. moving coil	10/6
5-0-5 mA. moving coil	17/6
0-1 amp. moving coil	17/6
2in. Flush mounting	
0-2 amp. R.F. thermo	7/6
0-3 amp. R.F. thermo	7/6
0-5 amp R.F. thermo	7/6
0-5 mA. moving coil	8/6
0-3 mA. moving coil	8 6
0-20 amp. moving coil	10/6
0-40 amp. moving coil	12/6
Hot Wire Amp. Meters	
0-9 amp. 2½in. flush	12 6
0-10 amp. 6in. surface	25/-

PYREX AERIAL INSULATORS

Ideal for aerial connections through cabin walls or through panels. Consists of glass dome with threaded rod and terminal ends and metal fixing flange. Price 2/- each

PLUG AND SOCKET

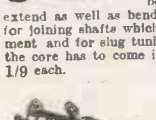
This brass cased plug and socket is extremely robust and ideal for P.A. or outside work. Ideal also for taking power to units as it insulates the ends of the wires. Contacts are quite suitable for carrying up to 10 amps. so this can be used for lighting or power. Price 2/6 per pair

JUMBO VALVE BASE

Ceramic 4-pin for transmitting valves. 805, etc. Price 3/6 each.

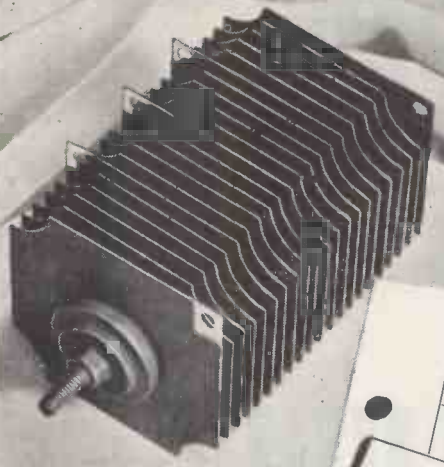
FLEXIBLE COUPLINGS

These are sometimes known as bellows couplings because they will extend as well as bend. They are ideal for joining shafts which are out of alignment and for slug tuning controls where the core has to come in and out. Price 1/9 each.



30 AMP ROTARY SWITCH

Single pole ON/OFF, a very robust switch, made by one of our most famous firms. Will give life-time of service. Price complete with pointer knob, 4/9.



WESTALITE RECTIFIERS TYPE 4

Next Smaller, see D.S. 405 Next Larger, see D.S. 403 Data Sheet 404 1st Edition

VOLTAGE RATINGS Per series element. Maximum peak reverse: 24·3 volts.
Ratings in various circuits with sinusoidal input.

Circuit	Load	Max. O.C. R.M.S. Input	Nominal Mean Output
Half-wave	Condenser	10 volts	10 volts
Voltage-doubler	Condenser	10 volts	20 volts
Phase bridge	Resistive	17·1 volts	12 volts
.. ..	Condenser	15 volts	15·2 volts
.. ..	Battery: AC res. ballast	18·0 volts	12 volts
		17·1 volts	12 volts

Inter Service Type Approval Certificate 479/4 (588/1) covering full approval for 55 °C. Category H.2 has been granted for type T4A rectifiers.

MOUNTING DETAILS
4A, B, C spindles horizontal, but not more than two horizontal layers.
4D may have spindle vertical.

PARALLEL PATHS
Economic limit 1 path of 4B, C, D but 1 or more 4A. Space limitations may limit paths. There

40

WESTALITE RECTIFIERS TYPE 14

Next Smaller, see D.S. 415 Next Larger, see D.S. 413 Data Sheet 414 1st Edition

VOLTAGE RATINGS: Per series element. Maximum peak reverse: 42 volts.
Ratings in various circuits with sinusoidal input.

Circuit	Load	Max. O.C. R.M.S. Input	Nominal Mean Output
Half wave	Condenser	15 volts	15 volts
Voltage doubler	Condenser	15 volts	28 volts
Phase bridge	Resistive	29·5 volts	22·5 volts
.. ..	Condenser	29·5 volts	30 volts
.. ..	Battery: AC res. ballast	36 volts	24 volts
.. ..	Battery: DC res. ballast	29·5 volts	24 volts
.. ..	Battery, choke ballast	36 volts	22 volts
3	Battery, choke ballast	36 volts/line	28 volts
3	Resistive	29·5 volts/line	34 volts
DC Stopper	Resistive	25 volts D.C.	—

Inter Service Type Certificate 479/4 (588/1) covering full approval for 55 °C. Category H.2 has been granted for type T14A rectifiers

MOUNTING DETAILS
14A, B, C spindles horizontal, but not more than two horizontal layers.
14D may have spindle vertical.

PARALLEL PATHS
Economic limit 1 path of 14D, C or B but 1 or 2 parallel paths of 14A. Space limitations may necessitate using more parallel paths. There is no restriction.

CURRENT RATINGS: Per parallel path (milliamperes mean)

Type	Non-preferred type 14D				Non-preferred type 14C				Non-preferred type 14B				Preferred type 14A			
Ambient °C. average	25	35	45	55	25	35	45	55	25	35	45	55	25	35	45	55
maximum	35	45	55	55	35	25	20	10	65	50	35	20	90	65	45	25
Half-wave: Voltage-doubler	25	20	15	—	140	110	70	15	240	200	140	75	300	240	185	100
Single-phase bridge: resistive load	110	85	45	—	65	50	35	20	130	90	65	35	180	120	85	45
Single-phase bridge: battery choke ballast	50	35	25	—	112	88	56	12	190	160	112	60	240	190	150	80
Single-phase bridge: condenser ..	88	68	36	—	200	150	100	20	330	280	210	100	400	330	250	140
Single-phase bridge: battery resistive ballast	160	120	65	—	125	100	80	50	210	175	130	80	276	210	160	100
Three-phase bridge, resistive or battery load	100	80	60	35												
DC Stopper																

DIMENSIONS and WEIGHTS. (Approximate)

	14D	14C	14B	14A
Overall size	¾" (20 mm) Dia.	1¼" (28 mm) Dia.	1¾" (45 mm) Sq.	2¼" (57 mm) Sq.
Maximum number of elements	90	90 (Inc. dummies)	90 (Inc. dummies)	90 (Inc. dummies)
In the following formulae N = Total number of discs used, i.e., elements + dummies.				
Length (ins.) .. .. (mm)	1 / 25·3 + 0·072N	1 / 25·3 + 0·076N	1 / 25·3 + 0·076N	1 / 25·3 + 0·076N
Weight (ozs.)	0·33 + 1·82N	0·94 + 1·93N	0·8 + 1·93N	0·8 + 1·e-
(grms.)	9·2 + 4N	26 + 4·55N	23 + 7·2N	

Cat. No. appears on the positive end, except when both ends are negative. Spindle No. 2BA projecting ¼" (8 mm) each end. Effective area of element = 3·31 sq. cms.

Type 14D

Type 14C

Type 14B

Type 14A

FIG. 1.

TESTS Flash Test Forward 2,000 volts AC R.M.S. to spindle.
Reverse Pass 260 mA DC. Voltage drop not to exceed 1·63 volts.
Apply 25 volts smooth DC per series element for four or more series elements seconds may be double the above.

414

WESTINGHOUSE BRAKE & SIGNAL CO

A page to remember — WOOLLEYS

UNUSED RADIO & COMPONENT BARGAINS

Illustration is with covers removed.

We are offering **AS NEW, COMPLETE TR.1196 TRANSCEIVERS,** as illustrated. Outfit comprises, 6 valve Superhet, 3 Valve Transmitter, Power Unit and Relay Unit. All complete on Chassis. Present range 4-6.5 mc/s. and output 2 watts. Can be easily converted to cover 1.5 mc/s.-7mc/s and power output up to 8 watts. It has a most versatile Receiver which can be easily adapted to cover any band of frequencies from medium broadcast to 30 mc/s. The Transmitter range can also be easily extended and by simply adding 200 pf. condenser to tank circuit will cover 1.5 mc/s. Circuit and conversion details included with each unit.

Each outfit is despatched in transit case at the amazingly low price of **£3/-/-** plus carriage **10/-**. If despatched **without Transit Case, £2/10/-** plus carriage **8/6.**

And why not build up the complete mobile outfit, ideal for ship to shore work and convert to 1.5 mcs. to 4 mcs.

Illustration shows converted equipment already in use and passed by P.M.G.

REMEMBER ! ! 9 Standard Valves, 2 Standard 460 Kc. IF's. 3 relays, a motor generator and a host of useful equipment and for breaking up we have a few with soiled cases but otherwise perfect and complete at **£2** each, plus carriage **8/6.**

BRAND NEW POTS

POTS, 100K, ¼ spindle ..	ea.	1/-
POTS, 1 meg., ¼ spindle ..	ea.	1/-
POTS, 3 gang each, 70K ..	ea.	1/-
HUMDINGER POTS, 100 ohm. Miniature wire wound ..	ea.	2/-
POTS, COLVERN, 200 ohms 5 watts. Wire wound, N.P. case ..	ea.	2/-
100K MINIATURE POTS ..	ea.	1/-

RESISTORS

ERIE Resistors, 47K, 2-watt, boxed in 50's and 5's. Also 150K, 70K, 1-watt. Price: 2 w., **3d.** ea. 1 w., **2d.** ea.

Wire Wound Vitreous 10-watt, wire ends 500 Ω, **9d.** ea.

Voltage Regulators 110/30 ma. 4 pin base. Two in series for 230 volts. **3/-** ea.

SLEEVING

We are able to offer for immediate delivery Sleeving in various grades, such as Permanoid, Micoflex Plastic and Tenaplas Silk covered. Prices are 20% below present trade.

SLEEVING various colours, 1 mm. and 1.5 mm. Permanoid, in coils of approx. 144 yds. **8/6** per coil.

TENAPLAS SLEEVING silk covered in 1 gross reels 1.5 mm. **15/-** per gross yds.

MICOFLEX, Plastic, in 3 gross reels 1.5 mm. **13/-** per gross yds.

PERIBRAID Sleeving 1.5 mm. 1,000 yd. reels **15/-** per gross yds.

SLEEVING in 3 ft. lengths × 18 mm. dia. **6d.** per length.

SLEEVING in 3 ft. lengths × 20 mm. dia. **9d.** per length.

ELECTRO-VOICE MOVING COIL MICROPHONES

No. 600 C. with built in matching transformer for direct connection to grid of amplifier valve. These mlkes are ex the famous BC.610 transmitter and have an excellent overall frequency response, they are all brand new with 9 ft. screen lead and 3 pin plug, packed in original carton. Price **£2** plus **1/6** postage and packing.

MISCELLANEOUS NEW ITEMS

Ferranti mc. meters boxed 0-5 m/a. flush square 2". **9/-** ea.

Valve Holders UX5 Amphenol. **5/-** doz.

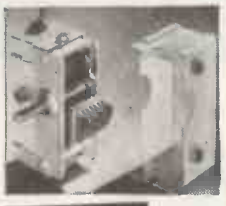
Valve Holders B9G Paxolin. **4/-** doz.

Valve Holders Jumbo Giant UX boxed. **2/6** ea.

Zenith 50 w. Bleeders 500 Ω. **2/-** ea.

All above items postage extra.

Foreign orders, please verify correct amount from U.K. to destination.



50 PF. VARIABLE CONDENSERS in screening Case, 3½in. × 1½in. × 2½in. Spacing 040.

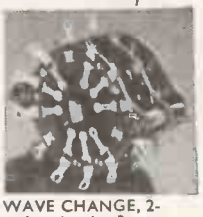
Only EA. **1/-**

CERAMIC VARIABLE CONDENSERS, split stator, plated vanes, spaced .035 ball bearings butterfly 15/15 P.F. extended spindle

EA. **2/6**

VARIABLE CONDENSERS, 100 pF. ceramic insulation.

EA. **2/-**



WAVE CHANGE, 2-wafer 6-pole 3-way Switches. EA. **1/3**

Yaxley type 1-pole, 6-way switches complete, less screws but with knobs.

EA. **6d.**

CERAMIC TRIMMERS, air spaced silver-plated vanes, 22 pF. Packed in 10s and singles, screwdriver adjustment.

DOZ. **5/-**

WOOLLEYS RADIO & ELECTRICAL SUPPLIES LTD.

615 BORDESLEY GREEN, BIRMINGHAM, 9 **Phone : VIC 2078**

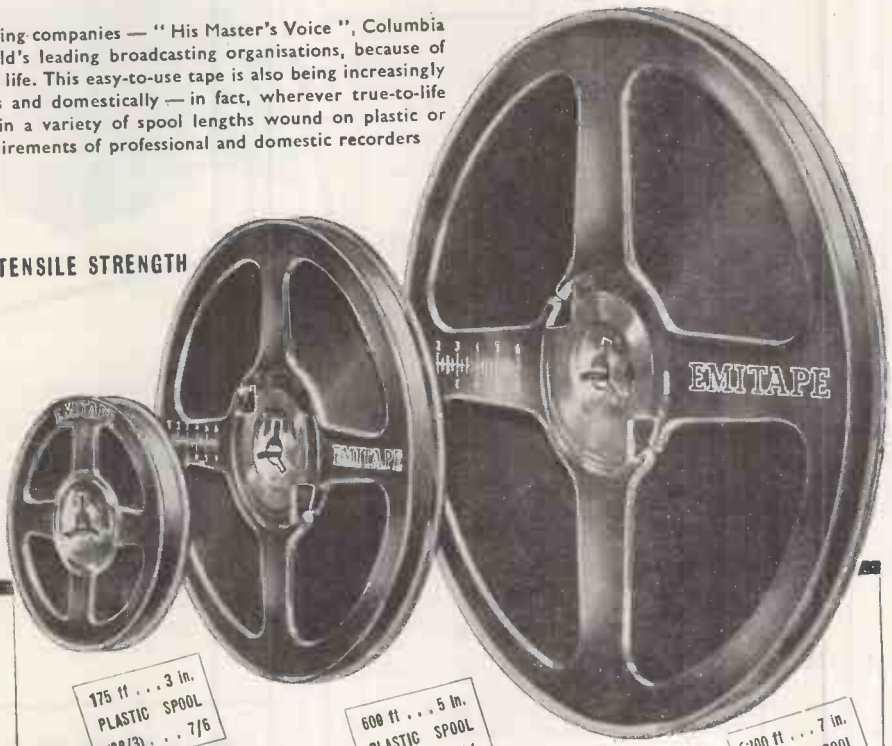
EMITAPE "88"

in ever-increasing demand

Emitape is used by the great recording companies — "His Master's Voice", Columbia and Parlophone — and by the world's leading broadcasting organisations, because of its fidelity, sensitivity and length of life. This easy-to-use tape is also being increasingly employed in laboratories, factories and domestically — in fact, wherever true-to-life recording is required. It is made in a variety of spool lengths wound on plastic or aluminium spools to meet the requirements of professional and domestic recorders with differing hubs.

Special Features

- HIGH SENSITIVITY • HIGH TENSILE STRENGTH
- P.V.C. BASE • ANTI-STATIC
- FREEDOM FROM CURL
- EDITING LEADER AND TRAILER STRIPS



175 ft . . . 3 in. PLASTIC SPOOL (88/3) . . . 7/6

600 ft . . . 5 in. PLASTIC SPOOL (88/6) . . . 21/-

1200 ft . . . 7 in. PLASTIC SPOOL (88/12) . . 35/-

TAPE ACCESSORIES

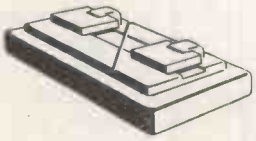
7" EMPTY PLASTIC SPOOL IN CARTON AP.87 5/6

5" EMPTY PLASTIC SPOOL IN CARTON AP.85 4/6

3" EMPTY PLASTIC SPOOL IN CARTON AP.93 3/-

Non-Magnetic Scissors AP.39 Price 16/-

Magnetic Tape Jointing Block AP.46 Price 8/-



P.V.C. Tape Jointing Compound AP.77 Price 4/6

Gummed Jointing Tape AP.37 Price 6/6

White P.V.C. Editing Tape 150 ft. Roll AP.38 Price 4/6

VISIT STAND 215 AT THE RADIO SHOW, EARLS COURT

Used by the leading Broadcasting Organisations and for recording the world's greatest artists on
'HIS MASTER'S VOICE,' COLUMBIA AND PARLOPHONE RECORDS

Full particulars of Emitape and editing accessories together with literature are obtainable at your local dealer or from:—
E. M. I. SALES & SERVICE LTD. RECORDING EQUIPMENT DIVISION, HAYES, MIDDLESEX. Telephone: SOUTHALL 2468

Export Enquiries for products mentioned in this advertisement should be addressed to :
E.M.I. INTERNATIONAL LTD. (also at Hayes).

BS.85

SPECIAL EDITION

Osmor News

OSMOR RADIO PRODUCTS
Limited (Dept. W69)
418 BRIGHTON ROAD,
SOUTH CROYDON, SURREY.
CROydon 5148/9 *(Trade Enquires Invited)*

PUBLISHED MONTHLY *VOL. 1. No. 5.* *SEPTEMBER 1955*

FREQUENCY MODULATION COMES TO TOWN— VIA SIMPLE CONSTRUCTIONAL TUNER!

OSMOR have won laurels for their coils, which played such a major part in the established success of Frequency Modulation. Osmor High "Q" Coils are the outcome of manufacturing experience, technical skill and constant experiment . . . the universal preference of technical experts and experimentalists proves their unquestionable superiority!

OSMOR 'Q' COIL PACKS

Size only 1¾ × 3½ × 2¼ with variable iron-dust cores and Polystyrene formers. Built-in trimmers. Tropicalised. Prealigned Receiver-tested and guaranteed. Only 5 connections to make. All types for Mains and Battery Superhets and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver. TR1196, Type 18, Wartime Utility and others.

The NEW Osmor 'SWITCH PACK'

Complete and Prealigned full circuit included. State which station required. 2 M.W., 1 L.W. or 3 M.W. **48/-** Inc. P. Tax.

SUPER 'Q' CUP COILS For Maximum Selectivity

A full range is available for all popular wavebands and purposes. The magnetic screening of the cup prevents other components from absorbing the coil's power, thus maintaining the high "Q" value. Simple one-hole fixing. ★ Only 1in. high. ★ Packed in dampproof containers. ★ Adjustable iron-dust cores. ★ Fitted tags for easy connection. L. or M.W. **5/-** inc. CIRCUIT.

FREE! Send 5d. (stamps) for fully descriptive literature including Circuit and practical Drawings, F.M. Tuner "The really efficient 5-valve Superhet," 6-valve s'het., 3-valve (plus rectifier) T.R.F. circuit. Battery portable Superhet circuit, Coil and Coilpack leaflets, and full radio and component lists, and interesting miniature circuits, etc.

New Coils to our Range

SCRATCH FILTER type QSF1, 6/9. To get the best from your records.

WHISTLE FILTER, type QWF1, with circuit, 6/9. Cut out the whistle on the Home Station.

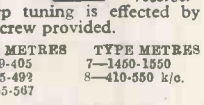
TAPE RECORDER 45 kc/s. Osc. Coil, type QT8, 7/6.

DUAL-RANGE High "Q" Coils for T.R.F., 10/6 pair.

Selective DUAL-RANGE Coil type QCD2. for Crystal Set operation, 5/-.

OSMOR STATION SEPARATOR 7/6 COMPLETE

The Separator may easily be tuned to eliminate any one station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.



Plugs into receiver

TYPE METRES	TYPE METRES	TYPE METRES
1—141-250	4—319-405	7—1450-1550
2—218-283	5—395-492	8—410-550 k/c.
3—267-341	6—455-567	

Special Separator to clear Radio Luxembourg, **10/6** each.

THE R.C. 3/4 WATT AMPLIFIER KIT. — Just released! Compare the advantages! Treble bass, AND middle tone controls! For crystal or magnetic pickup! A.C. Mains. 200/250 v. Valve line-up, 6V6GT, 6SG7, metal 6X5GT. Negative feedback. Built on stove enamelled steel chassis, measuring only 8in. × 4in. × 1¾in. Four engraved cream knobs are included in the price of the complete Kit with all necessary practical and theoretical diagrams, at £4/5/- only, plus 2/6 packing and post, or Instruction Book, fully illustrated, for 1/-, post free! This amplifier can be supplied assembled, tested, and ready for use at £5/5/-, plus p. and p. Hearing is believing!

The R.E.P. ONE-VALVE BATTERY RECEIVER KIT. Simple one-valve all dry battery receiver for headphones, easily built in one evening. All required components including headphones, can be supplied at inclusive cost of 42/- plus 2/- p. and p. Operated by Ever-Ready B114 type battery available at 7/9. Full assembly details available separately at 9d. plus 3d. post.

T.S.L. ELECTROSTATIC LOUDSPEAKERS! A much-wanted need in High Fidelity reproduction! Model LSH75. Size only 3in. × 3in. × ¼in. Weight 1¼oz. only. Capacity 800 pf. D.C. voltage 300 max. Tone frequency A.C. voltage, 60 volts max. effective. Test voltage at 50 cycles, 440 volts. Price only 12/6, plus 1/- p. and p. Model LSH100. Size 5in. × 4in. × ¼in. Capacity 1100 pf. Response identical to LSH75. Weight 3½oz. Price 21/-, plus 1/- p. and p. Fitting an electrostatic speaker to an ordinary loudspeaker system merely entails the use of two condensers and two resistors. These speakers have a high efficiency in the range of 5,000-20,000 cycles, and are a must for F.M., high quality recordings, and T.V. sound! Each speaker is supplied with full technical data, response curve, and wiring diagram.

PLAYING DESK! Two-speed 33 and 78 r.p.m. player by famous manufacturer. Complete with turn-over crystal pick-up. Already mounted on platform, ready to use, £5/19/6 only, plus 5/- P. and P.

COLLARO RC/54 PLAYER! Just released. Fawn leatherette covered portable case incorporating very latest Collaro 3-speed mixer-changer. Cream finish. Lightweight turn-over crystal pick-up head. Only £13/5/- cash, plus 5/- p. and p. complete, or 65/- deposit plus p. and p. and 12 monthly payments of 18/7.

Carrying cases in black leatherette finish. An extremely well-made case with chrome locks and corner-pieces for extra strength. This cabinet will house any 12in. Hi-Fi speaker, but can be put to a number of uses. Front panel and lid are removable. Size 18½in. × 10½in. × 16½in. high, 47/6, plus 5/- post and packing. N.B. To the many previous purchasers of this cabinet at 55/- we are now no longer able to supply the baffle with cabinet. Thus the reduction!

LATEST IMPORTED F.M. COMPONENTS

UT.340. A self-contained V.H.F. front end Unit incorporating a grounded grid amplifier, mixer oscillator (ECC85) and first I.F. amplifier. Completely wired and tested, 59/9.

UT.341. As above but with baseplate and 2-gang condenser incorporating 1.3 reduction drive. Supplied pre-aligned, 95/5.

TA.350. 6-button Coil Pack for long, med. and short waves, gram and off, together with a F.M. position which incorporates switching for change over from A.M. to F.M. Designed for use with UT.340 or UT.341, 85/-.

Ratio Discriminator Coils, **URF** 10/- each.

10.7 mc/s. I.F. Trans., UF376, 7/- each.

AM/FM. We are now demonstrating the Chapman all wave FM/AM Tuner at £32/10/- tax paid. For those unable to call, illustrated literature is available. H.P. terms £8/10/- deposit, 12 monthly payments of 44/-. Also FM Tuner model FM81 by Chapman at £21. Model FM56 by Armstrong, also £21. H.P. Terms available.

VALVES

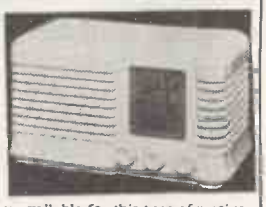
We have perhaps the most up-to-date valve stocks in the trade. A stamp will bring complete list but the following is a selection only of brand new imported valve types, fully guaranteed. Purchase Tax Paid.

EABC80		EL41	10/6	PY81	10/-
	10/-	EL84	11/6	PY82	9/6
EB41	7/6	EM80	9/-	PY83	11/6
EB91	7/6	EY51		UBC41	10/6
EBC41	10/-	(large)	11/-	UCH42	11/6
EBF80	11/6	EY51		UF41	10/6
ECC81	9/-	(small)	12/6	UL41	10/6
ECC82	9/-	EZ40	8/6	UY41	9/-
ECC83	9/-	EZ80	8/6	6AQ5	8/6
ECC85	10/-	PCF80	12/6	6AT6	8/-
ECH42	11/6	PCF82	12/6	6AU6	9/6
ECH81	11/6	PCC84	12/6	6BA6	8/6
ECL80	11/6	PL81	13/6	6BE6	9/-
EF41	10/6	PL82	10/6	6BW6	8/6
EF80	10/6	PL83	11/6	6X4	7/6
EF85	10/6	PY80	10/6	etc., etc.	
EF89	10/-				

THE "SUPERIOR" FOUR KIT. Our new four-valve receiver. A.C. mains, 200/250 v. M. and Long waves. As with our very successful "Economy Four" all required components are supplied. Valve line-up: 2 6SG7, 6 X5GT and 6 V6GT. Chassis ready drilled. Cabinet size, 10½ in. × 10in. wide. Maximum depth at base 5in. tapering to 3½in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete instruction booklet with practical and theoretical diagrams is provided. Booklet available at 1/6 post free. Our price for complete kit, £6/9/6 ! Please add 2/6 packing and carriage. If preferred, we can supply Cabinet Assembly only, comprising Cabinet and bracket wavechange switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at 45/-, plus 2/6 packing and carriage. N.B.—Our kits are even supplied with sufficient solder for the job.

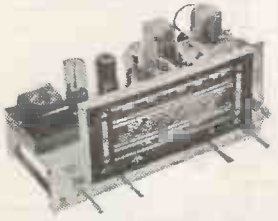
N.B. All our T.R.F. Kit circuits now include specially wound Denco "Maxi-Q" coils on polystyrene formers, improved performance! Price remains the same.

THE "ECONOMY FOUR" T.R.F. KIT A three-valve plus metal rectifier receiver. A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up 6K7 6J7 and 6V6. Chassis ready drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of ivory or brown Bakelite, or wooden, walnut finish cabinet. Complete instruction booklet with practical and theoretical diagrams. Each component brand new and tested prior to packing. Our price £5/10/- complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver — Booklet available at 1/6 post free. This is allowed if kit is purchased later. Please, 2/6 packing and carriage for complete kit.



THE R.C. GRAM REPLACEMENT CHASSIS KIT

To meet the very great demand for this type of receiver, we have produced this unit. For Long, Medium and Short Waves. Valve line-up: 6K8 Frequency changer, 6K7, I.F. Amplifier, 6Q7 1st Audio Detector and A.V.C. 6V6 Output, 6X5 Full-wave rectifier. For A.C. mains 200/250 volts. 4 watts output. Excellent quality. High sensitivity. Provision for gram. Attractive illuminated black, red, green and gold dial for horizontal tuning. Four controls are: Tuning, L./M./S. Gram. Vol./on/off. Tone (variable). Chassis size: 13½ in. × 5¼in. × 2¼in. Dial size: 10in. × 4¼in. Assembly is simplified by the use of a 3-waveband coil pack, and pre-aligned 465 Kc/s. I.F. transformers—high-grade drop-through half-shrouded Mains Transformer, with voltage adjuster panel. This chassis can easily be assembled in one evening. Illustrated pamphlet with full assembly instructions, practical and theoretical wiring diagrams and itemised price list, 1/6 post free. The main items for this receiver can be supplied separately, as under. Drilled chassis, complete with valve-holders, A/B panel, P/U panel, tuning condenser and ready-assembled dial and drive at 39/6. 3-waveband coil pack with gram position, 39/6, tax paid. Pair of 465 Kc/s. I.F. Transformers, 9/6 pair. Half shrouded drop-through Mains Transformer, 22/6. The total cost of ALL items purchased separately is nearly £10, but we shall be pleased to supply all the required components right down to the last nut and bolt at a special inclusive price of £8/8/-, plus 2/6 packing and postage. A set of four small brown and cream engraved knobs to suit is available at 1/2 each knob. This chassis is a professional job in every respect and can be seen and heard at our premises. This chassis can also be supplied, ready assembled in very limited quantities at £9/19/6, plus 5/- carriage and packing.



ARMSTRONG F.C.48. Their very latest high quality replacement chassis having provision for F.M. feeder unit, 8 valves, 4 wavebands. Independent bass and treble with unique thermometer visual indicator. Ready for use £23/18/- plus 5/- package and postage or £5/18/- deposit and 12 monthly payments at 33/9. Illustrated leaflet available.

DULCI RADIO/RADIOGRAM CHASSIS. All latest models including F.3 and F.3 push-pull are in stock. Cash or H.P. Ask for illustrated leaflet.

COLLARO 2010. Transcription motor with Studio Pick-up. This very popular unit can now be supplied from stock. £18/5/3 cash or 95/3 deposit, and 12 payments of 25/8.

London's largest selection of Amplifiers, Recording equipment, etc., etc.

THE R.C. RAMBLER ALL-DRY PORTABLE KIT

Full assembly details with practical and theoretical diagrams can be supplied at 1/6 post free. This is a truly professional 4-valve superhet —all dry—for medium and long waves. A cream plastic top panel, with dial engraved in red and green, adds to the very imposing appearance of this model which is housed in an attractive cream and grey leatherette covered attache-case type cabinet; measuring only 9in. × 7in. × 5¼in. Weight less batteries 4¼lb., with batteries 6¼lb. This set really has everything! Built-in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5in. speaker. Valve line-up 3V4, 1R5, 1S5, 1T4. Also the required components, exactly as specified, including cabinet, can be supplied from stock at the special inclusive price of £7/7/- plus 2/6 p. and p. (less batteries). Uses Ever-Ready 90 v. H.T. type B126 at 9/3. Also L.T. 1.5 v. A.D. 35 at 1/4.

RAMBLER MAINS UNIT! At last we are able to offer our special mains units kit for using our popular all-dry "Rambler" on A.C. Mains. Complete kit, which when assembled fits snugly into battery compartment, can be supplied at 47/6, plus 1/6 packing and postage. Price includes all required components, and full assembly instructions. N.B.—This unit is completely self-contained in a metal box measuring 7in. × 2¼in. × 1¾in. and is ideally suitable for ANY all-dry battery portable requiring 90 v. H.T. and 1.5 v. L.T.

SUPER-QUALITY 6-VALVE RADIOGRAM CHASSIS

Very limited quantity by Britain's leading quality manufacturers, 3 waveband, superhet, valve line-up, 6V6G, EZ40, ECH42, L63, EF41, and EBC41. Combined pick-up amplifier and A.F. amplifier on Radio and Gram. Employs a special circuit for gramophone pre-amplification. Large glass dial horizontal tuning measuring 11in. × 3¾in. Chassis measurement: 14¼ × 9 × 8in. This is a superior chassis designed to sell originally in a Radiogram costing £79. Our price is £12/19/6 only, tax paid, plus 5/- packing and carriage. We will gladly demonstrate this chassis or any other working item from our stocks, to personal callers!

REGAL. A well-made cabinet in medium coloured walnut veneer. Size 29½ × 14½ × 29½in. Uncut motor-board measures 25½ × 13½in. Record or tape storage aperture alongside motor-board measures 3½in. wide × 12in. deep. Price £9/19/6 plus 10/- p. and p. H.P. terms available.

CLYNE RADIO LTD.

18, Tottenham Court Road, London, W.1.

SELENIUM RECTIFIERS

L.T. Types		H.T. Type H.W.	
2/6 v. ½ a.h.w.	1/9	120 v. 40 mA...	3/11
6/12 v. ½ a.h.w.	2/9	250 v. 50 mA...	5/9
		250 v. 80 mA...	7/9
F.W. Bridge Types		250 v. 150 mA.	9/9
6/12 v. 1 a.	5/9	RM4 250 v. 250 mA.	11/9
6/12 v. 2 a.	8/9	300 v. 275 mA.	12/11
6/12 v. 4 a.	15/9		

CO-AXIAL CABLE. 75 ohms ¼in., 7d. yard. Twin screened feeder, 10d. yard.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001μF), .002 mfd. (2,000 pfd.). All at 5d. each, 3/9 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., 6/9 doz.; 6.5 v. 0.3 a., 6/9 doz.; 4 v. 0.3 a., 6/- doz.

ELECTROLYTICS (current production). NOT ex-Govt.

Tubular Types		Can Types	
8μF 450 v.	1/9	16 mfd. 350 v.	1/11
8 mfd. 500 v.	2/6	16μF. 450 v.	2/9
16μF 350 v.	2/3	24μF 350 v.	2/11
16μF 450 v.	2/9	32μF 350 v.	2/11
16μF 500 v.	3/9	32 mfd. 450 v.	4/9
32μF 350 v.	3/9	64 mfd. 450 v.	3/11
32 mfd. 500 v.	5/9	100 mfd. 450 v.	4/9
8-16μF 500 v.	4/11	8-8μF 450 v.	3/6
25μF 25 v.	1/3	8-8 mfd. 500 v.	4/9
50μF 12 v.	1/3	8-16μF 450 v.	2/11
50μF 50 v.	2/3	16-16μF 450 v.	4/11
100 mfd. 12 v.	1/9	16-32μF 350 v.	4/9
100 mfd. 25 v.	2/3	32-32μF 350 v.	4/9
Can Types		32-32μF 450 v.	5/11
8 mfd. 350 v.	1/3		
8 mfd. 450 v.	2/3		
16 mfd. 500 v.	3/9		

Many others in stock.

VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

WIRE WOUND POTS: 20 ohms, 500 ohms, 5K, 20K, 100K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K. Preset type, 1/9 each.

VIBRATORS. Wearite 12 v. 4 pin. Non-synchronous, 6/9. Oak 2 v. 7 pin, synchronous, 7/9.

EX GOV. E.H.T. SMOOTHING CONDENSERS

.25 mfd., 4,000 v. Blocks	4/9
.5 mfd., 2,500 v. Blocks	3/9
.5 mfd., 3,500 v. Cans	3/3
.1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated)	9/6
1.5 mfd., 4,000 v. Blocks	5/9

EX GOVT. METAL BLOCK PAPER CONDENSERS

2 mfd. 800 v.	1/9	6-6 mfd. 450 v.	5/9
4 mfd. 500 v.	2/9	8 mfd. 500 v.	5/9
4 mfd. 1,000 v.	4/3	8-8 mfd. 500 v.	5/11
4 mfd. 1,500 v.	4/9	15 mfd. 500 v.	7/9
4 mfd. 400 v. plus 2 mfd. 250 v.			1/11

EX GOVT. VALVES. VR137 11d., EA50, EB34, 12H6, 9d.

EX GOV. UNITS, type RF26 in original sealed cartons 39/6. Transmitter Receivers type TR9D complete with all valves 45/-, Carr. 6/6.

CONTROL PANEL with 1 six-position 3-wafer Yaxley switch, 1 pointer knob, 2 S.P.S.T. switches, various plugs and sockets. Only 1/6.

M.E. SPEAKERS. All 2-3 ohms, 8in. R.A. field, 600 ohms, 11/9. 10in. R.A. field, 1,000 ohms, 23/9.

MANUFACTURERS SURPLUS TRANSFORMERS

Fully shrouded upright. Primary 200-230-250 v. Sec. 425-0-425 v. 150 m.a. 6.3 v. 3 a. 5 v. 3 a. 37/9.

HEAVY DUTY BATTERY CHARGER

For normal 200/250 v. A.C. mains input. To charge 12 v. battery. Variable charge rate of up to 10 amps. Fitted Meter and Fuses. Guaranteed 12 months. Carr. 10/-. £6/19/6.

OIL FILLED BLOCK CONDENSERS

Bryce 11-7 mfd. 500 v. New unused Govt. surplus, only 5/9 each.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT with louvred crackle finished case. Mains input 200-250 v. Output 120 v. 40 mA., and 2 v. ½ a. Price with circuit, 29/6. Or in working order, 37/6.

R.S.C. TRANSFORMERS

FULLY GUARANTEED, INTERLEAVED AND IMPREGNATED

MAINS TRANSFORMERS

Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA. 6.3 v. 2 a., 5 v. 2 a., Midget type, 2½-3-3in. 17/6
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a... 19/9
250-0-250 v. 100 mA., 6.3 v.-6.4 v. 4 a., c.t., 0-4-5 v. 3 a. 26/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a... 23/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion 31/-
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a... 23/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 28/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.. 23/9
350-0-350 v. 100 mA., 6.3 v.-4 v., 4 a., c.t., 0-4-5 v. 3 a. 26/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a... 33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. 33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t., 5 v. 3 a., suitable Williamson Amplifier, etc. 49/9
450-0-450 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a. 69/6

TOP SHROUDED DROP-THROUGH TYPE

250-0-250 v. 70 mA., 6.3 v. 2.5 a. 13/9
260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a... 16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a... 18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a... 22/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 23/9
350-0-350 v. 100 mA., 6.3 v. 4 a., c.t., 5 v. 3 a. 22/9
350-0-350 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 23/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a. 29/11
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a... 29/9
E.H.T. TRANSFORMERS, 2,500 v. 5 mA., 2-0-2 v. 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 37/6

FILAMENT TRANSFORMERS

Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.	5/9	0-4-6.3 v. 2 a.	7/9
6.3 v. 3 a.	8/11	0-2-4-5-6.3 v. 4 a.	16/9
12 v. 1 a.	7/9	6.3 v. 6 a.	17/6
6.3 v. 2 a.	7/6	12 v. 3 a. or 24 v. 1.5 a.	17/6

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s. Primaries: 0-9-15 v. 1½ a., 11/9; 0-9-15 v. 3 a., 0-3.5-9-17 v. 4 a., 18/9. 0-9-15 v. 5 a., 19/9; 0-9-15 v. 6 a., 23/9.

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s. 120 v. 40 mA. 7/11
130 v. 50 mA., 6.3 v. 3 a. 14/9
120 v. 40 mA., 5-0-5 v. 1 a. 14/9
90 v. 15 mA., 6-0-6 v., 250 mA. 9/11

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc... 3/6
Small Pentode, 5,000Ω to 3Ω 3/9
Standard Pentode, 5,000Ω to 3Ω 4/9
Standard Pentode, 8,000 to 3Ω 4/9
Battery Pentode, 10,000 ohms to 3 ohms. 4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull 5/6
Push-Pull 8 Watts 6V6 to 3 ohms 8/9
Push-Pull 10-12 Watts 6V6 to 3Ω to 15Ω, sectionally wound 16/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω 16/9
Push-Pull 15-18 Watt, sectionally wound, 6L6, KT66, etc., to 3 or 15 ohms 21/9
Push-Pull 20 Watt high-quality sectionally wound, 6O6, KT66, etc., to 3 or 15Ω 47/9

SMOOTHING CHOKES

250 mA., 3 H., 100 ohms 11/9
150 mA., 7-10 H., 250 ohms 11/9
100 mA., 10 H., 150 ohms potted 9/9
100 mA., 10 H., 200 ohms 8/9
80 mA., 10 H., 350 ohms 5/6
60 mA., 10 H., 400 ohms 4/11

THE SKY FOUR T.R.F. RECEIVER

A design of a 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in either of cabinets illustrated above. It employs valves 6K7, SP61, 6F6G, and is specially designed for simplicity in wiring. Sensitivity and quality is well up to standard. Point-to-point wiring diagrams, instructions and parts list, 2/-. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite, or veneered walnut.

P.M. SPEAKERS. All 2-3 ohms. 6½in. R.A. 13/9. 6½in. Plessy with 5,000 ohm output transformer, 16/11. 8in. Rola Heavy Magnet, 19/9. 10in. Rola with Trans., 29/6.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., 25/9. To charge 6 v. or 12 v. battery at 2 a., 31/6. To charge 6 v. or 12 v. battery at 4 a., 49/9. ABOVE KITS CONSIST OF GREEN CRACKLE LOUVRED STEEL CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. Any type assembled and tested for 6/9 extra.

R.S.C. 6 v. or 12 v. BATTERY CHARGER For normal A.C. mains input 200-230-250 v., 50 c/s. Selector panel for 6 v. or 12 v. charging. Variable charge rate of up to 4 AMPS. Fused, and with ammeter. Well ventilated metal case with attractive crackle finish. Guaranteed for 12 months, 69/6. Carriage 2/6.

EX GOVT. MAINS TRANSFORMERS

All 230 v. 50 c/s. input. 48 v. 1 a. 8.8 v. 4 a. 9/9
978 v. 200 mA. 7/9

Carriage on following types 5/- extra.

0-11-22 v. 30 a. 72/6
16-18-20 v. 35 a. 79/6
7.7 v. C.T. 7 amps., 4 times 25/9
460 v. 200 mA., 6.3 v. 5 a. 27/9
300-0-300 v. 150 mA., 610-0-610 v. 150 mA., 1,200 v. 250 mA. 29/6
400 v. C.T. 150 mA. 4 v. 5 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a. 22/9
325-0-325 v. 150 mA., 6.3 v. 4-6 a., 5 v. 2-3 a. 29/9

EX GOVT. AUTO TRANSFORMERS

15-10-5-0-195-215-235 v. 500 Watts 27/9
Double wound 10-0-200-240 v. to 10-0-275-295-315 v. 1,000 watts 69/6
Double wound 0-110-240 v. to 0-130-140-150-160-170 v. 1,500 watts 69/6
Carriage on any of above 5/- extra.

EX GOVT. SMOOTHING CHOKES

250 mA., 10 H., 50 ohms 14/9
250 mA., 10 H., 100 ohms 14/9
250 mA., 3 H., 50 ohms 8/9
150 mA., 10 H., 50 ohms 10/11
100 mA., 10 H., 100 ohms, Tropicalised 6/9
100 mA., 5 H., 100 ohms, Tropicalised 3/11
50 mA., 50 H., 1,000 ohms, Potted 8/11
90/100 mA., 10 H., 100 ohms, Potted 8/9
50 mA., 5-10 H. 2/9
L.T. type 1 amp. 2/9

SPECIAL OFFER

Potted Mains Transformer. (Ex New Equip.). Primary 0-10-80-180-200-220-240 v., 50 c/cs. secs. 250-0-250 v. 60 mA., 6-3 v. 2a., 5. v. 2 a. Size approximately 3½×3×4½in. 10/11

CHASSIS

18 s.w.g. undrilled aluminium amplifier type (4-sided).
14in.×10in.×3in. 7/11
16in.×10in.×3in. 8/3

18 s.w.g. aluminium receiver type.
6in.×3⅜in.×1½in. 1/11
7¾in.×4½in.×2in. 2/9
10in.×5¾in.×2in. 3/3
11in.×6in.×2½in. 3/11

16 s.w.g. aluminium receiver type.
12in.×8in.×2½in. 5/3
16in.×8in.×2½in. 7/6
20in.×8in.×2½in. 8/11

16 s.w.g. aluminium amplifier type, 4-sided.
12in.×8in.×2½in. 7/11
16in×8in.×2½in. 10/11
20in.×8in.×2½in.13/6
14in.×10in.×3in.13/6

R.S.C. HIGH FIDELITY 25 watt AMPLIFIER A4

A NEW DESIGN FOR 1955

HIGH GAIN "PUSH PULL OUTPUT". BUILT-IN PRE-AMP. TONE CONTROL STAGES. INCLUDES 7 valves, sectionally wound output transformer, block paper reservoir condenser, and reliable small components. **AN INPUT OF ONLY 20 millivolts IS REQUIRED FOR FULL OUTPUT. THIS MEANS THAT ANY TYPE OF MICROPHONE OR PICK-UP IS SUITABLE.** Two separate inputs controlled by separate volume controls allow simultaneous use of "Mike" and Gram., or Tape and Radio, etc., etc. Individual controls for Bass and Treble "lift" and "cut". Six negative feedback loops giving total of 24 D.B. Frequency response ± 3 D.B. 30-20,000 c/s.

Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. **SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, DANCE HALLS, etc., etc. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS.** Size 12 × 10 × 9 in. For mains A.C. 200-250 v. 50 c/s. Power consumption 175 watts. Outputs for 3 and 15 ohm speakers. The kit is complete in every detail. Chassis is fully punched. Easy to follow point-to-point wiring diagrams are supplied. EXTRA HIGH SENSITIVITY, HIGHEST QUALITY for **9 Gns.** Or assembled ready for use 50/- extra.

H.P. Terms on assembled units. Deposit 26/- and 12 monthly payments of £1. Plus carr. 10/-:
Terms to include cover, mike, speakers, etc., on request. Cover as illustrated if required, price 17/6 extra.

BRAND NEW B.S.R. MONARCH 3-SPEED MIXER AUTO-CHANGERS. With crystal pick-up and dual point sapphire styli for standard or long playing records. Plays ten 7in., 10in. or 12in. intermixed. For A.C. mains 200-250 v. 50 c/cs. Supplied in sealed cartons with template and operating instructions. Only 9 gns. plus 5/- carr., or 2 gns. deposit and 11 monthly payments 17/6.

A PUSH PULL 3-4 WATT HIGH GAIN ASSEMBLED AMPLIFIER FOR £3/19/6. For mains input 200-250 v. 50 c/s. Complete kit of parts, including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick-up. This is not A.C./D.C. with "live" chassis but A.C. only with 400-0-400 v. Trans. Output is for 2-3 ohm speaker. Supplied ready for use. £3/19/6. Full descriptive leaflet 6d.

H.M.V. LONG PLAYING RECORD TURNTABLE COMPLETE WITH CRYSTAL PICK-UP (SAPPHIRE STYLUS). Speed 33⅓ r.p.m. BRAND NEW, CARTONED. Only £3/19/6 (approx. half price). Carr. 5/- (for 200-250 v. A.C. Mains).

R.S.C. A7 3-4 WATT QUALITY AMPLIFIER A highly sensitive 4-valve amplifier using negative feedback and having an excellent frequency response. Pre-amplifier and Tone Control stages are incorporated with separate Base and Treble controls giving full tone compensation for Long Playing records. Suitable for any kind of pick-up including latest high fidelity types. H.T. of 250 v. 20 mA. and L.T. 6.3 v. 1a. available for supply of Radio Feeder Unit, etc. ONLY 40 millivolts input required for full output. Fully isolated chassis with baseplate. For A.C. mains 200-250 v. 50 cycles. Output for 2-3 ohm speaker. Complete kit of parts with point-to-point wiring diagrams and instructions. Only £3/15/-.

R.S.C. 4-5 WATT HIGH GAIN AMPLIFIER TYPE A5

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads, in addition to all other types of pick-ups and practically all mikes. Separate Base and Treble controls are provided. These give full long playing record equalisation. Hum level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck preamplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 25/- extra, plus 3/6 carriage.

COLLARO HIGH FIDELITY MAGNETIC PICK-UPS. High impedance type. Limited number, brand new, boxed and perfect at fraction of normal price. Only 35/-.

COLLARO 3-SPEED AUTO-CHANGERS. New guaranteed units. Fitted 'Plug in' crystal pick-up heads for standard or long playing records. Very limited number available at approx. half price. For A.C. mains 200-250 v. 50 c/cs. Only £7/19/6. Carr. 7/6

DEFIANT RECORD PLAYING TURNTABLE COMPLETE WITH MAGNETIC PICK-UP. Pick-up is high impedance type. Unit is housed in a beautiful walnut veneered cabinet of attractive design. For all standard records (78 r.p.m.). Limited number. Brand new, cartoned, £5/19/6. Carr. 7/6.

ACOS HIGH FIDELITY CRYSTAL MICROPHONES. Type 22-2. Complete with table stand. Normal price 4 gns. Limited stocks, brand new, boxed £2/19/6.

R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. Supplied with walnut veneered wood or brown bakelite cabinet. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE." Ideal for use as "Baby Alarm." Sound amplification 4 watts. Price only £7/15/-. "Listen-Talk Back Unit" in bakelite or walnut veneered cabinet, can be supplied at 35/- each.

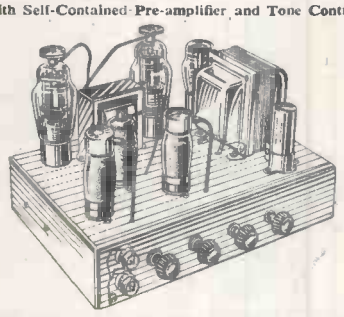
ALL DRY RECEIVER BATTERY SUPERSEDER KIT

All parts for an "All Dry" Battery Eliminator, complete with case. Completely replaces 1.4 v. and 90 v. batteries where normal mains supply of 200-250 v. 50 c/s. is available. Price with circuit, 38/9 Or ready for use, 45/6 Size of unit 5½ × 4½ × 2¾in. Suitable for receivers with L.T. loads of 125 mA. to 250 mA., thereby covering latest low consumption types.

BATTERY SET CONVERTER KIT. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v., 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only 48/9. Supplied ready for use for 8/9 extra.

R.S.C. A3 10 WATT "PUSH-PULL" HIGH FIDELITY AMPLIFIER

With Self-Contained Pre-amplifier and Tone Control



Large safety factors in every component A.C. and H.T. fuses, punched chassis with baseplate, screened input plugs, 6 valves, and with easy-to-follow point-to-point wiring diagrams. Everything supplied to last nut. Two independent inputs are provided with two associated independent volume controls so that programmes can be mixed together if desired, such as microphone announcements superimposed on a musical programme, or two independently controlled microphones, or even just gramophone/radio, fading over from one to the other. Variable base lift and cut with variable treble lift and cut tone controls are fitted, giving full long playing record equalisation for uncorrected pick-ups. They are also provided so that the user can alter the tonal value to suit his personal taste and surroundings. Terminals are provided for 3 ohm and 15 ohm loudspeakers. H.T. and L.T. available for the supply of a Radio Feeder Unit.

Six Negative Feedback Loops.
130 millivolts input only required for full output.
Frequency response 50-20,000 cycles.
Negligible hum and distortion.
For A.C. mains input 200/230/250 v. 50 c/s.

COMPLETE Kit of Parts **7 GNS.** (carriage 7/6).
Supplied, assembled and tested for 45/- extra.
Cover as for A4 amplifier 17/6 extra if required.
H.P. TERMS on assembled units. Deposit 23/6 and 9 monthly payments 21/-.

FOUR-STAGE RADIO FEEDER UNIT

Design of a HIGH FIDELITY L. and M. wave T.R.F. Unit with self-contained heater supply and thorough H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Flat topped response characteristic. Loaded H.F. coils. Two variable Mu controlled H.F. stages, 3 gang condenser tuning. Cathode follower output stage. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7¾in. Illustration, full set of easy-to-follow wiring diagrams and instructions and individually priced parts list 2/6. This unit can be built for only £3/15/-, including Dial and Drive Knobs and every item required.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS. HF1012, 10 watts, 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required we highly recommend this unit with an amazing performance, £3/17/6.

MICROPHONES. Crystal, hand or Desk type, high fidelity Acos, 50/-. Stand type with base and adjustable stem, £6/19/6. Both suitable for use with our amplifiers.

GOLDRING MAGNETIC PICK-UPS. Due to a fortunate purchase we can offer these popular high impedance pick-ups. Brand new, boxed, at only 23/9

Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-, 1/- extra under £2, 2/6 extra under £3. Full Price List 6d. Trade List 5d.
Open to Callers: 9 a.m. to 5.30 p.m. Saturday until 1 p.m.

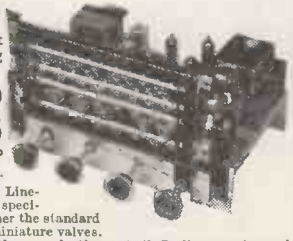
RECEIVER CHASSIS — Modernise your old Radiogram — RECORD PLAYERS

COMPLETE RADIOGRAM EQUIPMENT—QUALITY AT LOW COST

STERN'S DESIGN FOR HOME CONSTRUCTORS

The "SUPER-SIX"

A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.



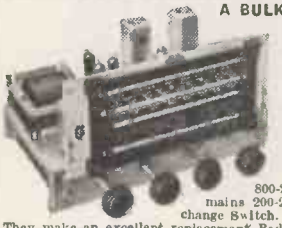
YOU CAN BUILD IT FOR £10/7/6

Including the OCTAL VALVE LINE-UP (£12/7/6 with the miniature valves).

Incorporating the new B.V.A. Miniature Valve Line-up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve line-up or the new B.V.A. range of miniature valves.
Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained.
A few brief details.

- Covers 3 wavebands 18-50 metres, 190-550 metres and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operation on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12×8×8in. Dial aperture 8½×4½in.
- For operation A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION and ASSEMBLY MANUAL is available for 1/6. It contains very detailed practical drawings and circuit diagrams and a complete Component Price List.



A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7-VALVE SUPERHET RECEIVER For only £12/19/6

(Carr. & ins. 7/6 extra)
H.P.—£4/6/6 Dep. 10 mths. at 19/2.

These receivers Models AW3-7 are made by a well-known set of manufacturers and incorporate the latest Osram Valve Line-up of X79—W77—DH77—H77—U78 and two N78s in Push-Pull for approx. 7 watts output. They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts. A Gram. position is on the Wave-change Switch.
They make an excellent replacement Radiogram Chassis having a P.U. connection on the Chassis. Extension speaker connection is also provided. Overall size of chassis; 12in. long × 7½in. × 6½in. high, dial aperture 8½×4½in. (Dial Escutcheon available for 4/9.)

THE MODEL F3PP. RADIO-RADIOGRAM CHASSIS

Model F3PP. A 7-valve 3-waveband Superhet Chassis with a Push-Pull Stage. This Chassis has been designed with particular regard to the quality of reproduction. It incorporates SEPARATE BASS and TREBLE CONTROLS, thereby ensuring the utmost flexibility of Tone on both Radio and Gram.
Briefly:

- Waveband coverage 16-50, 190-550 and 900-2,000 metres.
- Valve line-up X79, 6BA6, 6AT6, ECC83, GZ30 and two AQ5s in push-pull for approx. 6 watts output.
- Negative feedback and delayed A.V.C.
- Has independent mains supply socket for gram. connection.
- Overall size of Chassis 12×8in. high × 7in. with dial size 11½in. long × 4½in.

For use on A.C. Mains 100 110 volts and 200 250 volts.
Cash Price, tested and ready for use **£17/17/0**
H.P. Terms; Deposit £5/19/- and 12 monthly payments of £1/1/10 (plus 7/6 carr. and ins.)

WE RECOMMEND THE W.B. "STENTORIAN" P.M. SPEAKERS
They have the NEW CAMBRIC CONE and a matching device for 3 ohm-7.5 and 15 ohm outputs.

(a) 5in. Model HF510	£1 19 6	(d) 9in. Model HF912	£3 9 6
(b) 6in. „ HF610	£2 12 6	(e) 10in. „ HF1012	£3 17 6
(c) 8in. „ HF810	£3 5 6	(f) 12in. „ HF1214	£9 15 6

OTHER TYPES IN STOCK

3½in. P.M. 3 ohm V/Coil	15 9	8in. P.M. 3 ohm V/Coil	18/9, 19/6 & 25/-
5in. P.M. 3 ohm V/Coil	16 6	10in. P.M. 3 ohm V/Coil	25/- & 37/6
6½in. P.M. 3 ohm V/Coil	16 9	12in. P.M. 15ohm V/Coil	£5 5 0

All are NEW and FULLY GUARANTEED

This 3-SPEED AUTOCHANGER is by a Famous Manufacturer and is offered for £9/19/6 (Plus 7/6 carr. & ins.) Normal Price £13/10/-

Hire Purchase Terms £3/6/8 Dep. and 8 months at 18/10.

- These units will autochange on all three speeds, 7in, 10in and 12in
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphire for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14×12½in., with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS At this exceptional price.

WE CAN ALSO SUPPLY

(a) THE GARRARD 3-SPEED CHANGER MODEL R.C.80M.
(b) THE GARRARD 3-SPEED NON-AUTO MODEL "T."
(c) THE COLLARO 3-SPEED CHANGER MODEL R.C.54.
(d) THE COLLARO 3-SPEED NON-AUTO MODEL 3/554.
(e) THE B.S.R. 3-SPEED NON-AUTO MODEL HF100.

All of these are the very latest models. Send S.A.E. for details.

WE CAN SUPPLY FROM STOCK

The COLLARO 3-SPEED "TRANSCRIPTION" PLAYERS

MODEL 2010 with the NEW LIGHTWEIGHT "STUDIO P" CRYSTAL PICK-UP.

PRICE **£18/5/3** (plus 7/6 carriage and insurance)
H.P. TERMS: Deposit £6/1/9, 12 monthly payments of £1/2/4.

!!! EARLY NEWS !!!

About Mid-September we will have available

A COMBINED "A.M.-F.M." RADIO-RADIOG RAM REPLACEMENT CHASSIS

It is designed to the very latest specification, incorporating the NEW VALVE LINE-UP—AN INDUCTANCE TUNING UNIT (for FM)—generous sized OUTPUT TRANSFORMER providing matching for 3 and 15 ohm SPEAKERS—FERRITE ROD internal AERIAL (for AM)—"MAGIC EYE" INDICATOR and other outstanding features.
In designing this chassis particular regard has been paid to achieving really high-quality reproduction of both RADIO and GRAMOPHONE.
Descriptive leaflets will be available in late September. Send S.A.E. for one.

THE NEW ARMSTRONG F.C. 48

A high quality replacement Radio or Radiogram Chassis having provision for an F.M. Feeder Unit.
PRICE ASSEMBLED AND READY FOR USE. **£23/18/0**

(Plus 7/6 Carr. and Ins.)
H.P. Terms: £8 Deposit and 12 months at £1/9/2.

- 8 Valves including 2 double Triodes.
- 8 Watts output from push-pull tetrodes. Heavy negative feedback is used, resulting in negligible distortion and high damping factor.
- Provision for using FM adaptor to receive the present high quality transmissions from Wrotham and the new B.B.C. V.H.F. stations.
- An accessible socket at rear provides the power supply for this unit.
- Independent controls give BASS and TREBLE lift and cut with unique Thermometer visual indicator.
- Gram. position on a wavechange switch.
- 4 Wavebands Coverage 16-51, 50-120, 190-550, 1,000-2,000 metres.
- Large four-colour illuminated dial.

SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY—Select a RECEIVER CHASSIS and we will supply it TOGETHER WITH A 3-SPEED CHANGER AND AN 8in. or 10in. P.M. SPEAKER as follows:—

THE B.S.R. MONARCH, P.M. SPEAKER and:—

	Cash Price	Deposit	Monthly (12)
(a) With Model B3PP Chassis	£7 1 3	£5 15 0	£1 8 1
(b) With Model AW3-7 Chassis	£8 0 0	£6 0 0	£1 9 3
(c) With Model F3PP Chassis	£9 12 6	£7 4 6	£1 15 2
(d) With Model FC48 Chassis (Includes Goodmans 10in. P.M.)	£11 16 0	£8 17 6	£2 3 3

THE COLLARO MODEL R.C.54, P.M. SPEAKER and:—

(a) With Model B3PP Chassis	£8 3 0	£6 2 0	£1 9 11
(b) With Model AW3-7 Chassis	£8 10 0	£6 7 0	£1 11 1
(c) With Model F3PP Chassis } Includes latest Goodmans	£10 6 0	£7 14 0	£1 17 8
(d) With Model FC48 Chassis } 10-in. P.M. Speaker	£12 6 0	£9 4 0	£2 5 1

When submitting orders please include postage and packing.

STERN RADIO LTD.

!! A SELECTION OF HIGH QUALITY TUNING UNITS !!

THE DENCO F.M. FEEDER UNIT
INCORPORATING AN R.F. STAGE

A 5 VALVE SUPERHET DESIGN having a frequency coverage of 88 to 100 mc/s. This F.M. Receiver is designed to operate with any type of Amplifier and most Radio Receivers. It incorporates R.F.—F/Changer and two I.F. Stages followed by a Ratio Discriminator, the valve line-up being 6AM6—12AH8—two 6BA6s and 6AQ5. Overall size of assembled Chassis 7in. × 5½in. × 4¾in. high excluding power supply, or 7in. × 8½in. × 4¾in. high with power supply The CONSTRUCTOR'S MANUAL, containing Circuit Diagram and Component Layout, etc., is available for 1/6 nd WE CAN SUPPLY ALL SPECIFIED COMPONENTS including Valves and Drilled Chassis for Assembly as illustrated. or for £7/2/6 with Dial **£6/13/6** (plus 2/6 carriage and ins.)

WE WILL ALSO SUPPLY IT . . .

(a) Assembled and Ready for use, excluding Dial Assembly, £8/17/6.

(b) Assembled and Ready for use including Dial Assembly (as illustrated). £9/10/-

(c) Assembled and ready for use, with Dial Assembly and "Magic Eye" Indicator mounted in centre of Dial, £10/10/-.

(d) We can also supply (a), (b), and (c) with and including an HT/LT Power Supply for an additional £2/17/6. The Supply Unit is also available as a separate Unit, size 6½in. × 3in. × 5in. high. Provides 250 volts at 50 mA. and 6.3 volts at 2 amps.

THE DULCI F.M. TUNER

This Unit will be available early in September. It is a completely self-contained Tuner of outstanding performance providing F.M. coverage and incorporating;—

(a) The very efficient GERLER INDUCTANCE type TUNING HEART.
(b) Its own Power Supply arrangement.
(c) PICK UP SOCKETS for direct connection to Record Player.
(d) "Magic Eye" Tuning Indicator.
(e) Latest valve line-up—EABC.80, ECC85, two EF89's, 6x4 (Rectifier) and E.M.80.

Complete details of the Tuner are not available at time of going to press but will be to hand early in September—send S.A.E. for leaflet.

"STERN'S" MODEL CP3G/AM 3 WAVEBAND SUPERHET TUNING UNIT

A highly sensitive A.C. Mains Tuning Unit providing for excellent reception of stations on the short wavebands (16-50 metres) medium waveband (200-550 metres) and the long waveband (800-2,000 metres).

- Valve line-up: 6K8G (Frequency Changer), 6SK7g (I.F. Amplifier), 6Q7g (Detector, A.V.C. and 1st A.F. Amplifier), and 5Z4g (rectifier).
- A gramophone position is incorporated with the wavechange switch.
- This tuner is normally supplied with four controls—Tuning, Volume, Tone and the Wavelength Switch (Tone and Volume operate as both Radio and Gram.)—but if your Amplifier already has the Tone and Volume Controls we can omit both. When ordering please state what is required.
- Overall chassis dimensions are 12in. × 8½in. × 8in. including the full vision dial. Size 8½in. × 4¾in.

Price completely assembled and including built-in power supply £10/10/-. H.P. Terms. Deposit £3/10/-. 8 months at 19/9.
Price completely assembled excluding Power Supply £9. Carriage and Insurance 7/6 extra. (Dial Escutcheon is 4/6 extra.)

The GOODSELL F.M.I. TUNER

A 5 Valve Superhet Unit incorporating the NEW MULLARD INDUCTANCE type TUNING HEART. A really excellent Tuner giving full F.M. coverage and incorporating a "Magic Eye" Indicator. Requires Power Supply of 250 volts at 25 m/a. and 6.3 Volts 2 amps.
PRICE **£18/14/8** (plus 7/6 carr. and ins.).
H.P. TERMS. Deposit £6/5/- and 12 monthly payments of £1/2/11.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build a Midget "Alldry" Battery Eliminator, giving approx. 69 volts at 10 mA. and 1.4 volts at 250 mA. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver, requiring H.T. and L.T. voltage as above, or approx. to 69 volts. The Kit is quite easily and quickly assembled and is housed in a light aluminium case size 4½in. × 1½in. × 3½in. Price of complete Kit with easy-to-follow assembly instructions, 42/6.
In addition we can offer a similar COMPLETE KIT to provide approx. 90 volt sat 10 mA. and 1.4 volts at 250 mA. Size of assembled unit 7in. × 2¾in. × 1½in. Price 47/6.

SPECIAL PRICE REDUCTION
OF THE FAMOUS
SHAFTESBURY PORTABLE AMPLIFIER

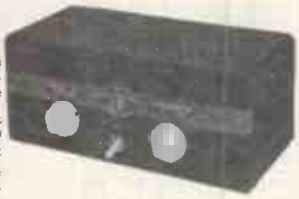
Suitable for home use and small Halls. Has matched inputs for both Record Players and Microphone. Also provides for the "mixing" and "fading" of both Gram. and speech as request. COMPRISING

(a) A 4-Valve High Gain Amplifier for use on A.C. or D.C. mains. 200-250 volts with 5 watts output. Incorporating independent Volume Controls for Mike and Gram., either of which can be faded at will, a variable Tone Control and independent input sockets for Mike and Gram.
(b) A Transverse Carbon microphone which obtains its polarizing current from the amplifier—no batteries are necessary.
(c) A 8in. Goodmans P.M. Speaker with the "Ticonal" magnet for first-class reproduction.

THE COMPLETE EQUIPMENT is all contained in the **PORTABLE CARRYING CASE** **£18/0/0**

Having been reduced from £30/9/-. HIRE PURCHASE TERMS DEPOSIT £4/10/- and 12 monthly payments of £1/4/9.

COMMERCIAL T/V CONVERTERS



Completely self-contained Units designed to operate with commercially made Television Receivers to enable the immediate reception of both the B.B.C. (Band I) and the Commercial (Band III) programmes.
No actual fitting and no alteration is required to your present receiver, it simply being a matter of connecting the Mains Supply, Band I and Band III Aerials to the sockets provided on the Converter, which is then connected to your T/V Receiver by a lead which is plugged into a Socket on the Converter and then into the T/V Receiver Aerial Socket.

The Controls on the Unit are;—
(a) Station Selector Switch which immediately selects either Transmitting Station.
(b) An On-Off Switch which also switches the T/V Receiver on or off.
(c) Band III Station Tuning Control.

THESE CONVERTERS ARE AVAILABLE;—

1. THE AERIALITE MODEL TA3 (illustrated here). Contained in a brown crackled finished case size 9½in. long × 4in. high × 4½in. deep. Price £9/10/-.
2. THE DULCI T/V CONVERTER. In polished walnut case size 9¾in. long × 6½in. high × 4½in. deep. Price £9/9/-.
3. VALRADIO TUNER. A turret type Converter (without case) for direct incorporation into an existing T/V receiver. In this instance it is essential that, when ordering, we are advised of either the I.F. frequency or the make and model number of the T/V receiver. Price £6.

A DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

Attractively finished in "Old Gold" and providing full control of BASS and TREBLE in conjunction with a main volume control.
It can be used with any amplifier and with any pick up, the range of frequency control provided by the unit affording ample compensation for all types of pick ups and all natures of recordings, i.e., English, American and long playing without recourse to pick up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12 watt amplifier advt. The unit measures only 9in. × 4in. × 2½in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price including drilled chassis, valves (6SN7 and 6J5), £3/16/9. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, £5/5/-.

YOU CAN BUILD A COMPLETE PORTABLE RECORD PLAYER for **£11/9/6**

SALVAGE BARGAIN ! ! !

DUE TO DAMAGE SUSTAINED IN OUR OWN WAREHOUSE WE ARE ABLE TO OFFER THE PORTABLE CASE ILLUSTRATED TOGETHER WITH THE COLLARO MODEL R.C.54 3-SPEED AUTOCHANGER for £6/19/6 (plus 10/- carriage and insurance) or separately CASE ONLY £1/5/- (plus 7/6 carriage and insurance).
The Portable Case is robustly constructed and finished in good quality grey rexine. It will accommodate the R.C.54 Autochange and a small amplifier. The case is physically undamaged but the outer and internal covering are soiled.

The MODEL R.C.54 is Collaro's latest 3-speed "mixer." Autochanger incorporating the famous Studio "O" Crystal Pick Up. These offered are not physically damaged but were subjected to dampness and need thoroughly cleaning.
It will be understood that they are not covered by a guarantee, but WE ENSURE THAT EACH AUTOCHANGER IS WORKING SATISFACTORILY BEFORE WE SUPPLY.
We can also offer a 3 Valve A.C. MAINS AMPLIFIER complete with P.M. SPEAKER for £4/10/- (plus 5/- carr. and ins.).
This will fit the Amplifier compartment of the above Portable Case and is designed to produce approx. 3 watts from a 6K8 output value. It incorporates separate TONE and VOLUME CONTROLS, and a pilot indicator lamp.

Accordingly a complete portable record player can be made up for £11-9-6

109 and 115 FLEET ST.
LONDON, E.C.4. *Phone:* CENTRAL 5812-3-4

Best Buy at Britain's

RECEIVER R1132A covers 100-124 Mc/s with variable tuning. Ideal for conversion to F.M. Complete with 11 valves and circuit diagram. Brand new condition. Requires external power supply. Regret owing to limited number these are only available for callers. Price **65/-**.

COMMUNICATION RECEIVER

PCR2 ex-government surplus manufactured by Pye Ltd. Three wavebands—12-50, 190-570 and 900-2,000 metres. Line-up: RF—EF39, FC—X61, 2 IF's—EF39, Det., AVC, 1st AF—EBC33, Output 6V6. In black case size 17½in. × 9½in. × 8in., with crackle front, illuminated calibrated dial, fly wheel tuning, aerial trimmer. Requires power supply and low impedance speaker. In first class condition, complete with all valves, **£4/19/6** plus 10/6 carriage. SPECIAL OFFER—can be supplied with built-in A.C. mains power pack, fully re-aligned and tested for **£3** extra.

RECEIVER 25/73 (TR1196) superhet receiver with 465 kc/s I.F.s. Complete with all valves—2-EF39, 1-EK32, 2-EF36, 1-EBC33. BRAND NEW with full conversion data. Price **30/-** plus 2/6 post.

R.C.A. AMPLIFIERS

MODEL M1—11220

★ **Manufactured by world famous Radio Corporation of America.**
★ **Brand new and unused.**
★ **Power output 12 watts at 5-7.5-15-600Ω.**
★ **Valve line up, 2 of 6L6, 4 of 6J7, 1 of 5U4.**
★ **Tapped transformer for use on 190-250 volts A.C.**
★ **Grey crackled case, size 17 × 11 × 9in.**

CIRCUIT SUPPLIED. ONLY £9. 19. 6. Plus 10/6 carriage
(LESS VALVES, AS SHIPPED BY MAKERS)
SET OF VALVES, NEW, BOXED, **59/6** POST FREE.

AVO "ALL DRY" BATTERY ELIMINATOR—government surplus. For A.C. mains 200/250 volts, output 1.4 volts at 300 mA and 65 volts at 10 mA. Employs metal rectifiers and VS70 stabiliser. Size 8½in. × 5in. × 3½in. Suitable for all personal portable type sets, full instructions supplied. New, in cartons and all tested prior to despatch. Price **39/6** plus 2/6 postage.

X'TALS

465 kc/s S.T.C., 200 kc/s American G.E.C., ¼in. pins, brand new and boxed at **10/-** each. 100 kc/s ¾in. pins, British at **15/-** each.
1,000 kc/s ¾in. pins, British standard 0.01% at **19/6** each.

DU MONT OSCILLOSCOPES. 5in. CRT, standard controls, 50 cycle mains operation. A de Luxe instrument suitable for laboratory use. Price **£35**. A few only Sylvania 'scopes, as advertised previously, still available at **£30**.

MARCONI SIGNAL GENERATORS Type TF390G. Brand new with spares, instruction manual and charts. Price **£25**.

HIGH VOLTAGE POWER PACKS ex U.S.A. Brand new. Input 115 volts A.C., output 1,000 volts at 250 mA. Brand new complete with two 1616 valves, double choke and paper smoothing. **£5/5/-** plus 15/- carriage.

COMMUNICATIONS RECEIVER ADMIRALTY TYPE B.28 (MARCONI CR.100). Valve line up 2 RF, F.C. separate local Osc., 3 I.F.s, 2nd Det., Output, B.F.O. and rectifier. Self contained power supply 200/250 volts A.C. 50 c/s. Variable selectivity (crystal filter). 6,000, 3,000, 1,200, 300 and 100 cycles. Frequency coverage 60 kc/s to 30 Mc/s in six ranges, continuous except for gap between 420 to 500 kc/s. Size 16in. × 13½in. × 12in. Weight 82 lb. The set for the serious operator. Thoroughly overhauled in superb condition, complete with new valves and air tested prior to despatch. A real bargain at only **£30** plus £1 carriage.

TRANSMITTER TYPE 12. Frequency coverage 1.2 to 17.5 Mc/s in four bands. M.O., Buffer, P.A., 2 stage Modulator, built-in stabilised A.C. mains power pack, P.A. Anode current meter M.C.W., C.W., and R.T. operation. V.F.O. or crystal controlled. Super "Table Topper" size 24in. × 12½in. × 17½in. Weight 134lb. Complete with all valves ready for operation. In first-class condition and tested before despatch, with circuit and full instructions. Only **£20** plus £1 carriage. Can be demonstrated to callers.

COMMUNICATIONS RECEIVER

R1155. BRAND NEW "MINT" condition, R1155A. **£11/19/6.** R1155B with super slow-motion drive, **£12/10/-**. R1155A, shop soiled models, as new, **£9/19/6**. Used models **£7/19/6**. Carriage on all models 10/6 extra. Re-aligned and aerial-tested before despatch and gladly demonstrated to callers. Send S.A.E. for full details of power packs and receivers or 1/3 for booklet. D/F. Loops and Visual Indicator Meters available.

A.C. MAINS POWER PACKS AND OUTPUT STAGE. All our power packs are guaranteed for 6 months.
Type A. In smart black metal case, size 8½in. × 4½in. × 6½in. less speaker, price **£4/10/-** plus 3/6 carriage.

Type B. With built-in 5in. speaker in black metal case size 13½in. × 5½in. × 7½in. Price **£5/5/-** plus 3/6 carriage.

Type C. With an 8in. speaker in specially designed beautiful black crackle cabinet to match receiver, size 11½in. × 10½in. × 6in. A de Luxe job. Price **£6/10/-** plus 3/6 carriage. NOTE: 10/- REDUCTION WHEN PURCHASING ANY OF THE ABOVE POWER PACKS WITH RECEIVER.

HEAVY DUTY L.T. TRANSFORMERS. Standard tapped primary. Type A, 30 v. 36 amp. or Type B, 50 v. 16 amp. Size 6in. × 5½in. × 8in. high. Weight 24lb. BRAND NEW, not ex.-Govt. Suitable for soil heating, rectifiers, chargers etc., special offer, **55/-** each, plus 5/- carriage.

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METER BARGAINS, ALL BRAND NEW

15 v. (50~) mov. iron 2½in. pnl. mtg....	8/6
3,500 volts moving coil 3½in. projection	10/-
150 milli-amp. 2in. sq. pnl. mtg.	7/6
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1 mA. 2½in. barrel flush pnl. mtg.....	22/6
1 milli-amp. 2½in. barrel desk type	25/-
100 micro-amps. barrel pnl. mtg. scaled 0-1,500 in 15 clear divisions. Only ...	42/6
500 mA. Thermo Couple 2in. sq. pnl. mtg.	5/-

METER RECTIFIERS. 1 mA. Salford Instruments, 8/6; 5 mA. Salford Instruments, 6/9; 2 mA., S.T.C. as used in E.M.I. Output Meter, **5/6**. All are full wave bridge and brand new.
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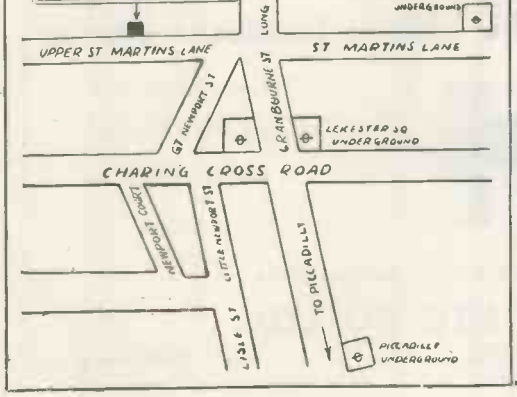

CHARLES BRITAIN (Radio) Ltd.

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LONDON, W.C.2. *TEMple Bar 0545*
One Minute from Leicester Sq. Station (up Cranbourn St.)
Shop Hours: 9-6 p.m. (9-1 p.m. Thursday) *Open all day Saturday*

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Behind the new RCA High Fidelity Amplifier stands nearly a quarter of a century's skill and experience in designing professional sound reproducing equipment. This Amplifier includes several exclusive features entirely new to audio engineering, thus making it many years ahead of its time both in design and construction.

The resulting performance will be found to give a new meaning to high fidelity reception and a new realism to recorded music.

The RCA High Fidelity Amplifier can be incorporated successfully into any existing home audio system. The versatility of its input and output facilities coupled with the wide measure of control afforded by the Pre-Amplifier means that it can be used in conjunction with most high quality audio equipment.

RCA PHOTOPHONE LIMITED
Lincoln Way, Windmill Road,
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PRE-AMPLIFIER

INPUTS—*Magnetic Pickup*
B.78. 16 mv input for rated output. 300 c/s Turnover. 6 DB Roll-off at 10 Kc/s.
A.78. 14 mv input for rated output. 500 c/s Turnover, 16 DB Roll-off at 10 Kc/s.
L.P. 13.5 mv input for rated output. 500 c/s Turnover. 12 DB Roll-off at 10 Kc/s. Flattened LF at 50 c/s to + 13 DB.
R.I.A.A. 11.5 mv input for rated output. 500 c/s Turnover. 14 DB Roll-off at 10 Kc/s. 3 DB Flattening at 50 c/s.
Crystal Pickup. .35 volt with inbuilt equalisation from constant amplitude to constant velocity output enabling switched replaying characteristics to be accurately employed.
Radio/Tape High Level 200 mv. Flat characteristic. Low Level 50 mv. Flat characteristic.
Microphone 6.5 mv for rated output. Flat characteristic.
Mixer Facilities for microphone input, with radio/tape/gramo inputs.
OUTPUT. 1.2 volts from cathode follower stage.
TAPE RECORDING OUTPUT. 1.2 volts cathode follower independent of monitoring.
BASS & TREBLE. Plus and minus 14 DB at 50 c/s and 10,000 c/s.
VOLUME. Twin ganged control giving correct gradation.
LOW-PASS FILTER. Switched 10 Kc/s, 7 Kc/s, 5 Kc/s and Flat.
HIGH-PASS FILTER. Inbuilt, attenuating below 20 c/s.
FILTER SLOPE. Variable to 35 DB per octave.
POWER REQUIREMENTS. 375 v/7 ma, 6.3 v/1 amp.

MAIN AMPLIFIER

OUTPUT. 12 watts rated. Peak in excess of 20 watts over 20-25,000 c/s.
DISTORTION. Total harmonic less than .1% at 10 watts—700 cycles.
NOISE LEVEL. 85 DB below rated output.
DAMPING FACTOR. 50—also variable from positive to negative values.
FREQUENCY RESPONSE. Within 0.2 DB 20—25,000 c/s ± 0.5 DB 10—60,000 c/s.
FEEDBACK. 40 DB total.
OUTPUT IMPEDANCES. 4 ohms, 7 ohms, 15 ohms.
INPUT VOLTAGE. 1.2 v for rated output.
ANCILLARY POWER SUPPLIES. 375 volts 45 milliamps, 6.3 volts 2.5 amps available for VHF Tuner, Pre-amplifier and Tape Reproducer amplifier.
POWER CONSUMPTION. 130 VA at full load. AC input 100/150 and 200/250 volts.

PRICE £48 . 0 . 0 COMPLETE.

MAINS TRANSFORMERS

FULLY INTERLEAVED
SCREENED AND IMPREGNATED. ALL GUARANTEED

ALL PRIMARIES ARE 200/250 v. Half Shrouded

HSM 63 (Midget). Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps. 16/3
HS63. Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. at 2 amps. 16/6
Output.
HS2. 250-0-250 v. 80 m/a. 19/–
HS3. 350-0-350 v. 80 m/a., 19/–. **HS30.** 300-0-300 v. 80 m/a.... 19/–
HS2X. 250-0-250 v. 100 m/a., 21/–. **HS75.** 275-0-275 v. 100 m/a. 21/–
HS30X. 300-0-300 v. 100 m/a., 21/–. **HS3X.** 350-0-350 v. 100 m/a. 21/–

Fully Shrouded

FSM63 (Midget). Output 250-0-250 v. 60 m/a., 6.3 v. at 3 amps., 5 v. 2 amps. 16/9
FSM66 (Midget). Output 250-0-250 v. at 60 m/a., 6.3 v. at 3 amps., 6.3 v. at 2 amps. 17/3
Output.
FS2. 250-0-250 v. 80 m/a. 21/–
FS30. 300-0-300 v. 80 m/a., 21/–. **FS3.** 350-0-350 v. 80 m/a.... 21/–
FS2X. 250-0-250 v. 100 m/a., 23/–. **FS75.** 275-0-275 v. 100 m/a. 23/–
FS30X. 300-0-300 v. 100 m/a., 23/–. **FS3X.** 350-0-350 v. 100 m/a. 23/–
All the above have 6.3 4-0 v. at 4 amps., 5-4-0 at 2 amps.
FS43. Output 425-0-425 v. 200 m/a., 6.3 v. 4 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded 47/6
FS50. Output 450-0-450 v. 250 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 4 amps., C.T. 5 v. 3 amps. Fully shrouded 67/6
F35X. Output 350-0-350 v. 250 m/a., 6.3 v. 6 amps., 4 v. 8 amps., 4 v. 3 amps., 0-2-6.3 v. 2 amps. Fully shrouded 65/–
FS160X. Output 350-0-350 v. 160 m/a., 6.3 v. 6 amps., 6.3 v. 3 amps., 5 v. 3 amps. Fully shrouded 44/–
HS6. Output 250-0-250 v. 100 m/a., 6.3 v. 6 amps., C.T. 5 v. 3 amps. For receiver R1355. Half shrouded 26/6
HS150. Output 350-0-350 v. 150 m/a., 6.3 v. 3 amps., C.T. 5 v. 3 amps. Half shrouded 27/9
F36. Output 250-0-250 v. 100 m/a., 6.3 v. 6 amps., C.T. 5 v. 3 amps. Fully shrouded 29/6
FS120. Output 350-0-350 v. 120 m/a., 6.3 v. 2 amps., C.T. 6.3 v. 2 amps., C.T. 5 v. 3 amps. Fully shrouded 29/9
FS150X. Output 350-0-350 v. at 150 m/a., 6.3 v. at 2 amps., C.T. 6.3 v. at 2 amps., C.T. 5 v. at 3 amps. Fully shrouded 31/6
The above have inputs of 200/250 v.

OUTPUT TRANSFORMERS

MIDGET OP. 5,000Ω to 3Ω 3/9
8,000Ω to 3Ω 3/9
OP10. 10/15 watts output. 20 ratios on Full and Half Primary 17/9
OP30. 30 watts output. 20 ratios on Full and Half Primary 25/9
Williamson's O.P. Transformer to Author's specification... £4/13/6
Chokes for Williamson's Amplifier, 30 H. at 20 m/a..... 16/6
10 H. at 150 m/a 32/–

FILAMENT TRANSFORMERS
All 200/250 v. Input

F3. 6.3 v. @ 3 amp. 8/11. **F3X.** 6.3 v. @ 1.5 amp..... 5/9
F4. 4 v. @ 2 amp. 7/6. **F6.** 6.3 v. @ 2 amp..... 7/6
F6X. 6.3 v. @ 0.3 amp. 5/–. **F12X.** 12 v. @ 1 amp..... 7/9
FU6. 0-2-4-5-6.3 v. @ 2 amp. 10/–. **F12.** 12.6 v. tapped 6.3 v. @ 3 amp..... 16/6
F24. 24 v. tapped 12 v. @ 3 amp..... 23/6
F29. 0-2-4-5-6.3 v. @ 4 amp..... 17/9
FU12. 0-4-6.3 v. @ 3 amp..... 17/6
FU24. 0-12-24 v. @ 1 amp..... 17/6
F27. Two windings 12 v. @ 1.5 amp..... 21/–
F34. 4-9-15-24 v. @ 3 amp..... 26/6
F39. 9-15 v. @ 6 amp..... 29/–
Transformers suitable for Low Voltage Lighting. Fully shrouded with terminal blocks, 230 v. Input. 12 v. @ 20 amp. £6. 12 v. @ 10 amp. £4/10/–
F5. 6.3 v. @ 10 amps. or 5 v. @ 10 amps., or 12.6 v. @ 5 amps., or 10 v. @ 5 amps. 34/–
F6/4. Four windings at 6.3 v. tapped 5 v. @ 5 amps. each, giving by suitable series and parallel connections up to 6.3 v. @ 20 amps. 51/6

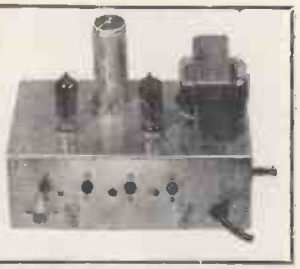
Quotations, etc., stamped addressed envelope please

C.W.O. (add 1/6 in £ for carriage)

Export enquiries invited

H. ASHWORTH (Dept. W.W), 676, Gt. Horton Road, Bradford 7, Yorks.

BAND 3 T.V. CONVERTOR 186/196 Mc/s.



("W. World," May 1954).

Kit of parts complete to build this most successful unit comprising drilled chassis, 7" × 4" × 2½", valves, wound coils, and all necessary components, slightly modified version using 8D3 instead of EF80 valves. £2/5/-, post free. Send for blue print and wiring diagram, 1/6 post free.
Provision has been allowed on chassis for small power pack and AE switching. Power Pack Components, including Mains transf., 30/- extra.

RADIO-GRAM CHASSIS

5 VALVE, SUPERHET, LATEST B.V.A. MIDGET SERIES VALVES

3 WAVEBANDS:—*L.W. 800m-2000m, M.W. 200m-550m, S.W. 16m-50m.*
Chassis size 13½in. × 5½in. × 2½in. Attractive Glass Dial 10in. × 4½in. edge lit by 2 pilot lamps. Horizontal or Vertical Station Names and 4 control knobs, walnut or ivory to choice. 4 position W/C switch, L.M. S. and Gram. P.U. sockets. Modern circuitry, all coils adjustable dust cored and only quality components used throughout. Delayed A.V.C. and neg. feed-back. A.C. mains 200/250 v. Double wound transf. isolates chassis from mains. Aligned and calibrated ready for use.

BRAND NEW & GUARANTEED £9.15.0 Carr. and ins. 4/6.

3-ohm speakers suitable for this chassis available 8" 19/6, 10" 25/-

This chassis is a genuine bargain and delivery is reasonably good.

BEST EVER VALUE IN RECORD PLAYERS

Latest B.S.R. Model. 3 speed Autochanger Mixer Unit. Famous Magidise 7in., 10in. and 12in. record selector. Modern cream styling. Dual X'tal cartridge stylus for high fidelity reproduction. As used by leading Radiogram Manufacturers. Complete with full instructions and template.

OUR BARGAIN PRICE 9½gns. post free.

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CONDENSERS.—Mica, S. Mica, ceramics. All pref. values, 3 pf. to 680 pf. 6d. ea. Tubulars, 450 v., Hunts and T.C.C .0005, .001, .005, .01, .02 and .1 350 v., 9d. .05, .1 500 v. Hunts, 1/-. .25 Hunts, 1/6. .5 Hunts, 1/9.

80 ohm CABLE CO-AXIAL

SPECIAL.—Semi-air spaced polythene-standard ¼in. diam. Stranded core-Feeder losses cut 50%. 9d. yd.
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BALANCED TWIN FEEDER per yd. (80 ohms) 6d.
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50 OHM COAX CABLE 8d. per yd. ¼in. dia.

SPEAKER FRET.—Expanded Bronze anodised metal 8in. × 8in., 2/3; 12in. × 8in., 3/-; 12in. × 12in., 4/3; 12in. × 16in., 6/-; 24in. × 12in., 8/6. etc.

JASON F.M. TUNER UNIT 87-105 mc/s

Kit of parts to build this modern and highly successful unit complete with drilled chassis and J.B. dial, wound coils and screening cans, 4BVA miniature valves, and all necessary quality components etc., for only £6/10/- post free. Superior dial calibrated mc/s., edge lit by 2 pilot lamps, 12/6 extra. Power Pack components kit, including double wound mains transformer, £2/5/- extra.
Tested and approved by "Radio Constructor," etc. Illustrated handbook with full details 2/-, post free.

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Carbon type. Pref. values 10 ohms-10 megohms. 20% Tol. ½ w. 3d.; ½ w. 5d.; 1 w. 6d.; 2 w. 9d.
10% Tol. ½ w. 9d.; 5% Tol. ½ w. 1/-; 1% Hi-Stab. ½ w. 2/-.

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Wire ends. Silicone coated, 25 ohms—10000 ohms, 5 w., 1/3; 10 w., 1/6; 15 w., 2/-. 15000 ohms—33000 ohms, 5 w., 1/9; 10 w., 2/3.

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18 g. Plain undrilled. Folded 4 sides, riveted corners. lattice fixing holes. Depth 2½in., 7in. × 4in., 4/6; 9 in. × 6in., 5/9; 11in. × 7in., 6/9; 13in. × 9in., 8/6; 14in. × 11in., 10/6, etc.

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K3/25 2 kV., 4/3; K3/40 3.2 kV., 6/-
K3/45 3.6 kV., 6/6; K3/50 4 kV., 7/3.
K3/100 8 kV., 12/6; K3/160 14 kV; 18/-; RM1 125 v. 60 mA., 4/-; RM2 125 v. 100 mA., 4/9; RM3 125 v. 120 mA. 5/9; RM4 250 v. 275 mA., 16/-; HT59 250 v. 200 mA., 26/6.

PRE-SET W/W POTS

T.V. knurled slotted knob type. 25 ohms to 30000 ohms, 3/-; 50000 ohms, 4/-; 50000 ohms to 2 Megohms (carbon) 3/-.

VOLUME CONTROLS

1in. semi Midget Type, Long spindles. All values 10000 ohms to 2 Megohms. Less sw., 3/-; S.P. sw., 4/-; D.P. sw., 4/9. All individually boxed. Guar. 12 months.

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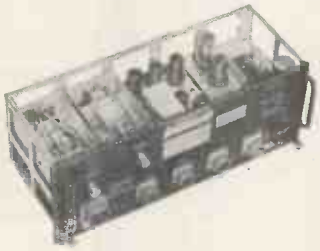
70 BRIGSTOCK RD., THORNTON HEATH, SURREY

Phone: THO 2188 Hours 9 am—6 pm. 1 pm. Wed. Open all day Saturday. BY THORNTON HEATH STATION. BUSES 130A, 133, 159, 166, 190. Terms: C.W.O. or C.O.D. Post & Packing up to ½lb., 6d., 1lb., 1/-, 3lb., 1/6, 5lb., 2/-, 10lb., 2/6. Send for our Bargain Lists, 3d.

PROOPS BROS. LTD.

The Walk-around Shop presents the AN/APN 1.

The AN/APN 1 Unit was originally designed for installation in aircraft and provided measurement of altitude during flight. It comprises the following:—



(1) R.F. TRANSMITTER

(2) RECEIVER

(3) A.F. AMPLIFIER

AS DETAILED RIGHT

In addition it also contains a vast amount of useful components including:—3 Relays, one being a 4-pole change-over type. 3 1 megohm 1 per cent wire-wound resistors. One 8×8×20 mfd. 350×350×150V D.C. condenser, 2 Panel mounting Fuse holders. 3 Twin-gang Potentiometers and several other components.

VALVE Line-up:—5×12SH7; 2×12SJ7; 2×955; 2×9004; 1×VR150/30; 2×12H6. Total of 14 valves, most of them are suitable for Car Radios.

THE COMPLETE UNIT is attractively housed in a black crackle metal case, suitable for rack or bench mounting; size 18″×7″×6″.

PRICE Complete (less dynamotor) Post & Pkg., 2/6 **42/6**

(1) R.F. TRANSMITTER

A sub-chassis 3½″×6¾″×2¼″ containing a R.F. Transmitter operating 67.42 cm. (445 Mc/s) with a bandwidth of 40 Mc/s. Modulation of its carrier is by means of a Moving Coil Transducer with a metal diaphragm. The proximity of the diaphragm effectively changes the resonant frequency of its tuned circuit, to produce frequency modulation. This transmitter utilises TWO 955 (VT 121) valves, and can quickly be converted for Radio Controlled Models; the frequency for this purpose being in the band, or for 70 cm. work.

PRICE, post paid **18/6**

(2) RECEIVER

A sub-chassis 3½″×6¼″×2¼″ houses a Receiver tuned to the transmitting frequency. Contains TWO 9004 valves. For use in 70 cm. band.

PRICE, post paid **12/6**

(3) A.F. AMPLIFIER

An Audio Frequency Amplifier in a sub-chassis 5″×3″×3¼″ R/C coupled, using TWO 12SH7 and ONE 12SJ7 valves; and can be used for Telephone Intercom., Pre-Amplifiers, etc.

PRICE, post paid **15/-**

ABSORPTION WAVEMETER

Easily converted to 2 metres or 70 cm. In Copper-plated metal case 3½″×4½″×5½″ with dial calibrated 0-100 and 120V Neon Tube. Coverage approx. 190-210 Mc/s.

New. **6/6** each post paid.

OSCILLOSCOPE CATHODE RAY TUBES

Type 3 BP 1., 3″ short persistence, complete with Mumetal screen and base.

NEW. Post paid. Only **22/6**

REFLECTOR

in bakelite case

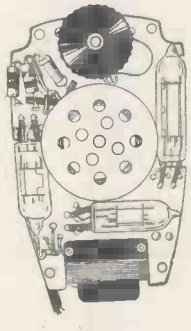
fitted with small bayonet cap holder. Size 5 inches in diameter by 3 inches deep. **2/6** post paid

ACCUMULATORS

Of well known manufacture. 2 volt, 10 ampere/hour. Lead Acid.

5/- Post and packing paid.

Miniature POCKET RADIO



Incorporating high "Q" technique using the New Ferrite rod. Made possible by simple conversion of an ex-Govt. Hearing Aid.

Technical Details. A Germanium Diode Detector circuit followed by the existing 3 valve Amplifier, giving adequate amplification throughout the medium wave band.

This conversion can be carried out in approximately 30 minutes.

THE COMPLETE KIT OF PARTS includes a Type **OL10** Hearing Aid (with Crystal microphone) in perfect working order with miniature ear phone and moulded ear insert attached: ferrite rod, germanium diode, components, circuit diagram and full instructions. Price **£2 6s. 0d.** post paid (or without crystal microphone £2 2s.). *Batteries extra:* 1.5v. L.T. (Type D18), 8d.; 30v. H.T. (Type B119), 4/3.

NOTE: As the crystal microphone is not used in the Pocket Radio, it can, if desired, be used as a general microphone and it does not require a matching transformer.

SEE and HEAR this Miniature POCKET RADIO demonstrated.

NOTE: Orders and Enquiries to Dept. 'W.' *Shop hours: 9 a.m. to 6 p.m. Thursday: 9 a.m. to 1 p.m.* ***OPEN ALL DAY SATURDAY***

PROOPS BROS. LTD. *The Walk-around Shop*

52 TOTTENHAM COURT ROAD · LONDON · W.1. *Telephone: LANgham 0141*

MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-.
300-0-300, 100 mA. 6 v. 3 amp., 5 v. 2 amp., 22/6.

Semi-Shrouded, drop-through 380-0-380 v., 120 mA., 6.3 v. 4 amp., 5 v., 2.5 amp., 22/6.

Drop thro' 350-0-350 v. 70 mA. 6 v. 2.5 amp., 5 v. 2 amp., 14/6.

Chassis mounting or drop-thro'. Pri. 110 250 v. Sec. 350-0-350, 250 mA., 6.3 v. 7 amp., 6.3 v. 0.5 amp., 5 v. C.T., 0.5 amp. 4 v. 4 amp. P. & P. 3/6, 32/6.

Chassis mounted and fully shrouded, 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.

250-0-250 80 mA., 6 v. 4 amp., 14/-.

Drop thro' 270-0-270, 80 mA. 6 v. 3 amp., 4 v. 1.5 amp., 13/6.

Drop thro' 270-0-270 60 mA., 6 v. 3 amp., 11/6.

250 v. 350 mA., 6.3 v. 4 a., twice 2 v 2 a., 19/6.

Auto-trans. Output 200/250 H.T. 500 v 250 mA., 6 v. 4 a., twice, 2 v. 2 a., 19/6.

250-0-250, 60 mA., 6.3 v. 1.5 a., 0-5-6.3 v. 1.5 a., 10/6.

Auto Trans. Input 200/250. H.T. 350 v. 350 mA. Separate L.T. 6.3 v. 7 a., 6.3 v. 1½ amp., 5 v. 3 amp., 25/-. P. & P. 3/-.

Primary, 230 v., fully shrouded, screened primary, 13 v. 1 amp., 7/6.

Pri. 200 v. Sec. 500-0-500 and 500-0-500 250 mA., both windings. 4 v. 3 amp. 4 v. 3 amp., 39/6. P. & P. 5/-.

Mains Transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350 100 mA., with separate heater transformer. Pri. 210, 220, 230, 240. Sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp. and 5 v. 2 amp., 30/-. P. & P. 5/-.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a., 13/6.

500-0-500 125 mA. 4 v. C.T. 4 a., 4 v. C.T. 4 a., 4 v. C.T. 2.5 a., 27/6.

500-0-500 250 mA. 4 v. C.T. 4 a., 4 v. C.T. 5 a., 4 v. C.T. 4 a., 39/6.

6½in. M.E. Speaker, 1,000 ohm field, 15/-.

R. & A. T.V. energised 6½in. speaker with O.P. trans, field coil, 175 ohms 9/6. P. & P. 2/6.

R. & A. 6½in. M.E. speaker, with O.P. trans. field 440 ohms, 10/6. P. & P. 2/6.

Volume Controls. Long spindles less switch, 50K, 500K, 1 meg., 2/6 each. P. & P. 3d. each.

Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., 4/- each. 10K and 50K, 3/6 each. ¼ and 1 meg., long spindle double pole switch, miniature, 5/- P. & P. 3d. each.

Trimmers, 5-40 pf., 5d 10-110, 10-250, 10-450 pf., 10d.

Twin-Gang .0005 Tuning Condenser, 5/- With trimmers, 7/6.

Twin Gang, .0005, with feet, size 3¼×3×1¼in., 6/6.

3-gang .0005, with feet, size 4¼×3×1¼in., 7/6.

T.V. Coils, moulded former, iron-cored wound for re-winding purposes only. All-can 1¼×1¼in., 1/- each, 2 iron-core All-can 2¼×1in., 1/6 each.

Used Metal Rectifier, 250 v. 150 mA., 6/6. Metal Rectifier, 230 v. 45 mA., 6/-.

Metal Rectifier, RM2, 125 v. 100 mA., 3/6.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/9; 42-1 with extra feed-back windings, 4/3. Miniature 42-1, 3/3. Multi-ratio 3,500, 7,000 and 14,000, 5/6. 10-watt push-pull, 6V6 matching, 7/-. 90-1 3 ohm speech coil, 6/6.

PUSH-BACK CONNECTING WIRE. Doz. yds., 1/6. Post paid.

STANDARD WAVE-CHANGE

SWITCHES. 4-pole 3-way, 1/9; 5-pole, 3-way, 1/9; 3-pole, 3-way 1/9; 9-pole 3-way, 3/6; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. 2-pole 11-way, twin-wafer 5/-; 1-pole 12-way single wafer 5/-. P. & P. 3d.

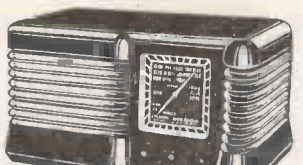
PERMEABILITY TUNED T.V. UNIT

Input 300 ohm balanced line, coverage 54 Mc/s—89 Mc/s and 174 Mc/s—217 Mc/s. Vision I.F.:—45 Mc/s., sound 40.5 Mc/s. Uses 6AK5 R.F valve, 6AK5 as mixer and 6C4 Oscillator. Provision for auto-gain control. Dimensions 9in. wide, 6½in. deep, 4in. high, 9in. blank-scale. Width including scale-overlap 14in. Four stages permeability tuned. Complete with 3 valves. Post and Pkg. 3/-. £2/19/6.

T.V. CONVERTER for the new commercial stations, complete with 2 valves. Frequency can be set to any channel within the 186-196 Mc/s band. I.F. will work into any existing T.V receiver between 42-68 Mc/s. Input arranged for 80 ohm feeder. EF80 as RF amplifier, ECC81 as local oscillator and mixer. The gain of the first stage, R.F. amplifier 10DB. Required power supply of 200 D.C. at 25 mA., 6.3 v. A.C. at 0.6 amp. Input filter ensuring freedom from unwanted signals. Simple adjustments only, no instruments required for trimming. Will work into any T.R.F. or superhet. Size 4½×2½×2in. P. & P. 2/6. £2/19/6. Double wound mains transformer, 200/250 v. metal rectifier, and smoothing condenser to suit above 18/6.

R.F. E.H.T. OSCILLATOR COIL. 6-9 KV with EY51 rectifier winding, and circuit diagram, 15/- As above but complete with 6V6, EY51 and associated resistors and condensers. Circuit diagram, 37/6. As above but complete with line O.P. transformer, scan coils and frame O.P. transformer, £2/19/6. P. & P. 3/.

PLASTIC CABINET, as illustrated, 11½in. × 6½in. × 5½in., in Walnut and Cream, also in polished Walnut complete with T.R.F. chassis, 2 waveband scale, station names, new wave-band, back-plate, drum, pointer, spring, drive spindle, 3 knobs and back. 22/6. P. & P. 3/6. AS ABOVE, with superhet chassis, 23/6. P. & P. 3/6. Either of the above items complete with 5" P.M. speaker and O.P. transformer, 17/6 extra. Used metal rectifier, 230 v. 50 mA., 3/6; gang with trimmers, 6/6; M. and L.T.R.F. coils, 5/-; 3 obsolete ex-Govt. valves, 3 v/h and circuit, 4/6; heater, trans., 6/-; volume control with switch, 3/6; wave-change switch, 2/-; 32×32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-.



Used A.C. mains 200/250 volts, 4 valve plus metal rectifier, medium wave superhet in polished walnut cabinet, size 14 × 9½ × 7½", complete with valves 6K8, 6K7 6Q7 and 6F6. 6½ P.M. speaker. Fully guaranteed. P. & P. 7/6. £3/15/-.

P.M. SPEAKERS. 6½" closed field 18/6. 8" closed field 20/6. 10" closed field 25/-. 3½" 16/6. P. & P. on each 2/-.

EXTENSION SPEAKER in polished walnut, complete with 8in. P.M. P. & P. 3/-. 24/6.

SINGLE SPEED PLAYER. A.C. mains 200/250 v., complete with needle armature pick-up in a really wonderful polished walnut cabinet, will take up to a 12 inch record. Pull-out draw on steel runners. Original list price £8/17/6, our price £4/19/6, post and packing 10/-.

Three speed automatic changer by a very famous manufacturer, current model. Will take 7in., 10in. or 12in. records mixed. Turnover crystal head. Cream finish.
VERY LIMITED QUANTITY.
A.C. Mains 200/250. £7/19/6. P. & P. 4/6.

1,200 ft. High impedance recording tape on aluminium spool. 12/6 post paid.

CUB one-sixth h.p. A.C. 220/230 v. by Brook Motors. Reversible for continuous running, £4/9/6 Post and pkg. 7/6.

Radiogram Chassis, 5 valve A.C./D.C. 3 wave-band superhet 195/255 v. 19-49, 200-550 and 1,000-2,000 metres, I.F. 470 Kc, size of chassis 13 × 6½ × 2½in., size of scale 7½ × 3½in. Valve line-up 10C1, 10F9, 10LD11, U404 and 10P14. Twin mains filter input, 2 dial lights and 8in. P.M., £8/17/6. P. & P. 5/-.

SPECIAL OFFER 8in. P.M. speakers, removed from chassis, fully guaranteed. All by famous manufacturers. P. & P. 1/6. 12/6.

CONSTRUCTOR'S PARCEL, medium and long wave A.C. mains 230/250 2-valve plus metal rectifier, comprising chassis 10½ × 4½ × 1½in., 2 wave-band scale, tuning condenser, wave-change switch, volume control, heater trans., metal rectifier, 2 valves and v/holders, smoothing and bias condensers, resistors and small condensers, and medium and long wave coil, litz wound 22/6. P. & P. 2/6 extra. Circuit and point-to-point, 1/3.

CONSTRUCTOR'S PARCEL, comprising chassis 12½ × 8 × 2½in., cad. plated, 18 gauge, v/h., I.F. and trans. cut-outs, back-plate, 2 supporting brackets, 3 wave-band scale, new wavelength stations names. Size of scale 11½ × 4½in., drive, sp., drum, 2 pulleys, pointer, 2 bulb holders, 5 pax. I.O. v/h., 4 knobs and pair of 465 I.F.s, twin gang, 16 × 16 mfd. 350 wkg., mains trans. 250-0-250 60 mA. 6.3 v., 2 amp., 5 v. 2 amp. and 6½in. M.E. speaker with O.P. trans. 39/6. P. & P. 3/6.

CR100 Coil packs in first-class condition less oscillator section, complete with 4-gang tuning condenser, 19/6. P. & P. 3/6.

CR100 465 Kc. I.F.s, types 3, 4 and 5 and F.B.O., new condition, 7/6 each. 465 Kc. Xtal for CR100, 12/6.

4-gang tuning condenser for CR100, 9/6.

POLISHING ATTACHMENT for electric drills. Quarter inch spindle, chromium plated 5in. brush, 3 polishing cloths and one sheepskin mop mounted on a 3in. rubber cup. Post and pkg. 1/6. 12/6. Spare sheepskin mops, 2/6 each.

POTATO AND VEGETABLE PEELER. By famous manufacturer. To suit models A200 and A700. Capacity 4½lbs. complete with water pump. All aluminium construction, white stove-enamelled finish. Originally intended for adaptation on an electric food-mixer, can be easily converted for hand operation, 39/6. P. & P. 3/-.

USED A.C. MAINS 5 VALVE, 3 WAVE-BAND SUPERHET CHASSIS

Size 11½ x 8½ x 3in., complete with 3 wave-band scale, size 10½ × 5½in., pair of 465 Kc/s IFs, tuning condenser, mains transformer, volume control with switch, tone control. 3 waveband coil pack (this is a completely detachable coil pack on separate small chassis), various small condensers and resistors and biasing condensers. 19/6. Post & Pkg. 3/6.

40-WATT FLUORESCENT KIT, A.C. mains 230/240. Comprising choke, power-factor condenser, 2 tube holders, starter and starter-holder. P. & P. 3/-. 17/6.

20 watt A.C. or D.C. 200/250 v. **FLUORESCENT KIT** comprising trough in white stoved enamel finish, two tube holders, starter and holder and barreter. Post and packing 1/6. 12/6.

Mains Droppers. 0.3 amps., 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, 1/6; 0.3 amps. 950 ohms, tapped 700 and 825, 2/6; 0.2 amp., 1,000 ohms, vitreous, tapped 2/6; vitreous, 0.3 amp., 700 tapped 680, 640, 600, 3/6. P. & P. on each 3d.

T.V. Width Controls, 3/6.

PERSONAL SHOPPERS ONLY. 9in. Enlarger, 17/6: 12in. 27/6.

Germanium Crystal Diode, 1/6, post paid Used 9in. Tube with ion burn, 17/6, post paid.

Line O.P. Transformer in aluminium can mounted in rubber, 12/6.

Speaker Matching Unit on aluminium chassis, 3-15 ohms reversible, 12/6.

Line and E.H.T. Transformer, 14 Kv., using ferrocart core, complete with line and width control, and corona shields U37 rectifier winding, 35/-.

Line and E.H.T. Transformer, 9 Kv., using ferrocart core, complete with built-in line and width control. Mounted on small all-chassis. Overall size 4½×1½in. EY51 rec. winding, 27/6.

Scan coils, low line low impedance frame, complete with frame transformer, to match above, 27/6. P. & P. 2/-.

Line and E.H.T. Transformer, 9 Kv. ferrocart core, EY51, heater winding, complete with scan coils and frame output transformer, and line and width control. £2/5/-. P. & P. 3/-.

As above, but complete with line and frame blocking transformers, 5 Henry 250 mA. choke, 100 mfd. and 150 mfd. 250 wkg. 380 mA. A.C. ripple. £2/19/6. P. & P. 3/-.

Valve Holders, moulded octal Mazda and loctal, 7d. each. Paxolin, octal Mazda and loctal, 4d. each. Moulded B7G, B8A and B9A, 7d. each. B7G moulded and B9A with screening can 1/6 each.

32 mfd. 350 wkg.	2/-
16×24, 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
16×8 mfd., 500 wkg.	4/6
16×16 mfd., 500 wkg.	5/9
16×16 mfd., 450 wkg.	3/9
32×32 mfd., 350 wkg.	4/-
25 mfd., 25 wkg.	11d.
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg., wire ends.	3/3
8 mfd., 500 v. wkg., wire ends.	2/6
8 mfd., 350 v. wkg., tag ends.	1/6
50 mfd., 25 v. wkg., wire ends.	1/9
100 mfd., 350 wkg.	4/-
100 mfd., 450 v. wkg., 280 mA., A.C. ripple	3/11
150 mfd., 350 v. wkg., 280 mA. A.C. ripple	4/6
200 mfd., 275 wkg.	7/6
16+16 mfd., 350 wkg.	3/3
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60+100 mfd., 280 wkg.	7/6
50 mfd., 12 wkg.	11d.
50 mfd., 50 wkg.	1/9

Miniature wire ends moulded, 100 pf., 500 pf., and .001, each, 7d.

Combined 12in. mask and escutcheon, in lightly tinted Perspex. New aspect edged in brown. Fits on front of cabinet, 12/6. As above for 15 in. tube, 17/6.

Frame Oscillator Blocking Trans., 4/6. Line Osc. Blocking Trans., 4/6.

CHOKES:
2-20 Hen. 150 mA., 15/-. P. & P. 3/-.
6 Hen., 275 mA., 15/-. P. & P. 3/-.
100 Hen., 40 mA., 15/-. P. & P. 3/-.
2 henry 150 mA., 3/6; 250 mA. 10 henry. 10/6; 5 henry 250 mA., 60 ohms., 8/6.

Wide Angle P.M. Focus Units. Vernier adj. state tube, 15/-.

Energised Focus Coil, low resistance mounting bracket, 17/6.

Ion Traps for Mullard or English Electric tubes, 5/-, post paid.

Standard 465 Kc. iron-cored I.F.s, 4×1½×1½in., per pr., 7/6. Wearite standard, iron-cored, 465 Kc. I.F.s, 3½×1½×1½in., per pr., 9/6.

Iron-Cored 465 Kc. Whistle Filter, 2/6.

465 KC. MIDGET I.F.s. Q.120 size 1½in. long, 1in. wide, ½in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair, 12/6.

ALPHA OFFER A SELECTION OF GOVERNMENT SURPLUS VALVES ALL TESTED BEFORE DESPATCH

Full list available 2½d. stamp. Complete catalogue 6d.

OZ4	6/-	6K7GT	6/6	25Z4G	9/-
IA5GT	6/6	6K7M	6/9	35L6GT	8/9
IA7	11/6	6K8G	8/-	35Z4GT	8/6
IC5GT	8/-	6K8GT	9/6	50L6GT	8/6
IL4	7/6	6L6G	9/-	AC6/PEN	5/6
IN5	10/-	6L7M	7/6	ATP4	6/6
IR5	7/6	6N7	7/6	E1148	2/-
IS5	7/6	6Q7G	9/-	EBC41	11/-
IT4	7/6	6R7G	8/-	ECH42	10/6
IU5	8/-	6SA7GT	8/-	ECL80	12/6
220VSG	6/9	6SG7	7/6	EF80	11/-
2A3	6/9	6SH7	6/-	EL41	11/6
2X2	5/-	6SJ7GT	8/-	EY51	13/6
3A4	8/-	6SK7	6/3	FW4/500	10/-
3Q4	9/-	6SL7	8/-	GZ32	12/6
3Q5	10/-	6SN7GT	9/-	H30	5/-
3D6	5/9	6SQ7	9/-	HL23DD	7/6
3S4	8/6	6SS7	8/-	KT2	5/-
3V4	9/-	6U4	14/-	KT33C	11/6
4D1	3/-	6U5G	8/6	KT66	10/6
42	8/-	6U7G	9/-	MS/PEN	5/-
5U4	8/6	6V6G	7/6	PCC84	11/6
5Y3GT	8/6	6V6GT	7/6	PCF80	11/-
5Z3	8/6	6X5GT	7/9	PCF82	11/-
5Z4G	8/6	7B7	8/6	PEN25	8/-
6A7	10/6	7C5	8/6	PEN46	8/6
6A8G	10/6	7C6	8/6	PEN220A	4/-
6AC7	6/6	7H7	8/-	PM12M	10/-
6AG5	7/6	7Q7	8/-	QP21	7/6
6AJ5	9/-	7R7	8/6	S130	8/6
6AK5	7/-	7S7	8/6	VR53(EF39)	6/6
6AL5	7/-	7Y4	8/6	VR54(EB34)	2/-
6AM5	5/6	80	8/6	VR55(EBC33)	7/6
6AM6	7/6	807	7/6	VR56(EF36)	6/-
6AQ5	8/6	8D2	2/9	VR57(EK32)	8/-
6AT6	8/-	9001	5/6	VR65(SP61)	3/9
6B4	5/-	9002	5/6	VR65A(SP41)	3/6
6B8G	4/-	9003	5/6	VR66(P61)	3/9
6BA6	8/6	9004	5/6	VR91(EF50)	6/-
6BE6	8/-	9006	6/-	VR91(EF50Syl)	8/-
6BR7	9/6	954	2/-	VR92(EA50)	2/-
6BW6	8/6	955	4/9	VR105/30(OC3)	5/6
6C4	8/-	956	3/6	VR116(B872)	4/-
6C5GT	7/6	12A6	6/9	VR119(DDL4)	4/-
6C6	6/6	12AT7	9/-	VR123(EF8)	6/6
6CD6G	13/6	12AU7	9/-	VR136(EF54)	7/-
6D3	7/6	12AX7	10/-	VR137(EC52)	6/3
6D6	7/3	12C8	8/-	VR150/30(OD3)	9/-
6F6G	7/6	12H6	5/-	VP23	8/-
6F6M	8/6	12J5	6/-	VT52(EL32)	8/-
6F8G	7/-	12K7	9/-	VT501(TT11)	6/-
6G6G	6/6	12K8GT	9/-	VU39(MU12/14)	8/6
6H6	3/6	12Q7GT	9/-	VU64(U12)	8/6
6J5G	5/-	12SJ7	8/6	VU111(V1907)	3/6
6J5GT	5/6	12SK7	6/6	VU120A	3/-
6J5M	6/6	12SQ7	8/6	X65	10/-
6J6	8/-	12SR7	7/6	X66	11/6
6J7G	6/6	25A6G	10/6	Y63	9/-
6K6GT	6/6	25L6GT	8/6	Barreter	
6K7G	6/-	25Y5G	9/-	Atlas 150A	4/6

Wire Wound Controls R.C.A.

Pre Set 25 ohms	2/6
Colvern CLR901 10K. ohms	2/-
Colvern CLR1232/268 500 ohms	2/6
Colvern 1,000 ohms, spindle ⅜in.	2/6

HEATER TRANSFORMERS

	Each
230 v. Input 2 volt .5 amp.	4/6
230 v. Input 2 volt 3.0 amp.	7/9
230 v. Input 4 volt 1.5 amp.	5/-
230 v. Input 4 volt 3.0 amp.	10/-
230 v. Input 5 volt 2.0 amp.	10/-
230 v. Input 6.3 volt .5 amp.	5/-
230 v. Input 6.3 volt 1.5 amp.	6/-
230 v. Input 6.3 volt 3.0 amp.	9/-
230 v. Input 12 volt .75 amp.	5/-

SENTERCEL RECTIFIERS

RM1, 3/9 ea.: RM2, 4/2 ea.: RM3, 5/- ea.: RM4, 16/- ea.

METAL RECTIFIERS

12 v. ½ amp., 1/6 ea.: 12 v. 1 amp., 4/6 ea.: 2 v. 1 amp., 3/- ea.: 250 v. 45 mA., 6/3 ea.: 250 v. 75 mA., 7/6 ea.: 300 v. 60 mA., 7/6 ea.

CRYSTAL DIODES

Plastic case, wire ends, 2 for 2/1.

"Another Alpha Kit for you to build."

3 Valve (6K7, 6J7, 6V6GT) Plus Metal Rectifier, 2 Wave Band Midget radio A.C. Mains, complete in every detail, full instructions, circuit diagram and shopping list 1/6. Complete kit down to nuts, bolts and solder £5/10/-. Post 2/6

POCKET TEST METER

Ex-Govt. volt meter two ranges 0-15 v.: 0-250 v. D.C. Complete in case, 17/6 each.

IRON ELEMENTS

Standard adaptable type, 230 v. 450 w., 1/8 ea. Morphy Richards, replacement type, 3/9 ea. H.M.V. replacement type 3/- ea.

PLIERS, with side cutters, 4/3 pair.

PUBLICATIONS

	Each
Midget Radio Construction Manual	3/6
Radiofolder "F" An inexpensive tape recorder	2/6
Radiofolder "B" A practical Oscilloscope	2/6
Radio Calculations Manual	3/6
Practical Circuits Manual	3/6
Radio and Television Laboratory Manual	2/6

	Each
L.E.M. Silver Mica 1,000 pF 10%	3½d.
L.E.N. Silver Mica 100 pF. 5%	3½d.
T.C.C. Silver Mica 50 pF. 10%	3½d.
L.E.M. Silver Mica 300 pF. 10%	3½d.
Hunts Silver Mica 374 pF. 1%	3½d.
L.E.M. Silver Mica 350 pF. 10%	3½d.
L.E.M. Silver Mica 25 pF. 20%	3½d.
T.C.C. Silver Mica 1,000 pF. 10%	3½d.

	Each
Tubular Condenser .5 mfd. 500 v.	6d.
Yaxley Switch 1 pole 8 way 1¼in. spindle	1/9
Arrow Toggle Slotted Dolly S.P.	1/9
Single Screened Cable ......yard	6d.

	Each
Eric Mains Dropper 725 ohms 7½% tapped	1/6
Dubilier Moulded Mica AP9 .005	4½d.
HF Pile Wound Chokes	1/-
Vibrator Clips	5d.
Dubilier Nitrogol B45 12 mfd. 350 v.	5/6
International Octal Valve Holders Paxolin	4½d.
Vitreous Enamelled Resistors 20 w. 5,000 ohms	1/-

B.S.R. MONARCH AUTOMATIC RECORD CHANGER

These units will autochange on all three speeds, 7in., 10in. and 12in. They play MIXED 7in., 10in. and 12in. records.
They have separate sapphire for L.P. and 70 r.p.m. which are moved into position by a simple switch.
Minimum baseboard size required 14in. × 12½in., with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price. These units are beautifully finished in cream enamel with cream bakelite arm.
COMPLETE WITH FULL INSTRUCTIONS, £9/19/6.

AMERICAN INDICATOR UNIT TYPE BC929A

Brand new incorporating 3in. tube 3BP1, with mu-metal shield, 2—68N7GT, 2—6H6GT, 6X5G, 2X2, 6G6G, 9 potentiometers, 24 v. aerial switch motor, transformer, and a host of small components. The whole unit which measures only 8½in. × 8½in. × 13½in. is brand new enclosed in black crackle box, and can be supplied at 65/- plus 5/-. P. & P.

Standard 1½in. Brown Knobs, per dozen	5/6
Zenith Dropper 910 ohms, each	2/6
Bakelite case. Double coil Buzzers, each	2/6
Erie Dropper, 1,340 ohms, 150 ohms, each	2/6
Box. 4 BA Nuts and Bolts, each	1/-
Intervalve Transformers Ex. Equip, each	2/-
Hand Microphone Bakelite switch in handle, each	7/6
High to low impedance headphone units (insert in lead) each	3/6
Rubber grommets, assorted, per dozen	6d.
Bakelite Needle cups, each	1d.
Sleeving, various colours, 1 MM, length	1½d.
Mains Switch, 2 hole fixing, S.P., each	1/6
Yaxley Switch, 3 P., 3 B., 3 W., each	1/6
Yaxley Switch, 1 Pole, 9 Way, each	1/9
Waxed Carton, 8 M.F.D., 450 v., each	1/9
Westectors, WX12, W4, WX6, each	9d.
Collaro HI FI Pickup, each	32/6

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; £5 add 2/- unless otherwise stated Minimum C.O.D. fee and postage 2/3.

MAIL ORDER ONLY

MAINS TRANSFORMERS

3-WAY MOUNTING TYPE

MT1
Primary; 200-220-240 v.
Secondaries; 275-0-275 v. 80 mA. 0-6.3 v. 4 amp. 0-5 v. 2 amp. Both tapped at 4 v. .... 17/6 ea.

MT2
Primary; 200-220-240 v.
Secondaries; 350-0-350 v. 80 mA. 0-6.3 v. 4 amp. 0-5 v. 2 amp. Both tapped at 4 v. .... 17/6 ea.

PENCIL RECTIFIERS

K3/25 5/8; K3/40, 7/6; K3/45, 8/2; K3/50, 8/8; K3/60, 9/8; K3/100, 14/8.

CONDENSERS

	Each		Each
8 × 8 mfd. 450 v.	4/-	32 × 32 mfd. 450 v.	6/11
8 × 16 mfd. 450 v.	4/-	32 × 32 × 8 mfd. 350 v.	5/6
8 × 24 mfd. 350 v.	3/-	32 × 32 mfd. 350 v. 25 mfd. 25 v.	5/9
8 × 32 mfd. 475 v.	3/9	60 mfd. 450 v.	2/9
12 × 4 mfd. 450 v.	2/-	64 mfd. 350 v.	2/-
16 mfd. 450 v.	3/-	Dubilier (B.R. Range);	
16 × 8 mfd. 350 v.	4/-	BR 850. 8 mfd. 500 v.	2/9
16 × 16 mfd. 350 v.	3/3	BR. 1650. 16 mfd. 500 v.	3/3
16 × 16 × 8 mfd. 350 v.	3/6	BR.2050. 20 mfd. 500 v.	3/6
20 × 20 mfd. 500 v.	4/9	8 × 8 mfd. 500 v.	4/-
24 mfd. 450 v.	2/9	BR.501. 50 mfd. 12 v.	1/9
24 × 16 mfd. 350 v.	3/6	16 × 16 mfd. 500 v.	5/-
32 mfd. 450 v.	3/-	16 × 8 mfd. 500 v.	4/9
32 × 8 mfd. 350 v.	3/6		
32 × 16 mfd. 350 v.	4/6		

OSMOR COIL PACKS

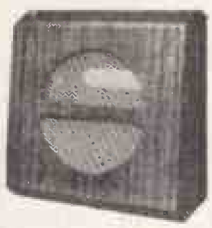
Type H.O., 48/- each. Type L.M., 40/- each. Type T.B., 50/- each. Type TRF, 40/- each.

SPRAGUE CONDENSERS

.05 mfd., 500 v.: 0.1 mfd., 1,000 v.: .1 mfd., 350 v.: .02 mfd., 750 v. All 9/- doz.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LOUDSPEAKER CABINETS



This attractive walnut finished cabinet is available for 6½in. or 8in. speaker units. Metal speaker fret, complete with back and rubber feet.

6½in. type: Measures 8¾in. × 8¾in. × 4½in. at base. Price 16/6 each.

8in. type: Measures 10½in. × 10½in. × 5in., at base. Price 20/6 each.

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

LOUDSPEAKER UNITS

Rola 5in. Speaker	17/6 ea.
Goodmans 5in. unit	18/6 ea.
Plessey 6½in. lightweight unit	16/6 ea.
Rola 6½in. standard type	17/6 ea.
Lectrona 6½in. with transformer	18/- ea.
Truvox 6½in. wafer type	20/- ea.
Plessey 8in. lightweight unit	17/6 ea.
R. & A. 10in.	25/6 ea.
Elliptical 4in. × 7in. unit	21/10 ea.
Mains energised 8in. unit, 1,000Ω	21/- ea.
Mains energised 6in. unit, 600Ω	17/6 ea.

CHASSIS

Aluminium Undrilled with Reinforced Corners. Available in the following sizes.

6in. × 4in. × 2½in.	4/6 ea.
8in. × 6in. × 2½in.	6/3 ea.
10in. × 7in. × 2½in.	7/3 ea.
12in. × 8in. × 2½in.	8/6 ea.
14in. × 8in. × 2½in.	9/6 ea.
16in. × 9in. × 2½in.	12/- ea.

All are four sided—ideal for radio receivers — amplifiers — powerpacks, etc.

PERSPEX IMPLOSION GUARDS. Incorporates escutcheon and filter. 12in. type, 11/6 ea.: 16in. type, 14/6 ea.

EX GOVERNMENT AND SURPLUS CONTROLS

This popular range is suitable for all Television constructors, etc. Keep your costs down when building the "Argus" or "Simplex" receivers. Available 500Ω, 600Ω, 1,500Ω double type, 2 KΩ, 5 KΩ, 10 KΩ, 20 KΩ, 25 KΩ, 50 KΩ, 200 KΩ, 100 KΩ, ¼ meg. Ω, ½ meg. Ω, 1 meg. Ω, 2 meg. Ω, 50 KΩ double type. All 1/2 each.

ALPHA RADIO SUPPLY CO.

5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

WHEN ORDERING PLEASE QUOTE "DEPT. W.W."

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit or for C.R. Tubes with falling emission.
Type A. Low leakage windings. Ratio 1 : 1.25 giving a 25% boost on Secondary.

2 volt	10/6 each With Tag
4 volt	10/6 each Panel and
6.3 volt	10/6 each Solder Tags
10.8 volt	10/6 each
13.3 volt	10/6 each

Ditto with mains primaries 12 6 each. No Boost.
Type B. Mains Input 220/240 volts. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Input has two taps which increase output volts by 25% and 50% respectively. This transformer is suitable for most Cathode Ray Tubes. With Tag Panel 21/- each.
Type C. Low capacity wound transformer for use with 2 volt Tubes with falling emission. Input 230/240 volts. Output 2-2½-2½-3 volts at 2 amps. With tag Panel 17/6 each.
All Isolation Transformers are individually boxed, labelled and clearly marked with relevant data.

RESISTORS. All values. 10 ohms to 10 meg., ½ w., 4d.; ½ w., 6d.; 1 w., 8d.; 2 w., 1/-.

HIGH STABILITY. ½ w. 1%, 2/-. Preferred values 100 ohms to 10 meg.

WIRE-WOUND RESISTORS
5 watt, 10 watt, 15 watt } 25 ohms—10,000 ohms..... { 1/3, 1/6, 2/-
15,000 ohms—50,000 ohms, 5 w., 1/9; 10 w. .. 2/3

WIRE-WOUND POTS. 3 WATT LAB. COLVERN, ETC.
Pre-Set Min. T.V. Type Knurled Slotted Knob. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/-. Ditto Carbon Track 50 K. to 2 meg., 3/-.
Standard Size Pots, 2½in. Spindle High Grade. All Values, 100 ohms to 50 K., 5/6; 100 K., 6/6.
W/W FXT. SPEAKER CONTROL 10Ω 3/-.

O/P TRANSFORMERS. Heavy Duty 50 mA., 4/6. Ditto, tapped primary, 4/9. Multiratio, push pull, 6/6. Tapped small pentode, 3/9. Miniature 3S4, etc., 3/9.

L.F. CHOKES 15/10 H. 60/65 mA., 5/-; 25/20 H. 100/120 mA., 11/6; 20/15 H. 120/150 mA., 12/6.

MAINS TRANS. 350-0-350, 80 mA., 6.3 v. tapped 4 v. 4 a., 5 v. tapped 4 v. 2 a., ditto 250-0-250, 21/-.

MIDGET TRANS. 250-0-250 v. 50 mA. 6.3 v. 2 a., 12/6.

HEATER TRANS. Tapped prim. 200/250 v. 6.3 v. 1½ amp., 7/6; tapped sec. 2, 4, 6.3 v., 1½ amp., 8/6. 6.3 v. 3 amp., 10/6.

CRYSTAL MIKE INSERT. Famous make, precision engineered. Size only 1½ × ⅝in. Bargain Price 6/6. No transformer required.

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AERIALITE EARTH RODS, 4/-.
ALADDIN FORMERS and cores, ½in., 8d.; ¾in., 10d
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
TYANA. Midget Soldering Iron. 200/220 v. or 230/250 v., 14/11. **TYANA TRIPLE THREE.** Complete with detachable bench stand. 19/6. 200/220 v. or 230/250 v.
NEW SOLON MIDGET IRON. 25 w., 22/-. **IDEAL FOR RADIO CONSTRUCTORS.** 200/220 v. or 230/250 v.
MIKE TRANSF. Ratio 50 : 1, 3/9 ea., new and boxed.
MAINS DROPPERS 3 × 1½in. Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms, per foot, .2 amp., 100 ohms per foot, 2 way, 6d. per foot, 3-way, 7d. per foot.
LOUDSPEAKERS P.M. 3 OHM. 5in. 16/6. 6½in. 17/6. Goodmans Elliptical 7 × 4 18/6. 8in. 19/6. 10in. 25/-. 6½in. Goodmans with trans. 21/-. Famous make 10in., 10 watt heavy duty speakers, 3 ohm, Aluminium voice coil, 39/6. 8in. Mains energised 2.5 K or 2 K. ohm field, with tapped output trans., 24/6; less trans. 21/-.
CRYSTAL DIODE. G.E.C. 3/6. Circuit Book 1/-.
H.R. PHONES. (Hi-grade Amer) 15/6 pr.
S. G. BROWN'S. 4,000 ohms 15/6 pr.
COPPER ENAMEL WIRE. ½lb. 16 to 20 s.w.g. 2/-; 22 to 28 s.w.g. 2/6; 30 to 40 s.w.g. 3/6.
SWITCH CLEANER Fluid, squirt spout, 3/9 tin.
TWIN GANG TUNING CONDENSERS. .0005 mfd. midget with trimmers 8/6; 375 pf. midget less trimmers 6/6; .0005 Standard size with trimmers and feet 9/-; less trimmers 8/-; ditto, soiled, 2/6.

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CERAMIC. EF50, B7G, B9A, Int. Oct. 1/-, B7G with can 1/9, B9A with can 2/6.
SPEAKER FRET. Woven Plastic TYGAN. Walnut tone. 12in. wide. 2/- per foot. Expanded metal, gold or silver, 9½in. × 12in., 2/- per piece.

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THREE WAVEBANDS: S. W. 16 m.—50 m. M. W. 200 m.—550 m. L. W. 800 m.—2,000 m.
FIVE VALVES: LATEST MULLARD ECH42, EF41, EBC41, EL41, EZ40.
12 month Guarantee, with 10in. P.M. Speaker, A.C. 200/250 v. 4-way Switch. Short-Medium-Long-Gram. A.V.C. and Negative feedback. 4.2 watts. Chassis 13½ × 5½ × 2½in. Glass Dial 10 × 4½in., horizontal or vertical available. 2 Pilot Lamps, Four Knobs, Walnut or Ivory, aligned and calibrated. Chassis isolated from mains. PRICE £10/15/-. Without 10in. Speaker, £9/15/-. Carr. & Ins. 4/6.

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FAMOUS MAKE. 3-speed Single Record unit with Acos 37 Turnover Head, each Sapphire Stylus plays 2,000 records. Starting Switch Automatically places Pick-up on records, 7in., 10in. or 12in. Auto Stop. Baseplate 12 × 8½in. Height 2½in. Depth 1½in. Price £7/15/6, post free.

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£4/19/6. **CONVERT YOUR RADIO.** Playing desk 15 × 22 × 7in. Walnut finish, drawer front with 78 r.p.m. motor, turntable and pick-up. Press lever start places High Impedance Magnetic pick-up on records 10in. or 12in. Auto Stop. Brand new in original makers' boxes. £4/19/6, carr. free.

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MAGSLIPS always in stock. Also Velodynes, Amplidynes, Servo-Motors, Selsyns, Torque-Amplifiers, Iron cored potentiometers, etc.

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TAPE recording amps, 12gns (mag. eye) or 18gns (meter ind.), inc. p. pack; complete T/R amps, 12watts, p.p., 19gns; 5watts, £14; others, UL/ output, £25.
REFLECTOGRAPH decks; £31 (Lodestar).
JASON F.M. kits; £5/14, or built £15/17.
GRUNDIG, Philips, Ferrograph T/R.
BARKER L/S supplied.
COM. TV convertors available from £5.
H.P. terms now available.
TEL. Gladstone 1770.
HARDING ELECTRONICS, 120a, Mora Rd., Cricklewood, London, N.W.2. [0032

TAPE recorders for sale, exchange or hire in Greater London. good quality tape recorders wanted for cash, all types of repairs, mechanical and electronic, carried out by specialists, all accessories available. we deal exclusively in magnetic recording equipment.
THE MAGNEGRAPH RECORDING Co., Ltd., 1, Hanway Place, London, W.1. Tel. Langham 2156 [3396

FERROGRAPH tape recorders as used and supplied by this studio for four years, thoroughly dependable; tape, microphones, blank disks, splicers, speakers; new Polyester tapes, 48 minutes recording from a 7in reel; transfer your tapes to our wide dynamic L.P.s; Garrard 301 turntable, used once, £2 off list price.
"EROICA" Recording Services (1949), Peel St., Eccles, Manchester. Eccles 1624. Director: Thurlow Smith, A.R.M.C.M [0122

CINE-VOX disc recording equipments, type C7J for high-quality recordings from existing microphone equipment; price from 28gns; also available as a complete channel inclusive of mic., amplifier and playback equipment, at 70gns; type C7 for highest quality professional requirements—recorder mechanism at 46gns, or complete channel at 110gns; demonstrations arranged in London.
PLEASE write for details to K.T.S., Ltd., "Coplow," Park Rd., Braunton, N. Devon. Tel. Braunton 224. Callers by appointment only. [0209

GRAMOPHONE AND SOUND EQUIPMENT—SURPLUS AND SECOND-HAND

H.M.V. 2300H disc recorder complete, microphone, four-channel mixer; nearest offer £140 secures.—Snellgrove, 3, Third Acre Rise, Oxford. [5005

FOR SALE AND WANTED ADVERTISEMENT FORM

TURN TO PAGE NO. 193

NEW COMPONENTS

FM. new W.W. design; coilsets, parts, available now; BEL, FM and transistor pioneers. —Marlborough Yard, London Archway, N.19. Arc. 5078. [0185

TRANSFORMERS 230v d/w tapped at 4v, 6v, 10v, 16v and 24v at 2 amps, 18/6; carbon microphone inserts, 2/6; push-button red and black motor switches suitable up to 1½hp. s/phase, 12/6; 1lb reels cord solder, 9/6; every car battery kept in stock fully charged less than half ring prices.
KINGSTON ELECTRICAL SUPPLIES, 134, London Rd., Kingston-on-Thames. [4995

COMPONENTS—SURPLUS AND SECOND-HAND

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. ELECTROLYTICS, capacity, voltage, size, type of mounting, price post paid: 400, 6v, 1×2in, lug, 1/6; 250+250, 6v, 1×2in, lug, 1/6; 25, 25v, 3/8×1¾, W/E, 1/6; 500, 12v, 3/4×1¾, W/E, 2/-; 1000+2000, 6v 1×3, clip, 3/9; 250, 12v, 3/8×1¾, clip, 1/9; 10, 25v, ½×1¼, clip, 1/3; 500, 50v, 1×3, clip, 3/9; 50+50, 150v, 1⅛×2, clip, 2/9; 100, 275v, 1⅛×3, clip, 3/6; 60+250, 275/350v, 1¾×4½, clip, 6/3; 40+40, 275v, 1¾×2, clip, 3/3; 24, 275v, 7/8×2, clip, 3/-; 32+32, 275v, 1×3, W/E, 3/3; 64+120, 275v, 1¾×4½, clip, 5/6; 8, 450v, ¾×2, clip, 1/9; 24+24+16, 350/425v, 1⅜×2 clip, 4/9; 16+16+8, 350/425v, 1⅜×2, lug, 4/3; 32+32, 350/425, 1⅜×2, clip, 4/3; 100+200, 350v, 2×4½, clip, 6/9; 16+32, 350v, 1⅛×2, clip, 3/6; 8+8, 350v, 1×2, clip, 3/3; 20+10, 450v, 1×3, clip, 4/-; 15+15, 450v, 20mf 25v, 1×3, lug, 4/3; 8, 500v, 1⅜×2¾, 2/6; 8+8, 500v, 1⅜×2, clip, 4/-; all all cans, some with sleeves, all voltages WKG, surge V where marked, new stock, guaranteed. 5mA meters, moving coil, bakelite case, 2in square, flush mounting, new, boxed; 7/- post paid; 50mA, 8/6.
MAINS trans., 250-0-250v, 80ma 6.3v, 2.5A, 6.3v, 0.6A, Pri. 0-210-230-250v, 12/- post paid.
TELEVISION chassis, cadmium plated, steel, size 14×13×2¼in, complete with 13 valve holders (9-B9A Pax, 1-B9A Cer, 2-B7G Cer, 1-Int. Oct. amph.), 20 various tag strips, cut away for metal rect., line trans., etc.; 9/11 each, post paid.
FRONT and rear tube mounts to fit above chassis, 3/- pair, post paid.
P.M. focus rings, wide angle, tetrode tube, fully adjustable, 12/- post paid.
SCANNING coils, wide angle, with mounting lugs, 19/6, post paid; line trans. to suit above coils, gives 12kv EHT, fitted width and line linearity coils, 19/6, post paid; both these items were used with above chassis, etc.
RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. [0015

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport Street, London, W.C.2. See our displayed advertisement, page 181. [0016

METAL-GLASS seals; single-way, hermetically sealed terminals for soldered connections and fixing; mostly 1kv and 2kv sizes, new (surplus). 65/- per 1,000 assorted.—P. B. Crawshay, 94, Pixmore Way, Letchworth, Herts. Tel 1851. [0087

WANTED, EXCHANGE, ETC.

EXTRUSIONS by Marley.

BUYERS requiring rigid and flexible tubes and sections in thermoplastic materials should ask for a quotation from Marley Extrusions, Dept. 129, Lenham, Maidstone, Kent. Harrietsham 381. [4735

WANTED, receivers A.P.R.4, also T.N.16, 17, 18, 19, etc., and any radio test gear.—LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

3000 type P.O. relays with 5,000ohm coils wanted in quantity.—Box 4623. [4880

PROFESSIONAL standard tape equipment, max. 7½in.—Box 5159. [4997

WANTED.—Acoustical amplifier, 12v D.C., 110v A.C., 50w output.—J. Spector, I.C.T.A., Trinidad, B.W.I. [5006

WANTED.—700L tape recorder for school.—Headmaster Boys' Modern School, Barnstaple. [5010

WANTED, tuning units, TN17, TN18, TN19, for R54/APR4 £50 each offered.—Box 4963. [0261

WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components.
LOWE BROS., 9a, Diana Place, Euston Rd., N.W.1. Eus. 1636/7. [4485

WANTED, HRO coils, Rxs, etc., A.R.88s, BS348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

WANTED communication equipment, tape recorders, test equipment, valves, radio, amplifiers, etc.—Ger. 8582, Leed Radio, 39a, Lisle St., Leicester Sq., W.C.2. [4993

WANTED, B.C.610 Hallicrafters, E.T.4336 transmitters and spare parts for same; best prices.—P.C.A. Radio, Beavor Lane, Hammersmith, W.6. [0079

WANTED, output meter, signal generators, valve testers of American type, and capacitance bridges.—R. Gilfillan & Co., Ltd., 7, High St., Worthing, Sussex. Tel. Worthing 8719. [4996

WANTED, good quality communication RYS tape recorders, test equipment, domestic radios, record players, amplifiers, valves, components, etc., estb. 18 years.—Call, send or 'phone Ger. 4638, Miller's Radio, 38a, Newport Court, Leicester Sq., W.C.2. [4824

WANTED, EXCHANGE, ETC.

WANTED, signal generators types TF144G, TF517F, TF762A, frequency meters type BC221, TS174, TS175; also receivers types R1359 and R1294.—Send price and details to Hatfield Instruments, Ltd., 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779/9857. [0037

ALL U.S.A. V.H.F. test and communication equipment; TS174, TS175, TS47, B.C.221 freq. meters; receivers 1294, 1359, Hallicrafters S.27, S 27CA, U.S.A.; APR4 and tuning units TN16, 17, 18 and 19, RCA AR88D-LF, Hallicrafters SX28; valves 707A-707B, 2K28, 2K39, 2K33, 2K41; highest offers given by return.—Ger. 8410 and 4447. Universal Electronics, 22, Lisle St., Leicester Sq., London, W.C.2. [0229

VALVES WANTED

NEW valves required for cash, all types, quantities; send list for quotation.—Langrex, 3, New Pk. Rd., London, S.W.2. [4836

CABINETS

LEWIS RADIO have the best selection and finest finish.—See page 176. [0224

EXCLUSIVE sale of cabinets in bakelite for television apparatus offered to constructors for different countries.—Apply Box 4928. [4947

WALNUT radiogram and television cabinets, soundly constructed; stamp for details.—R. Shaw, 69, Fairlop Rd., Leytonstone, E.11. [4330

METERS WANTED

WE urgently require meters of all types, meter components, test equipment, etc.; any quantity, large or small; prompt cash.—ANDERS ELECTRONICS, Ltd., 91, Hampstead Rd., London, N.W.1. Euston 1639. [4663

REPAIRS AND SERVICE

MAINS transformers rewound, new transformers to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship; fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 47898. [0113

MAINS transformers, E.H.T.s, chokes, field coils, etc., promptly and efficiently rewound or manufactured to any specification. LADBROKE REWIND SERVICE, Ltd., 820a, Harrow Rd. London, N.W.10. [0222

SERVICE sheets for hire or sale, over 2,000 models, radio and television, s.a.e. enquiries. Always at your service.—W. Gilbert, 24, Frithville Gardens, London, W.12. Tel. She. 3052. [4296

TRANSFORMER rewind service, mains, E.H.T transformers and chokes, prompt delivery, range of replacement types ex-stock or manufactured to your specification. METROPOLITAN RADIO SERVICE Co., 75, Kilburn Lane, London, W.10. Ladbroke 2296. [0200

NOTICE that Melton Electronics, Ltd., 387, Ashley Rd., Parkstone, Poole, Dorset, manufacture transformers, chokes, line and frame outputs, R.F. and E.H.T. coils, and a complete range of "C" core types.
YOUR enquiries for rewinding all Commercial Types will receive immediate attention. [4910

REWINDS and conversions to mains and output trans., pick-ups, fields, clock coils, etc., from 4/6; P.P. equipment a speciality; all work guaranteed.—N. L. Rewinds, 173, High Rd., Willesden Green, N.W.10. Tel. Wordsworth 7791. [5033

24-HOUR service, 6 months' guarantee, any transformer; rewind, mains outputs and l.f.s., etc.; all types of new trans., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth. [4268

D. C. BOULTON for repairs to any loudspeaker, specialists on heavy and P.A. types; cone assemblies, field coils, repair accessories, pressure units, microphones; transformers rewound and to specification; motor rewinds.—Lumby St., Manchester Rd., Bradford Tel 22838. [0171

ARMATURE rewinding service to the trade. vacuums, drills, grinders, hood dryers, dental motors, vacuum cleaners, armatures replaced from stock; 24 hours' service; every job guaranteed we also specialize in complete overhauls and rebuilds of vacuum cleaners; all vacuum cleaner parts, hoses, bearings, fans, brushes for any make in stock.—Regani Electric, 95, Park Lane, Leeds, 1. [0028

WORK WANTED

ELECTRONIC development, small qty. assy.; technical drawing.—Box 5515. [0219

WIRING and assembly carried out to A.I.D. standards; large or small orders accepted. —W.H.D., 43, Lawrence Drive, Ickenham, Middx. [5074

CAPACITY available for small plastic moulds and stamping tools; highest limits, clean work, reasonable prices; speciality; hearing aids and electronic components.—Tool maker, 23b, St. Stephens Ave., London, W.12. Appointment by phone, She. 7069. [0084

CAPACITY AVAILABLE

DUE to further expansion of our works and facilities manufacturers are advised that immediate capacity is available for the manufacture of transformers, chokes, and inductances, including wave-winding of all types.
HADFIELDS solventless varnish vacuum impregnation and enveloping processes to approved specifications.
MACHINE engraving on metal and plastics.—Enquiries to Melton Electronics, Ltd., 387, Ashley Rd., Parkstone, Dorset. Tel. Parkstone 233. [4911

PAINTS, CELLULOSE, ETC.

PAINT spraying handbook, 3/6 post free, cellulose and synthetic paints and all spraying requisites supplied; catalogues free.—Leonard Brooks, 53, Harold Wood, Romford. [0207

BUSINESS OPPORTUNITIES

FINANCE available for television/radio, or take shares.—Box 5463. [5061

MISCELLANEOUS

AUTOMATIC dual coil winding machines, range from 22 to 44 S.W.G.—Hawkins, 170, Witton Rd., Aston, Birmingham, 6. [5019

COPPER winding wires ex stock, competitive prices, 17 to 48 swgs, plain enamel, tinned, synthetic, silk, rayon, cotton covered and Litz types.—Box 4414. [4919

METALWORK, all types cabinets, chassis, racks, etc., to your own specification; capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd., (G4B1).—Chapman St., Loughborough. [0208

YOUR own tape recording transferred to disc.—Write, call or 'phone Queensway Private Recording Studios, 123, Queensway, W.2. Tel. Bay. 4992. Studio recordings, tape recording service. [4957

BUILD your own TV and learn about its operation, maintenance and servicing; qualified engineer-tutor available whilst you are learning and building.—Free brochure from E.M.I. Institutes, Dept. WW.58, London, W.4. (Associated with H.M.V.) [0180

LET professionals transfer your tape recordings; record your broadcasts; supply your requirements. D.s. 10in disk 15/6; 12in 16/6. Also LP-S Disk vouchers with tapes purchased from Sound News Productions, 59, Bryanston St., London, W.1. Amb. 0091. [4976

FOR sale, complete public address equipment; suit small factory; consisting of a Tannoy rack-mounted 120w amplifier, pre amplifier, two wave band radio, input and output switch panels, full monitoring and metering facilities; 6 horn loudspeakers 6 double wall or Ceiling mountng loudspeakers, 3 microphones (2 ribbon, 1 moving coil).—Box 5363. [5027

COPPER wires enamelled, tinned, Litz, cotton, silk covered, all gauges; B.A. screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes, coil formers; Tufnol rod, headphones, flexes, etc.; latest radio publications, full range available; list, s.a.e.; trade supplied.—Post Radio Supplies, 33, Bourne Gdns., London, E.4. [0138

BUILD your own highly efficient aerial for F.M. commercial TV, etc.; we supply an ex-radar antennae display consisting of moulded Bakelite insulator, stand-off mounting bracket, dipole elements, and director easily adjusted to suit whatever band required; these aerials have cost several pounds to manufacture; our special price only 15/- plus 1/6 packing and postage.
WALTON'S WIRELESS STORES, 48, Stafford St., Wolverhampton. [0145

NOTICES

BRITISH SOUND RECORDING ASSOCIATION. Details of membership, open to the professional sound recording engineer and all others interested in recording high quality reproduction and other branches of audio engineering, together with details of the London lecture programme and the Manchester, Portsmouth and Cardiff Centres, may be obtained from the Hon. Membership Secretary, H. J. Houlgate, A.M.I.E.E., 12, Strongbow Rd., Eltham, S.E.9. [0031

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

MULLARD, Ltd.

AN opportunity occurs for an Engineer, 25-30 years of age, to enter an expanding commercial engineering office handling magnetic materials and electrical and radio components. The post would suit a man educated to Grad. I.E.E. standard with good technical background who wishes to enter the commercial side of engineering. Starting salary will be not less than £620 p.a. with full employee benefits and scope for advancement in an expanding field.—Applications in writing should be addressed to the Personnel Officer, Century House, Shaftesbury Avenue, London, W.C.2. [5000

PYE, Ltd., Cambridge.

THE above company has vacancies in its Engineering and Research Laboratories for Design and Detail Draughtsmen, mechanical and electrical, also Engineering Tracers, for interesting work on a variety of projects. Applicants must have had drawing office experience, but experience in the electronics industry is not in every case essential.
SALARIES will be on a generous scale in accordance with qualifications and experience and there are good prospects of advancement for persons of suitable ability.
PLEASE write in confidence to Chief Engineer, Pye, Ltd., St. Andrew's Rd., Cambridge, giving brief details of attainments to date and stating which type of work interests you most. [4983

RADIO and television engineer (fully experienced) required; house available for right man.—Box 5510. [5079

TELEVISION engineer, fully qualified, able to drive; good wages for the right man.—Radio & Electrical Services, 35, Westbury Ave., Wood Green, N.22. Bowes Park 2068. [5030

SITUATIONS VACANT

ELECTRONIC Engineer.

INTERESTING post in new and expanding division of a large Co., for an energetic engineer to lead a small team on design and development of pulse generators, wide band amplifiers, oscilloscopes and other instruments; West London suburb, commencing salary £1,000 per annum.—Box 5113. [4990

MICROWAVE Engineers

ARE required by Decca Radar, Ltd., for work on advanced microwave and millimetric aerial design in a rapidly expanding Aerial Group. Applications are invited from Electrical Engineers and Physicists of H.N.C. standard or above, having practical experience in microwave components; the prospects for men of ability are considerable. There is a pension scheme in operation. British Nationality essential.—Please write, quoting reference RLA.108, to Decca Radar, Ltd., 2, Tolworth Rise, Surbiton, Surrey. [0168

ENGINEERS & Physicists.

FERRANTI, Ltd., in their new Laboratories are engaged in a programme of electronic development of great industrial importance. The work involves the use of digital computers to control machines and industrial processes and covers a wide and expanding field of application, offering long-term interest to those engaged in it.
DEVELOPMENT activity for these projects is taking place in the field of electronic circuitry (including pulse technique), digital computers, magnetic recording and servomechanisms; engineers and physicists having experience as well as interest in one or more of these subjects are invited to apply.
THE appointments are permanent and offer full scope for initiative in an expanding organization; a salary commensurate with the qualifications required will be paid; staff pension scheme; application form will be sent on request (quoting Ref./EP/AL) to—The Personnel Officer, Ferranti, Ltd., Ferry Rd., Edinburgh, 5. [4718d

TECHNICAL ASSISTANTS.

ELECTRONIC, to undertake development work of a varied and interesting nature, in a Missile Guidance laboratory now undergoing expansion. Types of work include micro-wave and pulse circuitry, field work on aerials, test gear and power supplies. Applicants should have electronic experience, preferably of radar, communication or telemetry work and hold, or be studying for, H.N.C. or equivalent. Service experience may be a qualification. Excellent salary with bonus. Pension Scheme. Prearranged holiday may be taken.—Apply, quoting Ref. WW/15, with full details of experience to the Assistant Manager.
THE FAIRY AVIATION Co., Ltd., Weapon Division, Heston Aerodrome, Hounslow, Middx. [4985

CINEMA TELEVISION, Ltd.

HAVE vacancies in the
VACUUM Tube Development Laboratory at Lower Sydenham.
FOR personnel in several fields of work, including cathode ray tubes, photocells and signal generating tubes; previous experience of similar vacuum work an advantage, but not essential; applications for interview giving details of age, qualifications and previous experience, are invited from suitable men and women; men applicants should be free from National Service obligations.
1. CHEMIST or Physical-Chemist.
GRADUATE to work on cathode ray tube phosphor screening processes and investigation of phosphor characteristics.
2. LABORATORY Assistants.
QUALIFICATIONS to G.C.E. advanced level in general science or with ordinary national certificate; successful applicants will be expected to continue studies at evening classes.
3. LABORATORY Technicians.
QUALIFICATIONS to G.C.E. ordinary level in science and mathematics; must have capacity for careful and detailed work and have considerable general mechanical aptitude.
4. VALVE Mechanics.
FOR experimental and pre-production electrode assembly; basic training in workshop practice, experience on small bench work and good manual dexterity essential.
5. SCIENTIFIC Glass Blowers.
WITH at least 2 years experience of branch and lathe work and the preparation of small metal to glass vacuum seals.
6. FINISHED Tube Inspector.
TO carry out performance checks on a wide range of vacuum tubes, manufactured on a laboratory scale; education approaching G.C.E. advanced level in general science essential.
ITEM 1. 39 hour week; items 2-6, 44 hour week.
PENSION scheme, canteen facilities, 25 minutes Charing Cross.
APPLY to Personnel Department.
CINEMA-TELEVISION, Ltd.,
WORSLEY Bridge Road, Lower Sydenham, S.E.26. [5026

RADIO and/or television engineer required for bench and outside repairs, driver; references, age, experience, salary expected.—Field's Radio, Ltd., 52, Hall Gate, Doncaster. [3542

ELECTRICAL SERVICE (EDGWARE), Ltd., require good service engineer, bench and outside; clean licence; top salary; permanent; congenial.—93, Edgware Rd., W.2. Pad. 2342 [4797

SITUATIONS VACANT

CIRCUIT Design Engineers ARE required by Decca Radar for positions created by the continued expansion of their Research Laboratories. These cover work in a wide field, embracing high and low power pulse, receiver, A.F.C., radar display, and test equipment design in standard and sub-miniature form. Applicants should preferably be of degree or H.N.C. standard, and have had previous experience in this field. A pension scheme is in operation. British Nationality essential.—Please write to Decca Radar, Ltd., 2, Tolworth Rise, Surbiton, Surrey, quoting reference RLA.103. [0167

GUIDED missiles in Canada.

A MAJOR company and leaders in the field of guided missiles development in Canada REQUIRES immediately a SENIOR Electronics Engineer FOR a Top Level Supervisory Position. ESSENTIAL qualifications include wide experience in the telecommunications and/or electronics field, together with recent supervisory experience in a modern and currently active missile project; specialised knowledge in guidance and control, servo mechanisms, telemetry and test equipment is preferred. THE candidate should also hold a Degree or H.N.C. in electrical, electronics or telecommunications or the equivalent A.M.I.E.E., etc. THE appointment will be on a contract basis and carries an excellent salary. COMPLETE first-class family transportation and moving allowances will be paid, which, together with the generous salary, will provide a very desirable transition to the new life. THIS is an exceptional opportunity to take up a position as one of the leaders in the profession. ALL applications will be treated in strictest confidence unless permission is given otherwise. WRITE to Box No. C.M., c/o Canadian Dept. of Labour, 61, Green St., London, W.1. [5066

FEDERATION OF MALAYA.

ASSISTANT CONTROLLERS OF TELECOMMUNICATIONS (ENGINEERING). Duties include staff management and responsibility for the maintenance, installation and operation of telecommunications equipment, including exchanges, carrier equipment, telegraph and railway signalling equipment and minor radio stations. Appointments on contract/gratuity terms with salary according to qualifications and experience in the range $718 to $1,645 (£1,001 to £2,303 per annum). Variable cost of living allowance also payable. Substantial gratuity; free passages; quarters provided, if available, at low rental or rent allowance in lieu; generous leave. Candidates, under 40 years of age, should be corporate or graduate members of the Institution of Electrical Engineers or hold a degree or diploma acceptable by the Institution for corporate membership and have at least two years practical experience in telecommunications work. Further details on application to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, in writing give brief details of age, qualifications and experience and quoting reference number BCD 133/23/03/. Closing date for receipt of initial inquiries Sept. 17, 1955. [4999

V.H.F. radio link engineer required

FOR the maintenance of Multi-Channel Links. Previous telephone and radio experience essential. APPLY giving full details of experience to Personnel Manager, Pye Telecommunications, Ltd., Ditton Works, Cambridge. [4891

RADIO technician required by the GOVERNMENT OF KENYA for service as Inspector of Police, Grade I (Supernumerary) for one tour of three years with possibility of permanency. Commencing salary (including present temporary allowance of 35% of salary) according to previous experience in scale £796 rising to £1,134 a year. Gratuity (at least £247 after three years service). Outfit allowance £30. Uniform allowance £10. Separation allowance payable to married men under certain conditions. Free passages. Liberal leave on full salary. Candidates, preferably unmarried, aged 20-35, should be at least 5ft 7in without footwear and be of good education. Vision—good standard required but men who wear spectacles are eligible provided that they are not greatly incapacitated without them. Candidates must hold City & Guilds Certificates in Radio and/or Telecommunications or have had at least four years experience with the Technical Radio Branches of the Services or with a reputable firm or a Government Department. Married men should note that it is unlikely that accommodation could be found for their families during the first tour.—Write to the Crown Agents, 4, Millbank, London, S.W.1, State age, name in block letters, full qualifications and experience and quote M1/36753/WF. [4984

SERVICE engineer required for duties in Singapore. A young single man would be preferred, but good experience with radar and echo sounding equipment is essential. AN initial two-year term of duty would be renewable by arrangement. There are generous leave and salary provisions for competent engineers and a training period covering the company's products would be given before taking up duties abroad. WRITE, giving full particulars of age, experience and salary required, to Box 4800. [4919

SITUATIONS VACANT

SIEMENS BROTHERS & Co., Ltd.

DEVELOPMENT & Research Laboratories.
There are vacancies for:—
SENIOR Engineers to take charge of long-term development in:—
(a) New types of Mercantile Marine radio communication equipment.
(b) Multi-channel carrier current telephone and telegraph equipment.
(c) Carrier current terminal equipment for radio links, and submarine cable systems employing submerged repeaters.
(d) Transistor applications.
(e) Electronic switching and computing.
(f) Electro-acoustics.
(g) Design of new components including miniaturization.
ASSISTANT Engineers and Laboratory Technicians to carry out the detailed development for the above.
TECHNICAL Sales Engineers for Carrier Equipment to undertake preparation of tenders, editing and writing technical publications, and training customers' engineers.
APPLICANTS with any of the following qualifications will be considered:—
(i) Degree in Physics or Electrical Engineering with some previous industrial experience.
(ii) Recent and prospective Science Graduates.
(iii) H.N.C. Electrical or Telecom Engineering or A.M.I.E.E.
(iv) O.N.C. or equivalent City and Guilds Certificates with practical industrial experience.
ALL are pensionable staff posts with good prospects of advancement.
SALARY according to qualifications and experience.
APPLY in writing to Siemens Brothers & Co., Ltd., Ref. 744/21, Woolwich, S.E.18, stating age, educational qualifications, experience and salary required. [5018

E. K. COLE Ltd. (Malmesbury Division).

THE Malmesbury Division of E. K. Cole is engaged in the development and production of radar and communication equipment associated with high priority defence projects. Vacancies exist in the Development Department for Project Engineers. Engineers and Assistant Engineers with training and experience in the following fields.
PULSE Circuits.
PULSE Modulators.
STROBE Systems.
VIDEO Amplifiers.
TIME Base Generators, etc.
H.F AND V.H.F Communication—airborne and ground receivers, transmitters and aerial systems.
APPLICANTS should have had technical training to Degree or Higher National Certificate standard, and in the case of project engineers and engineers appropriate technical design experience is necessary.
COMMENCING salaries will be dependent on qualifications and experience and will compare favourably with scales prevailing in the radio industry. A superannuation scheme is in operation. Applicants should apply in the first instance for a technical staff application form to Personnel Manager, E. K. Cole, Ltd., Malmesbury, Wilts. [4702

HER MAJESTY'S OVERSEA CIVIL SERVICE.

APPLICATIONS are invited for the following post:—
RADIO Engineer,
SOCIAL Development Department,
TANGANYIKA.
DUTIES are to be responsible for the operation and maintenance of the 20kw and 1.25kw transmitters, and two 250watts R.C.A. transmitters of the Dar-es-Salaam Broadcasting Service.
APPOINTMENT is pensionable on probation in the salary scale £912 to £1,164 p.a. plus a non-pensionable cost of living allowance of 10% of salary. Quarters, if available, provided at moderate rent. Free passages up to the cost of three adult fares. Leave at the rate of five days for each month of service.
CANDIDATES, preferably under 35 years, should have had at least 2 years' experience of the operation and maintenance of H.F. transmitters. Experience of installation an advantage. Grade C—B.B.C. examination or an engineering degree or other engineering qualification is desirable.
APPLY in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number BCD 178/8/05. [5052

SYLVANIA THORN COLOUR TELEVISION LABORATORIES, Ltd., require
CIRCUIT Engineers for research work on colour television systems, especially receiver display devices.
1. SENIOR Engineers. Must have had a number of years' experience of actual design work on electronic circuits, but not necessarily for television. Academic qualifications to degree standard preferred. Men of inventive character capable of making their ideas work are required.
2. ASSISTANTS to above senior men. Some experience of circuit work and at least H.N.C. or the equivalent essential. Salaries in line with present-day standard. Pension and Life Assurance scheme.
APPLY in writing to (quote B2710):—
SYLVANIA THORN COLOUR TELEVISION LABORATORIES, Ltd., Gt. Cambridge Rd., Enfield. [5057

SITUATIONS VACANT

E.M.I. ENGINEERING DEVELOPMENT, Ltd.

TRANSFORMER design.
A VACANCY has arisen at the Feltham laboratories of this active company for an engineer to work on transformer design and development; the person we are looking for will have at least Ordinary National and preferably have had some experience in the field; but this is not a pre-requisite for consideration; the post is pensionable, and prospects are excellent.—Please send your first reply to Personnel Dept. (ED/235), E.M.I. Eng. Dev., Ltd., Blyth Rd., Hayes, Middx. [5083

ELECTRONIC Wiremen and Radar Mechanics ARE required by Decca Radar to fill positions as Technical Assistants in their Research Division. These positions carry excellent rates of pay and the possibility of promotion to staff appointments. The work is of a varied and interesting nature, concerned with the development of modern navigational aids. There are good canteen facilities. British Nationality essential.—Write, quoting reference RLA.101, to Decca Radar, Ltd., 2, Tolworth Rise, Surbiton, Surrey. [0166

HER MAJESTY'S OVERSEA CIVIL SERVICE
APPLICATIONS are invited for the following post:—
TELECOMMUNICATIONS Engineer.
POSTS and Telegraphs Department, Sierra Leone.
DUTIES cover all general branches of telecommunications engineering, maintenance and construction of overhead and underground line plant, all types of telephone exchanges, telegraph apparatus, and point-to-point radio networks.
APPOINTMENT is either pensionable in the salary range £822—£1,562 p.a. gross or on contract for two tours of 18-24 months each, in the salary range £886—£1,758 p.a. gross, plus a gratuity of £25 to £37 10s for each completed 3 months satisfactory service. Free first class passages for the officer, his wife, and up to two children under 10 years of age. Government quarters are provided, if available, at low rentals. Leave is granted at the rate of 7 days for each month of resident service.
CANDIDATES should be A.M.I.E.E. or have passed or be exempt from Parts A and B of the Institution's examination. A sound knowledge of the theory of telecommunications engineering is necessary and extensive experience of its application.
APPLY in writing to the Director of Recruitment, Colonial Office, Great Smith St., London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number (BCD 108/15/03). Closing date for the receipt of initial applications 17th September, 1955. [4998

JUNIOR Wireless Operators required by the FALKLAND ISLANDS DEPENDENCIES ADMINISTRATION for service in South Georgia for one tour of 30 or 36 months. Commencing salary in the scale £330 rising to £420 a year. Free board and accommodation. Free passages. Leave on full salary. Candidates, unmarried, must possess a P.M.G. Certificate of Proficiency in Wireless Telegraphy and should have some knowledge of postal telegraphs and ships W/T services.—Write to the Crown Agents, 4, Millbank, London, S.W.1, State age, name in block letters, full qualifications and experience and quote M2C/41076/WF. [5034

BRITISH RAILWAYS—modernisation plan; signal engineering.
APPLICATIONS are invited from suitably qualified men for a vacancy for
TELECOMMUNICATIONS Assistant in the Headquarters of the Signal Engineer's Department, Eastern Region, at King's Cross. The post is mainly concerned with telecommunications development work under the Railway Modernisation Plan and offers an interesting career to a suitable man. Applicants must have a sound knowledge of electronics, also thorough knowledge and experience of multi-channel carrier-telephony, radio AM and FM, VF telegraphy, public address equipment, all types of repeaters and automatic telephony. Some knowledge of radar and computors desirable. Academic qualifications essential. The commencing salary will be £1,050 per annum. Certain residential and other travel concessions given. Applications should be addressed to the Signal Engineer, British Railways, Eastern Region, King's Cross Station, London, N.1, giving full details of experience and qualifications. Letters should be marked "D.4." [5009

SALES Engineer required with a good knowledge of the application of components and materials to the following:—
ULTRASONIC equipment.
RADAR equipment.
GUIDED missiles.
PREFERABLY with commercial background in addition; salary in accordance with experience; excellent opportunity for progress in a rapidly expanding organisation.—Box 5514. [5082

ELECTRONIC Engineer required who can undertake part or full time development of low frequency tuned circuits.—In first instance apply Box 5111. [4991

RADIO Testers and Mechanics required for commercial and Government equipment. Permanent positions for right men.—Apply, Britamer, Ltd., 48-56, Bayham Place, London, N.W.1. Tel. Eus. 7841/6. [4998

SITUATIONS VACANT

THE GENERAL ELECTRIC Co., Ltd., has vacancies for:

1. TRANSFORMER Designers for a number of development projects including guided missiles. The work involves design of a wide range of types including small power transformers—at mains or audio frequencies—and pulse transformers.

2. ENGINEERS for work on magnetic amplifier transductors.

APPLICANTS should have experience of the design and development of the above types of electronic components and possess H.N.C. C. & G. certificates or equivalent qualifications.

APPLICATIONS will also be considered from ex-Naval R.E.A.s, R.E.s and R.A.F. radar fitters who have reached the required technical standard.

APPLY stating age and experience to the Personnel Manager, The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry, Ref. RG. [4994

GOLD COAST GOVERNMENT. Broadcasting Engineers.

APPLICATIONS invited for one vacancy in each post of:—

A. HEAD of Engineering Training.

B. ASSISTANT in Engineering Training (Radio Frequency).

C. ASSISTANT in Engineering Training (Audio Frequency).

DUTIES: Post A. Responsible for formulating and carrying through a training scheme in radio engineering for new entrants to the service, courses of training "on the job" for existing staff, and a course and examination approximately equal to the B.B.C.'s Grade C examination for Technical Assistants who wish to qualify for promotion into the Senior Technical Assistant Grade.

POST B. Responsible under the Head of Engineering Training for the training of pupils scattered in small groups over wide areas by lectures and postal courses up to approximately the standard of the B.B.C.'s Grade C examination with emphasis on radio frequency subjects and on the theory and operation of radio frequency equipment. Will also be required to carry out some operational duties.

POST C. Responsible under Head of Engineering Training for the training of pupils scattered in small groups over wide areas by lectures and postal courses up to approximately the standard of the B.B.C.'s Grade C examination with emphasis on audio frequency and power frequency subjects; also for specialized courses on the theory and operation of audio frequency and wired broadcasting equipment used in a broadcasting organization. Will also be required to carry out some operational duties.

QUALIFICATIONS: All posts. Candidates should have passed or have been exempted from Sections A and B of the Associate Membership examination of the Institution of Electrical Engineers or hold equivalent qualifications. Additionally as follows:—

POST A. Have had previous teaching experience. Must be able to organize the training scheme in all its aspects, including postal courses, for its inception, and must have a thorough knowledge of the requirements for the engineering division of a broadcasting service.

POST B. Candidates with exceptional experience but not so qualified may be considered for appointment. Candidates should have a thorough knowledge of transmitter, aerial and feeder systems, receivers, etc., and should also have a sound knowledge of the fundamental theory of audio frequency and power frequency equipment and be capable of lecturing on these subjects. previous teaching experience is desirable.

POST C. Have had appropriate experience in radio engineering. Candidates not so qualified but of exceptional experience may be considered for appointment. Candidates should have a thorough knowledge of studio apparatus and acoustics, tape and disc recording and power equipment and should also have a sound knowledge of the fundamental theory of radio frequency equipment and be capable of lecturing in this subject. Previous teaching experience is desirable.

TERMS of Service: The appointment will be on contract/gratuity terms for one tour of 18 to 24 months with extension provision to two tours. Salary in range £1 600-£2 050 according to age, qualifications and experience. Gratuity at rate of £37/10 for each three months' completed satisfactory service. Free passages appointment and on leave for officer; once each way for wife and up to three children under 13 years each tour. Vacation leave with pay 7 days for each month's service. Kit allowance £30 may be payable. Basically furnished accommodation at £90 p.a rental. Income tax at low rates.

CANDIDATES in the United Kingdom should apply to the Adviser on Recruitment, Gold Coast Office, 13, Belgrave Square, London, S.W.1. for a form of application. Other candidates should send full personal details and statement of qualifications, experience, employments, etc., with approximate dates, to that address. [5065

ELECTRONIC Development Engineers required by well-known North London company, including specialist vacancy for test engineering department. Above average salaries for experienced qualified engineers.—Write Box 5114. [4989

TELEVISION: leading and progressive Murphy dealers need men with good theory background and able to drive, even if little practical experience. Good Salary, conditions and prospects.—Singer's, Pad. 7915. [5023

SITUATIONS VACANT

A DRAUGHTSMAN with mechanical design experience is required for the ELECTRONICS Division of Saunders-Roe, Ltd. Applications are invited from suitably qualified men, especially those with a basic knowledge of the principles of electronics plus experience in the design of electromechanical transducers servomechanisms and electronic assemblies. HOUSING assistance, pension and assurance schemes and other amenities can be offered. THOSE interested should write, quoting ref. WW/36, and giving details of age, experience, etc., to the PERSONNEL Officer, Saunders-Roe, Ltd., East Cowes, I.o.W. [5055

EX-NAVAL R.E.A.s. R.E.s or R.A.F. air or ground radar fitters. APPLICATIONS are invited for employment on development and prototype testing of radar and guided weapon equipments; there is plenty of scope for enthusiastic men with initiative and ability; the work is interesting and working conditions are good; the positions offered are permanent and are covered by a contributory pension scheme; salary according to age and experience. APPLICATIONS should be made to the Personnel Manager, The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry. Ref. RG/B [4710

TECHNICAL writer (radar) required by manufacturer in the London area to compile literature on radar equipment. A GOOD general educational and engineering background is necessary, with H.N.C. (including electronics) as the minimum technical standard. THE principal requirement, however, is the ability to assimilate information supplied by laboratory technicians and to prepare this in a clear logical sequence suitable for publication as a handbook. SALARY will be commensurate with experience and ability, but a minimum of £750 per annum is offered and, for a qualified radar engineer who is able to meet the requirements described above, there is scope beyond the position now vacant. WRITE, in confidence, giving full particulars of past experience, qualifications, age and salary required, to Box 4624. [4882

TECHNICAL writers required by large precision instrument manufacturers in the following fields:— BOILER house and process control gear. Aviation instruments. Radar and other electronic navigation equipment. AN engineering background is desirable but not essential, and applicants should be familiar with at least one of the fields mentioned above, and be able to write technical service literature. SALARIES are in accordance with experience and qualifications but are based on a generous scale. The positions are permanent and favourable pension and payment during illness arrangements, etc., are in operation. APPLICATIONS, which can be made in the strictest confidence, should be addressed to The Personnel Manger, Kelvin & Hughes, Ltd., New North Rd., Barkingside Essex. [4883

R. B. PULLIN & Co., Ltd., invite applications for the following vacancies in their recently formed and expanding Electronic Development Division:— (a) SENIOR Development Engineers: Applicants should possess an Honours Degree or equivalent qualifications, and should have had several years' experience of the development of electronic circuits, preferably including work on electrical servos and magnetic amplifiers. (b) DEVELOPMENT Engineers: Qualifications to O.N.C. or H.M.C. standard, together with some previous experience of valve circuit design. THE positions are of a permanent nature; they offer excellent prospects and the opportunity to work in a newly equipped Laboratory on a variety of projects requiring considerable individual technical responsibility and initiative. A COMMENSURATE salary will be paid. Contributory pension scheme, canteen and recreational facilities.—Applications will be treated as confidential, and should be made to the Superintendent, Electronic Development Division, R. B. Pullin & Co., Ltd., Phoenix Works, Great West Rd., Brentford, Middlesex. [0209

ENGINEER, experienced radio and L.F. amplifiers for factory installation service, preferably own transport.—Apply Gensign, 73, Great Peter Street, London S.W.1. [5037

DRAUGHTSMAN required for detail work on Radio Components. Apply in writing to Personnel Manager, A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, S.W.18. [0059

EXPERIENCED fault finders and testers required for work in London on radio and TV. Good positions for right men with one of the most progressive firms in the industry. APPLY, Works Director, Pye, Ltd., Cambridge. [5012

A VACANCY exists for an engineer to take charge of an expanding department engaged on the testing of a wide range of electronic equipment. Applicants should have the following qualifications:— (a) ABILITY to organize and control staff. (b) A SOUND technical background, with preferably a H.N.C. (c) EXPERIENCE of V.H.F. and pulse techniques. (d) EXPERIENCE of A.I.D. and I.E.M.E. procedure an advantage. Apply Airmec, Ltd., High Wycombe, Bucks. [5035

SITUATIONS VACANT

CHIEF Designer required by company manufacturing electronic and mechanical measuring instruments for industrial and aircraft use: salary £1,000-£1,200, housing assistance, pension scheme.—Full particulars to Box 5485. [5067

RADIO and TV testing offers scope for an interesting career; young men keen on electronics will be trained and given every opportunity to become qualified testers.—Reply to Pye, Ltd., Personnel Dept., Cambridge. [5014

RADIO service mechanics required by Smiths (Radiomobile), Ltd., for many parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [0342

SENIOR technician and technician for construction of prototype electro-mechanical apparatus in department of medical electronics.—Apply Personnel Officer, St. Thomas' Hospital, London, S.E.1. [5031

RADIO Luxembourg require recording engineer for West End studios, comprehensive knowledge of tape and disc recording essential; send full details of experience and salary to—Mr. R. Belcher, Radio Luxembourg (London), Ltd., 38 Hertford St., London, W.1. [5059

RADIO and TV testers and fault finders, Pye, Ltd., Cambridge, have vacancies in London and Cambridge for men with factory production experience; attractive rates of pay and prospects of promotion.—Reply to Ref. 124, Pye, Ltd., Personnel Dept., Cambridge. [4968

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wirers and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. [0238

MURPHY RADIO, Ltd., have vacancies in their electronics division laboratories for engineers and assistants on design and development work, and also on associated electro-mechanical problems; applicants will be considered in the following categories:
1. CANDIDATES with engineering or science degrees or equivalent who have experience in industrial design.
2. GRADUATES who have completed military service but have no experience in design work.
3. CANDIDATES with lesser qualifications but who have considerable experience in industrial design.
4. CANDIDATES under 21 who are at present engaged upon H.N.C. part-time courses.
THE range of work involved is part of an interesting long-term programme in an expanding field and includes:
1. NAVIGATIONAL aids.
2. V.H.F. and U.H.F. transmitters and receivers.
3. PULSE systems.
4. MAGNETIC information recording systems.
THESE posts are permanent and pensionable, and offer good scope to men of ability; applications, giving full details of qualifications, age, experience, should be addressed to Personnel Department (EDL), Murphy Radio, Ltd., Welwyn Garden City, Herts. [5032

McMICHAEL RADIO, Ltd., Slough, Bucks, have vacancies from time to time for electronic engineers to be engaged on Government projects; those wishing to be considered are invitd to write fully to the Chief Engineer, Equipment Division. [0198

SALES Representative.—Airmec, Ltd., High Wycombe, have a vacancy for a Technical Sales Representative. Able to drive and willing to travel abroad if necessary.—Apply, giving full details of experience and salary required to Personnel Officer. [5003

SENIOR Transformer Designer required to take charge of design office dealing with small transformers, power, audio, pulse, etc. Excellent prospects for an engineer with practical experience as well as academic knowledge: London area.—Box 3026 [4528

TRAINEE Television Service Engineer required by old-established London retail radio and electrical business. Good opportunity for keen man with aptitude for this work. Driving experience essential. State age and full details of career.—Box 5039. [5053

SENIOR and junior design engineers required for high fidelity sound reproduction projects.—Applicants should give full details of qualifications and experience by letter to Chief Engineer, Pye, Ltd., St. Andrew's Rd., Cambridge. [4917

REQUIRED to fill immediate vacancies, radar mechanics with experience of Army A.A. Mark 3, for employment as testers; write fully stating experience and qualifications.—Airtech, Ltd., Aylesbury & Thame Airport, Haddenham Bucks. Tel. Aylesbury 1163. [5039

RADIO Inspector required to cover the overhaul and testing of modern aircraft radio and radar equipment, the post is both permanent and pensionable; free transport to local towns, canteen facilities; write fully stating experience and qualifications.—Airtech, Ltd., Aylesbury & Thame Airport, Haddenham, Bucks. Tel. Aylesbury 1163. [5038

ADMIRALTY—Royal Naval Scientific Service. Engineers and Physicists (particularly with electronics) required in Experimental Officer and Assistant Experimental Officer grades in Experimental Establishments in London, Portsmouth, Weymouth areas, Gloucestershire and Scotland. Qualifications—British subjects, minimum of H.S.C. (Pass degree, H.N.C., or near equivalent an advantage.) London salary (men) E.O. £750-£920. A.E.O. £302/10-£670 (according to age). Appointments unestablished, but opportunities to compete for established posts. Application form from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting A214/5A. [4980

SITUATIONS VACANT

A TECHNICAL Assistant is required for secretarial staff of a radio manufacturers' Association in London. Good technical qualifications desirable plus the ability to record accurately and dictate reports, etc. Commencing salary £550 to £600 p.a.—Apply Box 5431. [5049

ELECTRONIC engineer, degree or equivalent, practical design experience of V.H.F. transmitters and receivers essential; small but rapidly expanding organization on South Coast (near Southampton).—Write full details, age, experience and salary expected to Box 5399. [0263

OLD-ESTABLISHED radio and electrical business, London, requires (a) Television Service Engineer; (b) Electrician; (c) Trainee for television or electrical work. Driving experience essential. Good prospects for capable men. State age and details of career.—Box 5440. [5054

ELECTRONIC test engineers required to work on a number of interesting projects, ex radar or wireless fitters would be suitable; must be capable of working with a minimum of supervision.—Apply in writing to the Chief Engineer, stating age and full details of experience, Messrs. J. Langham Thompson, Ltd., 88, High Rd., Bushey Heath. [5058

RESEARCH investigator to work on development of new batteries and allied projects: starting salary in the range £600-£800, according to experience; F.S.S.U. superannuation scheme.—Applications to The Director, Tin Research Institute, Fraser Rd., Greenford, Middlesex. [5080

ELECTRONICS Engineer, B.Sc., or H.N.C., for laboratory development work on miniature equipment using transistors. Work in Slough/Marlow area. 5-day week, canteen, pension scheme. Wide scope for energetic, versatile man with progressive ideas.—Full details of age, experience, salary required to Box 5430. [5050

A. H. HUNT (Capacitors), Ltd., require Draughtsmen, preferably with mechanical and electrical experience, for work on special purpose machines. Write giving age and previous experience to Personnel Manager, A. H. Hunt (Capacitors), Ltd., Bendon Valley, Garratt Lane, Wandsworth, S.W.18. [0057

LABORATORY Assistant required in the research laboratory of a group working on a missile system, some experience of electronics and circuit construction is required; the post would suit an applicant with N.C. or C. & G. who wishes to improve his technical and practical knowledge.
WRITE giving full details of qualifications and past experience quoting Ref. 71, to The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5047

ELECTRONIC Laboratory Assistant required for experimental work and electrical measurements; superannuation scheme; write, stating age, qualifications and/or experience and salary required to—Personnel Manager, The The Telegraph Condenser Co., Ltd., North Acton, W.3. [4724

A GRADUATE wishing to enter the field of guided missiles is offered a post in the system research laboratory of an advanced guided weapon project, theoretical knowledge of general electronics, transistors, or servo mechanism is required, some practical knowledge would be an advantage.
WRITE in detail, quoting Ref. 70 to—The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5044

EDISON SWAN ELECTRIC Co., Ltd., require a Technical Salesman to operate from the address below. The work will include liaison with customers of the Company's industrial valves. Send particulars of age, experience and salary required to—155, Charing Cross Rd., London, W.C.2. Reference K.S.P. [4979

SENIOR Engineers required for development of television with large manufacturing company in N. London area, excellent prospects for promotion in a large research and development establishment, four-figure salary, pensionable position.—Write in confidence giving details of experience to Box 5423. [5043

ELECTRONIC/Electrical engineer required by London component manufacturers for test gear development and supervision of maintenance; minimum age 30; a good salary can be offered to engineer with definite practical ability; write full details, experience and present remuneration.—Box 4568. [4861

SENIOR and junior electrical and mechanical draughtsmen required for the electronics drawing office of the British Thomson-Houston Company, Blackbird Road, Leicester. Please apply in writing to Manager, Drawing Offices, British Thomson-Houston Company, Ltd. Rugby, giving details of age, experience, etc. [4889

SOUND recording equipment maintenance and operating staff required; essential qualifications: Higher National Certificate or equivalent, plus experience servicing amplifiers and allied equipment; 5-day week, pension scheme, permanent employment, generous salary.—Write giving full particulars to Box 5393. [5028

APPLICATIONS are invited from senior project engineers with a specialised knowledge of the manufacture of electrical and mechanical products; applicants should have a good practical engineering background and a sound technical experience of tool design and planning and be capable of putting new projects on a sound production basis; these vacancies offer excellent opportunities to men seeking permanent and progressive positions; London area.—Applications, which will be treated in confidence, should give full details of experience and salary required and be addressed to Box 4395. [4927

SITUATIONS VACANT

JUNIOR Engineers required for development of television with large manufacturing company in N. London area, excellent prospects for promotion in a large research and development establishment, salary according to experience, pensionable position.—Write in confidence giving details of experience to Box 5422. [5042

SENIOR Engineers required for development of electronic instruments with large manufacturing company in N. London area, excellent prospects for promotion in a large research and development establishment, four-figure salary, pensionable position.—Write in confidence giving details of experience to Box 5421. [5041

ELECTRONIC engineers are wanted in large Midland engineering plant, the positions are progressive and interesting requiring qualified and experienced electronic engineers, senior and junior for rapidly expanding laboratory engaged upon measurement and control problems.—State age, qualifications and experience fully in confidence to Box 3686. [4678

JUNIOR engineers required for development of electronic instruments with large manufacturing company in N. London area, excellent prospects for promotion in a large research and development establishment, salary according to experience; pensionable position.—Write in confidence giving details of experience to Box 5402. [5040

ELECTRONIC valve engineer required for new research laboratory in north London area. Keen Junior Graduate of Higher National Certificate man. First year to be spent undertaking full time post-graduate course in applied electron physics at Imperial College, with full pay.—Reply, giving full particulars, to Box 5194. [5004

DEVELOPMENT engineers; a leading manufacturer of domestic radio and television equipment invites applications from qualified men with experience in this field for responsible positions in the laboratories.—Those interested should write, giving brief details of qualifications and experience, to the Personnel Manager (Ref. D.E.), Box 4594. [4872

ASSISTANT for technical service department of leading radio valve manufacturers in Central London. Would suit Nat. Cert. or C. & G. examinations student who has completed National Service. Salary according to age and experience, good prospects, pension scheme.—Box 864, Dorland Advertising, Ltd., 18-20, Regent St., London, S.W.1. [5071

TRANSFORMER design engineer, with experience in mass production of small transformers for electronic industry, required by progressive firm in West Country; applicant must have initiative, ability to control staff, and ambition to take departmental responsibility; write, with full details of age, experience and salary required, to—Box 5467. [5063

VACANCIES exist for engineers in radio and radar field at our various depots. Applicants should possess First Class P.M.G. Wireless Certificate or Ministry of Transport Radar Certificate. Applications from long-service Naval personnel welcomed.—Reply to W. H. Smith & Co., Electrical Engineers, Ltd., 68, Grosvenor St., Manchester, 1. [5072

ELECTRONIC engineers and physicists reqd. for rapidly expanding research department; candidates should have experience of electronic instrument development; experience in pulse circuits or ultrasonics desirable but not essential; B.Sc. or H.N.C. standard.—Write full particu. to Glass Developments, Ltd., Brixton, S.W.2. [5084

CHIEF inspector required by radio component manufacturers to take charge of mechanical inspection of piece parts and final electrical testing; knowledge of loudspeakers an advantage.—Write giving details of past experience and salary required to Electro Acoustic Industries. Ltd., Stamford Works, Broad Lane, Tottenham, N.15. [5021

A VACANCY occurs for a chief inspector; applications are invited from candidates with engineering qualifications and experience in the radio and television industry; salary range from £800-£1,000.—Apply giving full particulars of experience to Personnel Manager, Radio & Allied Industries, Ltd., Hirwaun Industrial Estate, Nr. Aberdare, Glam. [5022

ENGINEERS required for climatic testing of components and complete equipments. Work involves electrical testing measurement. Commercial or Services experience of electrical or telecommunications equipments desirable. Possession of H.N.C. or O.N.C. an advantage. —Reply in writing, stating age, qualifications and experience, to The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry. [4878

TRANSISTORS—an engineer is required for the design and analysis of transistor circuits with application to a guided missile, some experience of transistor circuit design is required, together with academic qualifications, consisting of a degree, N.C. or C. & G.; this is an opportunity to enter a small but expanding team working on these problems, where initiative and ability will be recognised. WRITE in detail, quoting Ref. 69, to—The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5045

A SENIOR mechanical designer is required by a Midlands manufacturer engaged in the complete engineering and production of a variety of electronic products.—First-class men with experience of design work in the light engineering field are invited to write, giving brief details of career and qualifications, to the Personnel Manager (Ref. S.M.D.), Box 4595. [4871

SITUATIONS VACANT

ELECTRONIC Engineer with good knowledge of H.F. measurements and interference suppression required for work in connection with measurement of radio and television interference; superannuation scheme; write giving full details of age, qualifications, experience and salary required to—Personnel Manager, The Telegraph Condenser Co., Ltd., North Acton, W.3. [4722

EX-SERVICE radar and radio technicians are invited to apply for posts as test engineers for work on radar and other electronic products of a large Midland manufacturing organization; further training will be given where necessary; 5-day week; excellent prospects.—Apply, giving details of experience to date, to the Personnel Manager (Ref. E.S.R.), Box 4592. [4870

DEVELOPMENT Engineer.—Muirhead & Co., Ltd., Beckenham, Kent, have a vacancy for Physicist or Electrical Engineer (with degree or similar qualifications) on the development of data transmission devices, miniature motors and instrument servo mechanisms, salary according to experience, pension scheme.—Apply in writing to Personnel Manager. [4982

X-RAY Development; young man required to assist in the design and development of X-ray apparatus; higher national or equivalent qualification essential, and test room experience in X-ray or similar industry desirable; an unusual opportunity offering scope to an engineer of imagination.—Write to Watson & Sons (Electro-Medical), Ltd., G.E.C. Estate, North Wembley, Middlesex. [5025

JUNIOR Electronic Engineers/Radio Mechanics wanted for installation, maintenance and operation small radio transmitting stations in U.K. and abroad; candidates must have good basic training in radio and some industrial experience; must be single and medically fit and prepared to travel abroad; excellent prospects; U.K. salary up to £500 after training and very much more abroad.—Write Box 4017.

TV and radio chief of test; progressive position offered in a North London factory for a man with experience of production testing TV and radio sets; qualifications to include C. & G. Telecom. III or equivalent, substantial practical experience and established ability to control staff, experience of test equipment design or maintenance desirable; substantial salary and prospects of promotion.
REPLY to Ref. 246 Pye, Ltd., Personnel Dept., Cambridge. [4969

EXPERIENCED senior and junior engineers, technicians, mechanics and wiremen at all levels required urgently for a rapidly expanding Telecommunications Dept. of a factory situated in the Oxford Circus Area; exceptionally interesting work on new types of telecommunications equipment; excellent working conditions and possibility of rapid advancement; apply in writing to—Box 5524. [5085

SENIOR radio engineers required for the development of domestic radio receivers, including portables; applicants should have had at least 5 years' previous experience and be capable of progressing designs up to production stage; knowledge of AM FM technique advantageous; write, giving full particulars of age, qualifications and salary expected to—Personnel Manager, Vidor/Burndept, Ltd., West St., Erith, Kent. [5056

ELECTRONIC engineer.—An electronic engineer is required for a development laboratory on a guided weapon project. Degree or H.N.C. preferable. The applicant should be capable of working on his own initiative with a minimum of supervision. Experience of pulse circuitry an advantage.—Write in detail, quoting Ref. 65, to The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5013

RADIO technicians required by International Aeradio, Ltd., for overseas service; permanent and pensionable positions, inclusive salary from £894 per annum to £1,373 per annum, tax free, according to marital status; free accommodation; kit allowance; free air fares; generous U.K. leave.—Qualified candidates to whom replies only will be sent please write quoting RT to Personnel Officer, 40, Park St., W.1. [0262

DRAUGHTSMAN.—Vacancies occur for two intermediate grade young draughtsmen in medium-sized Drawing Office in established electronic manufacturing firm in West Middlesex area. Applicants with general basic experience in light electro-mechanical devices or instruments can be considered provided they have some knowledge in electronics. Good salaries and prospects in an expanding organization. Canteen and pension scheme. Please state age, training and experience.—Box 5171. [5001

TECHNICAL Sales/Service Managers required for British West African branches of large British company distributing domestic radio receivers, V.H.F. radiotelephone equipment, intercommunication telephones, domestic and commercial refrigerators, air conditioners, and office equipment. Good technical radio background essential. Refrigeration experience desirable. Familiarization course arranged with U.K. manufacturers prior to departure for Africa. First class passage, sea/air, free furnished quarters, full pay on leave after approximately 18 months tours, pension scheme. Apply in own handwriting stating age (preferably between 21 and 30), whether married or single, full details education, qualifications, National Service and business experience. Original references should not be sent.—Apply T.S.D., Box 5489. [5069

SITUATIONS VACANT

SALES correspondent required by The Telegraph Condenser Co., Ltd., North Acton, W.3. Applicants must be experienced in conducting semi-technical correspondence, submitting quotations and generally dealing with customers. Knowledge of electrical/radio industry an advantage but not essential. Superannuation scheme up to 55 years of age. —Write, giving full details of experience, age and salary required, to Personnel Manager, T.C.C., Ltd., North Acton, W.3. [4887

SCIENTIFIC Information. A research laboratory on the outskirts of London is setting up a section for the collection of information on a wide variety of subjects. Applications are required from Graduates in Science (physics and mathematics for this post, which offers great scope for the man or woman in charge of the work.) Housing accommodation could be made available to the successful applicant.—Write Box W.U2099, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [4852

THE MITCHAM WORKS, Ltd., have a vacancy for a male Radio and Television Progress Engineer in their production control department. The successful candidate will be responsible for co-ordinating activities and progressing materials required for new designs, and therefore a reasonable knowledge of radio engineering is essential.—Please apply in writing to Mr. G. B. King, Personnel Officer, The Mitcham Works, Ltd., New Rd., Mitcham Junction, Surrey, quoting Ref. D.1. [5070

RADAR, television and radio testers; practical men with a sound basic knowledge of electronics and preferably some experience in one of the above categories are required by the test department of a leading Midlands manufacturer; the work is of considerable interest and offers scope for technical advancement; ex-Service technicians are particularly suitable.—Applicants should write, giving details of experience, to the Personnel Manager (Ref. R.T.R.), Box 4591. [4869

DESIGNER draughtsman required for interesting development work on the design of small electro-mechanical mechanisms for use in switches, thermostats and similar devices; salary up to £825 per annum according to experience and qualifications; contributory pension scheme, canteen, holiday arrangements honoured with pay.—Write, call or telephone for an appointment to Chief Draughtsman, "Diamond H" Switches, Ltd., Gunnersbury Ave., W.4. Chiswick 6444. [4874

COMPONENTS Liaison engineer. A vacancy has arisen at our Feltham branch for a man, preferably with a H.N.C. or Inter-B.Sc., and without N.S. commitments, who will be prepared and able, after a suitable training period to discuss components for radio and electronic equipment with Senior Engineers and outside suppliers. The salary and opportunities in this pensionable post are good. Apply in the first instance to Personnel Dept. (ED/260), E.M.I. Engineering Development, Ltd., Blyth Rd., Hayes, Middx. [5007

THE General Post Office has vacancies for Radio Operators at its coast radio stations and applications are invited from men between 21 and 35 years of age who hold the Postmaster General's First Class Certificate of Proficiency in Radiotelegraphy. Selected candidates will be considered later for permanent pensionable posts. Applications should be made to The Inspector of Wireless Telegraphy, Radio and Accommodation Department, Wireless Telegraph Section, Union House, St. Martins le Grand, London, E.C.1. [5078

TECHNICAL Publications, vacancies exist in this department for suitably qualified radio and radar technicians. The work consists of preparing servicing, installations and operational manuals for radar equipment. Applicants should have a sound basic knowledge of radio and radar theory, and be able to express themselves in good clear English. Similar experience would be an advantage, but is not essential. Apply in writing to address below, giving full details of experience and education, and stating salary required. The starting salary would be in the range of £500 to £650 per annum.—Ref. RWD/TW, Decca Radar, Ltd., 1-3, Brixton Rd., London, S.W.1. [4987

ELECTRONIC engineer.—An opportunity exists in the Guided Missile Section for an electronic engineer to take control of small design group dealing with power production and utilisation; sound electronic knowledge essential and good background of electro-mechanical and mechanical experience an undoubted advantage. Candidates should have practical experience of commercial electronic design and manufacture. A degree is not essential. Work is interesting and varied, working conditions good and prospects excellent. Write in detail, quoting Ref. 66, to The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5017

MINISTRY of Transport and Civil Aviation. Radio Technicians (men only) required at aerodromes and radio stations in various parts of U.K. Special training courses for keen technicians with basic quals. Interesting work providing and maintaining aeronautical telecommunications and electronic navigational aids. Prospects of permanent pensionable posts and advancement. Rates of pay (London) from £342/10 at age 19 to £467/10 at 25, rising (subject to qualifying test) to £565. Rates slightly lower in provinces. Shift and night duty allowances from 2/- to 5/- also payable. Candidates aged 19 or over with practical experience in maintenance of radio or radar equipment should apply to any Employment Exchange quoting Westminster 6627. [4981

SITUATIONS VACANT

SERVOMECHANISMS applied to guided missiles, an experienced engineer is required to work on the research and design of a complex servo forming part of a missile system, a sound theoretical knowledge, coupled with practical experience, is required; the work is of great interest and requires the use of advanced analysis and computing techniques. WRITE giving full details of qualifications and past experience quoting Ref. 72, to The Personnel Manager (Technical Employment), de Havilland Propellers, Ltd., Hatfield, Herts. [5048

DESIGN engineer for electronic instruments capable of designing complete instruments to production stage; experience necessary and a knowledge of production problems desirable. Academic qualifications degree, national diploma, or equivalent. Permanent situation covered by company's pension scheme.—Apply to Technical Director, Advance Components, Ltd., Marlowe Rd., Walthamstow, London, E.17. [5015

ELECTRONIC Engineer required by a large food concern in London for the development and application of various forms of process control; must have the ability to plan the layout, draw up specifications and supervise the installation; experience in the design of electronic control and measuring equipment is desirable together with some workshop experience; salary dependent on age and qualifications; contributory pension scheme.—Apply stating age, qualifications and experience to Box 5513. [5081

TEE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Allesley, Coventry, requires mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments for work on guided weapons and like projects; also required, senior and junior electronic development engineers, particularly in the field of microwave and pulse applications; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager, Ref. R.G. [0259

HONOURS graduate in Physics or Electrical Engineering is required to work in a laboratory engaged in research and development on frequency control problems relating to communication systems. The position, which is in the South of England, is open to men and women and affords excellent opportunities for detailed study of the theoretical and practical aspects of the subjects. Living accommodation, for single or married persons, could be made available.—Write Box W.U2141, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [4853

ELECTRONIC engineer—an experienced engineer is required for the research and design of circuits with application to a guided missile system, he should have at least two years experience and preferably be of degree standard, although applicants with H.N.C. or C. & G. will be considered; the work is of great interest and importance, offering responsibility and good opportunities for promotion.—Write in detail, quoting Ref. 68, to The Personnel Manager (Technical Employment) de Havilland Propellers, Ltd., Hatfield, Herts. [5046

DRAUGHTSMAN required for interesting work on electrical layouts and installations in connection with heavy works plant test schemes; the successful applicant will be required, in the first instance, to devote his efforts to the electrical test equipment of a new large turbo-alternator factory, where a good deal of personal initiative and drive will be expected; National Certificate or equivalent essential; salary in accordance with age and experience.—Apply in writing to Box A58, T. & G., 167, High Holborn, London, W.C.1. [5016

PHYSICISTS and Electrical Engineers are required for advanced work in a research laboratory on the outskirts of London dealing with ultrasonic vibrations in elastic media. Men or women applying for the posts must have an Honours Degree, and preferably should have studied mathematics to a post-graduate stage. The work involved is of great interest, and ready promotion is available to the person having the necessary ability. Housing accommodation could be made available to the successful applicant.—Write Box W.U2113, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [4851

HONOURS graduates in Physics or Electrical Engineering are required for advanced work in a Quartz Crystal Laboratory situated in the South of England. The positions offered afford excellent opportunities for men and women to specialize in the study of piezoelectric materials from both the theoretical and practical viewpoints. An interest in mathematics and electronics would be an advantage for this work. Living accommodation, for single or married persons, could be made available.—Write Box W.U2127, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [4854

TECHNICAL Liaison Officers. A leading electronics company has vacancies in London for senior and junior staff to participate in the development and marketing of radar equipment, computing devices and industrial electronic apparatus. Salary range £600-£1,000 per annum. Applicants should have technical qualifications, preferably to degree standard, and should have experience in dealing with Government establishments or senior staff in industry. The company is expanding rapidly in the electronics field and offers progressive careers and excellent staff conditions to capable men.—Applications, in writing, stating age, experience and salary desired, should be addressed to Box No. 4541. [4850

SITUATIONS VACANT

TECHNICAL radio engineer required to control technical aspect of radio and TV production and liaise between design department and works in a well-known London factory. Good position for a keen person with sense of responsibility.
APPLY Works Director, Pye, Ltd., Cambridge. [5011

SENIOR methods engineer required by a large and progressive engineering company situated in the London area; applications are invited from men with good engineering qualifications and experience in the manufacture of radio, television and services equipment; the accepted candidate will have extensive experience of this class of work and will be acquainted with the most up-to-date production methods, including work study and standard costs; for a man with the required knowledge, initiative and drive this vacancy provides excellent prospects; salary range from £800 to £1,500 per annum.—Please reply, in confidence, giving full details of previous experience to Box 4333. [4928

WAYNE KERR LABORATORIES have several vacancies for Development Engineers and Assistants for work on the design of electronic test equipment. The company, which has an established reputation for integrity of design and quality of workmanship, is at present working on a wide range of projects including precision audio oscillators, V.H.F. bridges, pulse generators and microwave equipment up to Q Band. The designs involve such techniques as encapsulation, printed circuitry, electro forming and advanced sub-miniature design. Salaries are decided by individual ability rather than by fixed salary scales.—Please write for an appointment to The Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey. [5051

MINISTRY of Supply requires Senior Examiners at various places in United Kingdom to inspect and supervise firms' inspection in one of following fields (a) Aircraft and Aero Engines. (b) Radar and Electronics. (c) Instruments and Electrical Equipment or (d) Materials (metallic and non-metallic). Qualifications—British of British parents. Recognised engineering apprenticeship or equivalent training in radio industry or (for materials posts) suitable training in chemistry, physics or metallurgy. O.N.C. or City and Guilds or equivalent qualification desirable. Experience A.I.D. procedure advantageous. Salary—within £660 (age 30)—£810, according to age and location. Not established but opportunities to compete for establishment may arise. State preference for duties and location when applying. Application forms from A.B.971, Ministry of Labour and National Service, London Appointments Office, 1-6, Tavistock Square, W.C.1. [4986

ADMIRALTY.—Temporary Production Inspectors required with experience in either mechanical, electrical, electronic or marine engineering for various places in the U.K. Duties involve work in connection with the manufacture, inspection, test and installation of equipment in H.M. Ships. Inspectors with radar and/or radio experience particularly needed. Candidates, at least 25, should have recognised apprenticeship, or equivalent training, plus additional relevant experience with industry or Government Department. They should preferably possess H.N.C. or O.N.C. in mechanical or electrical engineering, or have reached at least an equivalent standard of technical education with qualifications in appropriate subjects. Appointments unestablished, but opportunities may occur later to compete for permanent posts. Inclusive salary scales £690 to £810 per annum; entry at minimum of scale less about £20 for each year by which age falls short of 30. Salaries outside London somewhat lower. Application forms from M.L.N.S., Technical and Scientific Register (R), 26, King St., London, S.W.1, quoting D 355/5A. Closing date 9 September, 1955. [5077

MINISTRY of Supply requires (a) Chief Examiners; (b) Engineers in London area and provinces for technical direction of inspection from H.Q., or supervision of inspection at works engaged in development and production of guided weapons. Qualifications: British of British parents. Recognised engineering apprenticeship or equivalent in electronics. H.M.C. or appropriate City and Guilds or A.F.R.Ae.S., A.M.I.C.E. or Mech.E. or E.E. or exempting qualifications. For posts (a) manufacturing/inspection experience light mechanical engineering, preferably with knowledge of instruments, gyroscopes, servo systems, clockwork and related test equipment, for posts (b) manufacturing/inspection experience electronic equipment, knowledge of H.F. techniques and electronic servo systems advantageous. Salaries within (a) £772—£985; (b) £645 (age 25)—£1,035 according to age, qualifications, location of post. Not established but opportunities to compete for establishment may arise. Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting C494/5A. State (a) or (b) and location preferred when completing application. [4978

SITUATIONS WANTED

RADIO engineer/administrator (age 49) in radio and electronics for the whole of his working life seeks executive appointment with a company of standing where experience is important. A wide radio engineering experience including design and development organization and administration, production methods, government and inspection procedures and close liaison with Ministry departments is offered for a permanent post with a salary in the region of £1,000 per annum.—Please write Box 4436. [4900

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Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Park Garden, London, S.E.1 *Wireless World* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.: Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.

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