

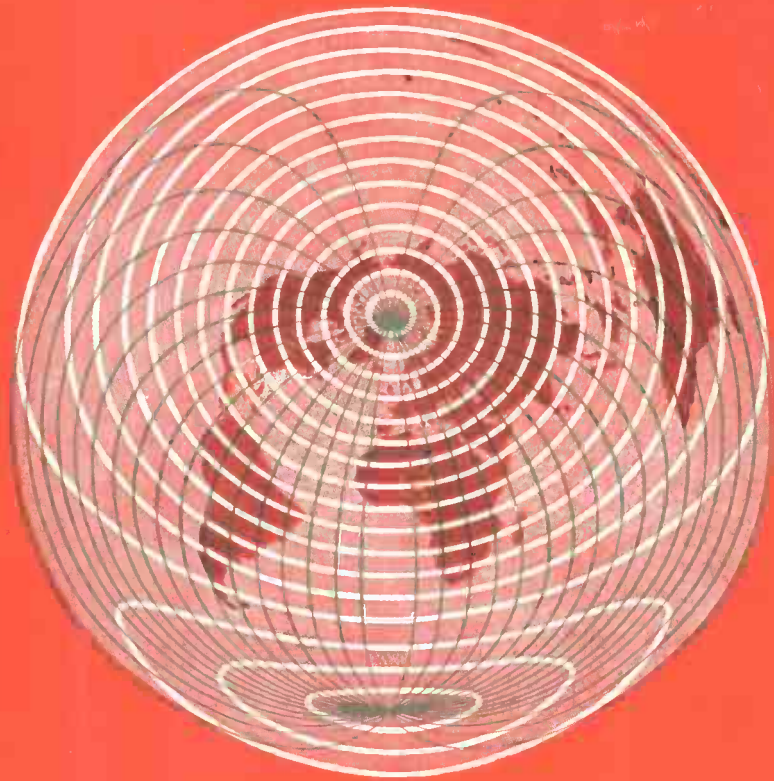
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SEPTEMBER 1957 • TWO SHILLINGS

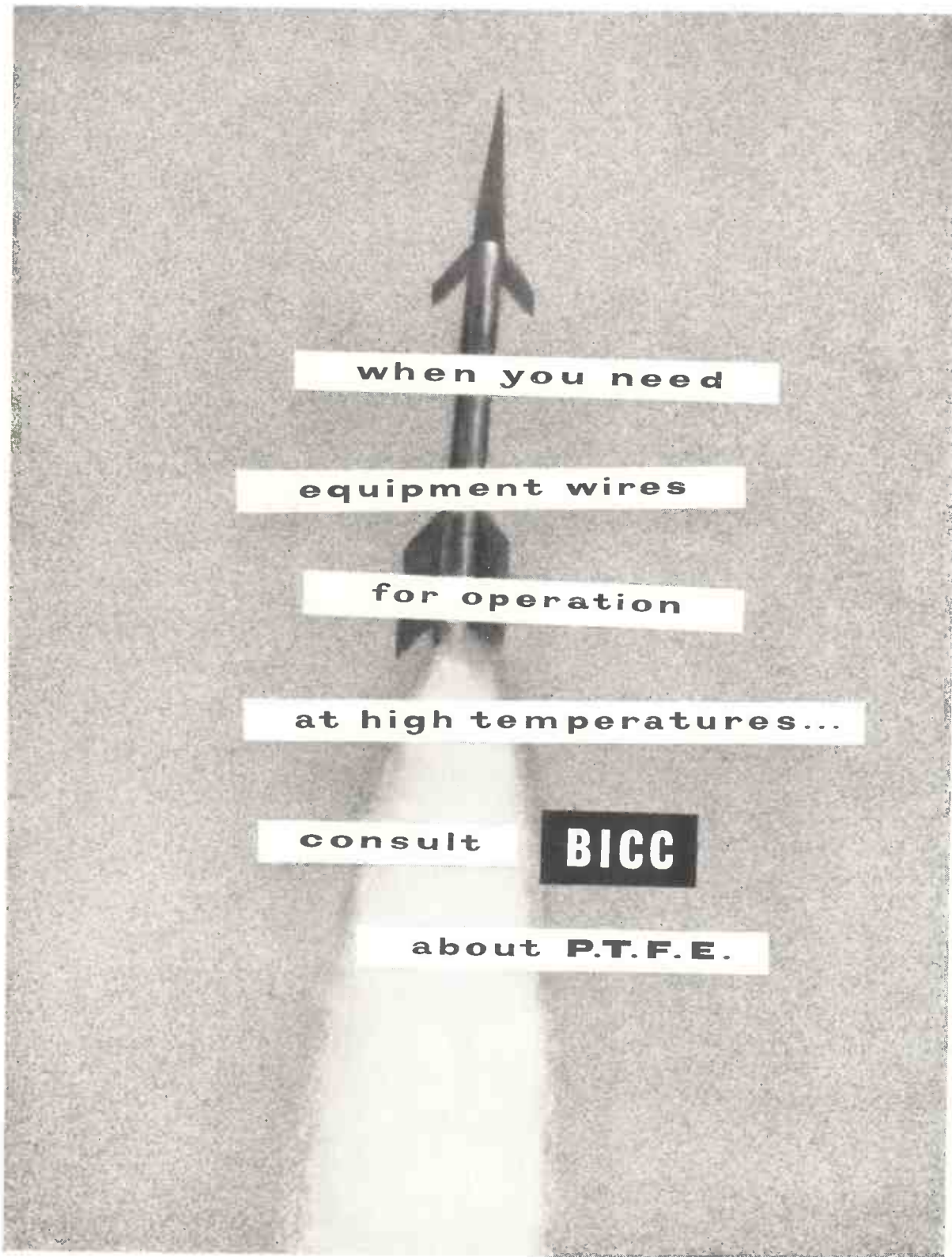
Show Guide

Wireless World

ELECTRONICS
Radio • Television



FORTY-SEVENTH YEAR OF PUBLICATION



BRITISH INSULATED CALLENDER'S CABLES LIMITED, 21 BLOOMSBURY, STREET, LONDON, W.C.1

Wireless World

ELECTRONICS, RADIO, TELEVISION

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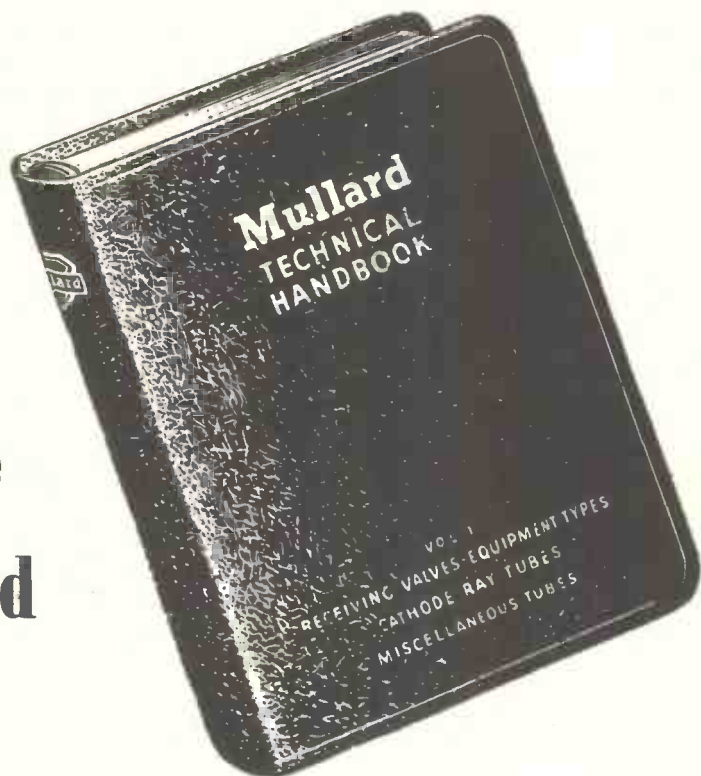
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Copyright Anomaly

THE new Copyright Act 1956, which came into force on 1st June, goes far to remedy the deficiencies of earlier Acts and takes into account the interests of those who broadcast sound and television programmes as well as those who make recordings by "disc, tape, perforated roll or other device."

In most of its provisions the new Act is wise and benevolent, and there is clearly an intention to treat home recording less harshly than some of those who represent opposing interests may have wished. In principle, the permission of the holders of three distinct copyrights must now be obtained, as well as that of the performer of a work, before a recording can be made from a broadcast programme; but the Act makes it clear that no fair dealing with *the work itself* "for purposes of research or private study" shall be held to constitute an infringement;¹ that it shall be a defence in any proceedings brought by *the performer* of a work that recording was made "for private and domestic use only";² that the making of a recording of a *broadcast* otherwise than "for private purposes" is restricted by copyright.³

Although, in view of the precision of wording in other parts of the Act, one may deplore the variations used in expressing the concept of private use it is, nevertheless, gratifying to find these saving clauses in the sections dealing with the performer's rights and two of the copyrights which may be involved when a private individual makes a recording of a broadcast programme for his own use. It comes as something of a shock to find, therefore, that no such exception is made in the provisions granting copyright to *the maker of a sound recording*.⁴ If a private recording is made from a "live" broadcast and the individual observes scrupulously the implied restrictions of private use, he is in the clear: if it is made from a "pre-recorded" broadcast he is not!

This seems to us to be a gross anomaly, and one

which should be clarified at the earliest opportunity. If the omission of the "private use" clause is intended to protect the gramophone record-making companies from dilution of their sales by the making of illicit tape copies which are played back for recreation and enjoyment rather than for serious study or research, we have every sympathy with the intention of this Section of the new Act. But, this end would have been better achieved by the inclusion in the Act of some further specific provision rather than by the omission of a concession which is implicitly granted by all other parties holding copyright. It seems grossly unfair that the powers given to the maker of a record should be greater than those protecting either the creator of a work, the performer or, for that matter, the broadcaster.

An amendment which draws a clearer distinction between the rights in commercially published records and others, such as those made as an intermediate stage in the process of broadcasting, seems already overdue.

European Radio Industry

A RECENT visit to the German radio exhibition has convinced us that if the present rate of progress is maintained we should be well able to hold our own in a European Common Market as far as technical originality, "know-how" and quality of workmanship are concerned. Although the products of the British and Continental radio industries show many superficial divergencies, these arise from the choice of emphasis and timing in development rather than from any fundamental differences in technical capacity.

Ultimately, commercial success will depend on the anticipation of public demand and the creation of new markets by bold and imaginative changes of style and method. What Frank Murphy once did in England, and Braun is now doing in Germany, can be done again, provided always that there is a sound technical background.

¹ Copyright Act 1956 [Section 6 (1)].

² Dramatic and Musical Performers' Protection Act 1925 [Sect. 1] as amended by the Copyright Act 1956 [Sixth Schedule, Part III].

³ Copyright Act 1956 [Sect. 14 (4b)].

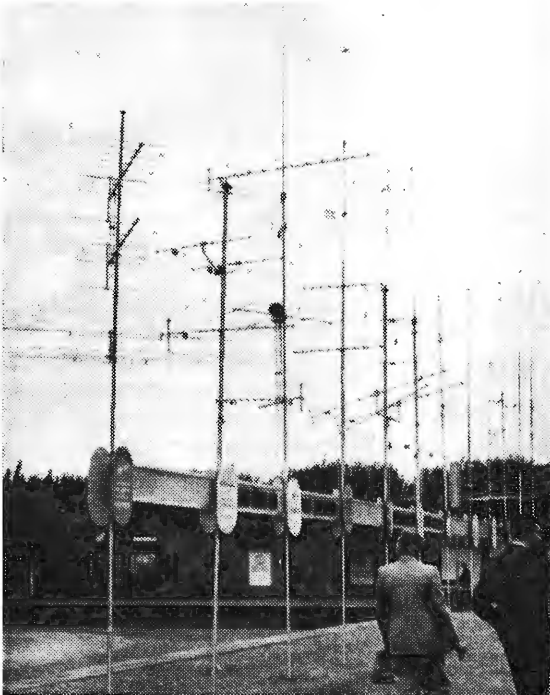
⁴ Copyright Act 1956 [Sect. 12].



DIE GROSSE DEUTSCHE RUNDFUNK- FERNSEH-

THE title of this year's German radio exhibition is commensurate with its size. It was held in Frankfurt's permanent exhibition grounds which cover 87 acres and are centred round a Festival Hall seating about 8,000. This hall was used exclusively as a television studio for the special transmissions arranged for the week of the fair. About 200 exhibitors were housed in seven other halls, two of which were comparable in floor area with the large and small halls at Olympia. Four of the smaller halls were each taken by leading firms in the industry and another large hall was given over to the smaller stand holders. The wide gangways inside the halls and the

Collective exhibit by the German aerial manufacturers.



open spaces in the grounds easily absorbed even the large week-end crowds of visitors.

Receiving aerials in Germany are generally of the multiple type with Band II and Band III, and in some cases even amateur band arrays on a single mast surmounted by a vertical whip for medium and long waves. There is as much difference of opinion as in Britain as to the forms which give the most efficient pick-up and this was emphasized by a collective display in the exhibition grounds of the designs of rival firms under the slogan "*Erst die gute Antenne bringt ein Gerät zur vollen Leistung*" ("Before all things a good aerial brings a receiver to full performance"). For the measurement of aerial performance a special calibrated test receiver (SAM316W) with a range of $3\mu\text{V}$ to 2V and 100Mc/s to 140kc/s is produced by Siemens and Halske. There can be no doubt that the Germans take the matter of aerial design very seriously.

Picture quality in the television receivers working on the stands showed similar variations to those seen at Earls Court, but the average performance, despite the supposed advantage of 625 lines, was not obviously superior. Most sets were placed in semi-darkness, but Siemens have introduced a selective light filter and showed their products under higher ambient lighting conditions.

The standard screen sizes are 43cm (17in) and 53cm (21in) with the latter in the ascendant. One or two firms are promising early autumn delivery of 61cm (24in) models. Printed circuitry is widely used, though in many cases it makes only a token contribution to the total assembly. Automatic gain control for both sound and vision is also well established, as is remote cable control of brightness, contrast and sound volume. In some Graetz receivers push buttons on the front of the set marked "*Plastisch*" (soft and rounded) and "*Scharf*" (sharp) give respectively a reduction or emphasis of the middle frequencies of the video spectrum, sometimes to correct faults in the transmission, but primarily to meet viewers' divergent tastes in picture quality. It is admitted that the effect is partly psychological and that widest acceptance is accorded to the choice of 2.7Mc/s as the mid-frequency for cut or lift. This is obtained by modifying feedback either by a parallel resonant circuit in series with the contrast control resistance or a series resonant circuit in parallel with it.



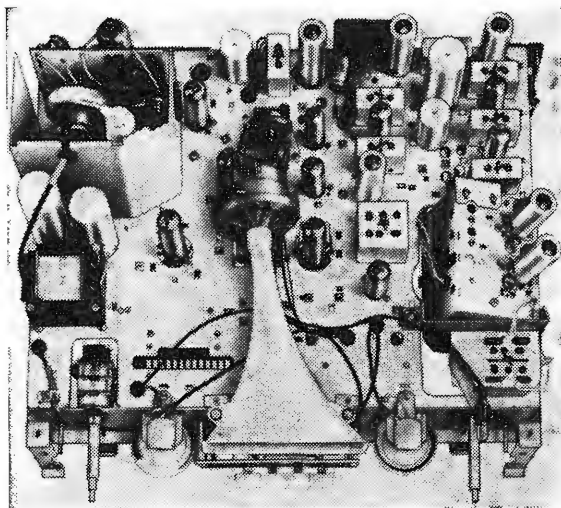
UND PHONO-AUSSTELLUNG

FRANKFURT-AM-MAIN
2nd-11th AUGUST, 1957

Given a prominent place in the Grundig hall and claimed to be the sensation of the show was a portable television set, "*Der erster deutscher tragbarer Fernsehempfänger.*" Of possibly greater interest to a British visitor was the demonstration by Schaub-Lorenz of reception of a live experimental Band IV transmission. Receivers marketed by this firm already have provision for the projected alternative German television programmes on Band IV.

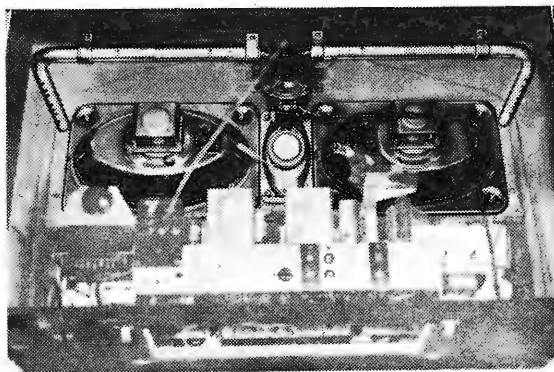
Although the basic design of German sound broadcast receivers has not changed materially there is still a lively interest in their performance—particularly in the effects of the array of piano key controls giving pre-set responses to suit different types of programme. It seems that the Germans—particularly the younger generation—are inveterate knob-twiddlers, and to satisfy this urge every set maker had arranged all his models in working order side by side on long tables or wall shelves, where they were continually besieged by visitors anxious to try their skill. The resulting pandemonium is no easier to describe than it was to endure.

Semi-silent alcoves or separate listening rooms were, however, provided for more mature assessment of the finer examples of *Musiktruhen* (literally "music-chests" i.e., high-quality radio-gramophones) which have not yet been displaced by any equivalent of Anglo-American "hi-fi." The German taste is for rich and pleasant musical sound, not necessarily an exact replica of the original, and has given rise to the cult of *raum klang* or three-dimensional sound. An interesting variant of the usual method of arranging several large and small direct radiator moving-coil loudspeakers to give omni-directional distribution through the front, sides and back of the cabinet is provided this year by Graetz with their *Schallkompressor* (sound compressor) system. (Incidentally, several firms this year are using horn-loaded pressure units for high frequencies and Graetz themselves use a flattened polythene horn for conducting high frequencies to the front of some of their television receivers.) For middle frequencies a horn takes up too much space, but the new Graetz pressure loading system is claimed to approximate the performance of an exponential horn and consists of two tubes of constant cross-section branching symmetrically from the driving unit. Pressure relief and radiation is graded along the tube,



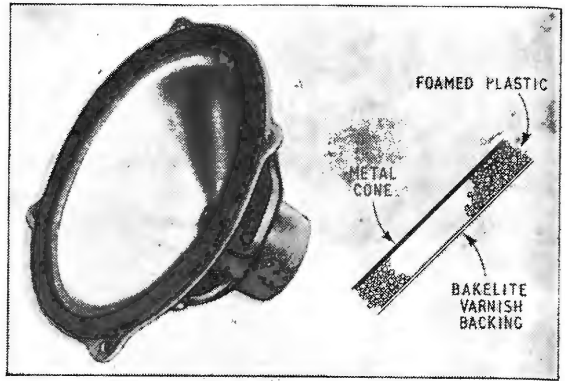
Television receiver chassis (Graetz F37) showing horn-loaded h.f. loudspeaker.

Graetz "*Schallkompressor*" tubular loudspeaker giving the equivalent of horn loading with the addition of a time delay in the range 500-7,000c/s.



first by pairs of small circular holes and finally by slots at distances from the origin calculated to give a smooth response over a range of 500 to 7,000c/s. The rest of the acoustic spectrum is filled out by moving-coil loudspeakers of conventional design. A time delay associated with the passage of sound through the tube system gives a unique and very pleasing disembodiment of the apparent sound source.

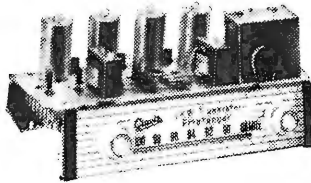
Another loudspeaker which created a favourable impression by its performance was the "Zellaton" made by Dr. E. Podszus und Sohn of Nürnberg-Fürth. This is a moving-coil direct radiator with a "sandwich" diaphragm consisting of foamed plastic coated on the front by thin, soft metal and on the back by a resin varnish. The high internal damping should rapidly dissipate energy stored in flexural vibration and this conjecture was supported by the oscillograms of pulsed tones which showed very little "hang-over."



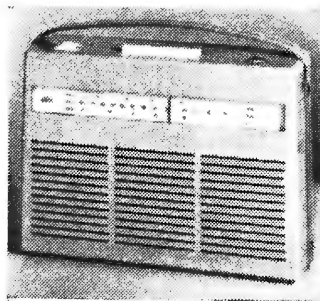
Zellaton moving-coil loudspeaker with composite diaphragm.

Apart from one or two "tweeters" there was no sign of any revival of interest in electrostatic loudspeakers, but this may be because the results obtained from combinations of moving-coil types are manifestly so good.

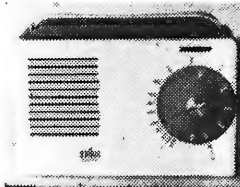
In the Braun Lautsprecherbox L1, for example, a vented loudspeaker enclosure for a low-frequency unit is topped by a row of four medium- and high-frequency moving-coil units, and gave a performance which was in every way comparable with the best Anglo-American standards of "high fidelity." It is associated with a neat combined playing desk and radio receiver. The use of separate receiver - amplifiers



Prototype all-transistor v.h.f. receiver (Graetz).



Braun "Transistor 1" mains/battery portable for long, medium and short waves, and (right) Braun "Exporter" battery portable for medium and long waves.



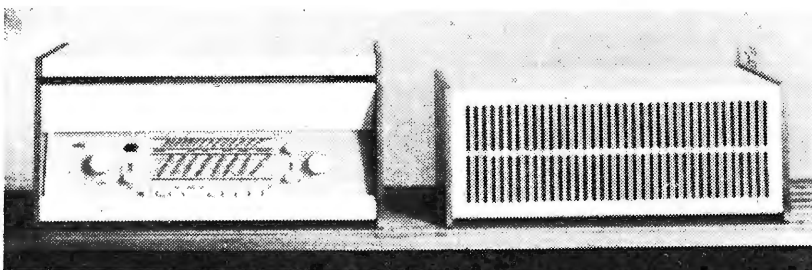
and loudspeakers has much to commend it, both from the point of view of acoustics and flexibility in installation and this practice is followed also in the Braun "Atelier 1" in which the separate units are of matched design so that they can be stacked, or used apart. The external appearance of all the Braun receivers is attractively simple and functional and makes a refreshing change from the so-called "Continental" styles. The

by Telefunken (Magnetophon) of a portable recorder (KL65KS) with a built-in vibratory converter for use on 6- or 12-V battery supplies as well as 110-240V a.c. mains.

A well conducted and much appreciated feature of the television programmes transmitted during the show was a daily technical report (2.0 to 2.30 p.m.) of interesting features of the new receivers and components. Representatives of the firms concerned brought samples to the studio and discussed the finer points of design with an interviewer.

The total attendance at the exhibition was 493,000.

The loudspeaker in the Braun "Atelier 1" can be installed separately, or used as a base for the radio-gramophone unit.



WORLD OF WIRELESS

Scientific Radio Meeting

A TWENTY-TWO man delegation is representing the U.K. at the twelfth general assembly of the International Scientific Radio Union, generally known as U.R.S.I. from its French title.

Delegates from twenty-five countries are attending the meeting being held at the laboratories of the National Bureau of Standards at Boulder, Colorado, U.S.A., from August 22nd to September 5th. They will discuss the reports of the Union's permanent commissions, which conduct continuous studies, and will plan future international programmes. There are seven permanent commissions covering, (1) standards and measurements, (2) troposphere, (3) ionosphere, (4) terrestrial noise, (5) radio astronomy, (6) radio waves and circuits, and (7) radio-electronics.

Among the members of the British delegation, which is led by J. A. Ratcliffe, of the Cavendish Laboratory, Cambridge, who is also president of commission 4, are Sir Edward Appleton, Dr. R. L. Smith-Rose (president of commission 2), Professor H. E. M. Barlow, Professor A. C. B. Lovell, Professor J. Sayers, Dr. W. J. G. Beynon, Dr. L. Essen, Dr. J. A. Saxton, R. Hanbury Brown, C. W. Oatley, and W. Proctor Wilson.

Audio Show

THIS YEAR'S show of sound recording and reproducing equipment, the ninth organized by the British Sound Recording Association, opens at the Waldorf Hotel, Aldwych, London, W.C.2, on September 20th for three days. At this show, which, incidentally, marks the twenty-first anniversary of the Association, 36 exhibitors (listed below) are participating.

The show opens at 12.0 on the first day and at 10.0 on the other two days, and closes at 9.0, 6.30, and 6.0 respectively. Admission is by ticket obtainable from exhibitors, dealers or S. W. Stevens-Stratten, 3 Coombe Gardens, New Malden, Surrey.

Acoustical	Lowther
Armstrong	Lustraphone
B-K Partners	Minnesota Mining & Mfg.
Beam-Echo	M.S.S. Recording
British Ferrograph	Musicaft
Dulci	Pilot
E.M.I.	Reslosound
Expert Gramophones	Rogers Development
Garrard	Rudman Darlington
Goldring	Simon
Goodsell	Sugden
Grampian	Tannoy
Grundig	Thermionic Products
Jason	Truvox
Kelly	Vitavox
Leak	Westrex
Lockwood	Wharfedale
Long-Playing Record Library	Wireless World

Radio Exports

PROVISIONAL figures for exports of radio equipment during the first six months of the year show an increase of 10% on the same period last year—£21.2M compared with £19.2M. It will be seen from the table that the largest percentage increase was in the export of sound reproducing equipment—33½%. This year's figure for capital goods excludes industrial r.f. equipment

previously included. Likewise, test gear is excluded from this year's figure for components.

It is noteworthy that during the Jan.—June period the import of radio equipment fell from £5.2M in 1956 to £4.8M this year.

	Jan.-June	
	1957	1956
Capital goods (transmitters, navigation aids, etc.)	7,868	7,853
Sound reproducing equipment	4,803	3,645
Components	4,799	4,203
Valves and c.r. tubes	1,991	1,554
Sound and television sets	1,728	1,943
	£21,189M	£19,198M

Frequency Planning

ON several occasions *Wireless World* has urged a more direct representation of the industry and users in matters of frequency allocation in this country. A step in the right direction was made last year when the R.C.E.E.A. formed the Frequency Planning Advisory Committee for liaison with the Post Office.

There now seem good grounds for believing that there will be a less autocratic system, for the Postmaster-General has decided to set up a new committee to advise him on the broad aspects of frequency allocation. Although its composition and terms of reference have not yet been settled it is understood that not only Government departments but the industry and users will be represented on the committee.

Two "Wireless World" Books

A NEW book and another edition of a hardy annual make their appearance in time for the Radio Show. The first, "Transistor A.F. Amplifiers," by D. D. Jones and R. A. Hilbourne, deals systematically with the subject, giving circuitry and designs. It includes a simple but brief account of how the transistor works before going on to the principles of design and practical applications, which are illustrated by circuits of five amplifiers with outputs ranging from 1 to 20 watts. The book is based on work carried out at G.E.C. Research Laboratories. Price 21s (postage 8d).

The hardy annual is "Guide to Broadcasting Stations," which has been completely revised. This 1957-58 edition contains operating characteristics of the short-wave broadcasting stations of the world and of the long- and medium-wave stations in Europe, all stations being listed both geographically and in order of frequency. Other sections cover standard time, standard frequency transmitters, and television and v.h.f. sound transmitters in the U.K. The price is 2s 6d (by post 2s 9d).

Television licences in the U.K. increased during the first six months of the year by 599,412, bringing the total at the end of June to 7,169,509. During the same period sound-only licences decreased by 445,087 to 7,418,943. The £1 excise duty on television licences announced in the April Budget was introduced on August 1st. Incidentally, this duty is not applicable to the Channel Islands.

April Showers!—Three shows in twelve days, two running consecutively and the third overlapping the other two, have been announced for next April. The dates of the I.E.A. exhibition at Olympia (16th-25th) and the Audio Fair at the Waldorf Hotel, London, W.C.2 (18th-22nd), have been known for some time. Now the R.E.C.M.F. announces its annual components show for the 14th-17th. It will again be held in two hotels—Grosvenor House and Park Lane House, London, W.1.

Copyright Disputes.—The offices of the Performing Right Tribunal are now at Someries House, Regents Park, London, N.W.1. (Tel.: Welbeck 1358-9.) The Tribunal, which was set up under the Copyright Act, has to determine disputes arising between licensing bodies and persons requiring licences to perform in public or to broadcast copyright works. It also has jurisdiction in the case of the public performance and broadcasting of records and the public performance of television broadcasts.

"Research For Industry" is the title of a survey of research being undertaken in technical colleges in London and the Home Counties for, or in collaboration with, industry, Government departments and research associations. It is issued by the Regional Advisory Council for Higher Technological Education and lists under each of some twenty-five colleges the nature of the research and for whom it is being undertaken. The twenty-page booklet is obtainable from the Council at Tavistock Square, London, W.C.1, price 1s 6d.

Scholarships open to British students for training in electrical and allied engineering are outlined in "Scholarships and Other Awards" issued by the British Electrical and Allied Manufacturers' Association. The scholarships and awards are grouped under the headings "Open to non-graduates," "post-graduates," and "study abroad for both graduates and non-graduates." The 48-pp booklet, which has been circulated to technical schools and colleges, is obtainable from B.E.A.M.A., 36 Kingsway, London, W.C.2.

Queen's University, Belfast, is again running a full-time day course for the post-graduate certificate in radio engineering. It begins on October 8th and is open to men and women graduates in either electrical engineering or physics. The subjects are radio theory, radio technics, circuit theory, servomechanisms, mathematics and physics.

Higher Technological Education.—Part-time day and evening courses, including radio and telecommunications, being conducted in London and the Home Counties, are listed in "Engineering Education in the Region," issued by the Regional Advisory Council for Higher Technological Education. It costs 2s 6d. The Council has again issued a bulletin of special courses in higher technology, being held in the region during the autumn term. The index ranges from acoustics to X-ray defraction embracing computers, electronics, microwaves, pulse techniques, radio telemetry, etc. It costs 3s. Copies are obtainable from the Regional Advisory Council, Tavistock Square, London, W.C.1.

Amateur courses in preparation for the Radio Amateurs' Examination are again being held at the Wembley Evening Institute, Copland School, High Road, Wembley (Mon. and Thurs.), and at the Isledon School, Upper Hornsey Road, London, N.7 (Mon.). Morse classes are to be held in connection with both courses.

Information Wanted.—Circuit details or instruction manual of the Bendix RA-10/DA receiver are required by a reader. Information should be addressed to S. M. Ashe, c/o the Editor.

Correction.—In the advertisement of G. & E. Bradley, Ltd., on p. 45 of the August issue one minus sign did not appear in the section dealing with r.f. output. This should read: "R.F. Output -7 to -83dBm., 8.5 to 9.6 KMc/s C.W. . . ."

TV on Tape.—The Ampex video tape-recording system will be described by Ross H. Snyder, of the Ampex Corp., at the Television Society's meeting on September 13th. The meeting will be held at 7 p.m. at 164, Shaftesbury Avenue, London, W.C.2. Visitors can obtain tickets from members or from the Society at the above address.

Research Grant.—The Paul Instrument Fund Committee has awarded £2,600 to Dr. C. N. Smyth and F. Y. Poynton, working at the Northampton Polytechnic, London, for the continuation of work on the construction of an ultrasonic microscope for which a grant was made in 1954. The committee, composed of representatives of the Royal Society, Physical Society, Institute of Physics and I.E.E. was set up in 1945 "to receive applications . . . for grants for the design, construction and maintenance of novel, unusual or much improved types of physical instruments and apparatus for investigations in pure or applied physical science."

A two-day exhibition, during which demonstrations of studio recording and reproducing equipment will be given, is being organized by the International Broadcasting Company. It will be held at their offices at 35, Portland Place, London, W.1, from 1.30 to 9.30 on September 28th and 29th. Complimentary tickets are obtainable from the I.B.C. or from Thermionic Products, Hythe, Southampton, or Lockwood & Co., Lowlands Road, Harrow, Middlesex.

Government Computers.—The Chancellor of the Exchequer recently announced that ten electronic computers are in use in Government departments on mathematical or scientific work. He added that a further five are being installed during the current financial year.

Radio-Controlled Models.—The number of transmitting licences issued by the Post Office for the radio control of models now totals 2,000. These licences cost £1 and remain in force for five years.

Scottish I.T.A. station at Black Hill, Lanarkshire, will be brought into service on August 31st. Tests on full power, giving an e.r.p. varying from 65 to 475 kW, were delayed owing to inclement weather which prevented final adjustments being made to the directional aerial 1,600ft above sea level. The transmitters and aerial, for operation in channel 10, were installed by Marconi's.

I.T.A. in Wales.—Preparatory to the anticipated opening of the I.T.A. station at St. Hilary, Glam., before Christmas, the programme contractors (T.W.W. —Television Wales and the West) are holding a week's exhibition in Cardiff. It will be held in the Sofia Gardens Pavilion from October 30th to November 7th, and will focus attention on set conversion for Band III reception. St. Hilary, which will operate in channel 10, is being equipped by Pye.

Programme contractors have been appointed by the I.T.A. for its station on Chillerton Down, Isle of Wight, which it is planned to bring into service by the summer of next year. The programme organization has been set up jointly by the Rank Organization, Associated Newspapers and Amalgamated Press.

Forward Scatter.—Contracts have been placed by the Supreme Headquarters Allied Powers Europe with two American companies for the supply of equipment for a communications system (combining both forward scatter and "conventional" radio relay links) between the allied countries in Europe. The headquarters will be in Paris.

Norwegian TV.—It is reported in the *E.B.U. Bulletin* that the Norwegian National Assembly has approved the plan drawn up by the broadcasting organization, Norsk Rikskringkasting, for the introduction of television in the country. Work on the construction of stations, linked to a studio centre in Oslo, is to begin immediately and it is planned to introduce a regular service in 1960.

Standard-frequency transmissions from Rugby on 60 kc/s (MSF) and 16 kc/s (GBR) are being discontinued from July 20th for several months while repairs to the long-wave aerial system are in progress. Some of those who normally use these transmissions may be able to employ the B.B.C. Droitwich transmission on 200 kc/s. Results of measurements made daily by the National Physical Laboratory on the MSF and Droitwich transmissions are given each month in our sister journal *Electronic & Radio Engineer*, and to assist users of Droitwich in obtaining the highest accuracy, the deviations of the transmission will now be given to 1 part in 10^9 instead of 1 in 10^8 .

T.I.D.U.—The Technical Information and Documents Unit of the D.S.I.R. has now been merged in the Lending Library Unit of the Department and operates from 20 Chester Terrace, Regent's Park, London, N.W.1.

F.M. broadcasting stations in the United States, which in 1949 totalled about 750 and by the middle of last year had dropped to 546, are now showing a slight increase. According to figures published in the business edition of *Electronics* the total at the end of May was 555. In each of two cities, Los Angeles and New York, there are now more applicants for f.m. channels than there are channels available. In Los Angeles 17 of the 20 available channels are occupied and in New York 16 out of 18.

S.I.M.A. Officers.—At the A.G.M. of the Scientific Instrument Manufacturers' Association, P. Goudime (Electronic Instruments) was elected president. The secretary is L. A. Woodhead (Cossor Instruments), and the treasurer P. J. Ellis (R. B. Pullin & Co.). The representative of the electronics section on the council is A. W. Jones (Fleming Radio), and of the surveying and navigational section R. Broadbent (Sperry).

PERSONALITIES

O. W. Humphreys, C.B.E., B.Sc., M.I.E.E., director of the G.E.C. Research Laboratories, Wembley, has been re-elected president of the Institute of Physics for a second term of office. He has been chairman of the International Special Committee on Radio Interference (C.I.S.P.R.) since 1953 and is chairman of the committee recently set up by the Postmaster General to advise him on the making of regulations covering radio interference from industrial, scientific and medical equipment.

Paul Goudime, M.A., managing director of Electronic Instruments, Ltd., of Richmond, has been elected president of the Scientific Instrument Manufacturers' Association. On leaving Cambridge University, where he took an honours degree in natural sciences, he worked on the design of aircraft navigational computers. He subsequently joined Simmonds Aerocessories where throughout the war he was head of the research department. In 1945 he formed Electronic Instruments, Ltd., and five years later the Minerva Detector Company, of which he is also a director.

Donald G. Fink has been nominated president of the American Institute of Radio Engineers. For nearly 20 years he was on the editorial staff of our New York contemporary *Electronics*, of which he was eventually editor. He resigned the editorship in 1952 to join the Philco Corporation as co-director of research operations.

Rupert P. Browne, O.B.E., B.Sc., Comp.Brit.I.R.E., has retired from the position of secretary of the Radio Industry Council owing to ill-health. In 1945 he became secretary of the R.I.C. on its formation in succession to the Radio Manufacturers' Association, of which he had been secretary for ten years. Mr. Browne, who is 60, had been associated with radio industrial organizations since 1924 when he joined the National Association of Radio Manufacturers.

George B. Campbell succeeds R. P. Browne as secretary of the R.I.C. He became assistant secretary of the Radio Manufacturers' Association in 1940 and has been acting secretary of the R.I.C. for some months.



G. B. CAMPBELL

G. G. Roberts, M.Sc., who joined Smiths Aircraft Instruments three years ago as head of the company's guided weapons department and became director of research at Cheltenham last October, has now been appointed technical director. On leaving the University of Wales he undertook some lecturing in London and then joined the Telecommunications Research Establishment where he was eventually in charge of the group responsible for airborne interception radar. In 1947 he joined the staff of the Guided Weapons Department of the Royal Aircraft Establishment, Farnborough, where he stayed until going to Smiths.

W. I. Flack, Assoc.I.E.E., has left T.C.C., where he has been for the past 14 years, and has joined the production engineering department of Radio and Allied Industries, Ltd., at Wexham Road, Slough. For the past two years he has been concentrating on the development of printed circuits. It may be recalled that he was the designer of the View Master television receiver and the Soundmaster tape-recorder.

P. W. Faulkner, O.B.E., who has been with the Plessey Co. since 1952 and a year later became general manager of the chemical and metallurgical division at Towcester, Northants., has been appointed an executive director of the company. He will continue to be in charge of the division. Mr. Faulkner is also a director of Technical Ceramics, Ltd., well known in the piezoelectrics field.

Lawrence Dilger, B.Sc., has joined the electronics division of Microcell, Ltd., at Camberley, Surrey, as senior designer responsible for the development of electronic computers.

Derek Barlow recently left Mullard, where he was in charge of research in the industrial control field, to become European editor of *Control Engineering*, published in New York by McGraw-Hill. Before joining Mullard he was for some time chief development engineer with Wayne Kerr Laboratories where he was concerned mainly with the development of radar and navigational trainers.

M. Clough has been appointed engineer-in-charge of the new B.B.C. television station at Rosemarkie, Inverness-shire. He joined the corporation in 1943 and after service at several sound transmitting stations has been on the staff of the Meldrum television station.

OBITUARY

Arthur Gay, works manager of H. J. Leak & Co., died suddenly on June 28th at the age of 49. He had been associated with H. J. Leak, the founder of the company, for very many years and had been works manager since 1946.

National Radio Show

PREVIEW OF TECHNICAL EXHIBITS

THE 24th National Radio Show opens to the public on August 28th, after a preview day for overseas visitors and invited guests. It is essentially an exhibition of domestic sound and television equipment and about 75% of the 122 exhibitors manufacture receivers, components or ancillary equipment.

We give in the following pages a preview of the technical exhibits, compiled from information available at the time of going to press. In the nature of things the information is bound to be incomplete, for inevitably there will be the last-minute releases

by manufacturers. In the October issue we hope to give an assessment of trends in the design of domestic sound and television receivers as portrayed at the Show.

Stress is again being laid by the organizers, the Radio Industry Council, on the opportunities for careers in the radio and electronics industry. On the first floor (Stand 308) will be found the "Careers in Electronics" display, covering the training and employment of engineers, technicians and servicemen.

ALPHABETICAL LIST OF EXHIBITORS

	Stand		Stand		Stand
Acos	213	G.E.C.	10 (D37)	<i>Practical Wireless</i>	117
Aerialite	7	G.P.O.	306	Price	120
Airmec	228	Garrard	22	Pye	13 (D6)
Alba	47	Goodmans	116		
Ambassador-Baird	51 (D18)*			R.A.F.	304
Antiference	24	H.M.V.	12 (D8)	R.C.A.	114
Argosy	2	Hartique	110	R.G.D.	27 (D30)
Avo	62	Hobday	123 (D7)	R.M. Electric	115
		Hunt	48	R.S.G.B.	309
B.B.C.	301, 302			R.T.R.A.	3
Barclays Bank	101	I.T.A.	303	Regentone	8
Belling-Lee	55	Invicta	23	Roberts	25
Bernards	119			Rola Celestion	16
Bowmaker	211	J.B. Cabinets	209		
Brimar	6	J-Beam Aerials	17	S.T.C.	60
<i>British Radio & Television Re-</i>		Jokki	208	Siemens Edison Swan	46 (D1)
<i>tailing</i>	122			Slingsby	215
British Railways	202	K.B.	15	Sobell	19
Bulgin	59	Keith Prowse	66	Sobell International	56
Burwell	205	Kerry's	212	Spencer-West	206
Bush	5, 37			Stella	34
		Labgear	217		
Collaro	26	Linguaphone	105	T.C.C.	58 (D28)
Cossor	29 (D38)	Lintronic	223	Tape Recorders	111 (D14)
		Lloyds Bank	218	Taylor	32
Dallas	216			Technical Suppliers	103
Decca	23 (D36)	McMichael	45 (D4)	Teleng	227
Defiant	4	Marconiphone	50	Telequipment	226
		Masteradio	35	Teleraction	38
Design Furniture	210	Meadow-Dale	224	The Star	310
Domain	219	Mercantile Credit	204	Thompson, Diamond & But-	
Dubilier	57	Midland Bank	201	cher	214
Dynatron	33 (D16)	Mullard	39 (D32, D34)		
		Multicore	61 (D17, D20)	Ultra	11
E.A.P.	9	Murphy	53 (D35)		
E.A.R.	41			Valradio	118
E.M.I. Institutes	307	N.I.D.	312	Vidor	52 (D27)
E.M.I. Records	18 (D12)	National Provincial Bank	112		
E.M.I. Sales & Service	108 (D11)			Walter Instruments	49
Econasign	225	Pam	42 (D24)	Westinghouse	113
Ekco	44 (D19, D22)	Perdio	63	Westminster Bank	102
<i>Electrical & Radio Trading</i>	121	Period High Fidelity	106 (D13)	Whiteley Electrical	65 (D21, D23)
Ever Ready	31	Peto Scott	30	Wireless & Electrical Trader	203
Expanded Metal	124	Philco	43, 305 (D31)	Wireless for the Bedridden	67
		Philips	20, 21 (D2, D3)	Wireless World and Electronic	
Ferguson	14 (D5)	Pilot	54 (D29)	& Radio Engineer	107
Ferranti	36 (D25)	Plessey	125 (D9)	Wolsey	40
Field ("Record Housing")	207	Plus-a-Gram	109		
Fund for the Blind	311	Portogram	1		

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

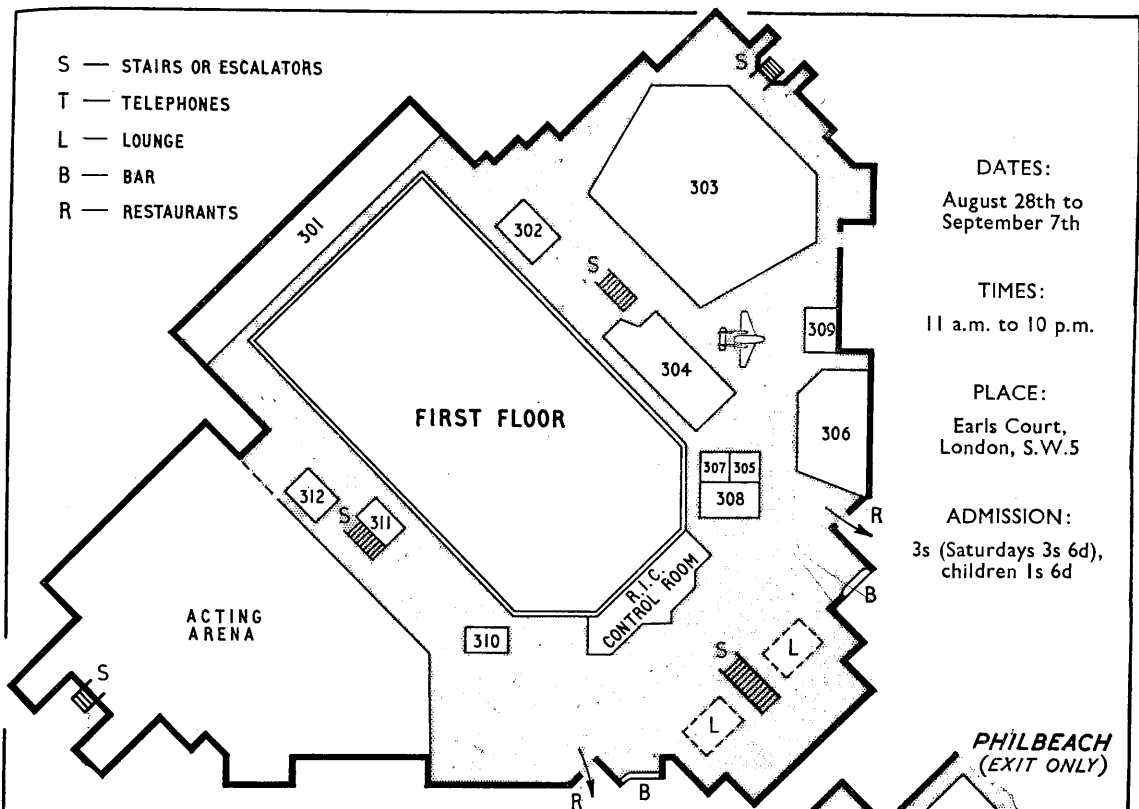
- S — STAIRS OR ESCALATORS
- T — TELEPHONES
- L — LOUNGE
- B — BAR
- R — RESTAURANTS

DATES:
August 28th to
September 7th

TIMES:
11 a.m. to 10 p.m.

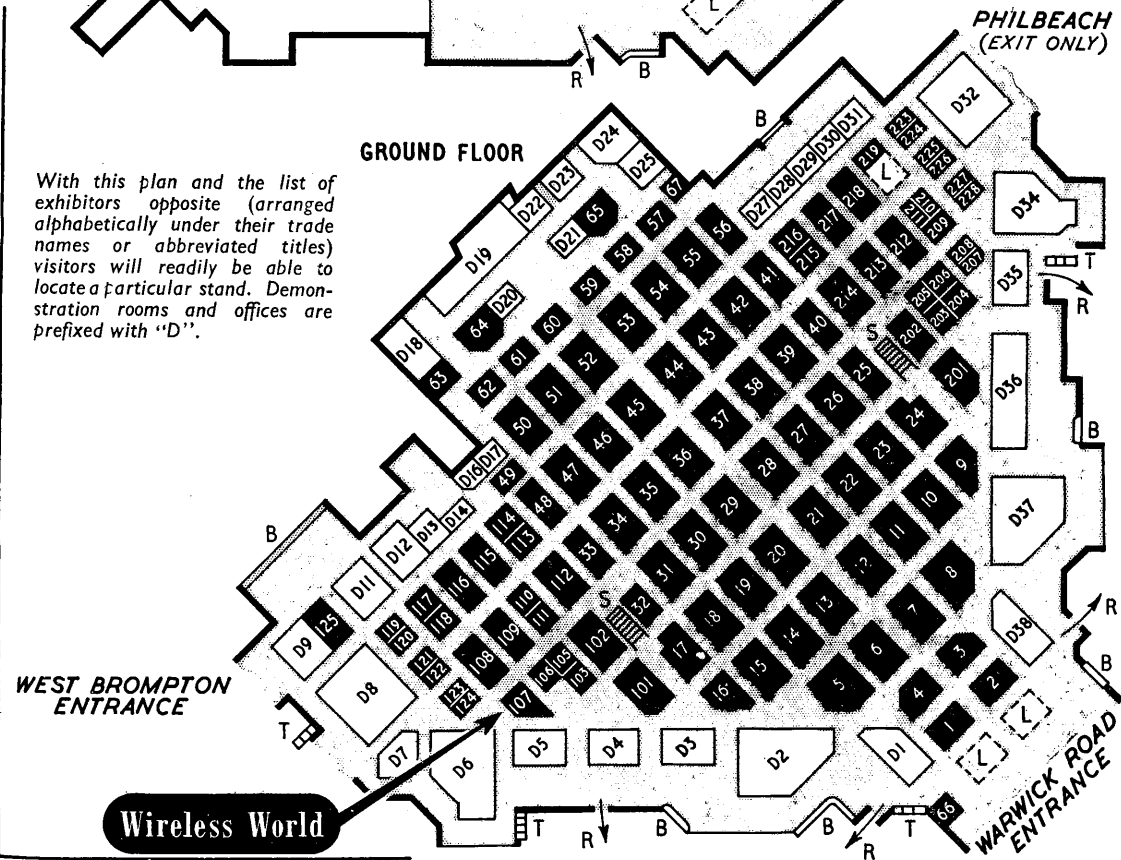
PLACE:
Earls Court,
London, S.W.5

ADMISSION:
3s (Saturdays 3s 6d),
children 1s 6d



With this plan and the list of exhibitors opposite (arranged alphabetically under their trade names or abbreviated titles) visitors will readily be able to locate a particular stand. Demonstration rooms and offices are prefixed with "D".

GROUND FLOOR



NATIONAL RADIO SHOW

Guide to the Stands

ACOS (213)

The new GP65 series of improved pickup cartridges which includes medium- and high-output models, as well as the usual wide range of replacement cartridges, are shown on this stand. An interesting feature is a projector showing pictures of good, badly formed and worn styli.

A newcomer to the range of piezo-electric microphones is the MIC-1. The overall length is only 4½ in with a maximum diameter of 1¼ in. A new "Foldaway-Pack" microphone will also be on show.

Cosmocord, Ltd., Eleanor Cross Road, Waltham Cross, Herts.

AERIALITE (7)

Several new separate B.B.C. and I.T.A. aerials, with the emphasis on wide spacing of elements in the Band-III models, will be shown this year. They will be accompanied by a comprehensive display of dual-band television models, included among which will be many factory-assembled types which only need opening out for erection on the site. Independent adjustment for directivity is provided.

Communal aerial equipment consisting of single and multi-band amplifiers and networks for distributing television and f.m. broadcast over a single cable in schools, hospitals, hotels and blocks of flats and Aerialite low-loss cables are included in this firm's products.

Aerialite Ltd., Castle Works, Stalybridge, Cheshire.

AIRMEC (228)

The portable Televet 877 and Radivet 211 test equipments will be demonstrated on this stand. These provide complete facilities for testing television, a.m. (long, medium and short waves) and v.h.f./f.m. receivers.

Each test set incorporates the appropriate signal generators (including a pattern and a.m. signal generator in the Televet), a wobulator (for showing the overall response of resonant circuits), audio oscillator, oscilloscope and a.c./d.c. valve voltmeter. The Televet also includes an e.h.t. voltmeter (with probe).

Airmec, Ltd., High Wycombe, Bucks.

ALBA (47)

The new Alba 14-in television portable weighs only 26 lb and makes use of a printed circuit. Several of the television models in the Alba range are this year fitted with v.h.f./f.m. sound receivers with switch selection of the Home, Light and Third programmes.

A new table model broadcast receiver also includes the v.h.f. band, and there is a series of bureau-style radio-gramophones. Other sound broadcast receivers include the "Happy Wanderer" portable which is available in mains- or battery-operated versions and a miniature receiver (Model C116) costing only 9½ guineas.

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

AMBASSADOR-BAIRD (51)

A special feature this year will be a new space-saving design of cabinet, for fitting into a corner of the room, which will house their latest 17-in and 21-in television receivers. Another attractive feature will be a complementary pair of sets in matching cabinets, one housing a 21-in television receiver and the other an a.m./f.m. radio-gram.

Record players and a high-fidelity recorder with an "ultra-linear" output stage are included.

Ambassador Radio and Television, Ltd., Princess Works, Brighouse, Yorks.

ANTIFERRENCE (24)

A new twin-band television aerial known as the "Antex Plus" is a combination of the Antiferrence "Antex," or "X" model, and a four-element Band-III Yagi, the two being interconnected in the factory for the most efficient operation with a single feeder. Each aerial section can be independently oriented.

Several of this firm's "Hilo"

models now include an f.m. aerial element, thereby providing for TV and f.m. reception with a single aerial assembly, when, of course, the television receiver also embodies an f.m. band.

Overseas visitors will be interested in the display of "Export" aerials, some of which will be for Band IV.

Antiferrence, Ltd., Bicester Road, Aylesbury, Bucks.

ARGOSY (2)

Described by the makers as a portable record player with built-in radio, rather than a radio-gram, is the new model PG19, which has an automatic record changer and incorporates medium- and long-wave reception. The G18 is another small table radio-gram, while in the larger range is the G101 console model. Also a new exhibit is the AP3 record player.

A printed circuit is used in the battery portable receiver model P1.

Amongst television receivers are two new 17-inch sets, 17C41 and 17K40, the latter being equipped for f.m. reception. A v.h.f. waveband is also provided now in the 21-inch receivers 21K40 (table model) and 21L40 (console).

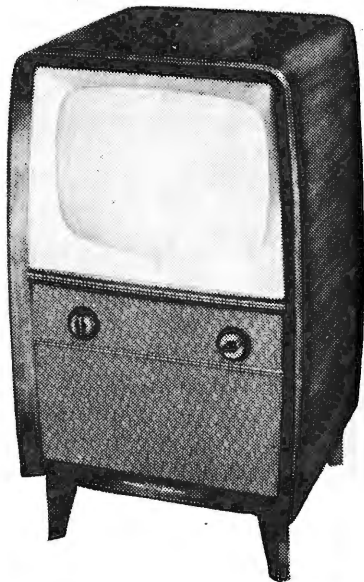
Argosy Radiovision, Ltd., Abbey Road, Barking, Essex.

AVO (62)

A comprehensive range of test equipment is shown. This includes a number of a.m. and f.m. signal generators giving full coverage of



"Golden V" indoor television and f.m. aerial made by Belling-Lee.



Right: Alba T724/FM console.

all the a.m., v.h.f./f.m. and television broadcast bands.

An interesting instrument which gives a clear and simple presentation of measurements is the LCR measuring bridge Type 1. The "Avo" d.c. amplifier will give a full-scale reading down to 3×10^{-13} amp, and has been designed in conjunction with A.E.R.E., Harwell, and the N.P.L., Teddington, for standardization purposes.

Avo, Ltd., 92/96, Vauxhall Bridge Road, London, S.W.1.

B.B.C. (301, 302)

A large part of the engineering section of the B.B.C. stand is devoted to recording. Modern studio magnetic-tape equipment can be compared with the steel-tape recorder used in 1935. The latest piece of recording equipment is for use in the field and will handle up to four microphones. The equipment used for locating faults in "salvaged" magnetic tape can also be seen in operation.

Demonstrations of v.h.f. sound reception compared with that provided by a medium-wave receiver are again being given throughout the duration of the show.

A s.h.f. radio link is being used to transmit television from one end of the hall to the other.

British Broadcasting Corporation, Broadcasting House, London, W.1.

BELLING-LEE (55)

An indoor aerial of compact and versatile design for reception of B.B.C. and I.T.A. television and f.m. broadcast is one of the latest additions to the Belling-Lee family of aerials. Known as the "Golden V" it has two elements which are adjustable for length and angle to provide the best reception on all three services.

A range of lightweight attic aerials made from strip and channel-section aluminium alloy is also new. The aerials are factory assembled and collapsed for transport, and the elements snap into position for erection.

In addition to a comprehensive display of outdoor TV and f.m. aerials there will be a wide selection of accessories including interference suppressors, connectors and terminals of all kinds.

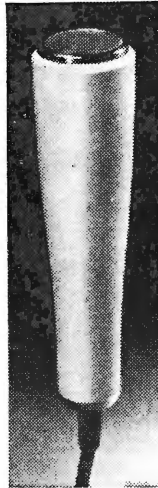
Belling and Lee, Ltd., Great Cambridge Road, Enfield, Middlesex.

BRIMAR (6)

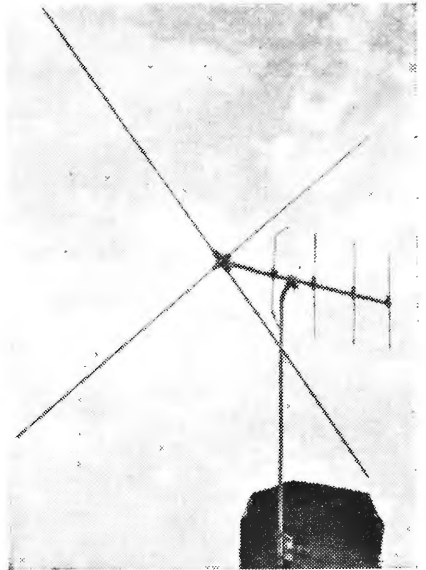
Special "Quality" valves in the "T" range of this firm will be featured in the display and also special-purpose valves for communications, transmitting and industrial purposes from the S.T.C. catalogue.

Among domestic types is a full range of a.c./d.c. television receiving valves covering Bands I and III, and valves for a.m./f.m. receivers.

New transistors will be shown, together with germanium diodes,



Acos MIC39-1 crystal microphone.



Antiference "Antex-Plus" twin-band television aerial.

Brimistors, thermistors and hermetic seals. In addition, there will be a selection of miniature and sub-miniature tantalum capacitors and a range of Permalloys including spiral tape cores. Quartz crystals and high-stability carbon resistors will also be on view.

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

BULGIN (59)

Several new components have been added this year to the extremely wide and comprehensive range of parts made by this firm. The total must now amount to several thousand separate items.

The additions include a new design of knob with coloured inserts for coding purposes on equipment having a multiplicity of knobs; neon signal lamps; panel signal-lamp fittings for 15 W lamps; cartridge fuses and switches of the type once known as key switches, but now called open-blade leaf switches. They have nickel-silver blades and pure silver contacts and are sufficiently small to justify the description "miniature".

Components designed for printed circuit applications are included.

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

BURWELL (205)

The principal feature of this firm's display will be a range of television and f.m. aerials built up from one basic unit and a series of add-on units. Known as the "View-Well" series the basic unit is a 3-element Band-III Yagi. Additional Band-III elements can be added in the form of directors.

Burwell Products, Ltd., 116, Blackheath Road, London, S.E.10.

BUSH (5, 37)

A special stand for demonstrating

television sets will provide seating accommodation for nearly 100 people.

A new 21-inch set, TV79, heads the list of television receivers to be shown.

Sound receivers include a new v.h.f. set, the VHF62. It gives reception also on medium and long waves, and aerials for all bands are built in, though sockets for external aerials are provided as well. Piano-key switches are used for wavechange, gramophone and on/off. Another new set is a lightweight battery portable, BP61, for medium- and long-wave reception. It has a 5-in loudspeaker and the on/off switch is operated by opening and closing the lid. The weight, with batteries, is 6 lb.

This firm has recently started to produce record players, and on show will be a single player and one with an automatic changer, types RP20 and RP21.

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

COLLARO (26)

A range of four-speed gramophone record players including a new design of record changer, the "Conquest," is shown. Four types of crystal and one ceramic cartridge are available to suit the various output voltages which may be required.

The latest version of the tape "Transcriptor" (Mark III) includes a completely redesigned, lighter mechanical interlocking system for the push buttons. A revolution counter has also been fitted. This "Transcriptor" can now be supplied with a suitable pre-amplifier and power pack.

Collaro, Ltd., By-Pass Road, Barking, Essex.

COSSOR (29)

Printed circuits are widely used in this year's Cossor receivers and portable record players giving compactness, light weight and reliability. Typical examples are the Models 544 and 545, the latter being a radio-gramophone.

A larger radio-gramophone, the Model 529 is provided with a v.h.f./f.m. range and has three loudspeakers with crossover networks. The perennial "Melody Maker" table model receiver is available in two forms both of which make provision for v.h.f./f.m. programmes.

The chassis of the Cossor television receivers (17 in and 21 in) have been redesigned for better performance, easier maintenance, and long-range versions for fringe areas are available.

Cossor Instruments will be showing kits of parts for constructing oscilloscopes, etc.

Cossor Radio and Television, Ltd., Cossor House, Highbury Grove, London, N.5.

DALLAS (216)

This firm of wholesalers will be showing also their own proprietary range of "Scala" portable electric gramophone reproducers. Six models are available from a 1½-watt single-valve (plus rectifier) amplifier with 4-speed turntable (Model SP/1) to one with an 8-watt push-pull output.

John E. Dallas and Sons, Ltd., Clifton Street, London, E.C.2.

DECCA (28)

Occupying a prominent place on this stand will be the Model 555, a television/radio-gram fitted with a 17-in tube, automatic record changer, twin-loudspeaker system and full-range tone control. The radio is for v.h.f.

The Model RG200 radio-gram is also a new model and it covers four wavebands including v.h.f. A triple-loudspeaker system is embodied together with 4-speed automatic record changer and turnover crystal pickup. This and the Model 500 are housed in contemporary-styled cabinets.

The range of television receivers includes 14-in, 17-in and 21-in models, some of which provide for v.h.f. radio reception.

There will be a new "Deccalian" record player with four-speed automatic changer and high-fidelity sound amplifier.

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

DEFIANT (4)

The redesigned range of television receivers has turret tuning, improved focusing and noise limiting and a.g.c. on both sound and vision. A 21-in model has been added to the range of table receivers and some 17-in television models are now available with provision for the reception also of the B.B.C. v.h.f. sound service.

Two new radio-gramophones—one

in the "Continental" style of cabinet—are to be shown; both have 4-speed automatic record changers.

Most of last year's sound broadcast receivers are retained, but a car radio receiver and a new midget receiver are interesting additions.

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

DESIGN FURNITURE (210)

Record storage cabinets with flexible roll-front doors, and tables for television receivers are the principal features of the display. A special table designed for the Murphy V310 and V320 receivers is worthy of note.

Design Furniture, Ltd., Carnwath Road, London, S.W.6.

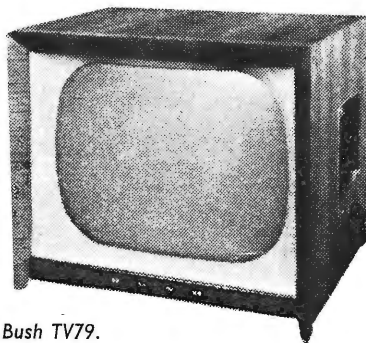
DOMAIN (219)

This firm specializes in metal trolleys for electronic equipment, and also stands for television receivers. A new range has been designed which goes up to sizes for the largest sets.

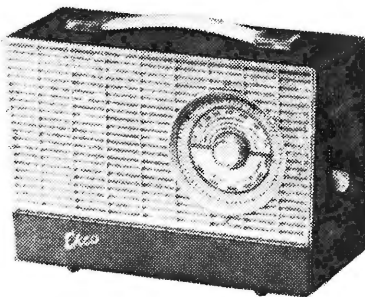
Domain Products Ltd., Barnby Street, London, N.W.1.

DUBILIER (57)

Fixed capacitors for receivers, transmitters and power-factor correction, fixed standard and precision resistors and volume controls will form the backbone of Dubilier's exhibit. Some miniature carbon-track volume controls will repay examination and there will be a comprehensive display of interference suppressors to be shown as complete units and also as separate components, such as miniature r.f.



Bush TV79.



Ekco Model BP321 ("Companion").

chokes and capacitors, for incorporating in small domestic electrical appliances. Some are designed especially for TV interference suppression.

Encapsulated, precision wire-wound resistors are another Dubilier product. A special feature will be made of capacitors and resistors for printed circuits.

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

DYNATRON (33)

A new 17-in combined television and f.m. receiver known as the "Knightsbridge," or alternatively as Model TV30CK, accompanied by a new radio-gramophone styled the "Edinburgh" (Model RG14) will occupy prominent places on this stand. The RG14 is an 11-valve set covering a.m. and f.m. transmissions and embodying a bass-reflex loudspeaker system. Another new item is a transportable record player designed for high-quality sound reproduction.

The exhibit will include 17-in and 21-in TV sets all with v.h.f. radio.

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

E.A.P. (9)

A new tape recorder, the "Triple Three," is an addition to the "Elizabethan" range. The amplifier incorporates a six-watt "ultra-linear" output stage which feeds either the internal speaker system of one 9-in x 5-in elliptical bass speaker and two 3-in-diameter tweeters, or any 15-ohm external speaker. Signals can be reproduced and recorded simultaneously, a "magic eye" providing recording level indication. A ribbon microphone is supplied. The "Elizabethan de Luxe," an improved version of the "Elizabethan" tape recorder, and the "Elizabethan" v.h.f./f.m. tuner are also shown.

E.A.P. (Tape Recorders), Ltd., 9, Field Place, St. John Street, London, E.C.1.

E.A.R. (41)

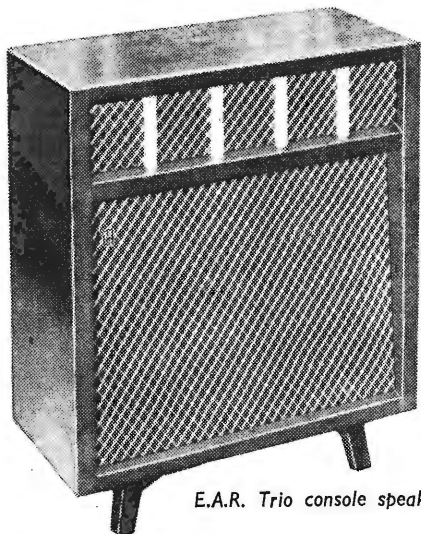
A wide range of console record reproducers as well as portable electric gramophones are shown. A new model is the "Concert Reproducer," which includes four loudspeakers in a reflex chamber sealed off from the amplifier, control unit and record player.

The range of high-fidelity units now includes a version of the "Triple Four" amplifier for use with low output variable reluctance pickups, a separate three-speaker system, and a switched v.h.f./f.m. tuner.

Electric Audio Reproducers, Ltd., The Square, Isleworth, Middlesex.

E.M.I. (18, 108)

Three types of "Emitape" are available; the "Long Play 99" which gives a 50% increase in recording time over the general-purpose "88" for a given spool size, and also "77" which is specially



E.A.R. Trio console speaker.



Decca Model 555.

tested for professional and scientific use. The range of seven spool sizes which can be obtained now includes $8\frac{1}{4}$ in. The specially made 5-ft-diameter spool which is shown holds 33,000 ft of 4-in-wide "Emitape." An accessory kit for tape editing purposes is also available. Magnetic recording "Emifilm" can be obtained in 35-, 17.5- and 16-mm sizes. The oxide coating is polished to reduce wear on the record and replay heads. "Emidisc" lacquer recording blanks in four grades and sizes are also on show.

Professional recording equipment shown consists of the L2 battery-operated portable recorder, the transportable TR51, and the TR90. E.M.I. Sales and Service Ltd., Hayes, Middlesex.

E.M.I. INSTITUTES (307)

The Institutes' postal tuition courses, with which components for the home construction of equipment are provided, are featured on this stand.

E.M.I. Institutes, Ltd., 43, Grove Park Road, London, N.4.

EKCO (24)

Among the new Ekco sets to be seen this year will be the Model TC315, a 21-in television receiver with f.m. radio. It embodies an aluminized tube, multi-channel turret tuner, flywheel sync, spot wobble and automatic picture and sound control. It will be accompanied by another 21-in model (T312), available either as a table set or, fitted with legs, as a floor-standing model. It does not provide f.m. reception but has many of the features of the TC315.

Included among new sound receivers will be a six-valve a.m./f.m. model (A320) with twin loudspeakers, self-contained aerials and a 7-watt output stage. The latest "Companion" battery portable (Model BP321) has a printed circuit,

low-consumption valves and a novel tuning scale.

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

EVER READY (31)

A number of battery portables by Ever Ready and the associate company Berec (Radio), Ltd., are shown. The Berec "Skyscraper" (Mark II) is a seven-valve superhet battery model covering medium and short waves (up to 30 Mc/s). Each company will be showing two portable transistor receivers. A nine-valve a.m./f.m. set is also shown by Ever Ready.

A number of dry batteries which have been specially developed for transistors are shown in addition to the usual very wide range made by Ever Ready.

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

EXPANDED METAL (124)

Fifteen vertical and thirteen chevron patterns in expanded aluminium mesh provide a change from the plain diamond array often seen in metal loudspeaker grilles. Anodization in 12 different colours is possible.

The Expanded Metal Co. Ltd., Caxton Street, London, S.W.1.

FERGUSON (14)

A number of recent additions to the range of radio or television receivers and radio-grams are shown. These include a lightweight battery portable, the "Flair," and a 3-valve (plus metal rectifier) a.c./d.c. mains transportable, the "Fame." The new radio-grams include the "Fantasia II," an a.m./f.m. model incorporating a push-pull output stage and 3-speaker system consisting of a 10-in bass unit, 6 x 4-in elliptical speaker and 4-in tweeter. The 305T and 307T are new 17- and 21-in tele-

vision fringe reception sets incorporating electrostatically focused tubes and keyed a.g.c. circuitry. Another new addition is the "Fortune" 2-valve record player with a 6-watt push-pull output stage and $6\frac{1}{2}$ -in twin diaphragm speaker.

Thorn Electrical Industries, Ltd., 105-109, Judd Street, London, W.C.1.

FERRANTI (36)

This firm has now brought out a record reproducer for the first time. It is a 4-speed transportable, model RP1008, in a lightweight case.

The range of television receivers includes a new 17-in console model, the TC1004, which has flywheel synchronization, and an automatic interference inverter. It incorporates a v.h.f. sound waveband.

Another new television set is the 21-in table model T1006. The cabinet forms a shell which can be removed from the base to expose the chassis and tube for servicing. Others in the range are the 14-in and 17-in table models T1001 and T1002, both of which are for a.c./d.c. mains, have turret tuners and automatic interference inverters.

Ferranti Radio and Television, Ltd., 41-47, Old Street, London, E. C.1.

FIELD ("RECORD HOUSING") (207)

The "Nordyk" line and other record storage carrying cases or cabinets, and also a number of hi-fidelity equipment units are available in both traditional and contemporary styles. A resistively loaded bass reflex loudspeaker cabinet can also be obtained.

The "Simplex" and "Royal" record indexing systems are useful accessories.

N. and S. B. Field and Co. Ltd., "Record Housing," Brook Road, London, N.22.

FUND FOR THE BLIND (311)

A live demonstration shows how blind people can be employed on the production and testing of radio equipment. Specially adapted test and measuring instruments are available for the use of the blind.

Greater London Fund for the Blind, 2, Wyndham Place, London, W.1.

G.E.C. (10)

Six germanium transistors and one germanium diode are used in the portable transistor sound receiver, BC1650, introduced by this firm. It is built on a printed circuit, has a ferrite-rod aerial for the two wavebands, medium and long, and uses a class-B push-pull output stage to drive the 7in x 4in elliptical loudspeaker. Power is from four unit cells, giving operation for about six months at four hours a day. Also on show will be the battery portable BC1452 and a.c./d.c. transportable BC6447, both with printed circuits.

In television receivers the latest sets are two 17-in table models BT8742 and BT2748, both of which incorporate v.h.f. sound and have a new type of 12-position turret tuner of light construction designed for clip-in-coils. Three positions on this turret are used for v.h.f. programmes.

Transistors will be featured in a display showing their construction and possible applications. There will also be a demonstration of the new "Periphonic" loudspeaker system.

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

G.P.O. (306)

The part played by the G.P.O. in providing and maintaining the links between the sources of programmes and the transmitters is featured on this stand. Among the equipment being demonstrated is an 11-stage video repeater capable of equalizing up to 60dB cable loss at 3 Mc/s. A waveform generator for lining up cable pairs is also shown. This produces a standard line period of approx. 100 μ sec containing negative-going 10- μ sec sync pulses, a positive-going sine-squared pulse and a positive-going bar of 40 μ sec duration. The shaped waveform is fed into the cable pair and the video repeater adjusted until the received and sent waveforms are as nearly identical as possible.

General Post Office, St. Martin's-le-Grand, London, E.C.1.

GARRARD (22)

In the RC98 record changer an electrical speed control and switch click suppressor are provided in addition to the standard features of the RC88 four-speed model. Other four-speed single record players and changers, and also the miniature battery-operated 45-r.p.m. BA1 are shown.

The range of crystal pickups available includes high-output or high-compliance models. A specially designed transcription pickup arm,

the TPA10, has the Garrard moving coil GMC5 pickup head fitted.

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

GOODMANS (116)

The Goodmans 315 reproducer is designed round a standard 12-in Audiom 60 bass speaker and the middle- and upper-frequency, horn-loaded pressure units introduced last year. The bass speaker is housed in a lagged reflex chamber loaded by an "Acoustical Resistance" unit. Constant-impedance attenuators giving 2dB steps up to 12dB are provided for the mid-range and treble units. Interesting, too, is a full-range electrostatic loudspeaker which will be demonstrated. A number of standard single- or two-speaker systems are also shown.

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

H.M.V. (12)

Most of the sound broadcast receivers and radio-gramophones in the H.M.V. range this year are capable of receiving the v.h.f./f.m. transmissions as well as the normal medium- and long-wave stations. Emphasis is on quality of reproduction and special elliptical loudspeakers have been developed to make the best use of the improved performance of f.m. stations.

A transportable television receiver (Model 1864) with a special lightweight chassis has been introduced and a new "fringe" model television receiver (Model 1867) also incorporates a v.h.f./f.m. sound broadcast receiver.

The Gramophone Company, Ltd., 21, Cavendish Place, London, W.1.

HARTIQUE (110)

A wide choice of television tables and record storage cabinets is offered by this firm in period and contemporary designs. The "Stayrite" all-purpose folding table will accommodate the largest television receivers.

Hartique Products, 243, Upper Street, Islington, London, N.1.

HOBDAY (123)

Distributors to the trade of television and sound receivers, record players, tape recorders, etc.

Hobday Bros., Ltd., 21/27, Great Eastern Street, London, E.C.2.

HUNT (48)

This firm specializes in the manufacture of fixed capacitors of all kinds, including miniature types. Improvements in some of their electrolytic types has enabled the upper limit of operating temperature to be raised to 85°C without reduction in the working voltages. Reduction in size for a given capacitance and voltage rating is another line of development and the results in the form of new miniatures and sub-miniatures will be shown on the stand. Among the dielectric materials used in Hunt

capacitors will be found paper (metallized), plastic film, mica and ceramic of various kinds. Some of these materials will figure in the range of capacitors produced especially for printed circuits.

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

I.T.A. (303)

This stand is largely devoted to the activities of the programme contractors — Associated-Rediffusion and Associated Television—but there is an information section where technical as well as organizational questions are dealt with.

Independent Television Authority, 14, Princes Gate, London, S.W.7.

INVICTA (23)

New models which have been produced since the last Radio Show are mains transportable, battery, and battery/mains receivers, and also one 17- and two 21-in television sets. The complete range includes a nine-channel Band III converter.

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

J. B. CABINETS (209)

Radio, television and radio-gram cabinets for the trade are available.

J.B. Manufacturing Co. (Cabinets), Ltd., Howard Way, Harlow, Essex.

J-BEAM AERIALS (17)

The distinctive type of "skeleton slot" developed by this firm is now used as the main element in a basic Band-III aerial described as a "Double Four." This consists of slot, two reflectors and four directors and where more gain than the basic unit provides is required additional units are added. These are termed "Plus" units, and take the form of extra directors.

J-Beam Aerials, Ltd., Westonia, Weston Favell, Northampton.

JOKKI (208)

A new system of record filing consists of strips of flexible plastic in several colours, cut with a groove to fit the edges of any size standard record, or the sleeves of microgroove records. Ready cut self-adhesive labels on which the titles can be written are available for sticking on the backs of the strips.

Power Judd and Co. Ltd., 94, East Hill, London, S.W.18.

K.B. (15)

A low-priced transportable receiver for a.m. sound reception, the "Minuet" is one of the new exhibits this year.

Reception of v.h.f. sound radio is a feature of the new "Majestic" 21-inch television receiver. A console model, it has a 90° c.r. tube, fly-wheel synchronization and a 10-inch high-flux loudspeaker. In the "New Queen Special" 17-inch set an internal aerial is provided.

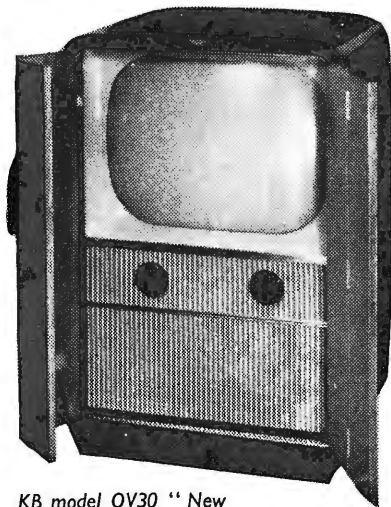
The compactness of the new "Minor" radio-gram will make it attractive to those with restricted living space, its detachable legs allowing it to be used as either a console or a table model. Equipped for reception of v.h.f., as well as long and medium waves, it has a 6-watt output into a 9 in x 5 in elliptical speaker. Another new exhibit is the "Tune-time" 4-speed portable record player, which has a printed circuit, a 7 in x 4 in elliptical speaker and an automatic changer.

Kolster-Brandes, Ltd., Footscray, Kent.

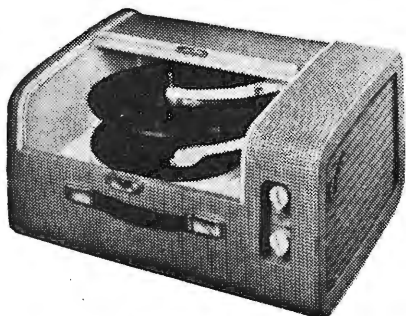
KERRY'S (212)

Wholesale distributors of many of the leading makes of receivers, electric gramophones, tape recorders and also of some makes of test instruments.

Kerry's (Great Britain), Ltd., Warton Road, London, E.15.



KB model OV30 "New Queen Special."



Left: Ferguson "Fortune" record reproducer.

LABGEAR (217)

Unorthodox designs of television aerials have been a feature of this firm's display at previous exhibitions and to them this year is added the "Diamond" indoor aerial, known also as Model C11. It covers all 13 TV channels and has provision for "peaking" the local station.

The "Bi-Square" principle of de-

sign is this year extended to an f.m. aerial giving, in compact form, a power gain of 10 dB compared to a plain dipole.

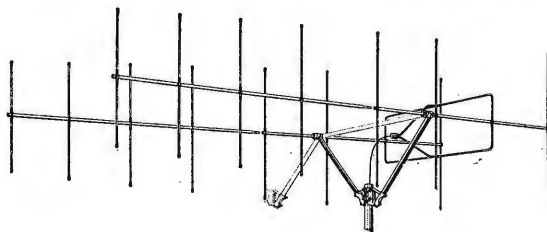
A range of test instruments is included this year. There is a precision television alignment generator, a signal-strength meter primarily for testing TV aerials, milli-voltmeter and a range of instrument kits. These include an oscilloscope, and a multi-range a.c./d.c. meter kit.

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

LINTRONIC (223)

A portable 30-watt public address unit complete with 12-in loudspeaker in a carrying case 22 in x 14 in x 12 in forms a basic unit for use with a microphone, electronic musical instrument or records. A twin-input mixer is provided.

A four-channel electronic mixer



One of the new Band III "Double Slot Beam" arrays made by J-Beam Aerials.



G.E.C. transistor portable (BC1650).

waves. Model T62DA has a loudspeaker specially developed for f.m. reproduction and is housed in a maroon plastic cabinet. The new ARG57 series radio-grams are notable for their use of printed circuitry.

The Marconiphone Company Ltd., 21, Cavendish Place, London, W.1.

MASTERADIO (35)

At least eight new receivers will be shown by Masteradio. Three are basically television sets, two radio-gramophones and two sound receivers. One television set, the Model THG17, is fitted with a 17-in tube, a multi-speed automatic record changer and high-fidelity sound-reproducing equipment. There is also a 21-in TV set which, among other features, embodies automatic focusing and neither focus nor ion-trap adjustments are required. A turret tuner gives all-channel coverage. This is the model TH21T.

The RG369 radio-gram for a.c. mains is a de luxe model with a.m./f.m. radio, multi-speed automatic record changer and large record storage space.

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

MEADOW-DALE (224)

An aerial which cannot fail to attract attention will be the Dale parabolic model for Band III. It consists of a dipole backed by eight reflectors arranged on a parabola and it gives,

(HF101) with headphone monitoring is suitable for use with a tape recorder or power amplifier.

Lintronic Ltd., 149, Strand, London, W.C.2.

McMICHAEL (45)

The centre-piece of attraction on this stand will be a new 17-in table model television receiver (M71T) of com-

relative to a dipole, a gain of 14 dB with a high front-to-back ratio and the comparatively narrow acceptance angle of 20°.

Shown also will be a range of "Convertible" aerial units which build up from a Band-I dipole to elaborate triple-band systems.

The Meadow-Dale Manufacturing Co., Ltd., The Dale, Willenhall, Staffs.

MULLARD (39)

While the main stand is devoted chiefly to electronic novelties, designed to illustrate more serious applications, there will also be a Home Constructor Centre adjoining demonstration room D34. Here, constructors will be able to consult some of the company's engineers on technical matters and see examples of equipment built around Mullard valves, transistors and c.r. tubes. Demonstrations of high-quality sound reproduction equipment will be given, including amplifiers built to Mullard circuits.

In the valve displays special emphasis will be placed on transistors and the new 90° deflection c.r. tubes.

Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1.

MULTICORE (61)

To demonstrate the use of "Savbit" solder alloy, which has been compounded to reduce the absorption of copper and so lengthen the life of soldering bits, a replica of a section of the Decca Radio factory has been erected on the stand and will be producing record player amplifiers.

The interests of the home constructor have not been overlooked and a special pack of 22 s.w.g. 60/40 alloy for home soldering of printed circuits has been introduced.

Established lines such as the Bib wire stripper, the solder thermometer and the recording tape splicer are being continued.

Multicore Solders Ltd., Hemel Hempstead, Herts.

MURPHY (53)

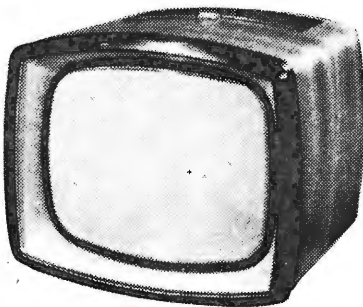
Fine tuning control has been eliminated from the latest range of table television receivers and only the four-position turret tuner has to be operated. The V320 is a 21-inch model while the V310 and V310C have 17-inch screens—the last-mentioned being pivoted in a decorative U-shaped stand. A flap on top of these receivers covers the controls and loudspeaker, and when raised it switches on the set and acts as a reflector to direct sound forward. Adjustable vision interference limiters are provided and also sound interference suppression.

Sound receivers will include six a.m./f.m. models. There are three table receivers, a console with emphasis on high-quality reproduction and two radio-grams with three-speed automatic changes.

Murphy Radio, Ltd., Welwyn Garden City, Herts.

N.I.D. (312)

The varied aspects of the work of the Institute on behalf of the deaf and hard-of-hearing are portrayed. Remote control devices enabling the



Murphy model V310

deaf to hear sound and television receivers without discomfort to other members of the household, hearing aids, and a machine for conversing with the deaf-blind are being demonstrated.

National Institute for the Deaf, 105, Gower Street, London, W.C.1.

PAM (42)

A complete range of television receivers using printed circuit chassis has eight models in all, built round a 17- or 21-inch chassis—a fringe model being obtainable in both cases.

Radio receivers include two a.m./f.m. and two a.m. only models. The six-transistor 720 portable is the successor to last year's model 710.

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

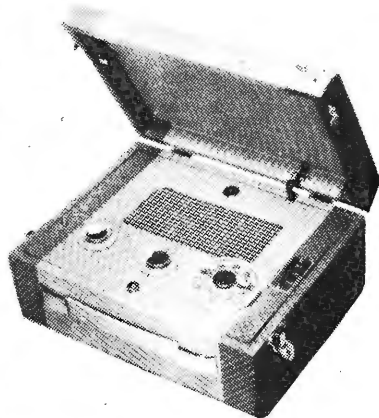
PERDIO (63)

A pocket receiver measuring 3½ × 5½ × 1in and weighing 13 oz has five transistors and a printed circuit. The life of the pen-type batteries is said to be about 115 hours with intermittent operation. It covers the medium broadcast wavelengths.

Perdio Ltd., Dunstan House, St. Cross Street, Hatton Garden, London, E.C.1.

PERIOD HIGH FIDELITY (106)

These newcomers to the industry specialize in period styled furniture to house television, radio or high



Invicta 29 mains/battery portable.

fidelity equipment; and any style of period or contemporary cabinet can be supplied.

Period High Fidelity Ltd., 28, South Street, London, W.1.

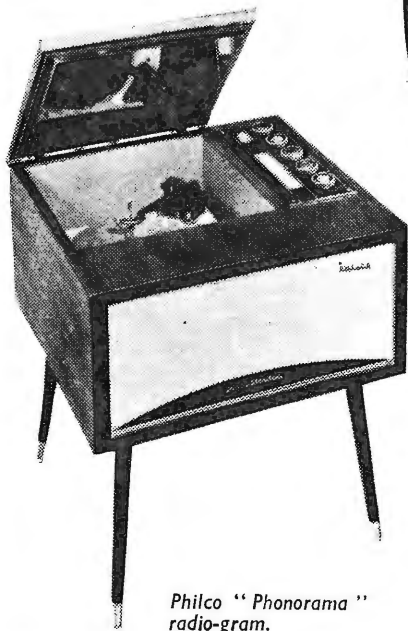
PETO SCOTT (30)

A transistor portable sound receiver is one of the more topical exhibits on the stand. Other sound equipments will include a 4-speed record reproducer, RC33, and a high-quality amplifier with a 10-watt output.

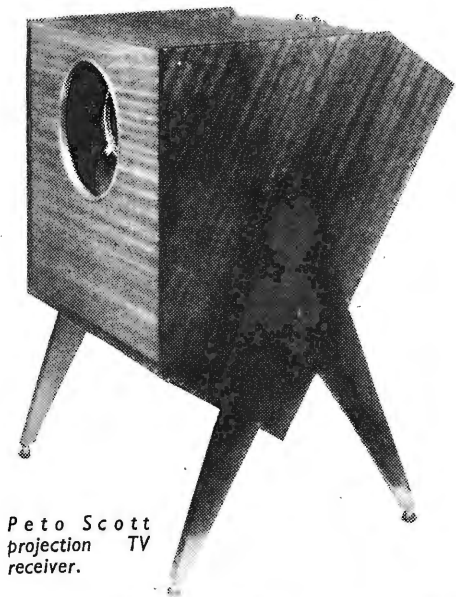
The new 17-inch television sets TV1722 and TV1723 contain several interesting features: a switch giving a choice of direct or flywheel line synchronization; independent Band-I and Band-III contrast controls; remote control sound muting switch; delayed a.g.c. on sound and vision; regulated e.h.t.; and a maskless picture tube.

In addition there will be a projection receiver using a 2½-inch tube. A forward-projection model gives a 4 ft × 3 ft picture on an external screen and a back-projection model a 2 ft × 1½ ft picture on a screen in the cabinet.

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



Philco "Phonorama" radio-gram.



Peto Scott
projection TV
receiver.

PHILCO (43, 305)

Optional remote control of station selection is a feature of many of the television receivers in the Philco range. Among sound receivers there are many models with v.h.f./f.m. coverage and at least two for f.m. only. Of these the new "Phonorama" radio-gramophone is of special interest on account of the two-stage acoustic loading provided for the loudspeakers in order to achieve the widest possible frequency range in a cabinet of reasonable size. There is a rotatable aerial for v.h.f. and provision, if desired, for feeding a.m. signals to the amplifier from an external tuner unit.

Another new production is the 3755 portable transistor record player making use of the Staar 3-speed battery-driven turntable.

Philco (Great Britain), Ltd., 30/32, Grays Inn Road, London, W.C.1.

PHILIPS (20, 21)

The latest a.m./f.m. sound receiver, the G75U, has 7 valves and 3 wavebands. It uses a ferrite aerial for a.m. and an internal loop for f.m. Housed in a plastic cabinet, it has a 5-inch loudspeaker and works from a.c. or d.c. mains. Two other a.m./f.m. sets will be shown, and for a.m. only, a printed-circuit transportable, a battery portable and a 12-V or 6-V powered car radio.

In sound reproduction equipment there is a new version of the "Disc Jockey Major" portable record player with a re-styled carrying case in a two-colour combination. Also on show will be the "Novosonic" high-quality sound equipment and a range of radiograms.

Automatic gain control and fly-wheel sync circuits are incorporated in the 21-inch television set model 2157U, which is a console type and uses a 10-inch loudspeaker. The

range also includes 17-inch and 21-inch table models with 90° tubes.

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

PILOT (54)

This year high-quality sound reproduction equipment is one of the main features of the Pilot exhibit and will be demonstrated. The HFA11 is a neat 10-watt amplifier incorporating a control unit for record frequency characteristic compensation, separate tone controls and switched "scratch" and "rumble" filters. The HFA12 with 12-watt output has a separate control unit (HFC12) and is notable for the inclusion of a muting switch for use with record changers.

Portable record reproducers include a new a.c./d.c. mains version of the "Encore," and the "Modernaire" radio-gramophone.

An f.m./a.m. table receiver (T91) and two portables—the "Little Maestro" and a newcomer, the "Poppet"—are the principal sound broadcast receivers, and the television range is notable for a new 17-inch model (TV111) and a special fringe area receiver (TV110F).

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

PLESSEY (125)

It would be impossible to do justice in a selective exhibit to the wide range of components, parts and accessories of various kinds which this firm supplies to the radio and electronics industry, but their stand will form an office where trade representatives from home and overseas will be able to obtain information on all Plessey products.

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

PLUS-A-GRAM (109)

A number of portable record reproducers and also a record player will be shown. These can play standard or long-playing records, and most of them can be operated with the lid open or closed. The new "Dansette Conquest" incorporates two speakers.

J. and A. Margolin, Ltd., 112-116, Old Street, London, E.C.1.

PORTOGRAM (1)

The TR/100 console is a three-speed tape reproducer incorporating a reflex loaded loudspeaker, and large storage compartment. There is also provision for a record reproducer and f.m. feeder unit.

The HF/65 console record repro-

ducer has an 8-watt amplifier with push-pull output stage.

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

PYE (13)

No fewer than eleven sound broadcast and ten television receivers are listed in the range of current models, and the possibility that others may emerge during the period of the Show is not precluded. All requirements are catered for, from the smallest personal portable to a radio-gramophone (Fen Man II RM) with provision for home recording as well as record playing from a 4-speed changer and radio reception of f.m. and a.m. stations.

Representative of the television receivers are the CW17 and CS17 models (with twin loudspeakers). Another notable receiver is the 14-in portable which has a high-sensitivity circuit.

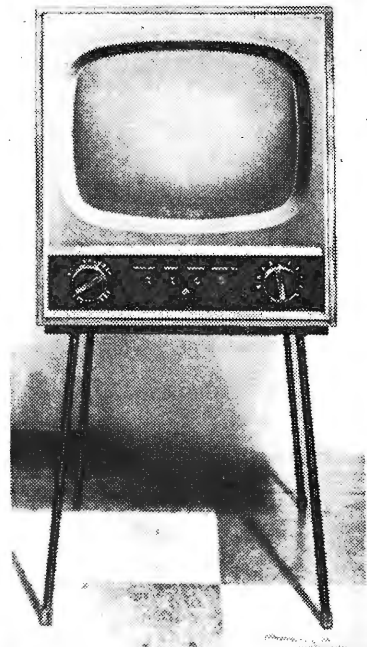
High-quality reproduction from records, either through the "Black Box" range of players or by equipment assembled from a choice of amplifiers and loudspeaker units is another activity of the Pye organization, which has assumed growing importance.

Pye Ltd., Cambridge.

R.A.F. (304)

Radio aids to navigation of military aircraft and the part played by electronics in the operational use of guided weapons are shown either by models or actual equipment. Among the equipment to be seen is the beam approach system Babs, Mk. 4, a

Pye Model
CS17.



radio altimeter (Mk. 8) and the ground installation for I.L.S. A section of the stand is devoted to activities of the R.A.F. Amateur Radio Society.

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

R.C.A. (114)

Two new high-quality "phonographs" have been introduced in addition to the Standard "New Orthophonic" complete range of units.

The "Vice-President" table or chair-side model is fitted with a four-speed record changer. The five-watt amplifier has separate bass, treble, and loudness controls and feeds a speaker system comprising a 10 in x 6 in elliptical speaker and two 4-in tweeters arranged for good sound dispersion.

The "President" is a larger single cabinet instrument with 20 watts output available from the amplifier. The speaker system comprises one 12-in and two 4-in units housed in an infinite baffle chamber.

R.C.A. Great Britain, Ltd., Lincoln Way, Windmill Road, Sunbury-on-Thames, Middlesex.

R.G.D. (27)

Two 17-in television receivers (one a fringe area model) and a 21-in model incorporating an f.m. receiver for sound broadcasting are being produced by this company and there are several new radio-gramophones to choose from including the "200 FM" with built-in ferrite rod and dipole aerials for medium, long and v.h.f. transmissions. In the "Cambridge" and "300 FM" models three loudspeakers cover bass, middle and treble frequencies, in the "Roxburg" four loudspeakers are used, two for the bass, and in the "1000" an additional mid-frequency unit brings the total up to five. A portable record player (Model "708") is fitted with a two-stage amplifier and a four-speed changer.

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

R.M. ELECTRIC (115)

The full range of "Strad" receivers available includes radio-grams, a 17-in table television set, record player and portable battery radio. The "Woodberry" radio-gram incorporates a 6-valve circuit for medium and long waves, and v.h.f./f.m. A 4-speed record changer is used. The television set includes a.g.c. and fly-back suppression circuitry.

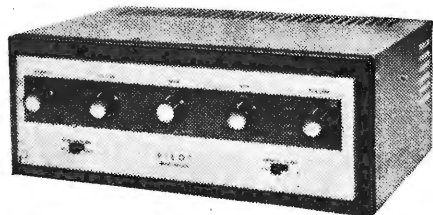
R.M. Electric, Ltd., 21, Seaton Place, London, N.W.1.

R.S.G.B. (309)

The emphasis is on home construction and examples of equipment constructed by members of the Society are shown. These include a transistor record player, a simple com-



R.G.D. "200 FM" radio-gram.



Pilot HFA11 amplifier.

munications-type receiver, mobile equipment and test gear.

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

REGENTONE (8)

The v.h.f./f.m. version of the Model 99 radio-gramophone is notable for its drop-down scale front which gives access to a record player in a lighted compartment. A newcomer to the radio-gram range is the ARG81 which is a low-built model with a v.h.f./f.m. range in addition to medium and long waves, and a 4-speed record changer.

Two new television receivers (T17.7 and T21) with 17-in and 21-in tubes are available either with or without the addition of a v.h.f./f.m. sound broadcast range.

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

ROBERTS (25)

A new battery portable (R77) resembling a leather field-glass case follows the firm's tradition of high-quality workmanship. It is a four-valve superhet for medium and long waves with printed circuit and ferrite rod aerial. It measures 9½ in x 3½ in x 6 in and with batteries weighs 4½ lb.

The R66 and RMB mains/battery portables and the RP4 battery model are being continued.

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

ROLA CELESTION (16)

An interesting new loudspeaker is the 415 which employs two pressure-driven units to cover audio frequen-

cies from 350 c/s upwards, the lower frequency unit driving a re-entrant horn.

Some additions have been made to the wide range of loudspeakers for radio and television manufacturers.

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

S.T.C. (60)

Silicon junction rectifiers have advantages over conventional rectifiers because of their greatly improved power/weight and power/volume ratios and ability to operate at high temperatures. A new 5-amp diffused-junction type will be shown, as well as 1-amp and 0.5-amp versions. Improved construction and higher voltage elements, giving savings in space, weight and cost, are the main feature of the recent Series 400 selenium rectifiers. Also shown will be contact-cooled selenium types and germanium junction photocells.

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

SIEMENS EDISON SWAN (46)

Miniature valves with low-consumption 25-mA and 50-mA filaments are a prominent feature of the valve display, which includes types for a.m. and f.m. receivers and a preferred range of television valves. The complete range of r.f., i.f. and a.f. hermetically-sealed transistors will also be shown.

Industrial valves and c.r. tubes will include the Vapatron, and a display will illustrate the methods of cooling this by vaporization of water.

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

SLINGSBY (215)

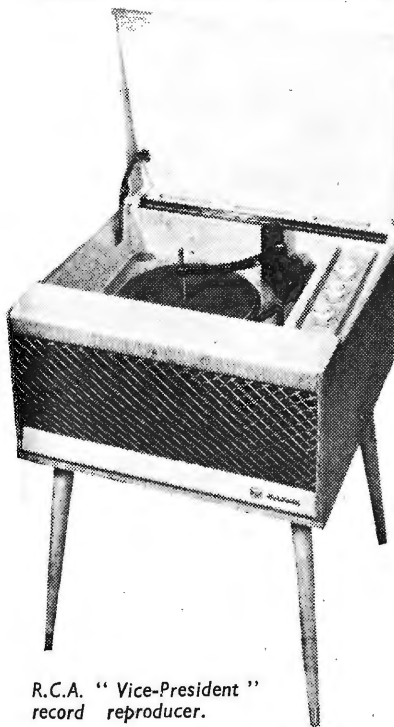
Equipment for handling and transporting television sets and radio-gramophones is the principal exhibit which includes light-tubular metal tracks and metal runways to facilitate van loading. Aluminium section ladders suitable for aerial installation work are also shown.

H. C. Slingsby, Ltd., 89, 95, 97, Kingsway, London, W.C.2.

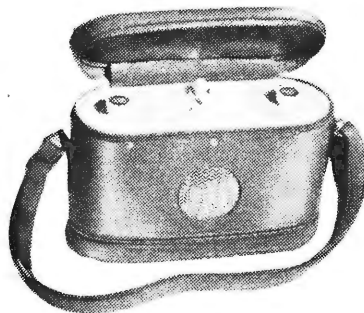
SOBELL (19)

Shown this year are 14-in, 17-in, and 21-in television sets in table and console cabinets, sound receivers and radio-gramophones. The Model TPS147DL is a new 14-in transportable TV set finished in beige and maroon leather-cloth. It embodies an all-channel tuner and normally uses a telescopic aerial, but an external one can be employed.

A 7-valve a.m./f.m. radio-gramophone, Model FMG708, with four-speed automatic record changer and push-button waveband selection, housed in a modern contemporary



R.C.A. "Vice-President" record reproducer.



Roberts R77 portable.

bureau-style cabinet with drop-down front, is also new.

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

SOBELL INTERNATIONAL (56)

The centre of attraction on this stand will be a combined television set, radio-gram, tape recorder and cocktail cabinet. A 21-in tube is fitted and the radio-gram unit has a 4-speed automatic record changer. High-fidelity audio techniques have been applied. It will be accompanied by a representative selection of export-model sets, mains/battery portables and sound receivers.

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

SPENCER-WEST (206)

Weighing only 17 lb, the latest portable television set produced by this firm has a 9-inch screen and measures 15½ in × 11½ in × 11 in. It has a 12-position turret tuner, fitted with wafers for local Band-I and Band-III stations, and gives a sensitivity better than 30μV. Automatic vision gain control and noise suppression circuits are incorporated, and the construction is based on printed circuitry. Optical enlargement is provided by a plastic window in front of the picture tube.

Aerial distribution amplifiers for Bands I, II and III are available and provision is made for interconnecting the amplifiers to supply the three services on the same wiring system. A range of Band-III converters and pre-amplifiers will also be on show.

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

STELLA (34)

Two new a.m./f.m. sets are on show this year, the ST239U and ST236A, both with seven valves and moulded plastic cabinets.

An f.m. waveband is provided in the ST312A radio-gram, which has a four-speed record changer, a dual-stylus pickup and push-button controls.

The latest wide-angle 90° c.r. tubes are used in two new television sets, the ST8617U 17-inch table model, with side-mounted controls and loudspeaker, and the ST5721U 21-inch console, which has its controls and speaker at the front.

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

T.C.C. (58)

Among the many capacitors to be shown by T.C.C. this year will be a new range with p.t.f.e. dielectric. Their special features are ability to operate at temperatures up to 200°C, high insulation resistance and good power factor. The T.C.C. range of tantalum electrolytics has been extended to include some new miniature types designed especially for aircraft instruments and transistor equipments.

Interference suppression capacitors, chokes and networks of various kinds will be on view, together with a very comprehensive display of printed circuits for sub-assemblies, accessories, amplifiers and receivers.

Telegraph Condenser Co., Ltd., North Acton, London, W.3.

TAPE RECORDERS (111)

The "Playtime Twin" portable record reproducer incorporates a four-speed turntable with high output turnover crystal pickup feeding two loudspeakers via the two-valve audio amplifier. The "Sound" three-speed tape recorder is an improved version of last year's model.

Tape Recorders (Electronics) Ltd., 784-788, High Road, London, N.17.

TAYLOR (32)

Among the new instruments shown is the 94B television waveform and alignment generator. This incorporates a pattern, a.m. and f.m. signal generators, and a television sweep oscillator, all covering frequencies from 4 to 220 Mc/s. Synchronizing waveforms for 525 (F.C.C.) and 625 (C.C.I.R.) line standards are available. An addition to the range of test meters is a new pocket-sized model, the 122A.

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

TECHNICAL SUPPLIERS (103)

A new TSL a.m./f.m. tuner has a high sensitivity with one r.f. and two i.f. stages on a.m., and three i.f. stages on f.m. The "Savoy" a.m./f.m. receiver incorporates a 12-watt push-pull audio output stage.

The "Geruphon Omni-D" resonator is a 4½-in-diameter 16-in-long tube containing an asymmetrically mounted loudspeaker. The "Concert Soundcorner" two-speaker system utilizes a room corner, and is mounted several feet from the floor.

Technical Suppliers, Ltd., 63, Goldhawk Road, London, W.12.

TELENG (227)

A new signal level meter (SL3B) with a range from 25 μV to 250 mV incorporates 12-channel turret tuning for measurements on cables or television aerials at frequencies between 40 and 220 Mc/s.

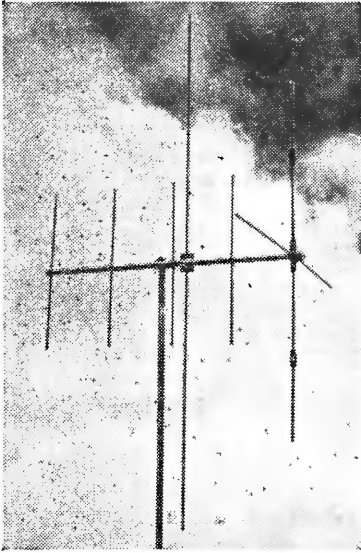
A wide range of other television equipment is also exhibited. This includes mast booster units for television distribution systems, wide-band amplifiers, and two turret conversion kits. A number of coaxial cable devices are also shown.

An item outside the television range is a three-valve superhet car radio receiver.

Telefusion (Engineering) Ltd., Church Road, Harold Wood, Romford, Essex.

TELEQUIPMENT (226)

A new portable calibrated oscilloscope, the "Serviscope," makes use of an automatically synchronizing time base. Triggering facilities are



"Triple Hi-Max Five D" television and f.m. aerial made by Telerection.

provided. Another calibrated oscilloscope, the 720, is also on show.

The WG44 television pattern generator covers two bands from 40 to 70 Mc/s and 170 to 220 Mc/s and gives both sound and vision signals. Four different types of picture modulation are available.

Tequipment Ltd., 313, Chase Road, Southgate, London, N.14.

TELERECTION (38)

A series of combined FM/TV aerials described as "Hi-max Triple-band" types is the latest addition to this firm's range of v.h.f. aerials. The main element is a Band-I dipole divided into three Band-III sections by means of miniature tuned circuits called phase correctors. This element functions efficiently on Bands I and III and reflectors and directors are added according to the overall gain required. To this combination is now added a horizontal f.m. dipole. All three systems share a single feeder.

Telerection Ltd., Antenna Works, St. Pauls, Cheltenham, Glos.

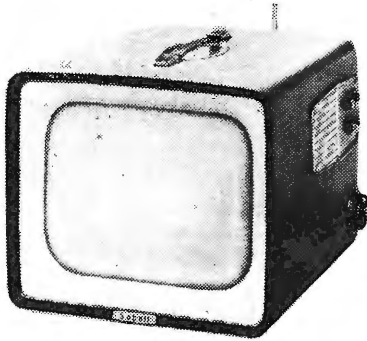
THOMPSON, DIAMOND & BUTCHER (214)

Manufacturers of "Convertogram" record players, "National Band," "Meritone" and "New World" electric gramophones and "Lamp-lifier" loudspeaker-amplifier units, and distributors of many of the leading makes of domestic receivers.

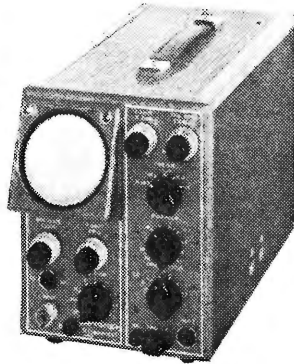
Thompson, Diamond and Butcher, Ltd., 5-9, University Street, London, W.C.1.

ULTRA (11)

Two new 21-in television sets have been introduced, the V21-50A table model and the WR21-62 console which also provides for v.h.f. reception of the B.B.C. sound broadcasts. There are also new 17in receivers



Sobell Model TPS147DL 14-in transportable television set.



Tequipment "Serviscope."

in both standard and fringe area versions either in table cabinets with optional matching stand or in console form. All these sets have built-in v.h.f./f.m. sound receivers.

The "Troubadour" small transportable sound receivers are new versions of a popular model, one for v.h.f. reception only and the other for a.m. on medium and long waves. Both sets are produced by the printed circuit technique.

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

VALRADIO (118)

Power conversion units for supplying a.c. mains-operated television receivers, radio-gramophones, tape recorders and other electronic equipment from d.c. supplies (including batteries) is the speciality of this firm. These now include transistor-type converters and a typical example operates "all-dry" portable receivers from car or boat batteries.

Valradio, Ltd., Browells Lane, Feltham, Middx.

VIDOR (52)

A number of battery portable models are shown. These include the "Vanguard" for a.m. and v.h.f./f.m. which incorporates internal ferrite rod and f.m. dipole aerials, a six-valve circuit, and a 7in x 4in elliptical loudspeaker. The "Marquisa" and "Lady Anne" can also be operated from a.c. mains. New transistorized battery portables are also on show.

The wide range of dry batteries

includes units for radio receivers, torches, hearing aids and photo-flash equipments.

Vidor, Ltd., Erith, Kent.

WALTER INSTRUMENTS (49)

In the 303 portable tape recorder a single tape speed of 3½in/sec is provided, the overall response being 40 to 10,000 c/s, with a signal-to-noise ratio better than 35 dB.

Walter Instruments, Ltd., Garth Road, Morden, Surrey.

WESTINGHOUSE (113)

Selenium rectifiers will be shown in various types of assembly to illustrate the methods of cooling and chassis mounting now possible. Contact-cooled rectifiers include the new edge-cooled type in which heat is removed by three edges of each square element, the fourth being left for connections. Conventional rectifiers with double-voltage elements (p.i.v. of 42V per element) will be displayed, and also miniature tubular types capable of withstanding high peak inverse voltages and copper-oxide types suitable for moving-coil meters.

Some new automatic chargers on view are designed expressly for recharging the batteries of radio-equipped vehicles.

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

WHITELEY ELECTRICAL (65)

The ready-to-assemble range of cabinets in traditional and contemporary styling now comprises four models for housing complete equipments, and eight speaker cabinets.

The wide range of loudspeakers available with diameters from 2½ to 18in, and incorporating the patented cambric cone, includes a number of models specially designed to cover the middle and upper frequencies.

A new control unit for the WB12 amplifier now gives a choice of two units for this amplifier. The WB v.h.f./f.m. tuner has three wide-band i.f. stages, limiter and Foster-Seeley discriminator.

The industrial and Services section includes permanent magnets, transformers and cores, wavemeters and other components. A section is also devoted to components for the home constructor.

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

WOLSEY (40)

A new Wolsey twin-band television aerial, known as the "Twin Super," is designed for mounting on the skirting board, or suspending from the picture rail, whichever is the more convenient. It is designed to provide more gain on Band III than on Band I.

Another new model is the "Interceptor 5" introduced for use in weak-signal areas. A range of aerial accessories together with communal aerial systems will be included.

Wolsey Electronics Ltd., Cray Avenue, St. Mary Cray, Orpington, Kent.

THE GYRATOR

I. Introduction to a Theoretical Concept which Preceded the Practical Device

By THOMAS RODDAM

ONE of the accusations made against engineers by laymen is that they use jargon. When I say that microwave plumbers use ferrites in gyrators I expect to be told that this is jargon. It isn't, of course. According to Quiller-Couch, the two main vices of one of his characters, J, are circumlocution and the use of vague woolly abstract nouns instead of concrete ones. What engineers do, however, is use new, though well-defined words. The microwave gyrator is a practical device, a thing, although if you are not an active follower of microwave practice you may not know much about it. One of its more attractive features is that the idea of a gyrator is a rather abstract one and preceded the invention of the actual device by some years. Things don't usually happen that way: usually someone makes something which works after a fashion, theorizes about it and thus improves it.

In these two articles I have adopted an historical approach. In the first one I have drawn heavily on a paper by B. D. H. Tellegen,* who is the man who really brought the gyrator to light and named it.

Before the war most of us would have been pretty confident that although we should have new inventions, new circuit theory and a whole bag of other novelties, the basic bricks of our theoretical world were complete, for good or bad. Resistance, inductance, capacitance and the ideal transformer formed a neat quartet with which we could build up our dipoles and two-terminal pairs. Then not long after the war the gyrator appeared on the scene, though it had not yet, I think, made its way into the textbooks. It is difficult to see now why it took so long before anyone saw the need for the gyrator because, as we shall see in this article, it is an obvious theoretical concept. Once it appeared as an idea, several practical, though not, of course, ideal embodiments followed, one of which is of very great importance.

Terminals and Terminations

In the course of this first article it will be necessary to look at the absolutely basic ideas fairly precisely. Already, in the previous paragraph, the reader will see that I have referred to a two-terminal pair. This is not just pedantic observation, a description which usually means "I don't understand it and I'm not going to let you know I wish I did." A four-terminal system, which is what the theoretician's black box is often called, has, obviously, four terminals. Usually, however, the black box also carries two labels, saying "In" and "Out", or something equivalent. Some of our theory applies perfectly well to the general black box with four terminals,

but it is much easier, and therefore much commoner, to deal only with the special "In-Out" case, which we therefore call by a special name, the two-terminal pair.

Let us deal first with the two-terminal network, which some people call a one-terminal pair. The circuit is shown in Fig. 1 and I shall not feel responsible if "Cathode Ray" uses this as a peg on which to hang a couple of articles. Now, if this network is to be one of those we deal with in ordinary circuit

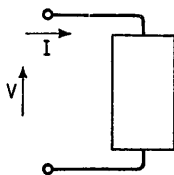


Fig. 1. Basic two-terminal network.

theory it must satisfy three rather important conditions. It must be linear, which means that although the equation relating V and I can contain terms in dV/dt and dI/dt , d^2V/dt^2 and d^2I/dt^2 , and so on, it cannot contain terms like I^2 . Rectifiers, silicon carbide resistors, both of them passive elements, are non-linear and are barred from our basic study. The reason for this is quite easily seen: the behaviour of non-linear elements is tied up with the actual sizes of currents, voltages and the devices themselves. Cannon balls and golf balls accelerate in the same way under gravity (linear theory) but produce quite different effects if they fall on your head (non-linear theory).

The network elements must be constant. You wouldn't get very far measuring the capacitance of a condenser microphone (which I suppose we should call a capacitor microphone, but who does?) in a boiler shop. Finally, the network must be passive: no valves, no generators, no concealed energy sources of any kind are permitted. This clearly means that our resistances must be positive, because, as has been shown in these columns, the only way to get a negative resistance is to use some sort of amplifier: anyway, a negative resistance is capable of pumping energy into a positive resistance, and the more rigid definition of "no energy sources" obviously applies.

The sort of equation we can finally write down must be made up of basic equations like:

$$\begin{aligned}v_1 &= Ri, \\v_2 &= Ldi_2/dt \\Cdv_3/dt &= i_3\end{aligned}$$

Here v and i are the voltage and current in small bits of the network, and all we have to do is combine them. Quite a lot has been written on methods of getting from the V - I equation to a network which

*Philips Tech. Review, Vol. 18, p. 120 (1956). For further references see Philips Research Reports, Vol. 3, p. 81 (April, 1948).

will satisfy it: this is a much more difficult problem than getting from the network to the V-I equation, for which we can use Kirchhoff's laws, Maxwell's circulating currents (a variant) or some other more elaborately simple methods like matrix algebra.

Whatever we do, however, we are limited to our three basic bits, the resistance, capacitance and inductance which are so familiar. Even the literature of two-terminal networks using only two kinds of element is pretty extensive: I am writing this with no references available and I will not try to guess how many papers have appeared this month, all over the world, on just this limited subject, but I am pretty certain that if you check up you will find a few.

We cannot spend more time on this, however, and must get on to our two-terminal pair. The basic circuit, shown in Fig. 2, is not unfamiliar, though there are differences of opinion about which way to draw I_2 . There are considerable advantages in drawing all the currents flowing from left to right in the upper arms; the same currents flow back in the opposite direction in the lower arms. Even this detail is sometimes rather important. In this particular connection, actually, it would be rather more convenient to draw I_2 the other way round, and many of the textbooks do this. The disadvantage is that when you come to connecting four-terminal networks in tandem the minus signs start creeping in. Let us start the way we mean to go on, even though it means that we will have to use minus signs here.

One way of discussing the behaviour of the network is by the impedance equations:

$$\begin{aligned} V_1 &= Z_{11} I_1 + Z_{12}(-I_2) \\ V_2 &= Z_{21} I_1 + Z_{22}(-I_2) \end{aligned}$$

This pair of equations is found in most of the books, I think. To see what the various Z 's are it is necessary to impose arbitrary conditions to simplify the equations. Suppose, for example, we make I_2 zero by leaving the right-hand side open. Then

$$V_1 = Z_{11} I_1 \text{ and } V_2 = Z_{21} I_1$$

Thus Z_{11} is the open-circuit impedance looking in at the left, and Z_{21} is the trans-impedance from right to left. Trans-impedance is another word, more useful and possibly more common, for mutual impedance, a term to make the women novelists shudder. By looking in at the right and leaving the left-hand terminals open we can see that Z_{12} is the trans-impedance from left to right.

Reciprocity

Now we come to the point where the textbooks push you out on a limb. In their various ways they tell you without much explanation that $Z_{12} = Z_{21}$, a condition which they describe as the reciprocity theorem. This is certainly true if the network contains nothing but resistance, capacitance and inductance elements. Since a real transformer can be represented by an equivalent network of inductances when considered as a two-terminal pair, though obviously not by the same network if you have a true four-terminal network, all the elements we usually consider leave us with the reciprocity theorem safe and sound. Our textbook writers have been on pretty safe ground until recently and the reciprocity theorem has become a matter of faith, not reason.

The transformer, the ideal transformer, enables

us to start probing more closely into the basis of our ideas. For the ideal transformer we can write:

$$V_1 = nV_2$$

$$I_1 = I_2/n$$

where n is the transformer ratio. Not surprisingly

$$V_1 I_1 = V_2 I_2$$

meaning that the energy we put in is equal to the energy we get out again. If this were not true, it would not be an ideal transformer. Suppose, for no particular reason at the moment other than as a mathematical exercise, that we write down the equations of an ideal black box for which:

$$V_1 = sI_2$$

$$I_1 = V_2/s$$

Here again the relationship $V_1 I_1 = V_2 I_2$ holds, so that this black box is ideal, passive, linear, constant. But now we have

$$V_1 = -s(-I_2)$$

$$V_2 = sI_1$$

and if we compare this with the impedance equations we wrote down earlier we see that $Z_{12} = -Z_{21}$. Obviously, therefore, this ideal black box does not satisfy the reciprocity theorem. It is indeed an anti-reciprocal network. Suppose that we connect a second similar black box in tandem. Then for the second one

$$V_2 = sI_3$$

$$I_2 = V_3/s$$

so that for the two boxes in tandem:

$$V_1 = V_3$$

$$I_1 = I_3$$

Two of these anti-reciprocity boxes in tandem thus bring us back to a one-to-one ideal transformer. This

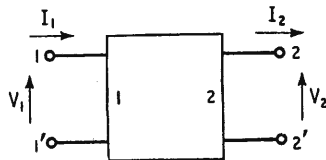


Fig. 2. Basic two-terminal pair.

property of the anti-reciprocity box is in some ways rather like that of our old friend the square root of minus one. Multiply a real number by j and you have an imaginary number; repeat the process and you are back in the realm of real numbers again, even though you are faced by a negative number instead. For this reason, which was, I suppose, not too deplorable before the anti-reciprocity box was officially named, it has been called an imaginary ideal transformer. Now, however, it is called a gyrator. Let us look at some of its properties.

Suppose that we open-circuit the right-hand side of our gyrator. Then V_2 must be zero. This means that I_1 must be zero too, from the defining equations:

$$V_1 = sI_2$$

$$I_1 = V_2/s.$$

Thus V_1 is finite and I_1 zero, V_1/I_1 , the input impedance is infinite and the short-circuited gyrator looks like an open-circuit. Make I_2 zero by open-circuiting the right-hand terminals and V_1/I_1 becomes zero; a short circuit.

Now let us connect an inductance across the right-hand terminals.

$$\begin{aligned} V_2 &= j\omega L I_2 \text{ so that} \\ \frac{V_1}{I_1} &= \frac{s^2}{j\omega L} = \frac{1}{j\omega L/s^2} \end{aligned}$$

This expression is just what we should expect if we

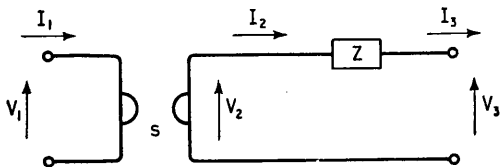


Fig. 3. A gyrator and a series impedance Z .

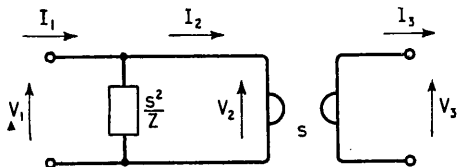


Fig. 4. A gyrator and a shunt impedance s^2/Z .

had a capacitance L/s^2 connected across the left-hand terminals, so that the effect of interposing the gyrator is to convert an inductive impedance into a capacitive impedance. Similarly, if $V_2 = I_2/j\omega C$, $V_1/I_1 = j\omega Cs^2$ and a capacitance has been transformed into an inductance. If $V_2 = RI_2$, $V_1/I_1 = s^2/R$, so that, as we might have expected by now, a resistance becomes a conductance. These results must be looked at rather more closely, and for this purpose we need a symbol for the gyrator, so that we can draw Fig. 3, which shows a gyrator and a series impedance Z . For this system we have:

$$\begin{aligned} V_1 &= sI_2 \\ I_1 &= V_2/s \end{aligned}$$

and

$$\begin{aligned} V_2 &= V_3 + I_3Z \\ I_2 &= I_3 \end{aligned}$$

giving us

$$\begin{aligned} V_1 &= sI_3 \\ I_1 &= V_3/s + I_3Z/s \end{aligned}$$

Now let us look at Fig. 4. For this system

$$\begin{aligned} V_1 &= V_2 \\ I_1 &= V_2Z/s^2 + I_2 \end{aligned}$$

and

$$\begin{aligned} V_2 &= sI_3 \\ I_2 &= V_3/s \end{aligned}$$

giving us

$$\begin{aligned} V_1 &= sI_3 \\ I_1 &= V_3/s + I_3Z/s. \end{aligned}$$

The final equations for the network of Fig. 4 are thus just the same as those we obtained for the network of Fig. 3; the gyrator acts as a "dualizer," turning any impedance into its dual.

All this is no doubt very interesting the reader may, and I hope does, think, but what is it all about? Here is a rather theoretical black box, which lends itself to a little mathematics, but what good is it, and if it is of any use at all, where can I get one? This first thing to do is to see what good it is and then hunt around to see if we cannot produce a reasonable approximation to an ideal gyrator. Let us look at Fig. 5. A gyrator and a resistance R are connected in series. We can write down the impedance equations for this circuit. They are:

$$\begin{aligned} V_1 &= R(I_1 - I_2) + sI_2 = RI_1 + (s-R)I_2 \\ V_2 &= R(I_1 - I_2) + sI_1 = (R+s)I_1 - RI_2 \end{aligned}$$

Suppose that we choose $R = s$. Then

$$\begin{aligned} V_1 &= RI_1 \\ V_2 &= 2RI_1 - RI_2 \end{aligned}$$

Although V_2 depends on I_1 as well as any ter-

mination applied to the right-hand side of the system, V_1 is completely independent of I_2 .

Fig. 6 shows another way of combining a gyrator with a resistor. For this circuit we write down the admittance equations rather than the impedance equations. We find that:

$$I_1 = \frac{V_2}{s} + \frac{V_1 - V_2}{R} = \frac{V_1}{R} + \left(\frac{1}{s} - \frac{1}{R}\right)V_2$$

$$I_2 = \frac{V_1}{s} + \frac{V_1 - V_2}{R} = \left(\frac{1}{s} + \frac{1}{R}\right)V_1 - \frac{V_2}{R}$$

Once again, then, if $s = R$ we have I_1 independent of V_2 although I_2 depends on V_1 .

A practical black box which does this is a most important device. Quite a lot of microwave generators are connected directly to an aerial feeder with no protective buffer amplifier. If the aerial does not provide an exact match for the feeder an echo is sent back and may interfere with the satisfactory operation of the oscillator. Of course the valve designer tries to make his valve as insensitive to pulling as possible, but how much easier his life would be if a small black box could be put in between valve and aerial to stop the reflections reaching the valve. It is not wasteful of energy, either. Suppose we terminate the system of Fig. 6, for which the last equations apply, in a resistance R_2 on the right. Then

$$\begin{aligned} V_2 &= I_2R_2 \\ I_2 &= \frac{2V_1}{R} - \frac{V_2}{R} = \frac{2V_1}{R} - \frac{I_2R_2}{R} \end{aligned}$$

$$\text{so that } I_2 \left(\frac{R + R_2}{R}\right) = \frac{2V_1}{R}$$

or $I_2 = 2V_1/(R + R_2)$.

For the case $R = R_2$ we have just $I_2 = V_1/R_2$, so that the applied signal V_1 produces in the load a current equal to that which it would produce if connected directly. Nothing is lost in the resistance R unless we send in from the right, when all the energy goes into R and none out to the left-hand terminals.

The practical device which really started off the

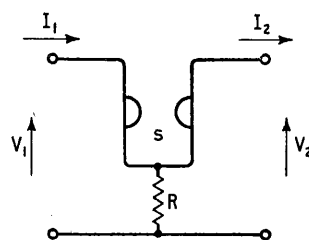
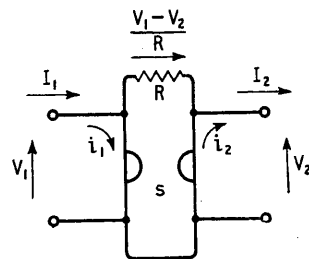


Fig. 5. Analysis of this circuit is the key to the utility of the gyrator.

Fig. 6. Another way of considering a gyrator and a resistor.



whole idea of the gyrotor and which was the origin for its name was not an electrical black box at all, but a mechanical one. You can draw a mechanical equivalent circuit for an electrical one, or an electrical equivalent for a mechanical circuit. If the mechanical circuit is a rotary system, with torque for voltages and velocity for currents, a perfect pair of gears is the equivalent of a perfect transformer. The gears may be bevel gears but the theory is the same even though the shafts have gone round through 90°. Now let us mount a gyroscope in suitable gimbals, which I will not try to draw. As you know by experience, if you try to turn the axis of the gyroscope it insists on turning, not the way you want it to turn but at right angles to your twist. At first sight, therefore, the gyroscope is doing just the same as the pair of bevel gears, but

if you do the mathematics you will find that instead of the primary torque being transferred as a secondary torque, the torque at the second shaft is proportional to the velocity at the first shaft. This is just the equivalent of our gyrotor equations, with

$$\begin{aligned} V_1 &= sI_2 \text{ replaced by} \\ T_1 &= sv_2 \text{ and} \\ V_2 &= sI_1 \text{ replaced by} \\ T_2 &= sv_1, \text{ where } T \text{ and } v \text{ stand} \end{aligned}$$

for torque and velocity.

The paper on the gyroscope† triggered off a number of others including one showing the one-way-only property we have already analysed. Here was an important application: in the second article we shall see how a practical device was made.

†Bloch, *Phil. Mag.*, Series 7, Vol. 35, p. 315 (1944).

Sequential Colour Again

NEW FRENCH SYSTEM GIVING SIMPLER AND LESS CRITICAL RECEIVERS

ALTHOUGH the frame sequential system of colour television was abandoned as a possible contender for public service in the U.S.A. on account of its non-compatibility, the general idea of sequential colour transmission has never been entirely killed. It has too many good points for that. The frame sequential system, for example, is notable for the quality of its colour reproduction and for the simplicity and non-critical nature of the transmitting and receiving equipment. And even though simultaneous colour transmission has been established in the U.S.A. in the shape of the N.T.S.C. system, the sequential process still persists in rearing its head in such devices as the Chromacoder* and the "Apple" and Chromatron single-beam colour c.r. tubes† where the colour phosphors are selected in turn.

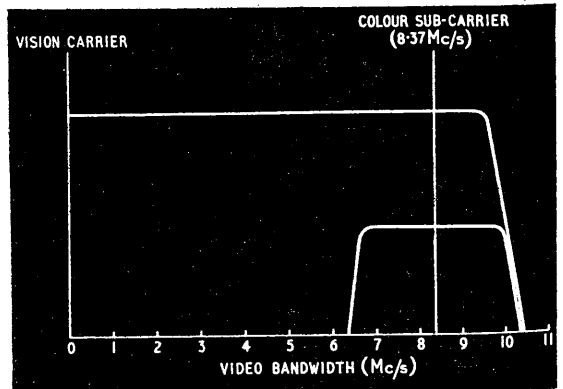
Now we have a sequential method of transmitting colour information in a new French system—a compatible system, it should be said—which has been devised by M. Henri de France and developed at the research laboratories of the Société Nouvelle RBV—La Radio Industrie. *Wireless World* saw it demonstrated in Paris recently on the occasion of the International Colour Television Symposium. In this system the main purpose of the sequential transmission is to simplify the receiver circuitry by eliminating the need for complicated expedients such as synchronous detection which are necessary with simultaneous transmission of the N.T.S.C. type.

It is well known that in the N.T.S.C. system the colour information is conveyed by two colour-difference signals (or derivations of them) which modulate two components in quadrature (90° phase difference) of a single sub-carrier frequency. At the receiver the recovery of these colour difference signals demands a synchronous detection system, using a local oscillator of sub-carrier frequency with

appropriate phase-displaced outputs. The arrangement is somewhat critical because the correct reproduction of transmitted colour information depends on accurately maintaining the frequency and phase synchronization of this local oscillator, and a complete regulating system is necessary for the purpose. Indeed, it appears from subjective tests that some receivers will not tolerate phase drifts of more than ±5°, which is more critical than the ±10° tolerance allowed on the B.B.C. test transmissions themselves! In addition, of course, there is the danger of possible cross-talk between the two components of the colour sub-carrier.

All this is avoided in the new French system by using the sub-carrier to transmit by simple amplitude modulation only one set of colour information at a time, instead of both sets at once. The two sets chosen are the red and blue primary colour-component signals from the three-colour camera, which are signified by E_B' and E_B' (the ticks indicating that they are gamma-corrected). By means of an elec-

Fig. 1. Frequency spectrum of the complete 819-line colour signal, E_T .



*A device for converting the output of a frame sequential camera to simultaneous transmission. See *Wireless World*, November 1954, p. 540.
†See *Wireless World*, January 1957, p. 2.

tronic switch these signals are applied alternately to the sub-carrier modulator at line frequency, so that in the first frame of a picture, red, say, is transmitted during line 1, blue during line 3, red during line 5 and so on, and in the second interlaced frame, blue is transmitted during line 2, red during line 4 and so on.

A separate luminance (brightness) signal is transmitted to provide the black-and-white signal for existing monochrome receivers, giving the compatibility feature in the same way as in the N.T.S.C. system. The multiplexing of the single-colour signal with the luminance signal is also achieved in the same way as in the N.T.S.C. system—by frequency interleaving the sidebands of the colour sub-carrier in the gaps in the sideband spectrum of the main video signal, at the same time making the sub-carrier frequency as high as possible to reduce the visibility of the resultant dot pattern on the receiver screen. For this interleaving purpose the sub-carrier has to be made an odd multiple of half the line scanning frequency, and actually it has been placed at 8.37 Mc/s in the 10-Mc/s video band, as shown in Fig. 1.

The French system, in fact, has a number of features in common with the N.T.S.C. system and might therefore be regarded as a modified version of it. For example, it takes advantage of the well-known limitations of the eye in colour vision by transmitting only the low frequencies of the red and blue primary-colour components to give a narrow-band colour signal. This actually has a bandwidth of 2 Mc/s, as can be seen from Fig. 1. Another point of similarity is the method of recovering the green primary-colour component (which is not transmitted as such) at the receiver by subtracting the red and blue signals from the luminance or "white" signal. On the other hand, in the French system it is only necessary to transmit two sets of information simultaneously, the luminance signal and one colour signal, whereas three sets have to be transmitted simultaneously in the N.T.S.C. system.

The feature which is really characteristic of the French scheme, however, is that the sequential method of colour transmission is made possible by taking advantage of the fact that 819 lines provide a vertical colour definition greater than the subjective requirements of the human eye. It will be realized that the advantages gained by the sequential, time-division multiplex, method of colour transmission must be paid for in the sense that the information available for display is reduced by a factor of two. Of the 737 active lines in the 819-line picture, one half, 368.5, are used for transmitting the red information and the other half for transmitting the blue information. This does not matter, however, because, as already mentioned, the 819-line system can afford to lose a great deal of vertical colour definition before the eye notices any difference.

The only difficulty with this line sequential method—as with all sequential systems—is that it produces stroboscopic effects at the receiver c.r.

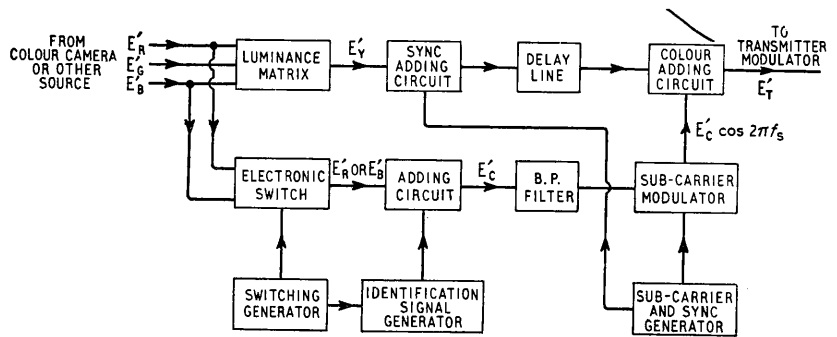


Fig. 2. Block schematic of the coding equipment at the transmitter.

tube. This, however, has been overcome in the colour receiver by an artificial means of obtaining a simultaneous display on the three-gun c.r. tube. It is a storage technique, which takes advantage of the fact that statistically there is very little difference between the information on two successive lines of a television frame. The red information transmitted during, say, line 1 of a frame is displayed on that line but is also passed through a delay device so that it emerges one line later and is displayed again along with the blue information on line 3. Thus two sets of information, red and blue, are available simultaneously for line 3 (the third simultaneous green signal being derived as already explained). Similarly the blue information on line 3 is delayed so that it is displayed simultaneously with the red information on line 5 . . . and so on with the rest of the frame and the following interlaced frame.

For correct reproduction of colours it is, of course, necessary for the receiver to "know" when red is being transmitted and when blue is being transmitted. To distinguish between them an "identification signal" is transmitted during the "back porch" of the sync pulse in front of every blue line. Actually there is a residue of sub-carrier imposed on the black level and the identification signal takes the form of a suppression of this residue preceding every blue line. At the receiver this is used for controlling an electronic switch which sends the red and blue signals to their appropriate electron guns in the tri-colour c.r. tube.

The Transmitter

A simplified block schematic of the transmitting end of the system is shown in Fig. 2. Here the gamma-corrected red, green and blue primary-colour components E'_R , E'_G and E'_B from the camera are first of all applied to a matrix (proportional adding circuit) which, by a linear combination of the three signals, provides the luminance signal E'_Y . Actually $E'_Y = 0.59 E'_G + 0.3 E'_R + 0.11 E'_B$ as in the N.T.S.C. system. After the sync waveform has been added, the luminance signal passes through a delay line, necessary to keep the luminance and chromaticity information in phase, and then through another adding circuit which superimposes on it the modulated colour sub-carrier.

The two signals E'_R and E'_B are also applied to an electronic switch which is operated at half the line frequency by the switching generator and produces the signals in alternate sequence at the output. The emerging signal, E'_R or E'_B , then

receives the identification signal—a negative pulse which later serves to block the sub-carrier modulator during the “back porch” period, as already explained. At this point the low-frequency components of the red and blue signals are selected by means of a band-pass filter, these components being called E_r and E_b . The resultant chromaticity signal, E'_G , has the value $E'_G = 0.07 + 0.18 (E_r \text{ or } E_b)$, and is applied to the sub-carrier modulator. If the sub-carrier frequency is f_s , then the modulated sub-carrier signal is $E'_G \cos 2\pi f_s$. This output from the modulator is finally superimposed on the luminance signal E'_Y , as already mentioned, to give a total video signal $E'_T = E'_Y + E'_G \cos 2\pi f_s$, the actual frequency spectrum of which is shown in Fig. 1. The complete video signal is then, of course, passed to the modulator of the television transmitter.

The Receiver

At the receiver the signal E'_T is obtained at the output of the video detector, and here the problem is to reconstitute from this the three signals E'_R , E'_G and E'_B in their original simultaneous form. In order to do this two special expedients are necessary. The first is the storage principle mentioned earlier. The second arises from the method used of transmitting a narrow-bandwidth colour signal so that for very fine detail the colour information is suppressed and only luminance information is available. Although the transmitted colour signals provide only low-frequency information, as far as the viewer's eye is concerned, it is possible to reconstitute in effect the original E'_R and E'_B full-band signals by adding to E_r and E_b suitable proportions of the high-frequency components of the luminance signal E'_Y . This is the well-known principle of “mixed highs.”

Fig. 3, then, shows the block schematic of the receiver in which these expedients are incorporated. Considering first the luminance channel, the total video signal E'_T , obtained from the output of the video detector, is first of all passed through a luminance amplifier and then through a subtraction matrix. Here suitable proportions of the reconstituted E'_R and E'_B signals are subtracted from the luminance signal E'_Y in order to recover the green signal E'_G , as already explained, which is

applied to the green electron-gun of the tri-colour tube. Also from the E'_T signal, a filter is used for extracting the high-frequency components of the luminance signal, which will be designated e_y , and the colour sub-carrier. The sub-carrier is amplified and detected so as to recover E'_G , and the colour identification signal is taken out to control the switching generator.

Electronic switch No. 1 directs the E'_G signal alternately at line frequency into two channels, which thereby become identified as red and blue channels. The signals in these channels are, of course, discontinuous, but by means of the storage technique mentioned earlier the gaps are filled in with repeated information. This is the purpose of the delay line, which is adjusted to the exact duration of a scanning line. By means of the second electronic switch it feeds in parallel the red and blue channels so as to fill in the gaps produced by the first switch. In this way continuous red and blue signals are obtained.

Finally, the continuous signals are passed through adding circuits, where the high-frequency components of the luminance signal, e_y , are added to them, and then to the appropriate electron-guns of the tri-colour tube. The actual value of e_y here corresponds to the following combination of high-frequency components of the original red, green and blue signals: $e_y = 0.59 e_g + 0.30 e_r + 0.11 e_b$. From this it can be shown that if the subtraction matrix is adjusted to obtain the linear combination $1/0.59 [E'_Y - 0.30(E_r + e_y) - 0.11(E_b + e_y)]$ then the required green signal $E'_G + e_y$ is obtained correctly.

Regarding the picture quality of the system, it has been mentioned that the vertical colour definition for a complete picture is reduced by a half on account of the time-division multiplex method of transmission. On the other hand, one can see that the vertical information is completely preserved if four successive frames are assembled for the construction of a picture. (It will be realized from earlier remarks that whereas the luminance information is interlaced in the normal 2:1 fashion, the chromaticity information, because of the breaks introduced by the sampling at line frequency, is interlaced 4:1.) Consequently, the designers say, it is difficult to give an exact figure for the vertical colour definition.

Moreover, the situation is complicated by the

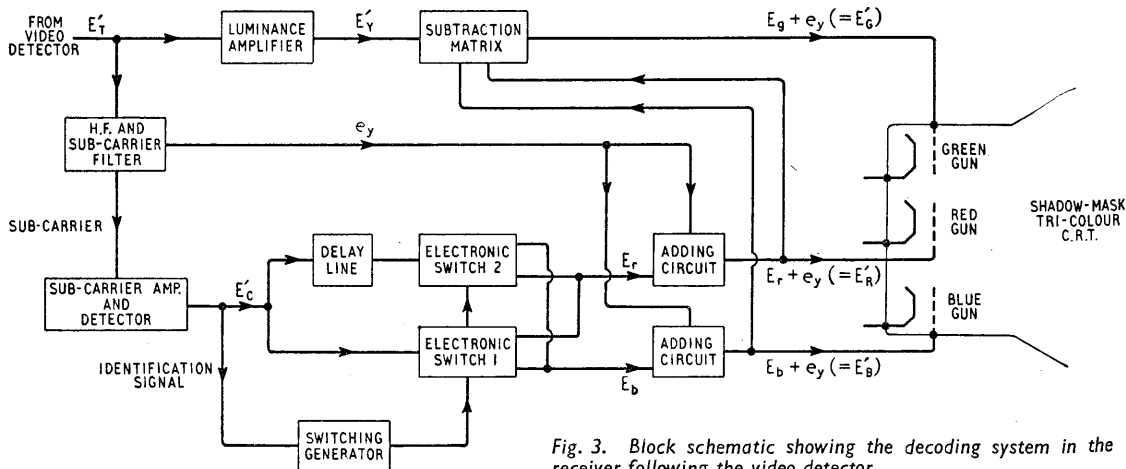


Fig. 3. Block schematic showing the decoding system in the receiver following the video detector.

fact that in the receiver each set of chromaticity information is displayed on two successive lines of a frame (e.g., line 1 and line 3) as a result of the storage technique, giving in effect one "thick" line as might be obtained by spot-wobbling. The associated effect, of "mixing up" slightly uncorrelated red and blue information along each line, may also affect the horizontal definition, depending on the nature of the subject being transmitted. At any rate the designers estimate that the vertical colour definition is still a good deal better than that obtained horizontally, and is probably in the region of 350 lines.

At the demonstration witnessed by *Wireless World*, the subject material consisted of slides, film, a monochrome test card and colour bars. The received colour picture was shown on an R.C.A. 21-inch shadow-mask tube, and a compatible monochrome picture on a 17-inch tube. In addition, the original E'_{R} , E'_{G} , E'_{B} picture, as it appeared before transmission, was displayed on a 15-inch R.C.A. shadow-mask tube for comparison purposes.

The received colour picture was in many respects very fair, and compared favourably with the E'_{R} , E'_{G} , E'_{B} picture, although both were somewhat desaturated. The subjective impression of horizontal resolution was inferior to that of a 405-line system at its best, although the test card showed the limiting resolution to be higher than 500 lines (on the monochrome receiver). It was perhaps as much as 10 dB down at 400 lines but trailed on up to 600 lines or more as a limit. Since the R.C.A. tube will not resolve more than 400 lines the picture appeared in colour to be somewhat soft. There was a colour error on the received picture in that small areas of

high contrast tended to go green. This was said to be an instrumental fault and not an inherent feature of the system. Otherwise the colour picture was quite good and not very noisy.

The compatible monochrome picture broke up into 405 lines interlaced in areas of saturated colour but this was obvious only on colour bars or on close inspection of normal pictures. Line strobing effects were visible on the monochrome display but were completely cured in the colour receiver by the delay-line storage system. As demonstrated, a reverse compatible picture turned out to be pure green, but a receiver would normally have a switch to connect all three tube grids together when colour was not being radiated.

On the whole the system is probably capable of giving similar performance to that of the N.T.S.C. system on 819 lines. It would probably be inferior if applied to 405 lines on account of the 200-line break-up which would occur on the monochrome display in saturated regions. From the engineering point of view, it is not so elegant as the N.T.S.C. system. The colour receiver is certainly simpler and less critical in operation than an N.T.S.C. receiver, and requires extra valves only for the amplification and detection of the sub-carrier, for the electronic switching and for the operation of the delay line. Moreover, some of the adding and subtracting operations shown in Fig. 3 can be achieved in the grid-cathode sections of the c.r. tube, thereby obtaining a further simplification. On the other hand, the delay line itself is a very expensive item to manufacture, and as a result the total cost of the colour set is likely to be about the same as that of an N.T.S.C. receiver.

LETTERS TO THE EDITOR

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

Gramophone Reproduction

I AM grateful for the clear statement by E. S. Mallett (August issue) on the components of the tracking weight, even if it makes the design of the proposed pickup more difficult.

It might still be possible to design a pickup with the desired tracking weight, if the lateral and vertical stiffness components are made very low compared with the lateral inertia, which should be fairly easy to arrange (the inertia being already near the practical limit). The head weight should be as high as possible, consistent with playing slightly warped records, so that the low-frequency vertical resonance is as low as possible, thus reducing the vertical lift, described by Mr. Mallett, to a minimum. The chief practical difficulty is that in reducing the vertical stiffness of the cantilever, care must be taken to avoid torsional resonance, and this may necessitate an oval tubular cantilever.

In passing, Mr. Mallett remarks that the vertical inertia is unimportant, not because it is not operative but because its contribution to the tracking weight is small. The implication is, presumably, that although the low- and high-frequency vertical resonances may be outside the recorded range, there is a vertical mid-frequency resonance, analogous to the lateral mid-frequency

resonance, which does not affect frequency response, but below which frequency stiffness is operative, and above, inertia. This resonance would be that of the vertical effective mass at the stylus with the vertical cantilever compliance, and in any practical design will fall within the audio range. As there is no positive record groove drive downwards, the stylus will fail to follow the vertical motion above this frequency, and needle talk and second harmonic distortion will be produced, perhaps combined with general irregular movement of the stylus, as it will no longer be in contact with both groove walls at all times. In existing pickups, the resonance will not be higher than about 10 kc/s, corresponding to a lateral trace frequency of 5 kc/s. The needle talk will presumably be above 10 kc/s and may, therefore, be largely inaudible, although proper tracing is not obtained. I had suspected previously that this was the case and, if correct, it means that correct tracing with the stylus always in contact with both groove walls can never be obtained (although damage may be largely eliminated). The alternative is to use a very high vertical stiffness to drive the resonance up to 40 kc/s; this means increasing the tracking weight up to 4 gm or so, regardless of how small the other components of the tracking weight may be.

I am glad that Mr. Mallett agrees that tracing dis-

tortion due to over-modulation is by far the worst distortion in record reproduction. It is a sad commentary on commercial records that many record lovers prefer certain pre-war recordings to modern pressings, because of lower tracing distortion.

If all this gives a depressing picture, it should be remembered that the solution is comparatively simple—impressed groove records with less high-frequency pre-emphasis.

With reference to Mr. Voigt's letter, I am pleased to note that his company, and presumably others, did not play the original wax before processing. The general principles of record production are well known, but the actual details are not, so that authoritative statements like Mr. Voigt's are to be welcomed. My impression that monitoring of the wax was usual was heightened by an actual case where I am told that this occurred. However, if it is pleasing to know that the originals are not monitored, it is disconcerting to learn, as I have done recently from Mr. C. E. Watts, that it is very difficult to find a pressing, itself unplayed, which does not show signs of playback at some stage of manufacture—impressed tracks with piled-up edges can be seen at extremes of acceleration, indicating that the fully plastic range has been reached or approached. The desire to monitor at various stages of manufacture is understandable, but the damage could be avoided by the use of thorn or plastic styli. In this connection, Mr. Briggs ("Sound Reproduction," Third edition, p. 311) refers to the playing of metal matrices with sapphire and diamond styli.

Banbury.

D. A. BARLOW.

Colour Television Aerials

MANY local authorities have decreed that only indoor aerials of certain narrowly specified types shall be permitted for television reception in their Council estates. If this restriction is to be held in force for colour television, it will obviously have a big influence on the choice of a system—always presuming, of course, that the future colour service really is intended for mass consumption. The N.T.S.C. system, for example, does not show up at all well under conditions of severe or even moderate "ghosting."

Perhaps the B.B.C. would like to demonstrate the N.T.S.C. system to the Television Advisory Committee in the "Dockland" areas of London, using indoor receiving aerials of this kind?

London, N.7.

O. G. MINTER.

Picture Quality

YOUR correspondent, S. Gould (July issue), has unconsciously put his finger on a great truth. He stated that tests he has carried out show that home movie viewers demand a larger minimum size of screen for colour pictures than for black and white. He adds that this fact indicates a way to pull colour TV out of the doldrums.

The truth of the matter is this: the nearer any representation approaches reality, the more critical the viewer becomes. This is shown forcibly in the attitude taken by viewers of stereo photography. If an ordinary black-and-white print of rippling water is shown, it is accepted readily, and may even be praised on the grounds of atmosphere, texture, etc. If, however, a colour stereo photograph of a similar subject is shown, the viewer's reaction is unfavourable, and the inevitable remark is made about the water's looking "frozen" or like "jelly."

This is clearly because the stereo photograph is so nearly real, i.e., it has colour, depth and actual size (if viewed in a properly constructed viewer) that the idea of immobile rippled water can no longer be accepted. The same argument applies to stereo photographs of any subject involving movement.

This principle will also operate with colour TV, which is one step nearer reality than black and white, but in this case the size and depth are wanting, instead of the movement. An improvement would be an increase in picture size, and this was found by the viewers mentioned by Mr. Gould to be more acceptable.

London, W.14.

E. W. ELLIOT.

Picture Height

I DISAGREE with "Diallist" and "Free Grid." I think the height of a console television receiver is just right. To look up at a picture soon makes one's neck ache.

"Free Grid" says the television receiver of the future will be of the projection type with the tube and associated equipment built into one wall and the screen in the opposite wall.

And shutters over the windows to darken the room? Amateur cinematographers will assure you that the picture on the screen from even the most powerful projector lacks brilliance, unless the room is really dark.

Hounslow.

O. V. WADDEN.

Wadden & Hill, Ltd.

Picture Resolution

AS a user of a large-screen forward-projection television receiver I read Mr. Jesty's article in the July issue with very great interest. I have a simple method of improving the disparity between horizontal and vertical resolution. A simple change of aspect ratio by reducing the frame amplitude gives picture dimensions more in keeping with those becoming increasingly adopted in the cinema and gives a very acceptable compromise between liness and disproportion.

It seems likely that a change of proportion in a rectangular tube is a simpler proposition than increasing time base frequency. Also existing receivers will still obtain an acceptable picture and can be brought to standard at a time of tube renewal. Obviously a change of time base frequency would render conversion imperative and we are none too sure of the difficulties or expense of modification.

London, N.2.

I. G. ABELSON.

Cleaning a File

"DIALLIST" has blotted his copybook at last (in the July issue). Nothing will ruin a file quicker than scrubbing it with a "file card"; the finer the file the quicker its destruction.

The "claws" of a file card are made of spring steel, and the fine cutting edges of a file are rapidly blunted by it.

The correct way to clean a clogged file is to take a piece of metal—preferably brass—some half-inch or so in width and of any thickness and convenient length, and push it across the width of the file at an angle of about 30 degrees; after the first stroke or two the corner of the brass assumes a contour identical with that of the file teeth, and it is then capable of removing every vestige of clogging material. It is true that there are difficulties where files other than flat files are concerned, but they are not insuperable.

Wimborne.

R. F. EAGLE.

"88-50" Pre-amplifier.—A Correction. The British Standard referred to in the footnote on page 316 of the July, 1957, issue is Amendment No. 1, July, 1954, to B.S. 1568:1953 (not B.S. 1968).

More About Potential

By "CATHODE RAY"

APPLICATION TO
SEMICONDUCTOR THEORY

LAST month we set out to discover the principle underlying the construction of the potential diagrams commonly used to show how transistors work. We got no further than considering what potential means, and how it comes about that potential diagrams with their hills and valleys make such good mechanical models of electrical devices. The reason is that potential and height are so closely analogous that it is possible for the same definition to cover both. Just as a mass in a gravitational field experiences a force proportional to the height gradient, so a charge in an electric field experiences a force proportional to the potential gradient. Because "positive" is conventionally regarded as "up" and "negative" as "down," and like charges repel, the force on positive charges is "downwards." So they are analogous to masses in the gravitational analogy. Negative charges on the contrary "fall" upwards, like gas-filled balloons.

We saw, too, why equipotential lines, analogous to map contour lines, are everywhere at right-angles to lines of force, which are used to mark the directions along which a field acts.

Since field strength in any direction is proportional

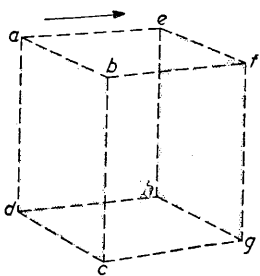


Fig. 1. This is a small cube marked out in a parallel electric field, in such a way that the edges ae , bf , etc., lie in the direction of the field. If the amounts of field passing through the two shaded faces are unequal, the cube must enclose a charge.

to (and therefore, with a suitable choice of units, equal to) potential slope in that direction, it is easy to draw a graph of field strength, given a graph of potential. In fact, the idea of slope is so familiar—in connection with valve characteristics, for instance—that one hardly needs to draw a separate graph just in order to see how the field strength varies. The only catch is that by convention the field is positive in any direction when it urges a positive charge in that direction. So it is positive *down* a potential slope. Consequently the field strength is reckoned as equal to *minus* the potential slope.

To solve our problem, however, we have to know how potential is related to the charges giving rise to it. The clue to this is that charges are the starting and finishing points for the imaginary lines of force representing the field. So if an intelligent microbe

taking its daily walk happened to notice that the number of lines of electric force lying alongside its path increased at the rate of n for every millimetre of the journey it would conclude that it was moving through a space charge of n units per millimetre. Of course, such a conclusion would only be valid if all the lines of force were lying parallel with the microbe's path, and its range of vision extended a definite distance all around at right-angles covering an area of say one square millimetre. Then the increase in lines of force per millimetre of path would be a measure of the space charge density per cubic millimetre.

Charge and Field Strength

If you reject the idea of intelligent microbes counting lines of force, on the ground that such microbes are imaginary, I would say yes, no wonder, for the lines of force are imaginary! I only brought them in because so many people seem to find it difficult to visualize fields without them. It would be better to refer to Fig. 1, showing a millimetre cube marked out in a parallel electric field having the direction ae . We could rightly say that if the field strength at the face $abcd$ was E_1 and that at $efgh$ was E_2 , then the charge inside the cube must be $E_2 - E_1$ units. Note that this specifies the polarity of the charge, because conventionally the direction of the field (which in this case is from $abcd$ to $efgh$) is from positive to negative. So if more were entering $abcd$ than was emerging from $efgh$ it would be because the charge inside the cube was negative. This is what the formula would indicate, for if E_1 was greater than E_2 then $E_2 - E_1$ would be negative.

On the average, then, the space charge density is proportional to (and therefore, with a suitable choice of units, equal to) the rate of change of electric field strength, or what we might call field slope or gradient through the space. Remember, we are confining our attention to parallel fields, because if the field were converging or diverging some of it would pass through the sides of the cube in Fig. 1 and upset the reckoning.

The interesting conclusion from all this is that charge is related to the field it creates in the same sort of way as the field is related to the potentials it sets up. Take the simplest possible example: the uniform field between the two parallel plates of an air capacitor. Fig. 2(a) shows an enlarged view of a sample; somewhere well inside, so as to be clear of edge effects. The thin horizontal lines represent the field, and their direction shows that the left-hand plate is charged positive. Because the field is parallel and there are no charges in the space, its strength

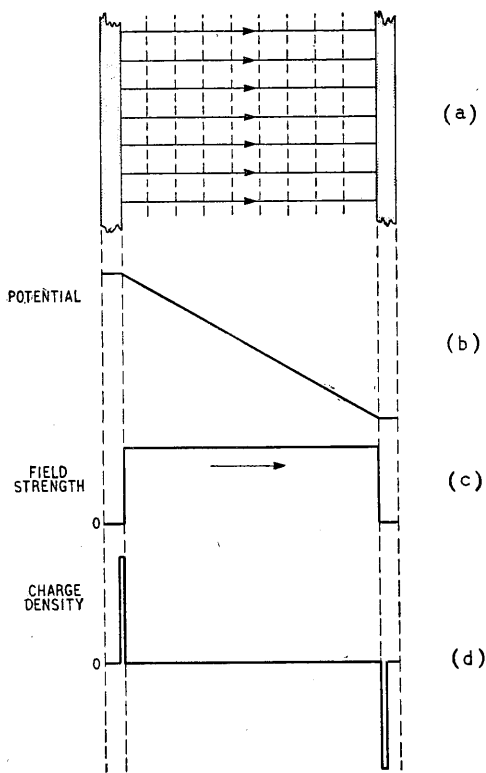


Fig. 2. Enlarged view of some of the space between parallel capacitor plates (a), with graphs of potential (b), field strength (c), and charge density (d). The arrow in (c) is to show that the field is being reckoned from left to right.

is the same everywhere in that space. This means that the potential gradient is the same everywhere, which is indicated by drawing the dotted equipotential lines at equal intervals all the way across. If these lines represent 10-volt intervals, we see that the capacitor must be charged to 90 volts.

We can easily draw the various graphs: (b) is the graph of potential, which is derived from the equipotential lines in (a) exactly as a section is derived from a contour map. There are, of course, no appreciable differences of potential inside the metal plates themselves. There would not be much point in marking a zero level on this graph unless we wanted to indicate the potentials relative to earth; the main thing is the p.d.—the difference between upper and lower levels.

A zero mark is needed for the field-strength graph (c) however, because (b) tells us where the field is zero—inside the metal. Since the field strength is reckoned as minus the potential gradient, which in this case is downwards from left to right, and constant, it is positive and constant. (If we reckoned from right to left, the potential gradient would be up, so the corresponding field-strength graph would go negative, indicating the negative field from right to left. That is the reason for the left-to-right arrow.)

Lastly, the charge. The only places where the field strength has any gradient at all are the inner surfaces of the plates, and there it is very steep indeed—apparently infinite. That represents the fact that

the opposite charges, being attracted to one another, crowd on to those inner surfaces, so the charge density is very great. It cannot be infinitely great, however, because charges of any one kind repel one another, so they do spread out a little. The steep upward gradient on the left of (c) calls for a large positive charge there, and the downward one on the right a large negative charge, as shown at (d). (The same result would be obtained from a right-to-left negative field graph.)

Now let us take an example of a space charge. Suppose the potential graph for the space was Fig. 3(a). Here the downward gradient at first is zero, increases steadily to a maximum midway, then decreases steadily to zero again. Plotting minus this gradient at (b) shows the field strength from left to right.

The gradient of (b) is positive and constant from left to midway, and negative and constant from midway to right; when plotted this indicates the distribution of charge in the space (c).

Potential by Trial and Error

This two-stage gradient method enables the charge distribution corresponding to any potential pattern to be found quite easily. Our problem, however, is precisely the reverse: knowing the distribution of charges, to derive the potential diagram. (The reason for wanting the potential diagram, of course, is that it makes a good mechanical model for giving an idea of how loose charges would tend to move. Fig. 3(a), for example, would show that if the charges represented at (c) were free to move they would tend to mix up, positive going to the right and negative to the left.) In general it is more difficult to work backwards; in fact, it really amounts to trying various potential patterns until one is found that agrees with the given charge distribution.

Mathematical readers may be boiling over by this time, having long ago realized that in their language the charge density is given by minus the second differential of the potential, and the potential is minus the second integral of the charge density, so if the potential variation is given as an equation one need only differentiate twice and reverse the sign to get

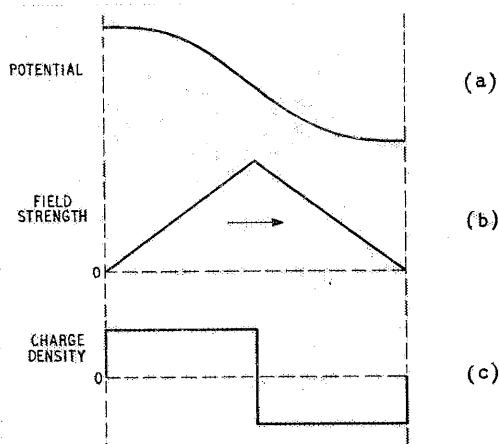


Fig. 3. These graphs apply to a situation where the only charge is in the space.

the equation of charge density, and given the equation of charge density one need only integrate twice and reverse the sign to get the equation of potential. The fact that the latter process can, by making use of well-known rules, often be accomplished is not really inconsistent with what I said about its being by trial and error, for this is how the well-known rules were originally found. Familiarity with the differential and integral calculus* makes everything we have done so far absurdly easy. The sorts of distribution likely to arise in elementary theoretical explanations of semiconductor phenomena are so few and simple, however, that even those who know nothing of the calculus should have no difficulty in dealing with them as we have been doing.

The first example showed that an abrupt change in the potential gradient indicates a charge concentrated on a surface at right-angles to the direction chosen for graphing. (Incidentally, it is really superfluous to specify the surface in this way, for the direction chosen for graphing is along the lines of force, and because a highly conducting surface is necessarily an equipotential surface these lines are bound to emerge at right-angles to it.) The second example showed that a gradual change in potential gradient means a distributed or space charge in that region.

These examples also show that where the potential graph is convex (i.e., sticking out) upwards the charge there is positive, and where downwards it is negative.

Uniform Clouds of Electrons

Suppose the space between two parallel plates is filled with a uniform cloud of electrons, so that the charge graph is as in Fig. 4(c); what does the potential graph look like? The field graph must have a gradient that is constant and negative, so must look like Fig. 4(b). But we don't know where its zero level is. The reason for that is lack of information about the difference of potential between the plates. Let us suppose the plates are uncharged; then the charge pattern is symmetrical and the field is zero at midway, as shown. Finally, the potential graph (a) must be such that its gradient starts at maximum

downwards, levels out midway, and returns to maximum upwards at the right. The mathematicians will tell us that the required shape is a parabola—a square-law curve. And to comply with our assumption it starts and ends at zero. Note that at these points the potential graph is abruptly convex upwards, showing that there is a positive charge on the inner surfaces of both plates, attracted there by the negative space charge. The graph also shows (if we didn't know already) that negative charges in the space are attracted towards the plates, so even if the assumed distribution shown at (c) were achieved

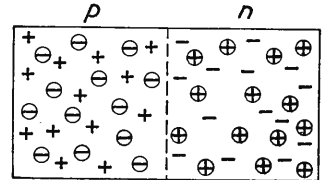


Fig. 5. Usual kind of diagram showing the sorts of mobile and fixed charges in a p-n junction.

it couldn't last for a moment; the electrons would instantly disperse towards the plates.

The situation inside solids such as semiconductors is complicated by a framework of fixed charges. In *n*-type germanium, for instance, there is a space charge of electrons, but this charge is neutralized by the equal number of fixed positive charges constituted by the atoms from which the electrons have become detached. So unless one works on such a magnified scale that account is taken of individual atoms and electrons, one sees no charge density, so no field and no potential differences. This situation is shown diagrammatically on the right-hand side of Fig. 5. In *p*-type germanium it is the loose charges that are positive ("holes") and the fixed ones are negatively charged atoms, as on the left-hand side.

When a single crystal of germanium comprises *p* and *n* regions, as in Fig. 5, representing a junction diode, the uniform distribution shown there does not last. Because the piece is all one crystal, the dotted line exists only on the diagram and means nothing to the electrons and holes. In their random movements, some are sure to cross it unawares. Directly a hole does so it leaves behind in the *p* region an

* For a simple introduction, see Chap. 27 of "Second Thoughts."

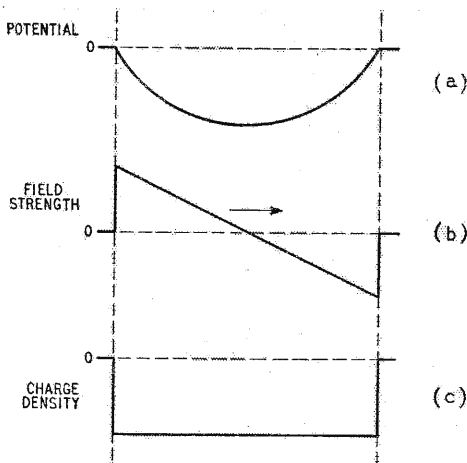


Fig. 4. Another example of space charge, this time all of one polarity—negative.

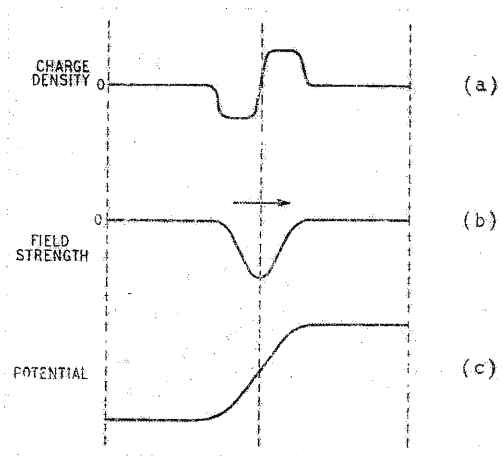


Fig. 6. Graphs applying to Fig. 5 after the mobile charges near the boundary have migrated and built up a potential difference.

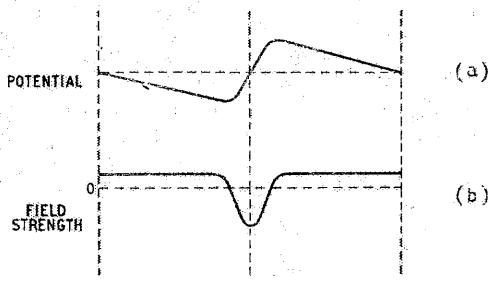


Fig. 7. If Fig. 6 (c) is modified to bring the terminals to the same potential, the effect on 6 (b) is as shown, and there is no need to modify 6 (a) at all.

unpartnered negative charge. Similarly, electrons straying across the line leave behind in the *n* region some positive charges, which are augmented by the immigrating holes. The result is net positive charge on the *n* side of the border and a negative charge on the *p* side, as shown in Fig. 6(a).

Potential Cliffs

According to another way of looking at it, holes crossing the boundary cancel out electrons there, leaving only the immovable positive charges; and similarly a belt of immovable negative charges is left on the left. Of course, the potential cliff thus created, and shown at (c), tends to prevent any further transfer of movable charges either way. A balance is reached when the height of the cliff has reached rather less than a quarter of a volt in germanium, and in silicon rather more.

Fig. 6(c) makes it look as if the terminals of the junction would be at different potentials, so that a

current would flow from *n* to *p* if joined by a wire. I have been unable to detect any p.d. however, using a valve voltmeter with an extremely high input resistance. If one assumes that the potential curve is like Fig. 7(a), so that there is no terminal p.d., the field curve (b) is practically the same except for being shifted bodily upwards, and this difference doesn't come out at all in the charge curve, so the same distribution of charges would cover Fig. 7(a).

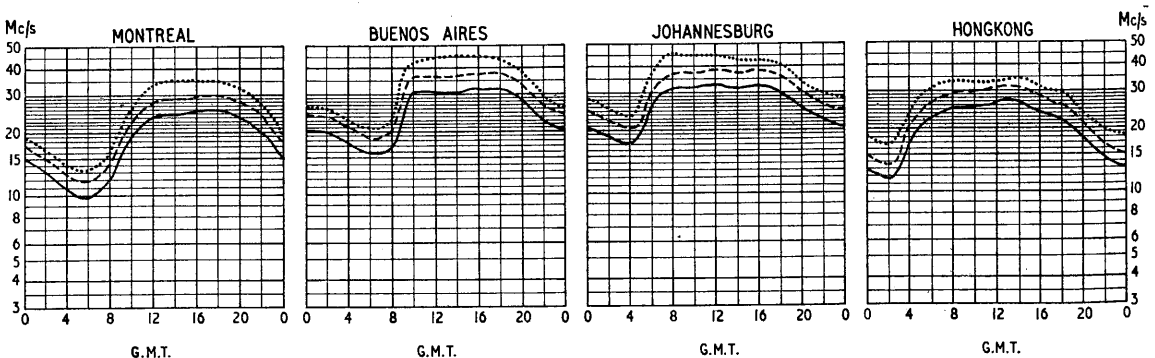
When an external voltage is applied, if it makes the *n* end positive it increases the height of the potential cliff, ensuring that no current can cross the boundary. The only charges having the correct polarity to respond to the applied voltage are fixed, so cannot flow. If the *p* end is made positive, the cliff is lowered, so mobile charges flow both ways and carry a continuous current.

This story takes no account of what are called minority carriers—the electron and hole pairs released by heat and light energy regardless of whether the semiconductor is *p* or *n* type. The *p-n* junction action as described would nearly fit the facts if the material was at a very low temperature. But at normal room temperature—and still more so when heated up—there are appreciable quantities of free electrons in the *p* region and holes in the *n*. These tend respectively to slide up and down the boundary cliff, causing a flow of current even when external voltage is applied in the direction that would otherwise stop current altogether. So a junction diode passes a certain amount of “reverse” current, and that amount increases steeply as the temperature is raised.

But this is not supposed to be a treatise on semiconductor physics; the only object is to enable such treatises to be followed more intelligently. The thing to do now, therefore, is to re-read one and see if it is any clearer. If not, let me know and I'll try to do better next time.

SHORT-WAVE CONDITIONS

Prediction for September



THE full 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

How Little Distortion Can We Hear?

Effects of Ear Distortion and Masking

By M. LAZENBY, M.A.

IN this article the smallest amount of non-linear distortion that can be detected by ear is calculated from known non-linear hearing effects. The result is compared with the directly measured value. The method of calculation is to determine the extent to which non-linear hearing effects produced by the fundamentals will hide any distortion products which may also be present.

This concealment may occur in two ways. In the first place the usual spurious frequencies produced by non-linearity are produced in hearing. Secondly, the fundamental raises the hearing threshold level for other frequencies where distortion products may be present. The original threshold level, and the extent to which this level is raised by noise present even in very quiet surroundings must also be taken into account. When the hearing of one frequency raises the threshold level for another, the latter frequency is said to be "masked".

Masking Effects: Harmonic Distortion. It is convenient to consider threshold level effects first. The various results obtained for the increase in the

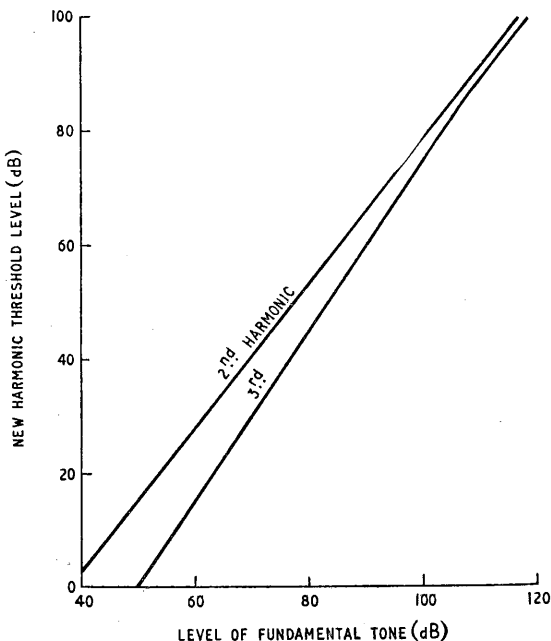


Fig. 1. Change in threshold level produced by fundamentals between 400 and 4,000 c/s.

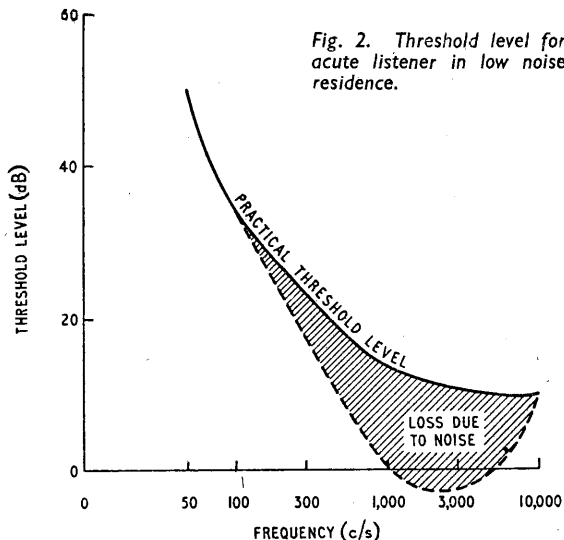


Fig. 2. Threshold level for acute listener in low noise residence.

threshold level produced by a given frequency may be summarized approximately as in Fig. 1 for fundamental frequencies between 400 and 4000 c/s (0 dB corresponds to the standard sound pressure of 2×10^{-4} dynes/cm²). It is necessary to consider also the increase in the threshold level caused by harmonics produced in hearing. However, from results on the level of these harmonics given later, it can be shown that for second and third harmonics the level is raised less due to harmonics produced in hearing than due to the fundamental. (This may not be the case for the higher harmonics, particularly at high fundamental levels.)

It is necessary to know also the practical threshold level in the absence of any applied sound. This is given in Fig. 2 for a person with very acute hearing, in a very quiet residence (total noise level only 33 dB).¹ The increase in the threshold level produced by the masking action of the noise which still remains even in these circumstances is also illustrated in Fig. 2. For frequencies between 400 and 10,000 c/s the threshold level is between 10 and 20 dB.

From data given by Sivian and White² the threshold level in the absence of noise is ≈ 10 dB lower for binaural listening. However, because of the masking effect due to noise (illustrated in Fig. 2) the practical threshold level of Fig. 2 will also apply to binaural listening for frequencies above 100 c/s. Below 50 c/s the results of Ref. 2 indicate that this effect of binaural listening disappears.

Any harmonic distortion present in the applied signal will not be detected unless it is above the actual threshold level under the conditions of detection. For this threshold level we must take the raised level produced by the fundamental (given in Fig. 1), or the original level (given in Fig. 2), whichever is the greater. Considering threshold level effects only, we thus obtain the minimum level of harmonic distortion which can be detected. By comparing this with the fundamental level, the smallest detect-

able percentage distortion is obtained. For example, at a fundamental level of 60 dB the raised threshold level for the second harmonic is 28 dB, from Fig. 1. This is greater than the initial threshold level of 10 dB. The smallest detectable second harmonic distortion at a fundamental level of 60 dB is thus $60 - 28 = 32$ dB down on the fundamental. This corresponds to a distortion voltage of $(\text{antilog}_{10} 1.6)^{-1}$ of the fundamental, i.e. $1/40$ of the fundamental, i.e. $2\frac{1}{2}\%$. The complete results are shown in Fig. 3 for both 10- and 20-dB no-signal threshold levels.

At frequencies lower than 800 c/s the smallest detectable distortion will increase for two reasons. In the first place, from Fig. 2 the initial threshold level is higher at such frequencies. When this higher threshold level is used in Fig. 3 the smallest detectable distortion is increased. Secondly, the few available data on the masking produced by low frequencies indicate that this is also greater.

For masking frequencies above 4000 c/s the few available data indicate a decrease in the masking. However, the threshold level in the absence of any applied sound increases above 10,000 c/s (which is the second harmonic of 5000 c/s). Thus it is not clear what will happen to the smallest detectable distortion. In any case the harmonics will pass outside the audible range for fundamental frequencies greater than about 8000 c/s.

Relation Between Harmonic and Intermodulation Distortion. To extend this analysis to intermodulation distortion it is necessary to discuss the relation between such distortion and harmonic distortion, following Warren and Hewlett.³ Supposing for simplicity that the distorted transfer characteristic has only square and cube-law distortion terms, we may put $e_o = a_1 e_{in} + a_2 e_{in}^2 + a_3 e_{in}^3$, where e_{in}, e_o are the sine wave input and output voltages respectively, and a_1, a_2, a_3 constants. $a_2 e_{in}^2$ and $a_3 e_{in}^3$ are the square and cube-law distortion terms respectively. Considering only two intermodulating sine wave signals we can write $e_{in} = A \sin a \pm B \sin b$. Evaluating e_o we find

$$\begin{aligned}
 e_o = & A(a_1 + \frac{3}{4}a_3(A^2 + 2B^2)) \sin a - \frac{A^2 a_2}{2} \cos 2a \\
 & - \frac{A^3 a_3}{4} \sin 3a \\
 & \pm B(a_1 + \frac{3}{4}a_3(2A^2 + B^2)) \sin b - \frac{B^2 a_2}{2} \cos 2b \\
 & \pm \frac{B^3 a_3}{4} \sin 3b \\
 & \pm AB a_2 (\cos(b-a) - \cos(b+a)) \\
 & \mp \frac{3A^2 B a_3}{4} (\sin(b-2a) + \sin(b+2a)) + \frac{3AB^2 a_3}{4} \\
 & (\sin(2b-a) - \sin(2b+a))
 \end{aligned}$$

Considering harmonic distortion, in this simple case the square-law distortion term gives rise only to second harmonic distortion, and the cube-law term only to third harmonic distortion. Considering intermodulation distortion the square-law distortion term gives rise to intermodulation products of frequencies $f_1 \pm f_2$ only, and the cube-law term to frequencies $2f_1 \pm f_2, f_1 \pm 2f_2$ only, where f_1, f_2 are the input frequencies ($a = 2\pi f_1 t, b = 2\pi f_2 t$).

The analysis is simplified if we confine it to cases where only one type of distortion (square or cube-law) is present. This is not in practice a great restriction. Square and cube-law distortion alone

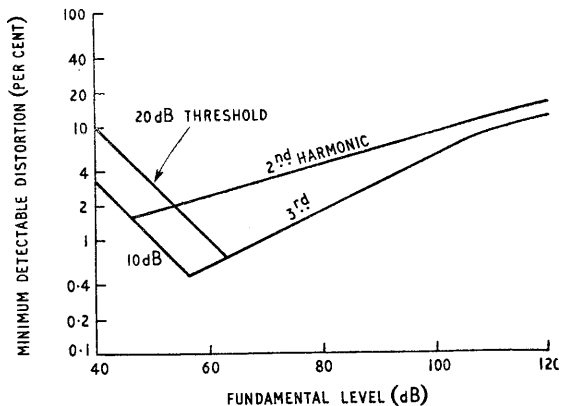


Fig. 3. Smallest detectable distortion (considering threshold level masking) for fundamentals between 400 and 4000 c/s.

occur to a fair approximation in single-ended and push-pull amplifiers respectively.

Using the subscripts h, i for the particular values of A, B when considering harmonic or intermodulation distortion respectively the harmonic distortion fraction of the fundamental divided by the intermodulation distortion voltage at any one frequency is equal to

$$\frac{1}{a_1} \cdot \frac{A_h}{2A_i B_i} \text{ or } \left[\frac{1}{a_1} \cdot \frac{A_h^2}{3A_i^2 B_i} \text{ or } \frac{1}{a_1} \cdot \frac{A_h^2}{3A_i B_i^2} \right]$$

considering square or cube-law distortion alone respectively. (This assumes that $\frac{3}{4}a_3(A^2 + 2B^2)$ and $\frac{3}{4}a_3(2A^2 + B^2)$ can be neglected in terms of a_1 . This will usually be possible in practice.) The relative magnitudes of different types of distortion will be significant if the same peak input voltage is applied in each case, i.e. if $A_h = A_i + B_i$. Thus, for equivalent distortions, the harmonic distortion fraction of the fundamental divided by the intermodulation distortion voltage at any one frequency is equal to

$$\frac{1}{a_1} \cdot \frac{A_i + B_i}{2A_i B_i} \text{ or } \left[\frac{1}{a_1} \cdot \frac{(A_i + B_i)^2}{3A_i^2 B_i} \text{ or } \frac{1}{a_1} \cdot \frac{(A_i + B_i)^2}{3A_i B_i^2} \right]$$

considering square or cube-law distortion alone respectively.

From this particular analysis we can convert intermodulation distortion data to harmonic distortion data and vice versa. Distortion figures for audio systems and the smallest detectable distortion have generally been given in terms of harmonic distortion, even if it is the equivalent intermodulation distortion that is fundamentally concerned. Moreover we are considering intermodulation arising practically. In this case the intermodulating frequencies and amplitudes may not be the standards for intermodulation distortion measurement. Thus we shall continue to refer to the equivalent harmonic distortion even though we will be concerned with the intermodulation frequencies produced at the same time by non-linearity.

Masking Effects: Intermodulation Addition Frequencies. We can now return to the smallest detectable intermodulation distortion. Considering only square and cube-law distortion, the addition frequencies arising in intermodulation distortion ($f_1 + f_2, 2f_1 + f_2, f_1 + 2f_2$) lie between one and three times the higher fundamental frequency. Now the

masking decreases fairly uniformly between one and three times the masking frequency. Thus the method used to obtain the results of Fig. 3 can also be applied to the *addition* frequencies arising in intermodulation distortion. In cases where a *difference* frequency lies between one and three times one of the fundamental frequencies the same reasoning will also apply. The amount the threshold level is raised in these circumstances will depend both on the ratios of the intermodulation product frequency to both fundamental masking frequencies, and on the amplitudes of these fundamental frequencies. Thus there are too many variables to allow calculation of the results in a simple form.

Certain facts however suggest the conditions under which the smallest detectable addition intermodulation distortion is a minimum. Suppose that, due to masking, the threshold voltage level at an addition frequency becomes T_a . The smallest detectable intermodulation level is then T_a or T_o , the threshold voltage level, whichever is the greater. The smallest detectable equivalent harmonic fraction is thus

$$\frac{A_i + B_i}{2A_i B_i} \left(\frac{T_a \text{ or } T_o}{a_1} \right)$$

or $\left[\frac{(A_i + B_i)^2}{3A_i^2 B_i} \left(\frac{T_a \text{ or } T_o}{a_1} \right) \text{ or } \frac{(A_i + B_i)^2}{3A_i B_i^2} \left(\frac{T_a \text{ or } T_o}{a_1} \right) \right]$

considering square or cube-law distortion alone respectively.

A simple first approach to determine the conditions under which these values are a minimum is to minimize either the functions of A_i and B_i , or T_a , separately. For a given $(A_i + B_i)$, T_a is a minimum when f_2 is as large as possible compared with f_1 , and B_i small compared with A_i . f_1 then produces

little masking at the addition frequency due to the large frequency difference between the two. f_2 is so small that it also produces little masking even at the comparatively near addition frequency. Alternatively, for a given $(A_i + B_i)$,

$$\frac{A_i + B_i}{2A_i B_i}, \quad \frac{(A_i + B_i)^2}{3A_i^2 B_i}, \quad \frac{(A_i + B_i)^2}{3A_i B_i^2}$$

are a minimum when $B_i = A_i$, $A_i/2$, $2A_i$ respectively. The minimum values are then $1/A_i$, $3/2A_i$, $3/4A_i$ respectively. In these last cases T_a is also a minimum in practice when $f_2 \approx f_1$.

Approximate calculations suggest that the smallest detectable equivalent harmonic distortion fraction is less if we minimize the functions of A_i and B_i and take $f_2 \approx f_1$, than if we minimize T_a alone. At some levels (which depend on the type of distortion) the difference can amount to a factor of 2 or 3 to 1 for square and cube-law distortion respectively.

Using these relations between B_i and A_i and the condition $f_2 \approx f_1$, the smallest detectable harmonic distortion fraction is $\frac{2(T_a \text{ or } T_o)}{a_1(A_i + B_i)}$ or $\frac{9(T_a \text{ or } T_o)}{4(A_i + B_i)}$

for square and cube-law distortion respectively. The masked addition frequency is twice and three times the fundamental respectively. Considering the *addition* frequencies arising in intermodulation distortion the smallest detectable equivalent harmonic distortion is then 2 and 9/4 times the values given in Fig. 3 for square (2nd harmonic) and cube-law (3rd harmonic) distortion alone respectively.

The ratios used above are not the same as those usually quoted for measured intermodulation to harmonic distortion percentages (3.2 and 3.8 for second and third harmonic alone respectively³). This difference will appear again in the complete analysis. It arises for several reasons. In the first place we are concerned with detection at one frequency at a time rather than addition over all distortion frequencies. The fundamental amplitude ratios we have considered are also not those standard for intermodulation distortion measurement. Finally, additional complications can arise in actual hearing. **Hearing Distortion Effects: Intermodulation Difference Frequencies.** Masking decreases rapidly if the masked frequency is reduced below the masking frequency. At any frequency below about 0.7 of the masking frequency the increase in the threshold level is much less than the values considered previously (given in Fig. 1). The masking is also much less than that given in Fig. 1 at frequencies many times the masking frequency.

For fundamental frequency ratios between 1/1.7 and 1.7 or 1/2.7 and 2.7 for the square-law or one of the cube-law distortion difference frequencies respectively, these difference frequencies are less than 0.7 of either of the fundamental frequencies. In some other cases a difference frequency arising in intermodulation distortion may be many times one of the fundamental frequencies, and less than 0.7 times the other.

In these cases then, the masking at the difference frequency due to either fundamental is very much less than the masking considered previously. In evaluating the smallest detectable distortion for such difference frequencies, the intermodulation produced in hearing becomes more important.

The *harmonics* produced in hearing were measured by Fletcher⁴ and the results are given in Fig. 4.

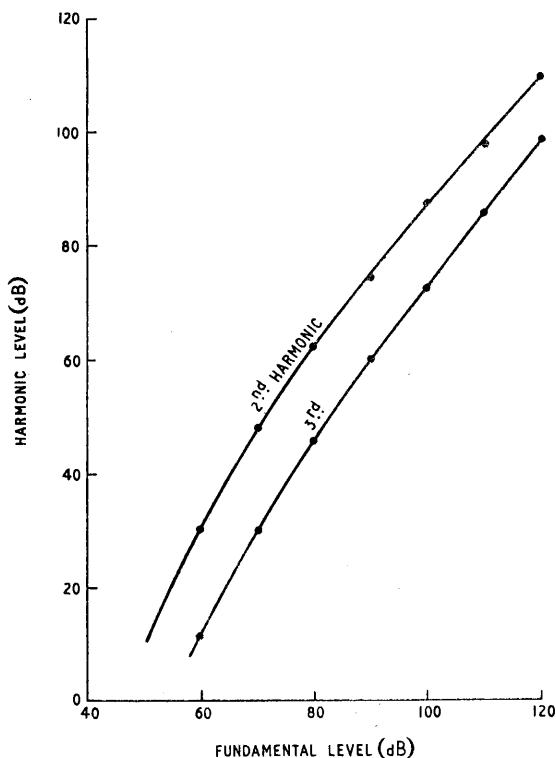


Fig. 4. Level of harmonics produced in hearing

In this figure the harmonic levels correspond to the absolute external sound levels which at the same frequency produce equal sensation levels to those of the harmonics produced in hearing. Fletcher reported that these results were independent of frequency. They agree with some measurements made at 650 and 900 c/s by Moe⁵; and with second harmonic distortion measurements made at various frequencies by Lawrence and Yantis,⁶ or at a single frequency by Egan and Klumpf,⁷ or Békésy.⁸

The paper by Egan and Klumpf suggests that the method of "best beats", which has been used to measure harmonic levels by all the authors cited, gives too high a value for these levels. This error is due to masking by the fundamental, and becomes considerable when the harmonic level is near the masked threshold level. This happens with the second harmonic at low levels, and with the third harmonic at all levels. Furthermore, no measurement of a harmonic level by this method should ever give a value lower than the masked threshold level. However, results on the levels of the cube-law distortion difference frequencies obtained by Moe⁵ do not seem to depend at all on whether these difference frequencies are above or below the fundamentals, although a similar error should occur only in the former case. Moreover, Moe measured levels of addition frequencies which are well below the masked threshold level which would be expected.

These harmonic distortion data can be converted into intermodulation distortion data by Warren's method of analysis considered earlier. This method assumes that hearing may be considered as a unity for all frequencies. However, the exact parts of the ear used in hearing are not the same for all frequencies. Thus there may be less interaction between different frequencies in hearing than is suggested by the distortion produced at one frequency. In this case the intermodulation produced in hearing would be less than Warren's type of analysis would

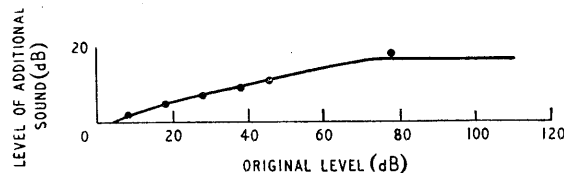


Fig. 5. Level of additional sound (in dB below the original level) to give a just noticeable change for frequencies between 500 and 8000 c/s

suggest. However, if this effect occurs we should expect the interaction to increase to the value given by Warren's analysis if the interacting frequencies are brought close together. Thus the smallest detectable distortion may be less than the value to be calculated using Warren's method; though with the fairly close frequencies we are considering (of ratios less than 2.7 to 1) the disagreement should not be large. The measured levels of the difference frequencies produced in hearing by fundamentals of 690 and 950 c/s (ratio 1.37 to 1) obtained by Moe⁵ do agree with those to be expected on this analysis from the harmonic levels also measured; although the corresponding addition intermodulation frequencies appear to be about 10 dB lower.

Fletcher⁹ also gives data on the smallest noticeable sound-level change at various levels and frequencies.

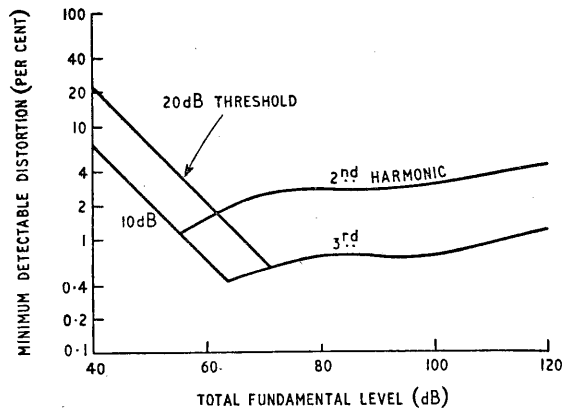


Fig. 6. Smallest detectable distortion (considering intermodulation produced in hearing) for distortion frequencies between 500 and 8000 c/s.

The results for any frequency between 500 and 8000 c/s are very similar and are presented in Fig. 5. From the level of the intermodulation produced in hearing the smallest external intermodulation level which will produce a noticeable change can be found from these data.

If the second and third harmonic voltage levels produced in hearing are L_2 , L_3 the corresponding intermodulation levels are

$$\frac{2A_i B_i}{(A_i + B_i)^2} L_2, \left[\frac{3A_i^2 B_i}{(A_i + B_i)^3} L_3 \text{ or } \frac{3A_i B_i^2}{(A_i + B_i)^3} L_3 \right]$$

The smallest noticeable external intermodulation level will be some fraction $1/N$ of these (given from Fig. 5), or the threshold level T_0 , whichever is greater. From Fig. 5, N is a maximum (and thus the smallest noticeable distortion a minimum) when the hearing distortion-level is a maximum. For a given $A_i + B_i$, (and thus L_2 , L_3),

$$\frac{2A_i B_i}{(A_i + B_i)^2} L_2, \frac{3A_i^2 B_i}{(A_i + B_i)^3} L_3, \frac{3A_i B_i^2}{(A_i + B_i)^3} L_3$$

are a maximum when $B_i = A_i$, $A_i/2$, $2A_i$ respectively. (Equivalent conditions arose in the discussion of addition intermodulation distortion.) The equivalent just noticeable second and third harmonic

$$\text{fractions are then } \frac{L_2}{Na_1(A_i + B_i)}, \frac{L_3}{Na_1(A_i + B_i)}$$

for square and cube-law distortion only respectively. This is provided that the just noticeable intermodulation level is not below the threshold level. If it is below the threshold level the equivalent just noticeable second and third harmonic fractions are

$$\frac{A_i + B_i}{2A_i B_i} \cdot \frac{T_0}{a_1}, \left[\frac{(A_i + B_i)^2}{3A_i^2 B_i} \cdot \frac{T_0}{a_1} \text{ or } \frac{(A_i + B_i)^2}{3A_i B_i^2} \cdot \frac{T_0}{a_1} \right]$$

respectively. For a given $(A_i + B_i)$ these fractions have minimum values (as above) when $B_i = A_i$, $A_i/2$, $2A_i$, respectively. The minimum values for the equivalent just noticeable second and third harmonic

$$\text{fractions are then } \frac{2T_0}{a_1(A_i + B_i)} \text{ or } \frac{9T_0}{4a_1(A_i + B_i)}$$

These various equivalent just noticeable harmonic fractions are plotted in Fig. 6 as percentages. Fig. 6 thus gives the smallest detectable distortion consider-

(Continued on page 439)

ing the intermodulation produced in hearing. It applies to the detection of *difference* frequencies arising in intermodulation between fundamentals of certain frequency ratios which have been evaluated above.

At low frequencies the smallest detectable distortion is again greater, both due to the increased threshold level as before, and also because the smallest noticeable sound level change is greater. Data on the smallest noticeable sound level change at 50 c/s (from Ref. 9) are given in Fig. 7. Taking the threshold level at 50 c/s as 50 dB from Fig. 2 the smallest detectable equivalent percentage harmonic distortion is given in Fig. 8 by the same method as before. An important point is that from the method of calculation this smallest detectable distortion applies to *distortion* frequencies of 50 c/s. This corresponds, for example, to intermodulation between 60 and 110 c/s.

Each distortion curve in Fig. 8 has a peculiar "kink" in it. This arises because the just noticeable energy change at 50 c/s alters suddenly at the threshold level. From Fig. 7 it can be seen that at low levels slightly above threshold the additional sound to give a just noticeable energy change is

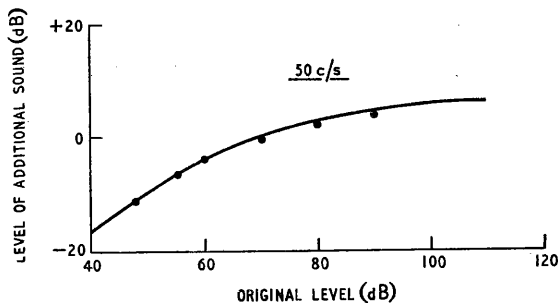


Fig. 7. Level of additional sound (in dB below the original level) to give a just noticeable change at 50 c/s.

considerably greater than the original sound. However, if the original signal is below the threshold level presumably as usual any additional sound above the threshold level will be noticeable. Thus, for signals just below the threshold level the additional sound to give a just noticeable change is only slightly greater than the original sound.

Random Uncertainty of These Results. The various results on masking summarized in Fig. 1, and the harmonic distortion measurements of Lawrence and Yantis,⁶ show a spread of up to about ± 10 dB about their mean. Thus our various results on the smallest detectable percentage distortion may in particular cases be in error by up to a factor of about 3.

Optimum Conditions for Distortion Detection. From our results the ear appears to be most sensitive to difference intermodulation distortion produced by roughly equal fundamental frequencies, next most sensitive to harmonic distortion; and least sensitive to addition intermodulation distortion. For all types of distortion the maximum sensitivity occurs at fundamental levels of about 50 to 70 dB. Intermodulation distortion of all types is best detected at particular ratios of fundamental frequencies and powers which are near to unity. The standard conditions for the measurement of intermodulation distortion, on the

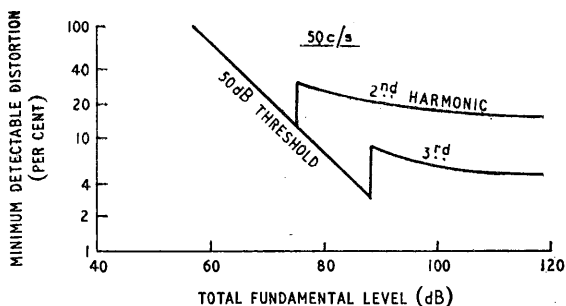


Fig. 8. Smallest detectable distortion (considering intermodulation produced in hearing) for distortion frequency of 50 c/s.

other hand, involve considerably different frequencies and powers.

Practical Results on the Smallest Detectable Distortion. For music Olson¹⁰ obtained a figure of about 0.7% total harmonic distortion for mainly second, and for both second and third harmonic distortion. The noise level was stated to be 25 dB and the peak electrical power 3 watts. Assuming a normal acoustic efficiency of 3% this peak power would produce sound levels of about 90 dB in a normal living room as used by Olson. This author also states¹¹ that the ear is most sensitive to distortion for sound levels of 70 to 80 dB. Brittain¹² was able to detect 0.4% total harmonic distortion, no levels being stated. For sine waves at 1000 c/s and second harmonic distortion Braunmühl and Weber¹³ give 0.7%; using two tones they obtained 1.3, 0.7 and 0.5% for frequency ratios of 1.05, 1.12 and 1.50 to 1 (lower frequency fixed at 800 c/s) respectively. On the other hand, these authors¹³ quote a figure of 4% for music, for both square and cube-law distortion.

The above results agree reasonably well with our calculations, but a number of observers using single or only a few sine tones have obtained lower values. Those of Newman, Stevens and Davies¹⁴ for the minimum detectable second harmonic distortion of 370 c/s (average for two observers) are reproduced in Fig. 9. Using two tones of frequency ratio 1.5 to 1 at a level of 60 dB Haar¹⁵ obtained 0.3 and 0.5% for square and cube-law distortion respectively at frequencies between about 1000 and 4000 c/s. In this case then, square-law distortion was easier to detect than cube law. The threshold level was 0 dB

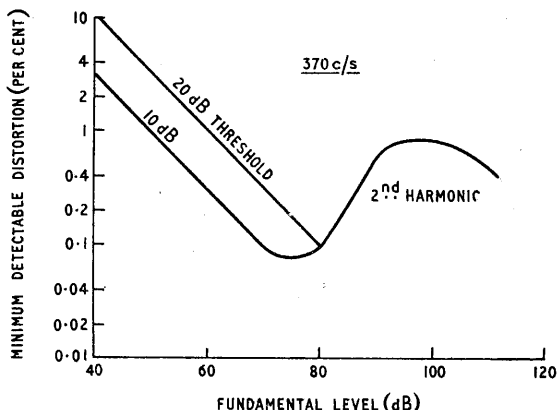


Fig. 9. Practical results of Newman, Stevens and Davies for 2nd harmonic distortion of 370 c/s.

at 1000 c/s, i.e. there was apparently no masking by noise.

Detailed sets of results for both square and cube-law distortion at various frequencies and levels have been given by Haar¹⁶ and Feldtkeller^{16, 17}; those of Haar being for single frequencies (corresponding to Fig. 3), and those of Feldtkeller for two frequencies of ratio 1.5 to 1 (corresponding to Fig. 6). At levels up to about 60 dB both these sets of results agree quite well with our calculations if we insert a suitable threshold level, and this level turns out to be within about 6 dB of the stated level in each case. At levels above 60 dB the results are fragmentary, but appear to disagree with our calculations in two ways. Thus at a given level the smallest detectable distortion decreases with increasing frequency up to at least 1000 c/s (in Haar's results up to at least 2000 c/s). The smallest detectable distortion at about 3 kc/s also appears to decrease with increasing level up to at least 80 dB, the lowest figures quoted by Haar and Feldtkeller being 0.5 and 0.3% respectively.

The results of references 13, 15, 16 and 17 all show an increase at low frequencies. Thus Braunnmühl and Weber¹³ give 2% for second harmonic distortion of 100 c/s; and Haar's¹⁶ results show a minimum at about 70 dB of 7% and 3% for second and third harmonic distortion of 100 c/s respectively. Haar's results for 100 and 150 c/s together at a level of 70 dB are directly comparable with our Fig. 8. His values of 5.2 and 1.8% for square and cube-law distortion respectively are however much lower than those in Fig. 8. Feldtkeller's results¹⁶ for the same frequencies show similar values of about 5% and 1%

(average for two observers) at their minima around 70 dB.

Extending our various calculations shows that the hearing sensitivity to distortion due to higher harmonics increases rapidly with increasing harmonic number. This effect is well known. It may explain another observation by Olson,¹⁰ that if the higher frequencies are removed the sensitivity to total distortion is decreased.

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- ³ *Proc. I.R.E.*, Vol. 36, p. 457, 1948.
- ⁴ *J. Acous. Soc. Amer.*, Vol. 1, p. 311, 1930. The results are reproduced in *Hearing: Its Psychology and Physiology* by S. S. Stevens and H. Davis. John Wiley and Sons, and Chapman and Hall.
- ⁵ *J. Acous. Soc. Amer.*, Vol. 14, p. 159, 1942.
- ⁶ *J. Acous. Soc. Amer.*, Vol. 28, p. 852, 1956.
- ⁷ *J. Acous. Soc. Amer.*, Vol. 23, p. 275, 1951.
- ⁸ *Ann. d. Physik*, Vol. 20, p. 809, 1934.
- ⁹ *Speech and Hearing*, p. 149. D. Van Nostrand Co.
- ¹⁰ *Elements of Acoustical Engineering*, p. 488. D. Van Nostrand Co.
- ¹¹ *Radio and T.V. News*, Vol. 44, p. 60, 1950.
- ¹² *Wireless World*, Vol. 59, p. 2, 1953.
- ¹³ *Akust. Zeit.*, Vol. 2, p. 135, 1937.
- ¹⁴ *J. Acous. Soc. Amer.*, Vol. 9, p. 107, 1937.
- ¹⁵ *Frequenz*, Vol. 6, p. 199, 1952.
- ¹⁶ *Akust. Beihefte*, Vol. 3, p. 117, 1952.
- ¹⁷ *Proc. 1st I.C.A. Congress on Electro-Acoustics*, 1953, p. 71. Published also in *Acustica*, Vol. 4, p. 70, 1954.

Commercial Literature

Aircrew Headset intended for pilots of aircraft who must have both hands free. The connecting cable is attached to one side of the headphones and passes back over the shoulder to avoid fouling the aircraft controls, while the small microphone is mounted on a light movable "boom" arm in the right position for the mouth. Leaflet from Ampivox, 2 Bentinck Street, London, W.1.

Ship Stabilizer Control, an electromechanical computer which senses five components of ship movement, combines them in the required ratio to take care of any sea condition and gives a signal to operate the hydraulic drive of the stabilizer fins. Outlined in a leaflet from Muirhead and Co., Beckenham, Kent.

Transistorized Batch Counter consisting of an amplifier, Dekatron counter tubes and a coincidence and relay unit. Is operated from a photocell or other device and gives a signal when a predetermined number of units have passed by this. Leaflet from Gate Electronics, Tudor Grove, Hackney, London, E.9.

Insulating Materials, including vulcanized fibre, mica, ebonite and laminated Bakelite sheet, tube and rod, press-board, cloths and tapes. Tables of properties, and sizes in which materials are supplied, given in an illustrated catalogue from the Anglo-American Vulcanized Fibre Company, Cayton Works, Bath Street, London, E.C.1.

Electronic Measuring Instruments, for sound, noise and vibration; non-destructive testing; and pulse/time techniques, including a very low-frequency c.r.o.; also stabilized power supplies, static neutralizer and oscillator-amplifiers. Short form illustrated catalogue from A. E. Cawkell, 6-8, Victory Arcade, Southall, Middlesex.

"Variacs" with Fuses, for use in laboratories, with the fuse fitted in the output (brush) circuit. The 230-V input voltage types have an output variable over 0-270V (at 2A

or 3A) and the 115-V types have an output variable over 0-135V (at 5A or 6A). Leaflet from Claude Lyons, Valley Works, Hoddesdon, Herts. Also leaflets on a two-signal radio generator for intermodulation distortion measurements; a pulse, sweep and time-delay generator; and a klystron oscillator—all three being General Radio products.

Battery-operated Tape Recorder, the German-built Butoba TPR2, has a spring motor giving 22 minutes' running at 3½ inches/sec and 40 minutes at 1½ inches/sec. The motor can be rewound while recording. Standard 5-inch reels can be used. Consumption is 400mA from a 1.5-V battery and 28mA from a 90- or 100-V battery. Frequency response is 50c/s—9kc/s±3dB. Input voltage for full output at 1kc/s is 1.5mV. Leaflet from the distributors, Henri Selmer and Co., 114-116 Charing Cross Road, London, W.C.2.

Band-III Pre-Amplifier for insertion in aerial downlead to television receivers. A single cascode stage, covering any one of Channels 8, 9 and 10, gives a gain of 15dB with a bandwidth of 3.5Mc/s. The power supply is incorporated. Leaflet from Labgear, Willow Place, Cambridge.

Transmitting and R.F. Heating Valves, including power rectifiers, magnetrons, klystrons, travelling-wave tubes; also thyatrons, voltage stabilizers, transistors, c.r. tubes and television camera tubes. An illustrated catalogue containing abridged data from the English Electric Valve Company, Chelmsford, Essex.

German Test Instruments by Rohde and Schwarz, including voltmeters and level indicators; valve voltmeters; wide-band amplifiers; noise and distortion meters; field strength meters; wattmeters; attenuators; bridges; oscillators and signal generators; frequency meters; noise, square-wave and television generators; and various accessories. Brief specifications and prices in a catalogue from the agents, Aveley Electric, Aveley Industrial Estate, South Ockendon, Essex.

Overcoming Line-Scan Ringing

Experimental Transformers with Tuned Leakage Reactance

By K. G. BEAUCHAMP, A.M.Brit.I.R.E.

IN a previous issue of *Wireless World* the author described a number of methods for reducing line-scan resonances or "ringing" associated with the line-scanning transformer of a television receiver.* It was shown that the most serious of these resonances is due to the leakage inductance of the e.h.t. overwind, which is necessarily large because of the method of construction of this coil. A simplified circuit of a line output stage, showing the transformer leakage inductances and stray capacitances, is shown in Fig. 1.

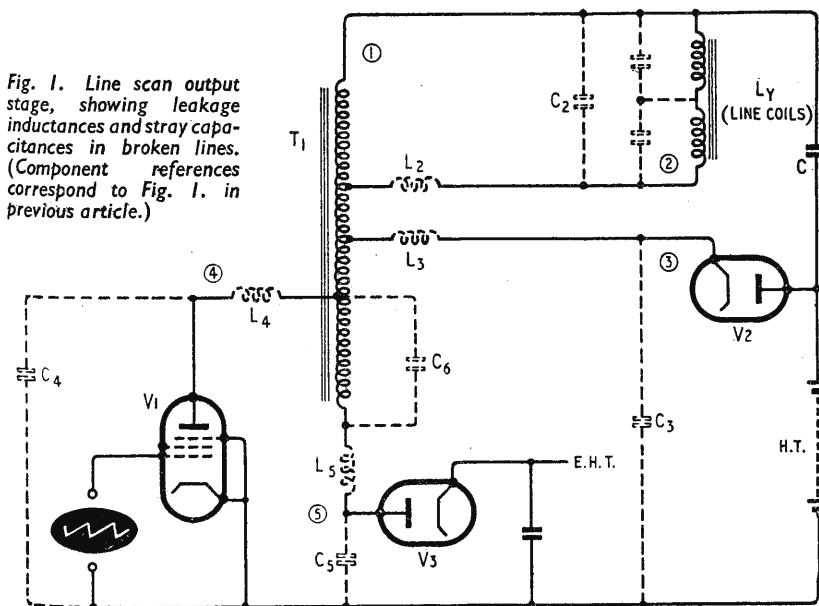
A large and rapid change of current takes place at the collapse of the scan when both V1 and V2 are temporarily rendered non-conductive due to a large negative voltage at the grid of V1 and consequent rise of V2 cathode potential. This current change through the transformer windings will shock-excite the numerous tuned circuits existing in Fig. 1, which are now free to resonate.

At the end of this retrace period, V2 is rendered conductive and should hold point 3 constant to enable a linear rise of current in L_y to take place. However, at the moment of V2 conduction some energy will remain stored in L_5 and the resonances set up during the flyback will continue during the first part of the scanning period around the path $L_5C_3L_3V2$ so as to cause a "ringing" potential to be developed across L_3 and modulate the current through the diode V2.

The resulting ripple superimposed on the linear rise of scanning current will produce velocity

*"Spurious Line Scan Resonances," by K. G. Beauchamp, March, 1955.

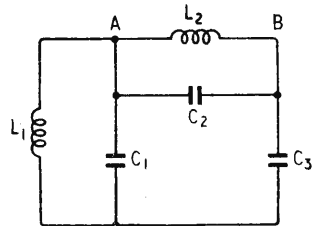
Fig. 1. Line scan output stage, showing leakage inductances and stray capacitances in broken lines. (Component references correspond to Fig. 1. in previous article.)



modulation of the trace, which will be seen as alternate light and dark striations at the left-hand side of the screen, continuing with diminishing intensity towards the screen centre.

The methods described previously were all directed at suppressing these resonances, preferably with little effect on the fundamental and lower

Fig. 2. Equivalent circuit of a line scan transformer.



resonant frequency of the main magnetic flux circulating around the transformer core. As a consequence of this "damping" technique some energy must be abstracted from the transformer and results in an overall loss of circuit efficiency. It has been shown previously that this loss can be made quite small, but where the scanning angle approaches 90° , as is now becoming common in the larger-screen receivers, then any methods leading to reduced efficiency in this section of the receiver can have a profound effect on the final design and materially increase its cost.

A very attractive solution to this problem has been arrived at† where not only are the deleterious effects of these unwanted resonances reduced but use is made of them to bring about certain improvements in the operation of the scanning circuit. Fundamentally the method consists of ensuring that the transformer is capable of resonating simultaneously at several frequencies; these frequencies having a definite numerical relationship with each other.

Reference to Fig. 2 will make this clear. This shows one simplified equivalent circuit for a line scanning transformer where only one leakage re-

†"High Efficiency 90° Cathode-Ray Sweep System," by C. E. Torsch, *Tele-Tech*, June, 1953.

sonance is considered, that of the e.h.t. overwind. In this diagram:

- L_1 = equivalent inductance of transformer windings and coupled scanning coils.
- L_2 = leakage inductance of the e.h.t. overwind coil.
- C_1 = equivalent lumped capacitance of transformer windings, scanning coils, valves, wiring, etc.
- C_2 = equivalent lumped capacitance tuning L_2 .
- C_3 = capacitance of e.h.t. rectifying diode plus wiring capacitances.

Now if the natural resonant frequency of the leakage branch L_2C_2 is made certain multiples of that of the main transformer resonance L_1C_1 , then the ringing potential of the leakage inductance can be made zero at the termination of the retrace period. This is because both resonant circuits will commence to ring at the same time (at the end of the scan period) and if their frequencies are arranged so that both oscillatory potentials pass through a null point at the cessation of the flyback, shown as point B in Fig. 3, then, as the boosting diode conducts at this point, no further energy will be supplied to the leakage circuit and further resonances will be avoided. This gives the necessary zero energy storage condition in the leakage inductance in order to prevent the continuance of ringing during the scanning period.

This minimum ringing condition exists for more than one ratio of resonant frequencies. The two lowest of these will be the third and fifth harmonic resonances of the leakage circuit relative to that of the main magnetic circuit. The condition where the frequency ratio is 3:1 is shown in Fig. 3. The resonances during the retrace period due to L_1C_1 and leakage reactance resonances L_2C_2 are shown separately, and their combined effects at two points on the auto-transformer winding are indicated by the dotted lines.

It will be seen that the resultants give a lower peak voltage at the anode of the line output valve and an increased peak potential at the e.h.t. rectifying diode. The reversal in polarity bringing about these different

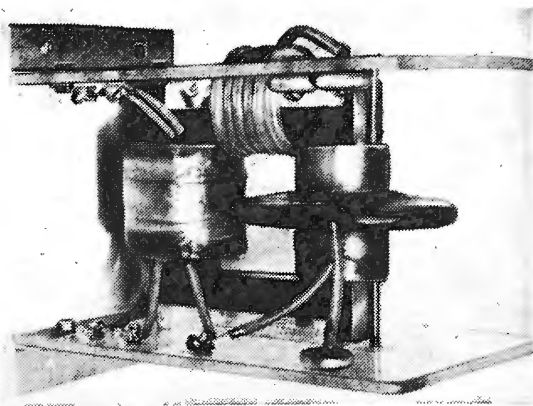


Fig. 4. Practical form of the experimental tuned-leakage-reactance line scan transformer.

effects is, of course, due to the disposition of the two valve anodes on either side of the leakage reactance resonant circuit. Quite apart from the absence of ringing in the displayed picture, this technique is of value in allowing the output valve and the boosting diode to operate under less stringent peak potential conditions. A reduction of up to 20% in peak potential may be obtained in this way.

The case where the frequency ratio is 5:1 is of less practical interest. Here the peak potential at the output valve anode is increased whilst that applied to the e.h.t. rectifier is reduced. However, as the resultant waveform applied to the rectifying valve is now becoming more rectangular in shape, an improved e.h.t. regulation can be expected.

Before considering the practical applications of the theory given above, it is as well to mention that the ratios actually required deviate slightly from those given previously. This is due to the boosting diode not becoming fully conductive until its cathode reaches a slight negative potential relative to the anode. This extends the realizable retrace period to rather more than one half cycle of the fundamental resonance, and in order to ensure zero energy storage ratios of approximately 2.7 and 4.4 were found necessary.

Considering now the transformer design, this must obviously be modified to give a higher leakage reactance for the e.h.t. overwind in order to reduce its resonant frequency to a smaller multiple of that of the fundamental transformer resonance.

Modern line scan transformer design invariably takes advantage of the reduced eddy current and hysteresis losses inherent in the use of ferrite core materials, and a "double-U" core of this material is usually adopted. With this arrangement the e.h.t. overwind may be placed on one limb of the transformer and the remaining windings on the opposite limb, as shown in Fig. 4. This will result in a very low coupling coefficient for the e.h.t. overwind and hence a large leakage reactance. Variation of this leakage reactance can be brought about by introducing controlled coupling between the two windings in the manner suggested in Fig. 5. The link-coupled coils L_3 and L_4 each consist of a small winding fairly tightly coupled to the main windings L_1 and L_2 respectively.

This is a convenient way of demonstrating the

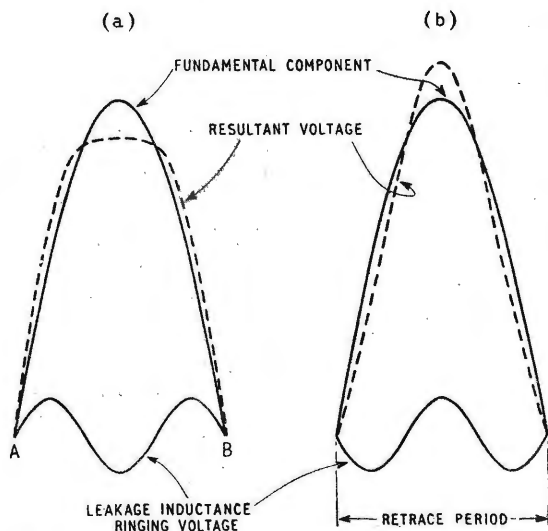


Fig. 3. Effect of tuning the e.h.t. overwind leakage reactance: (a) voltage at the anode of V1, (b) voltage at the anode of V3.

improvements resulting from tuning the leakage reactance. The ringing will be seen to go through a minimum as the inductance L_5 is varied, while in the case of a 2.7 ratio the e.h.t. produced reaches its maximum.

With careful design, however, it is possible to obtain the correct resonance ratio more simply. The procedure is to design the transformer with its e.h.t. overwind on a separate limb as previously suggested. The main transformer resonance is then adjusted by variation of an additional capacitor, C_1 , tapped at a convenient point across the transformer windings (say, across the scanning coil connections). This adjustment is carried out until "ring-free" conditions are observed on the screen, consistent with increased rectified e.h.t. potential.

The addition of capacitance in this way will, of course, reduce the peak potential across the winding. Schade† has shown that the relationship $V_{peak} \propto 1/\sqrt{C}$ is obtained. What is looked for, then, is a peak of e.h.t. superimposed on this gradual reduction in e.h.t. as C is increased.

If the necessary value of C_1 is found to be too large, giving rise to a lengthy retrace period and causing loss of picture information, then the e.h.t. wave winding will have to be redesigned to have a smaller self-capacitance. This can often be achieved by selecting suitable gear-ratios in the wave-winding machine to give a larger number of "cross-overs" per turn of the coil. The resultant diameter of the

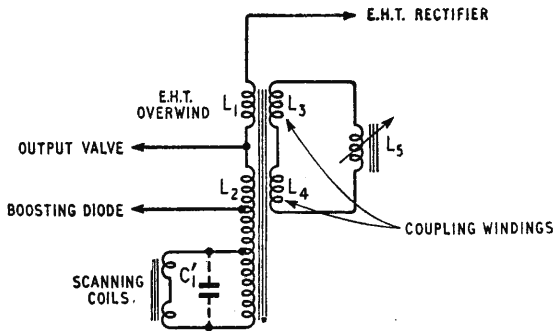


Fig. 5. Suggested method of varying the leakage reactance of the e.h.t. overwind by the use of coupling windings.

overwind will increase, but this is now of less importance as the peak potential between this winding and the corresponding windings on the other limb will be less than that existing in a conventional design between e.h.t. overwind and opposite transformer limb.

The price paid for this reduced potential gradient will be the increased insulation required between the inner turns of the overwind and the limb upon which it is wound. A former of Perspex or other material can be used here and must be capable of withstanding the peak potential existing at the anode of the line output valve during the retrace period.

†" Characteristics of High Efficiency Deflection and High-Voltage Supply of Kinescopes," by O. H. Schade, *R.C.A. Review*, March, 1950.

Transistor Oscillator Stability

Simple Frequency Drift Tests with R.F. Transistors

By M. G. SCROGGIE, B.Sc., M.I.E.E

THE experimenter has by now been supplied with copious information on the use of transistors as amplifiers, but surprisingly little on transistor oscillators. One gains a general impression that their frequency stability is poor, but as to how poor one is left to guess. The tests now to be described may have been rather sketchy, in that they do not provide precise data on the relationship of frequency stability to circuit parameters, but a rough idea may be better than none.

Several types of transistor were tried, chiefly the Ediswan XA102 and the Mullard OC45, which have comparable characteristics, with cut-off frequencies of several megacycles and, therefore, suitable for use in the

medium-frequency broadcasting band. Frequency variations were measured by beating the transistor oscillations against the carrier wave of the London Light Programme (1,214 kc/s) and comparing the audible beat frequency with a calibrated audio oscillator by the slow-beat method.

The oscillator was driven by a 1½-volt cell and enclosed in a tin-plate screening box (Fig. 1). To the mouth of a small hole in this screen was brought the end of a lead connected to the aerial terminal

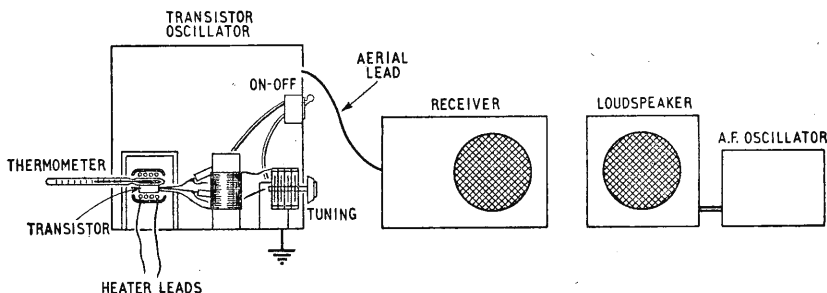


Fig. 1. Apparatus used for measuring frequency variations of transistor r.f. oscillator.

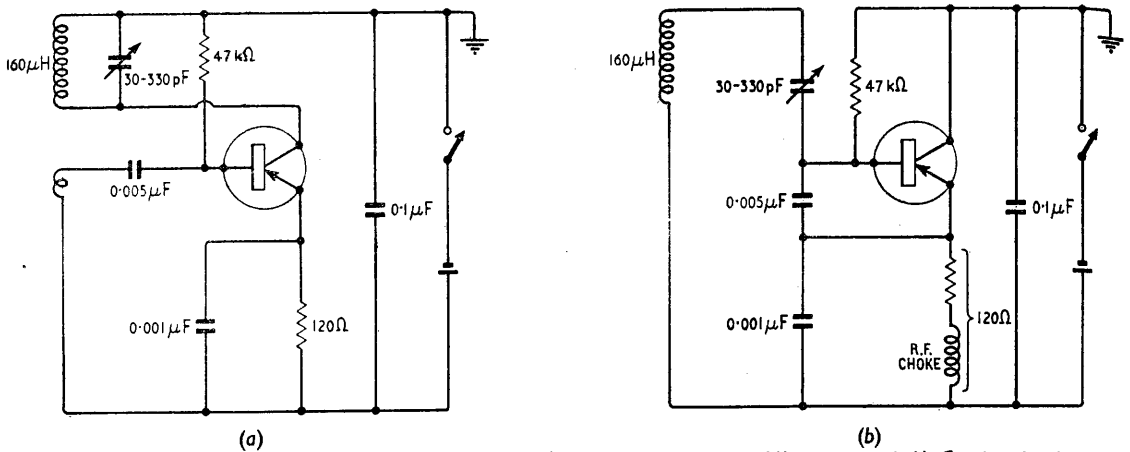


Fig. 2. The two oscillator circuits used in the tests: (a) ordinary "reaction coil" circuit, and (b) Gouriet circuit.

of a receiver; this lead was sufficient also to pick up the London programme. Another small hole allowed the scale part of the thermometer used for measuring the temperature of the transistor to project outwards. The thermometer bulb and transistor were wrapped together with a heater coil, covered with insulation tape and mounted in a wooden housing. When connected to the l.t. winding of a transformer, the heater raised the temperature about 8°C.

Fig. 2 shows the two oscillator circuits used for the tests: (a) an ordinary "reaction-coil" type, and (b) a Gouriet (or Clapp) circuit. In changing over from one to the other, as much of the circuit as possible was left common to both. Only quite a rough calculation was made of suitable values for emitter and base biasing resistors, and the same values were used for all transistors. The 160 μH coil was a single-layer solenoid 1½ in in diameter and 1½ in long. Only 10 turns, loosely coupled, were required in (a) to cause oscillation of about the same amplitude as in (b), judged by the collector current—about 0.5 mA in each circuit. The power consumption was, therefore, less than 1 milliwatt.

A number of runs, often lasting several hours, were made with each circuit and each transistor, noting various causes of frequency variation, such as ambient temperature, transistor temperature, battery voltage (for which a controllable source was arranged), and residual effects. Ambient temperatures were mainly in the range 14–20°C. The details would be tedious, but the following is a summary of the conclusions.

Measured under conditions of substantially constant ambient temperature, the transistor temperature coefficient was of the order of -500 in 10^6 per °C for circuit (a) and -50 for circuit (b). The great superiority of the Gouriet circuit (which in effect is a loose-coupled Colpitts circuit, the triode being "tapped down" on the capacitance side instead of on the inductance side as in a Hartley), compared with even a loosely-coupled reaction-coil, was clearly demonstrated. Although the individual figures for transistors covered a nearly 2:1 range, the 10:1 ratio for any one transistor in the two circuits was remarkably consistent. Whereas the temperature coefficient of the transistor could be objectionable on this waveband in a superhet receiver using circuit (a), the effects would be negligible in circuit (b).

Frequency variation due to varying supply voltage

was found to be quite negligible, even over much larger variations than those that would occur in practice. The fact that within the range of voltage used (1.20–1.55) the coefficient reversed in sign resulted in a fairly flat curve.

The only other material frequency variation observed—and it was very material, amounting to thousands in 10^6 —was an approximately exponential drift having a time constant of one to two hours, with certain samples of transistor. This time constant is far too long to be due to internal heating of the transistor junction (and was not observable at all in other samples), and the effects of ambient changes of temperature and voltage changes were eliminated in the tests. The cause has not yet been found, but is being sought.

Except for this last effect, which presumably is abnormal, the results seem to show that in broadcast receiver oscillators, and other applications with no more stringent requirements, there is no need to worry about the transistor as a cause of frequency instability, so long as a suitable choice of circuit is made.

CLUB NEWS

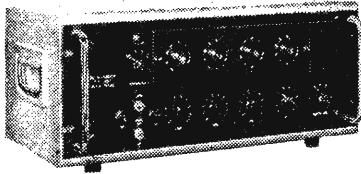
Birmingham.—A demonstration of the Eddystone 888 receiver will be given by Stratton & Co. at the meeting of the Slade Radio Society on September 13th. At the meeting on September 27th A. E. Robertson, assistant-head of the B.B.C. engineering training department, will give a lecture on microphones. Meetings are held at the society's headquarters, Church House, High Street, Erdington, Birmingham, 23, at 7.45. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

Bury.—The September meeting of the Bury Radio Society will be held on the 10th, when B. Barrett (G3DZU) will talk about the "Panda" transmitter. The meeting will be held at 8 at the George Hotel, Kay Gardens, Bury. Sec.: L. Robinson, 56, Avondale Avenue, Bury.

Kensington.—At the first meeting of the winter session of the Science Museum Radio Society, Major G. Watson (VP8BP) will give an illustrated talk entitled "Radio in Antarctica." The meeting will be held at 6 on September 10th at the Science Museum, South Kensington. Membership of the society is limited to civil servants. Sec.: G. C. Voller (G3JCK), The Science Museum, London, S.W.7.

Nottingham.—Meetings of the Nottingham Amateur Radio Club re-start today (August 27th) after a two-weeks' break. The club meets on Tuesdays at 7.15 at Woodthorpe House, Mansfield Road, Nottingham. Sec.: F. V. Farnsworth, 32, Harrow Road, West Bridgford, Nottingham.

Paralysis Circuits are sometimes used in electronic counters for blocking the action after each count so that there is no danger of counting spurious pulses, which may be produced, for example, when a photo-electric input is actuated by irregularly shaped objects on a conveyer belt. Seven different paralysis times are made available in an industrial batch counter recently introduced by Ericsson Telephones. This machine has a maximum speed of 350 pulses per second and will count into batches of any given number. The



display is on Dekatron tubes, and the required count per batch (anything up to 10,000) is set up on rotary switches. When the selected count per batch is completed the instrument automatically resets itself and begins counting another batch. Various ancillary devices can be supplied. One is a unit which supplies alternate output pulses, each having the duration of a batch; these pulses are suitable for alternately operating a pair of solenoids for controlling two chute flap mechanisms.

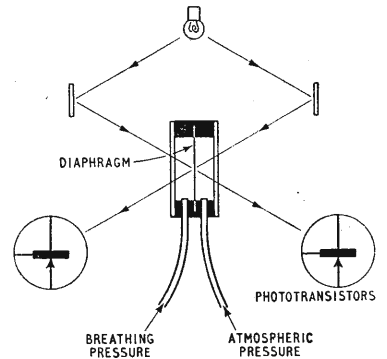
Video Tape Recording of television programmes by the American Ampex machine achieves a low tape speed of 15 inches/sec, as is well known, by means of a rotating head assembly and a concave tape guide, giving transverse tracks across the 2-in wide tape (see sketch). The 2-in diameter video-head drum rotates at 240 r.p.s., and each of the four heads records one complete track in about 1 millisecond. This gives an effective tape speed of

Technical Notebook

about 1,500 inches/sec. The tracks themselves have a centre-to-centre spacing of approximately 0.015in, and are 0.01in wide, allowing about 0.005in between the edges of adjacent tracks. As can be seen, the video signal is erased from the two edges of the tape to provide paths for the longitudinal recording of the audio and system control tracks. This leaves slightly more than 90° of arc of recorded information to allow for a continuous flow of information during playback. The same heads are used for playback, and their synchronization with the pattern on the tape is achieved by adjusting a vernier tracking control, the correct state of operation being indicated by the lock-in of a Lissajous figure on an oscilloscope. A 4,800-ft reel of tape will give 64 minutes playing time. One complete 525-line picture occupies about 1/2 inch of tape length and there are approximately 16 lines recorded in each track. A horizontal resolution of 320 lines is specified for the reproduced picture, although this can be increased. Further points are discussed by C. P. Ginsburg in *I.R.E. Transactions* PGTS-8 for June, 1957.

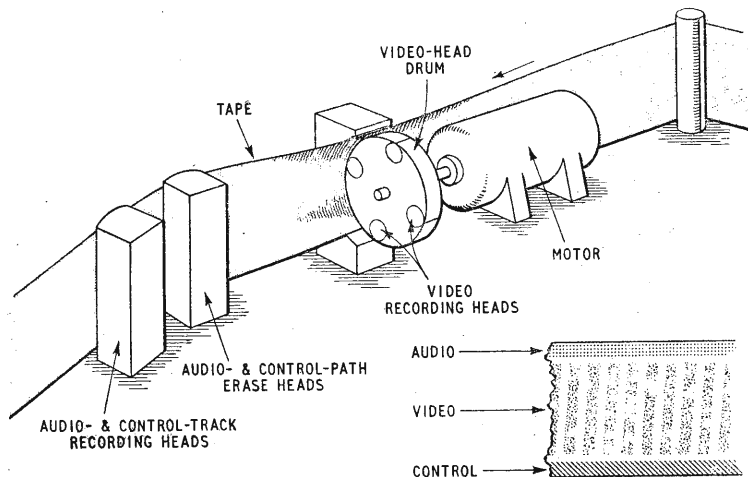
Aluminized Terylene is used as a light-reflecting diaphragm in an electronically controlled artificial respirator for new-born babies devised by the Midwifery Department of Glasgow University and the Physics Department of the Western Regional

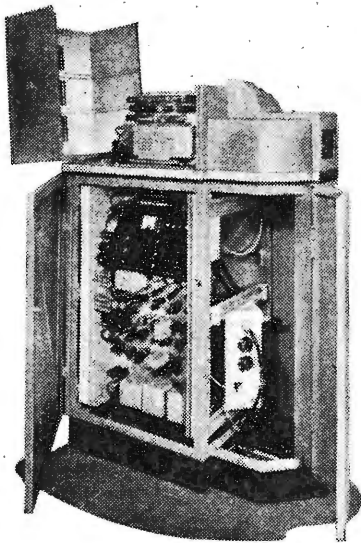
Hospital Board, Glasgow. The machine does not impose a regular breathing rhythm but whenever the infant makes the initial effort to breathe it responds with a supply of air or oxygen which forces the lungs into full operation. The slight change of pressure resulting from this initial effort is conveyed by a face-mask and tube to the left-hand side of the chamber shown in the sketch, the right-hand



side being at atmospheric pressure. This causes a slight flexure of the diaphragm, which produces an angular deflection of the light beams reflected on to the phototransistors. The resultant push-pull change of current through the phototransistors is then used to control the operation of a valve supplying air to the baby's face mask. Incidentally, if the baby stops breathing for a dangerously long time, the machine changes over to an automatic cycle and delivers regular doses of air.

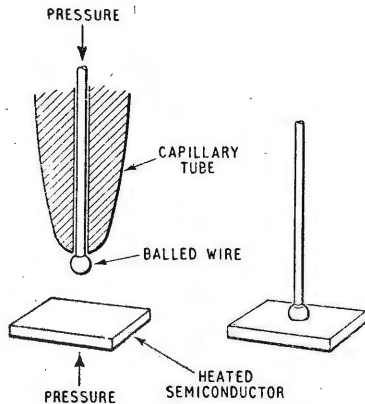
Vidicon Colour Film Scanner recently developed by Marconi's uses a camera containing three photoconductive pick-up tubes instead of the usual flying-spot system. One advantage is that the storage characteristic of the tubes avoids the need for fast pull-down of the film and for synchronous running. Moreover, by means of an optical multiplexing system the same camera can be used for televising from several film and slide projectors in sequence. In the equipment (which does not include the film projector) the division of light into three primary colour components is performed by two dichroic filters mounted as a





"V". Red light passes straight through, while green and blue are deflected to opposite sides, the light paths then being brought back into line by front-silvered mirrors. Further shaping of the spectral response of each channel is performed by a combination of dichroic and conventional colour filters. Neutral density filters are inserted in the individual light paths to the three Vidicons to ensure that they are operated over similar parts of their characteristics. The focusing and deflection yokes are made to close tolerances, and individual as well as common controls of height, width and centring are provided for accurate registration of the three component images. Switching facilities on a monitor in the operating console allow the individual pictures to be superimposed for this purpose. A degree of registration equivalent to 500-line definition at the centre and 400-lines in the corners is said to be achieved. Individual shading controls are provided to compensate for non-uniformity of sensitivity over the scanned area of the pick-up tubes.

Semiconductor Pressure Welding for attaching soft-metal leads to transistors and other semiconductor devices is being investigated at Bell Telephone Laboratories by O. L. Anderson, H. Christensen and P. Andreatch. The process appears to be similar to the cold pressure welding developed by G.E.C. (our May, 1951, issue, p. 181) except that a certain amount of heat is applied as well as pressure, though not enough to affect the semiconductor material. One method has been to use a heated element such as a wedge, a flat or a point, to press the metal against the heated semiconductor with a pressure sufficient to cause a slight deformation of the lead. Ad-



hesion occurs within a matter of seconds. Another method consists in butting the balled (or headed) end of a wire against the heated semiconductor by means of a capillary tube, as shown in the sketch. Bell Telephone claim that this "thermo-compression bonding," as they call it, has a number of advantages over other methods of attaching leads to semiconductors. The bond is stronger, they say; the technique is more readily adaptable to mass-production; no chemical flux or other chemical contaminant is involved in the process; and leads may be attached to much smaller areas—which, of course, would be invaluable in manufacturing high-frequency transistors. Adhesion takes place in seconds with pressures of a few thousand pounds per square inch. A gold-germanium bond appears to be the easiest to make, but gold, silver, aluminium and a number of alloys can be readily bonded to either germanium or silicon.

Packaged Crystal Oscillators, measuring only $4\text{in} \times 1\frac{1}{2}\text{in} \times 1\text{in}$, are being produced by the Bulova Watch Company of New York for airborne applications. A range of output frequencies from 180kc/s to 50Mc/s is available, with stabilities of up to ± 1 part in 10^8 and harmonic contents less than 5%. Circuits using either valves or transistors can be

supplied, and the units can be mounted on 7-pin plugs or other arrangements.

High-speed Correlation Computer, developed by the Ramo-Wooldrige Corporation for their data reduction centre at Los Angeles, shortens considerably the time required for analysing a signal recorded on a length of magnetic tape by automatically scanning the tape in sections. In orthodox correlation computers the entire length of tape has to be run through for each spacing of the two playback heads (giving correlation values at different time intervals) as explained in our March, 1955, issue, p. 137. In the Ramo-Wooldrige machine, however, each section of tape to be analysed is held stationary on a drum while the playback heads rotate about it. At the same time the heads are automatically displaced in steps to produce points in the correlation function graph. Both auto-correlation and cross-correlation analyses can be performed on the computer, which uses Ampex tape equipment.

Repeated Counting Measurements can be obtained automatically with a versatile frequency and time measuring equipment recently introduced by Venner Electronics. An automatic timer is fitted, which enables a count to be held on the decade display (pointer instruments) for an adjustable period of 0.5-5 seconds, after which the decades are reset to zero and counting begins again. The instrument, which is based on transistorized plug-in units, will measure frequencies (by counting cycles) in the range 10c/s-50kc/s, periods of waveforms in the range 0.00001c/s-10kc/s and time intervals between pulses from 1×10^{-4} second to $11\frac{1}{2}$ days. For frequency measurement the period of counting cycles can be set to 0.1 second, 1 second or 10 seconds. For measuring waveform periods, the cycles of an internal 10-kc/s crystal oscillator are counted, while in the case of pulse interval timing any one of six internal frequencies can be selected for counting, depending on the interval involved.

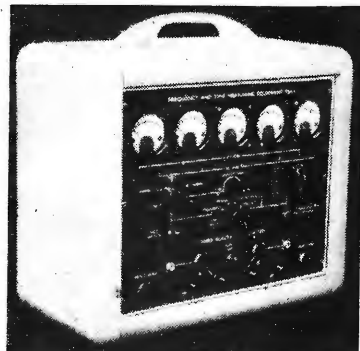
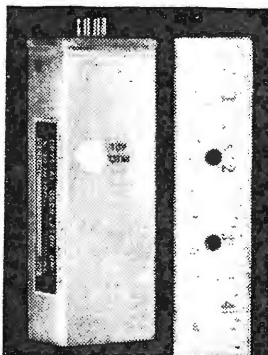
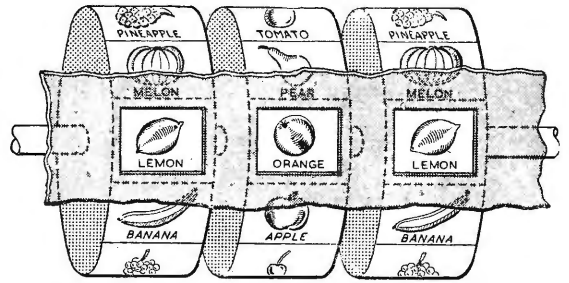


Fig. 1. Rotating drums of the mechanical fruit machine.



Simple Game of Skill Based on Pulse Techniques

Electronic Fruit Machine

By G. L. SWAFFIELD

THE electronic fruit machine described here is a game whose operation is analogous to that of the mechanical gambling device known both as the "fruit machine" and as the "one-armed bandit." The playing of this last-mentioned machine for cash prizes is illegal in this country, since the device is merely a game of chance. In it the player, after inserting a coin, pulls a lever (the "one-arm" of the nickname) to rotate three independent drums around the peripheries of which are printed pictures of different fruits. A viewing window in front of the machine presents the pictures of three fruit passing at any given instant, one on each drum. The general appearance of the arrangement is illustrated in Fig. 1.

A brake button on one version of the device permits the drums to be stopped in quick succession after predetermined intervals to display any combination of three fruit, while a list on the front of the machine indicates winning combinations, prize money being delivered automatically *via* a coin chute. The "jackpot," for example, is generally delivered with a winning combination of three lemons.

It is doubtful whether any skill can be acquired playing a machine of this sort, due mainly to the difficulty of distinguishing the fruit while the drums are still rotating. Its electronic counterpart, however, can be played in either of two ways: in the first, as before, only chance will yield a win, but in the second it will be beaten by a skilful player.

If, in the mechanical version, wins other than the "jackpot" are disregarded, then the operation of the fruit machine can be considered in terms of pulse trains.

With eleven different fruit around the periphery of each drum, of which only the lemon contributes towards a win, the appearance of the lemon can be represented by one pulse in a waveform whose recurrence frequency equals the angular frequency of the drum. Furthermore, the presence of the lemon for one-eleventh of the total periodic time determines the mark-space ratio of the waveform, in this case the ratio will be 1:10. In point of fact the p.r.f. will decrease gradually due to the natural decelerations of the drums, but for a limited number of revolutions an approximately constant p.r.f. will be maintained, making the graphical representation of the pulse trains in Fig. 2 legitimate.

The action of the brakes is also shown here. When the button is pressed the drums are stopped in sequence, and in the diagram the arrows illustrating the action of the brakes show that the first and last drums are stopped when a lemon is visible in each of the respective windows. The second drum however is stopped halfway between "lemons." This result is shown pictorially in Fig. 1, and on the basis of the "jackpot" only win, no prize would be delivered with this combination. This sequential operation of the brakes is simulated in the electronic model when the last-mentioned is played for a chance win.

In the new arrangement three flashing neon lamps replace the three rotating drums, being triggered by pulse trains of the type already discussed. The neon lamps all flash at regular intervals individually, no attempt being made to simulate slowing-down of drums. Their recurrence frequencies however are not harmonically related. Since the mark-space ratio of each train is constant at 1:10, the duration of a flash is equivalent to the time a lemon would take to pass the appropriate viewing window in the mechanical machine with ten other fruit on the drum. The electronic version is therefore a "jackpot" only machine.

A fourth flashing lamp is controlled by a push button. When held down continuously the button allows the lamp to flash at the same mark-space ratio (i.e. 1:10), but at a lower p.r.f. than the other

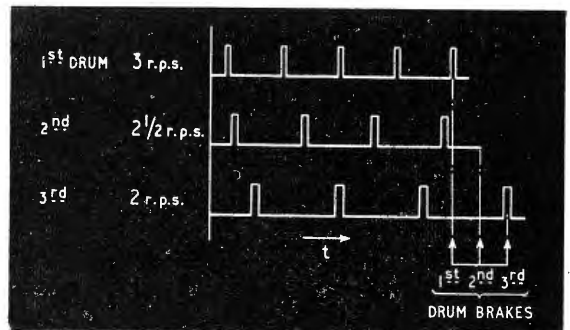


Fig. 2. Pulse-train analogy of the operation of the machine illustrated in Fig. 1.

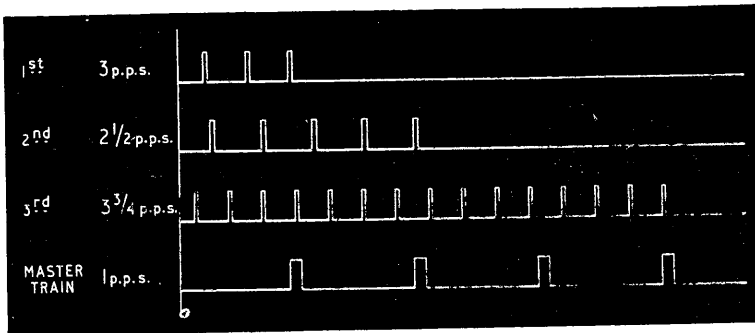


Fig. 3. Pulse trains used in the electronic version, showing coincidences between the first three and the master train.

three lamps. Push-button control commences only after a coin has been inserted and is limited to a fixed period of time after the first push, say approximately ten seconds.

If this fourth lamp flashes at the same instant as the first of the others, then the last-mentioned is permanently extinguished. Similarly, if during the fixed interval of ten seconds the fourth lamp flash coincides with that of the second, then that too is extinguished. Finally if by the same process the third lamp is extinguished still in this time limit, then the "jackpot" has been won, and a relay automatically trips to pour the appropriate win into the player's hands.

A win by such a means would obviously be by chance, no skill being required of the player.

The similarity of operation between this version and its mechanical origin can be seen in Fig. 3, where pulse trains produced by the neon lamps are presented in their correct time relation to one another. In this figure the lowest wave train, representing the push-button controlled or master neon flashes, is seen to coincide with the first pulse train at the master's first flash. With the first lamp now extinguished, the output from the master neon lamp source is free to work on the second train. The second master pulse is also successful, and play is now concentrated on the third and final pulse train. The third master pulse is ineffective, however, and not until the fourth pulse occurs is the final pulse train eliminated. This example demonstrates a win obtained three seconds after the button has been first pushed, this being the instant from which the time limit is started.

The element of skill is introduced by using the push button intermittently, thereby making the fourth lamp flash only when required. An experienced player will note the periodicity of the first lamp's flashes and use the button accordingly to make the flashes of the first and fourth lamps coincide. This same procedure is repeated to extinguish the second and third lamps within the prescribed time limit. To prevent the task of winning from becoming too easy, however, the circuit associated with the fourth or master neon lamp is arranged to have a finite recovery time equal to its normal or continuous periodic time. In Fig. 3, for example, where the master neon lamp flashes at 1 p.p.s., a maximum of ten manually controlled flashes could be obtained in the ten seconds' time interval.

The device is coin-operated, insertion of a 3d

piece triggering the three flashing lamps. Because the time limit only commences from the instant that the button is first pushed, a limitless period elapses during which the player can learn the "rhythm" of the machine.

A coin divider, associated with the 3d piece slot mechanism, arranges that half the coins inserted are delivered to the cash-box of the machine, and the remainder to the "jackpot," which, in the demonstration model illustrated, is visible through a window in the front of the machine. Normally, of course, the "jackpot" would be hidden from the

player as an empty "kitty" would offer little incentive for further play.

From an operational point of view this simple version of the device has one major disadvantage when compared with its mechanical parent in that it is possible to win only one prize. In fact a second model of the fruit machine has been designed delivering other prizes, but the modification involved is elementary from a circuit viewpoint, the additional detail being merely an extension of the mechanical design.

A second disadvantage is purely psychological. The absence of the mechanical noises that are normally associated with the operation of the parent machine detracts to a certain extent from the pleasure of the game—at any rate, until a win is achieved.

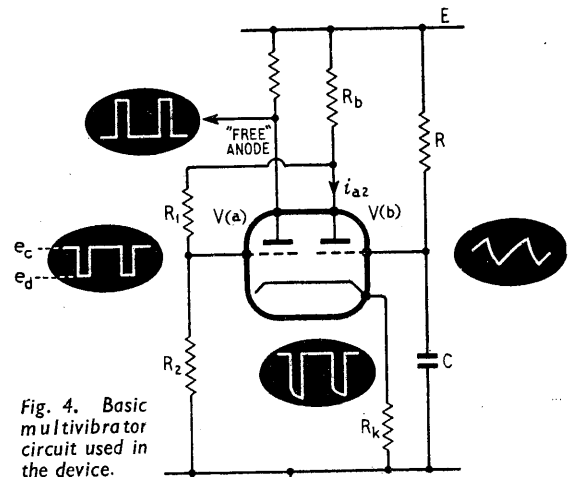


Fig. 4. Basic multivibrator circuit used in the device.

However, the compact size of the arrangement (it measures approximately 10 in \times 10 in \times 4 1/2 in), its mechanical simplicity, and the more rewarding type of play it provides are advantages which, it is felt, more than compensate for these drawbacks. Even as a novel way of saving 3d pieces the device commends itself.

Average Time for a Chance Win.—The switching circuits associated with the neon lamps are so arranged that when any portion of one pulse coincides in time with the other, a triggering action takes place and the appropriate lamp is extinguished. The limiting condition for extinction will there-

(continued on page 449)

fore be given by the two pulses being adjacent. It follows that the total period of time during which coincidence can occur is $t_1 + t_m$ seconds, where t_1 and t_m are the durations of the first and master pulses respectively.

The average number of first lamp pulses occurring is the ratio of master and first lamp's periodic times, T_m/T_1 , and hence the total favourable time interval τ for extinction is

$$\tau = \frac{T_m}{T_1} \times (t_1 + t_m) \text{ seconds}$$

Because this favourable time interval can occur once every T_m seconds the probability p of extinguishing the first lamp is τ/T_m . Hence,

$$p = \frac{t_1 + t_m}{T_1}$$

The average number of attempts necessary to achieve coincidence will be the inverse of this probability value, and since each attempt takes T_m seconds, the time taken to extinguish the first lamp will be

$$T_m \times \frac{T_1}{t_1 + t_m} \text{ seconds}$$

Replacing the suffix 1 by 2 and 3 respectively will give the times taken to extinguish the second and third lamps in turn, and the sum of these three times gives an average overall time for the operation:

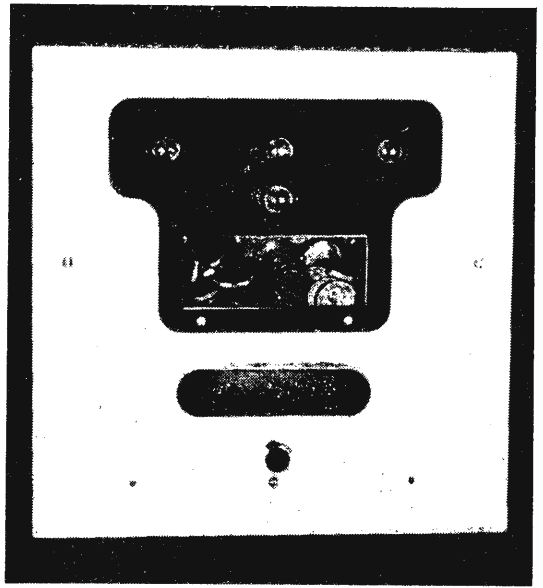
$$T' = T_m \times \left(\frac{T_1}{(t_1 + t_m)} + \frac{T_2}{(t_2 + t_m)} + \frac{T_3}{(t_3 + t_m)} \right) \text{ seconds.}$$

Substituting the values given in Fig. 3 for the periodic times and assuming equal mark-space ratios, the average overall time in the demonstration model is 8.2 seconds. This result shows that a time limit of ten seconds is very generous.

The expression for T' makes it quite plain that for a practical commercial version of the machine the value of t_m should be reduced and that of T_m increased to make wins by chance less frequent. If for example t_m were made negligible compared with the other pulse durations, and the remainder of the values left as in Fig. 2, the value of T' would approach 33 seconds.

The circuit arrangement lends itself easily to being modified to offer odds to suit any requirements.

Circuit Details.—The circuit uses eight of the



Front view of a demonstration model of the electronic fruit machine, showing the neon lamps and the "jackpot" container.

6J6 or ECC91 type of valve which is readily available on the "surplus" market for a few shillings. The envelope, mounted on a B7G base, contains two triodes sharing the same cathode.

Four of the valves function as multivibrators, three more as adaptations of the well-known Schmitt trigger circuit¹, and the final one as the time delay circuit.

The basic multivibrator^{2, 3}, Fig. 4, is worthy of comment as it is seldom encountered. The circuit is astable, and depends for its operation on the charge of capacitor C through resistor R towards the supply potential E, and the subsequent discharge of this capacitor through the cathode load resistor R_k via the diode formed by the grid and cathode of V(b). During the charging cycle, when V(b) is cut off, V(a) grid, and hence the cathode, is at a fixed positive potential e_c determined by the resistance chain R_b , R_1 and R_2 . As C charges, however, it reaches a potential where V(b) can draw current. By doing so the anode potential of V(b) falls and the grid of V(a) drops to a new level, e_a .

The resultant cathode potential drop is sufficient to leave the grid of V(b) well positive with respect to the cathode, while at the same time V(a) is cut off. The cathode potential is therefore due solely to the much smaller anode current i_{a2} and the discharge current of capacitor C. The last-mentioned thus starts to discharge towards a nearly constant potential, $i_{a2}R_k$, and for the discharge period the cathode voltage follows the grid voltage to within a grid-base of e_a . At this level V(a) is again able to contribute to the cathode current. The ratio of the anode resistors is so chosen that the current provided by V(a) is much the greater, and this ensures the rapid rise of the cathode potential as V(a) starts to conduct, cutting off V(b).

The cycle of operations is now ready to be repeated. Fig. 5 shows these cycles in graphical form, while the waveforms produced at the relevant electrodes are illustrated in Fig. 4.

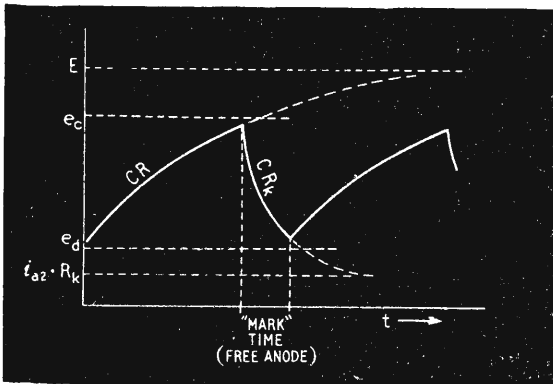


Fig. 5. Charge and discharge cycle at the grid of V(b) in the multivibrator circuit Fig. 4.

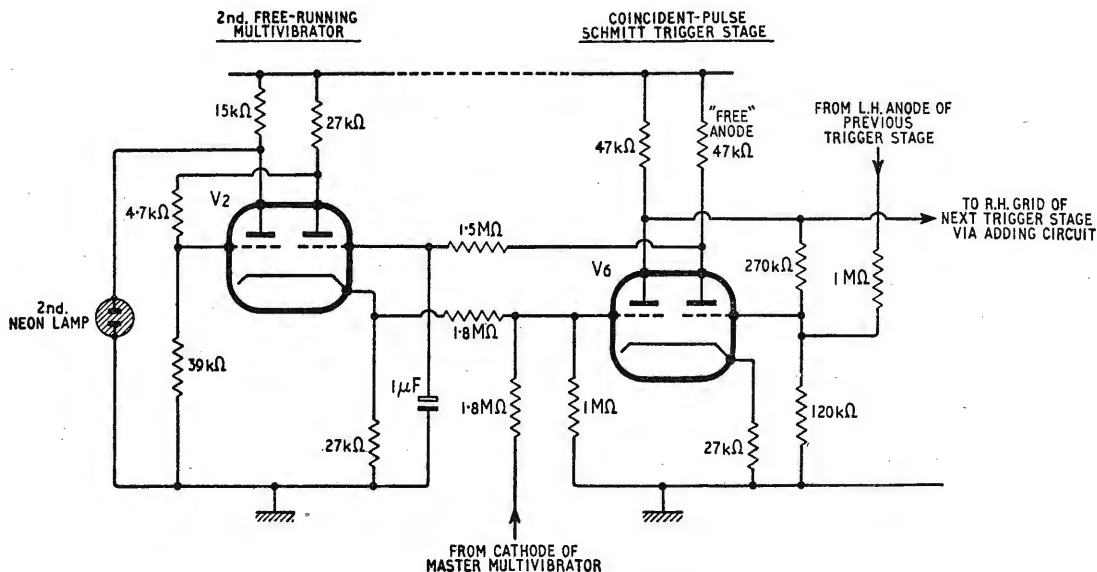


Fig. 6. The second pulse-train generator.

Fig. 6 shows the connections between the multivibrator producing the second train of pulses and its associated Schmitt trigger stage. The first and third pulse trains are produced in a similar manner, and to avoid circuit diagram congestion are therefore omitted here.

Connected to the "free" anode of each multivibrator is a neon lamp which will flash for the majority of the "mark" time. Normal persistence of vision creates the illusion that the lamps are triggered for a longer period than in fact they are, making the game appear simpler than it really is.

The first three multivibrators are astable and the fourth is of the same basic design as these but is controlled by a push button. It can either "free-run" when the button is held in continuously, or produce one or more pulses at its normal p.r.f. when the button is held in for short periods, depending on the duration of the last-mentioned.

At the instant that any of the first three neon lamps is triggered, the negative-going pulse produced at the cathode of the appropriate multivibrator is

fed to the first grid of its associated Schmitt trigger stage *via* an adding circuit.

The negative-going pulse appearing at the cathode of the fourth multivibrator is fed to each of the three Schmitt trigger stages also *via* the adding circuits.

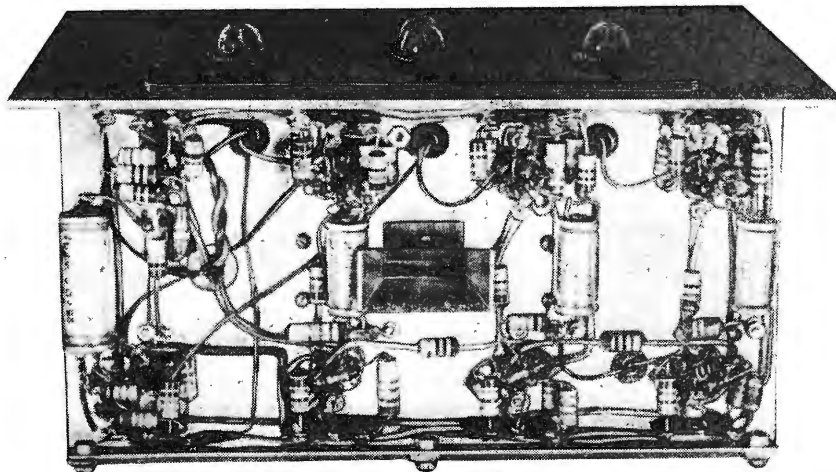
Now the first trigger circuit is arranged to operate only when a pulse from its associated multivibrator is coincident in time with that from the fourth multivibrator.

This condition also applies to the first grids of the two successive Schmitt trigger stages, but connections to their second grids (i.e., the right-hand grid of the trigger stage in Fig. 6) from the previous Schmitt valves permit the triggering action only when the previous stage, and hence lamp, has been switched off.

This switching process is achieved by coupling each multivibrator charging circuit to its associated Schmitt trigger "free" anode, the potential of which is reduced sufficiently to stop the multivibrator working when the trigger stage operates.

It follows that each multivibrator, and thus lamp, must be extinguished in numerical order, and in fact the circuit functions rather as a rotary switch.

In the "free" anode of the third and final Schmitt stage a relay is connected. Its purpose is twofold: first, it performs the relatively unimportant electrical task of switching off the third multi-



Top view of the machine, showing component layout and coin slot in the middle. The valves hang downwards from the underside of the chassis.

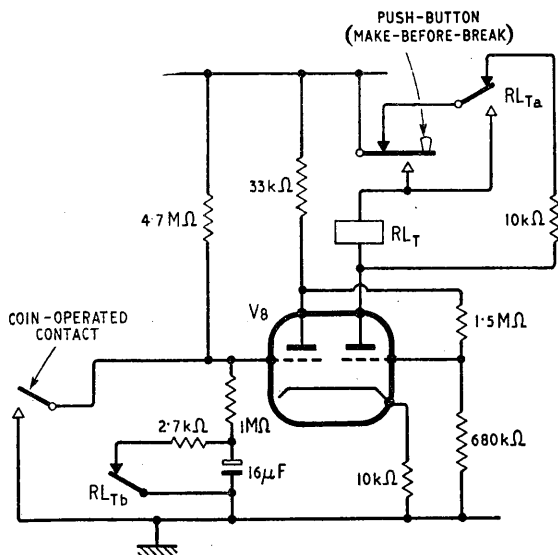


Fig. 7. Coin-triggered time delay circuit.

vibrator, giving an audible or visible indication of a win at the same time; and second, the action of the relay armature closing releases the catch holding the tray with the "jackpot" in position.

The final stage in the circuit controls the time of play. Here a compromise is made between electronic and electromechanical circuitry to satisfy the requirements that the stage must fulfil. These may be summarized as follows:

(1) The push button must be inoperative until the coin is inserted.

(2) Insertion of the 3d piece must make the push button functional and reset the trigger circuits and multivibrators for further play.

(3) The time limit must only commence from the instant that the push button is first pressed.

Fig. 7 shows the arrangement that satisfies these conditions and once again the Schmitt trigger circuit forms the basis of the design.

Just prior to the insertion of a coin, the left-hand valve of the double-triode combination will be conducting, and the right-hand valve cut off. As the coin is dropped in the slot, however, one of two pairs of contacts closes, to earth the left-hand grid momentarily, and the circuit triggers. Anode current to the right-hand valve will now flow *via* the push button and relay contacts RL_{Ta} , through the 10-kΩ anode load. Meanwhile the other pair of coin-operated contacts (not shown on the diagram) acts in a similar way to earth the grid of the first Schmitt trigger, thereby resetting the three multivibrators. This operation satisfies requirements 1 and 2, and play may now commence.

When the push button is pressed, the changeover contacts in the diagram, which are of the "make-before-break" type, divert the anode current from the 10-kΩ load to the coil of the relay RL_T . The coil is thus energized and the relay will be self-holding due to its contacts RL_{Ta} . At the same time, the contacts RL_{Tb} in the left-hand grid circuit will open, and the 16-μF capacitor will commence to charge towards h.t. potential through the 4.7-MΩ and 1-MΩ resistors in series. When the grid

potential has risen to within a grid-base of the cathode potential, however, the reverse switching action occurs, and relay RL_T is de-energized, resetting the circuit. The 16-μF capacitor is rapidly discharged through the 2.7-kΩ current-limiting resistor and the whole device is left in a state of suspended animation to await the pleasure of the next player. During the waiting period, lamps that have been successfully extinguished within the time limit will remain off until reset by the next coin.

Purely as a harmless game no more can be said for the electronic fruit machine than that it represents a rather novel application of conventional pulse techniques. It certainly cannot be said to offer any serious rivalry to ERNIE, and in a country where the making of "easy" money is the modern-day trend, deplorable though the fact is, a device which requires some skill in the operator should provide a welcome change.

As a last redeeming feature the similarity between the device and a "piggy" bank can be stressed. In fact, with its paying-off ability, perhaps a better title for the machine would be the "Poor Man's ERNIE."

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- 1 O. H. Schmitt. "A Thermionic Trigger," *Journ. Sci. Insts.*, 1938, 15, p. 24.
- 2 Webb and Morgan. "Simplified Television for Industry," *Electronics*, June, 1950, p. 70.
- 3 C. H. Banthorpe. "A Time-Base Oscillator," *Elect. Eng.*, April 1954, p. 168.

New "Wireless World" Book

"Basic Mathematics for Radio and Electronics," by F. M. Colebrook, B.Sc., and J. W. Head, M.A., is a third and revised edition of the well-known "Basic Mathematics for Radio Students," in which two additional chapters at a more advanced level have been added.

The first seven chapters cover elementary algebra and geometry, logarithms, trigonometry and the calculus (both differential and integral). They include such comparatively advanced subjects as series and limits, and give a thorough grounding in the use of vectors. The last chapter of this section deals with actual radio applications.

The new chapters (contributed by J. W. Head, mathematical consultant to the B.B.C.) deal with more advanced topics such as the Heaviside operational calculus, matrices arising in linear four-terminal networks, linear differential equations, and random variations with associated least squares techniques.

The mathematics outlined has many applications outside the field of radio so that the usefulness of this book is actually wider than the title might perhaps indicate.

The book has 359 pages including 90 diagrams and costs 17s 6d. It is issued by our publishers, Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

"Prefabricated Chassis." Since the article on page 390 of the August issue went to press, we have been informed that an improved version of T. K. Cowell's original design (September 1955 issue) has in fact been put into commercial production, and that supplies are obtainable from Cowell Developments, 67 Long Drive, East Acton, London, W.3.

Further Notes on the Portable Transistor Receiver

By S. W. AMOS*, B.Sc.(Hons.), A.M.I.E.E.

DETAILS OF PRACTICAL LAYOUT

THE articles in the May and July issues on the design of a portable transistor receiver aroused much interest and many requests have been received for more information on the practical layout of such a receiver and details of the screening required in the i.f. amplifier. It is hoped that this short article will provide the answers to these requests.

The arrangement of the components of the receiver is by no means critical and a large variety of different layouts is possible. The form of construction adopted in one receiver is illustrated in the accompanying photograph. This is a rear view of the receiver with the back removed and shows the components mounted on a vertical Paxolin panel with the Ferrite-rod aerial at the top and the battery at the bottom. The volume control and the combined wave-change and on-off switch are not visible in this photograph because they are situated in the 1-in gap between the Paxolin panel and the front of the cabinet. They are secured to the cabinet front as is also the loudspeaker. The loudspeaker magnet projects through a hole in the panel and is visible in the photograph. The gap between the panel and the cabinet front also accommodates a tuning scale, pointer and epicyclic slow-motion drive arranged as shown in the accompanying sectional drawing.

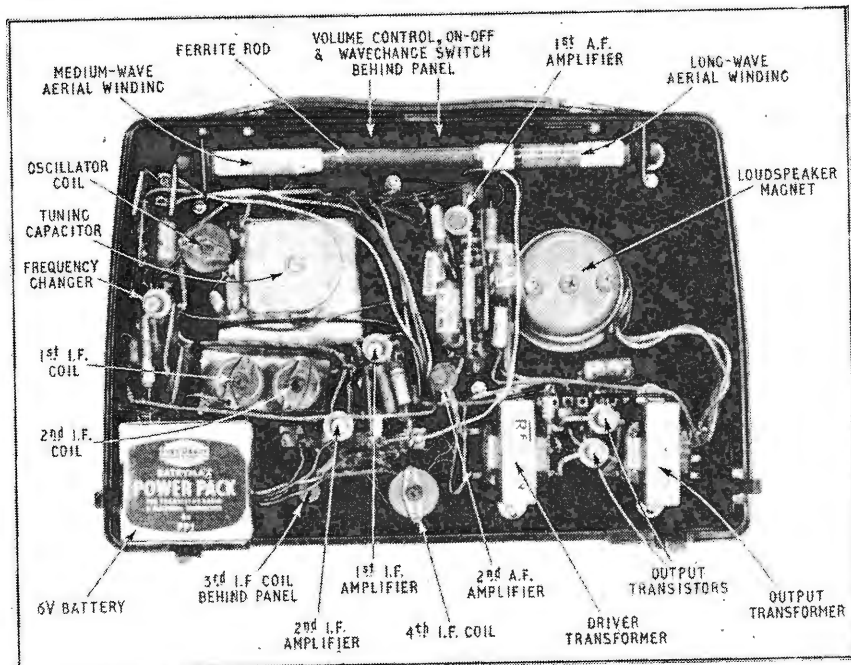
The best way to ensure stability in the i.f. amplifier would be to provide screening cans for all four

i.f. coils, but a somewhat simpler method is used in the receiver illustrated here. The first and second i.f. coils, which are coupled to form a bandpass filter, are placed close together and are contained in a rectangular copper box with an open top; the top edge of this box is visible in the photograph. A similar open-topped box is used to screen the third i.f. coil and to reduce coupling between the third and all the other i.f. coils in the set, the third i.f. coil is mounted on the opposite face of the Paxolin panel with the open top of the box facing the front of the cabinet. The third coil is thus not visible in the photograph, but the Bakelite screw securing it and the screening box to the Paxolin panel is indicated by an arrow. With this screening arrangement complete stability is obtained without screening the fourth i.f. coil.

If the first and second i.f. coils are placed as in the photograph they are coupled by a mixture of capacitive and inductive linkage by virtue of their close proximity. By suitable choice of spacing this combined linkage can be made to give the degree of coupling necessary for the required bandpass characteristic, the 2.7-pF top-end coupling capacitor shown in the circuit diagram (July issue) being then unnecessary. The coupling due to proximity can be substantially altered by reversing the connections to one of the tuned windings, presumably because the capacitive and inductive linkages can be aiding or opposing depending on the sense of the connections.

For this reason, and also because the coupling is affected by the proximity of the screen to the pot cores, it is not possible to state how far apart the first and second i.f. coils should be to give the required passband.

The spacing can be determined empirically in the following manner. Start with the pot cores wide apart; say 2 in between their centres. With the coils still inside the screening enclosure gradually reduce the spacing while noting the output of the receiver with a very

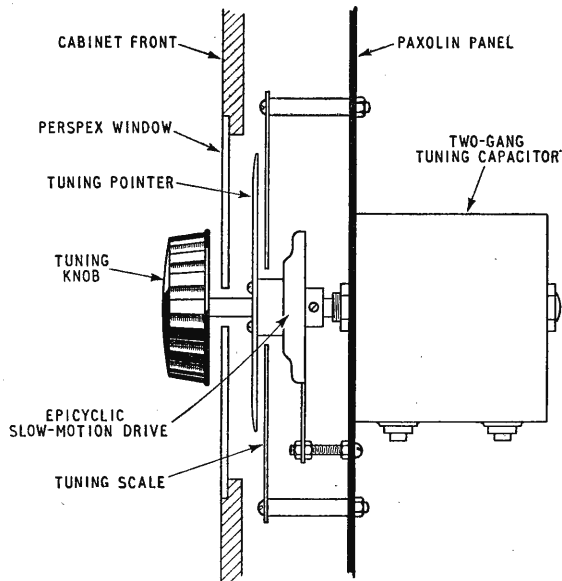


Layout of the portable transistor receiver described in the text. Components are marked to accord with the circuit diagram in the July issue.

weak signal injected into the aerial. The output will rise to a maximum as optimum coupling is reached; further decrease in spacing will widen the passband without significant change of gain. Fix the spacing at the widest value which gives the maximum output.

Since the original articles were published it has been found possible to simplify the construction of the i.f. coils without significant change in performance. The change is to omit the 99-turn tuned secondary windings and to tune the primary windings instead. To give the required Q values the primary winding should be wound with Litz and, as there is now plenty of room for it on the former, silk-covered 7/44 Litz wire may be used. If the original specification of 25 turns for the primary windings is adhered to, the capacitance required to tune the primary winding to 465 kc/s is $(99/25)^2 \times 200 = 3,150$ pF, but this is a non-standard value and it is preferable to use a primary winding of 26 turns and to tune with a close-tolerance 3,000-pF mica capacitor. The tertiary windings should remain as specified and the 30 k-ohm resistors shown across the primary windings of the first and second i.f. coils are still necessary. If simplified i.f. transformers of this type are used the top-end coupling capacitor between the first and second i.f. coils should now bridge the primary windings and the value should be 47 pF. Alternatively, of course, no coupling capacitor need be used and the required coupling can be obtained by placing the two pot cores in close proximity as described above.

Reminder:—As was pointed out on page 377 of the August issue an 8- μ F electrolytic capacitor,



Details of the pointer, scale and epicyclic slow-motion drive for the tuning capacitors.

to be marked C_{233} , should be inserted in the lead from the volume control (R_{14}) to the earth line in the circuit diagram on page 341 in the July issue. This capacitor must be connected with the positive lead to earth.

Books Received

An Introduction to Junction Transistor Theory, by R. D. Middlebrook, M.A., M.S., Ph.D. Theoretical treatment from basic to general practical aspects and including a new equivalent circuit. Pp. 296; Figs. 139. Price 68s. Chapman and Hall, 37, Essex Street, London, W.C.2.

Tape Recorders and Tape Recording, by H. D. Weiler. Includes general principles, recording and editing techniques, sound effects, servicing and synchronization with film. Pp. 190; Figs. 114. Price 24s. Radio Magazines Inc., Mineola, New York. Available in this country from A. F. Bird, 66, Chandos Place, London, W.C.2.

Copyright in Sound Recordings, by P. Ford, L.I.B., F.R.S.A., Barrister-at-Law. Revised and reprinted from *Sound Recording and Reproduction*, January, 1957. Pp. 10. Price 1s. British Sound Recording Association, 3, Coombe Gardens, New Malden, Surrey.

Nachrichtentechnische Fachberichte, Vol. 6. Forty papers by various authors on general signal theory, communication networks, broad band directional aerials, and miniature components. Pp. 192; Figs. 265. Price 18 DM.

Nachrichtentechnische Fachberichte, Vol. 7. Seven papers by various authors on long-distance line communication techniques. Pp. 36; Figs. 69. Price 6 DM.

Nachrichtentechnische Fachberichte, Vol. 8. Nine papers by various authors on network synthesis problems. Pp. 68; Figs. 94. Price 4 DM.

The above Nachrichtentechnische Fachberichte volumes can be obtained from F. Vieweg and Sons, Postfach 185, Braunschweig, Germany.

Radio Research 1956. Report on the work of the Radio Research Station, Slough. Covers propagation in relation to l.f. and v.l.f. navigational aids, forecasting transmission conditions, the effect of the ionosphere and troposphere on h.f., v.h.f. and u.h.f. waves, general ionosphere characteristics, and atmospheric noise; and also includes research on semiconductors and ferrites. Pp. 47; Figs. 4. Price 3s. Department of Scientific and Industrial Research, 5-11, Regent Street, London, S.W.1.

V.H.F. Radio Manual, by P. R. Keller, B.Sc., A.M.I.E.E. Covers principles and practice in v.h.f. (30-450 Mc/s) transmitting, receiving and communications equipment for a.m., f.m. or video modulation. Pp. 216; Figs. 194. Price 30s. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

Radio Control Mechanisms, by R. F. Stock. Compiled from articles in the *Radio Constructor*, and covers mechanical coupling methods between various radio systems and the controls of small models. Pp. 64; Figs. 67. Price 4s 6d. Data Publications, Ltd., 57, Maida Vale, London, W.9.

Fixed Paper-Dielectric Capacitors for D.C. for use in Telecommunications and Allied Electronic Equipment. B.S. No. 2131: 1956. Pp. 10. Price 3s 6d.

Flexible Insulating Sleeving for Electrical Purposes. B.S. No. 2848: 1957. Includes test methods. Pp. 29. Price 6s.

The above British Standards Specifications may be obtained from the British Standards Institution, 2, Park Street, London, W.1.

News from the Industry

Nash & Thompson, Ltd., the scientific instrument makers of Oakcroft Road, Chessington, have been acquired by Thorn Electrical Industries. Founded in the early 1930s, Nash & Thompson were largely responsible for the development and production of radar scanners for H2S—the bomber radar—during the war. Two new directors have been appointed, B. C. Fleming-Williams, general manager of the Sylvania-Thorn Colour Laboratories, and D. Talbot.

Cosmocord, Ltd., of Waltham Cross, Herts., manufacturers of Acos pick-ups, cartridges and microphones and also of some plastics mouldings, have been acquired by Pena Copper Mines, Ltd. It will be recalled that this mining company announced earlier this year that it was entering the field of electronics and has recently acquired Peto Scott Electrical Instruments.

Simon.—A controlling interest in Simon Equipment, Ltd., which incorporates Simon Sound Service and Simon Development, has been acquired by Harland Engineering Co., electrical and mechanical engineers, of 20 Park St., London, W.1. The two organizations have been closely associated for some time on the development and application of electronic control equipment. R. W. Simon continues as chairman of the company, and K. H. Williman as managing director. A modified version of Simon's multi-channel recording equipment, designed originally for ground-to-air communications at airports, has been supplied to three of the I.T.A. programme contractors. The modified equipment provides a single-channel recording for 32 hours without changing the tape.

P.C.D., Ltd., is the name under which two members of the Camp Bird Group—Photo Printed Circuits, Ltd., and P.D.C., Ltd.—will be known now that they have been merged. The company will operate from Bisley, Surrey. The new managing director is S. W. Hobday who, for the past six years, has been oscillograph development engineer at Southern Instruments, Ltd.

British Radio Corporation, Ltd., is the name adopted for the company which, as announced in our May issue, was being formed jointly by E.M.I. and Thorn Electrical Industries for the design and marketing of all domestic sound and television receivers under the Ferguson, H.M.V. and Marconiphone trade marks.

Elliott Brothers, of Century Works, London, S.E.13, and the Associated Automation group of companies, which includes Electroflo Meters Co., National Automatic Machines, Panellit, and Sauter Controls (all of London, N.W.10), and James Gordon & Co., of Stanmore, Middlesex, are being merged.

Wolsey Electronics, Ltd., is the new name adopted by Wolsey Television, of St. Mary Cray, Orpington, Kent.

Expert Gramophones, Ltd., of Great North Road, London, N.2, has been acquired by Wolsey Electronics. Since its inception Expert Gramophones has been under the technical direction of D. Phillips and he has been appointed technical director of the new board. The company, which specializes in the manufacture of sound recording and reproducing equipment, will no longer deal direct with the public but through dealers. Wolsey is a member of the Gas Purification Group, which also includes Grundig, Staar Electronics, and Electric Audio Reproducers.

A.B. Metal Products.—New directors of A.B. Metal Products, the firm recently acquired by the Gas Purification & Chemical Company, are J. R. Sorsbie, H. J. Kroch and Lewis Woolf, who was formerly sales manager of the company and will now be sales director.

Marconi's are to supply transmitting equipment worth approximately £160,000 for four new I.T.A. stations. The installations at each station include two 4-kW vision transmitters, two 1-kW sound transmitters, combining units and ancillary equipment. The first installation will be at Chillerton Down, Isle of Wight, which is planned to come into service next summer, and the other equipment has been ordered in readiness for future stations.

"Walkie-Talkie" f.m. transmitter-receivers have been supplied by Ekco Electronics, Ltd., for use by the members of the Sheffield University expedition climbing Mt. Kilimanjaro, Tanganyika. The expedition, organized by the Tanganyika Geological Survey, will also undertake work as part of the I.G.Y.

Replacement Components. Production and distribution of replacement components for non-current Peto Scott television receivers is now being undertaken by Direct TV Replacements, of 134-136, Lewisham Way, London, S.E.14.

Carr Fastener Company, of Nottingham, has opened new factories at Sutton-in-Ashfield and Worksop to increase production and, often more important, to give greater flexibility in the execution of orders for a wide variety of valveholders, terminal strips and connectors. The Sutton-in-Ashfield plant includes the latest types of automatic moulding presses and at Worksop the assembly lines are designed to be readily adaptable for long or short production runs.

E-V Limited, formerly Sapphire Bearings, now a member of the Camp Bird Industries Group, has acquired a factory at St. Ives, Cornwall, in addition to the existing factory at Bletchley, Bucks., where the production of sapphire gramophone styli now approaches 10 million a year. With the introduction of the new factory production of ceramic cartridges, which now exceeds 30,000 a week, is planned to reach 60,000 per week by the end of the year. Direct and indirect exports absorb about 80% of the company's cartridge production.

Mullard's contributions to the recently announced "Firestreak" air-to-air guided weapon include exceptionally sensitive infra-red photo-cells and sub-miniature valves.

Kolster-Brandes have opened a sound and television service depot at 41, Bent Street, Manchester, 8 (Tel.: Blackfriars 3939).

FOREIGN AGREEMENTS

Solartron Electronic Group entered into an agreement a few months ago with the Rheem Manufacturing Company, of New York, on the production of electronic equipment and the two companies have now formed a joint research and development organization, Rheem-Solartron, Ltd. Research will be centred at Dorking, where C. E. G. Bailey, of Solartron, will be in charge of research and development of electronic reading machines, on which the new company will initially concentrate.

Anglo-French Radar Co-operation.—Compagnie Française Thomson-Houston (C.F.T.H.), and Decca Radar Ltd., have concluded an agreement by which both firms will co-operate in the design and production of radar equipments for European air defence. An agreement has also been concluded be-

tween Decca and Société Nouvelle d'Electronique, an affiliated company of C.F.T.H., under which radar aerial systems developed by the Société RBV Radio-Industrie will be available for use by Decca.

Wayne Kerr Laboratories, of Roebuck Road, Chessington, Surrey, have entered into an agreement with the Robertshaw-Fulton Controls Company, of Pennsylvania, under which the two companies will have a joint development programme in the field of industrial process control. The products resulting from this co-operation will be manufactured by both companies. The American company is also licensed to use existing Wayne Kerr patented measurement techniques. Under the agreement Robertshaw-Fulton will be responsible for the promotion and distribution of Wayne Kerr products in the U.S.A., and an initial \$100,000 order for measuring instruments has been placed by the American company.

COMPANY REPORTS

Associated Television, Ltd., the programme contractors for the I.T.A. London (weekends) and Midlands (week days) stations record in their report for the year ended April 30th that the net profit for the year was £201,716, compared with a loss of £602,715 last year. The report records that the number of homes capable of receiving I.T.A. programmes rose during the year by 1,952,000 to 3,330,000.

Ekco.—In his annual report for the year ended last March the chairman of E. K. Cole, Ltd., stated that domestic television and sound radio continued to contribute the larger portion of the company's turnover and net profit, which totalled £758,574.

Ferranti.—Reference was made at the annual general meeting of Ferranti, Ltd., to the surface-to-air guided missile "Bloodhound," for which the company developed and produced the radar and electronic control equipment. It is also reported that the company has supplied the navy with the first equipment forming a new blind-approach system for landing aircraft on carriers.

OVERSEAS TRADE

Scientific Instruments.—Twenty-three member firms of the Scientific Instrument Manufacturers' Association are participating in a combined display of scientific and industrial equipment at Interkama, the International Congress and Exhibition of Measuring Instrumentation and Automation being held in Dusseldorf from November 2nd-10th.

Finland.—Among the exhibitors at the British Trade Fair at Helsinki, which opens on September 6th, are several radio manufacturers including Bush, Collaro, E.A.P., Pye, Smith's Motor Accessories, Tape Recorders, and Taylor Electrical Instruments.

Meteorological Radar.—Decca windfinding radar is being supplied to a number of forecasting and research stations of the Argentine National Meteorological Service. It is understood that 80% of Decca's production of windfinding radar is being exported.

Airborne Search Radar, Type E120, supplied by Ekco Electronics Ltd., is being installed in the Bristol "Britannia" airliners shortly to be delivered to the Mexican airlines, Aeronaves de Mexico, S.A.

True-motion radar installations are being supplied by Decca for three new vessels being brought into service by the Texas Company, of the United States.

Canada.—In the fifth edition of the "CABMA Register 1957-58 of British Industrial Products for Canada," which is prepared annually by the Canadian Association of British Manufacturers and Agencies, emphasis has been placed on capital and industrial goods. The Buyers' Guide lists alphabetically some 3,200 British products, a directory of over 3,700 British firms gives details of distribution arrangements in Canada, and there are directories of proprietary names and trade marks. The 624-page register is published jointly by Kelly's Directories and Iliffe & Sons for the Association; price 15s post free.

"Who Represents Who."—A firm of French publishers, Editions Sopal, 16 rue St. Marc, Paris 2e, have asked the British Embassy in Paris for assistance in finding out the names of United Kingdom firms represented in France together with those of their representatives. The information is required for inclusion in a guide called "Qui Représente Qui." The publishers claim a circulation of 17,000 copies. A copy of the guide is available for inspection in Room 753 of the Export Services Branch, B.o.T., Lacon House, Theobalds Road, London, W.C.1.

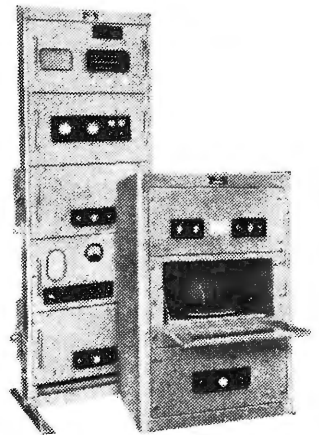
Chilean Agency.—International Electronic Engineering, Ltd., Ahumada 254, Oficina 1203, Santiago, wish to represent United Kingdom manufacturers of a wide variety of communications equipment ranging from pack sets to transmitters.

Instruments.—The French firm of Paris-Labo, 7 rue du Cardinal Lemoine, Paris 5me, are interested in representing United Kingdom manufacturers of scientific instruments, particularly electronic laboratory equipment.

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RANDOM RADIATIONS

By "DIALLIST"

Earls Court Hopes

THERE are quite a few things I hope to find at this year's Radio Show and by the time this appears in print I'll know whether they're there or not. First and foremost, genuine a.c.-only sound and television sets with double wound mains transformers. The conversion of the remaining d.c. districts is going ahead so rapidly that it shouldn't be long before there's little need for the a.c./d.c. receiver. It's a bit cheaper to manufacture a universal set, I know; but the difference in cost can't be all that much and I feel that the man in the street would gladly pay the extra, if it were dinned into him that a.c.-only models were definitely safer. I'd like also to see fewer control knobs tucked away at the back of the TV receiver. The front is the proper place for them and they needn't be unsightly if they're neatly covered by a hinged panel. And there's another thing that I mentioned a month or two ago. Lots of consoles are too low for comfortable viewing. The ideal arrangement is for eyes and screen centre to be at about the same level. It might be difficult to achieve this in a console without spoiling the proportions of the set; but table models with detachable screw-in legs are now very popular and something could be done with them. Why not make these legs telescopic? Any set owner could then adjust the height of his screen exactly to his liking.

Other Ideas

Those 3-position, pre-tuning, press-button v.h.f./f.m. receivers for which many readers and I myself have been pining for so long should be at Earls Court and I think there will be many more TV sets with a Band II range. In these the heaters of the audio valves should be able to be switched on while those of the vision circuits are off. If we can't have a.c.-only sets, separate heater chains for audio and video valves shouldn't be difficult to contrive. I hope to see a good deal more use made of spot wobble in sets with screens of the larger sizes. There doesn't seem to me to be much point in buying a whacking great set if, to avoid lininess, you have to sit so far from it that its screen subtends just the same angle at your eye as that of

a smaller set seen at its correct viewing distance! Has any manufacturer tried spot elongation, or astigmatism? Neither this nor spot wobble lead to serious loss of definition and the use of either means that a bigger TV set really gives you a bigger picture.

What a "Vac" Can Do

A FRIEND who lives not far from me has been having a very trying time as regards television reception for a long while now. At entirely unpredictable intervals terrific interference suddenly came on, completely wiping out his picture. Before making a report to the Post Office he kept a very careful log; but this showed that the trouble might occur at any time during programme hours—or it might be completely absent for days on end. Sometimes it lasted only a minute or two; sometimes it just went on and on. The P.O. engineers were awfully good about it, paying visit after visit to his home. But, as so often happens, the screen was perfectly clear whenever they were there. Then just a few days ago the interference began while one of the engineers was having a cup of tea with him. Laying down his cup, he dashed out with his instruments and soon returned in triumph. The culprit proved to be a small and rather ancient vacuum cleaner belonging to the very-house-proud next-door neighbour. The large modern

cleaner used daily by her "lady what obliges" had been properly suppressed and was quite harmless. But she kept the other in a cupboard in her drawing room and dived for it at any moment if she saw so much as a crumb or a speck of dust. It hadn't been suppressed. It has now, though no less than three suppressors had to be fitted before it could be silenced.

The Very Short Waves

IT SEEMS to me that we've a lot to learn about the propagation of waves of the centimetre—or even millimetre order. At present they're used for radar and over comparatively short distances for radio and television links; but I believe we'll soon be able by means of new techniques to send them much farther afield. It's only a short time, you know, since it was "proved" to the satisfaction of all the big noises in the scientific world that wavelengths not much under 100 metres were useless for long-distance communications. They were thought to be of so little commercial value that they were handed over to the amateurs to play with. It was only when they began to report regular communication with places as far away as New Zealand by means of fly-power transmitters and home-made receivers that the aforesaid big noises started to sit up and take notice. As a result a complete revision of short-wave theory



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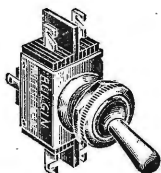
and practice took place. And not only that. Had it not been for the development of metre-wave techniques, we couldn't now have found room in the ether spectrum for television. I'm sure that there's a big future for the still shorter wavelets, once we've learnt how to use them.

Hearing Electrically

THE account of an entirely new method of making a stone-deaf patient hear which has been tried out in France impressed me enormously. Briefly, the secondary of a minute a.f. transformer was placed under the skin near the ear, one end of the winding being embedded in the auditory nerve and the other in a muscle. The primary, outside the skin, is worn in a position immediately over the secondary. A conventional microphone circuit completes the arrangement. What it comes to is that sounds are converted into electric impulses, applied directly to the auditory nerve. It is, I believe, agreed that the brain receives the messages conveyed by any of our nerves by being stimulated by tiny electric currents. In this instance the experiment of, so to speak, short-circuiting a completely inert eardrum and applying the impulses direct to the nerve seems to be showing very promising results. One wonders whether in the future something on similar lines may not be applicable to blind people—provided that the optic nerve has not been destroyed.

It Isn't Where It Was

REFERRING to my recent paragraph suggesting that it might be impossible to fix the exact position of any point on this coast because of tidal and other movements in its apparently solid surface, a kind reader writing from Scholes, Leeds, calls my attention to Wegener's theory of continental drift, according to which Greenland, for one, is moving westward at the rate of 30 metres a year. In other words, no matter how exactly you measure the position of any point by radar or other methods, you can't say precisely where it is now; you can only say where it was at the instant when the measurements were made! Part of the programme of the International Geophysical Year is concerned with more precise determination of latitude and longitude at more than 20 stations and a comparison of the values obtained with results from future I.G.Y.s may ultimately settle these questions.



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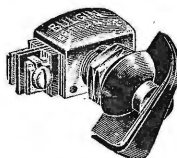
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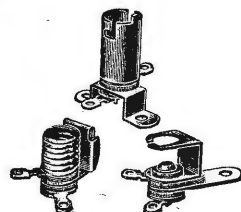
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Transistorized Tarantelle

ALTHOUGH I am a bit of a fiddler I am not entitled to describe myself as a violinist, as an officious police sergeant once told me in my younger days when seeking to know my profession or occupation for entering on the charge sheet.

Possibly owing to the devastating effects of my own amateurish efforts at fiddling, I hold very strong views about it. To my mind nothing sounds so cacophonous as the sound of a tyro trying to make music by scraping the intestines of a defunct cat. It is even worse than the sound of the nocturnal love calls made by the owner of the intestines in its lifetime. By comparison, few solo musical instruments give me greater pleasure than a violin in the hands of a competent player.

Some of the more offensive of the screech-producing fraternity are to be found among street musicians. I was all the more surprised, therefore, when recently I heard sounds of what appeared to be really inspired violin playing coming from the corner of the street. Hastening my footsteps, I suddenly came across a crowd of people standing spellbound before a deft-fingered catgut caresser standing in the gutter.

Presently I spied in the crowd somebody who was obviously a music critic listening intently to the performance. His status in the musical world was made obvious by the mingled look of distaste and admiration on his face; admiration at the faultless technique of the kerbside disciple of Paganini and distaste at the sugary, sentimental type of music which he was playing and which is anathema to all true musicians.

Suddenly, to my surprise, the critic shot out his hand, grasped the neck of the violin and jerked it from the grasp of the player. To the intense astonishment of the crowd—and momentarily, I confess, of myself—the violin continued to sob out its soul-searing strain while held at arm's length by the critic.

Needless to say, the police were soon on the scene to prevent a breach of the peace, and full explanations were forthcoming. As you can guess, a miniaturized and transistorized v.h.f. receiver was built into the hollow neck of the violin, the body being used to house the loudspeaker. The transmitter, playing desk and stock of records were being manipulated by an innocent-looking barrow boy a little way down the street.

Electronics in the Office

A FEW weeks ago I dropped into the Business Efficiency Exhibition at Olympia, being attracted by a good deal of ballyhoo in the lay Press to the effect that the modern efficient office had been completely "electronized."

I must confess that on the whole I was very disappointed. There were one or two electronic computers, but the main "electronic" exhibit appeared to be a great variety of recorders. I have deliberately refrained from using the expression "tape recorder" because, with one or two exceptions, all the machines were of the disc type, using modern unbreakable records that were, as one exhibitor put it, completely typist-proof, as not even the most ham-handed Harriet could miss a day's typing by dropping the records. I was told also that discs were easier and quicker to handle than tapes for office work.

There was no sign at the exhibition of the "Electronic Typist," which we have been told will one day displace the more human type.

One thing which certainly did interest me in the exhibition was the electric typewriter to which could be coupled a slave typewriter—or any number of them—in another room. It was, however, not made quite clear to me in which way this system of producing a duplicate copy was better than the use of carbon paper.

But there is one obvious use for a slave typewriter which occurs to me.

A girl will no longer fill in a spare ten minutes by rattling off a letter to "Darling George" if she realizes that her Ovidian rhapsodies are being monitored by an acidulous-looking female office supervisor in an adjoining room.

Psychiatrist's Corner

I HAVE a mania for collecting odd, unusual and mostly worthless facts about radio, and the desire to collect them comes over me in waves. This phenomenon is well known to psychiatrists and is, I believe, due to some "fixation" formed in childhood.

Thus, when very young, I collected useless things like matches and cigarette cards. But the mania soon gave way to one for collecting birds' eggs and stamps. This lasted until adolescence when naturally I started to collect blondes and brunettes, but eventually this proved as worthless and unsatisfactory as the cigarette cards and other things.

At present I am collecting worthless wireless facts. Can any of you tell me when we started to measure our wavelengths in metres instead of in feet? It may surprise some of the younger readers of *W.W.* that we ever did so, but I can assure them that we did; when it is remembered that this country was the cradle of wireless it is not so surprising.

When ships began to be fitted with wireless soon after the death of Queen Victoria, the wavelength of 2,000 feet became a recognized standard. The reason was very simple; it was found that the distance between a ship's masts was such that an aerial slung between them radiated at maximum efficiency when this wavelength was used. Later this 2,000 feet was turned into the famous 600-metre international ship's wavelength. But when did this change from feet to metres take place? I believe it was after the first international wireless conference which was held in Berlin in 1903 and I want you, if you can, to confirm or correct this quite useless piece of information.

Another worthless fact I want to know is this. We all know that the P.M.G.'s jurisdiction in the ether extends to an upper limit of three million megacycles, thus leaving us free to use a morse lamp without a wireless licence. But is there a lower limit to the P.M.G.'s control over the etheric spectrum?

I used to listen to the old Bordeaux-Lafayette station transmitting on a wavelength of 30,000 metres. But suppose I wanted to try to transmit on a wavelength ten times as long? I know the difficulties of erecting an aerial large enough to be an efficient radiator would stop me, but could the P.M.G. do likewise? A useless piece of information, I know, but, as I have said, I have a mania for collecting these things.

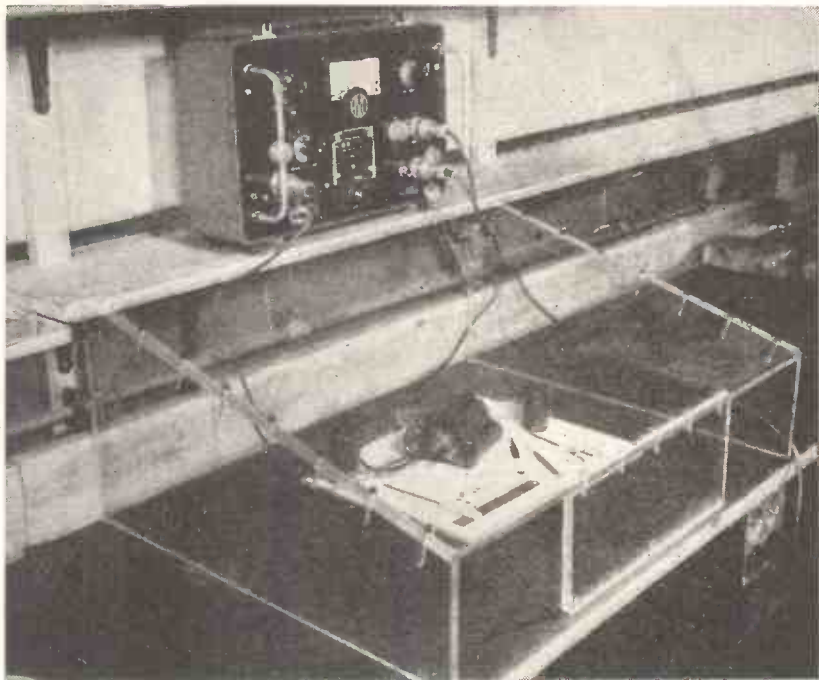


Soul searing strains.

AVO in action . . .

The photograph shows an AVO "D.C." Amplifier Type 1388 being used to measure current of the order of 10^{-13} A in the ionisation chamber of an "Avo" Radiac Survey Meter. A radio-active source is being used to calibrate the instrument and a Perspex screen is employed to protect personnel from Beta radiation.

This is a typical example of how the AVO organisation, working in conjunction with Government research authorities, continues to make its contribution in the fields of modern scientific development and industrial progress.



**RADIO
SHOW**
Stand
62

AVO Instruments:—

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| Model 8 AvoMeter | Model 7 AvoMeter Mk. II |
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| Electronic Test Meter | Electronic Test Unit |
| Valve Tester Type 160 | Valve Characteristic Meter
Mk. III |
| Universal Measuring Bridge
Type I | Electronic Multimeter Type 38 |
| D.C. Amplifier Type 1388 | Radiac Survey Meters |
| etc., | etc. |

A fully descriptive Brochure is available on request for each of the Avo Instruments listed above.

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CURRENT	0-40ma	0-200ma	0-50ma	10-100ma	0-150ma or 50-200ma at 250V, 100-200ma at 300V.	0-500ma	0-1A
A.C. OUTPUTS	6.3V 4A C.T. 6.3V 1A	6.3V 4A C.T. 6.3V 4A C.T. 6.3V 1A C.T.	6.3V 4A C.T. 6.3V 1A	6.3V 4A C.T. 6.3V 2A C.T. 6.3V 1A	6.3V 4A C.T. 6.3V 4A C.T. 6.3V 1A	6.3V 5A C.T. 6.3V 5A C.T.	6.3V 10A C.T.
D.C. SOURCE IMPEDANCE	<2Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω	<1Ω
STABILISATION FACTOR BETTER THAN	400:1	400:1	400:1	400:1	300:1	400:1	400:1
A.C. SOURCE IMPEDANCE 40c/s-100kc/s	<2Ω	<2Ω	<0.25Ω	<0.25Ω	<0.5Ω	<0.5Ω	<0.5Ω
RIPPLE AND NOISE CONTENT	<350μV	<300μV	<250μV	<300μV	<1mV	<300μV	<300μV
DIMENSIONS	9½" × 6½" × 6½" high	10" × 10" × 6½" high	9½" × 6½" × 6½" high	9½" × 7½" × 6½" high	9½" × 9½" × 6½" high	19" × 12½" × 10½" high	19" × 19" × 10½" high
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TRANSISTOR NEWS



from Mullard

OC70 and OC71 new high performance

Maximum working collector voltage tripled . . . maximum junction temperature raised to 75°C . . . maximum power output correspondingly increased. These features characterise the increased performance of the new versions of the OC70 and OC71 junction transistors — increases which are made possible by further improvements in transistor production techniques backed by Mullard experience in the manufacture of many hundreds of thousands of transistors.

The new OC70 and OC71 are offered for use at collector voltages of 30V peak and 20V d.c. in both grounded base and grounded emitter where the circuit base resistance to earth is less than 500 ohms.

The increased maximum junction temperature now allowed may be exploited by circuit designers either in operating the OC70 and OC71 at the original power dissipations at 20°C higher ambient temperatures or in increasing the power dissipation at the original temperature. Some low power circuits can now be developed to work at the high *ambient* temperature of 70°C.

A revised data sheet including a curve showing the maximum d.c. collector voltage against external base-emitter circuit resistance is available from the address below.

ABRIDGED DATA *

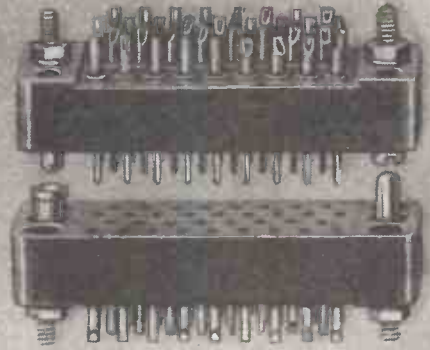
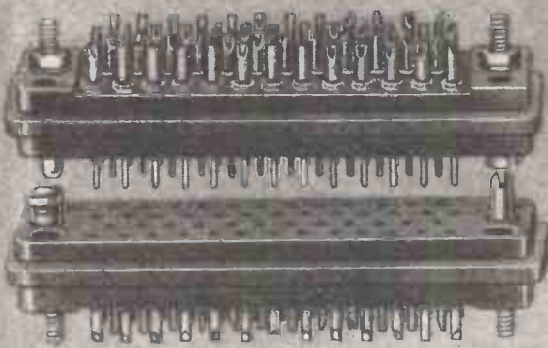
Max. junction temperature	75°C
Junction temp. rise above ambient in free air	0.4°C/mW
Max. collector dissipation at 45°C	75mW
Max. collector dissipation at 25°C	125mW
Max. collector voltage, grounded base or grounded emitter: V _c (pk) max. V _c max.	-30V -20V

*
(Common characteristics for OC70 and OC71 general purpose and audio pre-amplifier transistors.)

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BETWEEN CONTACTS:
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7-contacts: 3.1 kV
14 up to 50-contacts: 4.0 kV

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AVERAGE MATING
AND UNMATING FORCE
(per contact): 8 oz.

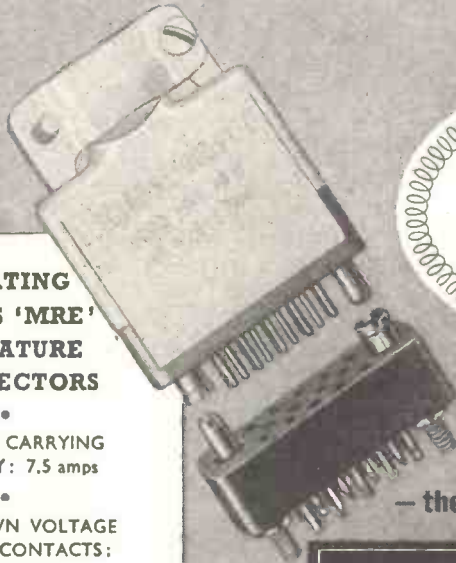
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High impedance: 200 microvolts for 10% fsd
- **Indication** Both meter and phones
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- **Immediate delivery**



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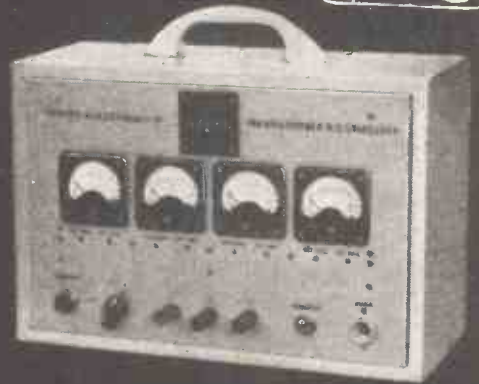
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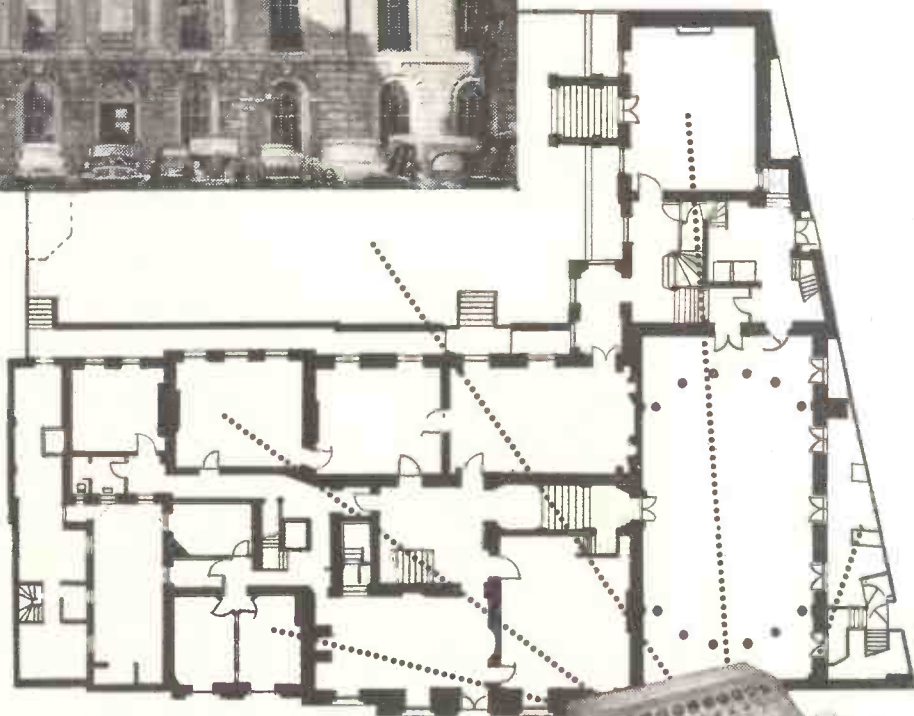
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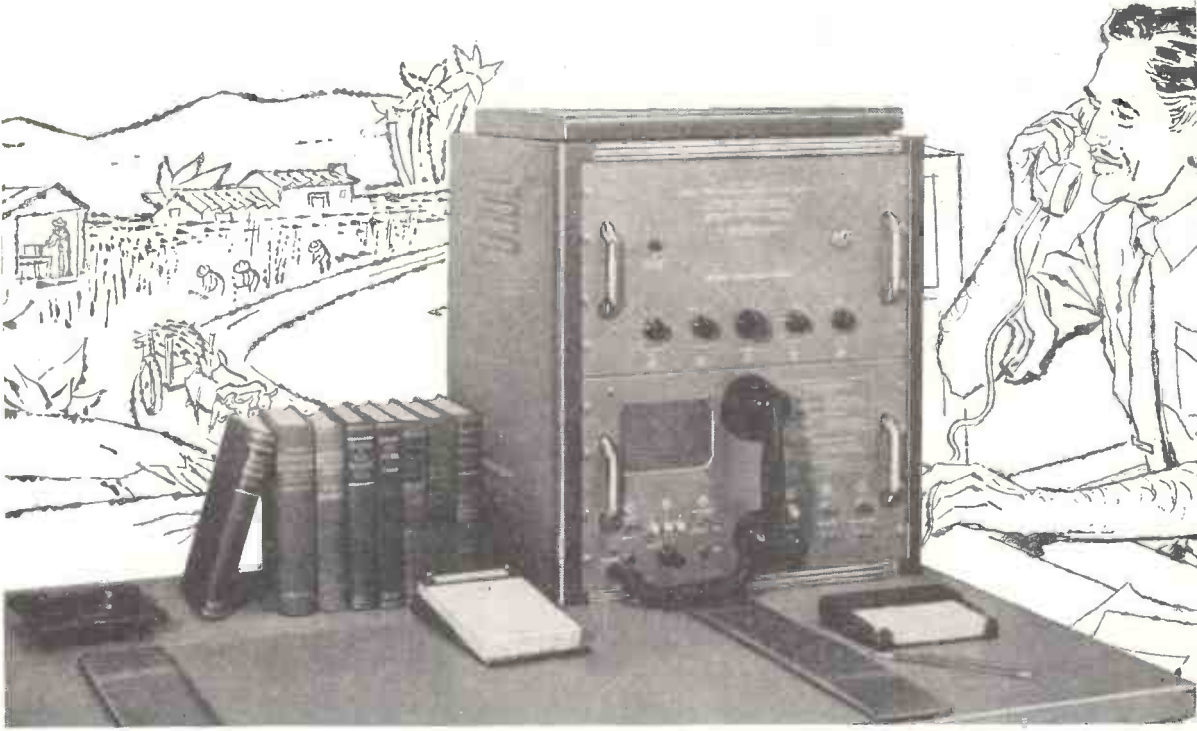
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"The Gramophone", Oct. 1956



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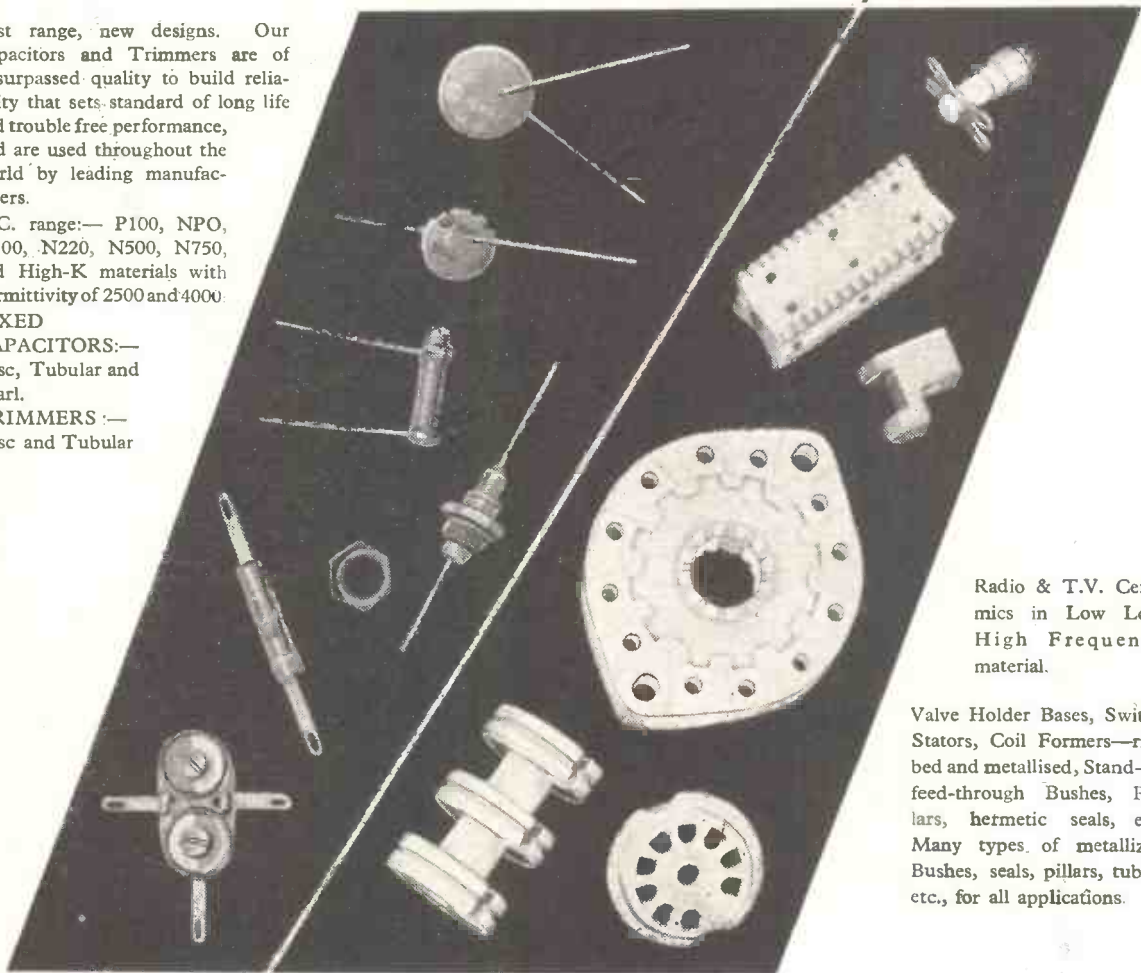
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Tel.: Ambassador 1041 (5 lines) Cables: Hallectric, London



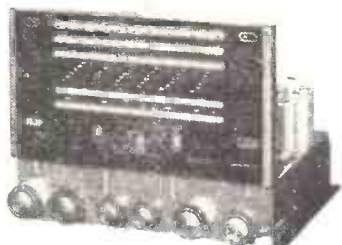
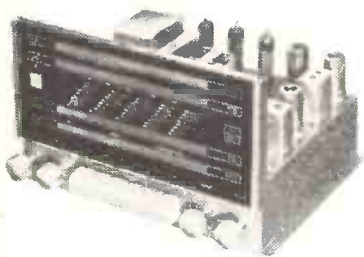
quality Audio & Radio equipment

GOOD

PB409 RADIOGRAM CHASSIS

★ 9 valves—6 watts peak output ★ Full VHF band (88-108 Mc/s) plus Long, Medium and Short ★ Push-pull output with Negative Feedback ★ Full Audio-frequency range (20-20,000 cps) ★ Separate Bass and Treble lift and cut controls ★ Quick-action "Piano Key" selectors ★ Magic Eye tuning ★ ECC85, ECH81, EF89, EABC80, ECC83, 2 x EL84, EZ81, EM81.

PRICE: 28 GUINEAS



BETTER

AF105 THREE-IN-ONE UNIT

★ AM and FM Tuners and High Fidelity Amplifier on one compact chassis ★ 10 valves—10 watts Push-Pull output ★ Full VHF band plus Long, Medium and 2 Short ★ Frequency range 15-30,000 cps ★ Distortion 0.5% ★ Hum 60dB ★ Separate extended range Bass and Treble controls ★ 20dB Negative Feedback over 3 stages.

PRICE: £37

Output: 10 watts nominal, 20 watts peak. **Response:** Within 1dB 15-30,000 cps. **Distortion:** 0.1%. **Hum:** 80dB down. **Sensitivity:** 8mV. **Output Valves:** 2 x EL34. **Equaliser:** 6 position. **Filter:** 6 position. **Inputs:** Mic, Radio, Gram, Tape (and record). **Bass and Treble:** Separate controls ± 15dB. **Negative Feedback:** 28dB overall, 3 loops. **Pick-up Matching:** 4 position selector. **Power Supplies:** 320 v. @ 60mA; 6.3 v. @ 2A. **Weight:** Amplifier — 25 lb. Control Unit — 5 lb.

PRICE: £32



BEST

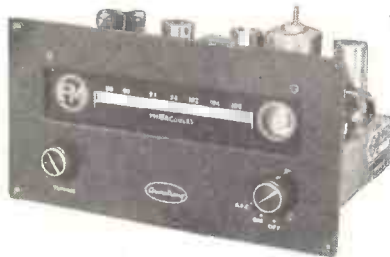
A10 MK II HIGH FIDELITY AMPLIFIER

with, of course,

the FM61 VHF TUNER

to obtain the full benefit of the superb quality of VHF/FM transmissions.

PRICE: £22/1/-



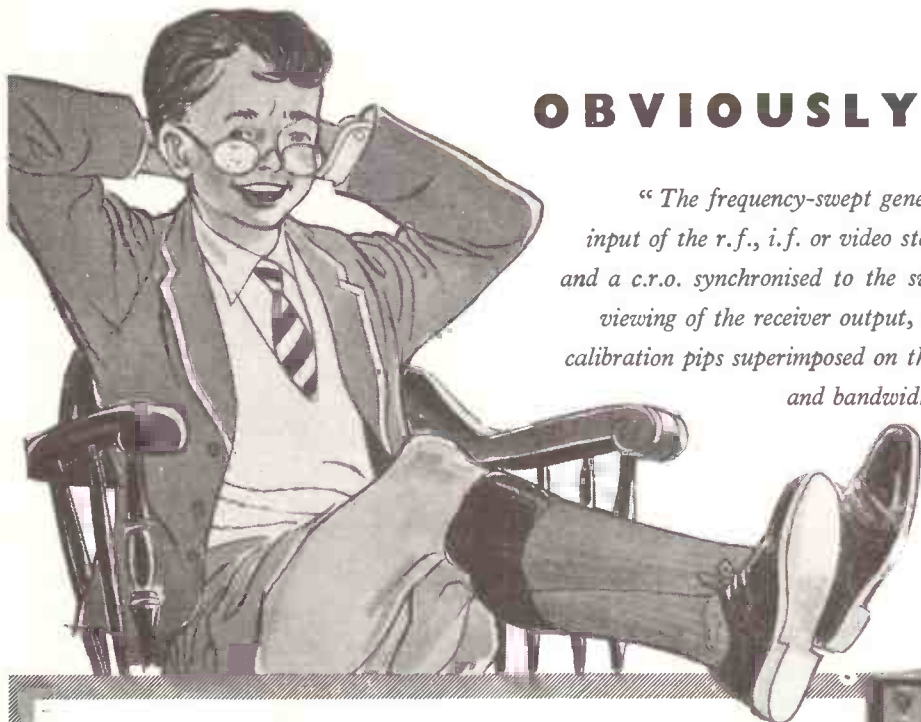
You are cordially invited to call at our Holloway Showroom (9-6, Sats, 5.30) for full demonstration of these and other models in our range. Please post this coupon for descriptive literature and details of Hire Purchase, Home Trial facilities and Guarantee.

NAME

ADDRESS

WWS

BSRA EXHIBITION, Waldorf Hotel, Sept. 20, 21, 22. Our Room No. 125.



OBVIOUSLY . . .

“The frequency-swept generator connected to the input of the r.f., i.f. or video stages of the receiver, and a c.r.o. synchronised to the sweep frequency, permits viewing of the receiver output, while internally generated calibration pips superimposed on the display enable tuning and bandwidth adjustments to be made with precision.”



THAT'S the Marconi V.H.F. Alignment Oscilloscope in a nutshell. If he'd had any breath left our young student might have added that other important applications include the adjustment of discriminators in f.m. receivers and the matching of aerials to transmission lines.

However, the lad's penetrating observation will have revealed to those who are no less observant that here is another important Marconi instrument.

If you don't know as much about it as he does it's time you did. Write and ask for the full facts and we'll send you an informative leaflet post-haste.

**MARCONI V.H.F.
ALIGNMENT OSCILLOSCOPE
Type TF 1104**

For use with television and f.m. receivers. Frequency-swept output and visual display on built-in c.r.t. facilitates rapid evaluation and alignment without ancillary equipment. R.F. ranges: v.h.f. bands I, II and III. I.F. range: 10 to 40 Mc/s. V.F. range: 5 kc/s to 10 Mc/s. Frequency sweep: 10 Mc/s max., with marker pulses at 0.5, 1.0, or 5 Mc/s intervals.



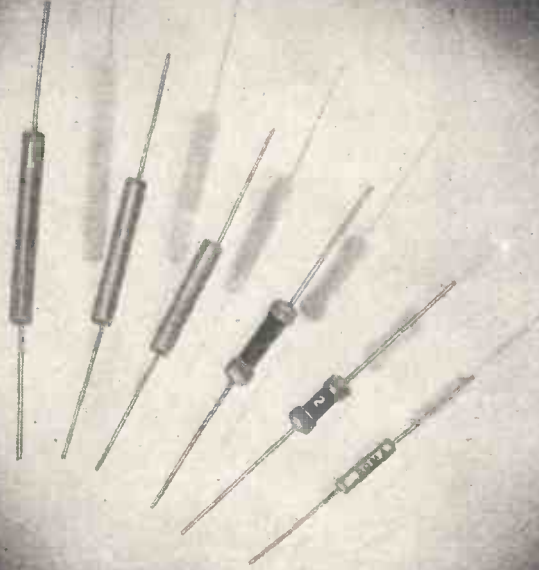
AM & FM SIGNAL GENERATORS · AUDIO & VIDEO OSCILLATORS · FREQUENCY METERS · VOLTMETERS POWER METERS · DISTORTION METERS · FIELD STRENGTH METERS · TRANSMISSION MONITORS DEVIATION METERS · OSCILLOSCOPES, SPECTRUM & RESPONSE ANALYSERS · Q-METERS & BRIDGES

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E·M·I

NEW RECORDING EQUIPMENT



MODEL TR51

This new Transportable Recorder replaces the well-known Model TR50 which is used by broadcasting and recording organisations and industrial research establishments throughout the world, meeting their exacting recording requirements under mobile conditions.

Model TR51 is built to C.C.I.R. recommendations and incorporates the proven features of its predecessor.

RANGE OF MODELS

- Model TR51A Full Track 15 and 7½ i.p.s.
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'77' "PEN TESTED"

for professional applications. Available on a range of spool sizes covering all professional and domestic hub machines.

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is a standard thickness base tape giving maximum sensitivity.

'99' LONG PLAY

is a specially developed thin base tape giving an increase of 50% playing time

For further details write to:—

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The L/2 Battery Portable weighs only 14½ lbs. (including batteries), is compact and easy to carry. It is used by broadcasting organisations throughout the world, (including the B.B.C.) for a variety of outdoor recording purposes. Where portability, combined with accurate and authentic quality recording, is essential—the L/2 Recorder provides the complete answer.

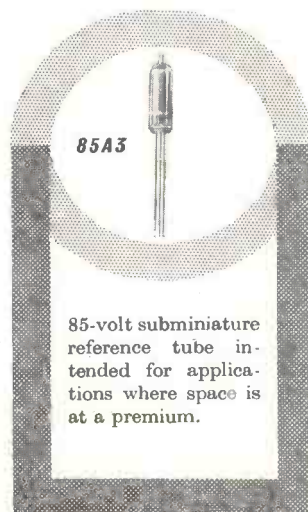
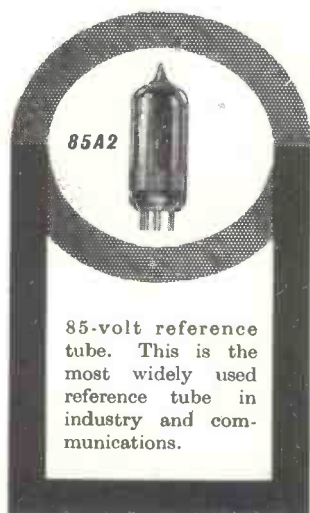
Voltage Reference and

This comprehensive range of Mullard gas-filled voltage reference and stabiliser tubes fulfils the needs of a variety of applications—both civilian and military.

The tubes are highly stable and mechanically strong. They have a long life and their operating characteristics are well defined.

Most of them are available to British Services CV Specifications and in Special Quality versions—both pinned and flying lead—for operation under rigorous conditions of shock and vibration.

Further information and data are readily available upon request at the address below.



Voltage Reference Tubes

These tubes provide a constant voltage standard of extreme accuracy. They are normally operated at the optimum constant current.

Abridged Data for Reference Tubes

(Please send for details of Special Quality Versions)

Type No.	Equivalent U.S. Type	CV No.	Construction	Preferred Operating Current (mA)	Burning Voltage Range at Preferred Operating Current (V)	Min. Voltage for Ignition (V)	Max. Incremental Resistance (ohms)	Typical Drift in Burning Voltage per 1000 hrs. (%)	Max. Voltage jump of typical tube at preferred operating current (mV)
85A2	—	CV449	B7G	6.0	83 to 87	115	450	0.1	5
85A3*	5783	—	Sub-min. flying lead	1.5 to 2.0	84 to 88	130	1000	0.5	5


Mullard

COMMUNICATIONS AND
INDUSTRIAL VALVE DEPARTMENT

Mullard Ltd., Mullard House,
Torrington Place,
London, W.C.1




Stabiliser Tubes




75C1

This 75-volt stabiliser combines a good regulation voltage with long term stability and a wide range current of 2 to 60mA




90C2

90-volt subminiature voltage stabiliser tube equivalent to the 5644.




90C1




150B2

90-volt and 150-volt stabiliser tubes. These two tubes offer particularly good long term stability and close tolerance characteristics.



108C1



150C4

The most important feature of these 108-volt and 150-volt stabiliser tubes is their low regulation voltage. The 150C4 is an improved version of the 150C2.

Voltage Stabiliser Tubes

These tubes are designed to give a constant output voltage despite wide variations of input supply. They have a wide current range and good regulation.

Abridged Data for Stabiliser Tubes (Please send for details of Special Quality Versions)

Type No.	Equivalent U.S. Type	CV No.	Construction	Nom. Burning Voltage (V)	Min. Ignition Voltage (V)	Current Range (mA)	Max. Regulation Voltage ** (V)
75C1	—	—	B7G	75	115 †	2.0 to 60	8.0
90C1	—	—	B7G	90	115 †	1.0 to 40	14
90C2 *	5644	CV3987	Submin. flying lead	90	125 §	5.0 to 25	5.0
108C1	0B2	CV1833	B7G	108	133 §	5.0 to 30	4.0
150B2	—	CV2225	B7G	150	180 †	5.0 to 15	5.0
150C4	0A2	CV1832	B7G	150	185 §	5.0 to 30	8.0

- * Preliminary information only.
- ** Measured over the range $I_{min.}$ to $I_{max.}$, where I = Operating Current.
- † This voltage covers operation in daylight or complete darkness.
- § In total darkness a somewhat higher voltage is required for ignition.

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selling point!*



POWER-POINT

A revolutionary miniature ceramic record player cartridge with two sapphire tips.

POWER POINT is a proved sales success—over 3,000,000 have already been sold abroad!

POWER POINT can be fitted to all popular pick-up arms.

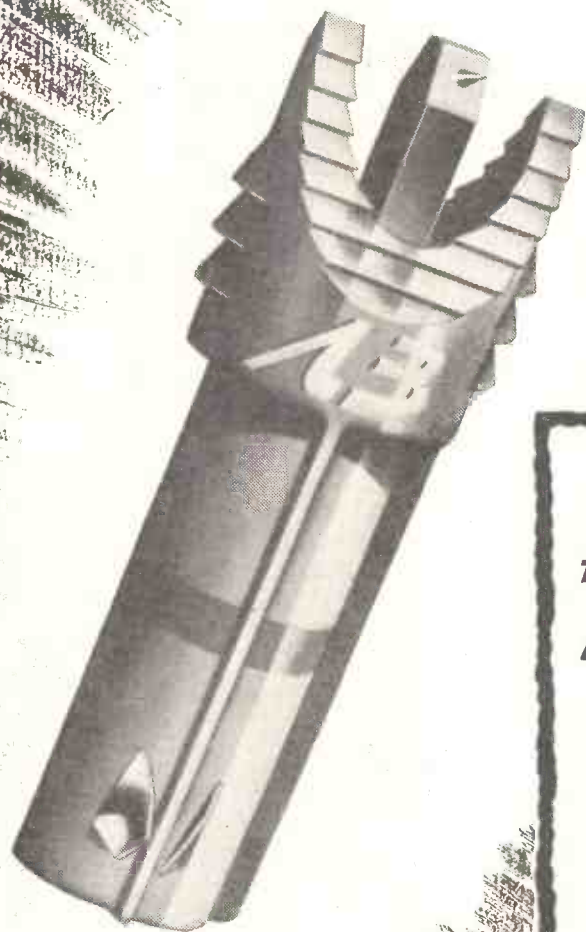
POWER POINT is so easy to handle and so quick to replace—it solves your stylus replacement problems!

POWER POINT gives higher fidelity, longer life, and reduces record wear to a minimum.

OVER 3,000,000 *POWER-POINTS*

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POWER POINT is backed by attractive display material and a carefully planned advertising campaign.

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HIGH FIDELITY DOMESTIC LOUDSPEAKERS

TANNOY PRODUCTS LIMITED. *Practitioners in Sound*
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The loudspeaker enclosures in this new range are designed to take full advantage of the outstanding performance of Tannoy Dual Concentric Loudspeaker Units. For the first time the dual-throated port principle is employed, marking a notable advance on the more orthodox type of reflex cabinet.

Both corner and side wall models make optimum use of the additional acoustic loading offered by walls and floor.

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THE DUAL CONCENTRIC



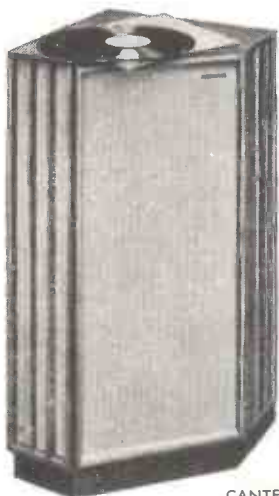
BASIC SPECIFICATION

12" and 15" models

Frequency response
30-20,000 c.p. \pm 3dB.

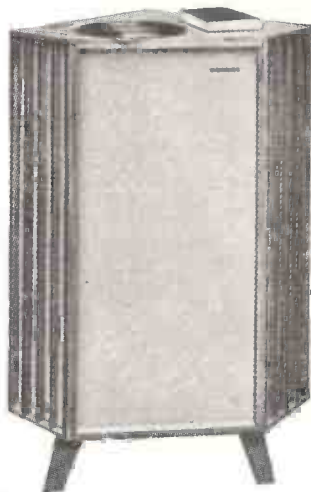
Polar Distribution for
60° inc. angle-4dB. at
10,000 c.p.s.

Intermodulation Products
less than 2%



CANTERBURY

Height 3'-1", width 2'-1", front to rear corner 1'-5"



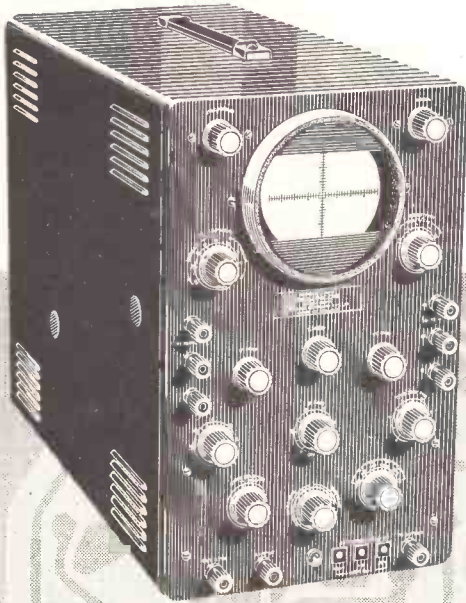
YORK

Height 3'-9½", width 2'-8", front to rear corner 1'-10½"

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COSSOR

PRINTED CIRCUITS



*Model 1071K Double Beam Kit Oscilloscope
List Price £57.10.0*

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* The illustrations show only three of the new range of Ever Ready Power Packs.

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Otherwise you are risking the dependability of your products and the reputation of your firm.

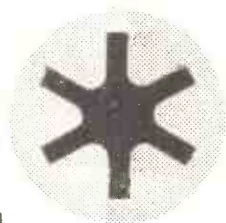
Incorporating Enthoven's unique 6-channel stellate core, **SUPERSPEED** is everywhere recognised as the most efficient cored solder wire for general assembly work on radio, television, electronic and tele-communication equipment. But there is also an Enthoven solder product that is *the best* for every other engineering and manufacturing application. Please write today for the new edition of our brochure "Enthoven Solder Products"—or consult us quite freely on your particular problems.



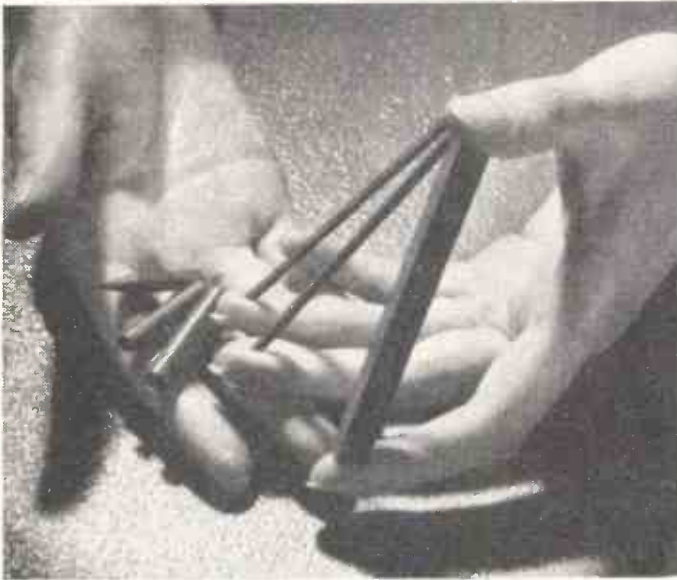
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MICROWAVE FERRITE TYPE F5X

- Available in rod or slab form.
- Suitable for X-Band frequencies and above.
- Specific rotation $30^\circ/\text{cm}$.
- Figure of merit $330^\circ/\text{db}$.
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Microwave measurements carried out at 9,750 Mc/s. on a 0.2" diameter rod supported in 0.7" diameter waveguide. The permittivity of the supporting material was virtually unity.



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- Minimum frequency band 9,600 to 9,800 Mc/s.
- Insertion loss 0.5 db max.
- Peak attenuation 30 db min.
- Power handling capacity 30 Watts mean.
- Dimensions $1\frac{3}{8}" \times 1\frac{1}{8}" \times 2"$ long.
- Total weight 3 ozs.



FERRITE ISOLATOR

Designed for operation up to a peak incident power level of 75 kW or a mean incident level of 75 Watts. The reverse attenuation is greater than 20 db over any 10% frequency band between 8,500 and 10,000 Mc/s with forward attenuation less than 0.8 db. V.S.W.R. less than 1.2 over the frequency band.



FERRANTI LTD · FERRY ROAD · EDINBURGH

Audiomaster

the amplifier of tomorrow

The very brief details given are nevertheless sufficient to show that the Audiomaster has been designed and produced without limitation or restriction. Here, in fact, is an amplifier which really does sound better than any other. Unique in performance, attractive in appearance. Audiomaster meets the highest professional requirements. The standard of workmanship and components used is unparalleled. You must hear it for yourself.

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CONTROLS

- Input Selector Switch (10 positions).
- 3-position Microphone Switch.
- Filter Slope Control.
- Low — Pass filter switch.
- Treble Control.
- Bass Control.
- Loudness Compensating Control.
- Amplifier/Record/monitor control.
- Volume Control — On/off switch.

SELECTOR SWITCH positions

- Tape N.A.R.T.B.
- Tape C.C.I.R.
- Disc L.P.
- Disc R.I.A.A.
- Disc A.E.S.
- Disc N.A.B.
- Disc Flat.
- Microphone.
- Tuner.
- Auxiliary.

power amplifier

Rated Power Output

- 25 Watts.
- 30 Watts at less than 0.1% total distortion.

Power Response

- Within 0.5 db of 1 KC/S level at 20 Watts, over range 30 C/S to 20 KC/S. Instantaneous peak power output in the order of 60 Watts.

Frequency Response

- Within 1 db of 1 KC/S level 15 C/S — 100 KC/S.
- Within 0 db of 1 KC/S level 15 C/S — 50 KC/S.

Harmonic distortion (at 400 C/S)

- Less than 0.05% at 20 Watts.

Hum and noise

- Better than 85 db relative to 20 Watts with 10 K/ohms source resistance.

Intermodulation distortion

- (40 C/S modulating 10 KC/S in a ratio of 4 to 1). 0.7% with peak corresponding to 20 Watt sinewave power, 1.0% with peak corresponding to 30 Watt sinewave power.

Sensitivity

- 240 Mv for 25 Watts out.

Phase Shift

- 10 degrees maximum at 10 C/S.
- 20 degrees maximum at 20 KC/S.

Output Resistance

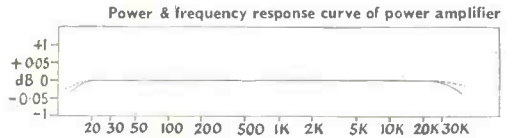
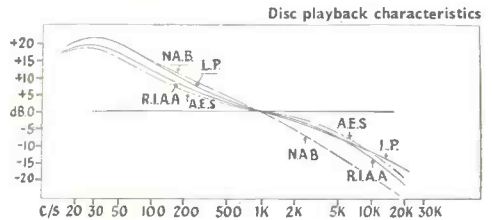
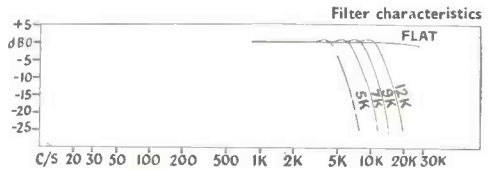
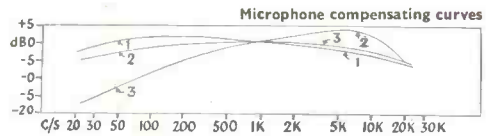
- 0.3 ohms at 40 C/S, 1 KC/S and 20 KC/S at 20 Watts output.

Damping Factor

- 50.

Output impedance

- 4, 8 and 16 ohms selected by switchings.



PRICE COMPLETE

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MASK SIC 5827

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MULLARD TYPE DG16—22
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TELCON No ET 3(a)
EMITRON JAFPI
MASK No SIC 5882

TELCON No M3
MULLARD DG 7-5 SERIES
MASK No SIC 5882

TELCON No G3
CINEMA TELEVISION 90EB4
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MASK No SIC 5965

TELCON No E.S.1
EDISON-SWAN 30 C.2
MASK No SIC 5965

TELCON No T15
20th CENTURY D6SAB-240

TELCON Nos T11-14
20th CENTURY D6SQ—565Q
MASK No SIC 5999

TELCON

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for
Cathode Ray Tubes

Precision Cathode Ray Tubes demand perfect screening. Telcon's high permeability low-loss magnetic alloy MUMETAL has proved in practice to be many times more effective for this purpose than any other material of equal thickness.

The Telcon Metals Division is pleased to announce that it has now in production a standard range of MUMETAL Shields for Cathode Ray Tubes of the more popular types made by leading manufacturers such as CINEMA-TELEVISION, COSSOR, EDISON-SWAN, EMITRON, G.E.C., MULLARD and 20th CENTURY ELECTRONICS LTD. Details and drawings are available on request. Special Shields can be made to customers' specifications.

Rubber Masks are available from The Standard Insulator Co. Ltd., Camberley, Surrey, for use with these Mumetal Shields.

Visit the
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No. 293



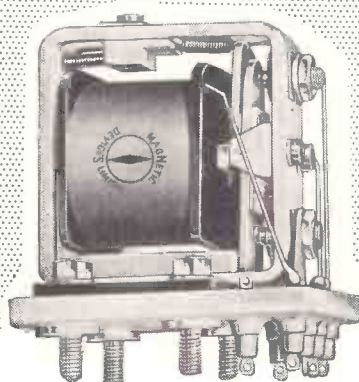
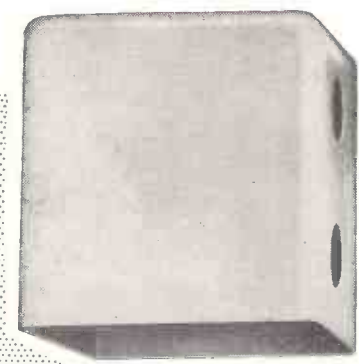
S.B.A.C.
Farnborough
1st-8th Sept.

THE TELEGRAPH CONSTRUCTION & MAINTENANCE COMPANY LTD

HEAD OFFICE Mercury House, Theobalds Road, London WC1. Tel. Holborn 8711

ENQUIRIES to Metals Division, Telcon Works, Manor Royal, Crawley, Sussex Tel. Crawley 1560

Voltage Regulating Relay



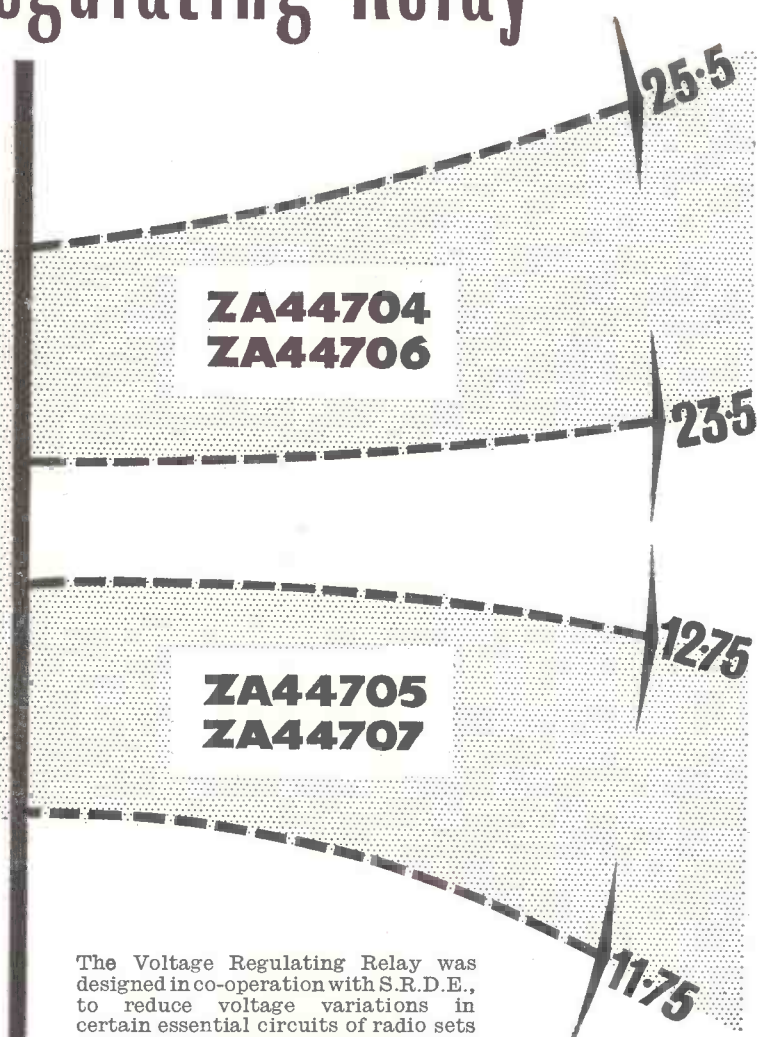
Two forms of the relay are available, either fully hermetically sealed or enclosed and tropicalised but unsealed. The inter-service reference numbers are as follows:—

Unsealed

ZA 44706 25.5V. make 23.5V. break
 ZA 44707 12.75V. make 11.75V. break

Sealed

ZA 44704 25.5V. make 23.5V. break
 ZA 44705 12.75V. make 11.75V. break



The Voltage Regulating Relay was designed in co-operation with S.R.D.E., to reduce voltage variations in certain essential circuits of radio sets and has many other applications of a similar nature.

This is particularly necessary in the case of vehicle-borne equipment, with power supplies consisting of lead acid batteries and a small charging generator.

The armature is balanced to withstand vibration, and the complete relay has been subjected to severe vibration testing.

Magnetic shielding is achieved by the iron case, enabling the relay to be used within reasonable proximity of transformers, chokes, etc.

The Voltage Regulating Relay complies with the stringent Ministry of Supply specification No. 166/1, to operate within tolerance, over a temperature range of $-40^{\circ}\text{C}.$ to $+85^{\circ}\text{C}.$

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A.I.D. & A.R.B. approved

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First in the field

These have been in regular quantity production for the past two years, and have proved themselves reliable and stable in a variety of applications. They are admirably suitable for all forms of DC to DC or DC to AC Converters, High Power portable Amplifiers and Public Address Equipment. "GOLTOP" Power Transistors are the first to be offered for immediate delivery in quantity. Representing the latest developments in semi-conductor technique for power applications, these entirely British-made p-n-p Germanium Junction Transistors will open up entirely new fields to designers of industrial, commercial and military equipment.

GOLTOP POWER TRANSISTORS

available NOW in commercial quantities

Available in 6 TYPES, all for 10-watts power dissipation:

V15/10P. V15/20P. V15/30P. for 15 volts max.
V30/10P. V30/20P. V30/30P. for 30 volts max.

Maximum Collector Power Dissipation (DC or Mean) for all types	$t_{amb}=25^{\circ}C$	$t_{amb} > 25^{\circ}C$ Reduction/ $^{\circ}C$
(1) Clamped directly on to 50 sq. in. of 16 S.W.G. aluminium	10W	200mW
(2) Clamped directly on to 9 sq. in. of 16 S.W.G. aluminium	4W	80mW
(3) As (2) but with 2 mil mica washer between heat sink and transistor	2W	40mW
(4) Transistor only in free air	1W	20mW

- * High power rating—up to 10W at audio and supersonic frequencies.
- * High current ratings up to 3A DC.
- * Long life.
- * Excellent resistance to mechanical shock.
- * Hermetic sealing and rigorous manufacturing control ensure uniformity and stability of a high order.



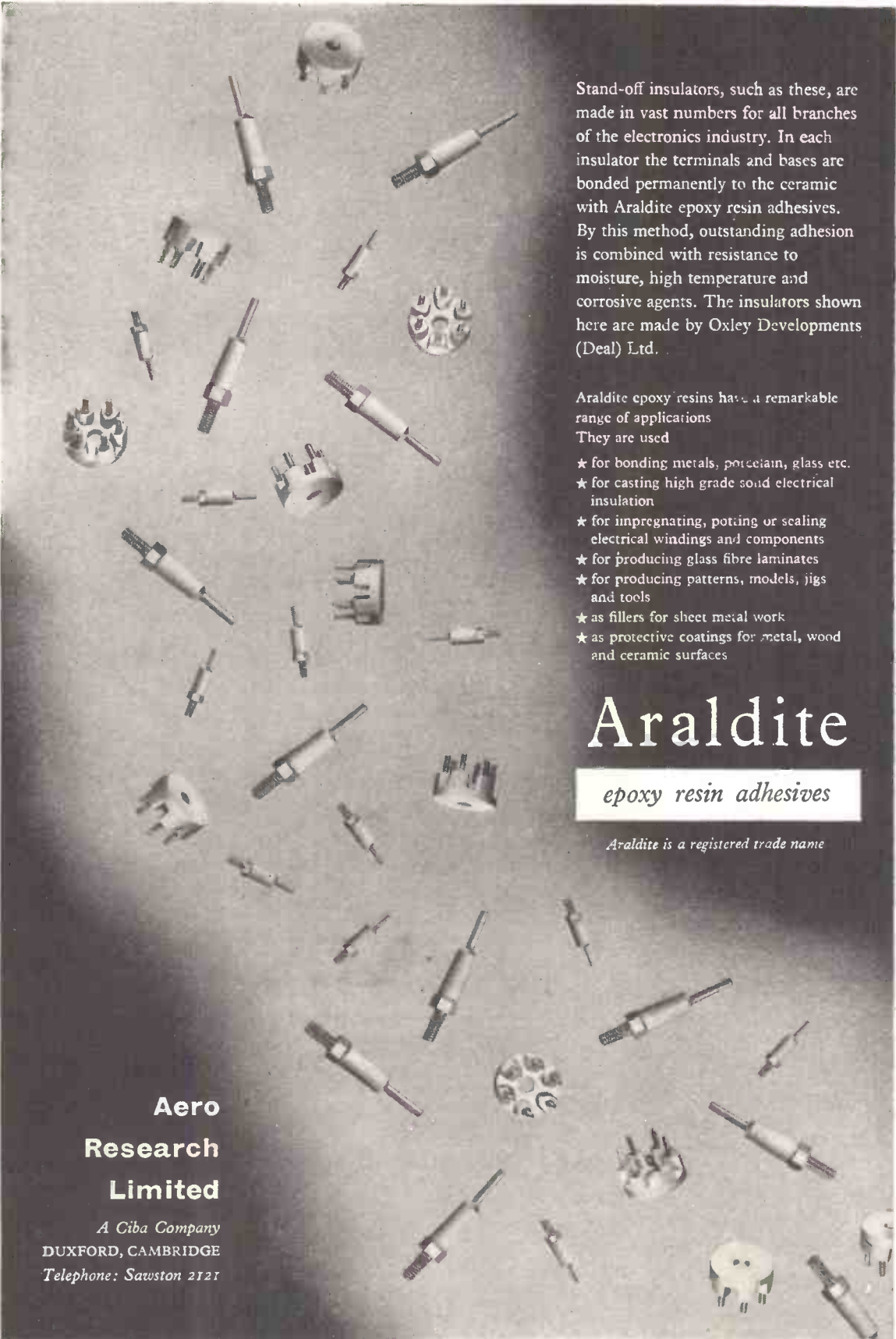
British Design, Materials and Craftsmanship

Data sheets gladly forwarded on request

All trade enquiries to: **Newmarket Transistor Co. Ltd.**

Erning Road, Newmarket. Telephone: Newmarket 2963 and 3203

TA 10705



Stand-off insulators, such as these, are made in vast numbers for all branches of the electronics industry. In each insulator the terminals and bases are bonded permanently to the ceramic with Araldite epoxy resin adhesives. By this method, outstanding adhesion is combined with resistance to moisture, high temperature and corrosive agents. The insulators shown here are made by Oxley Developments (Deal) Ltd.

Araldite epoxy resins have a remarkable range of applications
They are used

- ★ for bonding metals, porcelain, glass etc.
- ★ for casting high grade solid electrical insulation
- ★ for impregnating, potting or sealing electrical windings and components
- ★ for producing glass fibre laminates
- ★ for producing patterns, models, jigs and tools
- ★ as fillers for sheet metal work
- ★ as protective coatings for metal, wood and ceramic surfaces

Araldite

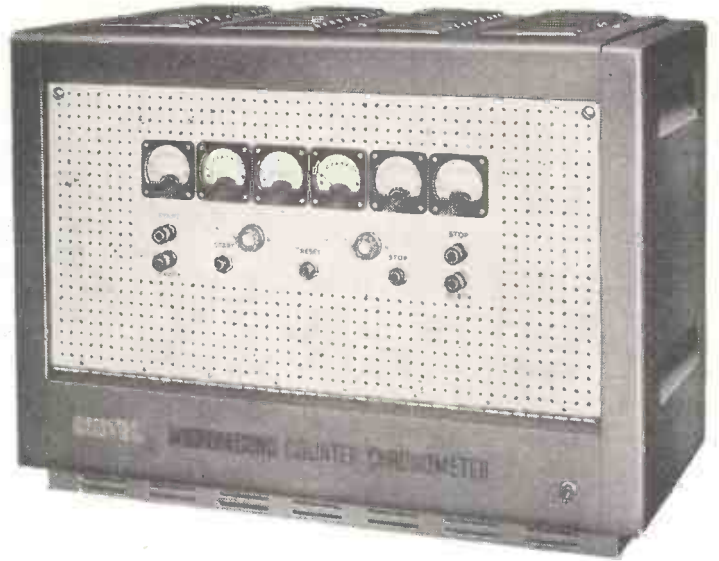
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Araldite is a registered trade name

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MICROSECOND CHRONOMETER



This equipment is designed to measure small intervals of time to a high order of accuracy and two ranges are provided:

- (1) 1 μ sec. to 1 sec. in steps of 1 μ sec.*
- (2) 10 μ sec. to 10 sec. in steps of 10 μ sec.*

Accuracy of each range is better than $\pm 0.005\%$ \pm the step interval.

Full details on this and other 'Cintel' Chronometers are available on request.

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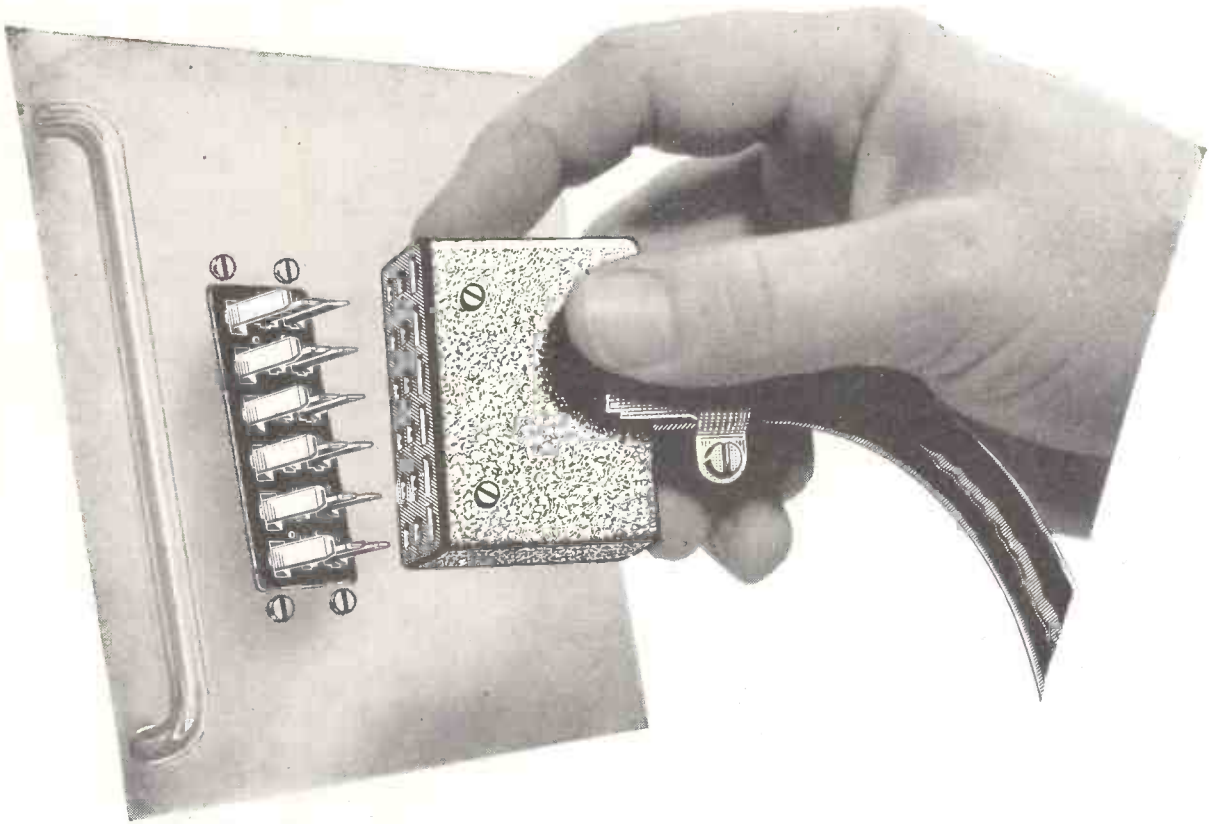
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HITHER GREEN 4600

SALES AND SERVICING AGENTS:

Hawnt & Co. Ltd., 59 Moor Street, Birmingham, 4

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'MULTICON' PLUGS AND SOCKETS

The reliability of the connectors used can determine the dependability of electrical and electronic equipment.

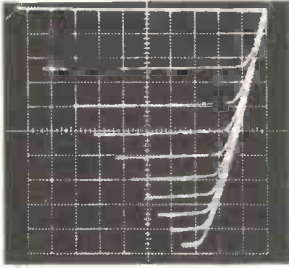
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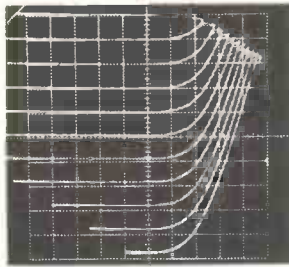
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PAINTON
Northampton England

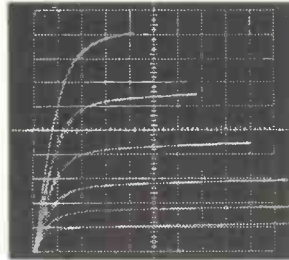
NEW TRANSISTOR-CURVE TRACER



HIGH COLLECTOR CURRENT
PNP transistor, collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 5 v with a 0.25-ohm load, base current is 50 ma/step. Vertical deflection is 1000 ma/div, horizontal 0.5 v/div.



HIGH INPUT CURRENT
PNP transistor, collector current vs collector voltage with base grounded and constant-current emitter steps. Collector sweep is 0 to 1.5 v, emitter current 200 ma/step. Vertical deflection is 200 ma/div, horizontal 0.1 v/div. Zero voltage is at center scale.



LOW INPUT CURRENT
NPN transistor, collector current vs collector voltage with constant-current base steps. Collector sweep is 0 to 1.5 v, base current 1 microamp/step. Vertical deflection is 10 microamp/div, horizontal 0.1 v/div.



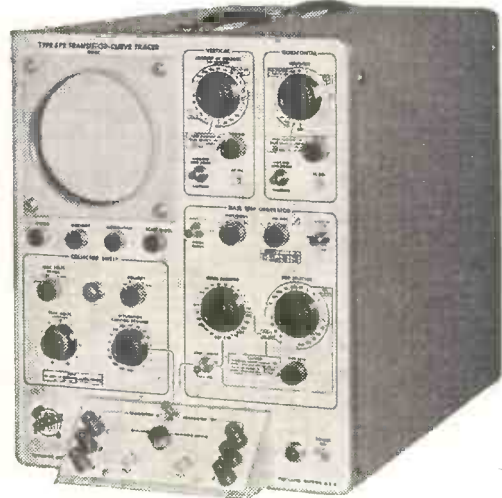
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**has 10-Ampere Collector Supply
2.4-Ampere Base Supply**

**Displays 4 to 12 curves
per family
with input current from
1 MICROAMP/STEP
TO 200 MILLIAMPS/STEP**



The Tektronix Type 575 traces characteristic curves for both PNP and NPN transistors on the face of a cathode-ray tube. Seven different types of curves can be plotted. Vertical deflection is calibrated in collector current, base voltage, base current and base source voltage. Horizontal deflection is calibrated in collector voltage, base voltage, base current and base source voltage. Collector current supply is capable of 10 amperes from 0 to 20 v, 1 ampere from 0 to 200 v. Constant current or constant voltage step supply to either base or emitter is calibrated in 17 values from 1 microamp/step to 200 milliamps/step, and in 5 values from 0.01 v/step to 0.2 v/step with 24 values of driving resistance from 1 ohm to 22 kilohms. Input steps are adjustable from 4 to 12 per family, with repetitive or single-family display.

TYPE 575 TRANSISTOR-CURVE TRACER £373
Delivered in England • The above price is exclusive of duty.

Tektronix, Inc.

P. O. Box 831D, Portland 7, Oregon, U.S.A.

Phone CYpress 2-2611 • TWX-PD 265 • Cable: TEKTRONIX

NOW a moulded track potentiometer

at the **same cost** as
sprayed track types

The dual advantages of high efficiency and low cost per unit have been achieved in this improved preset potentiometer. A carbon track is moulded directly onto a blanked insulated base, and this, in conjunction with the moving carbon contacts, offers far superior quality performance than has ever previously been available at such low cost. The maximum power rating of the control is half-watt. Outstanding advantages are:

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- * IMPROVED SHELF LIFE
- * EMINENTLY SUITABLE
EXPORT EQUIPMENT

Full details of specification will gladly be sent to designers in response to requests quoting 'Potentiometer Type PP'.

Patents Pending.

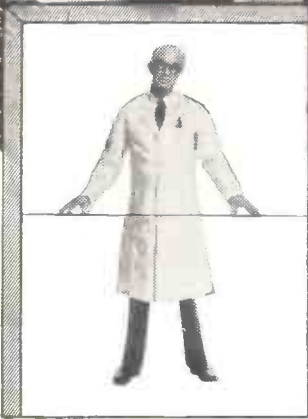
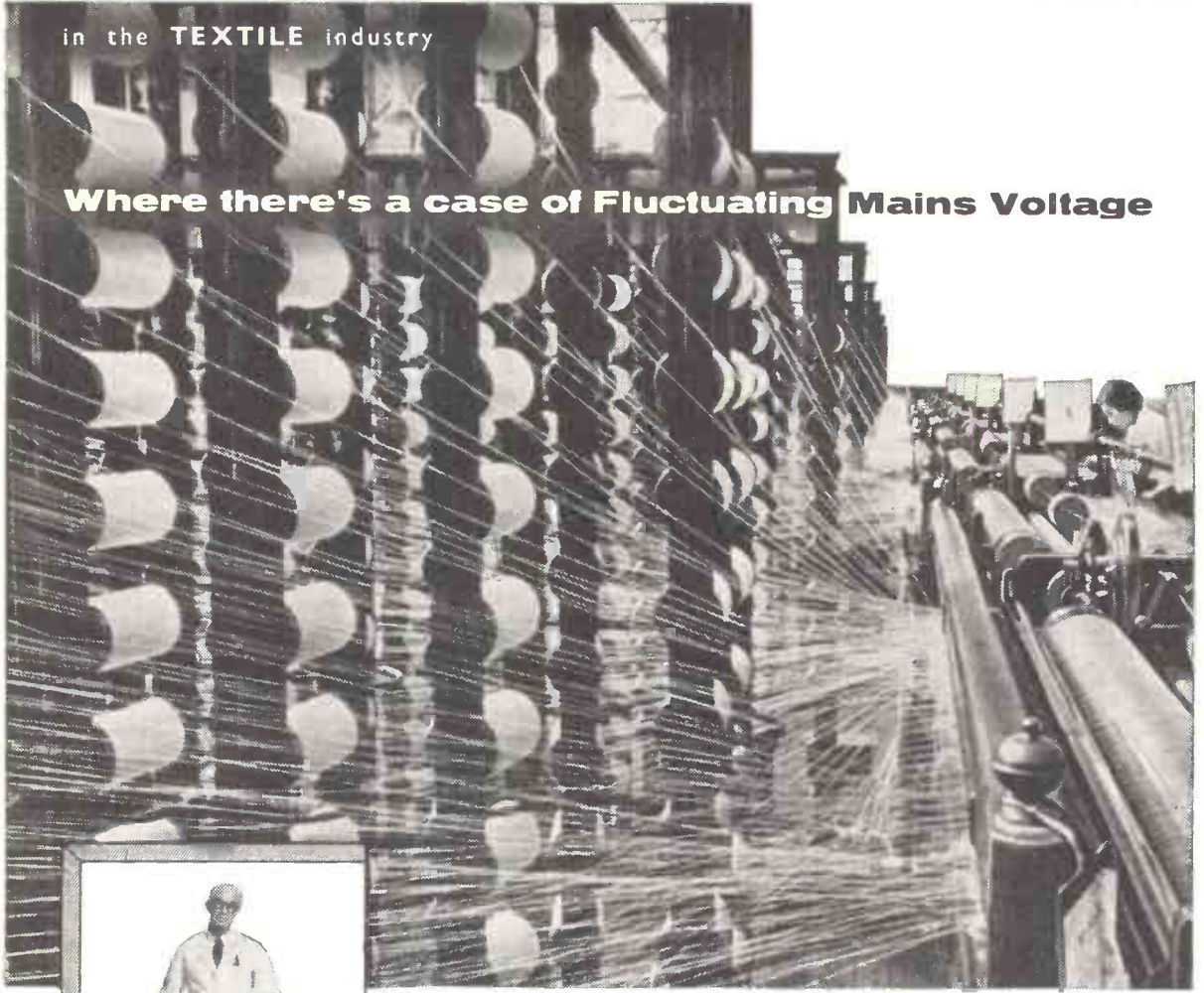


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KEMBREY STREET, SWINDON, WILTS
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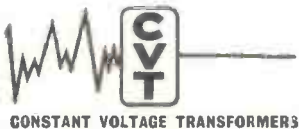
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there's a case for *Advance*

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Full technical details available Leaflet W.28

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FOR THE



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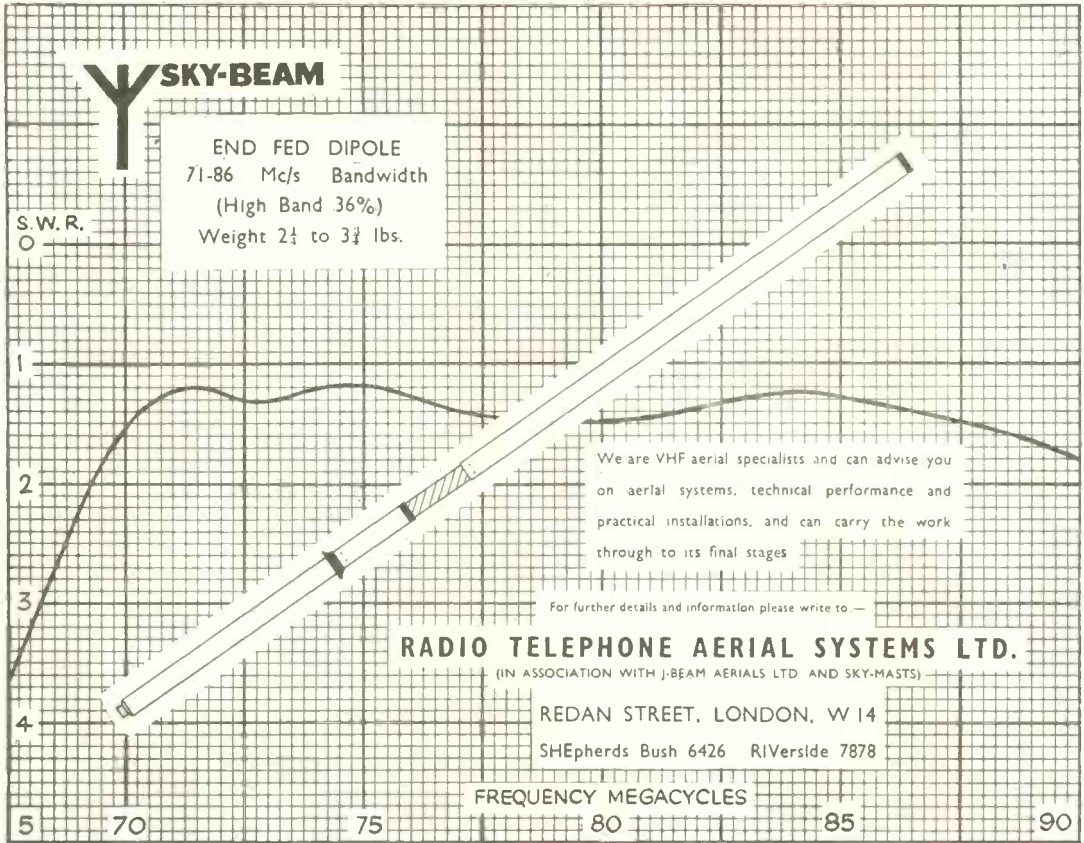
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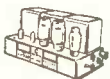
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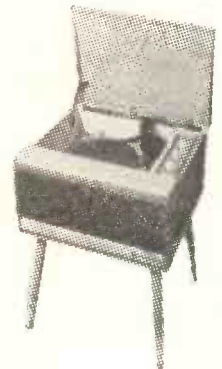

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Above is the RCA "PRESIDENT" High Fidelity phonograph, ready-to-play, automatic changing, console record reproducer of outstanding quality. Panoramic multiple speaker system; new triple control with balanced loudness feature; 20 watt peak push-pull power from extended range amplifier; elegantly styled in superb cabinets in walnut, light oak, or dark oak finishes.

The RCA "VICE PRESIDENT" High Fidelity phonograph (illustrated right) is a beautifully styled record reproducer with a quality of reproduction never before associated with instruments of its size. Panoramic triple speaker system; 10 watts peak power from push-pull amplifier with frequency range 40-20,000 cycles; triple control system; 4-speed changer.

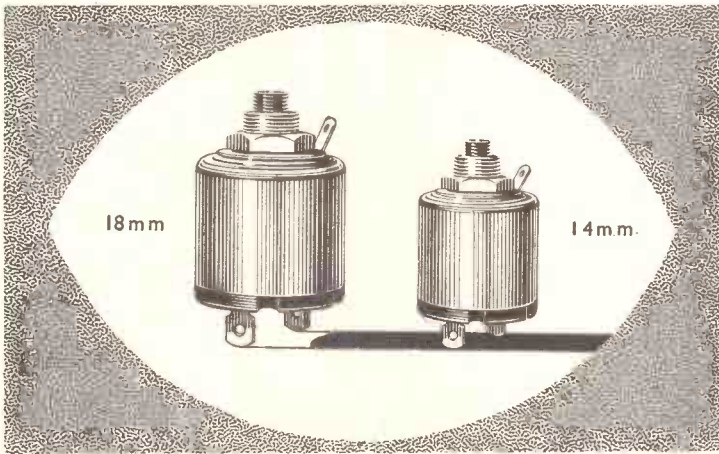
41 GNS. (plus £1.15.0 optional legs) tax paid.



RCA GREAT BRITAIN LIMITED, Lincoln Way, Sunbury-on-Thames, Middx.
(An Associate Company of Radio Corporation of America) Telephone: Sunbury-on-Thames 3101.

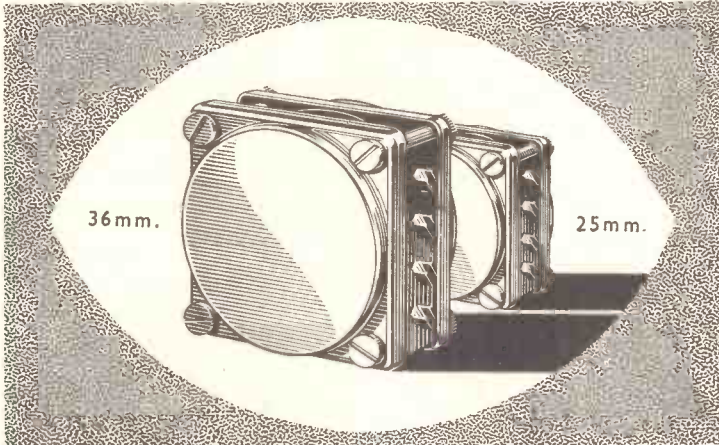
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have these outstanding features



- * Pot core design facilitating rapid assembly
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Wherever high quality pot cores are required, there will be a Mullard type available to meet the specification, furthermore, they can be supplied wound to customers individual requirements.



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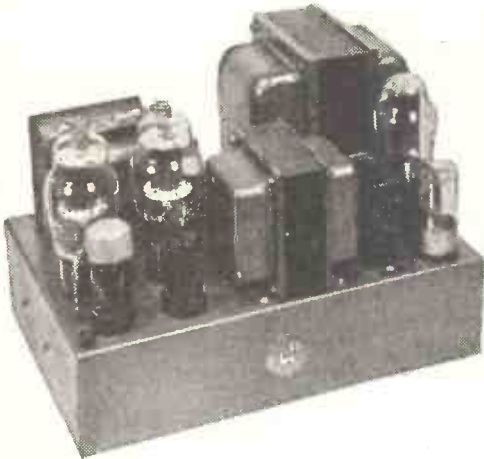
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HARTLEY-TURNER SOUND EQUIPMENT

The Hartley-Turner 20 Watt Amplifier has been designed with first rate performance as the main objective. With a power handling capacity of 20 watts the full dynamic range of an orchestra can be reproduced without distortion even on peak levels.

This unit when terminated by a high grade loudspeaker such as the 315 results in a clarity of reproduction which is rarely obtainable with other equipment.



BRIEF SPECIFICATION

Input Sensitivity: 1 Volt for full output into 4 or 16 ohm load.

Frequency Response: Flat 40-20,000 c/s (—1.5 db at 32 c/s; —4db at 30 Kc/s).

Hum Level: —80 db at 20 Watts.

Additional Power Supplies: 6.3 V. at 1 A., 300 V. at 5 mA. (stabilised), 6.3 V. at 2 A., 300 V. at 25 mA.

Chassis Size: 12in. × 18in. × 8in. high.

Weight: 27 lb.

Power Requirements: 100-125 V. A.C. or 200-250 V. A.C., 50-60 c/s.

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(Carriage Paid in Great Britain)

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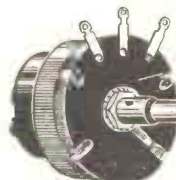
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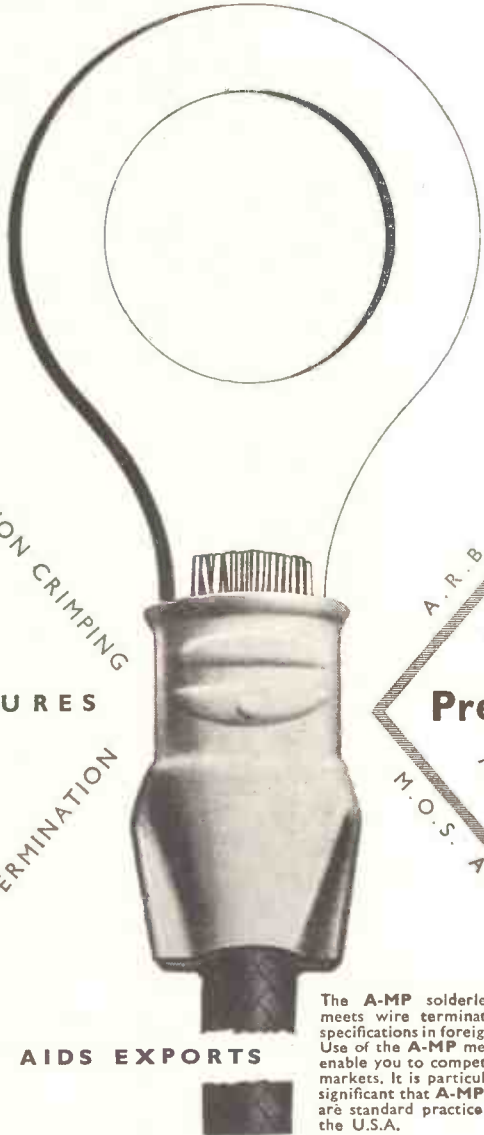
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★ Trade Mark of AMP Incorporated, U.S.A.

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"... the construction and workmanship of this Rogers FM tuner is a delight to behold. The chassis is rigid and the wiring neat."

"... the signal is held like a limpet over a few degrees of the dial then disappears and the inter-station noise increases until the next signal drops in and is held firmly, with no "off-tune" positions of distortion."

"The discriminator is of the Foster-Seeley type and provides first class audio quality."

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(GRR Home Test No. 37 by Donald W. Aldous, M.Inst.E., M.B.K.S., G.R.R. March 1957).



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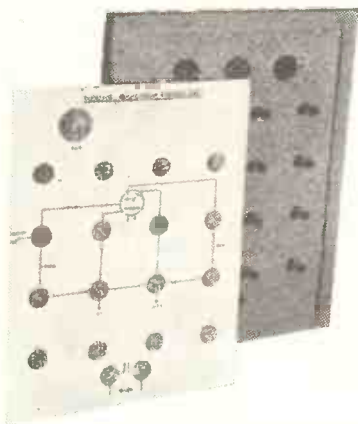
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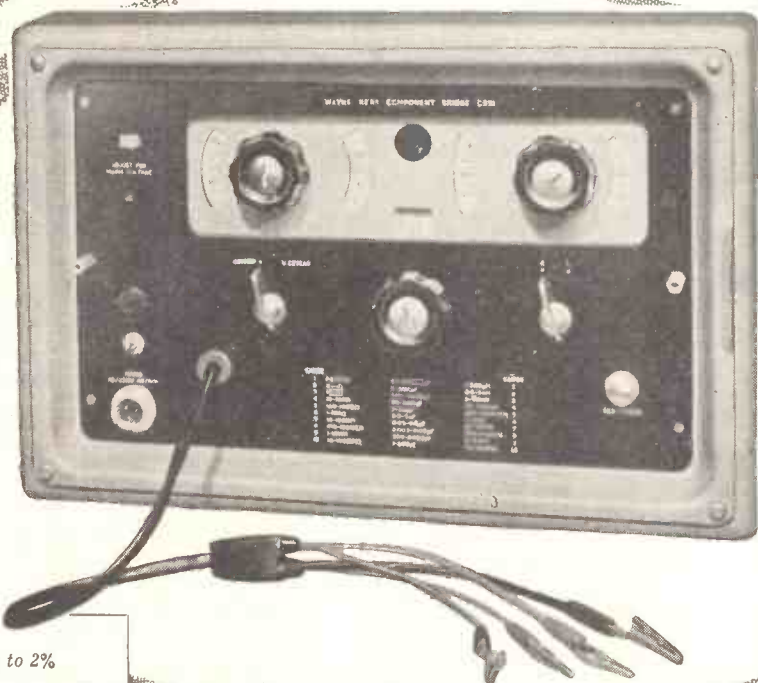
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- Accuracy to 2%
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 Inductance: 1 μH to 0.5 MH.
 Resistance: 1 m Ω to 1000 M Ω.
 Accuracy 2%
 Power Supply: 110/125 and 200/250v.
 Dimensions: 17" x 7" x 11½" high.
 Weight: 25 lbs. approx.
 Price: £75.0.0

**Exceptional Range covers 1 picofarad to 5 farads
 1 microhenry to infinity 1 milliohm to 1000 megohms**

Operating at mains frequency, the B.521 has an effective ratio of 10¹²:1 and is intended for the rapid and direct measurement of virtually all components and networks likely to be encountered in electronic apparatus, whether in the laboratory or the service workshop.

The usual three-terminal facility associated with bridges of this design permits the measurement of complex impedances in situ, that is to say, an

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The low impedance ranges together with the in situ facility make it possible to measure switch contact resistance, dry joints, earth bonding efficiency, high value electrolytics, etc.



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 Type B601**

A wide range transformer ratio-arm bridge for the measurement of resistance, capacitance, inductance and complex impedance between 15 kc/s and 5 Mc/s. Impedances between any two terminals of a three terminal network can be measured. Price £140.



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A portable instrument covering the range 10 kc/s to 10 Mc/s with an output of +10 db/s to -50 db/s on 1 volt p. to p. amplitude stabilised to 0.5 db over its full frequency range. Price £175.

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SIZE ONLY 10—6—6ins.

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For 200-230-250v. 50 c.p.s. A.C. mains.
Outputs for 3 and 15 ohm speakers.

Chassis finish stoved Grey
—Blue hammer.

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MAXIMUM POWER OUTPUT
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RATED OUTPUT 10 WATTS.

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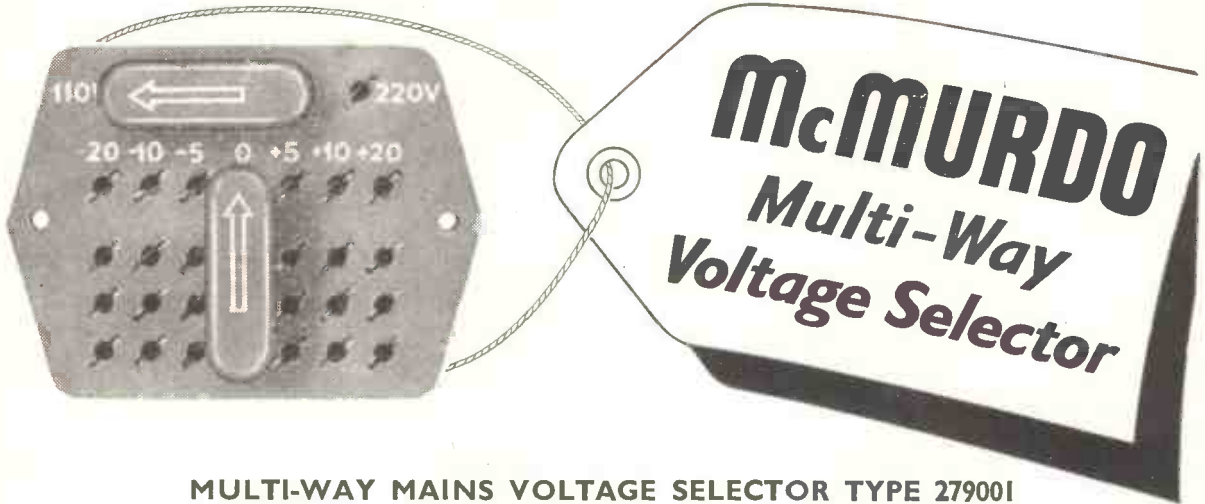
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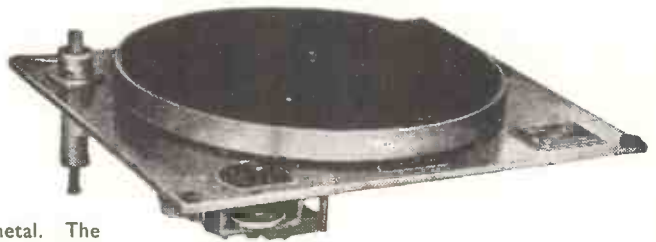
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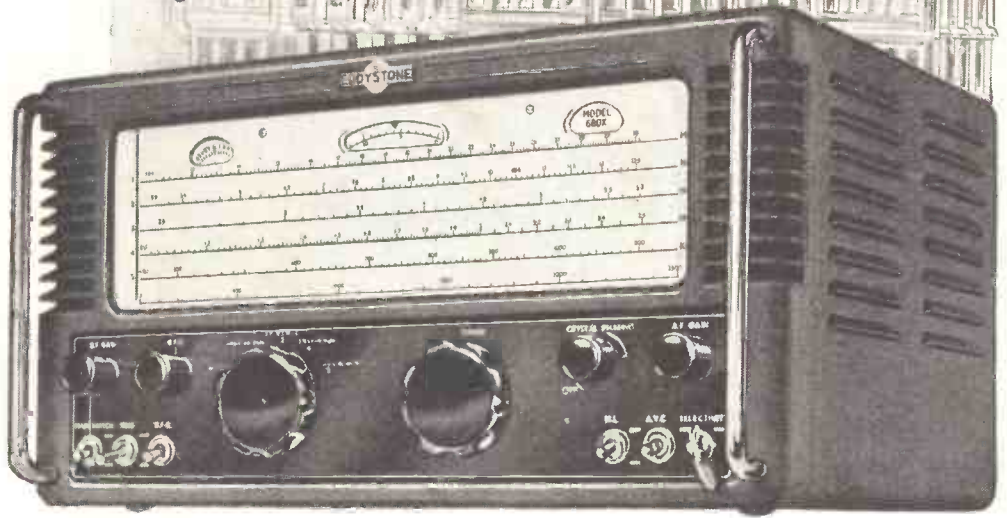
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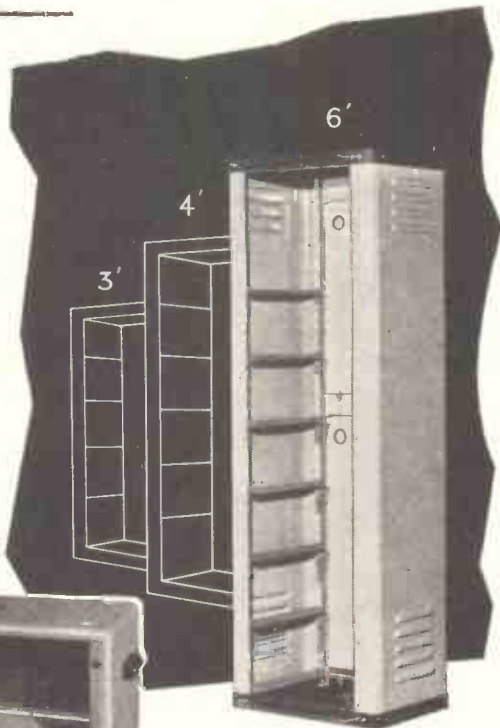
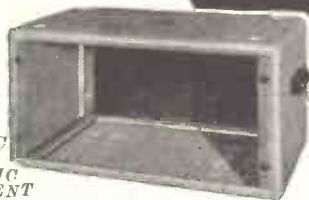
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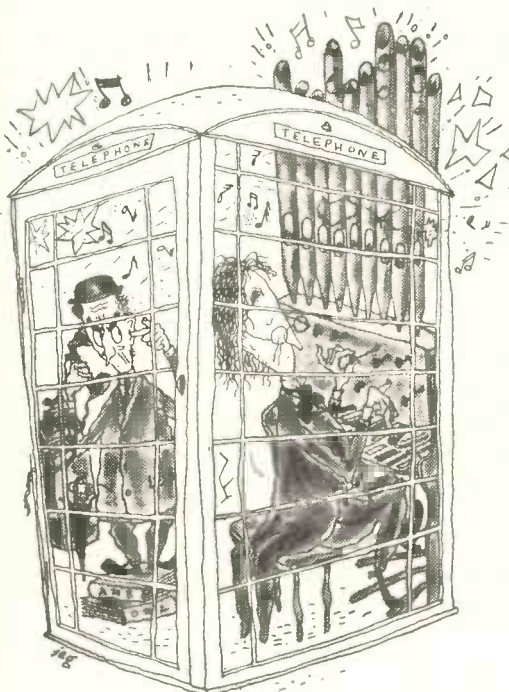
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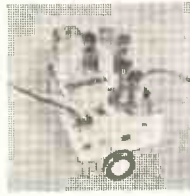
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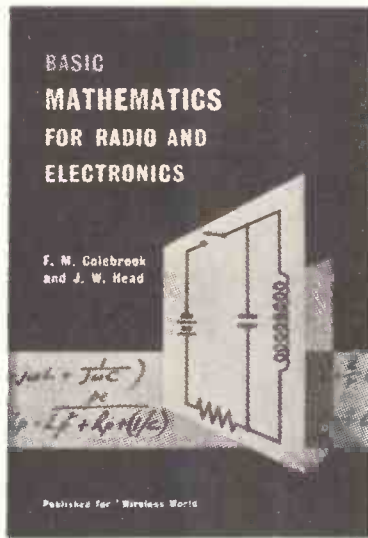
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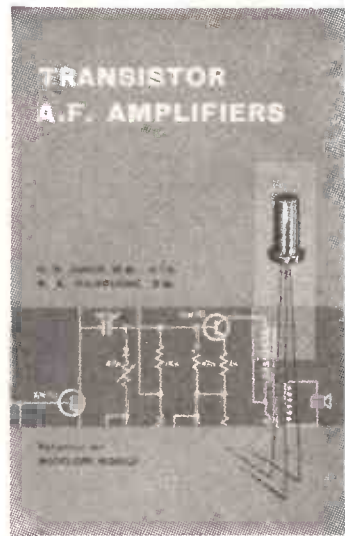
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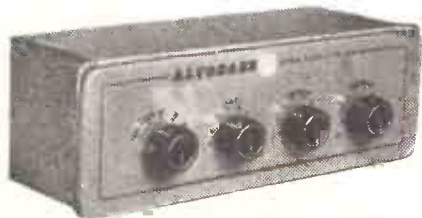
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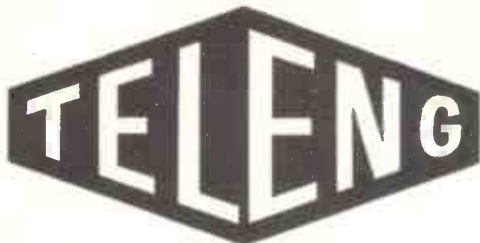
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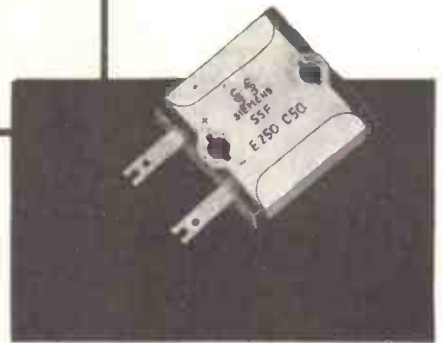
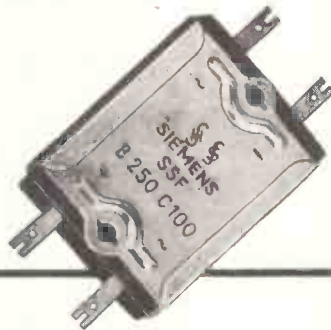


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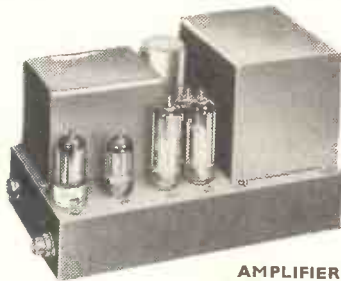
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Three switched ranges. Crystal speaker gives precise audible count of each single pulse on lowest range or immediate appreciation of significant flux change on medium range. Calibrated flash cycle on all ranges.

Sensitivity

Average back ground count 90 per minute.

Utility

General laboratory monitoring.
Isotope tracing and contamination detection.
Location and relative assay of Uranium and Thorium ores.
Examination of path or flow in industrial processes.
Qualitative measurement and illustrative experiments in education. Realistic training in nucleonic practice at a harmless radiation level. Geological mapping, and cave and mine exploration.

Facilities

Portable, completely self-contained. High tension from internationally available 30 volt layer-type batteries, potential automatically disconnected as case is opened. Battery life under continuous day and night operation exceeds shelf-life. Easily cleaned anti-contamination feet on base protect case. Anti-glare panel and substantial hood simplify count and promote accuracy.
Finger tip audio and range change.
Output socket for miniature earpiece, 'scope, or scaler (insertion of jack mutes speaker for "secret" counting).
Extra long, wide shoulder strap for field survey leaves both hands free.
Size 9in. by 6in. by 3in., weight with batteries, 3lb.

* (Set of miniature batteries supplied with instrument for £2 15s. 3d. extra.)

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Reflectograph

RR Series 102 RECORD REPRODUCER Home Model



A high performance portable tape recorder for use in the home and incorporating a number of features normally fitted only in professional equipment.

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All signals from the two built-in speakers are from the tape via the playback head and amplifier.

The input signal and playback signal from the tape can be directly compared by a "Break-in" switch.

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Fast forward, slow-return type

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This feeds a Reflectograph Type H.E.

Ferrite core erase head.

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For full information on the Reflectograph Range please write to the manufacturers
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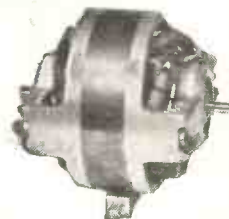
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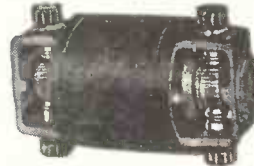


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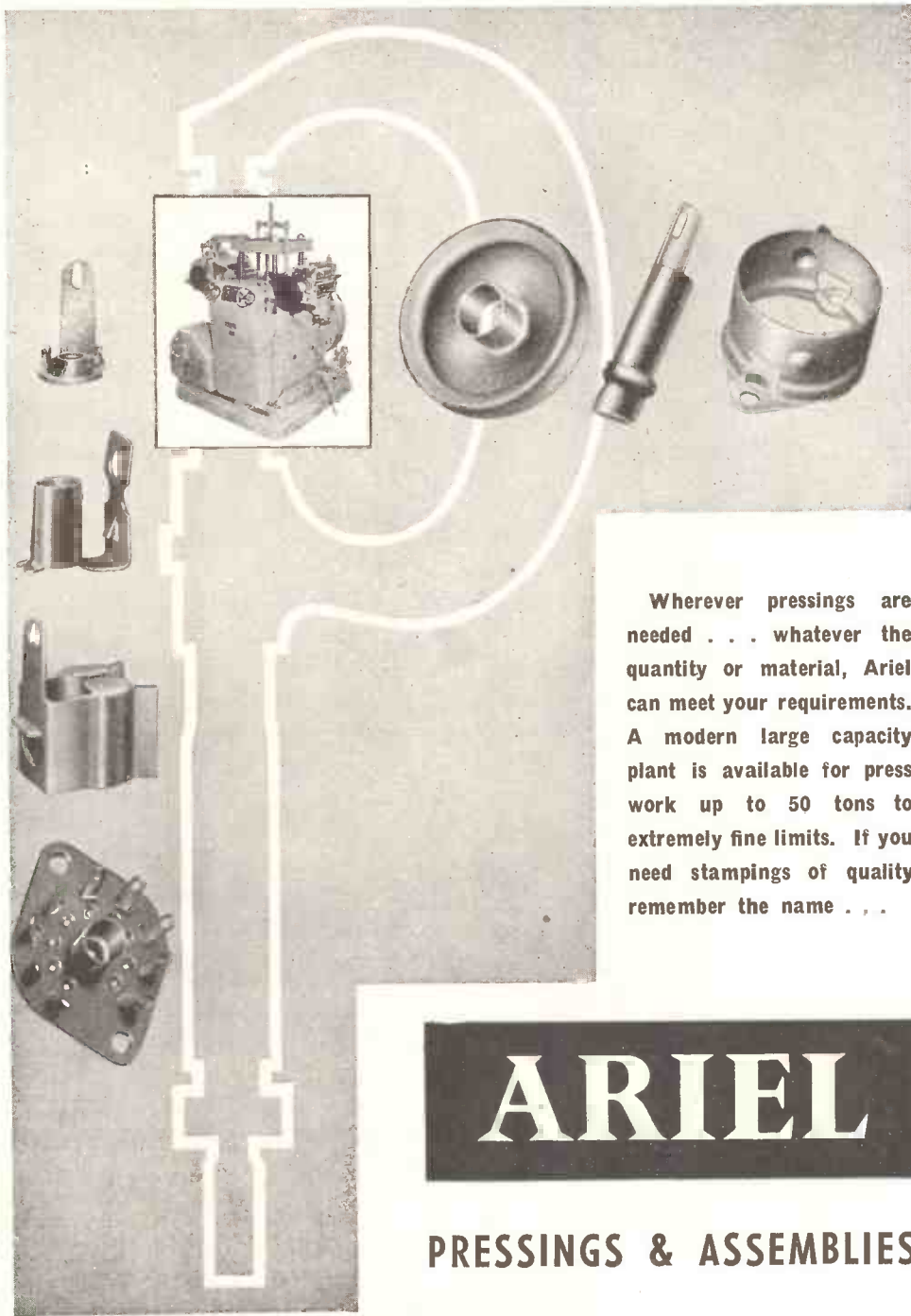


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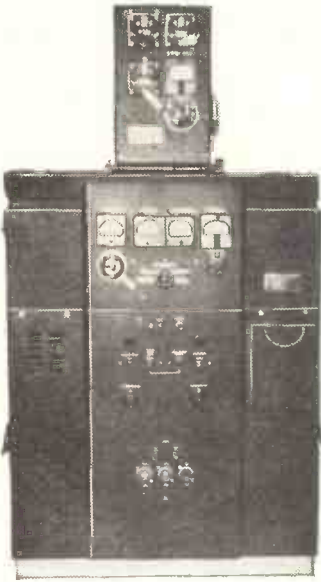
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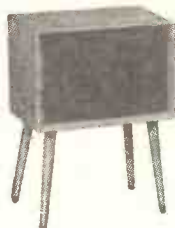
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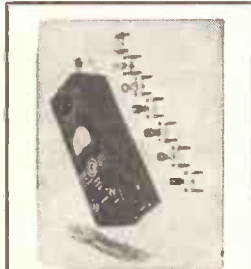


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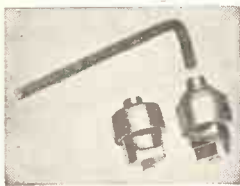
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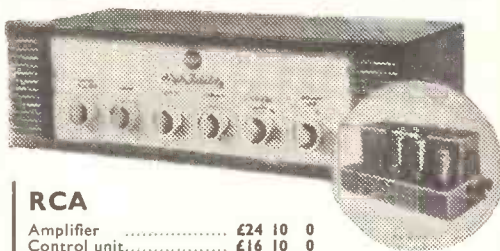
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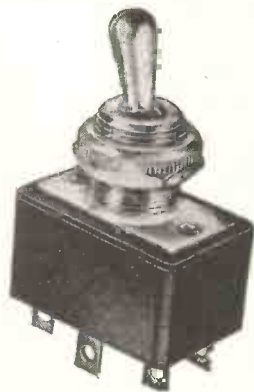
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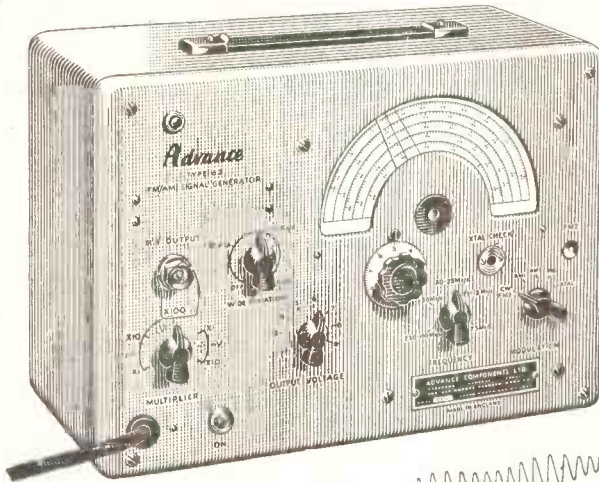
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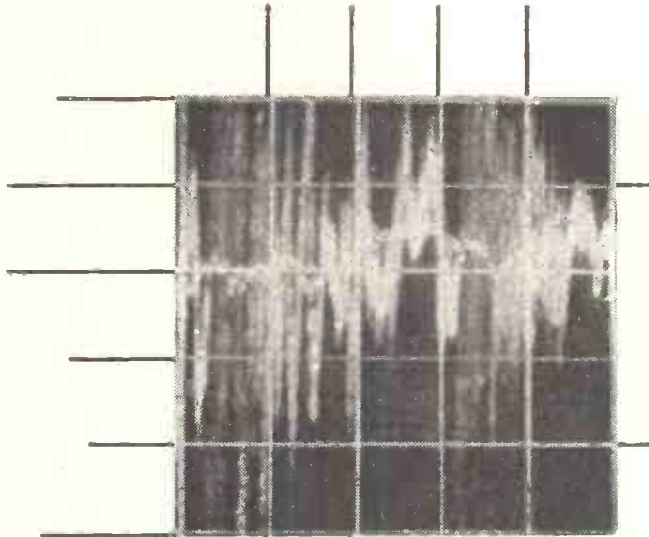
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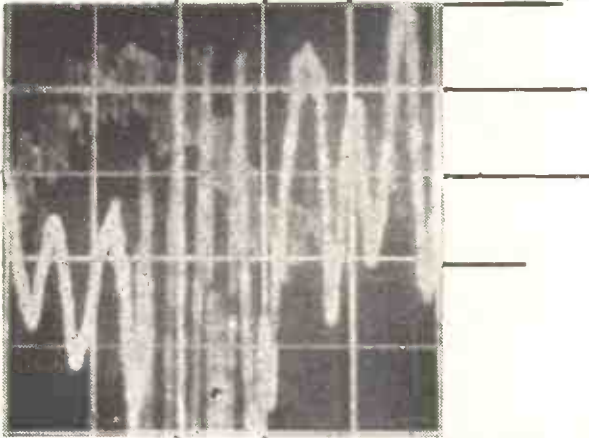
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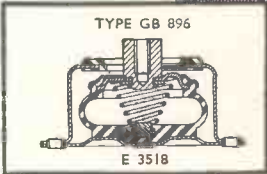
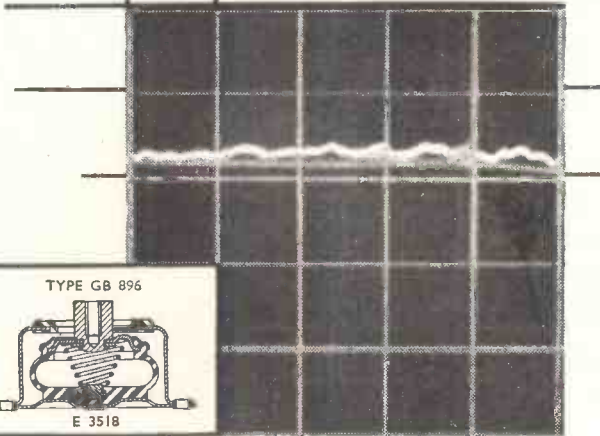
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Isolator "A" with some damping, but snubbing at resonance (15 c.p.s.). Metal to metal impact. Transmitted acceleration approx. 12 g. for sinusoidal input of ± 0.026 ". Envelope contains transients as high as 10,000 c.p.s.



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Where airborne application of instrumentation is concerned, it is all too easy to find "progress" has resulted in the substitution of one element of chance, not necessarily human, for another and the nett gain can actually be well below unity.

The new enemy is vibration. The more complex and sensitive the equipment, the more potent is the enemy, and protection against vibration becomes part of the design problem. Attempts to achieve isolation have often magnified the problem, for it is obvious that if a major component of the offending vibration happens to be at the resonant frequency of the isolator employed, danger is increased by the isolator itself.

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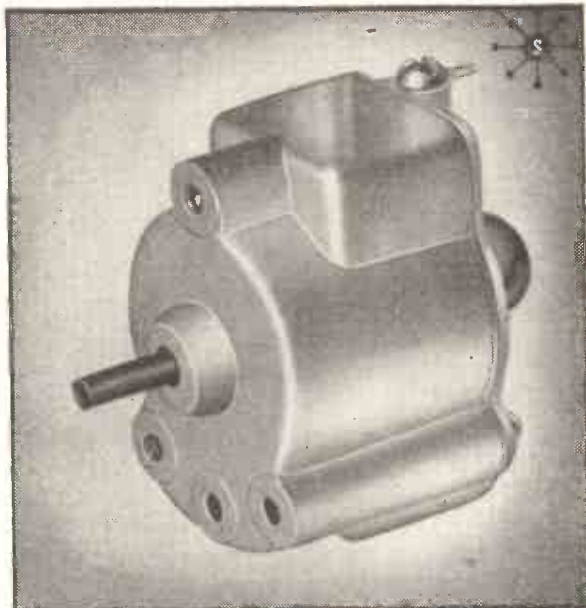
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Manufacturers are invited to write or telephone for full information on this governor controlled constant speed motor. Only slightly larger than a match-box, the Staar-Kinder Motor presents a noiseless power unit of extremely low current consumption.

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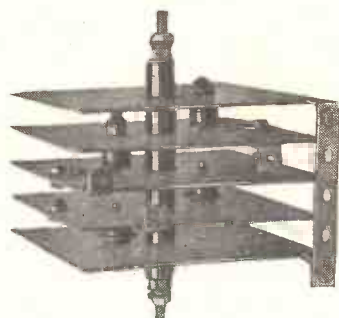
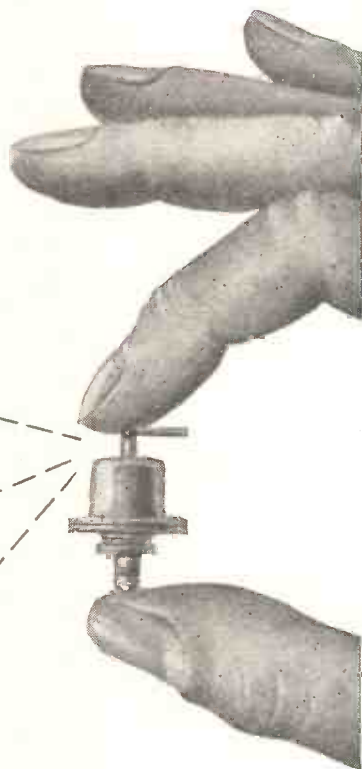


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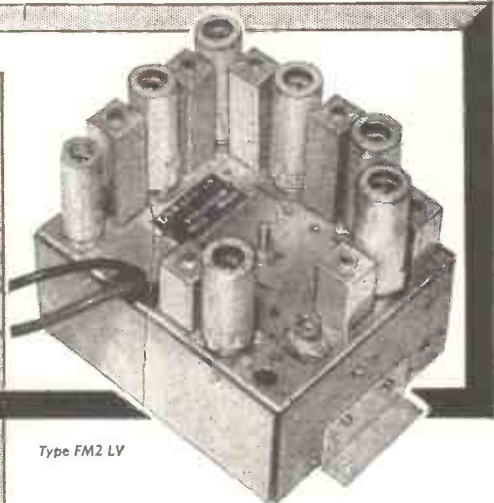
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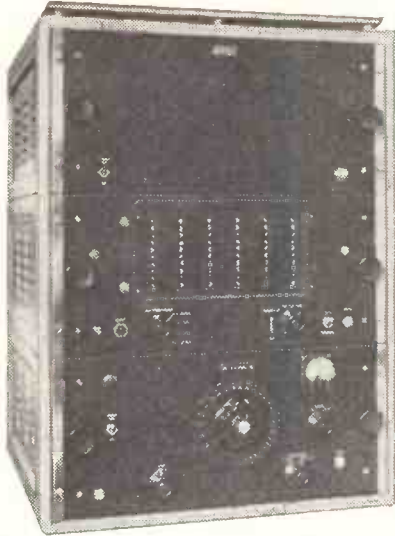
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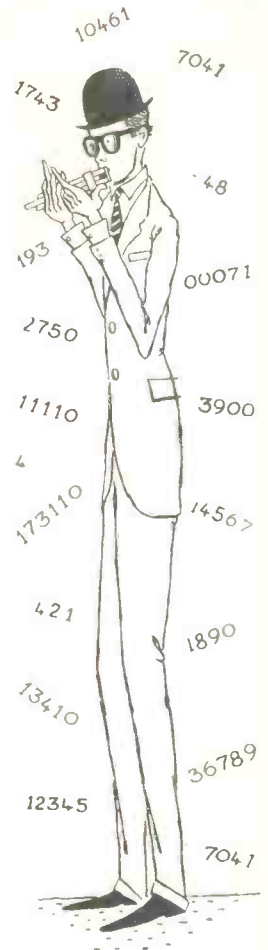
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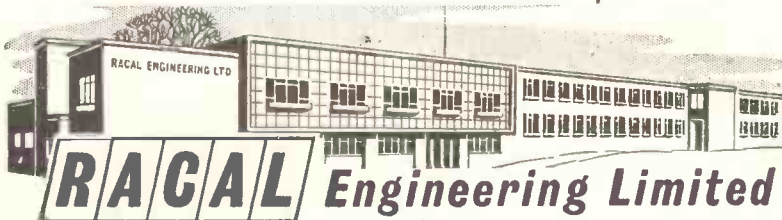
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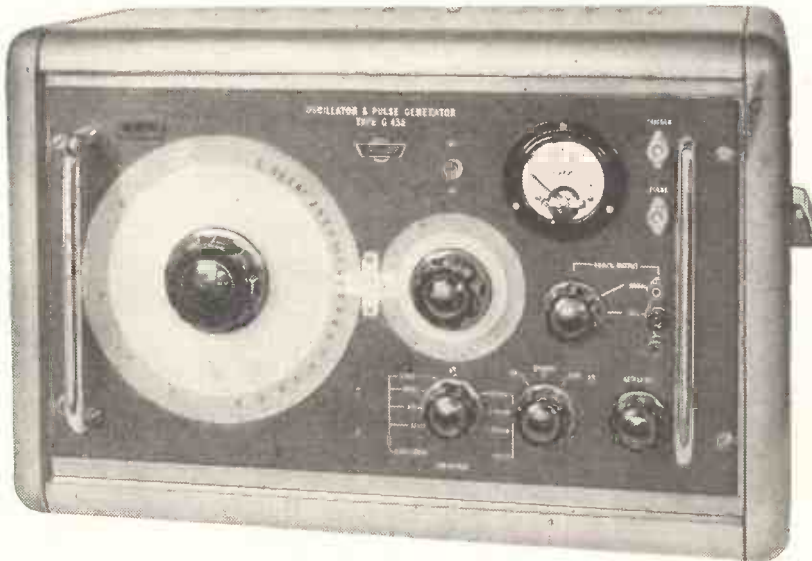
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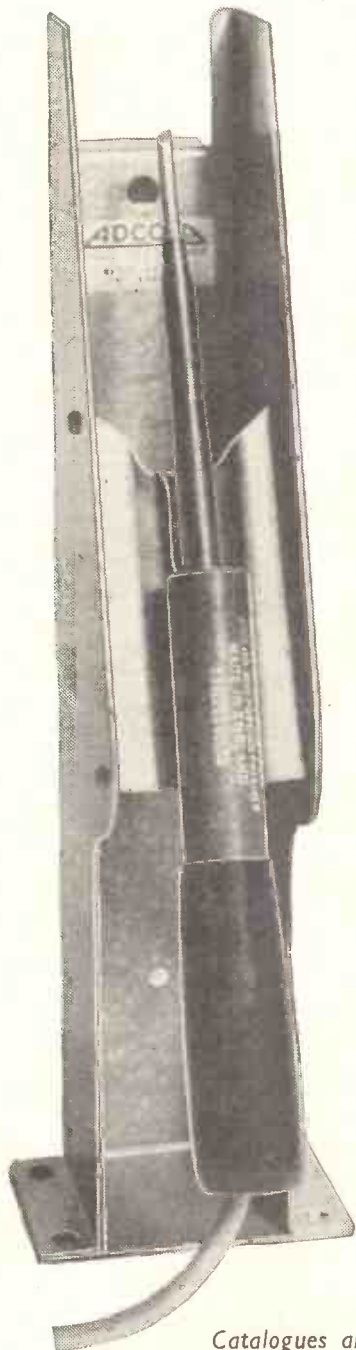
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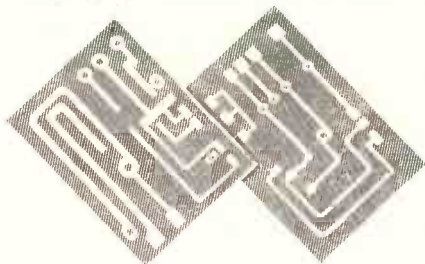
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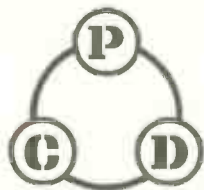
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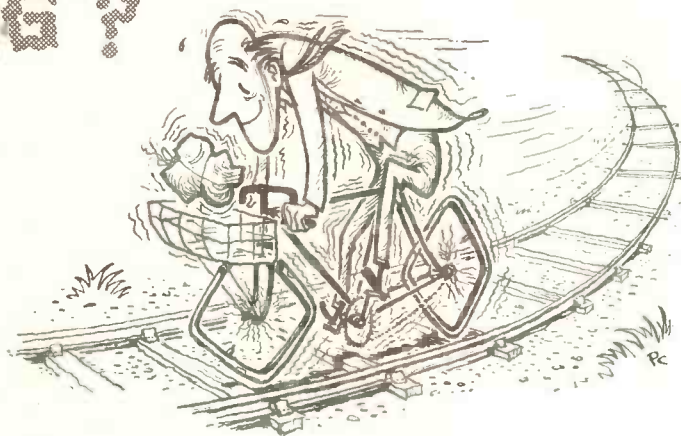
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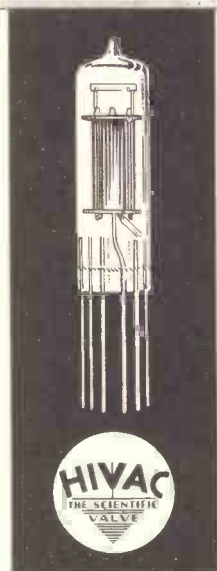
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XR7	HF Pentode	200	100	100	-2.0	7.5	2.5	5.5	250K	466
XR8	HF Triode	150	100		-2.5	8.0		4.2	475K	468
XR9	HF Twin Triode	300	100		-1.85	8.5		5.0		474
XG2	Gas Tetrode	150	Details on application.							

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	3	Lenco	GL56	Ex/stock	23	7	0	2	11	0	9 of 51/-	11	13	9	12 of 21/10	16	10	0
SECTION II	PICK-UPS.																	
	4	Ortofon	Type "C"	Ex/stock	26	14	0	2	18	9	9 of 58/1	13	17	4	12 of 25/4	20	5	0
	5	Goldring	600 (with BJ Arm)	Ex/stock	12	9	2	1	7	5	9 of 27/5	6	4	7	12 of 11/8	9	5	11
SECTION III	TUNER UNITS.																	
	6	Collaro	—	Ex/stock	5	7	5	1	0	0	6 of 20/-	—	—	—	—	3	17	6
	7	Goodsell	FMT501	Ex/stock	19	14	0	2	3	4	9 of 43/4	9	17	5	12 of 18/5	16	10	0
SECTION IV	AMPLIFIERS.																	
	11	Quad	Mark II	Ex/stock	42	0	0	4	12	4	9 of 52/4	21	0	6	12 of 39/4	42	0	0
	12	R.C.A.	N/Ortho	Ex/stock	41	0	0	4	10	0	9 of 90/-	20	10	3	12 of 38/5	41	0	0
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	17	Goodmans	Axiom 150	Ex/stock	10	15	9	1	3	8	9 of 23/8	—	—	—	—	10	15	9
SECTION VI	COMPLETE LOUSPEAKER ASSEMBLIES.																	
	23	Classic	Model 501	Ex/stock	32	9	0	3	11	4	9 of 71/4	16	4	6	12 of 30/5	32	9	0
	24	Classic	Model 502	Ex/stock	29	13	6	3	5	3	9 of 65/3	14	16	9	12 of 27/9	29	13	6
SECTION VII	TAPE DECKS, ETC.																	
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SECTION VIII	COMPLETE TAPE RECORDERS.																	
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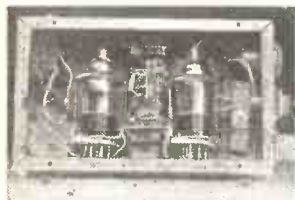
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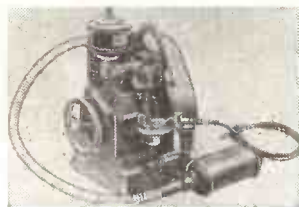
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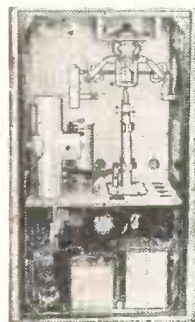
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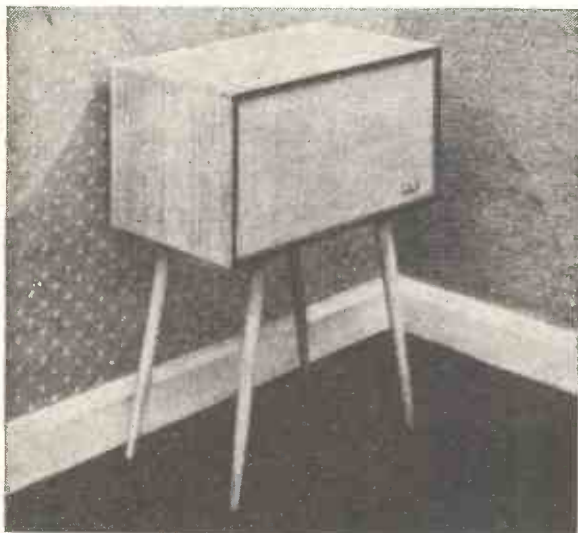
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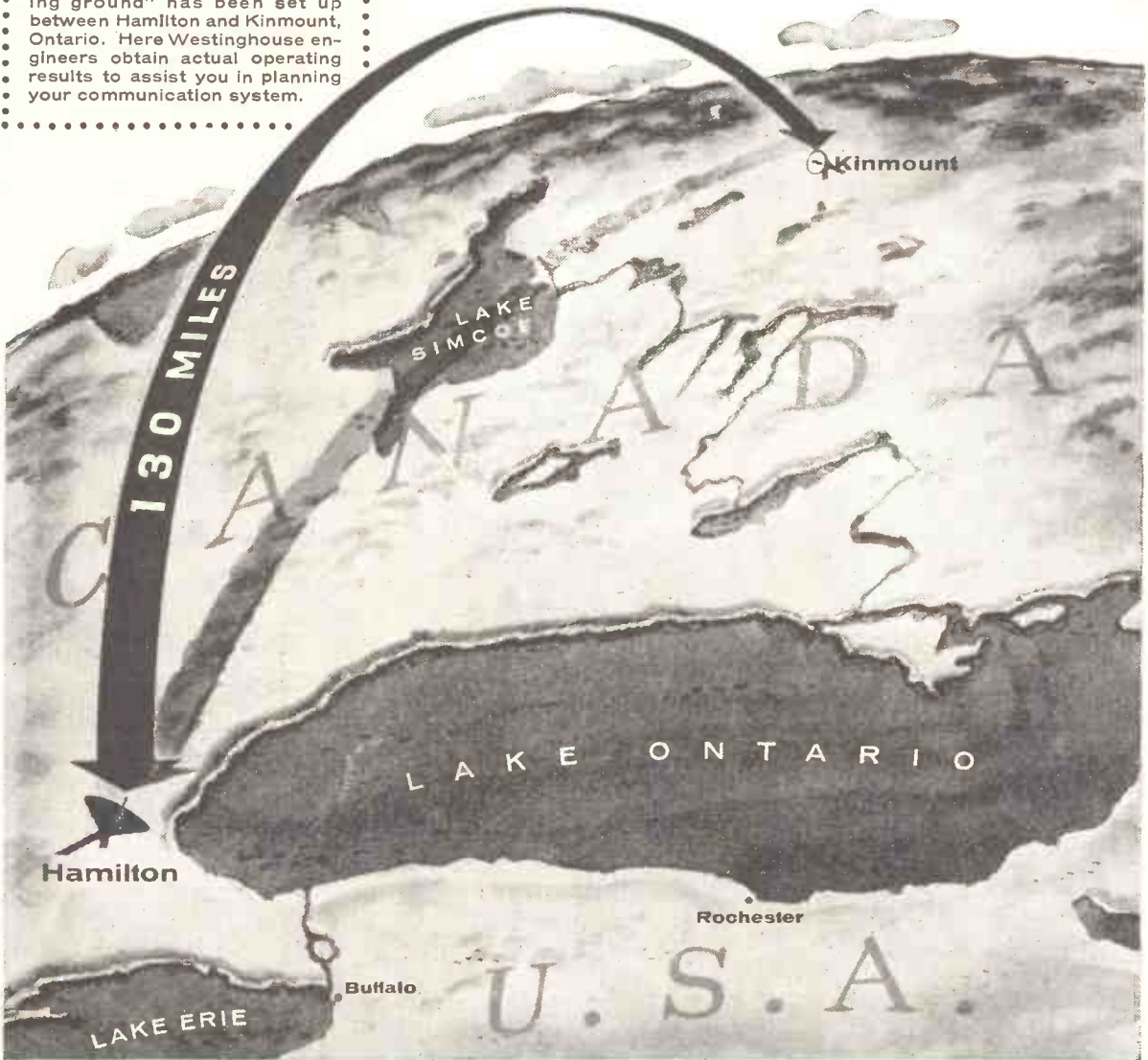
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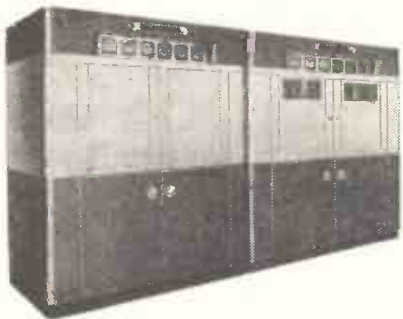
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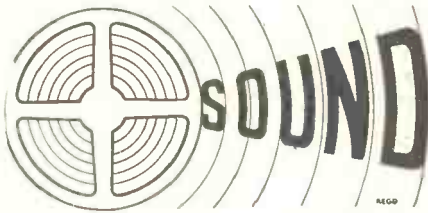
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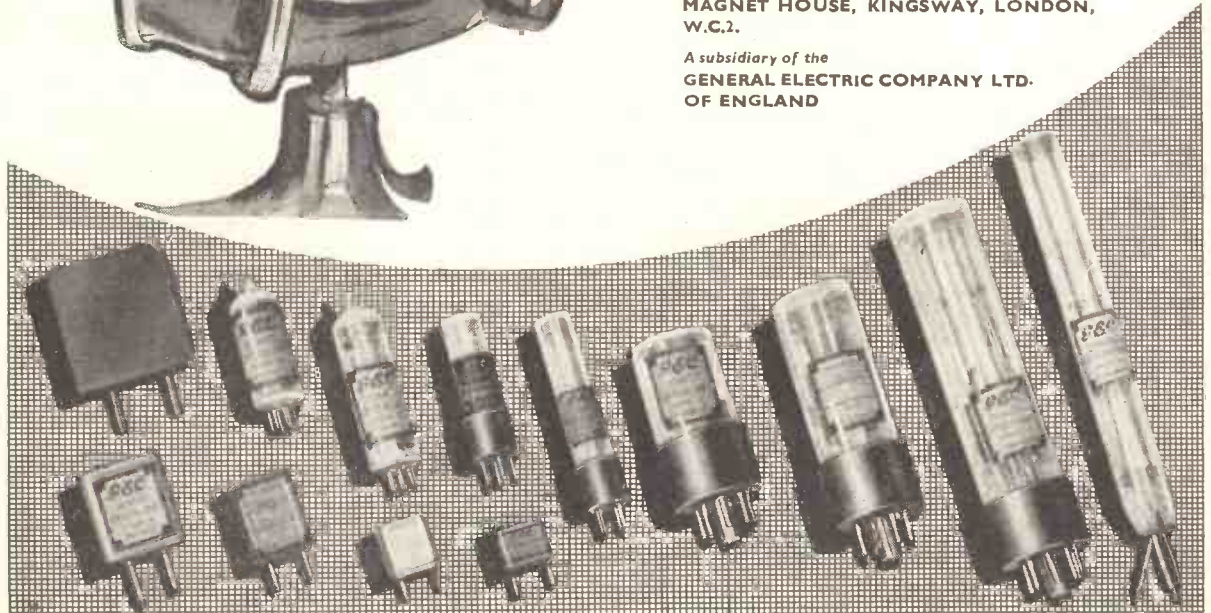
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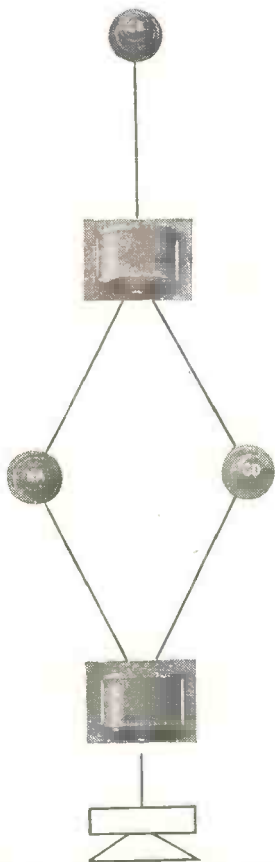
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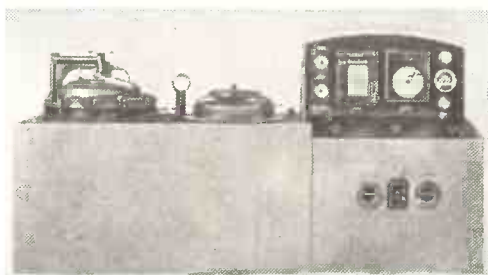
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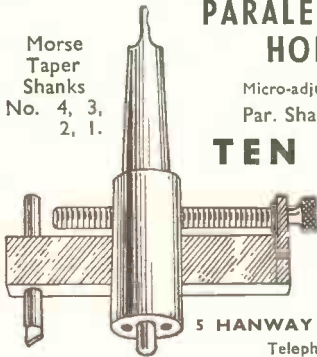
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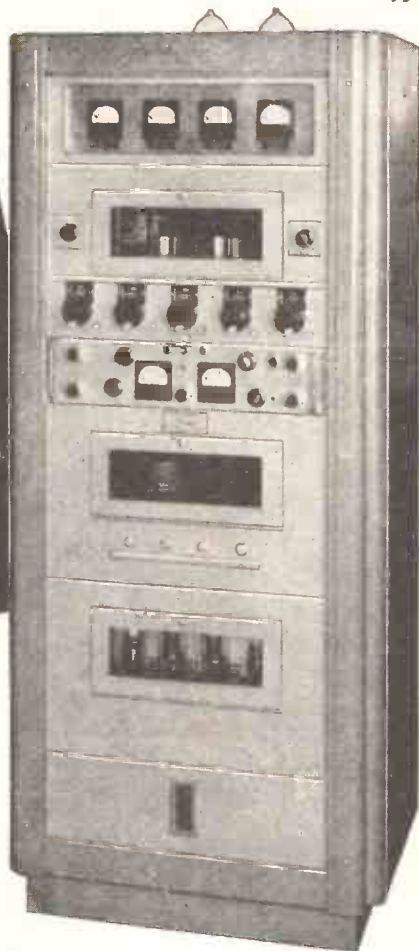
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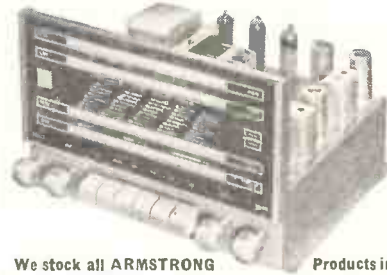
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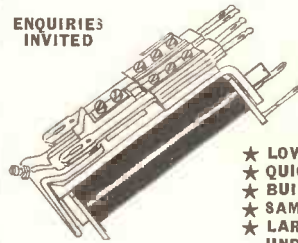
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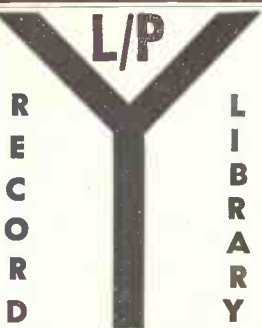
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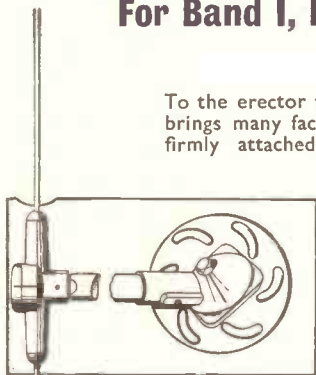
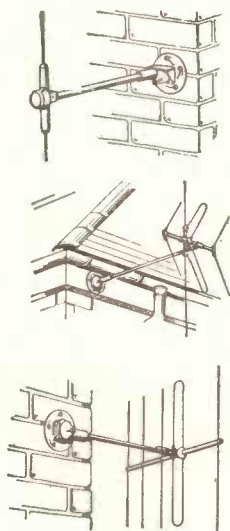
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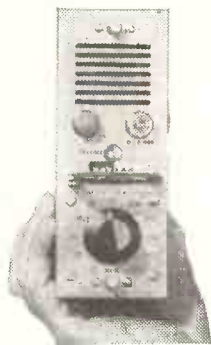
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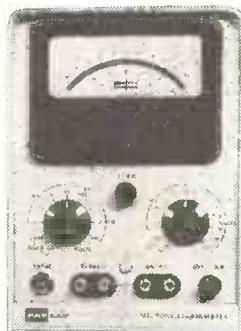


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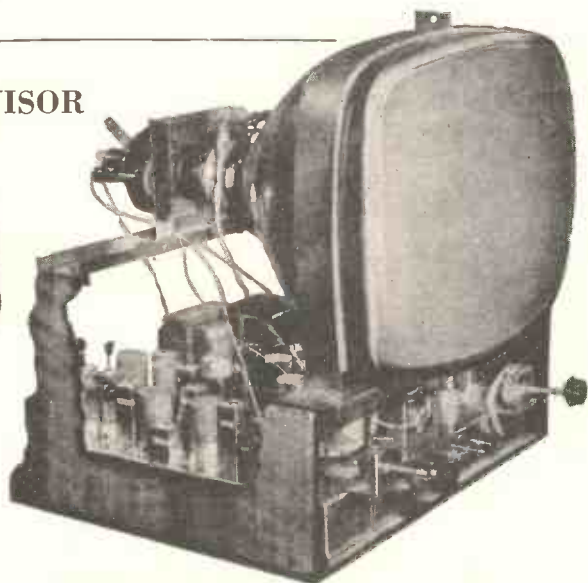
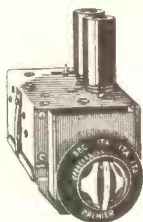
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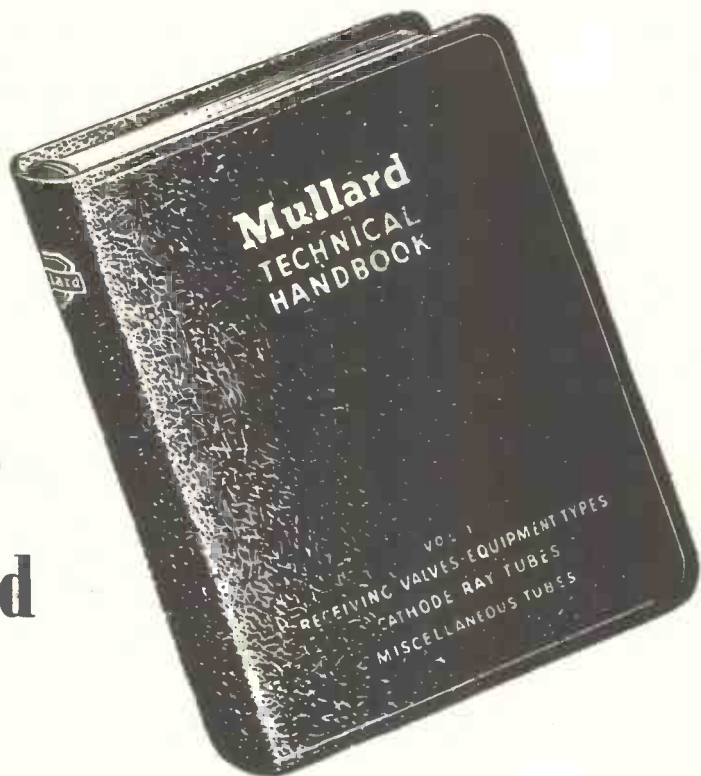
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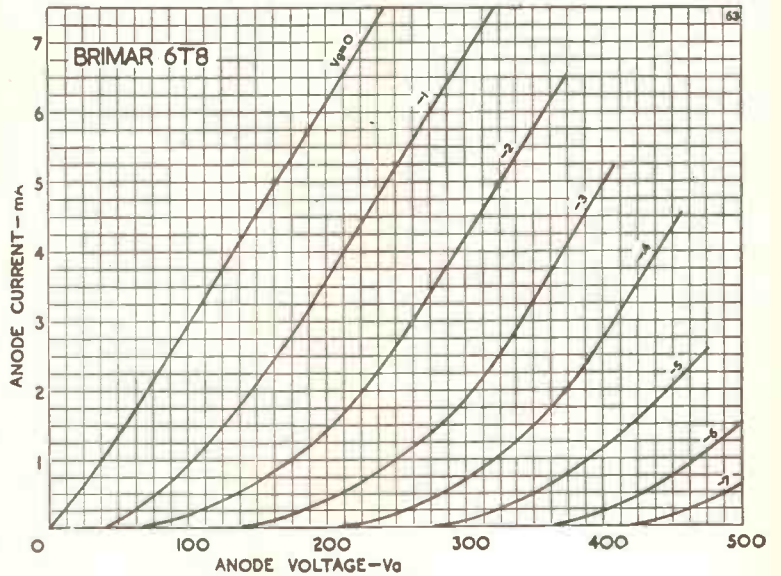




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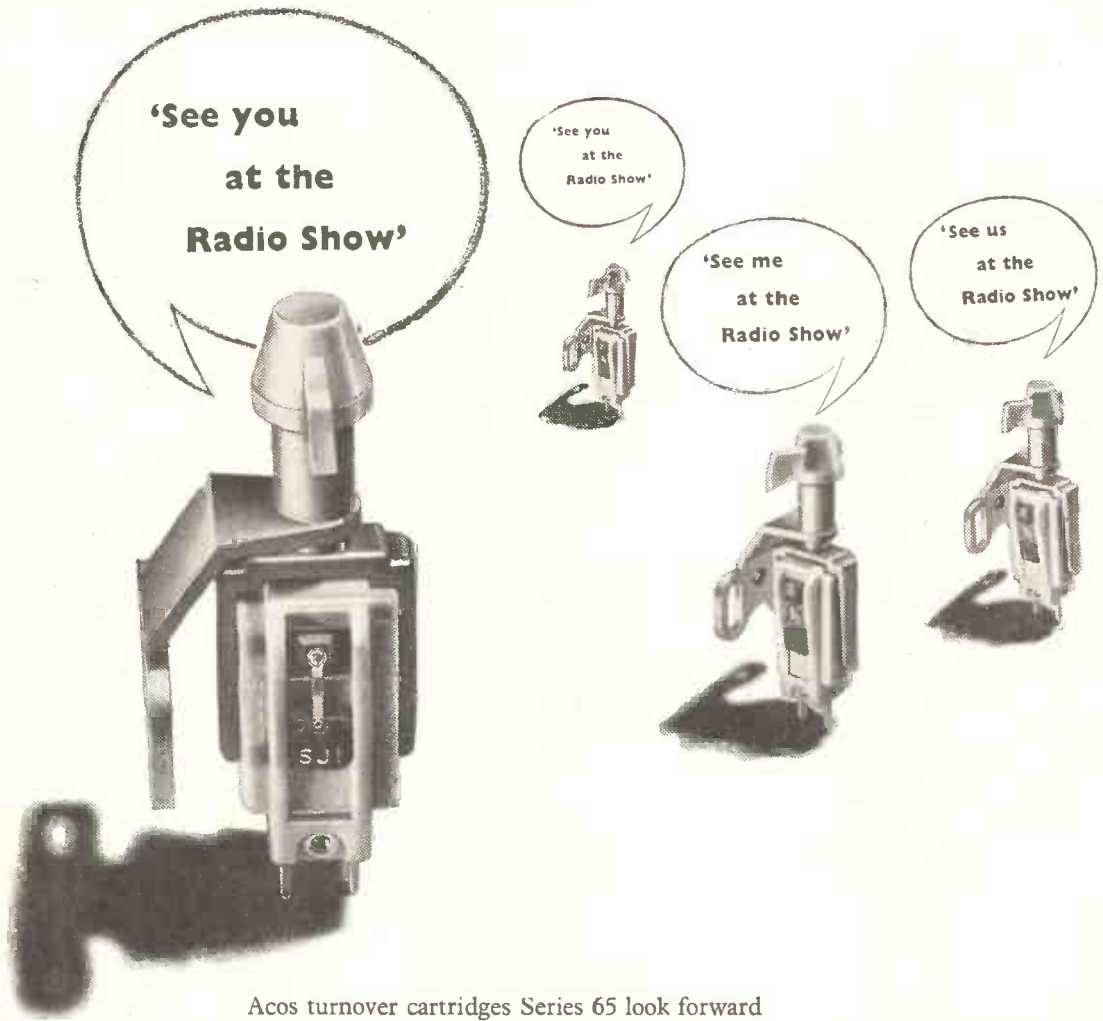
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L1314 2 amp.

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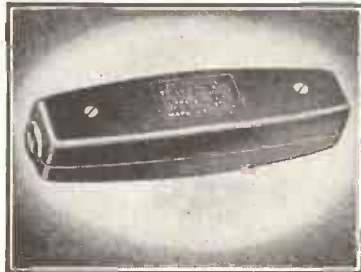
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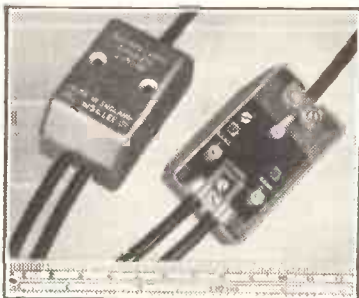
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"BELLING-LEE" NOTES

THE GOLDEN "V"

For B.B.C., I.T.A. and F.M. reception

It was not our intention to write about this again this month, but we have just returned from a business tour and have been very surprised at the results obtained by ourselves, and by reports from a number of people who have tested the "Golden V" for us in different parts of the country.

In our hotel in Bristol we could see that a picture was there, but it wasn't worth looking at. That was on band I from Wenvoe about thirty miles away. We were not surprised. In Birmingham, in the Grosvenor Room of the Grand Hotel, with walls about a yard thick, we received pictures of entertainment value from both Sutton Coldfield and Lichfield. This was more than we expected. Members of the trade who tested the "Golden V" in the Potteries were very surprised with the results obtained. These are the facts, but we would only offer this aerial for use in locations of really strong signal and weak interference.

It is reasonable to assume that if the "Golden V" is offered for sale in any particular district, there will be a good chance of satisfactory results. No reputable dealer would stock an article that his customers could not use. We cannot over emphasise the fact that the user must move the aerial about to find the optimum signal, and remember, the standing wave pattern may require the elements to be other than vertical. In fact, we expect the best results to be found with the elements adjusted as a "V." But varying the angle, we believe, affects the matching of the line by capacitance between the elements. However, we would prefer not to try and be too technical about such a device, although perhaps it is worth recording that it is resonant on band III. It works surprisingly well in a great number of unexpected places on B.B.C., I.T.V. and band II with F.M., and it looks as good as it is.



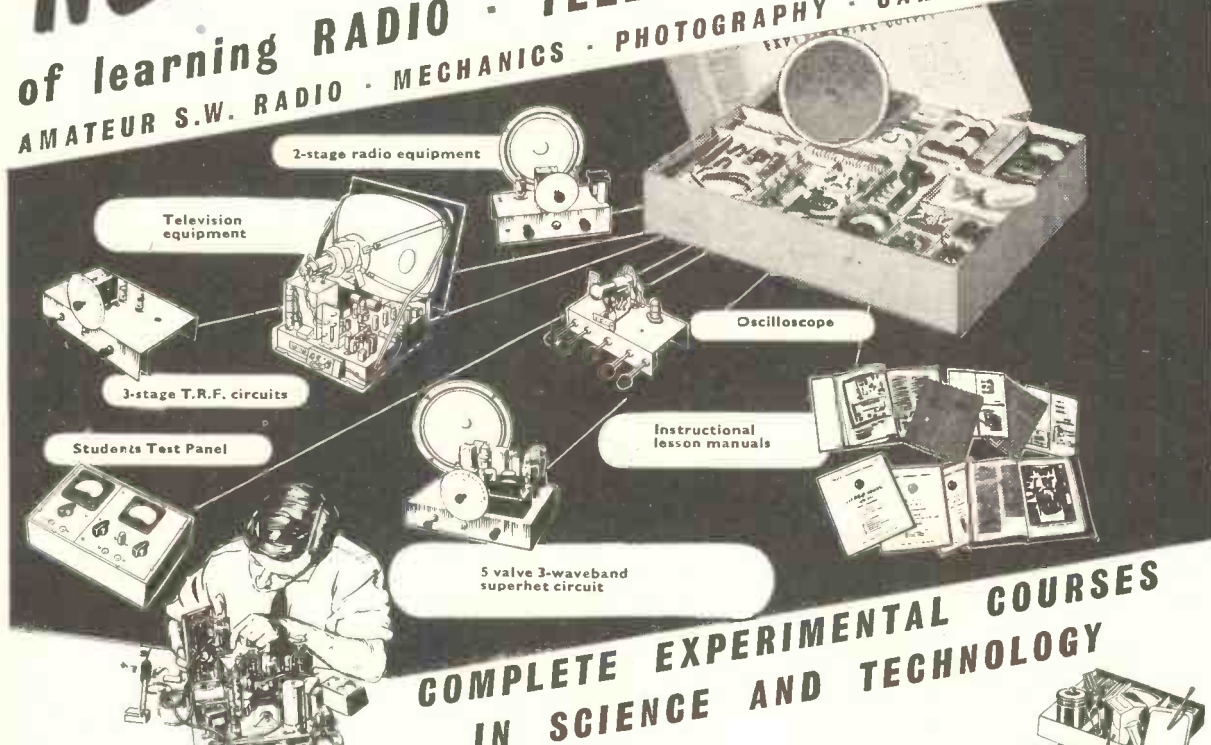
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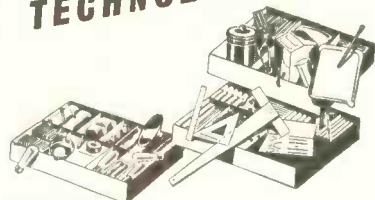


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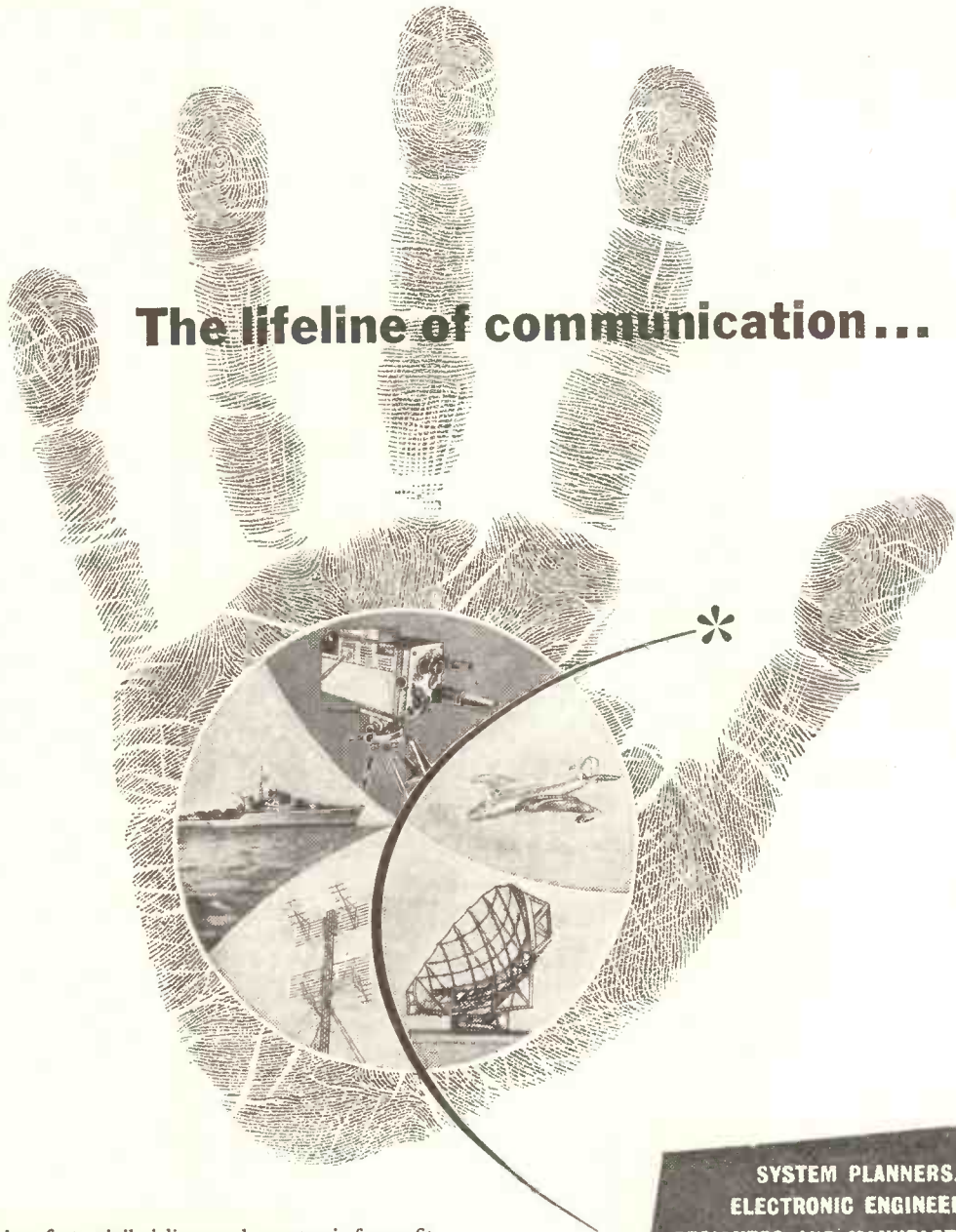
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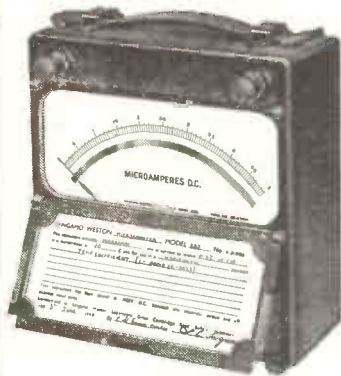
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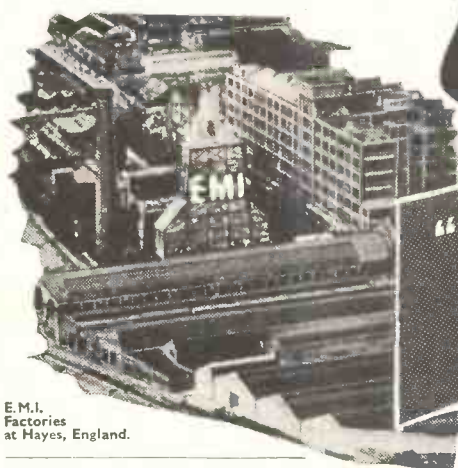
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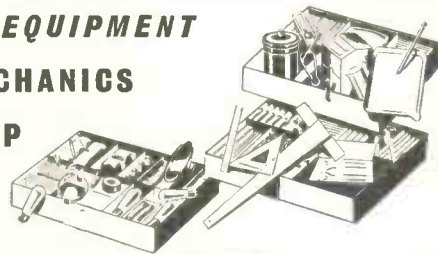
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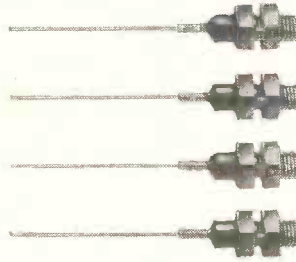
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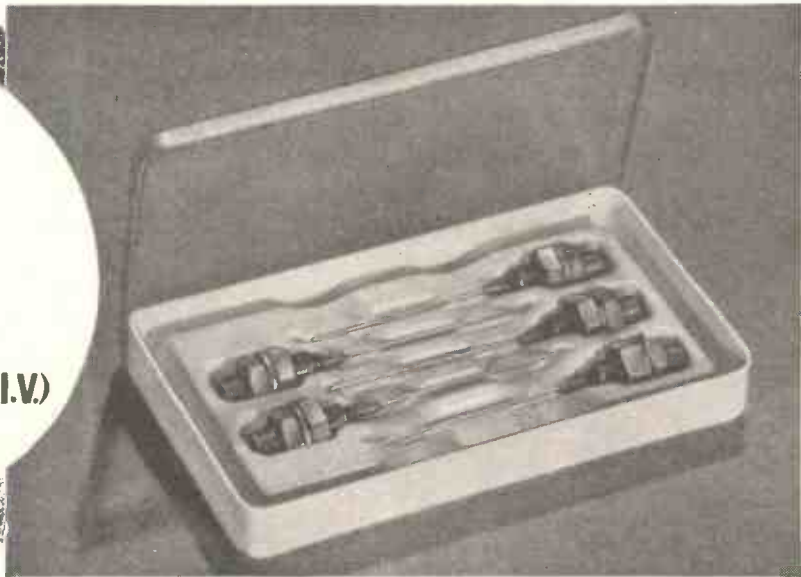
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 Input Impedance: 850 K.ohm shunted by 30 p.F.
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 Gain Control Range: 3:1
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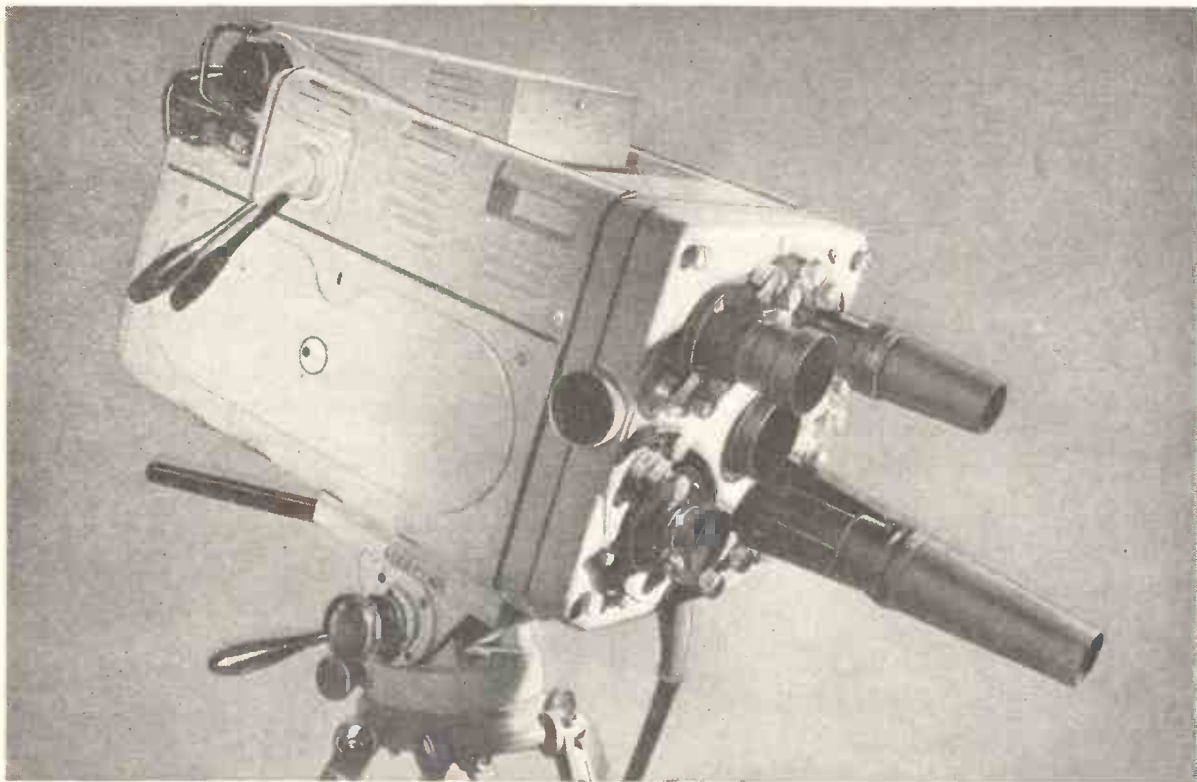
PHYSICAL
 Dimensions: 9½" × 6½" × 10½"
 Weight: 15½ lbs.
 Construction: Aluminium alloy.

TYPE WM4 PRICE £55

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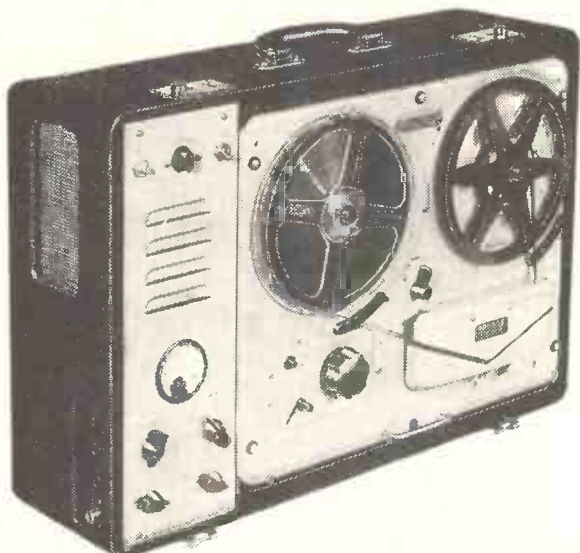
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★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

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★ The power output is 4 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.

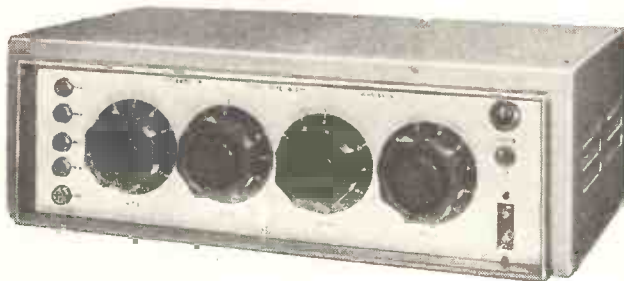
★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

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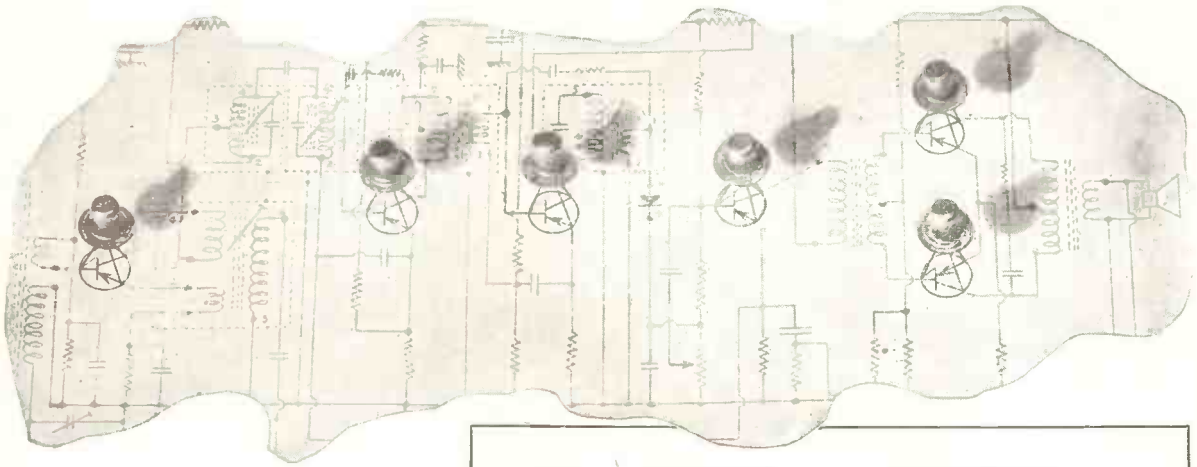
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 XB102	L.F. Stage	Average current gain 30. Noise factor * (common emitter) 6db.
 XB103	L.F. Stage	Average current gain 66. Noise factor * (common emitter) 6db.
 XC101	† Output Stage	* $f = 1000$ c/s, source impedance = 500Ω $V_c = -2V$, $I_c = -0.5mA$. Maximum collector dissipation (absolute) 115mW at 35°C ambient. Maximum junction temperature (absolute) 70°C. Thermal resistance in free air 0.3°C/mW. Thermal resistance with appropriate heat sink 0.21°C/mW.

† The XC101 is also available in matched pairs for push-pull output.

RV.35a

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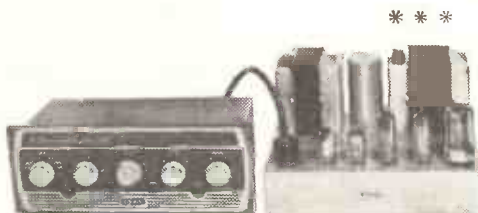
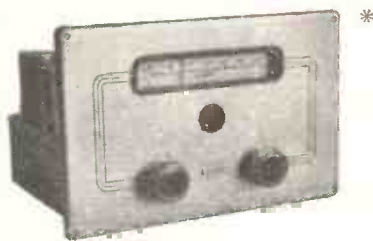
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● *The full test report appeared in the February, 1957 issue of "Wireless World," pages 22 and 23.*



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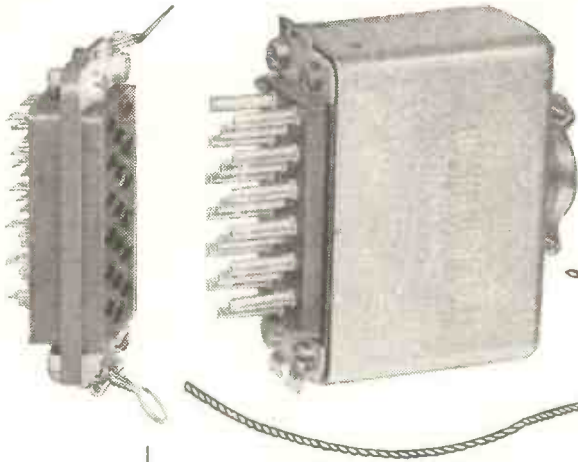
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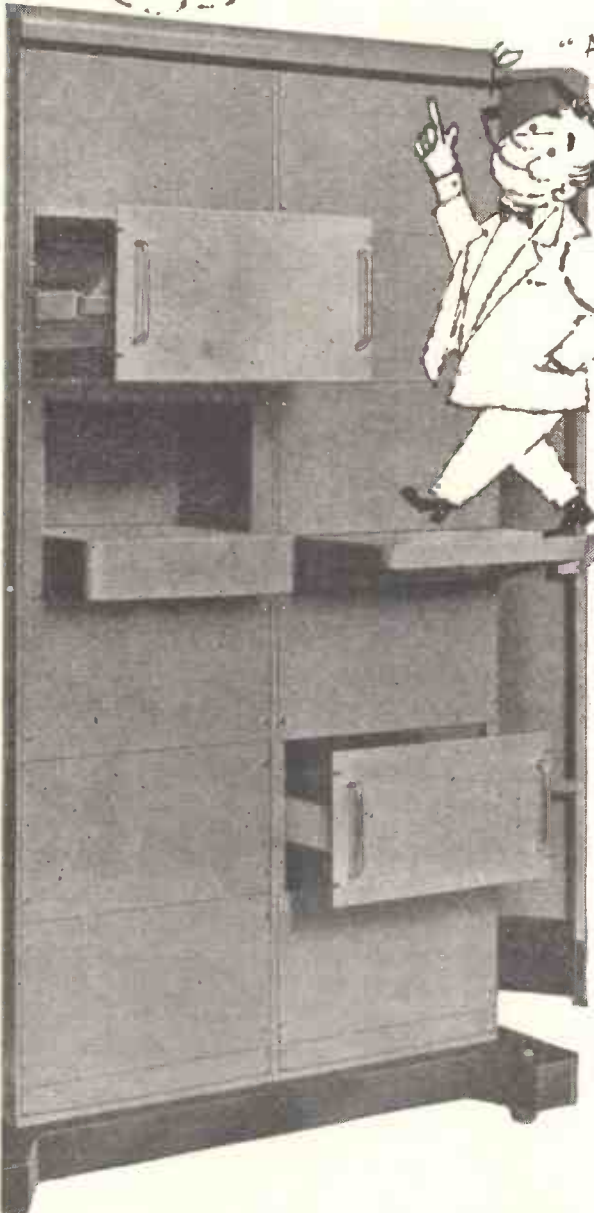
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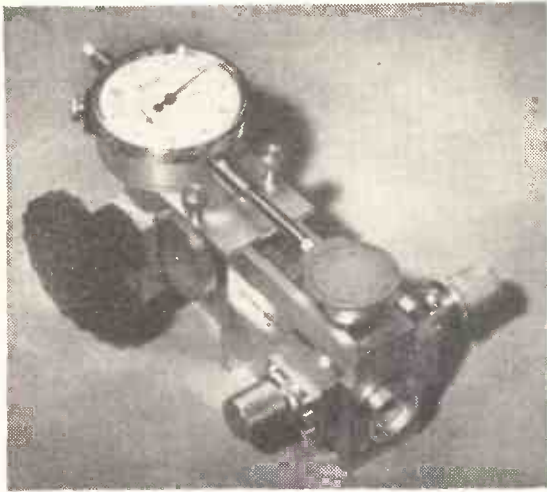
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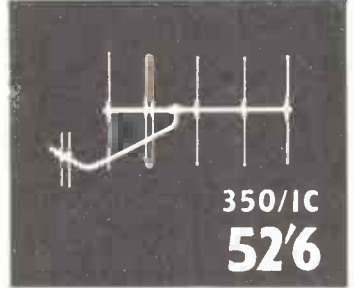
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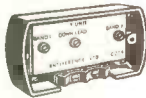


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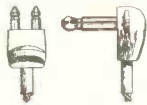
A/S DANAVOX Miniature Components



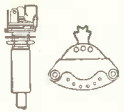
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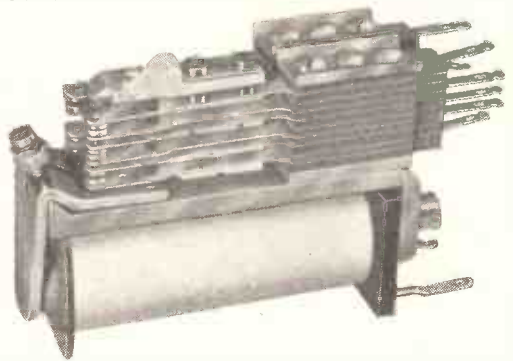


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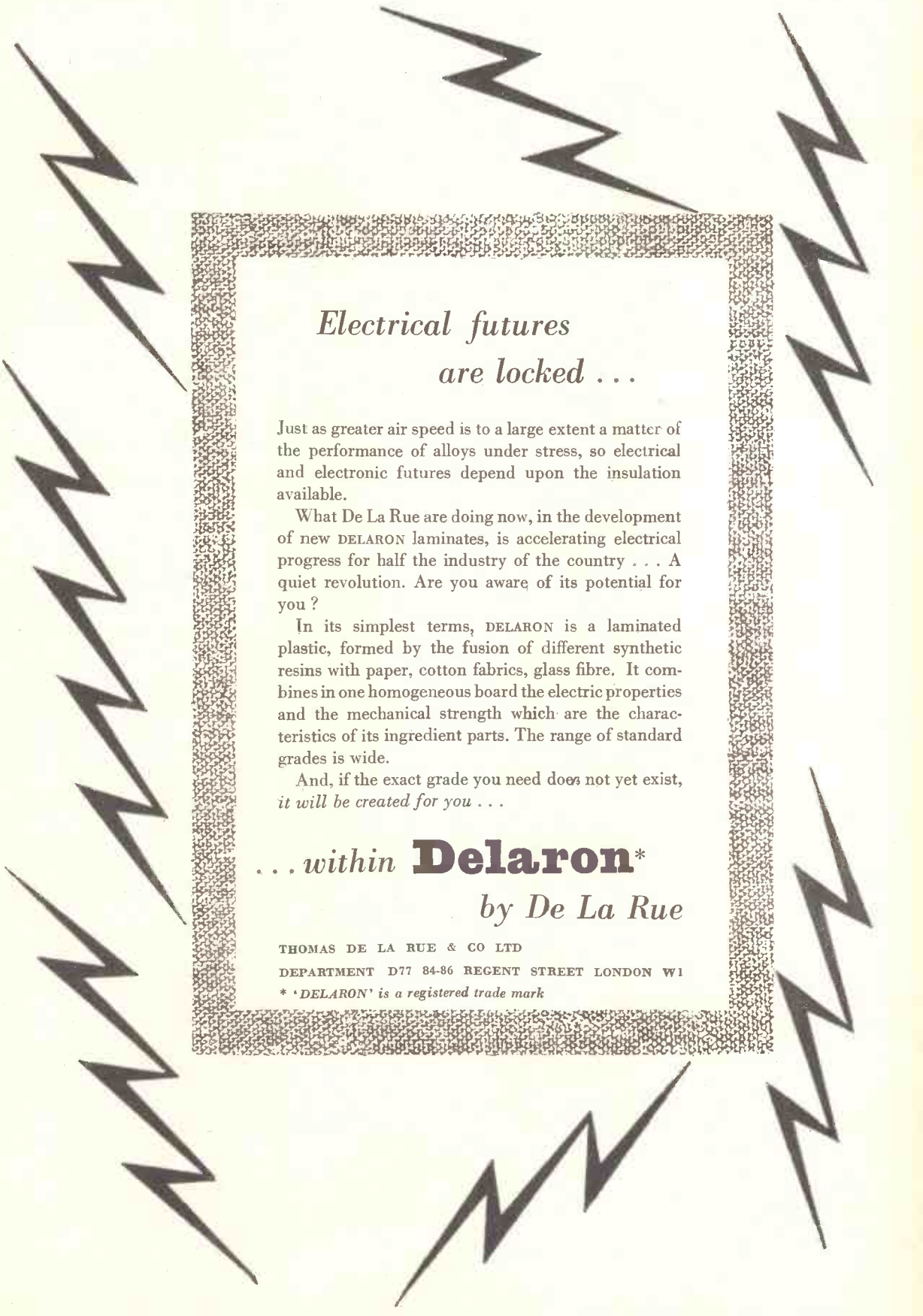


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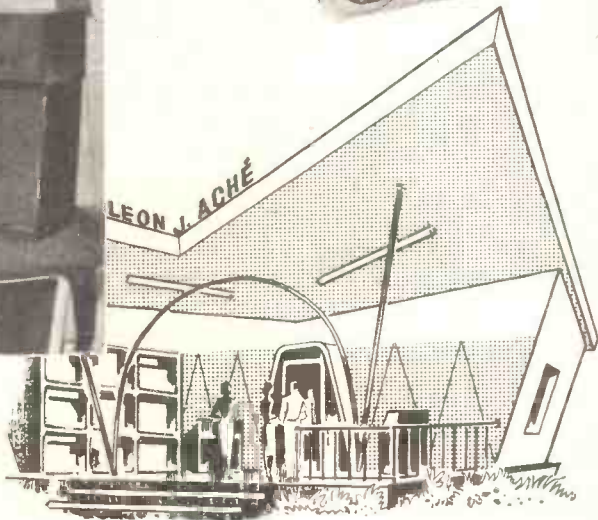


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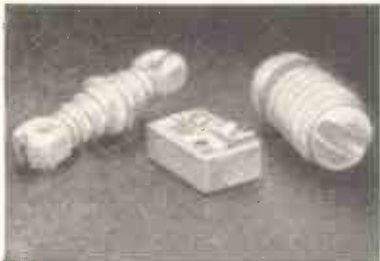
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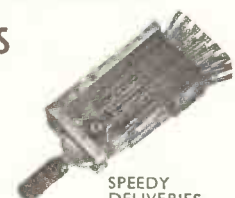


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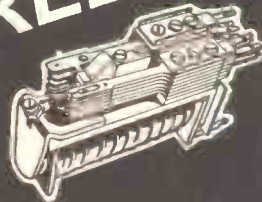
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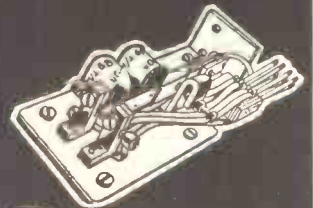
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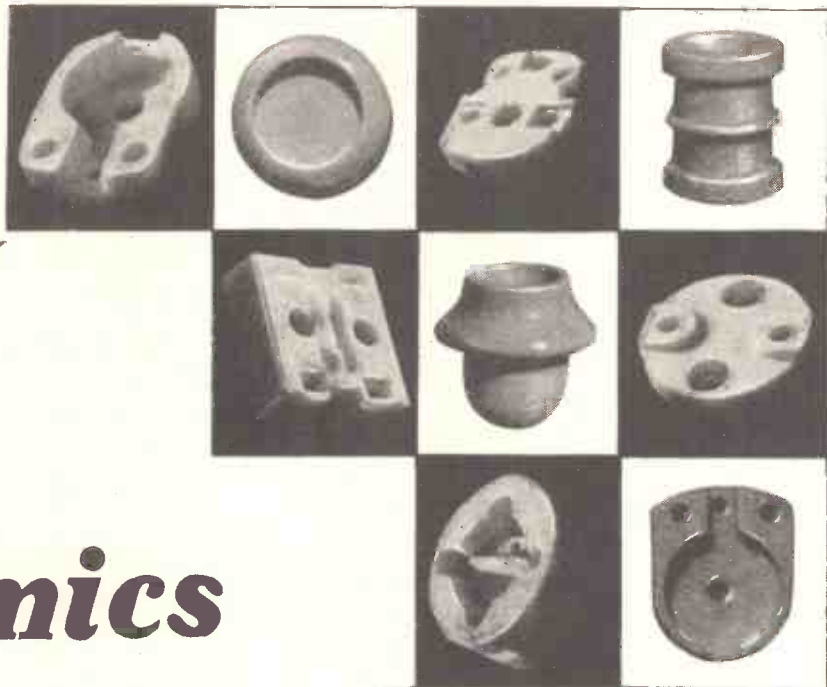
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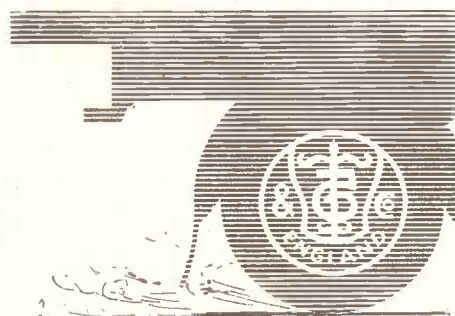


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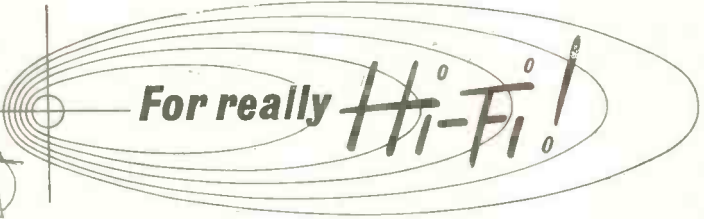
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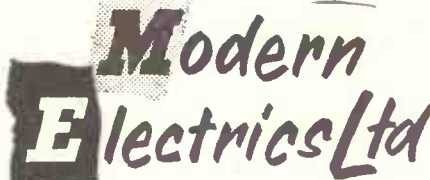
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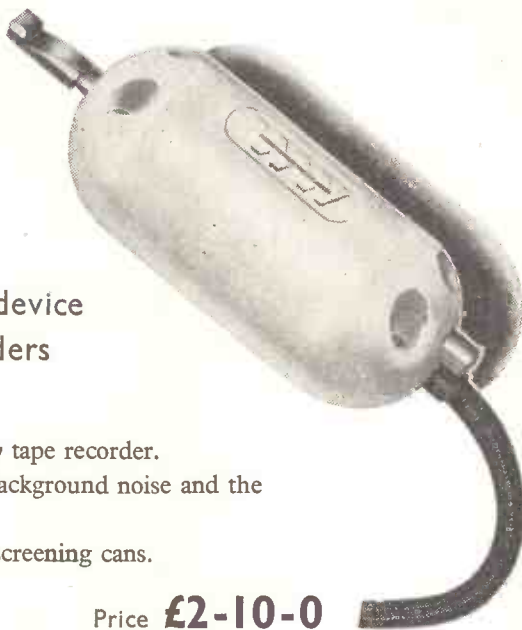
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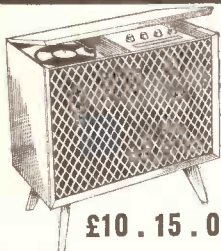
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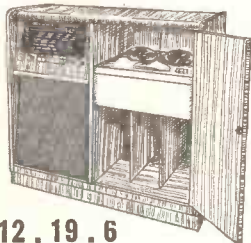


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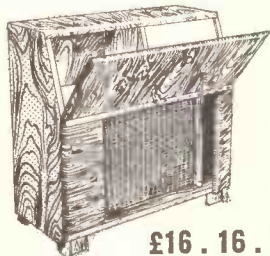
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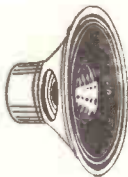
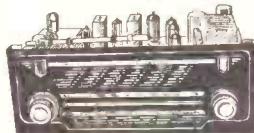


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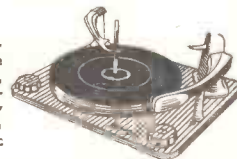


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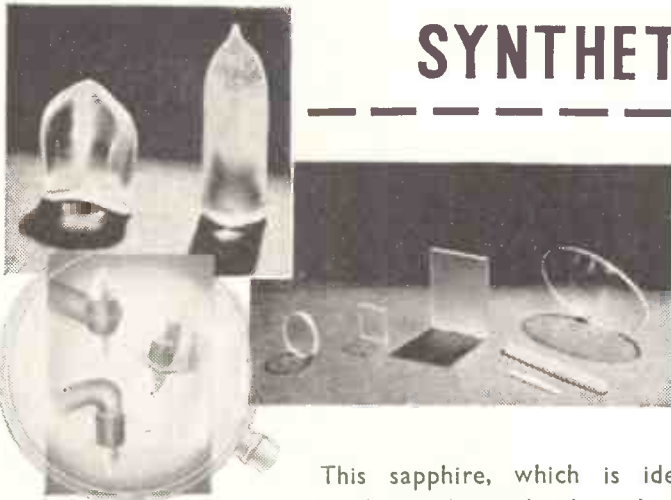
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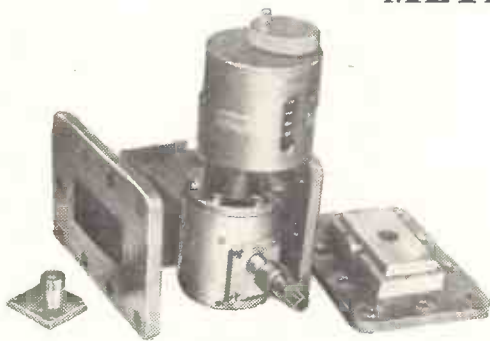
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RT37/PPN2 BEACON TRANSMITTER-RECEIVER. 214-234 Mc/s. Size 13in. x 10in. x 5in. Contains 5 3A5, 3 1S5, 1 IR5 and 2 2 v. synchronous vibrators. Operates from 2 v. accumulator via 2 built-in vibrators. Complete with telescopic mast antenna system (9½ft.), lightweight headphones. Technical Manual, super quality carrying haversack, cords, co-ax cables, plugs, etc. Total wt. 28lb. BRAND NEW, boxed. American equipment, 72/6.

PYE 45 Mc/s. IF STRIPS. Complete with 7 valves and CIRCUIT. New. ONLY 39/6. **RF UNITS.** ALL BRAND NEW AND BOXED. RF24 7/6, RF 26 25/-, Post 2/6.

Two-Way MORSE TRAINING SETS, W/T Mk. 3. Consists of 2 valve oscillators (ARP12's) (one with pitch control), for 1 or 2 operators. Has provision for creating "atmospherics." In polished oak case 12½in. x 10in. x 8in., wt. 16 lb. Complete with valves, leads, 2 keys, 7-way terminal board, circuit and instructions, but less batteries and phones. Ideal for Cadets, Scouts, etc. SNIP. 19/6, carr. 7/6.

VARIAC TRANSFORMERS. Semi-variable input 200-240 v. 50 c/s. Output 7.5 amps., 1.65 KVA. 8 x 4½ x 4 inches. Wt. 14lb., 89/6.

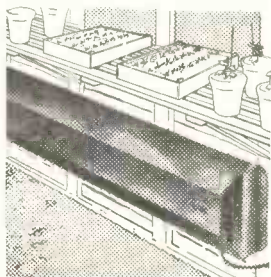
MAINS DIMMERS. 300 ohms, 1 amp, 300 watts, twin ceramic formers, 15/-.

FIELD TELEPHONES. Army type D, Mk. 5. Buzzer calling. Ideal for building sites, farms, workshops, etc. Complete with handset and batteries. Tested, 39/6 each. **CRYSTALS.** 200 Kc/s American GEC, 10/- each. 100 Kc/s R.C.A. bars, 19/6 each.

PLEASE ADD POSTAGE OR CARRIAGE ON ALL ITEMS

CHARLES BRITAIN (Radio) Ltd.
11 UPPER SAINT MARTIN'S LANE,
LONDON, W.C.2. TEMple Bar 0545
One minute from Leicester Square Station (up Cranbourn Street)
Shop Hours: 9-6 p.m. (9-1 p.m. Thursday) Open all Saturday

INSTANTUS HEATER



Convector heater, 1 kW. rating, 4ft. long, made from heavy gauge sheet steel (galvanised). Can be used for greenhouses, workshop, aviary, etc., etc. Price £2/10/-, or with thermostat, £4/5/-, carriage 5/- GUARANTEED 5 YEARS. 2 KW MODEL. Free standing thermostatically controlled, £5/17/6.

DON'T BE CAUGHT LIKE THIS



CAR STARTER CHARGER KIT

All parts to build 6- and 12-volt charger which can be connected to a "flat" battery and will enable the car to be started instantly. Kit comprising the following.

- Mains transformer 22/6
 - 5-amp. rectifier 17/6
 - Regulator Stud Switch 3/6
 - Resistance Wire 2/-
 - Resistance Former 2/6
 - Mains on/off Switch 2/6
 - 0.5 amp. Moving Coil Meter 12/6
 - Construction Data 1/6
- or if bought all together price is 52/6, plus 2/6 post and packing.

FLUORESCENT LIGHTS



These are complete fluorescent lighting fittings. Built-in ballast and starters—stove enamelled white and ready to work. Ideal for the kitchen, over the work-bench and in similar locations.

- Single 40. 4ft. 3in. long, uses a 40 watt tube.
- Twin 20. Uses 2 20-watt standard tubes. Price 39/6 each, with tubes.
- Carriage and ins. up to 150 miles 5/8, up to 250 miles 7/6.

POCKET TRANSISTOR RECEIVER

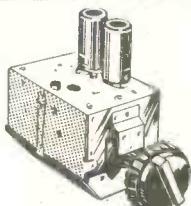
All the parts to build cigarette box receiver, £2/17/6, includes Ferrite aerials but not the earpiece, battery or case.

WESTINGHOUSE (U.S.A.) METERS



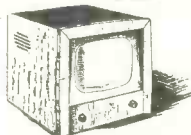
All moving coil flush mounting type, outside diameter of face 3 1/4 in.

- 0-500 v. D.C. 20/-
- 0-1.5 kV D.C. external multiplier. 25/-
- 0-2.5 kV D.C. external multiplier. 25/-
- 0-15 v. A.C. 15/-
- 0-1 mA. 25/-
- 0-50 mA. 15/-
- 0-100 mA. 15/-
- 0-150 mA. 15/-
- 0-250 mA. 15/-
- 0-500 mA. 15/-



TURRET TUNER

Brand new stock, not surplus, with coils for Band I and III, complete with valves PCC84 and PCF80—I.F. Output 33/38 Mc/s with instructions and circuit diagram 79/6. With knobs 3/6 extra, post and ins. 2/6.



14" T.V. CABINET

14in. T.V. cabinet of the latest styling made for one of our most famous firms—beautifully veneered and polished—limited quantity—19/6 each. Carriage and packing 3/6 extra.

CABINETS FOR ALL

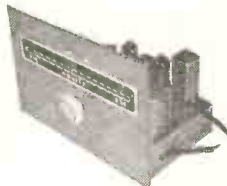


The CONTINA

Another addition to our range of cabinets. This is of new revolutionary design, styled after the best of Continental radios. Externally, it is finished in highly polished dark walnut veneer, with panelling picked out in gold. Interior is of same very high standard, its veneer being light mahogany which contrasts nicely with the dark walnut and generally gives a very pleasing appearance. The doors slide on metal runners and are fitted with gold insert finger plates. A really excellent cabinet for any home—size 3ft. 1 1/4 in. long, 1ft. 3in. deep, 2ft. 1 1/4 in. high, including legs which are 10in. from floor. Motor board 12 1/2 in. x 7 in., equipment aperture 17 1/2 x 9 in. gives ample space for 8in. speaker. Ample storage space for recordings. Price £19/19/-, carriage and insurance, 20/-.

F.M. TUNER

This is a high fidelity unit which although moderately priced has a performance equal to the highest priced. Its stability is very good and extremely good results have been received with the simplest of aerials as far away as Eastbourne. The unit is made up ready to work and has its own power supply for A.C. mains. Demonstration at all our branches. Price 12 gu. or £1/12/- down and 6 payments of £2. Post plus insurance 5/.



THIS MONTH'S SNIP

The OCTAVIAN



3 valve 4 watt with frequency response better than 40-15,000 C.P.S. Control panel size 8in. x 2 1/4 in. comes fixed to chassis but is intended for independent mounting. Separate bass and treble controls giving fullest variation of cut and lift. Separate switch, absolutely no mains hum. Remarkable value at £4/19/6. Post and insurance 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 7 1/2 x 9 x 7 1/4 in., wall mounting, designed for ships' use, but equally suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

UNITS FOR CONTROLLED AUTOMATIC ROTATION



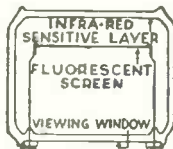
We have two items of equipment which form part of the radar system EC84. These two units work together to form a Tower rotating device, with remote control. Item 1, known as Tower 24A, is in fact the geared driving motor which rotates the mast. This is quite a heavy construction and would rotate a heavy 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 selegn transmitter/receivers and it is these that provide the impulses which cause

the aerial to rotate backwards or forwards. 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.

THERMAL DELAY

VACUUM RELAY

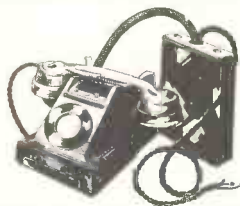
This can be the basis of a process timer—plastic sealer controller. Sequence switching—infra red indicator—overload protection. Our booklet free with the relay or separately 1/6, gives suggested circuits. Hermetically sealed with 4-pin base, heater resistance approx. 1,500 ohms. Approximately 17 milliamps through the heater coil will cause the contacts to close. Limited quantity—8/6 each, post and insurance 1/6.



"SNIPER-SCOPE"

"Cats eye" used for seeing in the dark. Will work burglar alarms counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Price 5/- each. Post and ins. 1/-. Data will be supplied with cells if required.

OFFICE TELEPHONES

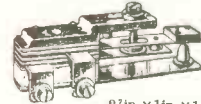


New G.P.O. telephone sets with internal bell and push button switch easily connected together to form office intercom. Price £2/10/- each. Carr. & ins. 4/6.

MAKE SERVICING SAFE

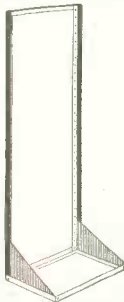
Mains isolation transformer wonderfully built. 500 watt continuous or 2000 watt intermittent loading. Double insulated and double screened. Screens brought out separately. Size approx. 14in. x 6in. x 6in. Weight approx. 40 lbs. Price while stocks last £5/12/6.

THERMOSTATS



2 1/2 in. x 1 in. x 1 1/4 in. high. Useful for the control of appliances such as convector, gluhepta, vulcanisers, hot plates, etc. Adjustable to operate over temperature range 50-550 deg. F., fitted with heavy silver contacts. 1 1/2 amp., 3/6; 5 amp., 8/6; 2 amp. QMB, 5/6; 15 amp. QMB, 15/-; 15 amp. wall mounting type, 19/6.

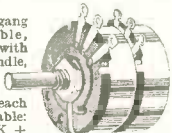
RACKING EQUIPMENT



STANDARD OPEN RACK 6ft. high and 19in. wide, heavy steel construction. Price £2/15/-, plus carr. MICA PANELS Pure mica panels size 2in. x 4in., 3/- per dozen.

MORGANITE POTENTIOMETERS

Single and 2 gang types available, standard size with good length spindle, all new and boxed.
Gang type 3/- each—values available: 5K + 5K, 100K + 100K, 1 meg. + 1 meg. Single types 1/- each, values available: 10K, 25K, 50K, 100K, 250K, 1 meg., 2 meg.



CRYSTAL MICROPHONE

Miniature crystal type has high gain and is suitable for all purposes—tape recorders—amplifiers. Price 4/9, post and ins. 9d.



VARIABLE RHEOSTAT TRANSISTORS

A good range of transistor parts, miniature transformers, electrolytics, etc., available at all branches.
Red Spot and audio... 10/-
Blue Spot 1.6 Mc/s... 15/-
White Spot 2.5 Mc/s... 20/-



W.D. CIRCUIT DETAILS

Diagrams and other information extracted from official manuals. All 1/6 per copy, 12 for 15/-

- | | |
|---------------------------|---------------------|
| American Service | R.109 |
| Sheets | 78 receiver |
| A.1134 | 76 receiver |
| BC.348 | R28/ARC5 |
| BC.312 | R1116/A |
| R.103A | RA-1B |
| E.C.342 | AR85D |
| RA-1B | AN/APA-1 |
| R-208 | 78 |
| R-1155 | 76 |
| R-1124A | R.T.18 |
| R-1132A/R-1491 | CAY-46-AAM- |
| R-1147 | RADAR |
| R-1224A | A.S.B.-3. |
| R-1082 | Indicator 62A |
| R-1355 | Indicator A.S.B.3 |
| B.C.1206-A/B | Indicator 62 |
| B-455-A (or -B) | Indicator 6K |
| B-455-B (or -C) | R.F. unit 24 |
| B-455-A (or -B) | R.F. unit 26 |
| Transmitter T1154/ | R.F. unit 25 |
| B.D.J.N. | R.F. unit 27 |
| Fifty-eight walkie-talkie | Wireless set No. 19 |
| Frequency meter | Demobbed valves |
| B.C.221. | |

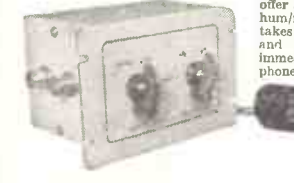
FREE THIS MONTH
To all "Wireless World" readers who send S.A.E. we will present free a copy of our booklet:—
"MAKING AN ELECTRIC BLANKET"

MULLARD AMPLIFIER



A Quality Amplifier designed by Mullard. Power output exceeds 10 watts. Frequency response almost flat from 10 to 20,000 C.P.S. For use with the Acos "Hi G" and other good pick-ups. Made up and ready to work is £12/10/- or £1/10/- down and 8 payments of £1/10/-, plus 10/- carriage and insurance.

MULLARD PRE-AMP. We are pleased to offer as a ready-made unit. It uses the low hum/noise high gain pentode type EP36. It takes its power supply from the amplifier and incorporates 2 switches to provide immediate compensation, for radio, microphone, L.P. and 78 records. The price of this unit is 24 post and insurance 3/6 extra.
Or 10/- down and 9 payments of 10/-. If purchased with above, combined price is £18 or 30/- down and 8 payments of £2.



AUTO-CHANGER 30/- DEPOSIT

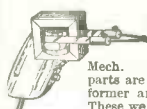
3-SPEED & 4-SPEED GRAMOPHONE AUTO-CHANGER

Latest types by all famous makers are invariably in stock at competitive prices. BSR, Monarch, Garrard, etc. Latest models from £3/10/-, or deposit £1/10/- and 8 payments of £1 plus 5/- carriage and insurance.



MAKING A SOLDER GUN

A 7-second solder gun of the type costing £3-4 was described in Prac. Mech. Only two essential parts are required—(a) transformer and (b) push switch. These we can supply at 13/6, plus 2/- post. The rest of the parts you will have in your own "junk" box. Copy of the article concerned given free with the kit.



BABY ALARM

Unlike most baby alarms, this not only enables you to hear baby but also to talk to him. Price complete with one microphone and 100ft. twin flex £6/19/6, carriage 3/6, additional microphone, 19/6.



CLOCK CASE

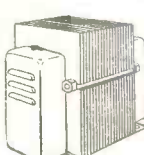
Also suitable for barometer or other instrument. Nicely polished. Price 4/6, post and packing 1/6.



Clock numerals to suit these cases etched on metal, 2/6.
Post 9d. if ordered separately.

TRANSFORMERS SNIP

Standard tapped mains input. Output 6.3 at 3 amp. 5 v. at 2 amp. and 350-0-350 at 80 millamps. Equipment but guaranteed perfect. 2/9 plus 2/6 post and packing. (Note this transformer is a half shrouded drop-through type.) Similar voltage but 250 m.a. 27/6. Post 3/6.



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, £4/10/-, plus 3/6 post. Constructional data free with the parts, or available separately, 1/6.



BARGAINS TO CLEAR

AC/DC Superhet Chassis. Long Medium and Short wave, modern 5 valve circuit, unused, but may be slightly storage soiled. Only 29/6 (coil pack worth more) non-callers add 6/6 carriage and insurance.

AC Superhet 5 Valve Chassis. Medium and two Short, unused but less valves and mains transformer. Uses standard octal range, 27/6 (again coil pack worth more), non-callers add 6/6.

AC Superhet 7v 5 Waveband Chassis. H.F. stage. Unused, less valves and power pack. Slightly soiled. Coil pack worth twice as much, circuit diagram supplied, £2/15/-, carriage and insurance 7/6.

AC 4 Valve Superhet, complete with valves but less scale and pointer, unused. Circuit diagram supplied, 39/6 plus.

Note that the above four chassis although unused will need checking. On account of low price no guarantee is given. Nor, we regret, can technical assistance be given.

1mf. 350 v. small tubular metal. Made by Dubilier. 2/6 per dozen.

Germanium Diodes. B.T.H. with wire ends, 10d. each or 9/- dozen.

Midget I.F. Coils, dust cored, size 1 1/2 x 1 in. 465 Kc/s, 4/6 pair. Standard size I.F. Coil, dust cored, 465 Mc/s, 4/6 pair. Coil Pack for Superhet, 465 Kc/s I.F. Medium and 2 short waves, 9/6.

Cathode Ray Tube. VCR 97. Instrument type, new 7/6 each, carriage 3/6.

Bakelite 5 amp. electric wall switch. "Hicraft," 9d. each or 8/- per dozen.

Series, parallel and off-electric wall switch, made by Crabtree. Price 1/3 each or 13/6 per dozen. **Amplifier, ex-Government unit 1134,** contains one double triode and one triode, 6/6, post and insurance 2/6.

Connecting wire, PVC covered 24 swg. copper, 2/6 per 100ft. or 5 coils different colours for 10/-. **Scanning coils,** by very good maker, new and unused, 4/6 complete.

Choke, 200 m.a., first-class. Made for Services—new, 6/6, post 1/6.

10v. Superhet 1 1/2 metre, ex-Govt., but unused. Complete with valves. Easily converted for Band III, 39/6, carriage and packing 7/6.

Mains Transformer, 250-0-250, 60-80 m.a. 6.3v. Standard mains input. Half shrouded, 12/6, post and insurance 2/6.

R.F. 25 Tuning Unit. New, unused and complete with valves, 9/6, post 2/6.

Cathode Ray Tube, VCR 517, 8/6 each, carriage 2/6.

Mains Lead, metal screened to stop interference, 9d. yard.

Thermo-couple, mounted on valve base, useful for experiments and schools, 6/6 each.

Midget push-pull input transformer and push-pull output transformer, to match, 8/- the pair.

Note: Orders for small components over £2 are post free, otherwise please add sufficient.

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 1 1/4 x 3 1/4 in. Chassis size 15 x 5 x 2 1/2 in. deep. Price £5/- plus 1/6 post. Note: We can supply cabinet for this. 39/6 and 5/- p. and p.

Complete T.V. Commercialising Outfit Sent for 14/6

Hundreds of people have already fitted our T.V. converter and now enjoy BBC and ITA programmes—you can do the same. Our outfit contains: ITA Converter—ITA Aerial—36ft. Co-ax Down Lead—Interference Suppressor—Illustrated detailed instructions—nothing else to buy, all for £8/10/-, carr. and ins. 4/6 or 10/- payments of £1.



ELECTRONIC PRECISION EQUIPMENT LTD.

266 London Road, Croydon. Phone: CRO 6558. Half-day Wednesday.

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 addressed to E.P.E. LTD., Dept. 2, SUTTON ROAD, EASTBOURNE. All enquiries to Eastbourne address and please enclose S.A.E., terms are cash with order.

LASKY'S RADIO

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL

TRANSISTORS AT A REASONABLE PRICE

R.F. P.N.P. Junction type, suitable for medium and low frequency oscillators, frequency changers and I.F. amplifiers **21/-**
1.5 to 8Mc/s (double spot—yellow & red)
AUDIO P.N.P. Junction type, suitable for high gain and low frequency amplifiers, and for output stages up to 250 milliwatts. **10/-**
(double spot—yellow and green).
Post Free.

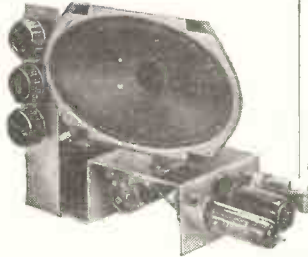


SPECIAL PRICES FOR 6 AND OVER.

- ★ TESTED AND GUARANTEED EFFICIENT
- ★ HERMETICALLY SEALED and unaffected by temperature variations.

Full operating data and circuit diagrams for a simple receiver superhet, T.R.F., multi-vibrator, relaxation oscillator, audio amplifier, oscillators signal tracers, etc., supplied with each Transistor.

MULLARD TRANSISTORS		BRIMAR TRANSISTORS	
OC70 or OC71	OC72	OC16	TS1 15/-
21/-	30/-	60/-	TS2 21/-
			TS3 24/-
			TP1 or TP2 40/-
			TJ1 30/-
			TJ2 35/-
			TJ3 40/-



LASKY'S 4-WATT PORTABLE GRAM AMPLIFIER

Will suit any type of crystal or magnetic pick-up. Uses 3 valves: EL84 output, L63 and E280 rect. Speaker and controls are completely separate and can be mounted as shown or on anywhere in cabinet where most suitable.
COMPLETE with 3 valves and knobs, less Speaker. **79/6**
Carr. 5/-.
7 x 4in. Elliptical Speaker, if required, 19/6 extra.
Details and circuit diagram post free on request.

AUTO-CHANGERS

Our stocks are constantly changing. See us for your requirements or send for our list



COLLARO 4-SPEED MIXER AUTO-CHANGER

Latest model RC.456 incorporating auto and manual control enabling records to be played singly or automatically. Complete with Studio crystal pick-up and sapphire stylus. List £13.17.0. **LASKY'S PRICE £9.15.0**

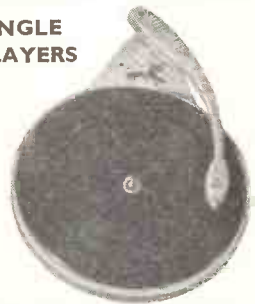
B.S.R. 4-speed with t.o. crystal pick-up. £8/15/-, post 5/-.

INTRODUCING LASKY'S TRANSISTORISED SUPERHET FRONT END TUNER ON PRINTED CIRCUIT

Uses three R.F. Transistors and one Germanium Diode, three I.F. transformers. Ferrite rod aerial. Operates on one 6 v. battery and one 1.5 v. cell.
Size of printed circuit, 3 1/2 in. x 3 1/2 in.
CAN BE BUILT FOR **£5.12.9**
Full details and illustrations post free on request.
Demonstrations at both addresses.
NOTE:—This Tuner in conjunction with our Transistor Amplifier (see below) makes an excellent Transistorised radio. Cabinets available.



SINGLE PLAYERS

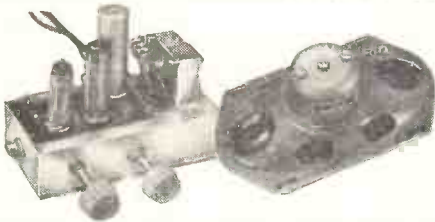


Collaro 3/554 3-speed Single Player with Studio T p.u., crystal cartridge and styl. **LASKY'S PRICE £6.19.6**
Carr. 3/6.
Collaro 4/456 4-speed Single Player £7/19/6.

CABINETS AND CASES
Large selection for TV sets, radiograms, record players, tape recorders, etc. at attractive prices.

PICK-UP BARGAIN
"RONETTE" Lightweight Crystal Pick-up with 2 cartridges. **LASKY'S PRICE 45/-**
Post 2/6.

ACOS HGP37 p.u. cartridges, l.p. and standard, complete with styl. List 41/7.
LASKY'S PRICE 17/6
Post 1/-.



LASKY'S PORTABLE GRAM AMPLIFIER KIT

2 watts. Note small dimensions: approx. 6 1/2 x 3 1/2 in., max. height 5 in. Uses EL84 output and 6X4 rectifier, double-wound transformer, tone control, output transformer, etc. Built on a T.C.C. PRINTED CIRCUIT which greatly simplifies construction and eliminates wiring errors.
COMPLETE KIT, including valves, printed circuit, full instructions, less Speaker **58/-**
Carr. 2/6.
7 x 4 in. Elliptical Speaker, if required, 19/6 extra.

THE TELETRON "COMPANION"

3-TRANSISTOR POCKET RADIO. T.R.F. circuit covering and long waves, with balanced armature output, Ferrite aerial. Note small size of case: 4 1/2 x 3 x 1 in. You can build this novel transistorised pocket receiver for only **89/6**
Full instructions and price list, 6d. post free. All components available separately.
Teletraon Coil FX25, 15/- Ardent Trans. D240, D239, 10/- each. Case and Fret, 8/6.

ALL TRANSISTOR COMPONENTS stocked. Trans., midget, min. and sub-min. Coils, Ferrite Rods, sub-min. Condensers, etc.

SUB-MIN. TRANSISTOR INTER-STAGE TRANSFORMERS. 4-1 ratio each **6/6**
Post 1/-.

TRANSISTOR TURNTABLES. 45 r.p.m., 6 volt, complete with pick-up **£5/19/6**
Post 5/-.

LASKY'S NEW MINIATURE 200 milliwatt TRANSISTOR AMPLIFIER KIT

FOR CONSTRUCTION ON A PRINTED CIRCUIT

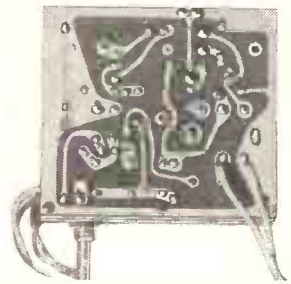
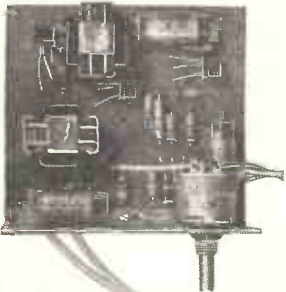
Size: 3 1/2 x 3 1/2 in. Height can be under 1 in.

Uses our new hermetically sealed Transistors and operates from 6 volt battery. The great popularity of this new kit has enabled us to substantially reduce our price.

SEND FOR FULL DETAILS, CIRCUIT DIAGRAM AND SHOPPING LIST, 1/-.
Post free.

LASKY'S PRICE FOR THE COMPLETE KIT including 4 Transistors, all brand new components, latest T.C.C. Miniature condensers, printed circuit and full instructions. **79/6**
Post 2/6.

You can have a demonstration at either of our addresses and you will be amazed at the results!
All components available separately.



MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE

RADIO · TELEVISION · HI-FI · ELECTRONICS · RECORDERS

CONTINENTAL AM/FM RADIOGRAM CHASSIS



LASKY'S PRICE
£16.19.6
Carr. 12/6.

Further purchase enables us to re-offer this wonderful bargain! Built throughout of latest high grade components. 5 valve plus metal rect., gram socket and switch, piano key wavechange, tone control, independent AM/FM tuning. Covers med., long and V.H.F. wavebands. Valve line-up: ECC85, ECH81, EF89, EA8C80, EL81. For A.C. mains 100-250 v. Also available: the IMPERIAL DE LUXE AM/FM Radiogram chassis with every up-to-date refinement and 3 speakers, £25. Post and packing 15/-.



WONDERFUL OFFER OF THE FAMOUS 'CHAMPION' BAND III CONVERTERS

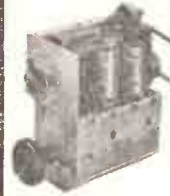
A high grade model covering all channels, Bands I and III, B.B.C. and ITV. Uses valves PCC84, EF80 and U78 rectifier. Incorporates own power supply. In attractive cream plastic case. Listed at £10.10.0.

LASKY'S PRICE
79/6
Post 5/-.



STILL FURTHER REDUCED!

BAND I-III TUNERS. Covers channels 8-4 pr. 1-9 with provision for 10 more coil sets. Output 16-19 Mc/s, easily modified to other outputs. Complete with power supply for 200-250 v. A.C., 2 Mazda valves, knob and circuit diagram.

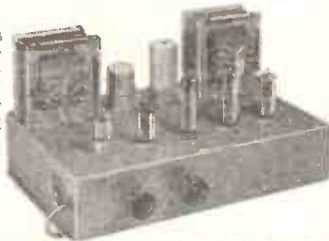


LASKY'S PRICE
97/6
Post 3/6.

HI-FI AMPLIFIER BARGAIN OFFER!

LIMITED QUANTITY ONLY

Complete with Mullard valves. Famous 5/10 circuit. Push-pull, 12 watts output. Separate bass and treble controls. Remote control for volume. Valves: Mullard, 2 EL84, 1 ECC83, 1 EF86 and rect. EZ80. Chassis: 12 1/2 in. wide, 8 1/2 in. deep, maximum height 7 in. Grey hammered enamel finish. For A.C. mains 200-250 v.



LASKY'S PRICE
£8.19.6
Carr. and pkg. 7/6.

BUILD YOURSELF A HIGH GRADE RECORD PLAYER!

We can supply the Units, Amplifiers and Cases for building either the Auto-Changer or Single Player illustrated.



Take this opportunity to build yourself an Auto or Single Player of high performance and handsome appearance. Any of these Units demonstrated at either of our addresses.

AMPLIFIER. 4 watt, 3 valve (EL84 output, L63 and EZ80 rect.), 7 in. x 4 in. elliptical speaker, separate bass and treble controls. Will suit any type of auto-changer or single player. Price, complete with 3 valves, knobs and speaker. **£59/6.** Post 5/-.

CASE FOR AUTO-CHANGER, as illustrated, size 18 in. x 15 in. x 9 in., fawn/brown finish. **79/6.** Post 5/- (Others from 69/6.)

CASE FOR SINGLE PLAYER, as illustrated, size 15 1/2 in. x 13 in. x 7 1/2 in., grey, with black/silver bands. **69/6.** Post 5/- (Others from 49/6.)

PLAYER UNITS. We recommend the following Collaro units with Studio turnover crystal pick-up:—
4-speed AUTO-CHANGER, RC4/456 **29 15 0**
3-speed SINGLE PLAYER, 3/554 **26 19 6**
4-speed SINGLE PLAYER, 4/456 **27 19 6**
(Other types of Auto-Changers and Single Players in stock.)
All the above are available separately.

MULLARD 510 AMPLIFIER KIT WITH T.C.C. PRINTED CIRCUIT

All specified components are used and you have your choice of transformers and chokes by Partridge, Haddon, W/B, Ellison or Gilson. Demonstrations given at any time.



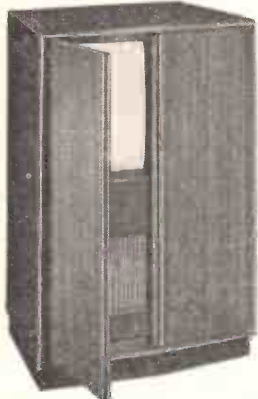
COMPLETE KIT of parts and Printed Circuit for building the Mullard 510, from **10 Gns.** Details on request. Book 3/6 post free. Printed Circuit separately, 22/6.

We can also supply this built ready for use. Price according to transformers used.

OSRAM 912 AMPLIFIER. Everything in stock for this fine quality hi-fi Amplifier. Can be built conventionally or on printed circuit. **BOOK** and full details, 4/-, post free.

All components for either above Amplifiers supplied separately. Price List on request.

BAND III AERIALS. All types, outdoor or indoor, also Diplexes, Crossover Boxes, Co-axial Plugs, Socket and Cable.



SUPERB TV CABINET ALMOST HALF PRICE

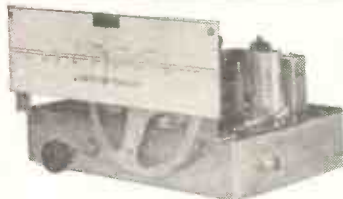
Dimensions: 36 in. high, 19 in. deep, max. width 26 in. Constructed of finest laminated wood with straight grain walnut veneer, inlaid maple. Fitted two full-length doors. Has cut-out for 21 in. projection TV but can easily be adapted for any size c.r. tube. Also can be adapted to house hi-fi equipment or a radiogram. A really handsome cabinet which cost £20 to manufacture.

LASKY'S PRICE
£10.19.6

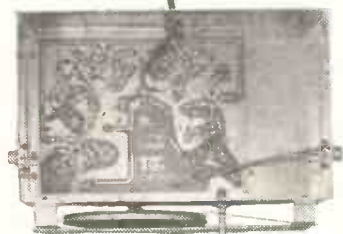
Carr. 21/- extra. Strictly limited number.

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE

LASKY'S RADIO



LASKY'S F.M. TUNER
PRINTED CIRCUIT VERSION
OF G.E.C. 912 F.M. TUNER
FOR HOME CONSTRUCTION



Note these star features:—

- ★ HIGH SENSITIVITY.
- ★ ALL BRAND NEW T.C.C. CONDENSERS.
- ★ AERIAL COIL AND R.F. COUPLING COIL PRINTED ON CIRCUIT.
- ★ 5 VALVES AND 2 GERMANIUM DIODES.

By the use of a printed circuit the I.F. and R.F. amplifiers are extremely stable at maximum gain and results are consistent on all tuners.

- Valve line-up—
R.F. Amplifier, Z719 or EF80.
Mixer and Osc. B719 or ECC85.
1st I.F. amp., W719 or EF85.
2nd I.F. amp., W719 or EF85.
2 Germanium Diodes GEX.84.
Driver Limiter, Z719 or EF80.

CAN BE BUILT FOR 8 gns.
(Including Valves)
Post and pkg. 2/6.

G.E.C. F.M. Tuner Book plus our full data and shopping list 2/6 post free. All parts available separately.
ALIGNMENT SERVICE available.

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL

BUILD THIS GRAND BATTERY PORTABLE FOR ONLY 7 GUINEAS

OR AS A MAINS/BATTERY FOR ONLY 9 GNS.



PRINTED CIRCUIT makes construction amazingly easy and accurate. You can build this fine 4-valve superhet portable in an hour or so, and performance equals ready-built sets costing pounds more!

FOR ONLY £7/7/- plus 3/6 carr. and pkg., you can build this Portable using all brand new components and valves, only batteries extra. Printed circuit, circuit diagram, and full instructions supplied.

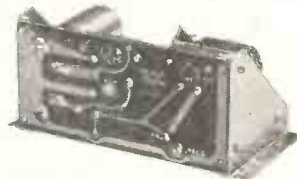
If you would first like to study the layout of this portable send 1/6 for Circuit Diagram, illustrations and full data.

SPECIAL COMBINED OFFER

FOR ONLY £9/9/- plus 3/6 carr. and pkg., you can build this job as a mains and battery Portable using the Power Unit illustrated and described below.

DEMONSTRATIONS GLADLY GIVEN AT EITHER OF OUR ADDRESSES.

POWER SUPPLY UNIT



for the above 4-valve portable. For 200-250 v. A.C. Latest design using PRINTED CIRCUIT, brand new TCC condensers, latest S.T.C. metal rectifiers, etc. Made for the new low consumption valves; constant voltage h.t. and l.t. guaranteed, valves cannot be over-run. COMPLETE KIT, including Printed Circuit and full instructions. 45/-.

Note: The above Power Unit is also suitable for most other battery portables.



10 STAR FEATURES

- ★ PRINTED CIRCUIT, size 7 1/2 x 2 1/2 in.
- ★ 4-valve Superhet, med. and long waves.
- ★ Low consumption Valves. Double Battery Life.
- ★ Ferrite Rod Internal Aerial.
- ★ 5in. P.M. Moving Coil Speaker.
- ★ Brand New T.C.C. Capacitors.
- ★ Automatic Volume Control
- ★ New Style Contemporary Case
- ★ Lightweight and Handsome Appearance.
- ★ Every Component available separately.

JASON F.M. TUNER

Special parcel containing data book, chassis, front panel, dial, drive, tuning condenser, full sets of coils, I.F.'s ratio detector, etc. Post 2/6. DATA BOOK with price list 2/- Note: This tuner uses 4-6AM6 and 2 crystals and can be built for £6/15/-, plus 3/6 post.

JASON "ARGONAUT"

Super-sensitive Tuner for F.M. and medium waves. Complete parcel with power supplies. Post 3/6. £13.19.6 DATA BOOK 2/- post free. Chassis Assembly 57/9 post 2/6. I.F. and Coil Set 78/- post 1/6. All components available separately.

OTHER F.M. TUNERS

TSL, £17/10/- DULCI, £17/10/- Also Quad, Leak, R.C.A., Rogers, Pamphonic, etc. DULCI H4/T 4-wave AM/FM Tuner, £20/17/-.

HI-FI SPECIALISTS!

Selective Demonstrations of all the latest and best Hi-Fi equipment are given at our Tottenham Court Road showrooms. Call and see our large and comprehensive stocks.

PICK - UPS. Garrard, Leak, Connoisseur, Orthophone, B/J., etc., etc. SPEAKERS. Wharfedale, Goodmans, G.E.C., Lowther, Lorenz, etc., etc.

NOTE. We can still supply Goodmans Speakers at pre-increase prices. Why wait and pay more?

AUDION 60 ... £9 2 6 TREBAX £6 4 0
AXIOM 150, Mk. II £10 15 9 AXIOM 22, Mk. II £14 14 0

TRANSCRIPTION TURNTABLES. 3 and 4 speed Garrard, Connoisseur, Collaro, Lenco, etc.

AMPLIFIERS. Quad, Rogers, Leak, R.C.A., Pamphonic, Unitelex, W.B., etc.

CABINETS. Wide selection and bargain value in Cabinets and cases to house your speakers and hi-fi equipment.

NEW BRENNEL MARK IV DECK

Now available! Entirely redesigned to permit of conversion to stereophonic sound with 4 heads for dual channel operation when required.

DECK only 22 gns.

DECK WITH PRE-AMP. UNIT and magic eye indicator ready for use with any standard amplifier 38 1/2 gns.

COMPLETE MARK IV TAPE RECORDER, as illustrated. Counter 30/- extra. 53 gns.



Come and inspect the new Brennell Mark IV and have a demonstration. Full details post free on request.

HIRE PURCHASE TERMS AVAILABLE
on certain items. Write stating requirements.

TAPE DECKS

Collaro "Tape Transcriptor," Mk. III, £22.

Truvox Deck, Mk. III, 23 gns.

Truvox Deck, Mk. IV, £27/6/-.

Lane Deck, £18/10/-.

Wearite Decks, £35 and £40.

TAPE RECORDERS

Leading makes — Grundig, Elizabethan, Truvox, Sound, Vortexion, etc.

ALL LEADING MAKES OF RECORDING TAPE IN STOCK. Also all types of Spools.

COLLARO TAPE DECK MOTORS, set of 3, clockwise, anti-clock, capstan. List £5/15/-.

LASKY'S PRICE 95/- Post 5/-.

MAGNETIC RECORDING TAPE, kraft base, on Cyldon metal spool, 1,200ft. 10/6. Post 1/-.

HI-FI ELECTROSTATIC SPEAKERS ("TWEETERS")

Easy to fit to any radio, TV receiver or amplifier. Full data and circuit diagram supplied.

LSH75. For outputs up to 6 watts, 8/-.

LSH518. For outputs of 10-12 watts, 12/6.

LSH100. For outputs up to 20 watts, 14/-.

Post free.

LPH65. MOVING COIL TWEETER. Imp. 5.5 ohms, freq. range 2,000-2,200 c/s. For outputs up to 6 watts. 2 1/2 in. diameter. All post free. 39/6

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE

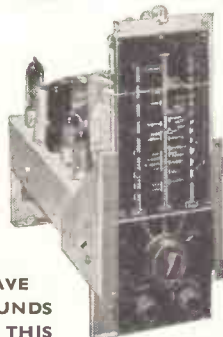
EVERYTHING FOR HOME CONSTRUCTOR & SERVICEMAN



TRUVOX 'SENIOR' SPEAKER DRIVING UNIT (pressure type)
Power handling cap. 15 watts peak. With 12ft. cinema horn reproduces down to 17cps.
List £7/15/- Lasky's Price **59/6**
Carr. 5/-

MOVING COIL P.M. SPEAKERS

- 2 1/2 in. 17/6
- 3 in. and 3 1/2 in. 19/6
- 5 in. 19/6. 6 1/2 in. 17/6. 8 in. 21/-
- 10 in. 29/6. 12 in. 29/6
- 6 1/2 in. with transformer 21/-
- 7 x 4 in. Elliptical. 19/6
- 10 x 7 in. Elliptical. 32/6



SAVE POUNDS ON THIS 6-VALVE RADIOGRAM CHASSIS COMPLETE WITH VALVES

Famous Manufacturer's Surplus. 6-valve 3-wave Superhet. 13-50 m. short. 200-550 m. medium. 1,000-2,000 m. long. Brand new Mullard valves: ECH42, EF41, L83, EB41, 6V6, g.t., EZ40 and finest quality components. Gram., switch, 465 Kc/s I.F. tone control, three-colour dial. Overall size 13 1/2 x 5 in. height 12 1/2 in. Aperture required for dial and controls 11 x 3 1/2 in. Complete with valves, output trans., knobs, etc.

LASKY'S PRICE £10/19/6
Carriage and packing 7/6 extra.

5-VALVE RADIOGRAM CHASSIS COMPLETE WITH VALVES

3-wave superhet, 16-50 m., 200-550 m., 1,000-2,000 m. Brand new Mullard and Mazda valves—6C9, 6F15, 6LD20, N108, U107. Overall dim. 13 1/2 in. long, 6 in. deep, 7 in. high approx. for A.C. mains 200/230 v.

LASKY'S PRICE, 7 GNS.
Carr. and Pkg. 7/6 extra.
Price without valves, £5/4/-.

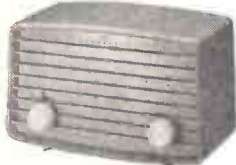
SPEAKER COVERINGS. Large stocks of Tygan and "Someweave" Speaker Coverings. Any size piece cut. Send for samples and prices.

MAKERS' SURPLUS TV COMPONENT BARGAINS

- WIDE ANGLE 38 mm.**
- Line E.H.T. trans., ferrox cube core, 9-16kV 25/-
 - Scanning Coils, low imp. line and frame 25/-
 - Ferrox-cube cored Scanning Coils and Line Output Trans., 10-15 kV., EY51 winding. Line Trans. Complete with circuit diagram, the pair 50/-
 - Frame Output Transformer 6/6
 - Scanning Coils, low imp. line and frame 17/6
 - Frame or line blocking osc. transformer 4/6
 - Focus Magnets Ferrox-dure 19/6
 - P.M. Focus Magnets, Iron Cored 19/6
 - Duumag Focallisers 22/6
 - 300 m.A. Smoothing Chokes 15/-
 - Electromagnetic focus coil with combined scan coils 25/-

- STANDARD 35 mm.**
- Line Output Transformers 6.9 kV. E.H.T. and 6.3 v. winding. Ferrox-cube 19/6
 - Scanning coils. Low imp. line and frame 12/6
 - Ditto by Igranite 14/6
 - Frame or line blocking oscillator transformer 4/6
 - Frame output transformer 7/6
 - Focus Magnets, Without Vernier 12/6
 - With Vernier 17/6
 - Focus Coils, Electro-magnetic 12/6
 - 200 m.A. Smoothing Chokes 10/6

LASKY'S NEW MIDGET T.R.F. CONSTRUCTOR PARCEL



CAN BE BUILT FOR ONLY 99/6
Post & Pkg. 5/-.

Handsome contemporary design case, overall size 8 1/2 in. wide, 4 1/2 in. deep, 5 in. high. 2 latest double-purpose valves EBF9 and ECL80, contact coated rectifier. For A.C. mains 200-250 v. Med. and long wave. 5 in. P.M. speaker. Plastic cabinet in cream, pastel green, pink, blue.

FULL DATA, instructions, circuit diagram and shopping list, 1/6 post free.

All components available separately.

CABINET only, as illus., 12/6 plus 4/6 post and pkg.

NOTE: This new parcel will not be ready until 21st September approx. Orders will be dealt with in strict rotation, therefore order early.

★ **LASKY'S fully transistorised portable for home constructors on printed circuit. Watch for full details.**

LASKY'S RADIO



NEW AND PERFECT 16" METAL CONE C.R.T.

Type T901. Note. Not "seconds" but perfect tubes in original cartons. Gives large 11 x 14 1/2 in. picture. Guaranteed by us for 3 months. See our previous adverts in "W. World" or send for details.

LISTED AT £23. 9. 10

LASKY'S PRICE £8. 9. 6

Carr. and Insur. 22/6 extra.

Masks, Anti-Corona, Bases and Ion Traps available.

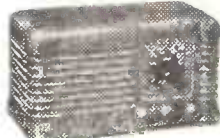
FEW ONLY 17in. C.R. TUBES

Rectangular, aluminised or ion trap 0.3 heater. Brand new and unused. **£12.19.6**
Carr. and Insur. 22/6.

MAINS TRANSFORMERS

- All 200-250 v. 50 c.p.s. primary, finest quality, fully guaranteed.
- MBA/3. 350-0-350 v. 80 m.A. 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. 19/6
- MBA/7. 250-0-250 v. 80 m.A. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts. 19/6
- AT.3. Auto trans. 0-10-120, 200-230-240 v. 100 watts 19/6
- MT/34L. Tapped input 250-0-250, 120 m.A. 6.3 v. 5 amps., fully shrouded 27/6

LASKY'S RADIO CONSTRUCTOR PARCELS



PARCEL No. 1
Contains everything to build a 4-valve 3-wave superhet for 200/250 A.C. mains. Uses 6K8, 6K7, 6Q7, 6V6 valves. Attractive wood cabinet, walnut veneer, or plastic Cabinet as illustrated. Size 12 x 6 1/2 x 5 1/2 in. deep. **CAN BE BUILT FOR £7.19.6**
Carr. and packing 2/6.

PARCEL No. 2
Contains everything to build a T.R.F. 3-valve set for 200/250 A.C. mains, medium and long waves. Uses 6K7G, 6J7 6V6 and metal rectifiers. Neat plastic cabinet, walnut or ivory finish, or wood cabinet. Size 12 x 6 1/2 x 5 1/2 in. deep.

CAN BE BUILT FOR £5.10.0
Carriage and packing 2/6

INSTRUCTION BOOK for either above sets 1/- post free.

CABINETS ONLY, plastic or wood, 17/6. Post 2/6.

All parts/omono available separately.

ALL-DRY POWER UNITS

Further purchase enables us to again reduce price

By Decca. Suitable for any battery radio using 1R5, 1T4, etc., 67 1/2 volts H.T., 1 1/2 volts L.T. Mains input 200-250 adjustable. In metal chassis with rubber feet and black plastic cover. Size: 7 in. x 5 in. x 1 1/2 in. Mains lead and on/off switch. Complete with two metal rectifiers, ready for use. Listed at £14/15/-.

LASKY'S PRICE 29/6
Post 3/6.

If too large to fit into your portable, stand it on or by it.

FILAMENT TRANSFORMERS

- All 200-250 v. 50 c.p.s. primary, finest quality, fully guaranteed.
- 6.3 v. 1.5 amp. 5/11
- 6.3 v. 3 amp. 9/6
- 0-30 v. 2 amp. tapped voltages 19/6.

GERMANIUM CRYSTAL DIODES

- GEX.00 1/6 GEX.34 3/6 WG5 3/6 GEX 54 and O474 5/- GD3 3/6, GD4 3/6, CG12E 5/-.

FERRITE ROD AERIALS

Med. and long waves, wound ready for use. Each 6/9, post 1/-.

FERRITE ROD

5 in. long, 1/2 in. diam., with full instructions for making a Ferrite rod aerial 2/6, post 1/-.

LASKY'S FOR VALVES 20,000 IN STOCK

Here are a few examples of brand new surplus and imported valves:

- EB91 7/6 EV41 10/6 EY86 14/6
- EB41 7/6 EF80 10/6 EZ40 8/6
- EABC80 10/- EF85 10/6 EZ80 8/6
- EAF42 10/- EF86 12/6 PCF82 12/6
- EB41 10/- EF89 10/- PCC84 12/6
- EC085 10/- 6K8 10/6 PL81 13/6
- EC084 15/- 6V6 8/6 PL82 10/6
- EC083 9/- 6K7 5/6 PL83 11/6
- EC082 9/- 6Q7 10/6 PY80 10/6
- EC081 9/- 6R7 6/6 PY81 10/6
- 12A7 8/6 5Z4 9/6 PY82 10/6
- 12A7 8/6 DAF96 10/- PY83 10/6
- 12AX7 9/6 DL86 10/- 6AT6 7/6
- EB93 10/6 DK96 10/- 6AT7 7/6
- ECF82 15/- DF96 10/- 185 7/8
- ECH42 11/6 DM70 9/- 384 9/-
- EC81 11/6 EY51 12/6 1T4 9/-
- ECL80 10/6 EC84 11/6 1R5 7/6

Also full stocks of B.V.A. Valves and C.R. Tubes at the new lower list prices.
WRITE FOR COMPLETE LIST

LASKY'S RADIO

LASKY'S (HARROW RD.) LTD.

TWO ADDRESSES FOR PERSONAL CALLERS
OPEN ALL DAY SATURDAY. EARLY CLOSING: THURSDAY.

42 TOTTENHAM COURT ROAD, W.1

370 HARROW ROAD PADDINGTON, W.9

Between T.C.R. and Goadge St. Stns. MUSEum 2605

(Opposite Paddington Hospital) LAD 4075 and CUN 1979

ALL MAIL ORDERS TO HARROW ROAD PLEASE

HETERODYNE FREQUENCY METERS

TYPE LM14

Designed and built to United States Navy specification, these Crystal Controlled instruments combine all the advantages of the well known BC.221 Frequency Meter, plus many additional features which increase their usefulness.

- ★ Frequency range 125-20,000 kcs. in 2 bands.
- ★ Accuracy better than .02% in 125-2,000 kcs. band, and better than .01% in 2,000-20,000 kcs. band.
- ★ Voltage stabilisation circuit ensures accuracy not affected by power supply fluctuation.
- ★ Separate power switches allow standby filament operation without HT supply.
- ★ Modulation switch enables instrument to be used as a Signal Generator.
- ★ Has corrector for WWV.
- ★ Supplied with removable shock protection mounting.
- ★ Size only 8½in. x 8in. x 8½in., weight 11½ lbs.
- ★ Brand New and Unused.

Further details on application.



UNIVERSAL ELECTRICAL INSTRUMENTS CORPORATION
138 Gray's Inn Road, London, W.C.1.

FOR
VALVES
GUARANTEED ALL
TESTED
BEFORE DISPATCH

024	5/6	6BSG	4/-	6S7	8/6
1A3	3/6	6BA6	7/6	6SK7	6/-
1A5GT	0/-	6BE6	8/-	6SL7	8/-
1A7	12/6	6B6	9/-	6SN7	8/-
1C2	9/6	6B7	11/6	6SQ7	9/3
1E5GT10/6	6BS7	13/-	6U4GT	14/-	
1L4	8/6	6BW6	8/6	6U5G	8/6
1LD5	3/6	6BW7	10/-	6U6	8/6
1M5	10/6	6C4	7/-	6U7G	8/6
1R5	8/-	6C5GT	6/6	6V6	7/-
1R4	10/6	6C6	8/6	6V6GT	7/6
1R5	7/6	6CH6	7/6	6X4	7/6
1T4	7/6	6D6	5/-	6X5G	7/6
2C26	2/6	6F1	13/6	6XGT	7/6
2X2	3/6	6F6G	7/6	6Y10/2	12/6
2A4	7/-	6F6M	7/6	7B7	8/6
3D6	5/-	6F13	14/-	7C5	8/-
3Q4	9/6	6F33	5/6	7C6	8/-
3Q5	9/6	6F15	14/-	7H7	9/-
3R4	8/6	6GBG	4/6	7Q7	9/-
3V4	9/-	6H6	2/6	7S7	9/6
4D1	3/-	6J5G	5/-	7Y4	8/6
42	8/-	6J5GT	6/6	75	11/6
5E4G/0/6	6J5M	6/6	77	8/6	
5T4G	8/-	6J6	6/6	80	8/6
5Y3G	8/-	6J7G	6/6	807	8/6
5Y3GT	8/-	6KGGT	7/-	8D2	9/6
5Z4G	10/6	6K7GT	7/-	9D2	9/6
6A7	13/-	6K7G	5/9	9001	5/6
6A8G	10/6	6K7M	6/9	9003	5/6
6AC7	6/6	6K8G	8/9	9004	5/6
6AG5	5/6	6K8GT	9/6	9006	5/6
6AK5	6/6	6L6G	9/-	954	9/-
6AK7	7/6	6L7	7/6	955	9/6
6AG7	9/-	6L18	11/6	956	8/6
6AL5	6/6	6N7	7/-	10C1	12/6
6AM6	9/-	6P25	13/6	10C2	9/-
6AQ5	7/6	6Q7GT	9/-	10P1	12/6
6AT8	8/6	6S7GT	8/-	12A8	6/6
6AU6	10/6	6SG7	7/6	12AH811	6/6
6B4	5/-	6SH7	6/-	12AT6	10/6

12AT7	9/-	DM70	8/6	KT33C	10/-
12AU7	9/6	EABC80	KT66	15/-	
12AX7	10/-	10/-	KTW61	10/-	
12BA6	4/-	EAC91	7/6	(KTW62)8/-	
12BB16	10/-	EAF42	12/6	KTW63	8/6
12C8	7/-	EB41	9/-	KTZ41	6/-
12H6	3/-	EBC41	10/-	LP220	5/-
12J5	4/6	EBCF80	11/-	MH4	7/6
12T7	10/-	EC91	9/6	MH41	7/6
12K7	9/-	ECC84	12/6	N78	12/6
12K8	13/-	ECC85	10/-	P81	3/9
12Q7	9/6	ECC91	6/-	P216	3/11
12R7	2/6	ECCF80	14/6	PENAA15/-	
12S7	7/6	ECP82	15/-	PEN26	5/-
12S7	5/6	ECH35	11/6	PEN46	7/-
12S7	8/-	ECH42	10/6	PEN220A	
12S7	6/-	ECH81	11/-	PC84	4/-
12S7	8/-	ECL80	10/6	PCF90	11/-
12S7	8/6	ECL82	13/6	PCF82	12/6
12S7	7/6	EF90	10/-	PCL83	12/6
1487	13/6	EF22	8/6	PL81	13/6
15D2	7/6	EF40	12/6	PL82	10/-
20D1	10/6	EF41	11/-	PL83	10/-
20L1	13/6	EF85	12/6	PL83	10/-
20P3	13/6	EF86	12/6	P225	3/11
20P5	11/6	EF89	12/6	PX25	12/6
25L6GT	9/6	EF92	8/6	PY80	10/-
25Y5G	9/6	EL32	6/6	PY81	10/-
25Z4G	9/-	EL33	14/6	PY82	8/-
25Z5	9/-	EL41	10/6	PY83	12/-
25Z6GT	9/6	EL42	11/6	QP21	7/6
30F5	12/6	EL84	11/-	R19	13/6
30FL1	12/6	EM34	10/-	SP220	3/11
30P4	15/-	EM90	11/-	U10	10/-
35L6GT	9/6	RY61	11/6	U22	8/-
35W4	9/6	EY86	12/-	U25	13/6
35Z4GT	8/6	EY91	8/-	U45	15/-
ACG/PAN	5/-	EZ40	10/-	U91	12/6
HL23DD	6/6	EZ80	10/-	UAF4211/6	
ATP4	3/6	EZ90	9/-	UB41	9/6
DAF96	10/6	E1149	2/-	UBC41	10/-
DF96	10/6	GZ33	12/6	UC42	11/-
DE73M	9/-	H30	5/-	UBP80	12/6
DK96	10/6	HL23DD	6/6	UC4212/6	
DL96	10/6	HL22	12/6	UCH81	12/6
		HL309	13/6	UF41	10/-
		HL309	13/6	UL41	11/-
		K40N	9/-	UL54	12/6
		KB32	8/-	UY41	10/-
		KT24	4/6	UY85	10/6
		KT2	5/-	VR21	2/9

VR53	(EF39)	6/6	VR57	(EBC32)	8/-	VR91	(EFP60)	4/-	VR116	4/-	VT52	VU111	2/6
VR54	(EBC33)	7/6	VR58	(EBC33)	7/6	VR92	(EBC33)	7/6	VR137	5/6	VT501	W77	8/6
VR55	(EBC33)	7/6	VR59	(EBC33)	7/6	VR93	(EBC33)	7/6	VR150/30	8/6	VU39	W729	13/6
VR56	(EBC33)	7/6	VR60	(EBC33)	7/6	VR94	(EBC33)	7/6	VR150/30	8/6	VU39	X65	10/-
VR57	(EBC33)	7/6	VR61	(EBC33)	7/6	VR95	(EBC33)	7/6	VR150/30	8/6	VU39	X65	10/-
VR58	(EBC33)	7/6	VR62	(EBC33)	7/6	VR96	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR59	(EBC33)	7/6	VR63	(EBC33)	7/6	VR97	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR60	(EBC33)	7/6	VR64	(EBC33)	7/6	VR98	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR61	(EBC33)	7/6	VR65	(EBC33)	7/6	VR99	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR62	(EBC33)	7/6	VR66	(EBC33)	7/6	VR100	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR63	(EBC33)	7/6	VR67	(EBC33)	7/6	VR101	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR64	(EBC33)	7/6	VR68	(EBC33)	7/6	VR102	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR65	(EBC33)	7/6	VR69	(EBC33)	7/6	VR103	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR66	(EBC33)	7/6	VR70	(EBC33)	7/6	VR104	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR67	(EBC33)	7/6	VR71	(EBC33)	7/6	VR105	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR68	(EBC33)	7/6	VR72	(EBC33)	7/6	VR106	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR69	(EBC33)	7/6	VR73	(EBC33)	7/6	VR107	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR70	(EBC33)	7/6	VR74	(EBC33)	7/6	VR108	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR71	(EBC33)	7/6	VR75	(EBC33)	7/6	VR109	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR72	(EBC33)	7/6	VR76	(EBC33)	7/6	VR110	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR73	(EBC33)	7/6	VR77	(EBC33)	7/6	VR111	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR74	(EBC33)	7/6	VR78	(EBC33)	7/6	VR112	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR75	(EBC33)	7/6	VR79	(EBC33)	7/6	VR113	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR76	(EBC33)	7/6	VR80	(EBC33)	7/6	VR114	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR77	(EBC33)	7/6	VR81	(EBC33)	7/6	VR115	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR78	(EBC33)	7/6	VR82	(EBC33)	7/6	VR116	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR79	(EBC33)	7/6	VR83	(EBC33)	7/6	VR117	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR80	(EBC33)	7/6	VR84	(EBC33)	7/6	VR118	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR81	(EBC33)	7/6	VR85	(EBC33)	7/6	VR119	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR82	(EBC33)	7/6	VR86	(EBC33)	7/6	VR120	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR83	(EBC33)	7/6	VR87	(EBC33)	7/6	VR121	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR84	(EBC33)	7/6	VR88	(EBC33)	7/6	VR122	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR85	(EBC33)	7/6	VR89	(EBC33)	7/6	VR123	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR86	(EBC33)	7/6	VR90	(EBC33)	7/6	VR124	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR87	(EBC33)	7/6	VR91	(EBC33)	7/6	VR125	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR88	(EBC33)	7/6	VR92	(EBC33)	7/6	VR126	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR89	(EBC33)	7/6	VR93	(EBC33)	7/6	VR127	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR90	(EBC33)	7/6	VR94	(EBC33)	7/6	VR128	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR91	(EBC33)	7/6	VR95	(EBC33)	7/6	VR129	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR92	(EBC33)	7/6	VR96	(EBC33)	7/6	VR130	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR93	(EBC33)	7/6	VR97	(EBC33)	7/6	VR131	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR94	(EBC33)	7/6	VR98	(EBC33)	7/6	VR132	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR95	(EBC33)	7/6	VR99	(EBC33)	7/6	VR133	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR96	(EBC33)	7/6	VR100	(EBC33)	7/6	VR134	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR97	(EBC33)	7/6	VR101	(EBC33)	7/6	VR135	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR98	(EBC33)	7/6	VR102	(EBC33)	7/6	VR136	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR99	(EBC33)	7/6	VR103	(EBC33)	7/6	VR137	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR100	(EBC33)	7/6	VR104	(EBC33)	7/6	VR138	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR101	(EBC33)	7/6	VR105	(EBC33)	7/6	VR139	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR102	(EBC33)	7/6	VR106	(EBC33)	7/6	VR140	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR103	(EBC33)	7/6	VR107	(EBC33)	7/6	VR141	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR104	(EBC33)	7/6	VR108	(EBC33)	7/6	VR142	(EBC33)	7/6	VR150/30	8/6	VU39	X79	11/6
VR105	(EBC33)	7/6	VR109	(EBC33)	7/6	VR143	(EBC33)	7/6	VR150/30	8/6	VU39		

Stern's "fidelity" TAPE RECORDER

IT HAS EVERYTHING — EXCEPT A HIGH PRICE

TESTED AND APPROVED AT THE TRUVOX LABORATORIES

IT INCORPORATES: The NEW TRUVOX Mk. IV TAPE DECK together with the "fidelity" MODEL HF/TR2 TAPE AMPLIFIER (both fully described on this page), and a Rola 10 x 6in. P.M. speaker.

● BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THIS MODEL—TRULY "Hi-Fi" RECORDINGS ARE OBTAINABLE and it is comparable to much higher-priced Recorders.

Alternatively send S.A.E. for ILLUSTRATED LEAFLET.



PRICE . . . Including CRYSTAL MIKE and 1,200ft. reel of PLASTIC TAPE.

£49.10.0. (OR £3 EXTRA WITH REV. COUNTER.)

(Plus £1/10/- carriage and insurance, of which £1 is refunded on return of Packing Case.)

CREDIT SALE: Deposit £12/8/- and 9 monthly payments of £4/10/8.

HIRE PURCHASE: Deposit £24/15/- and 12 monthly payments of £2/5/11.

A COMPLETE KIT OF PARTS TO BUILD THE "fidelity" TAPE AMPLIFIER Model HF/TR2 including POWER SUPPLY UNIT

FOR ONLY **£12.0.0** (Pins 5/- carr. and ins.)

This amplifier has been expressly designed to meet the requirements of High Fidelity reproduction. It is based on a new design, completed by the Mullard Technicians and only really high-grade components are incorporated; truly HIGH FIDELITY Recordings are obtainable whilst "Hi-Fi" reproduction is assured by use of a high-quality Output Transformer by Gilsen. It incorporates a "magic eye" Recording Level Indicator, a two-position equaliser for 3½in. and 7½in. speeds, and an effective Tone Control arrangement. Monitoring and Extension Speaker Socket are incorporated and in addition a position is provided to enable it to be used as an independent Amplifier for Gramophone Records or Radio Tuning Unit. Overall size: 11in. x 6in. x 6in. high. Suitable for nearly all makes of Tape Decks. When ordering, please advise make of deck in use.

THE ASSEMBLY MANUAL, PRACTICAL DIAGRAMS, etc., are available for 2/9 or send S.A.E. brief details.

WE ALSO SUPPLY THE HF/TR2 ASSEMBLED AND READY FOR USE FOR £16.0.0. (Plus 6/- carr. & ins.). H.P. TERMS: Deposit £3 and 9 monthly payments of £1. CREDIT TERMS: Deposit £4 and 9 monthly payments of £1/9/4.



THE NEW TRUVOX MKIV TAPE DECK

UNDOUBTEDLY ONE OF THE BEST TAPE DECKS ON THE MARKET.

PRICE **£27.6.0** (Plus 10/- carr. and ins.)

CREDIT TERMS: Deposit £6/17/- and 9 monthly payments of £2/10/-.

H.P. TERMS: Deposit £13/13/- and 12 monthly payments of £1/5/4.

SPECIFICATION:—● 3 B.T.H. shaded pole motors with silent friction drive eliminating wow and flutter. ● Push-button controls, electrically and mechanically interlocked (patented). ● Patented electric-type push-button controlled brake. ● Inching to assist editing; tape loading on the drop-in principal accommodation for reels of 7in. diameter. ● Tracking sense. To British and American standards. ● Playing times: Up to 3 hours with L.P. Tape or 2 hours with Standard Tapes. ● Two tracks side by side, with safety gap. ● Playing time indication by precision revolution counter or large visual type indicator plate, according to choice. ● Positive Azimuth adjustment of Record/Player Head. ● High Impedance Heads. ● The metal work is Gold Hammered finish. ● Overall size 14½in. x 12½in., from top of face of panel, overall depth 5in.

The Mk. IV DECK CAN ALSO BE SUPPLIED INCORPORATING PRECISION REV COUNTER for £30/9/-. H.P. TERMS: Deposit £15/4/6 and 12 months of £1/8/3. CREDIT SALE: Deposit £7/12/3 and 9 months of £2/15/-.



STERN'S TAPE PRE-AMPLIFIER AND ERASE UNIT

Provides the "Link" between the HIGH-QUALITY AMPLIFIER and TAPE DECK.

STERN'S MODEL HF/TR1.P. . . . A completely assembled Pre-Amplifier with own Power Supply. Can be supplied correctly matched for use with Truvox, Brenell or Collaro Decks, and incorporates Recording Level Indicator and Monitoring facilities. Please send S.A.E. with any inquiry.

PRICE **£11.10.0** (Plus 5/- carr. and insurance)



Home Constructors!

YOU CAN BUILD A COMBINED TAPE RECORDER-RADIOGRAM AT HALF THE NORMAL COST.

As will be seen from this advert. there are several combinations with or without a Record Player.

This is a very popular and successful combination and we will supply ALL ITEMS FOR **£79.0.0**

OTHER TAPE EQUIPMENT

PORTABLE CASE as illustrated above	£5 0 0
ACOS CRYSTAL MICROPHONE	£2 10 0
ROLA 10in. x 6in. P.M. SPEAKER (7in. x 4in. 19/6)	£1 10 0
PLASTIC TAPE of all lengths—L.P. and Standard. IN STOCK	
WE WILL SUPPLY ALL ABOVE including a 1,200 ft. reel	
Plastic Tape for	£9 5 0

WE MAKE SPECIAL PRICES FOR COMBINED ORDERS WE WILL SUPPLY

- (a) The model HF/TR2 AMPLIFIER and POWER UNIT, both fully assembled, together with the TRUVOX MK IV TAPE DECK for . . . **£38 10 0**
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS . . . **£35 0 0**
- (b) The model HF/TR2 AMPLIFIER and POWER UNIT both fully assembled, together with the TRUVOX TAPE DECK incorporating PRECISION REV COUNTER . . . **£41 10 0**
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS . . . **£38 0 0**
- (c) The model HF/TR2 AMPLIFIER and POWER UNIT, both fully assembled, together with the COLLARO TRANSCRIPTOR . . . **£35 0 0**
ALTERNATIVELY as above but the HF/TR2 Amplifier and P/Unit as a COMPLETE KIT OF PARTS . . . **£31 10 0**
- (d) The model HF/TR1.P TAPE PRE-AMPLIFIER together with the TRUVOX MK IV TAPE DECK . . . **£35 0 0**
- (e) ALTERNATIVELY as in (d) above but Truvox Deck incorporating PRECISION REV COUNTER . . . **£38 0 0**
- (f) The model HF/TR1.P TAPE PRE-AMPLIFIER together with the COLLARO TRANSCRIPTOR . . . **£31 10 0**

PLEASE INCLUDE 12/6 to cover cost of Carriage and Insurance. HIRE PURCHASE and CREDIT SALE TERMS are available on all above (excluding Kits of Parts). Send S.A.E. for details.

NOTE . . . The Collaro Transcriber is in short supply and there may be a delay in delivery. We will however book an order.

The Deck switches of the Transcriber must be "wired-up." We will complete this wiring, for use with either the HF/TR2 or the HF/TR1.P. for an extra charge of £1.0.0.

Open Monday to Friday 9 a.m.—6 p.m. Saturday 9 a.m.—1 p.m.

STERN RADIO LTD.

(DEPT 109/W)

109 & 115, FLEET ST., LONDON, E.C.4

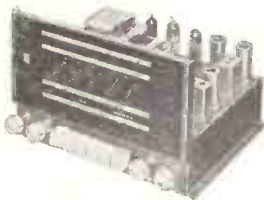
Telephone: FL Eet St. 5812/3/4

IT'S MUCH BETTER

MODERNISE YOUR OLD RADIOGRAM

IT'S MUCH CHEAPER

THE NEW ARMSTRONG P.B. 409 AM/FM RADIOGRAM CHASSIS



PRICE £29.80
(Plus 7/6 carr. & ins.)

TERMS: Credit Deposit £7/7/- and 9 monthly payments of £2/14/- H.P. Dep. £14/14/- and 12 monthly payments of £1/7/8.

BRIEF SPECIFICATION:—

A 9 valve line up employing the latest MULLARD preferred-type valves. ● Provides complete coverage of the V.H.F./F.M. Transmissions, plus the SHORT, MEDIUM and LONG waves. ● Has Push-Pull output, with negative feedback, for 6 watts Peak output. ● Quick action "Piano Key" Selectors and separate Bass and Treble Controls. ● Has "Magic Eye" Tuning Indicator. ● Dimensions 13in. x 9 1/2in. x 8in. high, Dial size 1 1/2in. x 5 1/2in.

THE FOLLOWING DULCI TUNER UNITS ARE IN STOCK

MODEL H.4.T. This model is the "TUNEE UNIT VERSION" of the H.4 Radiogram Chassis illustrated and described above. It has the same coverage of A.M. and F.M. Wavebands (4 altogether) and precisely the same in size and appearance, except that it has three Controls only, being TUNING, WAVECHANGE and Volume On/Off, mounted centrally on the chassis. A self-contained Tuner incorporating own Power Supply.

PRICE £20.17.0
(plus 7/6 carr. & ins.)

CREDIT TERMS: Deposit £5/4/3 and 9 monthly payments of £1/18/4. H.P. TERMS: Deposit £10/8/6 and 12 monthly payments of 19/4.

THE DULCI MODEL H.11



"The Heart of High Fidelity"

A COMBINED AND SELF-POWERED AM/FM TUNER:

"Hi Fi" CONTROL UNIT and AUDIO PREAMPLIFIER Incorporating Switching and connections for direct use with TAPE EQUIPMENT. **PRICE £29.3.10**
(Plus 7/6 carr. & ins.)

CREDIT TERMS: Deposit £7/6/- and 9 monthly payments of £2/13/6. H.P. TERMS: Deposit £14/12/6 and 12 monthly payments of £1/7/8. A truly High Fidelity Unit containing the functions of an A.M./F.M. Tuner—Pre-amplifier Tone Control Unit, all on one chassis, designed for use with any High Quality Main Amplifier (i.e., the Mullard 5-10 at £9/10/-, or Williamson, etc.).

BRIEF DESCRIPTION:—

- Covers 4 wavebands being Short—Long—Medium and the V.H.F./F.M. Band.
- Separate Bass and Treble Controls.
- Gram Equalising.
- Magic-Eye Tuning.
- Latest E.V.A. 7-valve line-up, plus two matched Diodes.
- Overall size 12in. x 9in. x 7 1/2in. high.

THE DULCI V.H.F./F.M. TUNER

A self-contained Tuning Unit providing complete F.M. coverage. Performance is really outstanding. **PRICE £17.10.0**
(Plus 5/- carr. & ins.)

CREDIT TERMS: Deposit £4/7/6 and 9 monthly payments of £1/12/1. H.P. TERMS: Deposit £9/15/- and 11 monthly payments of 17/8. **BRIEF DETAILS:—**

- Designed to operate with any make of Amplifier and most Radio Receivers.
- Incorporates its own Power Supply.
- Has the highly efficient GERLER INDUCTANCE TUNING HEART.
- A "Magic-Eye" TUNING INDICATOR is incorporated.
- Employs the latest valve line-up—EAB080, ECC85, two EF89's 6 x 4 (Rectifier and EM80 Indicator).
- A very attractive Dial (size 10 1/2in. wide x 6in. high) is incorporated and the overall size of Chassis is 6in deep x 9in. wide x 5 1/2in. high.

The T.S.L. V.H.F./F.M. TUNER is also in stock. It is very similar to the above Dulci F.M. Unit both in general appearance and performance. **PRICE—PRECISELY the same as the Dulci V.H.F./F.M. Unit.**

THE ARMSTRONG MODEL A.F. 105 AM/FM RADIOGRAM CHASSIS A Genuinely Hand Made Chassis



Developed to meet the needs of those who require really high quality radio and record reproduction but who, for reasons of expense or lack of room in existing or proposed cabinets, cannot consider the normal high-fidelity system. The A.F.105 is as good as, or better than, many of the high quality amplifiers, and Associated units. Independent and continuously variable Bass and Treble controls give a wide range of control. SEND S.A.E. FOR DETAILS.

PRICE £37 (Plus 7/6 carr. and ins.)

CREDIT SALE TERMS: Deposit £9/5/- and 9 monthly payments of £3/7/10.

HIRE PURCHASE TERMS: Deposit £18/10/- and 12 monthly payments of £1/14/4.

THE MODEL A.F.O.—3 Waveband A.M. only RADIOGRAM CHASSIS



PRICE £11.16.4
(plus 7/6 carr. & ins.)

H.P. TERMS: Deposit £5/18/4 & 8 monthly payments of 17/8. This is a standard 5-valve A.C. Mains Superhet Receiver Chassis covering Long — Medium — Short Wavebands, having Gram and Extension Speaker Sockets. Reproduction from both Radio and Gram is really good and it makes an Ideal Chassis for a simple domestic installation. Overall size is 12in. x 7in. x 7 1/2in. high. Really Modern Demonstration Rooms are now available for the convenience of callers.

Stern's "fidelity" F.M. TUNING UNIT

A 5-Valve Tuner incorporating the latest Mullard Permeability Tuned Unit. Price assembled less Power Supply: **£14.10.0**
(Plus 7/6 carr. & ins.)



TERMS: (a) H.P. Deposit £7/5/- and 9 monthly payments of 18/4; (b) Credit Deposit £3/12/6 and 9 monthly payments of £1/6/7. Provides "Hi-Fi" reproduction with any make of Amplifier and many Radio Receivers. It incorporates: ● The latest Valve line-up—ECC85, 2 type EF85, EF91 and EM90. ● A "Magic Eye" Indicator. ● Power consumption is 1.7 amps at 6.3 volts and 25 m/a at 250 volts. **STERN'S "fidelity" COMBINED A.M. and F.M. TUNING UNIT**

This is IDENTICAL to the Stern's F.M. Tuner illustrated above, but in addition incorporates the MEDIUM WAVEBAND and thereby also provides a selection of foreign stations. **PRICE £18.18.0** (Plus 7/6 carr. & ins.)

TERMS:—(a) H.P. Deposit £9/9/- and 10 monthly payments of £1/1/-; (b) Credit Deposit £4/15/- and 9 monthly payments of £1/14/7. Send S.A.E. if further data required.

STERN'S POWER SUPPLY UNITS

Fully smoothed with all output connections terminated to Compacting Blocks, thereby enabling ease of connecting to a Radio Tuner Unit or Amplifier etc. (the Compact 5 Amplifiers are immediately connected in this way). Overall size of Units is 9 1/2in. x 3 1/2in. x 4 1/2in. high. **TWO MODELS ARE AVAILABLE** Type "A" Unit provides 200-300 volts at up to 70 m/a and 6.3 volts at 3 1/2 amps.



PRICE £2.17.6 (Plus 2/- carr. and ins.). Type "B" Unit provides 250-300 volts at up to 100 m/a and 6.3 volts at 3 1/2 amps.

PRICE £3.3.0 (Plus 2/- carr. and ins.). **WE ALSO SUPPLY THESE UNITS AS COMPLETE KITS OF PARTS**

A detailed wiring-up leaflet is supplied (this is available separately for 9d.) and they are very quickly and easily assembled. **Type "A" Unit Complete Kit. PRICE £2.9.6** **Type "B" Unit Complete Kit. PRICE £2.15.0** (Carriage and insurance is 2/- extra.)

THE DULCI MODEL H.4

COMBINED AM/FM RADIOGRAM CHASSIS



A 4 Waveband Receiver designed for first-rate reproduction of Radio and Gram.

PRICE £24.6.6
(Plus 7/6 carr. & ins.)

CREDIT TERMS: Deposit £6/2/- and 9 monthly payments of £2/4/7. H.P. TERMS: Deposit £12/3/3 and 12 monthly payments of £1/2/7.

BRIEF SPECIFICATION:—

- Covers Short, Medium, Long and F.M. Wavebands.
- Employs full A.V.C.
- The Latest 7-valve line-up.
- For 3 or 15 ohm P.M. Speakers.
- "Magic Eye" Tuning Indicator.
- Excellent Tone range up to 4 watts output.
- Internal aerial for local stations.
- Overall size 12in. x 8 1/2in. x 7 1/2in. high.
- A Good Quality Chassis and Well Recommended.

THE DULCI MODEL H.3

COMBINED AM/FM RADIOGRAM CHASSIS



This model is very similar to the model H.4 described above but covers 3 WAVEBANDS instead of 4 (omitting the Short Band) and is for 3 ohm Speakers only. Overall size is as for the H.4.

PRICE £20.17.0 (Plus 7/6 carr. & ins.)

CREDIT TERMS: Deposit £5/4/3 and 9 monthly payments of £1/18/4. H.P. TERMS: Deposit £10/8/6 and 12 monthly payments of 19/4.

RECORD PLAYERS THE VERY LATEST MODELS ARE IN STOCK

MANY AT REDUCED PRICES !!!
TRANSCRIPTION UNITS—AUTOCHANGERS
SINGLE RECORD PLAYERS

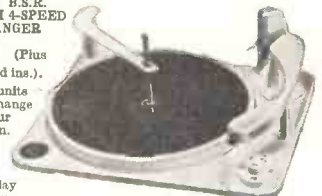
Send S.A.E. for ILLUSTRATED STOCK LIST

CASH ONLY OFFER !!!

This latest B.S.R. MONARCH 4-SPEED AUTOCHANGER

£8.7.6 (Plus 5/- carr. & ins.)

- These units will autochange on all four speeds, 7in. and 12in.
- They play MIXED 7in., 10in. and 12in. records of same speed.
- They have separate sapphires for L.P. and 78 r.p.m. which are moved into position by a single switch.
- Minimum baseboard size required 14in. x 12in., with height above 8 1/2in. and height below baseboard 2 1/2in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.



WE ALSO HAVE A FEW ONLY

COLLABO MODEL 456 4-Speed "Mixer" Autochangers. The Units are BRAND NEW and incorporate the STUDIO "O" Pick-up.

PRICE £9.19.6 (Plus 5/- carr. & ins.)

FOR CALLERS ONLY

We have in stock various KITS OF PARTS including F.M. Tuners, AM/FM Tuners, Midget Battery Portable and Mains Units, etc., etc. We also have the most comprehensive stock of WIRELESS and ELECTRICAL COMPONENTS.

Open Monday to Friday 9 a.m.—6 p.m.
Saturday 9 a.m.—1 p.m.

STERN RADIO LTD.

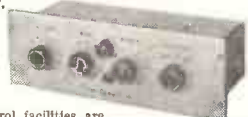
AMPLIFIERS **HIGH FIDELITY** **TUNING UNITS**
PRE-AMPLIFIERS **FOR THE** **RADIO RECEIVERS**
HOME CONSTRUCTOR

—COMPLETE KITS OF PARTS FOR THE "Hi-Fi" ENTHUSIAST—

QUALITY OF THIS NATURE HAS NEVER BEFORE BEEN OFFERED AT SUCH LOW COST

STERN'S REMOTE CONTROL UNIT
 Designed in particular for use with the MULLARD 5-10 Main Amplifier.

Ideally suited for simple domestic installation as an alternative to the more elaborate Pre-amplifier (shown and described opposite). Tone Control facilities are really excellent and in conjunction with the "5-10" Main Amplifier reproduction is of very high quality. Perfectly suitable for use with all the popular Record Players (B.S.E., Collaro, Garrard) and the modern Radio Tuner Units. Front Panel contains: (a) Coloured Indicator, (b) Separate BASS and TREBLE CONTROLS, (c) 3 position Selector Switch; (d) Volume Control. Inputs on back for Radio and Gram, and Gram equalising is incorporated. FULL DATA is contained in the 5-10 MAIN AMPLIFIER MANUAL at 1/6.



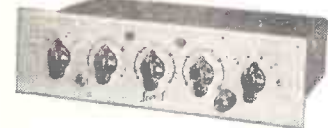
The MULLARD "5-10" MAIN AMPLIFIER



Probably the most popular and successful Amplifier yet designed and certainly needs no recommendation from us. Our kit is complete to MULLARD'S specification including the latest ULTRA LINEAR OUTPUT TRANSFORMER and the recommended Mullard Valve line-up. All specified Components are supplied and Power Supply is available to drive a Radio Tuner Unit.
PRICE OF COMPLETE KIT OF PARTS £9.10.0
 (Plus 5/- carr. & ins.)
 or alternatively we supply—
FULLY ASSEMBLED AND TESTED for £11.10.0
 (Plus 5/- carr. & ins.)
 The ASSEMBLY MANUAL containing FULL SPECIFICATION is available for 1/6. It also includes full data on the REMOTE CONTROL UNIT.

STERN'S "fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT

"A design for the Music Lover"



This unit can be used with any Main Amplifier. Briefly it has inputs for all types of MICROPHONES, HIGH and LOW GAIN PICK-UPS and a RADIO TUNING UNIT. It incorporates (a) GRAM EQUALISING CONTROL, (b) STEEP CUT FILTER, (c) Continuously variable BASS and TREBLE CONTROLS, a variable OUTPUT CONTROL which enables its use with any type of Amplifier, and Jack Sockets on Front Panel for TAPE RECORD and TAPE FLAYBACK. Used with the "5-10" the reproduction is comparable to that normally associated only with the very expensive commercially made High Fidelity Amplifiers. **£6.6.0**
PRICE OF COMPLETE KIT OF PARTS
USE £8 (plus 5/- carr. & ins.).
 We ALSO OFFER IT ASSEMBLED READY FOR THE ASSEMBLY MANUAL contains full specification, and is available for 1/6.

THE MULLARD "3-3" QUALITY AMPLIFIER



A small Compact Amplifier capable of VERY HIGH QUALITY REPRODUCTION on both RADIO and GRAM. **£6.19.6**
 (Plus 5/- carr. & ins.)
 Alternatively supplied ASSEMBLED and READY FOR USE **£8.12.6**
 (plus 5/- carr. & ins.)
 The complete SPECIFICATION and ASSEMBLY DIAGRAMS are available for 1/6.
 Developed from the very popular 3 valve 3 watt Amplifier designed in the Mullard Laboratories. We strictly adhere to their specification but in addition we have added switched equalising for L.P. and 78 records and a position for Radio Inputs, plus additional power to feed a Radio Tuning Unit. Extremely simple to assemble and ideally suited to incorporate with an F.M. Tuner and Record Player in a small installation.

BRITAINS FINEST "HI-FI" AMPLIFIER



The GENUINE WILLIAMSON
 "Still sets the standard for all amplifiers."
 Many versions of the Williamson have been offered to the public at various low prices, but the only Williamson's is the Amplifier built to the designer's specification and employing the very highest grade Components that he specifies, i.e. PART-RIDGE TRANSFORMERS, CHOKES, etc. It is only in doing this that the exceptionally high standard that has made this Amplifier so famous, particularly in America, is obtained. WE HAVE DONE THIS!!! and we offer these KITS OF PARTS, including Partridge and other high grade Components, as follows—
 (a) To build the MAIN AMPLIFIER ONLY **£14.10.0**
 (Illustrated above.)
 (b) To build the TWIN POWER SUPPLY UNIT only **£13.10.0**
 (Insufficient space to illustrate this.)
 (c) COMPLETE KIT to build both above **£27.0.0**
 We will also supply COMPLETELY ASSEMBLED and will be pleased to quote. Credit and H.P. Terms are available. The complete SPECIFICATION and general ASSEMBLY INSTRUCTIONS are available for 3/6.
 Our "fidelity" PRE-AMPLIFIER, illustrated and described above, or alternatively the RCA Pre-Amplifier at £18/5/-, is recommended for use with the Williamson.

SPECIAL PRICE
REDUCTIONS FOR PURCHASERS OF A COMPLETE "Hi-Fi" AMPLIFIER WE WILL SUPPLY...

- (a) The COMPLETE KIT OF PARTS to build both the MULLARD 5-10 and the REMOTE CONTROL UNIT for **£11.11.0**
- (b) The COMPLETE KIT OF PARTS to build both the MULLARD 5-10 and the "Fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT for **£15.15.0**
- ALTERNATIVELY WE WILL SUPPLY ASSEMBLED AND FULLY TESTED, as follows— **£14.0.0**
- (a) The MULLARD 5-10 and the REMOTE CONTROL UNIT for **£14.0.0**
 CREDIT SALE TERMS, £3.10.0 Deposit and 9 monthly payments of £1.5.8. H.P. TERMS, £7 Deposit and 9 monthly payments of 17/9.
- (b) The MULLARD 5-10 and the "Fidelity" PRE-AMPLIFIER-TONE CONTROL UNIT for **£18.18.0**
 CREDIT SALE TERMS £4.15. Deposit and 9 monthly payments of £1.14.7. H.P. TERMS, £9.9. Deposit and 12 monthly payments of 17/6.
 WHEN ORDERING PLEASE INCLUDE 7/6 to cover cost of Carriage and Insurance.

A COMPLETE KIT OF PARTS, STERN'S "HIGH QUALITY" 8-10 WATT AMPLIFIER



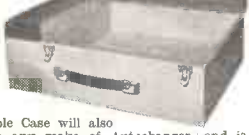
Has power supply available for Radio Tuning Unit.
Price of COMPLETE KIT OF PARTS
 (plus 5/- carr. & ins.) **£7.10.0**
WE ALSO OFFER IT ASSEMBLED
and READY FOR USE for £9.10.0
 (plus 5/- carr. & ins.)
 This amplifier has proved one of the most popular models yet offered to the HOME CONSTRUCTOR. It provides really excellent reproduction up to 8 watts, employing 6V6's in push-pull and incorporating negative feedback. Provides for the use of both 3 and 15 ohm Speakers. The complete SPECIFICATION and BUILDING INSTRUCTIONS are available for 1/6.
 "Wire-to-Wire" Diagrams are included and all Components are available separately.

THE FOLLOWING HIGH FIDELITY AMPLIFIERS ARE IN STOCK

- STERN'S COMPACT 5 AMPLIFIERS. Expressly developed for very high quality reproduction of Gram Records and particularly FM Transmission. Available in 2 models as follows.
- COMPACT "5-2". A two-stage high sensitivity amplifier having separate Bass and Treble Controls. Price **£6.6.0**
 - COMPACT "5-3". A three-stage version of the "5-2", but having an additional stage incorporating negative feedback. Price **£6.16.0**
 - Power supply is obtainable from a small separate unit. Price (additional to above), **£2.10.0.**
 - THE DULCI MODEL D.P.A.10. A 10 watt, "Ultra Linear" High Fidelity Amplifier with separate PREAM-TONE Control Unit **£19.19.0**
 - THE LEAK MODEL TL/10 and "POINTONE" PRE-AMPLIFIER. A universally known Amplifier and now quite accepted as one of the best in production. **£28.7.0**
 - THE ARMSTRONG MODEL A.10 Mk. II. With associate PREAM-TONE CONTROL UNIT, this model is perfectly consistent with Armstrong's very high reputation. **£32.0.0**
 - THE ROGERS "JUNIOR". With associate PREAM-TONE CONTROL UNIT. **£26.0.0**
 - THE RCA "ORTHOEPHONIC". 12-20 watt, high Fidelity Amplifier and associate PRE-AMPLIFIER TONE CONTROL UNIT **£41.0.0**
- HIRE PURCHASE and CREDIT TERMS are available on all models.
 Illustrated and Descriptive leaflets are available. Send S.A.E.

SPECIAL CASH ONLY OFFER!!

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER, and a matched 6 1/2 in. P.M. SPEAKER, ALL FOR **£8.7.6** ONLY (plus 7/6 carr. & ins.).
 The Amplifier consists of a 2 Stage design incorporating the modern B.V.A. valves types EOC83, EL84 plus E280 Rectifier and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger, and is attractively finished in Maroon and Grey colour Rexine. WE ALSO SUPPLY SEPARATELY.



(a) The 2-Stage (plus Rectifier) AMPLIFIER... **£4.2.6**

- (b) The PORTABLE CARRYING CASE **£3.17.6**
 - (c) 6 1/2 in. P.M. SPEAKER **16/9**
- We also have a smaller PORTABLE CASE ideal for Record Players. PRICE ONLY £3/3/- (plus 3/- carr. & ins.). Attractively finished in high grade Rexine and robustly constructed with initial measurements at 13 1/2 x 15 1/2 in. It will seem therefore that it will accommodate all makes of Record Players including Autochangers. An uncut baseboard is also supplied.

DEPT. 109/W
109-115 FLEET ST.
LONDON, E. C. 4
 Phone: FLEet Street 5812-3-4.

CLYNE RADIO LTD.



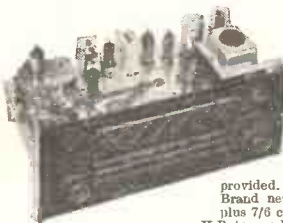
18, TOTTENHAM COURT ROAD, LONDON, W.1

MUSEUM 5929/0095

(50 yards only from Tottenham Court Road Tube)

All post orders please to:—24-26, HAMPSTEAD RD., LONDON, N.W.1

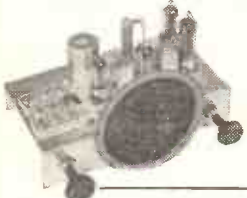
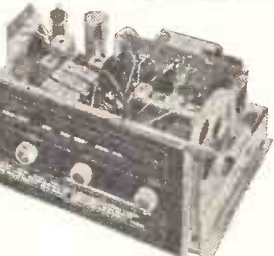
EUSTON 5533/4/5



RC7, F.M. A most attractive AM/FM chassis employing 9 valves with Push-Full output. Covers Long, Medium, Short and F.M. wavebands. Valve line-up: 5Y3, 2-6BW6, 12AU7, EABC80, EP89, 6CH81, EOC85 and 6BM1. Built-in Ferrite Rod Aerial for A.M. reception. Controls: 2 dual, Tuning/Wavechange and Volume ON/OFF/Tone. 6.8 watts output. Very attractive easily read dial in BLACK and GOLD. Size (overall) 15in. x 6in. Chassis dimensions (overall): 15in. x 6in. x 7 1/2in. Indoor Aerial for F.M. provided. For use on A.C. mains 200/250 v. 50 cycles. Brand new and fully guaranteed. PRICE 26 gns. plus 7/6 c. & p.
H.P. terms: Deposit £13/13/- and 12 months at £13/4.

RC5 F.M. AM/FM CHASSIS. This is a most attractive chassis employing the very latest circuitry and highly efficient miniature valves. Waveband selection is by means of a piano-keyboard type push-button control—separate bass and treble controls are provided also a built-in Ferrite Aerial which automatically comes into operation on all A.M. Bands and is rotatable by means of a knob situated on the front panel. This Chassis is supplied complete with two permo-dynamic 10in. x 7in. elliptical speakers and one high-frequency tweeter unit (cross-over network is incorporated in Chassis wiring). Valve line-up: EOC85, ECH81, EP89, EABC80, EL84, EM80 and C100 metal rectifier. Overall dimensions: 20 1/2in. x 8in. x 6 1/2in. high. For use on A.C. Mains 110/250 v. PRICE: £25, plus 7/6 carr. and pkg. H.P. terms: £12/10/- deposit and 12 monthly payments of £12/11.

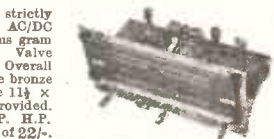
RC4 F.M. AM/FM RADIOGRAM CHASSIS A new style AM/FM Chassis employing a printed circuit F.M. Tuner section. Valve line-up: 8 valves: EOC85, 6BA6, 12AH6, 6BA8, 6AL5, 6AT6, EL84, 5Y3. Most attractive dial 12 x 5 1/2in. fully illuminated, with figures in green, red and white on black background. Four controls: Tuning, Volume, Wavechange and Tone/On/Off. Dimensions (overall): 13 x 9 x 6in. Frequency coverage (four wavebands): 1,000-2,000 m., 200-550 m., 15-50 m., 88-100 mc/s. This is an excellent and very efficient chassis. Price £22/10/- plus 8/- P. & P.



SWITCH TUNED FOUR STATION RECEIVER CHASSIS (Manufacturers' Surplus). A most attractive unit covering 4 pre-set stations in the medium waveband. A complete receiver (less cabinet) including built-in good quality 5in. loudspeaker, and frame aerial. Employs Union Superbet circuit and miniature valves:—UOH42, UAF42, UL41, UY41. Dimensions (overall):—5 x 9 x 5 1/2in. For use on A.C./D.C. mains 200/250 v. Absolutely brand new. Few only at £25/5/- plus 2/6 P. & P.

SPECIAL PURCHASE! MANUFACTURER'S SURPLUS

Owing to favourable purchase we can offer strictly limited quantity of these handsome chassis. AC/DC 200/250 v. for Medium and Long Waves, plus gram position. Incorporates own frame aerial. Valve line up: U107, N108, DH107, W107 and X109. Overall chassis size 12 x 5 1/2 x 7 1/2in. high. Attractive bronze dial with gold and cream lettering. Dial size 1 1/2 x 4 1/2in. Scale length 7 1/2in. Logging scale provided. Price £7/19/6 only, tax paid, plus 3/6 P. & P. H.P. terms. £7 deposit plus four monthly payments of £2/-.



DULCI
DULCI H.3 AM/FM Chassis (7 valve). Covering Long, Medium and F.M. bands. Most attractive dial in RED and GOLD on BLACK background. £20/17/- plus 5/- c. & p.
All Dulci products available ex stock. Illustrated leaflets and H.P. terms available.
Demonstrating at Tottenham Court Road:

JUST ARRIVED! Further limited stocks of Acos HGP37 crystal pick-up insert complete with sapphire stylus, suitable for B.S.R. Monarch, etc. Brand new only 18/6 and 9d. P. & P.

BY LEADING MANUFACTURER!!!
(limited quantity)
6 1/2" Dual Concentric Cone Loudspeakers, 3.5 ohm speech coil. This is a quality unit at only 35/- each brand new

VALRADIO T/V TUNER
Limited stocks of this well-known unit available at much reduced price. An ideal pre-fabricated front end for any superhet T/V receiver with 18 mc/s I.F. Continuously variable tuning covering ALL bands, from 40-100 mc/s and 170-225 mc/s. Valve line-up: PCC84, PCF50 (series heaters). Whilst stocks last only £25/19/6 plus 2/- P. & P.

SPEAKERS & ENCLOSURES
Full range in stock by WHARFEDALE, W.B., T.S.L., etc. Your enquiries welcomed.

TRANSISTORS!!!

SURPLUS—P.N.P.	
RED SPOT (Audio/Experimental Applications)	10/- ea.
BLUE SPOT, R.F. up to 1.6 Mc/s.	15/- ea.
WHITE SPOT, R.F. up to 2.5 Mc/s.	20/- ea.
STANDARD—BRIMAR	
T.S.1	18/- ea.
MULLARD	
OC70	21/- ea.
OC71	24/- ea.
OC72	30/- ea.
(ALL POST FREE)	

JUST RELEASED!!!
THE NEW R.C. TRANSISTOR/RECEIVER KIT
This receiver, covering medium waveband, which can be assembled in about 1 hour, will give amazing volume and tonal quality when used in conjunction with a good aerial and earth. Incorporating PNP Transistor and Germanium Diode. For headphones reception.
Included with the kit of parts is a handsome plastic case in black and white, measuring 4 1/2 x 2 1/4 x 1 1/2in. This case accommodates the complete receiver, including battery.
PRICE OF COMPLETE KIT: 25/- plus 1/3 P. & P.
Lightweight high resistance headphones can be supplied separately at 15/- pair. If, however, the kit is purchased complete with headphones this will be supplied at a SPECIAL INCLUSIVE PRICE OF 37/6 plus 1/6 P. & P. Optional extra. 100ft. coil single 7/38 coloured P.V.C. covered wire, suitable for both aerial and earth. 2/6 only.

THE TELETRON COMPANION
At last we are able to offer an efficient pocket portable TRANSISTOR receiver. This is a regenerative three transistor unit covering Medium and Long Wavebands. Dimensions only: 4in. x 3in. x 1in. Completely self contained in a smart plastic cabinet. Employs highly efficient Teletron coils and circuitry. Complete set of components with all assembly instructions only 89/6 plus 1/3 p. & p. or full parts sold separately if required.
Instruction leaflet and price list 6d post free!

THE JASON FM TUNER
Based on the booklet by Data Publications Ltd., 2/- post free, including our individually priced Parts List. Highly sensitive, free from drift. Incorporates 4 valves 6AM6 and 2 specially graded G.E.C. Crystals. The kit supplied includes drilled chassis with tuning condenser, scale calibrated in mc/s, and attractive bronze stove-enamelled front plate already mounted (illustrated). Front plate size 9in. x 5in. Chassis 7in. x 4 1/2in. x 1 1/2in. Complete standard kit £6/15/- plus 2/6 P. & P. Fringe area kit £7/15/- plus P. & P.

FM POWER PACK KIT. We can now supply complete kit for power pack suitable for the above F.M. tuner or any other similar type. Price for the complete kit is 37/6 only or 52/6 for ready assembled unit. This pack is extremely small, incorporating valve rectifier type 6X4 and built on chassis size only 6 x 4 x 1 1/2in. Optional extra for power pack. Bulgin Octal Plug 2/3.

AM/FM KIT
Introducing the JASON AM/FM KIT for medium waves and P.M.I.
As illustrated this is a very high quality chassis incorporating 5 of the latest miniature valves, plus DM70 magic eye. Kits are available for chassis complete with output stage at £15/5/-. Also less output stage but with own built-in power pack at £13/19/6 only. These are high fidelity units and exceptional value at these prices which include all required components and full constructional details. Fully illustrated Data Booklet with full construction details, plus individually priced component list, available per return of post 2/- post free. Both plus 3/6 P. & P.

THE T.S.L. FM TUNER
We can now supply this FM/VHF adaptor either in kit form or fully assembled, wired and tested. Our price for the ready-built unit, which incorporates its own power supply, is £13/15/- only, tax paid, plus 5/- P. & P. or H.P. terms. Magic eye tuning indicator, 19/- extra. Or the kit complete as specified £10/19/6 plus 3/6 P. & P. The booklet "FM TUNER CONSTRUCTION" (32 pages) with full technical data and point-to-point wiring diagrams, together with our separately priced parts list, is available at 3/6, post free.

ANNOUNCING OUR NEW F.M. TUNER KIT! (printed circuit). This is our printed circuit version of the Osram 912 F.M. Tuner—using T.C.C. printed circuit and condensers, incorporating 5 valves and two germanium diodes. Attractive black and gold dial, with gold eucalypton plate. Dial aperture only 5 x 3in. Osram F.M. booklet plus our additional instructions and individually priced components list—2/6 post free or the Kit absolutely complete at £8/3/- plus 2/6 P. & P. Alignment service available if required. We are demonstrating at 18 Tottenham Court Road.

Our advantageous H.P. and Credit Sale terms are available on any single item over £5. Your enquiries invited.

Please add postage under £1, or Cash with order. C.O.D. charge extra—open 9 a.m. to 6 p.m. Monday to Friday. Sorry but we close 1 p.m. on Saturday.

THE "SUPERIOR FOUR" KIT

Our superior four-valve receiver A.C. mains, 200/250 v. M. and Long waves. As with our very successful "Economy Four" kit, all required components are supplied. Valve line-up: 2 6BG7, 6 X50T, and 6 YGGT. Chassis is ready drilled. Cabinet size 10 1/2 in. wide, 10 in. high, 10 in. depth at base 5 in. tapering to 3 1/2 in. 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 P. & C. If preferred, we can supply Cabinet Assembly only, comprising Cabinet and Bracket wave-change switch; dial, pointer, drum pulleys drive spindle, drive spring and knobs, at 4/5/-, plus 2/6 P. & C. N.B.—Our kits are even supplied with sufficient solder for the job.



THE FIRST AND STILL THE BEST !!

THE R.C. RAMBLER ALL-DRY PORTABLE KIT
Full assembly details with practical and theoretical diagrams, 1/6 post free. This is a truly professional 4-valve superhet—all dry—for medium and long waves. Cream plastic top panel, with dial engraved in red and green adds to the very imposing appearance of this model which is housed in attractive cream and grey leatherette covered attaché-case type cabinet, measuring only 9 in. x 7 in. x 5 1/2 in. Weight less batteries 4 1/2 lb., with batteries 6 1/2 lb. This set really has everything. Built-in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5 in. speaker. Valve line-up 3V4, 1B5, 1S5, 1T4. 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. B.T. type B128 at 10/- . Also L.T. 1.5 v. A.D. 35 at 1/6.

RAMBLER MAINS UNIT. For using our popular all-dry "Ramblér" on A.C. Mains. Complete kit, when assembled fits snugly into battery compartment, supplied at 4/7/6 plus 1/6 packing and postage. Includes all required components, and full assembly instructions. N.B.—This unit is completely self-contained in a metal box measuring 7 in. x 2 1/2 in. x 1 1/2 in.



N.B.—All our T.R.F. Kit circuits include specially wound Denco "Max Q" coils on polystyrene formers, improved performance. Price remains the same.

THE R.C. 2 AMP. BATTERY CHARGER KIT. Includes handsome well-ventilated black stove-enamelled steel box, size: 7 1/2 in. x 3 1/2 in. x 3 1/2 in. Fully shrouded first quality transformer, brand name G.E.C. rectifier. Mains fuse, etc. For charging 6 or 12 v. batteries at 2 amp. Absolutely complete kit with full practical and theoretical instructions. Price 33/6 plus 2/6 P. & C. Can be supplied assembled and tested at 41/6 plus P. & P. Heavy duty crocodile clips suitable for car battery leads, optional extra at 1/6 per pair.

THE R.E.P. 1-Valve RECEIVER. All dry battery operation, for use with head phones, the complete kit is available at 42/-, less batteries plus 2/- P. & P. or full instructions at 8d. post free.

RC2.A. Small Portable Gram Amplifier. This little Amplifier is built around a Printed Circuit and employs the very latest highly efficient valve type ECL82. It is ideal for use where space is limited. Although of such small size 7 in. x 5 1/2 in. x 2 in. (overall) with a control panel 3 1/2 in. x 1 1/2 in., reproduction is excellent. A wide range tone control is provided. Output approx. 3 watts max. For use on A.C. Mains 200/250 v. NOTE THE PRICE 59/6, plus 2/- P. & P.

RC1.A. AMPLIFIER. A small high quality gramophone amplifier employing the latest circuitry and highly efficient miniature valves. Very neat chassis finished in bronze stove enamel. Size (overall) 5 1/2 x 4 x 5 in. Valves 6X4, ECL82. Output 3 watts max. Controls: Volume, Tone/On/Off. For use on A.C. mains 200/250 v. Price £3/10/6 plus 2/- P. & P.



CONSTRUCTORS NOTE !!
RADIO DATA BOOKS AVAILABLE, i.e. Valve guide, Colour code, etc. Send stamp for list.

VALVES. We have perhaps the most up-to-date valve trade. A stamp will bring complete list of brand new imported valve types, fully guaranteed. P.T. paid. Also all usual surplus types available such as 6V6GT, etc.

SURPLUS BARGAINS—METERS

F.S.D.	Size	Type	Fitting	Price
50 microamp	D.C. 4 in.	M.C.	Rectangular	110/-
50 microamp	D.C. 3 1/2 in.	M.C.	F.R.	95/-
100 microamp	D.C. 2 1/2 in.	M.C.	F.R.	45/-
200 microamp	D.C. 3 1/2 in.	M.C.	F.R.	65/-
500 microamp	D.C. 2 in.	M.C.	F.R.	18/6
750 microamp	D.C. 2 1/2 in.	M.C.	B.P. (scaled 0-100)	15/-
1 mA.	D.C. 2 in.	M.C.	F.R.	22/6
1 mA.	D.C. 2 in.	M.C.	F.Sq. (1954 by Elliott)	25/-
1 mA.	D.C. 2 1/2 in.	M.C.	F.Sq. Type	30/-
50 mA.	D.C. 2 in.	M.C.	F.R.	8/6
1 mA.	D.C. 2 in.	M.C.	F.R.	10/6
.5 amp.	R.F. 2 in.	Thermo	F.Sq.	6/6
1 amp.	R.F. 2 in.	M.C.	R.P.	10/-
120-120 amp.	D.C. 2 in.	M.C.	F.Sq. (shunt required)	15/-
150 amp.	A.C. 4 in.	M.I.	R.P.	45/-
1 amp.	R.F. 2 1/2 in.	Thermo	R.P.	7/6
3 amp.	R.F. 2 in.	Thermo	F.Sq.	6/-
20 amp.	D.C. 2 in.	—	R.P. (with shunt)	10/6
30 amp.	D.C. 2 1/2 in.	M.I.	F.R.	12/6
15 volt	A.C. 2 1/2 in.	M.I.	F.R.	10/6
15-0-15 volt	D.C. 2 1/2 in.	M.C.	F.R.	12/6
300 volt	A.C. 2 1/2 in.	M.C.	F.R.	35/-
300 volt	A.C. 3 in.	M.I.	F.R. Rd.	30/-

SPECIAL U.S. 0-1 mA. 2 1/2 in. taken from equipment but perfect, 22/6 each. R.P. = Round Projection. M.C. = Moving Coil. Thermo = Thermo-coupled. P. Sq. = Flush Square. F.R. = Flush Round. M.I. = Moving Iron.

METER RECTIFIERS. 1 mA. by G.E.C. at 6/6, also 5 mA. by G.E.C. at 6/6.

THE R.C. 3/4 WATT AMPLIFIER KIT. Compare the advantages. Treble, bass AND middle controls. For crystal or magnetic pick-up. A.C. Mains 200/250 v. Valve line-up: 6V6GT, 6BG7 metal 6X5GT. Negative feedback. Built on stove enamelled steel chassis, measuring only 8 in. x 4 in. x 1 1/2 in. 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. & P. Hearing is believing.



PRE-SET TUNER UNIT. (Manufacturers surplus). A two valve (TR41, VP41) superhet tuner unit covering two pre-set stations. Light and Home services, for feeding direct into any suitable amplifier. Power requirements: 200 volt at 20 mA. D.C. and 4 v. at 2 amp. Built-in power supplies may be added if required. Dimensions 9 in. x 3 1/2 in. x 7 1/2 in. (overall). Unit only, 45/- plus 2/6 P. & P. All components for built-in power supplies with full modification details available for 20/- extra.



RETURN OF A WINNER!!!
(Exclusive)

We have been most fortunate in obtaining further limited supply of this fine and popular cabinet. Instantly recognised as being of leading High Quality manufacturers stock, this trolley-type cabinet is finished in polished dark solid walnut. Can easily be adapted to accommodate tape recorder, amplifier, radio-gram etc., etc. External measurements: 24 in. x 16 in. x 29 in. The whole is mounted upon "easy run" castors. Unrepeatable at this price £5/19/6, plus 15/- C. & P.

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, 6I7 and 6V6 Chassis ready drilled. Cabinet size 12 in. long by 6 in. high by 6 in. 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 1/5 post free. This is allowed if kit is purchased later. Plus 2/6 packing and carriage for complete kit.



GRAMOPHONE MOTORS are in SHORT SUPPLY!

COLLARO AC 3/554: Three speed, single player for A.C. mains 200/250 v. cream finish, complete with turn-over crystal pick-up incorporating the well-known high output "T" type head. Strictly limited quantity at £6/19/6 plus 3/6 p. and p.

FOUR-SPEED CHANGERS
Collaro EC458 Mixer Auto-Cleaner in cream with Studio "O" insert. £9/15/- B.S.R. Menaroh Mixer Auto-Changer, in cream and gold. £3/15/- Both plus 3/6 p. and p. B.P. Terms available. Stocks rapidly diminishing.

RECORDER AMPLIFIER

(Well known manufacturer's surplus). This is a brand new amplifier designed for use with a famous wire recorder. A simple modification is all that is required to make this unit ideal for use with any Tape Deck. Specifications: Valve line-up 7G5, 2A7, 6B17, 6BR7, 6X4. Neon Record Level Indicator. Controls: Volume/Record Level. Tone Control, Record/Playback Switch. High and Low level inputs for Mikes and Radio. External Speaker Socket. Built-in 8 in. Loudspeaker with High Flux magnet. Separate Power Pack. Dimensions: Amplifier 5 1/2 in. H. x 1 1/2 in. W. x 3 1/2 in. D. Power Pack: 6 1/2 in. x 6 in. x 5 in. High (overall). Full modification details are supplied. Price £8/19/6. P. & P. 3/6.



10 in. CABINET SPEAKER. Ideal for P.A. etc. Comprises solid wood cabinet complete with carrying handle. Painted dark brown, with built-in good quality 10 in. P.M. speaker, 3 ohm speech coil, complete with lead and Igrano Jack plug. Brand new. Price only 45/-, plus 3/6 P. & P.

Have YOU had a copy of our 108 PAGE comprehensive CATALOGUE? This invaluable publication is only 2/- post free.

RC3.A. Small 3-Valve Portable Gram Amplifier. An excellent little amplifier for portable gram, giving high quality output. Separate Bass and Treble controls. 2-3 watts output. Valve line-up: EZ80, EL84, EC083. Provision for mounting 6 in. loudspeaker. Fully isolated from mains 200/250 v. A.C. Overall size: 6 1/2 in. L x 5 1/2 in. H x 2 1/2 in. D. PRICE £3/19/6 (less Speaker and Output Transformers), plus 2/6 P. & P.

RC4.A. (STALLION). This is supplied complete with high flux 8 in. P.M. Speaker and Baffle. Incorporating three octal type valves 6Q7, 6V6 and 6X5, this robust and well-made unit is ideal for use in the larger type of record player and is equally suitable for use in conjunction with a radio feeder unit. Separate bass and treble controls are provided: also provision is made for an extension speaker and mains supplies to gram. motor. Output approx. 4 watts. Size overall 13 in. x 4 in. x 9 in. high. For use on A.C. Mains 100/200/250 v. PRICE £5/19/6, plus 2/6 P. & P. H.P. terms £2/19/6 deposit and four monthly payments of 16/6 per month. Fit our portable cabinet "G" at 85/- without modification.



RECORD PLAYER CABINETS—to suit all types of single record and auto-changer units. Priced from 45/- . Send stamp for fully illustrated list.

SELENIUM RECTIFIERS

L.T. Types
 2/6 v. 1/2 a.h.w. . . . 1/9
 6/12 v. 1/2 a.h.w. . . . 2/9
F.W. Bridge
 6/12 v. 1 a. 4/11
 6/12 v. 2 a. 8/9
 6/12 v. 3 a. 11/9
 6/12 v. 4 a. 14/9
 6/12 v. 6 a. 19/9
 6/12 v. 10 a. 25/9
H.T. Type H.W.
 120 v. 40 mA. 3/9
 250 v. 50 mA. 5/9
 250 v. 80 mA. 7/9
 250 v. 150 mA. 9/9
 300 v. 250 mA. 12/11

BATTERY CHARGING EQUIPMENT

ASSEMBLED CHARGERS

6 v. 1 a. 19/9
 6/12 v. 1 a. 25/9
 6 v. 2 a. 29/9
 6/12 v. 2 a. 38/9
 6/12 v. 4 a. 56/9
 Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. and packing 3/6.

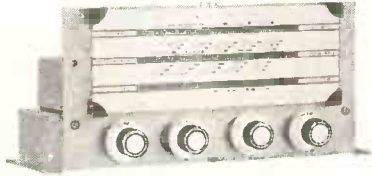
BATTERY CHARGER KITS
 Consisting of Mains Transformer F.W. Bridge. Metal Rectifier, well ventilated steel case, Fuses, Fuse-holders, Grommets, panels and circuit. Carr. 2/6 extra.
 6 v. or 12 v. 1 amp. 22/9
 6 v. 2 amps. 25/9
 6 v. or 12 v. 2 amps. 31/6
 6 v. or 12 v. 4 amps. 53/9
BATTERY CHARGER KIT
 Consisting of F.W. Bridge Rectifier 6/12 v. 5 a. Mains Trans., 0-9-15 v. 6 a. output, and ammeter. Only 49/9. Post 3/-.

ASSEMBLED CHARGER
 6 v. or 12 v. 2 amps.
 Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only 47/9 Carr. 3/6.

All for A.C. MAINS 200-250v., 50 c/s. Guaranteed 12 months. Assembled 6v. or 12v. 4 amps.



Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. **75/-** Ready for use with mains and output leads. Carr. 3/9. Or Deposit 13/9 and five monthly payments 13/9.



AM/FM RADIOGRAM CHASSIS PUSH PULL 6-8 WATTS OUTPUT
 Current manufacture. For 200-250 v. mains. Covers L. and M. Wavebands plus F.M. Valve line up: 12AT7, 6BJ6, 12AH8, HABC30, 19A85, 19AQ5, 19AQ5, 35W5. Only 22 gns. plus 7/6 carr. Or deposit £2/12/- and 9 monthly payments of £2/12/-.

CO-AXIAL CABLE. 75 ohms. 1/2 in., 8d. yard Twin screened feeder 11d. yard.

DIAL BULBS. M.E.S., 8 v. 0.2 a., C/9 doz. 6.5 v. 0.3 a., 5/9 doz. 2.5 v. 0.3 a. 3/9 doz.

ELECTROLYTICS (current production). NOT Ex Govt.

Tubular Types	Can Types
8 mfd. 450 v. 1/9	16µF 450 v. 2/9
8 mfd. 500 v. 2/6	16 mfd. 500 v. 3/9
16µF 350 v. 1/11	32µF 350 v. 2/11
16µF 450 v. 2/9	32 mfd. 450 v. 4/9
16µF 500 v. 3/9	100 mfd. 450 v. 4/9
8-16µF 500 v. 4/11	8-8µF 450 v. 2/11
25µF 25 v. 1/3	8-16µF 450 v. 3/11
50µF 12 v. 1/3	16-16µF 450 v. 3/11
50 mfd. 25 v. 1/9	32-32µF 350 v. 4/9
50µF 50 v. 1/9	32-32µF 450 v. 5/9
100 mfd. 12 v. 1/9	100-100 mfd. 350 v. 5/9
100 mfd. 25 v. 2/3	64-120 mfd. 350 v. 7/6
3,000 mfd. 6 v. 3/9	100-200 mfd. 7/6
6,000 mfd. 6 v. 3/11	275 v. 6/11

Many others in stock.

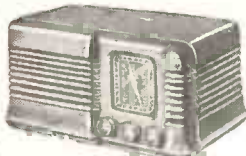
VOLUME CONTROLS with long spindles, all values, less switch, 2/9; with S.P. switch, 3/9.

EX GOVT. STEP UP/STEP DOWN TRANSFORMERS. Double wound 80/100 watts. 10-0-100-200-220-240 v. to 5-0-75-115-125-135 v. or Reverse. Only 11/9, plus 2/9 post. 10-0-100-200-220-240 v. to 9-0-110-122-136-148 v. or Reverse. 200 watts, 35/9 plus 7/6 carr.

EX GOVT. METAL BLOCK PAPER CONDENSERS
 4 mfd. 500 v. 2/3
 4 mfd. 1,000 v. 3/9
 8 mfd. 500 v. 4/6
 10 mfd. 500 v. 3/9

OIL FILLED BLOCK CONDENSERS
 Bryce 11-7 mfd. 500 v. New unused Govt. surplus, only 5/9 each.

THE SKY FOUR T.R.F. RECEIVER



A design of a 3 valve 200-250 v. A.C. Mains L. & M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. 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, 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite, or veneered walnut.

5 CORE FLEX. Henleys circular rubber 14/36. Each lead colour coded. 1/6 yard.

EX GOVT. MAINS TRANSFORMERS
 All 230 v. 50 c/s. input
 120-0-120 v. 40 mA. 5/9
 250-0-250 v. 60 mA., 6.3 v. 3 a., 6.3 v. 1 a. Potted 4 1/2-3 1/2 in. 11/9

HEAVY DUTY OIL FILLED MAINS TRANSFORMERS
 Suitable welding or soil heating. With input of 200-250 v. 50 c.p.s., output is 12 v. 80-100 amps. Only £6/19/6, carr. 7/6.

EX-GOVT. VIBRATOR UNITS. 12 v. input 280 v. output. Suitable for car radio, etc. 16/6.

MANUFACTURERS SURPLUS TRANSFORMERS. Primary 200-240-250 v. Drop through type 250-0-250 v. 70 mA. 6.3 v. 3 a., 11/9. Postage 2/9.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all dry battery eliminator. Size 5 1/2 x 4 1/2 x 2 in. approx. Completely replaces batteries supplying 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types. Complete kit with diagrams, 39/9, or ready for use, 46/9.



Type BM2. Size 8 x 5 1/2 x 2 1/2 in. Supplies 120 v., 90 v., and 60 v., 40 mA, and 2 v., 0.4 a. to 1 amp. fully smoothed THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 2V. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. **SUITABLE FOR ALL BATTERY RECEIVERS** normally using 2 v. accumulator. Complete kit with diagrams and instructions 49/9 or ready for use 59/6.

JUNCTION TRANSISTORS for Audio stages. Only 7/6. **MINIATURE MOTORS.** 24/28 v. D.C. or A.C. Size only 2 1/2 x 1 1/2 in. Spindle 1 1/2 in. long, 1/2 in. diam. Made by Hoover Ltd., Canada. Price only 9/9. **M.E. SPEAKERS.** 2-3 ohms R.A. 8 in. Field 600 ohms, 11/9.

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. 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.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 25/9
 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. 25/9
 300-0-300 v. 100 mA., 6.3 v. 4 v. 4 a. c.t., 0-4-5 v. 3 a. 26/9
 350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a. 23/9
 300-0-300v. 130 mA., 6.3v. 4 a. c.t., 6.3v. 1 a., suitable for Mullard 510 Amplifier 350-0-350 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a. 33/9
 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
 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 a. 4 a. c.t., 0-4-5 v. 3 a. 23/9
 350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a. 29/9

VIBRATORS. Oak and Wearite Synchronous 7 pin 2 v., 7/9, 6 v. 8/9.

FILAMENT TRANSFORMERS
 Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a. 5/9
 6.3 v. 2 a. 7/6
 0-4-6.3 v. 2 a. 7/9
 12 v. 1 a. 7/9
 6.3 v. 3 a. 8/11
 6.3 v. 6 a. 17/6
 12 v. 3 a. or 25 v. 1.5 a. 17/6

CHARGER TRANSFORMERS
 All with 200-230-250 v. 50 c/s. Primaries:

0-9-15 v. 1 1/2 a., 11/9; 0-9-15 v. 3 a., 16/9;
 0-3.5-9-17 v. 3 a., 17/9; 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., 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, 8,000Ω to 3Ω 4/9
 Push-Pull 8 Watts 6V6 to 5 ohms. 8/9
 Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω 15/9
 Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω 16/9
 Push Pull EL84 to 3 or 15 ohms. 16/9
 Push Pull 15-18 Watts, sectionally wound, 6L6, KT66, etc., to 3 or 15 ohms. 21/9
 Push-Pull 20 Watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω 47/9

SMOOTHING CHOKES
 250 mA., 5 H., 100 ohms. 11/9
 150 mA., 7-10 H., 250 ohms. 11/9
 100 mA., 10 H., 200 ohms. 8/9
 80 mA., 10 H., 350 ohms. 5/6
 60 mA., 10 H., 400 ohms. 4/11
 1 amp. 0.5 ohm. L.T. type 6/6

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

NEW 1957 DESIGN. HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-amp stages are incorporated. Sensitivity is extremely high. Only 12 millivolts minimum input is required for full output. THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP. Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram, etc., etc., can be simultaneously applied for mixing purposes. AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 v. 1.5 a. FOR A RADIO FEEDER UNIT. Price in kit form with easy to follow wiring diagrams.



Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE. Frequency response ± 3 D.B., 30-20,000 c/cs., Tone Controls ± 12 D.B. at 50 c/cs., ± 12 D.B. to -6 D.B. at 12,000 c/cs., Hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12x9x9 in. approx. Power consumption 150 watts. For A.C. mains 200-230-250 v. 50 c/cs. Outputs for 3 and 15 ohm speakers. EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS, or OUTSIDE FUNCTIONS. IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, 12 v. Rotary Converters, etc., at kept cash prices or on terms with amplifiers.

Cover as illustrated 10 GNS. 17/6 extra. Only car. 10/-
Or Factory built with 12 months' guarantee £12/19/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 35/9 and 9 monthly payments of 28/11.

LT/45 HIGH QUALITY TAPE DECK AMPLIFIER

COMPLETE WITH POWER PACK and OSC. STAGE. Suitable for Collaro, Lane, Truvox, Aspdin, Brennel, etc., etc. State make of Deck when ordering. Chassis size 12-7-9in Overall size 12-7-6in. For 200-250 v. 50 c/cs. A.C. mains. Output for standard 2-3 ohm speaker. Only 15 millivolts input required for full recording. Only 2 millivolts minimum input required from recording head. Magic Eye recording level indicator. Provision for feeding P.A. amplifier. Negative feed-back equalisation. Linear frequency response ± 3 D.B. 50-11,000 c/cs. Facilities for recordings at 15in., 7in. or 3in. per second. Automatic equalisation at the turn of a knob. When switching from record to playback position automatic demagnetisation of heads is assured. Separate gain and output controls. Valves type ECC83, ECC83, EL84, EZ80, EM34. Output 4 watts.

12 Ready for use. GNS. Carr. 7/6. Unit supplied with makers' 12 months' guarantee. We know of no other make which represents the same exceptional value. We can supply Decks and microphones with above at a special inclusive price. Leaflet 6d.



R.S.C. ULTRA LINEAR 12-14WATT AMPLIFIER



LINEAR LG3 MINIATURE 3 WATT GRAM. AMPLIFIER

For 200-250 v. 50 c.p.s. A.C. Mains, Chassals and P.U. connections fully isolated. Fitted vol. (with mains switch) and Tone Control. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohms speaker. Guaranteed 12 months (valves 3 months). Only 6/9/6 carr. 3/9.

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 Bass 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. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. 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 the blue hammer 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. Or Deposit 22/- and five monthly payments of 22/- for assembled unit.



COLLARO RC456 4 SPEED AUTO-CHANGERS

With studio pick-up with turnover head. BRAND NEW. Cartoned, latest model. For 200-250 v. 50 c.p.s. A.C. mains. Very limited number at only £8/19/6. Carr. 5/6.

COLLARO RC54 3 SPEED AUTO-CHANGER

As above unit but for normal 3-speed requirements. Brand new cartoned but for 110 v. 50 c.p.s. A.C. mains. So that the unit can be operated from normal 200-250 v. A.C. mains we are supplying free with every changer a suitable auto-transformer with input and output voltages clearly marked. Limited number only. 7 gns. Carr. 5/6.

PORTABLE CABINETS.

Attractively designed and finished in 2 tone rexine. Provision for speaker and amplifier. Inside dimensions 17 1/2 x 12 1/2 in. Depth 7 in. 59/6 plus 1d 1/2 in. Carriage 5/-.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER.

Suitable for use with Garrard, B.S.B. or any other record playing unit, and most microphones. Total negative feedback 12 db. Separate Bass and Treble Controls. For convenience when mounted in cabinet, mains switch is incorporated in control. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves used. Size of unit only 6 x 5 x 5 1/2 in. high. Chassis is fully isolated from mains. Guaranteed 12 months. Only £5/9/6. Or Deposit 22/- and five monthly payments of 22/- Send S.A.E. for leaflet.



PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms), consisting of a high quality 12in. speaker of orthodox design, supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A3 or any similar amplifier. Rating is 10 watts. Price only 25/17/6. Or Deposit 13/- and nine monthly payments of 13/-.

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 Bass and Treble controls giving full tone compensation for Long Playing records. Suitable for any kind of pick-up including latest high fidelity types. H.F. of 250 v. 20 mA. and L.T. 6.3 v. 1.5 a. 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/-, carr. 3/6 or factory built 22/6 extra. Or Deposit 18/6 and five monthly payments of 18/6 for assembled unit.

P.M. Speakers recommended for use with A7, A5 or L45 amplifiers. Plessey 12in. 8 ohm, 29/11. 6in. Celestion and Goodmans with high flux density magnet 19/9.

NEW 1957 MODEL A11 HIGH-FIDELITY PUSH-PULL AMPLIFIER WITH "BUILT-IN" TONE CONTROL, PRE-AMP STAGES

Two input sockets with associated controls allow mixing of "mike" and gram, as to A10. High sensitivity. Includes 5 valves, ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer, specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B., 30-30,000 c/cs. Six negative feedback loops. Hum level 60 dB. down. ONLY 25 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12-9-7in. For A.C. mains 200-230-250 v. 50 c/cs. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Despite improved performance due to use of latest miniature valves price remains as previous model but extra input now provided.

Only 8 GNS. or factory built 45/- extra. Carr. 10/-. If required louvred metal cover with 2 carrying handles can be supplied for 17/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 25/6 and nine monthly payments of 25/6.

LINEAR "DIATONIC" 10-WATT HIGH FIDELITY AMPLIFIER.

Incorporating pre-amp. For A.C. mains input 200-230-250 v. 50 c.p.s. A compact attractively finished unit with two separately controlled inputs, and outputs for 3 and 15 ohm speakers. Separate Bass and Treble controls. Five latest type miniature Mullard valves. Only 12 Gns. Send S.A.E. for leaflet and credit terms.

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. £4/10/9. Please state whether 3 ohm or 15 ohm required.

P.M. SPEAKERS.

2-3 ohm 5in. Goodmans 17/9. 7x9in. Elliptical 19/6. 6in. Rola, 19/9. 8in. Rola, 19/9. 10in. R.A., 29/9. 12in. Plessey 3 ohms, 10 watts, 59/6.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode P-changer is used. Pentode I.P. and double Diode Second Detector. Delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W. Ch. Sw. incorporates Gram. postica. Controls are Tuning, W. Ch., and Vol. Output will load most Amplifiers requiring 500 m. v. input depending on Ae. location. Only 250 v. 15 mA. H.T. and I.P.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is £4/15/-. Point-to-point wiring diagrams and instructions, 8/6.

RECORDING TAPE. 1,200 ft. Reels Purton, Medium Coerativity, 15/9.

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 1/9 extra on all orders under £2, 2/9 extra under £5 unless carriage charge stated. Full Price List 6d. Trade List 5s. Open to Callers: 9 a.m. to 5.30 p.m. Saturday until 1 p.m., S.A.E. please with all enquiries.

G.W. SMITH & CO

(RADIO) LIMITED

Phone: GERRARD 8204/9155

Cables: SMITHEX LESQUARE

334 LISLE STREET, LONDON, W.C.2

MIDGET RECORDER MOTORS

Size only $1\frac{1}{2} \times 1 \times 2\frac{3}{4}$ in. Will operate from 4.5 to 24 volt D.C. Fitted with reduction gear. Supplied brand new, 12/6 each. P.P. 1/-.

H.D. AUTO TRANSFORMER. 110/230 volts, 1,000 watts, 79/6 each. P.P. 5/- Also 150 watts, 21/-, P.P. 2/-.

L.T. TRANSFORMER BARGAIN. Input 200/250 volts. Output 12 volts 5 amps. Brand new, 12/6 each. P.P. 2/6.

SURPLUS TRANSISTORS

Junction type, P.N.P. Red spot, for audio, 10/- Blue spot, R.F. 1.6 mc/s., 15/- Few only genuine Mullard OC71 or OC70, 12/6 each.

MINIATURE TRANSFORMERS.

$\frac{3}{4}$ in. sq. 4.5 : 1 or 10 : 1, 4/6 each.

SUB MINIATURE CAPACITORS.

Size only $\frac{1}{2} \times \frac{3}{8}$ in., 6, 8, 16 or 30 mfd. 3 or 6 volt, 2/9 each. .001, .002, .005, .01, .02, or .04 mfd., 9d. Miniature 2 gang 365 pf., 8/6 each.

6FT. POST OFFICE RACKS. Standard 19in. "U" channel type, 79/6 each. P.P. 12/6.



CRYSTAL MICROPHONE INSERTS

Sensitive, ideal for tape recorders, amplifiers, etc., 5/6 each. P.P. 6d.

POST OFFICE JACK LEADS. 4ft. screened lead fitted with 2 standard jack plugs, brand new, 3/- each. P.P. 6d. Standard socket. 9d.

WESTON DUAL RANGE OHMMETER

Incorporates a 2 1/2 in. moving coil meter, ranges, 2,000 and 200,000 ohms. Supplied brand new with leads and leather carrying case, 39/6 each. P.P. 2/6.

HEAVY DUTY L.T. TRANSFORMERS.

Input 230 volts. Output 17.5 volts, 35 amps. (service rating, OK 50 amps.). Brand new, 72/6 each, P.P. 5/-.

HOOPER ROTARY TRANSFORMERS.

Latest type, small. 24 volt D.C. input, 210 v. 140 ma. output. New, 15/6 each. P.P. 2/-.

HEAVY DUTY SLIDER. 1 ohm, 12 amps, brand new, 6/6. P.P. 1/9.

R.G.A. OUTPUT TRANSFORMERS

Completely potted. Centre tapped primary, 8,000 ohms. Secondary tapped, 3, 7.5, 15, 500 or 600 ohms. Separate feedback winding. 15 watts rating. Ideal for 6L6, KT66, EL84's etc., brand new, 27/6 each. P.P. 2/-.

ROTARY CONVERTORS.

Input 24 v. D.C. Output 230 volts A.C. 50, cycles 100 watts. Supplied unused, 92/6 each. P.P. 5/-.

A.R.88 WAVECHANGE SWITCHES

Ceramic, 8 bank, 6 position, complete with screens. Brand new, 17/6 each. P.P. 2/6.

MODULATOR 67



These bargain instruments contain a COMPLETE A.C. MAINS POWER PACK. Input 230 volts 50 cycles. Output 350 volts. 120 mA. and 6.3 volts 5 amps. Lcho and condenser smoothed and uses 5Z4 rectifier. (Transformer actually 200 mA.). Also included in the unit are 11 other valves, 5 SP61, 1 VR116, 2 EB34 and 3 EA50, and many other useful components, pots, resistors, switches, etc. Size of case 18 x 9 x 7in., which is finished in grey. Supplied brand new, 49/6 each. P.P. 7/6.

HALLICRAFTER S. 36A. V.H.F. COMMUNICATION RECEIVERS. Improved version of S.27. Specification: Completely self contained except for headset or speaker. Operation 110/230 volt A.C. Superhet receiver, for A.M. or F.M., incorporating R.F. and 3 I.F. stages, A.V.C., noise limiter, and 5 meter. Frequency coverage 27.8 to 143 mc/s. Supplied brand new, £45 each. P.P. 15/-.

COSSOR DOUBLE BEAM OSCILLOSCOPE

TYPE 339A. Standard model. Operation 110/200/250 volt A.C. Ten time base positions, 6 cps. to 250,000 cps. Input frequency range, 10 cps. to 2 mc/s. Offered in perfect operational condition, fully tested, £27/10/- each. P.P. £1.

MARCONI SIGNAL GENERATORS. Laboratory instruments at a fraction of original cost. Operation of all types, 200/250 volt A.C. Type TF-390G. Frequency coverage 16 to 150 mc/s. Brand new with leads and charts, £25 each. P.P. £1. Ditto to 100 mc/s., £22/10/-, Type TF-517G. Frequency coverage 16 to 58 mc/s. and 150 to 300 mc/s. Brand new £35 each. Ditto complete with TF-675 pulse generator, £42/10/-, P.P. £1.

Type TF-144G. Standard model. Frequency coverage 85 kc/s. to 25 mc/s. Completely overhauled, £75. P.P. £1.

AMERICAN BEACON TRANSMITTER/RECEIVERS

RT 37/PPN-2. Brand new and boxed, complete with instruction book. Equipment comprises transmitter/receiver with 9 valves (5 3A5, 3 1S5 and 1 IR5), with built-in 2 v. vibrator power pack, spare vibrator, head-set connector leads and 10ft. collapsible aerial. Frequency coverage 214/238 Mc/s. Price 72/6 each. P.P. 6/-.

AMERICAN ROTARY TRANSFORMERS

Models available for either 6 or 12 volt D.C. input Output 250 volts D.C. 80 mA. Ideal for car radios or razors, etc., brand new 22/6 each. P.P. 3/-.

HEAVY DUTY MAINS ISOLATING TRANSFORMERS. Specification:—Primary 230 volts 3 amps. Secondary 230 volts 3 amps. (service rating, OK 5 amps.). Ideal for laboratory or workshop use. Supplied brand new in original transit cases, £6/10/- each. P.P. 10/-.

R.1155 SUPER SLOW MOTION DRIVES. Improved version as fitted to Model L and N. Supplied brand new and boxed, 12/6 each. P.P. 1/6.

AMERICAN GEARED MOTORS



American 24 volt D.C. motor with built-in precision gearbox giving twin outputs 20 r.p.m. and 6 r.p.m. Will also operate on 12 v. giving reduced outputs. Size 7in. x 1 1/2 in. Shaft dia. 1/2 in. Supplied brand new only 19/6 each. P.P. 3/-.

ADMIRALTY REFLEX RE-ENTRANT P.A. LOUDSPEAKERS

Twin units. Impedance 3 ohms. Extremely sensitive and directional. Ideal for all outside work. Complete with 600 ohm line transformer. Price 32/6 each. P.P. 5/-.

PARMECO PRESSURE UNITS. Heavy duty, 3 ohm coil. Not new but all tested, 39/6 each. P.P. 3/-.

L.T. TRANSFORMER BARGAIN. Input 200/250 volts. Output tapped, 3, 6, 9, 12, 24 or 36 volts 5 amps. 35/-, P.P. 3/-.

A.C. MAINS BLOWER MOTORS

220/230 volt 300 watts. 1 1/2 in. dia. outlet. Housed in metal box and fitted with dust filter pads. Supplied complete with 4 spare filters, 2 way outlet adaptor and 2 lengths of hose. Brand new only, £4/19/6 each. P.P. 7/6.

COPPER AERIAL WIRE. Ex-U.S.A. 300ft. reels, 3/6. P.P. 1/-.

ALUMINIUM CHASSIS. Best quality, 18 swg. Four sided, reinforced corners. 6 x 4 x 2 1/2 in., 3/6 10 x 7 1/2 x 2 1/2 in., 5/3 7 1/2 x 5 1/2 x 2 1/2 in., 4/6 13 1/2 x 9 x 2 1/2 in., 6/9 11 1/2 x 7 1/2 x 2 1/2 in., 6/- Postage 1/- all sizes.

BARGAIN 6.3 VOLT FILAMENT TRANSFORMERS

Potted, hermetically sealed, ceramic terminations, all brand new. Made by famous manufacturer.

Type 1. 200/250 volt input. Outputs: 6.3 v. C.T. 5.6 amp., tapped 5 v.; 6.3 v. C.T. 4.8 amp., tapped 4 v.; 6.3 v. C.T. 1 amp., tapped 4 v., 19/6 each.

Type 2. 200/250 v. input. Output: 6.3 v. C.T. 3.3 amp., tapped 5 v.; 6.3 v. C.T. 1 amp., tapped 4 v.; 6.3 v. C.T. .9 amp.; 6.3 v. C.T. .6 amp., 15/6 each. Postage both types, 2/-.

BENDIX COMMAND TRANSMITTERS 2.1 to 3 mc/s. Complete with all valves and crystal, 22/6 each. P.P. 3/-.

460 KC/S B.F.O. UNITS. Brand new and complete with 1S5 valve. Fully screened in aluminium case, only 8/6 each. P.P. 1/-.

AMERICAN SUPER LIGHT-WEIGHT HEADPHONES

Magnetic type, res. 50 ohms. Fitted with rubber earmoulds to fit inside the ear. Extremely good quality, ideal for communication receivers etc., supplied brand new, 15/- pair. P.P. 1/-.

TRANSFORMER BARGAIN. Input 200/250 volts. Output 250/0/250 volts 200 mA. 6.3 volt 4 amp., 5 volt 2 amp. Brand new, 27/6 each.

6 VOLT VIBRATOR PACKS

Output 120 volts 30 mA. Fully smoothed, uses standard Mallory 4 pin vibrator. Supplied brand new and boxed, 12/6 each. P.P. 2/6.

MAINS NEON PANEL INDICATORS. Chrome escutcheon. 200/250 v. Red, amber or clear, 3/9 each. P.P. 6d.

HEATER TRANSFORMER. Brand new. Input 230 volts. 6.3 volt 1.5 amp. output 5/9 each. P.P. 1/-.

50 MICROAMP METERS

2 1/2 in. flush mounting meter housed in grey instrument case, complete with a chrome handle. Resistance 800 ohms. Supplied brand new and tested, 59/6 each. P.P. 2/6.

HOURS OF BUSINESS: 9 a.m.-6 p.m. Thursday 1 p.m. Open all day Saturday. Please print name and address clearly.

LOOK! THOUSANDS OF BARGAINS AVAILABLE WHICH WE ARE UNABLE TO ADVERTISE. IT IS WORTH YOUR WHILE TO PAY US A VISIT

SMOOTHING CHOKE BARGAINS

4H. 22.5 mA. 4/6 10H. 120 mA. 8/6
 8H. 50 mA. 5/6 15H. 60 mA. 5/6
 8H. 250 mA. 10/6 15H. 300 mA. 10/6
 9H. 100 mA. 7/6 20H. 120 mA. 10/6
 10H. 60 mA. 4/6 30H. 30 mA. 3/6
 Collins potted choke 8H. 100 mA. 8/6
 Bargain Parmeko choke 5H. 200 mA. 5/6
 Rich and Bundy choke 50H. 120 mA. 15/6
 Swinging choke 8/40H. 30/300 mA. 10/6
 Swinging choke 3/6/4. 2H. 250 mA. 10/6
 P.P. under 10/- 1/3, over 10/-, 2/-.

8 MFD. PAPER CONDENSERS. Brand new T.C.C. visconyl type. 750 volts working 5/6 each. P.P. 1/-.

CONVERTOR TRANSFORMERS. Midget. Input 220/240 volts. Output 220 volts 25 mA., 6.3 volts 1 amp. New, 10/6. P.P. 1/-.
 Midget contact rectifier to suit, 7/6. P.P. 6d.

DYNAMO EXPLODER UNITS

Used for detonating explosive charges. Operation is by hand generator, giving 1,800 volts D.C. across output terminals. Ideal also for use as photo flash generator. Brand new only £3/19/6 each. P.P. 5/-.

CHARGING AND MODEL TRANSFORMERS.

1. Pri. 200/250 v. Sec. 3.5, 9 or 17 v. 1 amp., 9/9
 2. Pri. 200/250 v. Sec. 3.5, 9 or 17 v. 2 amp., 14/3.
 3. Pri. 200/250 v. Sec. 3.5, 9 or 17 v. 4 amp., 16/6
 4. Pri. 200/250 v. Sec. 6.3 v. 3 amp., 4 v. 1.5 amp. 9/6.

5. Pri. 200/250 v. Sec. tapped, 3, 4, 5, 6, 8, 10, 12, 15, 18, 20, 24 or 30 volt 2 amp., 18/6.
 Postage 1/6 all types.

L.T. METAL RECTIFIERS. Full wave and bridged. 12 v. 1 amp., 6/3; 12 v. 2 amp., 9/3; 12 v. 4 amp., 13/9; 24 v. 1 amp., 12/6; 24 v. 4 amp., 22/6. P.P. 1/- all types.

0-1 MA. METERS



Brand new moving coil meters, round flush mounting with 2 1/2 in. scale, calibrated 0/300 volts. Resistance 100 ohms. Supplied complete with rectifier. 25/- each. P.P. 1/-.

AMERICAN BD-91 SWITCHBOARDS. 25 line, complete with automatic ringer and seat, etc., brand new, £50. P.P. £2.

INSTRUMENT POTENTIOMETERS. Brand new Colvern type. 100,000 ohms, 10 watts, 3 1/2 in. dia. Ideal for bridges, etc., 10/6. Ditto twin gang 5,000 ohms, 10/6. P.P. 1/-.

INSTRUMENT TRANSFORMERS. Parmeko. Input 230 volts. Output H.T. 195 volts 85 mA. tapped 130 v. and 65 v. L.T. 6.3 v. 5 amp., 6.3 v. .3 amp. Brand new, 14/6. P.P. 1/6.

ADMIRALTY 12 VOLT D.C. MOBILE AMPLIFIERS

Separate mic. or gram. inputs. Output 10 watts, matched, 3, 15 or 600 ohms. Not new, but all tested, £8/19/6 each. P.P. 5/-.

SOUND POWERED BALANCED ARMATURE EARPIECES. Brand new, 3/6 each. P.P. 9d. inserts only, 1/9. Brand new sound powered handsets, 19/6 each. P.P. 1/-.

G.P.O. BELL UNITS. Supplied brand new complete with 2 bells, induction coil, etc., 7/6 each. P.P. 2/6.

BARGAIN GRAM MOTORS

Garrard centre drive motors complete with turntables. 200/250 volt A.C. Adjustable mechanically from 0 to 45 r.p.m. Only 22/6 each. P.P. 3/-.

TRANSMITTER/RECEIVER No. 19 MK. II COMPLETE KITS



Brand new in original transit cases. Equipment comprises TX/RX, 12 volt rotary power pack, variometer, control boxes, all necessary connecting leads, aerial base and mounting platform. For R.T. or C.W. frequency coverage A set, 2 to 8 mc/s. B set, 229 to 241 mc/s and intercom system. Complete with 15 valves and tuning meter. Only £11/19/6 each. P.P. £2.

Also available transmitter/receiver complete with power pack only, in very good condition, £5/10/- each. P.P. 15/-.

CHEAP "G" CORE TRANSFORMERS

Wonderful offer. Made to highest specification, fully potted, hermetically sealed, ceramic terminations, fully tropicalized. ALL BRAND NEW.

1. 230 v. primary. Sec. 510/0/510 v. 300 mA. 375/0/375 v. 100 mA. 6.3 v. 9 a. 2 x 6.3 v. 2 a. 2 x 6.3 v. 1 a. 6.3 v. 1.5 a. 6.3 v. 5 a. 5 v. 3 a. 82/6. P.P. 5/-.
2. 230 v. primary. Sec. 360/0/360 v. 200 mA. 360/0/360 v. 65 mA. 6.3 v. CT. 5 a. 6.3 v. CT. 2 a. 6.3 v. 5 a. 5 v. 4 a. 5 v. 3 a. 65/- P.P. 4/6.
3. 230 v. primary. Sec. 350/0/350 v. 400 mA. 25 v. 1 a. 21 v. 5 a. 6.3 v. 5 a. 6.3 v. 1 a. 5 v. 4 a. 75/- P.P. 5/-.
4. 230 v. primary. Sec. 665/0/665 v. 50 mA. 800 v. 5 mA. 4 v. 4 a. 2 v. 1.5 a. 42/6. P.P. 2/6.
5. 200/250 v. primary. Sec. 350/0/350 v. 180 mA. tapped 250 v. 6.3 v. 1.5 a. 5 v. 3 a. 42/6. P.P. 2/6.
6. 115/230 v. primary. Sec. 430/0/430 v. 200 mA. common tapping 950 v. 5 mA. 35/- P.P. 2/6.
7. 200/250 v. primary. Sec. 250/0/250 v. 50 mA. 6.3 v. 1 a. 19/6. P.P. 1/6.
8. 230 v. primary. Sec. 3,850 v. 5 mA. 4 v. 2.5 a. 4 v. 1 a. 52/6. P.P. 3/-.
9. 230 v. primary. Sec. 1,250/0/1,250 v. 5.5 mA. 6.3 v. 1 a. 6.3 v. 1 a. 4 v. 1 a. 42/6. P.P. 2/6.
10. 230 v. primary. Sec. 2 x 6.3 v. 5 a. 2 x 6.3 v. 1 a. 35/- P.P. 2/6.
11. 230 v. primary. Sec. 2 x 6.3 v. 0.75 a. 2 kv., 12/6. P.P. 1/3.
12. 230 v. primary. Sec. 6.3 v. 5 a. 6.3 v. 4 a. 2 x 6.3 v. 3 a. 6.3 v. 2 a. 6.3 v. 1.5 a. 6.3 v. 1 a. 45/- P.P. 3/-.
13. 230 v. primary. Sec. 3 x 6.3 v. 3 a. 6.3 v. 1.5 a., 32/6. P.P. 2/6.

Many other types in stock.

As above specification but not C core.
 1. 200/250 v. primary. Sec. 330/0/330 v. 180 mA. 2 x 6.3 v. 2 a. 5 v. 3 a., 42/6. P.P. 3/-.
 2. 230/250 v. primary. Sec. 2 x 350/0/350 v. 52 mA. 4 x 55 v. 30 mA. 2 x 5 v. CT. 3 a., 39/6. P.P. 3/-.

REPANCO TRANSISTOR KITS

Repanco TRANSEVEN 7 transistor portable. All components including 7X4 elliptical speaker, except cabinet (available shortly) £8/12/6. P.P. 3/-.

All components sold separately. Full instructions and component list, 1/6. Repanco 3D. 3 transistor radio. All components including 5in. speaker, 90/-.

Full instructions and list, 9d. Repanco F.M. kits available, instruction envelope, 1/6. Repanco transistor components. P.P. interstage transformer, 8/6. P.P. output 8/-.

Dual range ferrite slab aerial, 13/6. 315 kc/s I.F. 5/-.

Combined 1st I.F. and oscillator coil, 11/6.

EX-NAVY SOUND POWERED TELEPHONES



This type requires no batteries to operate and can be fitted in moments. Uses hand generator for calling, giving an extremely loud buzzing note, and also a neon indicator. Ideal for field activities, factories, office, etc. Only 45/- each. P.P. 4/6.

METER BARGAINS

50 microamp 2 1/2 in. Pj. M.C. 49/6
 100 microamp 2 1/2 in. FM. M.C. 39/6
 200 m/amps. 2 1/2 in. FM. M.C. 9/6
 1 amp. R.F. 2 1/2 in. Pj. T.C. 5/-
 300 volt A.C. 2 1/2 in. FM. M.I. 25/-
 1.5 amp. A.C./D.C. 2in. FM. M.I. 6/6
 500/0/500 microamp 2 1/2 in. FM. M.C. 25/-
 20/0/20 amp. Lucas car type 8/6
 2ma. meter rectifiers, STC 5/6

POWER UNIT TYPE 3

Input 200/250 v. Output 250 volts 80 mA. 6.3 v. 3 amps. Double choke and paper condenser smoothed. Fitted with output volts and current meters. Housed in grey case for 19in. mounting. Brand new, 72/6 each. P.P. 5/-.

PANORAMIC RADIO ADAPTORS

Brand new ex-U.S.A. Operation 110/230 v. A.C. Bandwidth 200 kc/s. For I.F. frequency 455/475 kc/s. £30 each. P.P. 15/-.

CHEAP MAINS TRANSFORMERS.

Standard replacement type. Pri. 200/250 v. Sec. 250/0/250 v. 80 mA. 6.3 v. 4a. tapped 4 v. 5 v. 2 v. Tapped 4 v. Brand new, 18/6, Ditto 350 v. 18/6. P.P. 1/6.

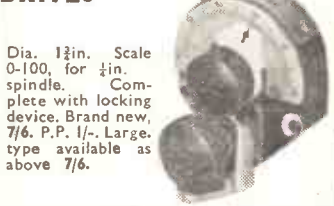
CHEAP P.M. SPEAKERS.

All new and unused. 3 ohm coils.

Plessey 2 1/2 in. 16/-	Elac 10in. 27/6
Goodmans 3 1/2 in. 17/6	Plessey 12in. 32/6
Elac 5in. 17/6	Elac 7 x 4in. 18/6
Elac 6 1/2 in. 17/6	Plessey 10 x 6in 27/6
Elac 8in. 19/6	Std. O/P tr. 3/7

Postage under £1 1/3 over 2/-.

MINIATURE SLOW MOTION DRIVES



Dia. 1 1/2 in. Scale 0-100, for 1/2 in. spindle. Complete with locking device. Brand new, 7/6. P.P. 1/-.

Large type available as above 7/6.

VOLTAGE REGULATOR TRANSFORMER. Input 220 volts. Output variable from 200 to 240 volts 7.5 amps., 87/6 each. P.P. 5/-.

A.C. MAINS POWER PACKS. Input 230 v. Output 250 v. 50 mA. 6.3 v. 2 a. fully smoothed, 5Z4 rectifier. Housed in metal box with other useful gear including, 2XEF50, VR137, EA50, and Y65. 32/6 each. P.P. 3/-.

4 SPEED RECORD CHANGERS

Brand new B.S.R. 4 speed changers, UAB £8/15/-.

Brand new COLLARO RC546. 4 speed changers, £8/15/- P.P. 3/6.

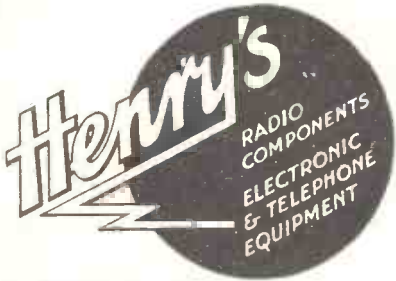
DON MK. 5 FIELD TELEPHONES. complete, tested with batteries, 39/6 each. P.P. 3/-.

AR-88 COMMUNICATION/RECEIVERS Model L.F. Very good condition, £45 each. P.P. £1. Many other types in stock, H.R.O. CR100, PCR, etc.

VALVE BARGAINS

50,000 valves in stock. All new and guaranteed. Many obsolete types. Send for lists.

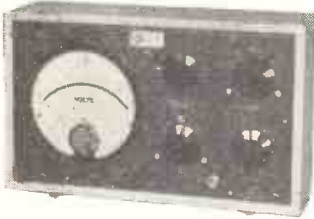
EF86 12/6	EY51 10/6	EF80 9/6
EL84 12/6	ECL80 11/6	PX25 15/6
ECC81 9/-	EZ81 10/6	6J6 3/6
ECC82 9/-	6SN7 5/11	VU111 1/9
ECC83 9/-	EF73a 10/6	807 6/- etc.



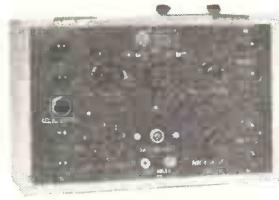
PIRANI HIGH VACUUM TEST EQUIPMENT

Manufactured by "W. G. PYE LTD." for
M.O.S. ATOMIC RESEARCH STATION

5, HARROW ROAD,
PADDINGTON, W.2.
PADDINGTON 1008/9 and 0401.
CABLES: HENELEC, LONDON.



PIRANI CONTROL UNIT



PIRANI BRIDGE UNIT



PYE SCALAMP GALVANOMETER
(SOLD SEPARATELY £12-10-0)




PIRANI GAUGE HEAD
WITH CALIBRATOR

THIS COMPLETE VACUUM TESTING EQUIPMENT (5 ITEMS AS SHOWN)
OFFERED BRAND NEW IN ORIGINAL CARTONS. WITH INSTRUCTION BOOK.

£33-10-0 CARR. PAID.

(SPARE PIRANI GAUGE HEADS, EDWARDS TYPE M6, LESS CALIBRATOR, 15/- EACH.)



QUARTZ CRYSTALS

FT243—FUNDAMENTALS

80 Types 5706.667 Kc/s to 8340 Kc/s (in steps of 33.333 Kc/s).

120 Types 5675 Kc/s to 8650 Kc/s (in steps of 25 Kc/s).
(Excluding Types 7000/7300 & 8000/8300)

5'- EACH

Complete Sets of 80 Crystals, £7/10/-.
Complete Sets 120 Crystals, £10.

7000 Kc/s to 7300 Kc/s in steps of 25 Kc/s } **7'6D**
8000 Kc/s to 8300 Kc/s in steps of 25 Kc/s } **EACH**

FT241A — 54th HARMONIC

80 Types 20 Mc/s to 27.9 Mc/s (in steps of 100 Kc/s)
(Excluding 27 Mc/s)

27 MC/S 10/-

5'- EACH

COMPLETE SET OF 80 CRYSTALS £6.0.0

TCS COLLINS TYPE 3-PIN. FT249

1665.5 Kc/s 1700 Kc/s 2073.5 Kc/s } **10'- EACH**
1962.5 Kc/s 2072.5 Kc/s 2400 Kc/s }

100 Kc/s Gold Plated D.T. Cut.....	22/6
150 Kc/s Two Pin Round	12/6
160 Kc/s " " 10X	12/6
200 Kc/s FT241A	10/-
500 Kc/s FT241A	10/-
500 Kc/s Brook's Special Holder	15/-
5000 Kc/s Piezo 2-Pin Holder	12/6

P.O. TYPE 4B CERAMIC		
100 Kc/s	819.6 Kc/s	15'- EACH
163.9 Kc/s	1000 Kc/s	

CERAMIC 2-PIN BANANA PLUG FUNDAMENTALS			
15,010 Kc/s	16,335 Kc/s	18,025 Kc/s	10'- EACH
15,110 Kc/s	16,435 Kc/s	18,125 Kc/s	
16,135 Kc/s	16,700 Kc/s		

DC 11A 2-PIN			7'6D
1740 Kc/s	1780 Kc/s	1764.5 Kc/s	

MARCONI AND GEC GOLD PLATED 2-PIN			
10,245 Kc/s	10,300 Kc/s	10,500 Kc/s	7'6D

MARCONI, S.T.C. 10X TWO-PIN				
(Fundamental Frequencies in Kilocycles)				
10,100	10,445	10,567	10,878	11,751
10,166	10,500	10,622	11,437	11,788
10,189	10,501	10,755	11,463	11,814
10,233	10,511	10,767	11,500	11,851
10,245	10,534	10,800	11,501	11,876
10,300	10,545	10,823	11,526	12,000
10,433	10,556	10,856	11,587	12,685
				7'6D EACH

N.B. ALL CRYSTALS ARE NEW AND TESTED FOR ACTIVITY AND GUARANTEED



5, Harrow Road, Paddington, W.2
Opposite Edgware Road Station
PADdington 1008/9
OPEN MONDAY to SAT. 9-6. THURS. 1 o'clock
SEND 3d. FOR 28-PAGE CATALOGUE

Over 300 different types B.V.A. & American valves in stock. Send for Lists.



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JUNCTION TYPE P-N-P
(British Manufacture)

- RED-SPOT 800 kc/s Audio Frequency..... 10/-
- BLUE-SPOT 1.6 Mc/s Mixer and Frequency Changer 15/-
- WHITE-SPOT 2.5 Mc/s R.F. and I.F. Amp..... 20/-

All Transistors are Tested and Guaranteed
N.B. The Red-Spot is similar to Mullard OC71

"EAVESDROPPER"

THREE-TRANSISTOR POCKET RADIO
(No Aerial or Earth required)

Variable Tuning. Total cost, as specified, including Transistors, Transformers, Coils, Condensers and Battery, etc., with circuit and plastic case.

All items sold separately. **77'6** POST FREE
With single 'phone, 82/6. With Min. Hearing Aid, 92/6.

The New "TRANSISTOR-8"

Push-pull Portable Superhet

Can be built for £11/10/-

This Portable 8 Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set. Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

TEN STAR FEATURES

- ★ 8 Specially selected Transistors
- ★ 250 Milliwatts Output Push-Pull
- ★ Medium and Long Wwaves
- ★ Internal Ferrite Rod Aerial
- ★ 7 x 4 Elliptical High Resistance Speaker
- ★ Drilled Plastic Chassis 8½ x 2½in.
- ★ Point to Point wiring and practical layout
- ★ Economical. Powered by 7½ v. battery
- ★ Highly sensitive
- ★ Attractive lightweight contemporary case

We can supply all these items including Cabinet for **£11/10/-**
All parts sold separately

Send for circuit diagrams, assembly data, illustrations and instructions, and full shopping list 1/6.

N.B. Pair of OC72's supplied at additional cost of 40/-
Call & hear demonstration model.
Further details in the August issue of "Radio Constructor."

TRANSMITTER/RECEIVER

ARMY TYPE 17 MK. II

Complete with Valves, High Resistance Headphones, Hand-mike and Instruction Book and Circuit.

Frequency Range: 44.0 to 61 Mc/s.
Range approximately: 3 to 8 miles.
Power requirements: Standard 120 v H.T. and 2 v. L.T.

Ideal for Civil Defence and communications.

BRAND NEW **59'6**

Calibrated Wavemeter for same 10/- extra

THE TELETRON "COMPANION"

THREE-TRANSISTOR POCKET RECEIVER
MEDIUM AND LONG WAVES. NO AERIAL OR EARTH

Tuned R.F. Circuit. Ardent Transformers. 3 Transistors. Drilled Plastic Chassis and Cabinet, size 4½ x 3 x 1in., and all Components. Balanced Armature Output. Batteries, Knobs and Transistor Holders. Total cost

89'6

ALL PARTS SOLD SEPARATELY



MINI-TWO TWO-TRANSISTOR MINIATURE POCKET RADIO

(No Aerial or Earth)

The smallest Transistor set offered on the market. Variable Tuning. Drilled Chassis, Plastic Case size 3in. x 2in. x 2in., Miniature Hearing Aid, 2 Transistors and all components including 1½ volt Battery, Circuits and full practical layout diagrams.

Total Cost **55'6** Complete.

COLLARO RC456

4-speed auto-changer. Latest type with crystal turnover pick-up. £9/15/-.

TRANSISTOR SIGNAL TRACER

Complete Kit with 2 Transistors, Components, Phones with Circuit and plastic case. 42/6

TRANSISTOR SQUARE WAVE GENERATOR

Complete Kit with 2 Transistors. Components, Circuit and plastic case. 25/-

DIODES

B.T.H. GERMANIUM	1/6
MULLARD OA74	2/6
IN21	3/6
IN22, IN23, IN21A	5/-

"HOMELIGHT"

2-TRANSISTOR PERSONAL PORTABLE
No Aerial or Earth Required
Variable Tuning

We can supply all components including 2 Transistors, Diode, Resistors, Condensers and Miniature Hearing Aid and Plastic Case size 4½ x 2½ x 1½ and 1½ v. Battery FOR 55/-.
All items sold separately.

R.F.24 10/- R.F.25 12/6 R.F.26 25/-
Brand new with valves, carr. 2/6.

COLLARO RC/3/554

3-speed single player with crystal turnover pick-up type "T." £8/19/6. carr. 3/6.
Brand new in original carton.

CATHODE RAY TUBES

VCR139A	£1 15 0
VCR139A Mn-Metal Screen	5 6
VCR97, Full T.V. picture (carr. 2/-)	£2 0 0
VCR5170, Full T.V. picture	£1 15 0
MU-METAL SCREENS for VCR97 or 617	10 0
VCR97, Slight-cut-off. Carr. 2/-	15 0
3PB1, Brand new	£1 10 0

TRANSISTOR PUSH-PULL AUDIO AMPLIFIER

(200 MILLIWATTS OUTPUT)

Build this Push-Pull Amplifier which is ideal for Crystal or Magnetic Pick-up Amplification, Baby Alarm, Microphone Amplifier, etc. Powered by 6-volt Dry Battery lasting for months. Complete Kit of Parts including 4 Transistors and all Components with Circuit (less Speaker) and plastic case, £4/10/-.

MODEL-MAKERS' MOTORS

Two types available 12 or 24 v. with ¼" spindle 10/- each.

6 v. VIBRATOR PACKS

Output 120 v. 30 m.a. 12/6 Brand new.

There is always a fine selection of equipment at

BENDIX COMMUNICATION RECEIVER M.N.26C

A superb 12 valve receiver covering 150-1500 kc/s in 3 bands, 150-325. 325-695, 695-1500 kc/s. I.F. frequency 112.6 kc/s.

Valve line-up: 6K7 1st and 2nd R.F. 6L7 Mixer. 615 Oscillator. 6K7 I.F. Amplifier, 6B8 1st and 2nd Det. and A.V.C. 6J5 B.F.O. 6F6 Audio Output. Also Radio Compass output stage: 6N7 Compass Modulator. 6N7 Audio Oscillator. 6K7 Loop Amplifier, 6K7 Compass Output.

Power Supply 28 volt D.C. 1.6 amps to internal Motor Generator, which can be easily changed for 12 volt Generator as unit was designed for both supplies (Details available). THE PERFECT CAR RADIO. Size 15 1/2 in. x 6 in. For A.C. mains operation supply required: 6.3 v. and 230 v. 100 mA. Circuit diagram and connection chart free with each unit. Price £3/10/-, plus 10/- carriage. 12 v. Dynamotors available (U.S.A.) at 30/- each.



DESYNN TYPE ANTENNA or Beam position indication system

This comprises a transmitter unit and Indicator which will operate on 12 or 24 volts D.C. and will indicate with instantaneous and smooth pointer movement. The Transmitter is a specially designed potentiometer and will operate the Receiver on a simple three-wire system and the receiver in this instance is calibrated in Gallons but dial could be easily altered to indicate a 360 deg. sweep. Transmitter and Receiver with full instructions. Price 12/6, plus 2/- p.p.

WATERPROOF PLUGS & SOCKETS

3-pin 5 amp., non-reversible. Suitable for caravan and trailers, etc. 1/6 per pair, post paid.

STUD SWITCHES

20 segment 5/16in. studs, base 5in. square with handle and housing. New and boxed, 5/- each, plus 1/6 p.p.



MAINS CHANGING TRANSFORMER

(Admiralty Pattern) 230/100-110-130 v. Separate primary and secondary with earthed screen winding between. Totally enclosed in 7in. x 6in. x 8in. black steel case with detachable lid exposing terminal block and tapping link. Secondary very conservatively rated at 0.44 amps. (core size 3 sq. in.), tested to 2,000 v. Weight 19lb. Price £1 each, including packing and postage.

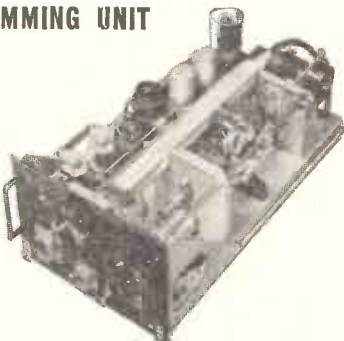


ARR 2 RECEIVERS

Covering 235 to 358 Mc/s. Containing 3 6AK5s, 7 9001s, 1 12A6. Good condition. Price 25/-, plus 3/- post and packing. Circuit supplied. Size 10 1/2 in. x 4 1/2 in. x 5 1/2 in. Black crackle finish.

A.P.Q.9 RADAR JAMMING UNIT

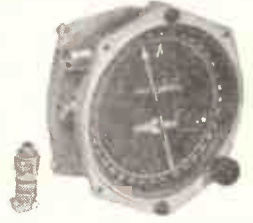
Containing 913A Photo Multiplier Cell, complete with resistance network and lightproof box. Wide band amplifier (2) 6AC7 and 6AG7, driving a pair of parallel 807s which Grid modulate a pair of 8012s in push pull Lecher lines, these cooled by blower motor. Cathode loaded by Co-axial stubs which simultaneously guillotine tune anode and grid lines with a counter mechanism. Output is matched to aerial by a matching stub. Suitable for use in centimetric bands. Brand new. Price £5, plus 10/- packing and carriage.



AZIMUTH INDICATOR

Bendix Radio Compass

Azimuth indicator, for use with D.F. loop on manual operation. Flexible cable entries on both sides of unit. Dial face calibrated in degrees and adjustable for corrections. Small dial lamps are fitted for night use and unit is supplied with plug for input. Size 6in. dia., 2 1/2 in. deep. Grey crackle finish. Brand new and boxed. Price 15/-, plus 2/6 p.p.



A.F. Amplifier. For audio frequency amplifier on sub-standard chassis 5in. x 3in. x 3 1/2 in. R/C coupled, using 2-12SH7 and 1-12SJ7 valves, and can be used for telephone intercommunication pre-amps etc. at 10/-, post paid.

Inspection Lamp. 2 pole S.B.C. Holder with 6ft. spring loaded lead, in case 3in. x 3in. x 4in. with on/off Switch on front panel at 6/-, post paid.

4 Aircraft Instruments for 10/- post paid

1. Speed of Sound (MACH) Meter. 1. Rate of Climb. 1. Air speed Indicator. 1. Altimeter. The lot 10/- post paid.

Plastic Handles. 9in. long 1in. at centre tapered. In three attractive pastel shades, i.e. Pink, Blue and Grey. 2/6 pair, post paid.

Slow Motion Drive. With dial scaled 0-100 over 180 deg. 5 to 1 ratio. Complete with lock and ceramic coupler. These have been removed from T.U.5 Tuning Units, 5/-, post paid.

Solenoid C4C 12 v. D.C. 1/2 in. Travel. Quick and powerful action. Size 2 1/2 in. diameter 5in. long 7in. overall. Gun firing actuator, 7/6, post paid.

Indicator Unit CPR-55ABB. Chassis containing 4 6AC7 and 3 6H6 valves. Tube holder and screen for 5 B.P.I. New less C.R.T. 17/6, plus 8/6 postage and packing.

Auto Selector Switch. 12 v. D.C. or manual operation 5 contact. At present wired for 4 position. Housed in Watertight cast case, 10 way terminal block and cord grip cable entries. Price 3/-, plus 2/- postage and packing.

Two 400 microamps Meter Movements. American Beam Approach Indicator containing two separate movements, one 200-0-200 microamps the other 400 microamps F.S.D. with shunt removed, two S.B.C. Neon Holders. New and boxed 10/-, post paid.

110 Volt Motors. A.C./D.C. 1/30 h.p. 400 r.p.m. Size 4in. long, 2in. wide, 2 1/2 in. high, 1/2 in. spindle protruding 1in. from either end. Diecast body 230 v. 60 watt bulb in series. Motor will run off 230 v. mains. New condition. Price 15/-, plus 2/- postage and packing.

BC.461. Reel Control Boxes, containing 1 re-settable 3 figure counter and drive. 1 Pilot lamp and bulb (red), 3 pole 3-way wafer switch, housed in diecast aluminium box 4 1/2 in. x 3in. x 1 1/2 in., 8/6, plus 2/- postage and packing.

Spirit Levels. XI. Overall length 3 1/2 in. Chromium Plated 1/2 in. Hex. Metal Body. Beautifully made by well-known manufacturer. New and boxed 3/6 each plus 6d. postage. Limited quantity.

BEACON RECEIVER BC1206A

Covering 200-400 kc/s. Valve line-up: 6K7 RF; 6SA7 frequency changer; 6SK7 I.F. amplifier; 6SQ7 det; 28D7 O/P.

This was designed to run on 24/28 v. D.C. HT/LT. Excellent basis for car radio; size 6 x 5 x 4in. Good working order. £3/5/- each plus 5/- carr.



TRANSFORMERS

HEAT TRANSFORMERS

6.3 volt, 1 1/2 amps.; brand new, 6/6, plus 1/- p.p.

SMALL MAINS TRANSFORMERS

Input 230 v. 50 cycles, output 250 v. 40 mA., 6.3 v. 1.5 a. Size 3.9in. x 2.4in. x 2in. Ideal for TV converters. Price 12/6 each, plus 1/- p.p.

CHARGER TRANSFORMERS

For 6 or 12 volt; 230 volt 50 cycles input, 9 and 17 volt 3 amp. output. Price 15/6 each, plus 1/- p.p.

All these fine offers PROOPS

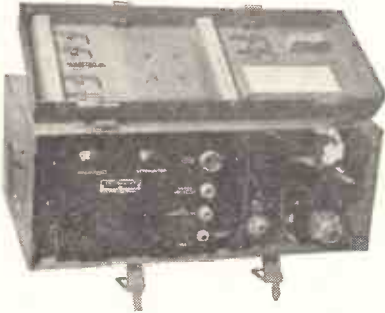
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for **£5.10.0**
plus packing and carriage

**The TS184 A/AP—
A REAL 70cm. TEST GEAR for £5.10.0**

Portable precision for mobile hams, amateur T.V. telearchics, (with acknowledgements to Free Grid) and those Monitor Ring the latest U.H.F. Allocations.

Resonant Cavity Wavemeter.

Calibrated 400-430 Mc/s. Tuning stops adjustable to any 30Mc/s band within 400-470 Mc/s coverage.

Calibrated scale rack and pinion drive piston input attenuator—and alternative fixed coupling loop input provide facilities for use as Signal Generator.

Plug-in 'Telescopic Probe Antenna' 6J6 detector and monitor amplifier, 2-600 ohm phone jacks for modulated signals. Panel output terminals for metering 6J6 output current.

Power required 6 volts at 300 mA and 30 volts at ½ mA.

Circuit diagram and instructions for adjusting tuning stops supplied. Details of suggested free running oscillator to plug in front panel. Socket for signal generator operation (or built-in oscillator for those who prefer) and comprehensive circuit description available shortly; automatically sent to every purchaser as soon as ready.

Spirit Levels V.5 lin. long × ¾ in., 2 hole fixing, ground base suitable for Tripod and Camera work, etc. New and boxed 1/6 each post paid.

Lamp Bulbs 6.8 Volt, Miniature B.C., American manufacture. Box of 10 3/6 post paid.

Crystal Microphone Inserts Suitable for connection directly into pick-up sockets of Radio or Gramophone Amplifier. No transformer required. Very sensitive. Guaranteed. 4/6 each post paid.

Neon Lamps S.B.C. Mains voltage. 1/9 each post paid.

Neon Lamps M.B.C. 100 volt. 1/6 each post paid.

Colour Filters 4½ in. dia. 4 colours: Amber, Red, Green and Purple. These filters have three equidistant clips and should be suitable for Photographic Safelights, etc. Supplied in fibre carrying case. Price 3/6 post paid.

Meters (Oil Temperature Indicator). 2½ in. sq. Panel mounting. Basic movement 1 M.A. or better. New and boxed. 5/- each post paid.

12 Volt Horns American manufacture, used condition, but in working order. 5 in. dia. with fixing plate. Price 5/- each plus 2/- postage and packing.

B.29 Marconi Communication Receiver. 15-560 Kc/s, 4 Bands, mains AC/DC internal power supply. Brand new and fully valved. £7/10/- plus 10/- postage and packing. Limited quantity.

Ground Position Indicators This unit contains beautifully made gears. Three "M" motors, 24 v. D.C. motor, switches, lamps, lenses, drives, bearings, variable ball and plate assembly. Perfect for the model maker. Price 30/- plus 7/6 carriage.

Control Box BC.938A Seven push buttons, miniature toggle switch, 3-position cam operated switch, two jack sockets. American, brand new and boxed. Size 4×3×3 in. 7/6 post paid.

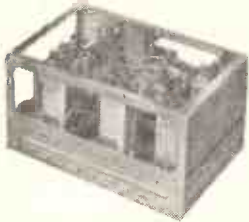
70 C.M. Antenna system used with APS-13. New and boxed. 3/6 post paid.

Heliograph Mirrors Two 5 in. dia. mirrors. One duplex, one signalling. Packed in metal transit case. 3/6 post paid.

Reflector in bakelite case. Fitted with small bayonet cap holder. Size 5 in. dia. × 3 in. deep. 2/6 post paid.

**RECEIVER UNIT
Ex 1143A**

Suitable for conversion to 2 metres or F.M. Wrotham transmissions. Valve line-up: (4) EF50. (1) EL32. (2) EF39. (1) EBC33. (1) EA50. Supplied with circuit diagrams. Fully valved. 25/- each, plus 3/- p.p.



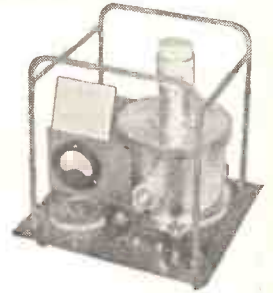
COMPRESSOR AND VACUUM PUMP

(Edwards Type 4) A beautifully constructed pump, coupled with a 24 v. D.C. Motor mounted on rigid steel base, cover and complete with hose coupling Vacuum 10 cm. mercury. Pressure 10lb. per sq. in. 2.6 cu. ft. per min. Unit in case size: 16in. × 7in. × 8in. New and boxed £4/0/0, plus 10/- postage and packing.

'S' BAND PRECISION WAVEMETER

2,900 to 3,150 Mc/s. TEST SET 288 A.M. Ref. 10SB/6161.

Comprising exceptionally rugged silver-plated Wavemeter Type 1665, resiliently mounted and directly tuned by 1½ in. dia. calibrated micrometer with 6½ in. thimble scale. Temperature correction for micrometer attached. Resonance indicated on 100 microamp meter. Equally suitable for laboratory use with milliwatt power or, with loose coupling, for high powers. UR21 connecting cable and coupling probe supplied. Brand new in robust moisture-proof case with jacking-off screws and tool. Price £15, plus £1 packing and carriage.



OSCILLOSCOPE UNIT

With internal 12V Vibrator Power Pack

Suitable for Modulator Indicator or conversion to Oscilloscope unit. Containing V.C.R. 139 A. 2-VR.56, 1-VR.54, 2-EF.50. Size 1ft. 6in. × 9½ in. × 8in. Price £3, plus 10/- carriage.

GYRO UNIT AND INVERTER

Inverter: 12 volt D.C. input, 3 phase 190 cycle output. (These inverters can be used successfully as 12 v. D.C. Motors for Models.)
Gyro Unit: operates on 3 phase output from Inverter. Peak speed 11,400 r.p.m. Caged. Precision made equipment. These units are ideal for experimenting and demonstration purposes. Size: Inverter 4×3×3 in.; Gyro 4 in. dia. incl. cage. Price 12/6 per pair, plus 3/- p.p.

AN/APN.1 TRANSDUCER

This Unit consists of Magnet and Coil which is attached to an aluminium diaphragm suspended freely and perforated to prevent air damping. Mounted on a Ceramic cover which sits over the diaphragm is a form of 2-gang capacitor which has a swing from 10-50 pF.

The above unit is used as part of Wobbulator described on page 252 of the June 1956 "Wireless World." Price 7/6 p.p.



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Shop hours 9 a.m. to 6 p.m.—Thurs.: 9 a.m. to 1 p.m.

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LONDON'S GREATEST DEALERS IN RADIO AND ELECTRONIC EQUIPMENT

A.M. HEAVY DUTY BATTERY CHARGERS. Maximum D.C. output 22 volt 10 amp. Fine and coarse switching. Completely fused. Supply voltage A.C. 200-250. £12/10/- ex warehouse.

BANKS OF RESISTANCE MATS. Comprising one 690 ohm, one 150 ohm, two 80 ohm mats. Size 8 x 6½ in. 7/6 Bank of four. Postage 2/-.

A.M. HEAVY DUTY TRANSFORMERS. Pri. 220-230 v. Sec. 50 v. 30 amp. £6/10/-, carr. 10/-, Pri. 200-250 tapped. Sec. tapped 28, 20, 30, 31 v., 21 amps. £4/10/-, carr. 7/6.

NEVLIN 3,000 WATT AUTO TRANSFORMERS. Input 200-250 v., output 110 v. Completely enclosed in metal case, with input voltage selector switch and fuses. Supplied brand new at a fraction of maker's price. £9/15/-, plus carr.

BLOCK CAPACITORS. 10 mfd., 500 v. wkg. at 140 deg. F. Sub chassis mounting, 5/6. 4 mfd. 800 v. wkg. at 160 deg. F., 3/6. 4 mfd. 400 v. wkg. at 160 deg. F., 2/6. 4 mfd. 250 v. wkg. at 160 deg. F., 2/- 2-25 mfd. 2,000 v. wkg. tropical 6/6. 0.5 mfd. 2,000 v. wkg. at 160 deg. F., 2/9. All condensers supplied new and guaranteed. Postage on all condensers 1/6. Special price for quantities.

SPECIAL OFFER OF BRAND NEW BOXED A.M. VALVES. RCA 1616 6/-, 1625 4/6. British PEN46 5/-, VUI20A 2/-, 6U5 5/-, 12U5 4/-, 35L6 5/-, 50L6 5/-, 7H7 3/6, 7B5 5/-, SP42 4/-, 955 4/-, 9004 4/-, 12SJ7 4/-, 12H6 4/-, VR150 5/-, PEN25 4/6, AR8 5/-, ARP12 4/-, APT4 4/-. Postage on all valves 1/6.

ARMY FIELD TELEPHONES. Type D5. Completely reconditioned. Buzzer calling. Complete with handset and batteries. Built in strong metal cases. Suitable for farms, building sites, workshops, etc., 49/6, carr. 4/-. Other types of field telephones available. Let us know your requirements.

ADMIRALTY INTEGRATORS. Type AS91 incorporating very fine galvo. movement, coil 40 ohms, centre zero to F.S.D. 1 microamp. Small mirror one metre radius. A very useful laboratory instrument, 65/-, carr. 4/-.

METRO-VICKERS Master Voltmeters, 0-20 volts A.C. 50 cy. M1 6in. mirrored scale, 17/6, p.p. 3/-.

2in. sq. ½ amp. RF meters, 5/6, p.p. 1/6.

HEAVY DUTY SLIDING RESISTORS. 1 ohm 12 amp. slider control 8/6. 300 ohm 1 amp. geared drive 32/6. 1,100 ohm 0.4 amp. horizontal sweep control 17/6. 5.3 ohm 8 amp. geared drive 22/6. 0.4 ohm 25 amp. geared drive 15/6. 50 ohm, 1 amp., slow motion gear drive, 10/6. 17.5 ohm, 5 amp. fixed, 10/6. 95 ohm, 3.3 amp., no control but fitted with adjustable tappings, 22/6. American 12in. dia. field rheostats 38 ohm 5.6 amp. res. out., 2.1 amp. res. in. 45/-.

Postage on all resistors, 3/-.



S.T.C. RECTIFIER SUPPLY UNIT No. 11 TYPE ZB 10235

Specification:—A.C. input 100-260 volts. 45-65 cycles. D.C. output 24 volts 11 amps. and 130 volts 600 m.a. very conservatively rated. L.T. and H.T. completely smoothed. All circuits fused. Mains on/off switch. Built in grey metal cabinet as illustrated. Height 5ft. 0in., width 1ft. 7½in., depth 1ft. 1½in. Weight 200 lbs.

These units were originally designed to supply L.T. and H.T. power in conjunction with Bay Power No. 3 to S.O.S./T. 3 channel telephone system, but are ideal heavy duty L.T. and H.T. supply units for the electronic industry, research laboratories, schools, etc., etc. Complete with Instruction Book and circuit. Supplied brand new at a fraction of the maker's price.

£17.10.0 ex-warehouse

If further technical details are required, Instruction Book will be forwarded against a deposit of One Pound. Export enquiries are welcomed. We have a limited number of these units ready packed in original transit cases at a small extra charge.

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LUCAS HEAVY DUTY 12 VOLT D.C. WINDSCREEN WIPER MOTORS. A very useful geared motor. 16 r.p.m., on 12 v., 8 r.p.m. on 6 v. 17/6. P.P. 2/6.

HEAVY DUTY A.M. ROTARY TRANSFORMERS. Type 10K 24-31 input 18 volts. Output 7.2 v. 13 a. and 225 v. 0.11 amp. Easily converted into a powerful high speed motor for 220-240 v. A.C. Data supplied. Brand new 15/-, carr. 4/-.

ALKALINE BATTERIES. Crates of five cells giving 6 v. at 58 A.H. Size of wood crate 15 x 5½ x 11½ in. £5/19/6, plus carr. 7/6. Single cells 2.4 v. 18/20 A.H. Size 4½ x 6 x 3½ in. 15/-, carr. 2/-.

NUTS, BOLTS, WASHERS. Special bargain offer. 5/- Cartons of mixed 2, 4 and 6 B.A. nuts, bolts and washers. Postage 1/-.

HIGH GRADE SLEEVING. 1½ mil.-5 mil. Mixed bundle 2/6, postage 1/-.

VARIAC TRANSFORMERS. Input 115 v. Output 0.130 v. 5 amp. cont. 7.5 amp. max., 65/-.

HOOVER A.C. 230 v. HOT AIR BLOWERS. Element enclosed in 4ft. flexible metal tubing. Supplied brand new at a fraction of maker's price—£6/10/-, carriage extra.

S.T.C. FIELD-HAND TELEPHONES. Type YA 7783. A self-contained unit. Measuring 9 x 2½ x 2½ in., which can easily be held in the hand. With built-in buzzer and battery compartment. Complete with 4½ v. battery. Supplied brand new at a fraction of maker's price, 65/- each. Postage and packing 2/6.

CONSTANT VOLTAGE TRANSFORMER by Sola U.S.A. Pri. 90-125 v. or 190-250 v. Sec. 115 v. at 2KVA. Pri. and Sec. completely isolated for 50 or 60 cycle operation. Approx. weight 200 lb., £19/10/- each. £35 per pair. Ex warehouse.

BRAND NEW A.M. 2½in. ROUND M.C. METERS. By famous makers. 0-30 MA, 0-100 MA, 0-500 MA, 12/6. P. & P. 2/-.

2in. round. 0-500 microammeters with mounting clip, 17/6. P.P. 2/-.

AMERICAN C.R. TUBES 5CPI. New in maker's cartons 25/-.

P.P. 3/-.

7in. C.R. Tubes. NC13, CV961. New in maker's cases 27/6, carr. 4/-.

TELEPHONE CABLE. Type D3 1/3 mile drums. Brand new, 19/6,

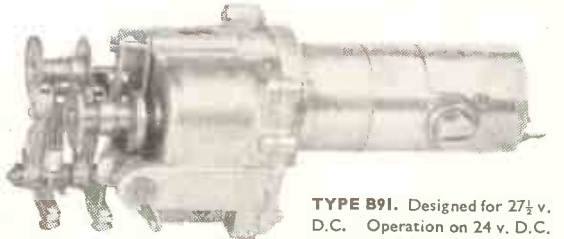
carr. 4/-.

Commando assault telephone cable P.V.C. 1,000 yard drums. Ideal phone cable and very useful in the home and garden, 8/11. P.P. 3/-.

TWIN P.V.C. BELL WIRE. 0.024 23 s.w.g. Various colours. 220 yard coils, 22/6. P.P. 2/-.

Sterling Wire Co. Equipment Wire, 7/36. Stranded copper P.V.C. Yellow, Blue, Green, Brown or Red, 500 yard drums, 27/6. P.P. 2/6.

Special Offer of LOW VOLTAGE GEARED MOTORS MADE BY A LEADING AMERICAN MANUFACTURER



TYPE B91. Designed for 27½ v. D.C. Operation on 24 v. D.C. No. 1 drive 24 r.p.m. No. 2 drive

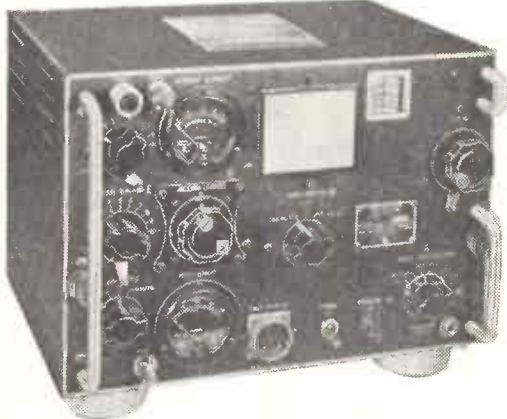
6 r.p.m. and on 12 v. D.C. No. 1 drive 16 r.p.m. No. 2 drive 4 r.p.m. Overall size of motor and gear box, 7½ in. x 3½ in. x 3 in. Weight 1 lb. 14 oz. Supplied brand new at a fraction of the maker's price.

22/6, postage and packing 1/6.

TYPE B92. Designed for 12-volt D.C. Gear box fitted with two ½ in. dia. drives, fitted with cams which operate a double-ended plunger spindle. This assembly can easily be removed if not required. No. 1 drive 20 r.p.m. at 12 v. D.C. 15 r.p.m. at 6 v. D.C. No. 2 drive 5 r.p.m. at 12 v. D.C. 3 r.p.m. at 6 v. D.C.

32/6, postage and packing 1/6.

TCS TRANSMITTERS



The renowned American TCS Model designed by the Collins Company for static or mobile use. Covers 1.5-12.0 mc/s. in 3 bands, and is complete with 7 valves, employing 2 of 1625 in P.A. Stage, 1 each of 1625 in Buffer and Modulator Stages, and 3 of 12A6 in Oscillator Stage. Provision for VFO or Crystal Control. 4 Crystal positions. Radio Telephone or Radio Telegraph. Has Plate and Aerial Current Meters. Power Requirements 12v LT & 400v HT. In black crackle case, size 11 x 13 x 11in., condition BRAND NEW AND UNUSED. ONLY £12/10/- (carriage, etc., 15/-).

We can also supply the TCS RECEIVER, which matches the Transmitter in size and appearance, and covers similar frequencies. Complete with 7 valves, 1 each of 12SA7 and 12SQ7, 2 of 12A6 and 3 of 12SK7. Power Requirements 12v LT & 225v HT. IN BRAND NEW CONDITION. ONLY £8/10/- (carriage, etc., 15/-), OR THE TRANSMITTER AND RECEIVER TOGETHER £20 (carriage, etc., 30/-).

The double Dynamotor Power Unit, Type 21881B for 12 volts operation, delivering 400v for Transmitter and 225v for Receiver, is available at £12/10/- (carriage, etc., 15/-).

RI155 SUPER SLOW-MOTION TUNING ASSEMBLY. As used on all late model RI155s. Easily fitted to "A" sets, etc. ONLY 12/6.

RF UNITS TYPE 26. For use with the R.1355 or any receiver with a 6.3 v. supply. This is the variable tuning unit which uses 2 valves EF54 and 1 of EC52. Covers 65-50 Mc/s. (5-6 metres). Complete with valves, and BRAND NEW IN MAKER'S CARTONS... ONLY 25/- each. Brand New Type RF 24. 5 positions covering 15-30 Mc/s., ONLY 7/6 (postage 2/6).

A.C./D.C. BLOWERS. 220/250 volts, 300 watts. 1 1/2 in. diam. outlet. Complete with filter pads. BRAND NEW. ONLY £4/19/6.

INSULATION TESTERS (MEG-GEERS). Read up to 20 megs. at 500 volts pressure. Overhauled, and in perfect order. With leather carrying case. ONLY £9/19/6, OR less case £8/10/-.

POWER UNIT TYPE 3. Primary 200/250 v. 50 cycles. Outputs of 250 v. 100 mA. and 6.3 v. 4 amps. Fitted with H.T. current meter, and voltmeter. For normal rack mounting and has grey front panel size 19in. x 7in. ONLY 70/- (carriage, etc., 7/6).

EHT TRANSFORMERS. 5.5 kV. (Rect.) with 2 v. 1 a., 79/6, 7 kV. (Rect.) with 2 v. 1 a., 79/6, 7 kV. (Rect.) with 2 v. 1 a., 89/6, 2.5 kV. (Rect.) with 2-0-2 v. 1.1 a., 2-0-2 v. 2 a. (for VCR 97 tube, etc.), 42/6 (postage 2/- per trans.).

6 v. VIBRATOR PACKS. Output approx. 130 v. at 30 mA., fully filtered and smoothed. Complete. ONLY 12/6.

100-0-100 VOLTS METERS by Sangamo Weston. 2 1/2 in. circular, basic movement being 500-0-500 microamps. A really first-class centre zero meter for hundreds of uses. BRAND NEW IN MAKER'S CARTONS. ONLY 27/6.

500 MICROAMPS METER. 2in. circular as used on British No. 19 Wireless Sets. Calibrated 0-15 and 0-600 volts, resistance 500 ohms. A very fine instrument, and A SNIP AT ONLY 15/-.

MARCONI SIGNAL GENERATOR TF144G

Frequency coverage 85 kc/s. to 25 Mc/s., and known as a Laboratory Standard. For normal A.C. mains, and complete with all leads. Reconditioned. AS NEW. ONLY £75.

MARCONI SIGNAL GENERATORS TF-390G

Frequency coverage 16-150 Mc/s. BRAND NEW IN MAKER'S ORIGINAL TRANSIT CASES, with instruction manual. For normal A.C. mains operation. A unique opportunity to acquire Laboratory Equipment at a fraction of original cost. ONLY £27/10/-.

MARCONI BAND III CRYSTAL CALIBRATORS

Frequency range 170-240 Mc/s. Incorporates 5 Mc/s. crystal for better than .001 per cent. accuracy. Directly calibrated dial, internal A.C. mains pack. Complete with spare set of valves and instruction manual in maker's transit cases. BRAND NEW. ONLY £4/19/6.

CLASS D WAVEMETER

Another purchase of this famous crystal-controlled wavemeter which has been repeatedly reviewed and recommended in the "R.S.G.B." Bulletin as being suitable for amateur transmitters. Covers 1.9-8.0 Mc/s., and is complete with 100/1,000 kc/s. crystal, 2 valves ECH35, two 6-volt vibrators and instruction manual. Designed for 6 v. D.C. operation, but simple mod. data for A.C. supplied. BRAND NEW IN MAKER'S TRANSIT CASES. ONLY £5/19/6. Transformer for A.C. modification, 7/6. OR a few instruments less Crystal £3/10/0.

METERS

F.S.D.		SIZE AND TYPE	PRICE
50 microamps	D.C.	2 1/2 in. Flush circular	59/6
100 microamps	D.C.	2 1/2 in. Flush circular	39/6
250 microamps	D.C.	2 in. Proj. circular	30/-
500 microamps	D.C.	2 in. Flush square	27/6
1 m/a D.C.		2 in. Flush square	22/6
10 m/a D.C.		2 1/2 in. Flush circular (blank scale)	10/6
150 m/a D.C.		2 in. Flush square	7/6
200 m/a D.C.		2 1/2 in. Flush circular	12/6
10 amps D.C.		3 1/2 in. Proj. circular	20/-
20 amps D.C.		2 in. Proj. circular	7/6
40 amps D.C.		2 in. Proj. circular	7/6
15-0-15 amps D.C.		3 1/2 in. Flush square	25/-
30-0-30 amps D.C.		Car type moving iron	5/-
15 volts A.C.		2 1/2 in. Flush circular moving iron	8/6
300 volts D.C.		2 in. Flush square	10/6

WIRELESS SET NO. 19 MK. II.

The famous Army Tank Transmitter-Receiver. Incorporates "A" set (TX/RX covering 2.0-8.0 mc/s., i.e., 37.5-150 metres); "B" Set (VHF TX/RX covering 230-240 mc/s., i.e., 1.2-1.3 metres), and Intercomm. Amplifier. Complete with 15 valves as follows: 6 of 6K7G, 2 of 6K8G, 2 of 6V6G, and 1 ea. 6B8G, 6H6, E1148, EF50, 807, and booklet giving circuits, notes, etc.

Size 17 1/2 in. x 8 1/2 in. x 12 1/2 in. Magnificently made by famous American firms. IN BRAND NEW CONDITION. ONLY £4/19/6 (carriage, etc., 10/6). OR with 12 volt Rotary Power Unit £5/10/- (carriage, etc., 15/-).

AMERICAN COMMAND RECEIVERS. A few still available. Top band model (1.5-3.0 Mc/s.). Used, good condition, 65/-, OR BRAND NEW IN CARTONS, 75/-.

L.T. HEAVY DUTY TRANSFORMERS. Ex-Admiralty, with 230 v. 50 cycles primary. Secondaries 5, 10, 15, 20, 25, 30 volts at 5 amps. ONLY 29/6. (Postage 2/9).

12-WAY SCREENED CABLE. In 10ft. lengths, fitted with plugs, originally made for use with the 19 Set. UNUSED. ONLY 17/6 per lead.

POCKET VOLTMETERS. Not ex-Govt. Read 0-15 v. and 0-300 v. A.C. or D.C. BRAND NEW AND UNUSED ONLY 18/6.

WALKIE TALKIE TYPE 18. Covers 6.0-9.0 Mc/s. Transmitting and receiving units in metal case, complete with valves. In excellent condition. ONLY 79/6.

CRYSTALS. British Standard 2-pin 500 kc/s. 15/-. Miniature 200 kc/s. and 465 kc/s. 10/- each.

AMERICAN 14 v. DYNAMOTORS. Output 225 v. 60 mA. Ideal for car radio or running electric shaver from car battery. ONLY 45/-.

159 RECEIVER UNIT. Contains 1 each valve, types EF50, EA50, SP61, RL37, and 24v selector switch. ONLY 7/6.

Cash with order please, and print name and address clearly

PLEASE ADD POSTAGE OR CARRIAGE COSTS ON ALL ITEMS

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SPECIAL 'HAM' OFFER!!!!

TEST SET 102

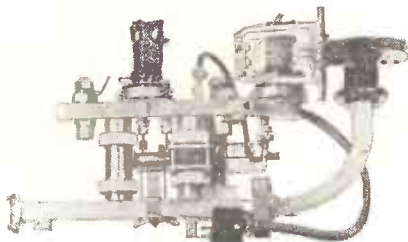
Consists of impregnated mains transformer 200-250 v 50 cycles, 12 v 2 amp, 6 v 3 amp, output 280 v at 80 ma. S.T.C. metal rectifier 80 ma. 1-DET19, 1-6J5. Bulgin plugs, sockets and pilot lights. Mains leads. Circuit is a multi vibrator locked mains type, with a cathode follower. Can be utilized for:

- Audio Amplifier
- Audio Oscillator
- V.F.O.
- External Synchronizer
- Stabilized Power Unit
- Modulator Etc.

Brand new including circuit only 40/-, p.p. 3/-.



3 CM MAGNETRON/KLYSTRONS ASSEMBLY



- Includes:—
- 1 725A Magnetron
 - 2 723A/B Klystrons
 - 2 CV253 Crystal Diodes
 - 1 IB24 TR Tube
 - 1 CV115 ATR Tube

ASSOCIATED WAVEGUIDE ASSEMBLY PRICE £7 10 0 each. P. & P. 7/6.

PULSE TRANSFORMER and MAGNET FOR ABOVE £3.

MINIATURE I.F. STRIP TYPE "373" 9.72 Mc/s. Valve line up 3-EF. 91, 2-EF 92 1-EB 91. Size 10 1/2 in. by 2 1/2 in. by 3 in., completely valved with screening cans. 8-way Jones socket 50 K output potentiometer co/ax output socket. Ideal for modification to FM Tuner as described on page 107 of the April "Practical Wireless." Price 45/-. Less valves 8/6.

BENDIX RECEIVER MN267. Covering 3.4-7 Mc/s. 325-695 Kc/s., 150-325 Kc/s. Valves used 5-6K7, 2-6N7, 2-6J7, 1-6L6, 1-6F6. Complete with switching motor and 12 v. Dynamotor. Only 65/-. Carr. 8/6.

AMERICAN GEARED MOTOR. 24 v. D.C. with built-in precision gearbox. No. 1 drive 24 R.P.M. No. 2 drive 6 R.P.M. On 12 v. No. 1 drive 16 R.P.M. No. 2 drive 4 R.P.M. Overall size of motor and gearbox 7 1/2 in. x 3 1/2 in. x 3 in., weight 1 lb. 14 ozs. Brand New. Only 29/6. P. & P. 2/-.

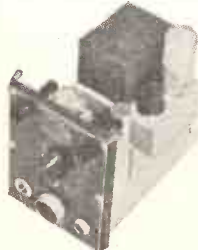
DIPLOE AERIAL No. 4A. 52ft. hard drawn 7/22 copper wire with centre insulator, fitted with feeder sockets. Both ends have 3-link insulators and slotted wire adaptors. Brand new. Price 9/-. P. and P. 2/-.

HIGH RESISTANCE HEADPHONES. Complete High Resistance Headgear Mk. IV with cord and plug Brand new and boxed. 11/- post 1/6

INDICATOR UNIT TYPE 182A. Unit contains VCR 517 6in. cathode ray tube with mumetal screen, 1 5U4G, 3 EF50, and 4 SP61, 9 wire-wound volume controls. H.T. mains transformer, numerous resistors, condensers and other components. Fully smoothed. Brand new, 65/-. Plus carriage 7/6.

HOOVER ROTARY TRANSFORMERS. 11.5 v. input, 490 v. output at 65 mA. and 6 v. input, 300 v. output at 75 mA. Guaranteed and tested, only 27/6. P. & P. 2/6.

RCAF AMPLIFIER UNIT
12 v. input. Vibrator. OZ4. Microphone Transformer into a 6K6GT output valve with negative feed back. Size 8 in x 5 1/2 in x 8 1/2 in. Brand new, 35/- each. P. & P. 3/-.

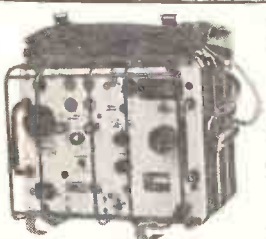


TEST OSCILLATOR TS 170/ARN5

Complete Test Transmitter or Signal generator, cavity for Receivers or other UHF applications in the 330 Mc/s Range, Modulated 90 to 150 cycles. Valves 3-959, 3-1N21, 1-3Q4. Milliammeter 0-1 and 3 crystals. Brand New £4 10 0. Carr. 7/6.

R109A RECEIVER

8 valves 5 ARP 12's, 3 AR 8's covering 2-12 Mc/s on two frequency bands. Contains 6 v. Vibrator Pack and built-in 3 1/2 in. Goodman speaker, operates from 6 v. battery, consumption 2 amps. Housed in metal case 13 x 12 x 1 1/2 in. Designed for Mobile or Ground station. Operates with any normal aerial. Complete, guaranteed and tested including circuit. Very good condition. Only 85/-. carr. paid



Save £££'s on your Beam Antenna

Aerial whip antenna sections. 4ft. lengths can be utilized for beam antenna construction. Brand new. Six for 12/6. Plus carriage 2/-. Twelve for 24/-. Plus carriage 3/-.



LOUD HAILER SPEAKER

Sound powered with output transformer, impedance of speech coil 7 ohm, handling capacity 8 watts. Ideal for inter-communication. Complete with carrying strap. Price 25/-. Packing and carriage 5/-. 2 for 45/-. Carr. 7/6.

COMMAND TRANSMITTERS

2.1-3 Mc/s	valved less crystal	17/-
3-4 Mc/s	valved with crystal	25/-
4-5.3 Mc/s	valved less crystal	17/-
5.3-7 Mc/s	valved less crystal	17/-

P. & P. 3/- each.

GRAND OPENING

Visit our newly opened BARGAIN STORE in our own warehouse. SEE FOR YOURSELF!! Three thousand square feet of warehouse space loaded with a tremendous variety of resistors, condensers, chokes, transformers, valves, head sets, microphones, test sets, receivers, transmitters.

EVERYTHING IN ELECTRONICS. ROCK BOTTOM PRICES!!

FM WOBULATOR CAPACITOR

Excellent for Sweep Generator. Frequency modulation unit permanent magnetic field and a moving mechanism driving a metal diaphragm supported at its rim. This diaphragm acts as a moving plate of the frequency modulator capacitor. Tested. Price 7/- each.

R.F. UNITS

R.F. 24, 20-30 Mc/s, 8/6 each
R.F. 25, 40-50 Mc/s, 8/6 each
R.F. 26, 50-65 Mc/s, 25/- each
All valved. Postage 3/- on each.

WESTERN ELECTRIC SHUNT MOTORS.

27 v. 1 1/2 amps giving 3,000 R.P.M. Continuous duty, rated 1/50 H.P. works off 12 v. and 6 v. at reduced R.P.M. length of shaft 1 1/2 in. Motor 3 1/2 in x 2 1/2 in. Brand new and boxed. Only 17/6. P. & P. 1/6.

24 v. giving 5,000 R.P.M. continuous duty. Shaft 1 1/2 in. Motor 1 1/2 in. x 2 1/2 in. works off 12 v. at reduced R.P.M. Brand new. Only 12/6. P. & P. 1/6.

TUNING UNITS

TU-6-B 3000-4500 KC
TU-7-B 4500-6200 KC
TU-8-B 6200-7700 KC
TU-10-B 10,000-12,500 KC
These well known units have Micro Meter dials with 2,500 divisions over 180 degrees rotation. Giving plenty of mechanical bandspread. Velvet vernier drive, high Q tank circuit and heavy duty 6-way ceramic switch and variable transmitting condensers. Price 14/- each. P. & P. 4/-.

LOW IMPEDANCE PADDED HEADPHONES TYPE D.L.R. 3.

Complete with cord and plug. Brand new. Price 9/-. P. & P. 1/6.

U.S.A. INDICATOR BC929A.

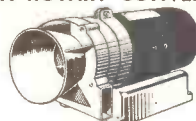
Complete with 3 BPL shield and holder. Aerial switching unit. 7 valves: 2-6H6GT, 1-6X5GT, 1-2X2, 1-6G6, 2-62N7. Brand new. Original cartons. 55/-. Carriage 7/6.

PARMEKO C CORE TRANSFORMER.

Inter-valve Transformer. Ratio 4/1 600 ohms CT. 1 1/2 in. x 1 1/2 in. x 2 in. Original cartons. 6/- post paid.

AMERICAN ROTARY CONVERTORS

With cooling Fan. Input 12 v. D.C. Output 300 v. at 90 mA. Completely suppressed. Brand new. 19/- each. Plus P. & P. 3/-.



Hours of business:
8.30 a.m. to 6 p.m.
Monday to Saturday.

OPPOSITE
BRITISH MUSEUM

Relda Radio Ltd.

(Dept. "W") 32A, Goptic Street, London, W.C.1. Phone: MUSEum 9607

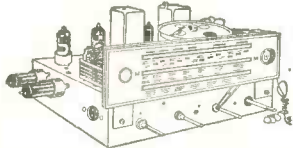
Carriage charges apply to England and Wales only.

Terms: Cash with order.

All orders despatched same day.

EXPERT ENQUIRIES INVITED.

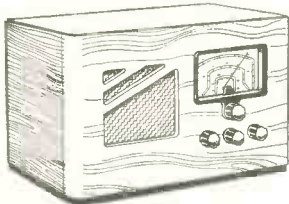
ARGOSY PUSH-PULL RADIO-GRAM CHASSIS. 139/6



8 valve 2-EBF80, 2-EL42, ECH81, EBC41, EZ80, EM34. Latest models. 3 w/and and gram. Switched. Over 10 watts output. Full tone range. 4 knob control. Size 12 x 7½ x 7¼ in. Less valves. Ins., carr. 5/6.

RADIO GRAM CHASSIS. 29/9
5 valve s/het, 3 w/and, front drive. Including speaker and knobs. Less valves. Chassis 12 x 8 x 10in. Ins., carr. 4/6.

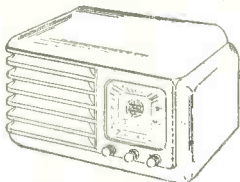
HOME RADIO. 79/6



5 valve (octal) s/het, 3 w/and receiver. A.C. Gram., P.U. sockets. In wooden cabinet, 18½ x 11½ x 8½ in. Ins., carr. 7/6.

A.C./D.C. MIDGET RADIO. 99/6

5 valve, CCH35, EF39, EBC33, CL33, 35Z4 or metal rec; 3 control knobs Switched for gram. In attractive brown plastic cabinet. 15 x 7½ x 9 in. Ins., carr. 4/6.



RADIO GRAM CHASSIS. 39/9

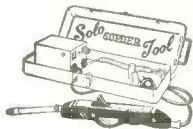
3 w/and and gram. s/het, 5 valve (octal). Ideal for table gram, giving high quality output. 4 knob control. 8in. P.M. speaker, 7/9 with order. Set of knobs 2/- Chassis 12 x 6 x 7½ in. Ins., carr. 4/6.

R.F. 24 UNIT. 7/9. Incl. valves. Ex W.D. Drawings FREE with order. Tuning 20-30 mc/s. P. & P. 2/6.

V.H.F. 1125 RECEIVER. 7/9. Incl. valves. Drawing FREE with order. P. & P. 1/9.

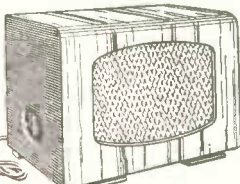
SELF FEED SOLDERING

6-12 volt, 100-125 volt. 29/6; 6-12 volt, 200-240 volt, 45/- Made for the American market. Car battery or mains. Export quality. Complete in light carrying case. Reel of solder and spare parts. P. & P. 2/9. EXPORT ENQUIRIES INVITED.

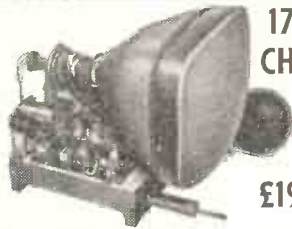


BEAUTIFUL EXTENSION SPEAKERS. 29/9

Complete, fitted with 8in. P.M. speakers, "V.B." or "Goodmans" of the highest quality. Std. matching to any receiver (2-5 ohms). Flex and switch included. Unrepeatable at this price. Money back guarantee if not completely satisfied. Ins., carr. 3/-.
Ins., carr. 3/-.



TERMS AVAILABLE



17" T.V. CHASSIS

£19.19.6

17in. Rectangular tube on adapted chassis. All channels.

Valve line-up (5 valves) 6SN7, 6Y6, EY51, 2-6D2s Others, 6L18, EL38, and 7-6F1's.

12 month's guarantee on tube. 3 months on chassis and valves.

TURRET TUNER 50/- extra. Less valves. Complete and working on any channel 1-5. With 5 valves £21/19/6. With all valves £25/19/6. Ins., carr. 25/- (incl. tube). State B.B.C. channel (and I.T.A. channel if TURRET TUNER required). Drawing 3/6 or FREE with order.

14IN. T.V. CHASSIS, TUBE, SPEAKER. £13/19/6.

As above with 14in. round tube, Less valves. 3 months guarantee. With 5 valves £15/19/6. With all valves £19/19/6. Ins., carr. (incl. tube) 25/- TURRET TUNER 50/- extra.

RECTANGULAR T.V. TUBES

(Used). 12 MONTHS' GUAR.

17in. £7.10.0. 14in. £5.10.0.

6 months full replacement, 6 months progressive. Made possible by the high quality of our tubes. Ins., carr. 15/6.

CONVERT YOUR 9in., 10in., 12in. to 14in., 15in., 16in.

Our pamphlet is FREE and on many sets costs only the tube to give you these giant pictures. SPECIAL OFFER. 14-15-16in. T.V. TUBES. £5. Perfect. See them working. 12in. T.V. TUBES. £6. 15/6 ins., carr. on all tubes.

T.V. CHASSIS, TO CLEAR. 79/6

Complete chassis by famous manufacturer. R.F. E.H.T. unit included. Drawing 2/6 or FREE with order. Chassis in 3 separate units. (Power, s/vision and time base inter-connected.) These chassis can easily be fitted into existing console cabinets. Less valves and tube. Channels 1-2, 3-5. 1.F.s 16-19.5 mc/s. Easily converted to I.T.V. channel. Ins., carr. 10/6

T.V. CONSTRUCTOR CHASSIS

SOUND AND VISION STRIPS. 35/6. Tested, working, complete less valves. 1.F.s 16-19.5 mc/s. P. & P. 2/6. Drawing 2/6 or FREE with order.

POWER PACK. 39/6. 6-10 KV. R.F. EHT unit included. Tested, working, less valves. Drawing 2/6 or FREE with order. Ins., carr. 5/- **TIME BASE. 25/6.** Tested, working. Incl. focus unit, etc. Less valves. P. & P. 3/6.

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350-0-350 v. 80 m/a., 4 v.-4 v. heaters. 200-250 v. Prim 3/9
350-0-350 v. 80 m/a., 12 v.-4 v. heaters. 200-250 v. Prim. 2/9
280-0-280 v. 80 m/a., 6 v.-4 v.-4 v., 200-250 v. Prim. 5/9
(Drop through, half shrouded). All above 2/3 post.
425-0-425 v. 5 v. 6 a.-6.3 v. 12 a.-6.3 v. 6 a. 200-250 screened primary. P. & P. 2/6 17/6

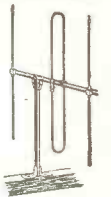
HEATER TRANSFORMERS

0-200-250 v., 4 v. @ 2½ amp. (post 1/9)... 8/9
0-200-250 v., 12 v. @ 1½ amp. (post 1/9)... 8/9

O.P. TRANSFORMERS, STD. SIZE. 2-5 ohms (post 1/-). 1/3; 20 for £1. P. & P. on 205/6.

T.V. AERIALS. 25/6

For all I.T.A. and F.M. channels. For outdoor or loft. 3 element, at half their original cost. P & P. 2/6.



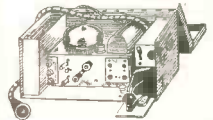
CAR AERIALS. 6/9. Whip antennae, 50in. long, collapsing to 11in., one hole fixing. Post 1/-.

BURGLAR ALARMS. 2/3. Made by Truvovx. Can work from bell battery. New, incl. bell. Post 1/9.

SPEAKERS. 8/9. 8in. P.M. Let the lady of the house follow that radio or T.V. programme. P. & P. 1/9.

TELEPHONE SETS. 7/9

Ex W.D. wireless remote control unit E.M.K.II. New condition. Morse tap, switched, jack plugs, etc.; less phone Carr. 3/6.



COIL PACK SETS. 3/9. This bargain incl' 3 band coil pack, pair 465 I.F.s and std. 2-gang cond. Printed dial. Post 2/3.

HEADPHONES. 1/9. Single earphone and headband. C.-L.R. type. Ideal for crystal sets, extension on radio, etc. Post 1/3.

CO-AX. CABLE. 6d. yd. Good quality, cut to any length. Post on 20 yds. 1/6. 100 yds. 45/-, post 3/6.

CHASSIS. 1/- each, 6 or 8 valve, latest type midget valve design for A.M. and F.M. New cadmium plated s.w.g. steel. 12½ x 7½ x 2½ in. P. & P. 1/6. Post on 4, 3/-; 12 for 10/-, carr. 5/-.

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Boxed VALVES		3 months guarantee	
1A5	2/9	6K7	3/9
1B5	4/9	6N7GT	4/9
3A4	3/9	8SN7GT	8/9
3A8	3/9	8D2	3/9
4D1	2/9	8D3	7/9
5U4	8/9	12AU7	5/9
6Z4	8/9	12S67	1/9
6F12	7/9	12SJ7	1/9
6D2	6/9	EAF42	8/9
6H8.M	1/9	EAF37A	4/9
EB91	6/9	EP37	4/9
EBP80	8/9	EL42	8/9
EBC41	8/9	EL32	8/9
ECH42	8/9	EL22	6/9
ECX45	8/9	ET11	6/9
EF39	6/9	EX66	3/9
EF41	8/9	T77	7/9

American T.V. Tubes	U.K. All at 3/9 each.
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ID6	6A7 78 42
6D6	6C6

Barrettors 301 and 302 also at 3/9 each. Full list on request.

ELECTROSTATIC T.V. TUBES

All at 10/- each
89J, 4in.; E4205/B/7, 2½ in.; DG7-5, 2½ in.; 09D, 4½ in.; E4103/B/4, 1½ in.; VCR131, 11½ in.

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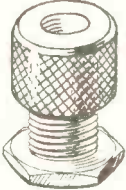
DUKE & CO.
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NOTE—New phone Nos, Ilford 6001-3.

PRE-SET CONTROL LOCK

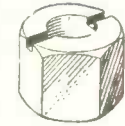
Designed to lock the spindles of pre-set potentiometers or trimmers without rotational or lateral displacement of shaft.



Will accept wide range of panel thicknesses.

TYPE P

Very attractive appearance for panel mounting



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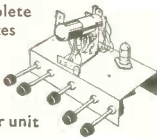
SELENIUM RECTIFIERS. 24v. 10 amp bridge. 49/6 ea. 350v. 1 amp 4-wave, 32/6.
ESSENTIAL MERCURY RELAYS. Mounted in pairs, 28/10/- per pair.
COMMAND RECEIVERS. BC454B. 3-8 M/cs, new boxed, 45/- ea. Also used good condition, 35/- ea. 1.5-8 M/cs, and 100-550 K/cs, 55/- ea. (both used).
RESISTANCE UNITS TYPE 281. comprising 12, heavy-duty (10in. long) 80 ohm non-inductive carbon resistances in perforated metal box. Ideal dummy load for RF measurements, 32/6 ea.
TEST OSC. TS170-ARMS. 300 Mics with Four 3Q4's. Two 959's, Three crystals, 1 M/ra meter, piston attenuator calibrated 1-1,000 microvolts. New, boxed, 75/- ea.
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MAINS TRANSFORMERS. RCA spares for ET4326 TX. 190-250v. input. 10v. 10A. 24v. 10A Twice, all CT. HV insulation, 28/6 ea.
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HR RELAYS PO 3000 TYPE. 6,800 ohm coil, 2M 2B, 11/6 ea. 20,000 ohms 1B1M, 16/- ea.
COLLARO RC458. Latest 4-speed Autochanger, 29/18/6 ea.
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300 OHM 1 AMP TWIN SLIDER VARIABLES. Spindle controlled, 27/6 ea.
SPECIAL PRICES QUOTED for the following valves in minimum lots of 100. 6AC7M, 6J6, 6AK5, 6SN7GT, 6K7G, 6AG6, EL22, 6F9, 6T11, 12CTM.
We have for disposal a number of brand new VHF transmitters (not ex-WD), manufactured by one of England's leading firms. They comprise two units for standard 19in. rack mounting and brief specification is as follows: Crystal controlled. Input 100 watts or half power to QTY7-40 PA. Freq. range 116-132 Mc. Plate and screen modulation. Volume compression circuit. Co-ex. aerial C/o relay. Mains operated. Fully tropicalised. Easily modified for the 2 metre band or as they stand are an excellent proposition for the commercial user. They may be inspected during normal business hours at address below or other times by appointment. To save correspondence a copy of the manual is available against a deposit of 23 (Refundable) and the price per equipment ex-warehouse is 245. These are cheap as production cost was many times this figure. All sets supplied with complete set of 17 BVA valves.
All goods except where stated are carriage paid England, Scotland and Wales. We regret we cannot accept overseas orders. S.A.E. enquiries.

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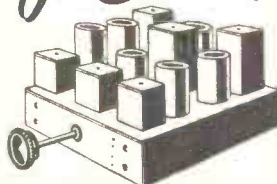
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Wiring diagram and holed chassis available.

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100 Microamp	2 1/2 in.	MC/FR	50/-
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5 "	2 1/2 in.	MC/FR	12/6
30 "	2 1/2 in.	MC/FR	12/6
100 "	2 1/2 in.	MI/FR	25/-
25 Amp.	2 1/2 in.	MI/FR	7/6
50 "	5 in.	MI/PR	60/-
50-0-50 Amp.	2 in.	MC/FS	12/6
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GROSS POINTER METERS. With 2 separate 100 microamp movements. Brand new. 22/6, post 2/-.

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CIRCUIT TESTER in wood case 9 in. x 6 in. x 4 in. 2 1/2 in. Flush Round meter, 50 milliamps, basic movement 10 M/A with leads, 10Ω pot. provision for 1.5 v. batt. Ideal for conversion, 17/6, post 2/6.

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Ideal for charging 24 volt batteries on electrically propelled vehicles. Rating 22 v. 10 amps., controlled by two 4-position rotary switches for fine and coarse control which enables 6/24 vt. Batts. to be charged. Input 200/250 v. A.C. 50 cy., fused for A.C. and D.C. Brand new £17/10/-, Carr. 15/-.



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All batteries sealed and unused. All plus 1/6 post and pkg. Special reduction for quantities.	

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POST OFFICE LAMP JACKS No. 10 1/- each.....doz. 9/-

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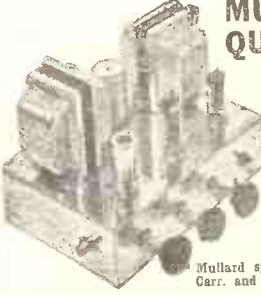
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An ideal companion unit to the JASON Tuner. A really first-class 3-valve 3-watt Amplifier giving Hi-Fi quality at a reasonable cost. Mullard's latest circuit. Valve line up: EF98, EL84, EZ80. Extra HT and LT available for Tuner Unit addition.

Variable treble cut and bass boost controls. Sensitivity 100 MV for 8-watt output. Frequency response + or - 1db, 40 c/s to 25 kcs.

Complete amplifier wired and tested with quality sectioned output transformer to Mullard specification (less speaker) **£8.8.0**
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JASON F.M. TUNER UNIT 87-105 m/cs



F.M. TUNER-UNIT (87 mcs-105 mcs) by Jason. As described in Radio Constructor. Designer Approved Kit of parts to build this modern highly successful unit, drilled chassis and superior type dial as illustrated, coils, cans and all quality components, etc. for only 5 Gns., post free. Set of 4 spec. EF91 or equiv. valves 30/-, post free. Illustrated handbook with full details. 2/-, post free. Free with KH. 48-hr. Alignment Service, 7/6 and 2/- p.s.p.

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8/500 v. ... 2/9	16 + 16 + 8/850 v. 5/6
8 + 8/500 v. ... 4/6	32 + 32/350 v. ... 5/6
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16 + 16/450 v. ... 3/6	60 + 60/450 v. ... 6/6
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20% Type, 1 w., 3d.	5 w. } 25 ohms—1/3
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SPECIAL—Semi-air spaced polythene. 50 ohm Coax 1/4 in. diam. Standard core. Losses cut, 50%.

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B.S.R. L.F. SIGNAL GENERATORS, checked, tested £12/10/- 250 v. 250 mA RECTIFIERS, Selenium 1/2 wave, square fins, 11/-, 100 + 300 mfd. 275 vw. Cans, 5/6; MEG. POT., D.P. 8 1/2 in. sp., small, 3/6. MIDGET CERAMICS, Tubular 10, 20, 50, 300, 3,000 p.f., 5/- doz. 32 + 32 250 v. 2/6, 16 + 16 350 v. 3/6. GOODMANS P.M. SPEAKERS, 5 in., 17/-, 6 1/2 in., 18/-, 7 x 4, 17/6, 8 in. (F.M. Quality), 22/6, 10 x 6, 26/-, 10 in. 25/-.

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- Measurement or calibration of the frequency of transmitters, oscillators, or signal generators.
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Electrical Characteristics

Fundamental Frequency Range: 125 kc/s to 250 kc/s; 2,000 kc/s to 4,000 kc/s.
 Calibrated Frequency Range: 125 kc/s to 20 Mc/s.
 Overall Accuracy: 0.01% or 25 cycles, whichever is the greater, within the specified temperature range.
 Operating Temperature Range: -30°C to +50°C (-22°F to +122°F).
 RF Output (Functioning as a test oscillator): 2 millivolts.

ALSO AVAILABLE V.H.F. VERSIONS OF ABOVE TS174 TS175

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 Accuracy: 0.05% (throughout the temperature range).
 Signal Input: (Sensitivity) 20 millivolts to 2 volts.
 Signal Output: 50 to 20 millivolts modulated at 1,000 cycles.
 Temperature Range: -40°C to +50°C (-40°F to +131°F).

Calibrated Frequency Range: 80 to 1,000 Mc/s.
 Fundamental Frequency Range: 80 to 200 Mc/s.
 Accuracy: 0.05% (throughout the temperature range).
 Signal Input: (sensitivity) 20 millivolts to 2 volts.
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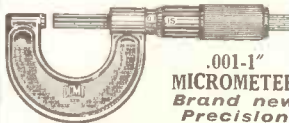
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7/6 REDUCED FROM 21/- 7/6

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All-in-one Radiometer A.C./D.C.
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The one you require enclosed if available in a dozen assorted of our best choice. 10/6

DEMOMBED VALVES MANUAL 2/6

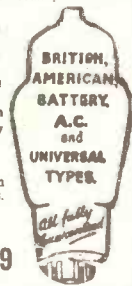
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SUITABLE ANY T.V. using lower side band

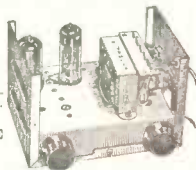
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Completes with built-in power supply, 230-250 v. A.C. mains. Case 5 1/2 in. long, 3 1/2 in. wide, 4 1/2 in. high. Incorporating gain control and band switch.

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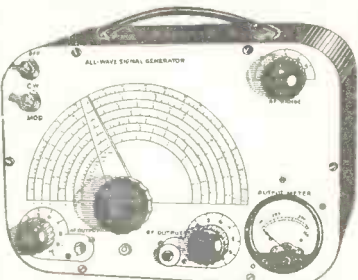
Co-ax cable 8d. vard.



Illustrated with cover removed.

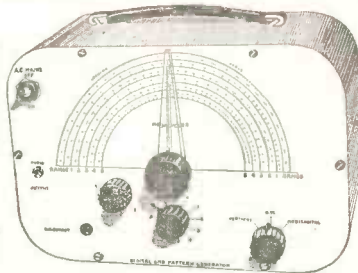
Coverage 120 Kc/s.-230 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8 Mc/s.-28 Mc/s., 16 Mc/s.-56 Mc/s., 24 Mc/s.-84 Mc/s. Metal case 10 in. x 6 1/2 in. x 4 1/2 in. Size of scale, 6 in. x 3 1/2 in. 2 valves and rectifier. A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F., output continuously variable 100 milli-volts, C.W. and mod-switch, variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%.

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Complete in case, grey hammer finish. **19/6** P. & P. 1/6. Point to point wiring diagram 1/- free with kit.

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incorporating ferrite rod aerial
Medium and long waves. In grey leatherette. Size 9 in. x 7 in. x 6 in. Valve line up IT4, IR5, IS5, 3V4. Complete kit of parts (less batteries).

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12 v. 2½ amp. 15/- 24 v. 2½ amp. 25/-
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COMMAND TRANSMITTERS. 4 to 5.3 mcs. Complete with valves and crystal. New and boxed, 35/- P. & P. 3/-.

APQ9 TRANSMITTER. Containing 931a Photo Electric cell (complete with network). 2-6AC7s, 1-6AG7, 2-807s and 2 blower-cooled 8012s. With rev. counter. Brand new, 89/6, carr. 12/6.

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PARMEKO MOVING COIL HAND MICROPHONE. 200 ohm imp. Fitted on/off switch, complete with 12yds. flex 30/-, P.P. 2/6.

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VARIABLE VOLTAGE REGULATOR TRANSFORMERS. Input 230 v. A.C. at 21 amps. Output 57.5 volts in 16 equal steps to 230 v. at 21 amps. Ex-Govt., in perfect condition, £12/10/-, carr. 15/-.

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RCA AR-88 L.F. RECEIVER (C.R.91). In very good condition. Freq. range: 550 kc/s. to 31.9 Mc/s. continuous on 6 wavebands, £45, carr. £2 U.K. only.

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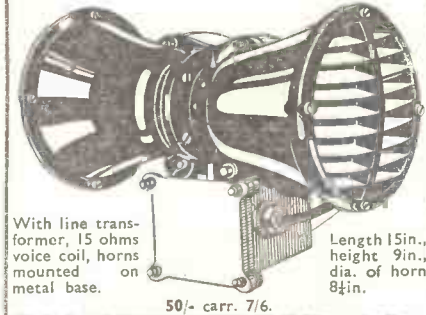
TRANSMITTER-RECEIVER No. 19. Mk. II complete with 15 valves. Frequency range A set 2-8 meg., B set 230-240 Mc/s. in good condition, £3/19/6, carr. 10/6. 12-V. ROTARY POWER UNIT for above, £1, carr. 5/-.

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With line transformer, 15 ohms voice coil, horns mounted on metal base. Length 15in., height 9in., dia. of horn 8½in. 50/- carr. 7/6.

METERS
0-50 microamps. D.C. m/c., projecting 2½in. round, 49/6 each.
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0-300 v. A.C. 2½in. Flush mounting, 25/- each
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0-300 v. A.C. 3½in. Flush mounting, 25/- each
S. METERS 2in. circular calibrated in decibels 5 mA. FSD 25/- each.
All brand new and boxed, P. & P. 1/- each.

SWINGING CHOKE 8/40 henrys—3/10.3 m/a. 110 ohms D.C. resistance. 15/-, post 3/6.

BENDIX DYNAMOTORS. 28 v. D.C. input, 230 v. D.C. output at 100 mA. New and boxed. 19/6. P.P. 2/6.

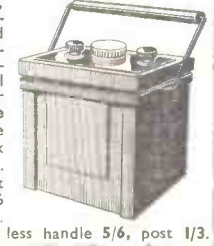
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MICROPHONE STANDS 3 sections of 18½in. per section. Extends to 56in. Stands securely on 3 legs which fold together for carrying. A robust job, only 21/-, P.P. 2/6.

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These vacancies arise with the continued expansion of the Company in the field of Office Automation, in which LEO Computers Ltd. holds a significant place as the first to develop a fully operational Automatic Office.

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Require

ELECTRONIC ENGINEERS—Senior and Junior, for instrumentation and high power audio amplifier development. Design or development experience essential for senior positions, also desirable for junior posts.

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Write, giving fullest details of qualifications, experience and availability and details of remuneration required.

The Secretary,
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MURPHY RADIO LIMITED

have vacancies for

EXPERIENCED ENGINEERS

in their domestic receiver design laboratory to work on receivers and radio-gramophones for home and export markets covering transistor, valve, and hybrid circuitry and for both amplitude and frequency modulation reception. Good conditions of employment including pension scheme and active sports club, catering for many different sports and hobbies. Welwyn Garden City offers pleasant surroundings and successful applicants from the Greater London area would qualify for housing after a period. Applications giving full details of age, experience and qualifications should be addressed to Personnel Department (R.8),

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Positions of wide scope and interest can be offered to qualified Engineers wishing to specialise in the

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A well established organisation of world repute offers progressive posts to ENGINEERS, PHYSICISTS, DRAUGHTSMEN AND TECHNICIANS OF ALL GRADES for a planned expansion of a branch of their Research and Development Division. The projects include Marine and Airborne Radar, Guided Weapon Systems, Microwave Links, and Electro Mechanical Devices. All the posts are pensionable and offer outstanding scope for advancement to candidates possessing initiative, originality of thought, and an aptitude for hard work.

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ENGINEERS (Electrical). The successful candidates will be required to undertake the design of small motors, generators, transformers etc. as used in electronic and electro-mechanical equipment. Qualifications required are, H.N.C. or equivalent and at least 3 years' experience in this field.

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DESIGN DRAUGHTSMEN. Candidates for these posts should possess H.N.C. or equivalent and have had at least 5 years' experience in the Industry, with an accent on mechanical design. They must be capable of interpreting the design engineers' requirements and translating these into production drawings.

Those interested in any of the above posts are invited to write, in confidence, giving details of qualifications, experience and salary required to
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Good Technical background and commercial experience essential.

Confidential applications in writing to:

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required to design and develop magnetic systems for use with Travelling Wave Tubes.

Previous experience in designing and engineering permanent or electro-magnets is desirable.

The post carries non-contributory superannuation and good opportunities for promotion. Company's house may be available to rent. Please apply giving preliminary details to:

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RESEARCH AND DEVELOPMENT

Vacancies exist in the Research Department of a large instrument manufacturing organisation in South-East Essex for

GRADUATE PHYSICISTS

OR

ELECTRICAL ENGINEERS

of merit and some years of industrial experience for the investigation of long term problems associated with Echo-Sounding and Non-Destructive Testing.

The work embraces acoustics and electronics and involves the application of the basic physical principles underlying ultrasonics, telecommunications and computers. Some knowledge in these fields would be an advantage.

The initial salary will be in accordance with experience and qualifications within a scale which allows ample scope for future development. A contributory pension scheme is available and assistance in housing or removal expenses may be given in suitable cases.

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**INTERESTING U.H.F.
PROJECT**

Degree or equivalent. U.H.F./
V.H.F. experience essential

Apply Box No. 0059 c/o W. World.

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A number of vacancies, offering good career prospects, exist for:—

Radio Operators — Male
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Apply, giving details of education, qualifications, and experience, to:—

Personnel Officer,
G.C.H.Q. (FOREIGN OFFICE),
53 Clarence Street,
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Tester Trouble Shooters and Electro/Mechanical Inspectors with experience of Multi-Channel Transmitters and Receivers required by a large Electrical Engineering Company in the Eastern suburbs of London. A very sound knowledge and experience of commercial radio and television would be acceptable. Good rates of pay to the selected candidates. Please reply, giving full details of experience, to Box No. 0491 c/o "W.W."

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An interesting position exists for an experienced television development engineer for work in connection with Continental type T/V receiver design.

The successful candidate must have sound theoretical knowledge and practical ability. Several years' laboratory experience is essential, and he should be capable of working on his own initiative. A very attractive salary will be paid consistent with qualifications and experience.

Applicants should write in the first instance to the
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RADIO DIVISION

Vacancies exist for two Radio Engineers at least C.G.I. Telecommunications 3rd year standard. These positions are permanent and offer excellent prospects for right men:—

Development Laboratory—requires assistant engineer for advanced receiver design work. Present programme includes several transistor and printed circuit projects.

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DUTIES: To undertake the design and development of test equipment for television, including work on special television camera applications. Considerable personal responsibility and freedom is given, and there are no set rules regarding the number of people engaged on a project, the allocation of project leaders etc.

QUALIFICATIONS: The ability to design and develop equipment and aggressively progress a project through to the stage where a model is made and the information is available for a production drawing office. Candidates should preferably be of degree standard, or Corporate Members of one of the Professional Institutions, but consideration will be given to others who have considerable practical experience in the field. The ability to progress the project through to a satisfactory conclusion is the prime requirement. Due to expanding activities men with drive and initiative can be sure of progressive advancement.

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DUTIES: To undertake the design of Test Equipment covering practically the whole electronic field, including Telecommunication, Guided Weapons, and Nucleonics. Considerable personal responsibility and freedom is given, and there are no set rules regarding the number of people engaged on a project, the allocation of project leaders, etc.

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Comprehensive pension and assurance schemes are in operation, and Canteen and Social Club facilities are provided.

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A vacancy exists at Plessey Nucleonics for a Senior Design Draughtsman to become responsible for the design of electronic equipment. Applicants should have had several years' experience in this field and be familiar in designing such equipment to Ministry specifications, where sound methods of design and construction are most important. The successful candidate will be expected to operate with very little supervision and lead a small team on the design of electronic devices in the nuclear energy field. Promotion prospects are good, and this small team will be expanded during the next two years. Applications in writing should be sent to the Chief Engineer, Plessey Nucleonics Ltd., Weedon Road, Northampton.

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Qualifications: We shall be pleased to receive applications from any man with or without academic qualifications, who is able to demonstrate suitable experience and training.

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An engineer is required to investigate various problems relating to interference filters and screened compartments for which a knowledge of filter networks is necessary.

Attractive commencing salaries are offered which will be based on experience, qualifications and age in each individual case. A Pension Scheme is in operation and all applications, giving full details of career so far, should be sent to the SECRETARY.

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are required for posts in fundamental research projects on microwave electronic devices and on new methods for millimetre wave generation. Applications are invited from men with initiative and the ability to work without close supervision, which are requirements for these progressive posts. Microwave, valve technology, or vacuum system experience is desirable. Suitable educational qualifications are Ordinary or Higher National Certificate in Electrical Engineering or Applied Physics. Salaries for these posts are attractive. Applicants must have satisfied National Service requirements:

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Experienced in one or more of the following:—

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4. Fault finding in, and maintenance of, electronic apparatus.
5. Maintenance of Teleprinters or Cypher Machines and associated telegraph equipment.

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Five-day week, good working conditions, single accommodation available. Apply to: **Personnel Officer, G.C.H.Q. (FOREIGN OFFICE), 53 Clarence Street, Cheltenham.**

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Experience in one or more of the following:—

1. Maintenance of radio communication receivers.
2. Sub-assembly lay-out, wiring and testing of radio type chassis.
3. Cabling, wiring and adjustment of telephone type of equipment.
4. Fault finding in, and maintenance of, electronic apparatus.
5. Maintenance of Teleprinters or Cypher Machines and associated telegraph equipment.

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SPECIAL RATE: 38/- to 70/-
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TESTERS
TRAINEE TESTERS**

FOR AM/FM RECEIVERS

**GOOD RATES AND
CONDITIONS**

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SALES LIAISON ENGINEER

required by a company situated in Hampshire selling to the radio, communication and industrial electrical industries. Applicants should possess a sound engineering background; a knowledge of radio components would be an advantage. The appointment offers an excellent salary and considerable scope to a man of first-class ability. Please reply, giving full details to Box No. 0565 c/o W. World.

Major Oil Company requires immediately for employment in British Borneo

**MULTI CHANNEL
RADIO ENGINEER**

to take charge of Radio Section of communications. Responsible for initiation of Radio Projects, Installation and Maintenance of V.H.F. and H.F., including S.T. & C. and Storno Units. Must have planning and organising ability. A working knowledge of Telephone Systems desirable. Corporate Member I.E.E. or Technical Education admitting to Associate Membership of I.R.E. Approximate age 27/30 years. Single or married. Family accommodation available immediately. Pension Fund covering employee and family. Tours 3 and 2 years' duration with paid home leave and each tour in addition to local leave. Travelling expenses paid for interview in London. Applications will be treated in strictest confidence.

Please write giving full details to **Box Z.F. 381, Deacon's Advertising, 36, Leadenhall Street, London, E.C.3.**

TECHNICAL ASSISTANTS (Ref. 391) are required to work on the installation and maintenance, in the establishment or on site, of electronic computers. Candidates should have experience of electronic circuit equipment and some theoretical background preferably to O.N.C standard. These are new appointments in the expanding field of digital computing.

TECHNICIANS (Ref. 393) are also required for developing and testing units as well as for commissioning and servicing completed machines. Candidates should have completed a full time Services course in radar or electrical control equipment or have had commercial radio/TV experience. Arrangements can be made to pursue technical education on day release basis.

The above are new and permanent staff appointments in the expanding **COMPUTING MACHINES** field. Write or 'phone (Elstree 2040) for interviews to:

**Personnel Department,
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**THE AUSTIN MOTOR COMPANY
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have immediate vacancies for two **ELECTRONIC ENGINEERS.**

They should have qualified to graduate standard.

One will be required to take charge of a section of the Research Laboratories dealing with the application and design of electronic equipment as applied to Machine Tool and Conveyor Control.

The other will be engaged in the application of Electronics to Mechanical Test Equipment and Internal Combustion Engines. Some previous knowledge of vibration and acoustic measurements would be an asset.

The above posts are permanent with good prospects. Salaries will be dependent on qualifications and previous experience.

Applications with full details to—
PERSONNEL MANAGER

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A number of appointments are available for interesting work providing and maintaining aeronautical telecommunications and electronic navigational aids at aerodromes and radio stations in various parts of the United Kingdom.

Applications are invited from men aged 19 or over who have a fundamental knowledge of radio or radar with some practical experience. Training courses are provided to give familiarity with the types of equipment used.

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Apply to the Ministry of Transport and Civil Aviation (ESB1/RT), Berkeley Square House, London, W.1, or to any Employment Exchange (quoting Order No. Westminster 2109)

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Apply in writing initially giving full details of age, experience and qualifications to:—

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have vacancies to offer in their steadily expanding organisation for **ELECTRONIC DEVELOPMENT ENGINEERS** to be concerned with the design of a variety of equipment including specialised instruments and **TELE-COMMUNICATIONS SYSTEMS**.

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A comprehensive pension scheme is in operation; Canteen and Social Club facilities are available.

Existing Holiday arrangements will be respected.

Applications will be treated in strict confidence and should be made to:

**THE SUPERINTENDENT,
ELECTRONIC DEVELOPMENT
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R. B. PULLIN & CO. LTD.,
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A North/West Birmingham Company require a young engineer to assist in development, to a practical industrial stage, of novel light current equipment for use as integral parts of industrial mechanical engineering products of world wide repute.

This is an excellent opportunity for a permanent and progressive position in which can be gained experience in the application of transistors, relay circuits, special high accuracy measuring circuits, servos, and associated null balance systems.

Extensive experience in this field is not essential but a good grasp of fundamental theory to Higher National level, an absorbing interest in light current devices, and an ability to appreciate and create new ideas is necessary.

Age: 23—30 years.

Apply, giving details of qualifications, training and age to Box No. 0375, c/o "Wireless World."

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Duties cover operation and maintenance of Vision Equipment, working on shift basis.

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Vacancies exist for both Senior and Junior Engineers in the Television Development Department and for Junior Engineers in the Test Equipment Department.

Senior Engineers should have academic qualifications and several years' development experience. Junior Engineers require either academic qualifications or experience in development or equipment calibration and maintenance.

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Required by Central Electricity Authority to work in the Electronics and Instruments Section of the Research Laboratories at Leatherhead, Surrey, on problems of vibration, acoustic noise, or radio interference.

Candidates should have a degree or equivalent qualification, and the ability to apply fundamental knowledge to a wide variety of problems.

The work on vibration and noise involves a study of the fundamental problems, development and use of measuring techniques in the generating and transforming stations of the C.E.A. and an assessment of the results. The work on radio and television interference from high-voltage transmission lines involves field strength and voltage measurements at radio frequencies, calibration of equipment and analysis of experimental data.

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Applications stating age, qualifications, present position and salary, and giving full details of experience, should be forwarded to:

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for the design of Television and Radio Receivers and associated Test Gear.

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with mechanical design experience are immediately required for the

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Applications are invited from suitably qualified men with a basic knowledge of the principles of Electronics plus experience in the design of electro-mechanical transducers, servo-mechanisms and electronic assemblies.

The Company operates liberal pension and assurance schemes and some assistance with accommodation may be offered.

Those interested are invited to write to the

Personnel Officer,
Saunders-Roe Ltd.,
East Cowes, I.W.

quoting ref. WW.62, and giving details of age, experience, etc.

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Holloway Road, London, N.7.

Principal: A. S. M. Symons, Ph.D., B.Sc.,
A.R.C.S., D.I.C., F.Inst.P.

Department of Telecommunications

Head of Department: J. C. G. Gilbert,
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Evening classes in Industrial Electronics, Computers, Radar Principles and Practice, Electro-acoustics and Audio Frequency Engineering.

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Special evening course in Television Engineering including colour; and frequency modulation techniques.

All the above courses include practical laboratory and workshop experience.

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New term commences 23rd September 1957.
PROSPECTUS FREE on application to the Secretary.

I.T.A.

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Enquiries should be addressed to:
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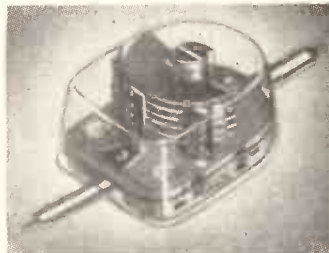
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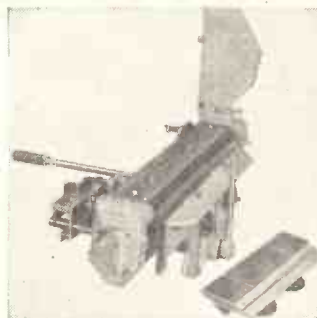
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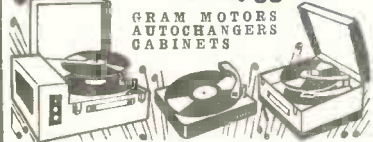
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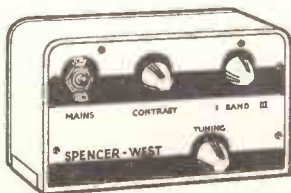
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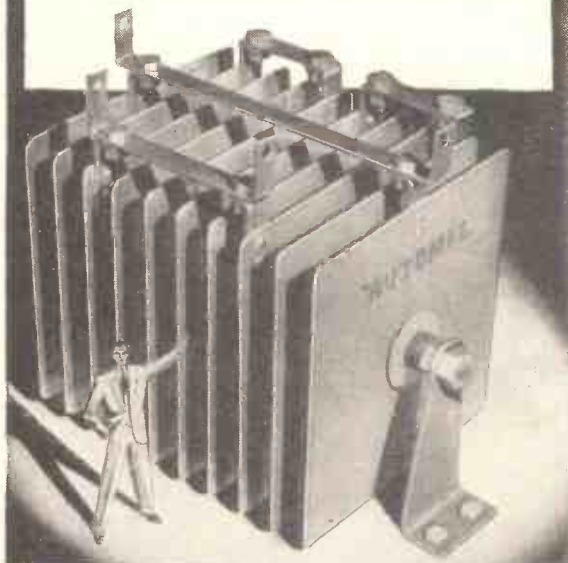
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Readers are warned that Government surplus components and valves which may be offered for sale through our displayed or classified columns carry no manufacturers' guarantee. Many of these items will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

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WW/9/57

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 TUBES transformers, pri 110v, 200-240v, sec. 300-0-300v, 4v 2amp, 6.5v 2.5amp, 11/-, 2-gang condenser, .0005, var. size, 2 1/2in x 2in x 1 1/2in, 3in spindle, 4/-; P.M. focus rings.
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ELECTROLYTICS, capacity, voltage, size, type of mounting: 50mfd, 25v, 1 1/2in x 1 1/2in, tag, 1/6; 100mfd, 12v, 1 1/2in x 1 1/2in, tag, 1/6; 500mfd, 12v, 1 1/2in x 1 1/2in, tag, 2/-; 10mfd, 25v, 1 1/2in x 1 1/2in, W/E, 4mfd, 150v, 1 1/2in x 1 1/2in, tag, 1/3; 8mfd, 150v, 1 1/2in x 1 1/2in, tag, 1/3; 2in x 1 1/2in, tag, 1/9; 8mfd, 500v, 3in x 1 1/2in, clip, 2/6; 16mfd, 350v, 2in x 1 1/2in, prong, 1/9; 20mfd, 450v, 2in x 1 1/2in, clip, 2/-; 24mfd, 275-350v, 2in x 1 1/2in, clip, 2/-; 32mfd, 275-350v, 2in x 1 1/2in, clip, 2/6; 32mfd, 2in x 1 1/2in, clip, 2/6; 40mfd, 150v, 2in x 1 1/2in, prong, 1/6; 40mfd, 350v, 2in x 1 1/2in, prong, 2/-; 40mfd, 450-525v, 2in x 1 1/2in, 2/9; 50mfd, 350v, 2in x 1 1/2in, W/E, 3/-; 100mfd, 270-350v, 2in x 1 1/2in, clip, 3/5; 100mfd, 350-425v, 3in x 1 1/2in, prong, 1/2; 125mfd, 350-425v, 3in x 1 1/2in, prong, 3/6; 200mfd, 35v, 1 1/2in x 1 1/2in, tag, 200mfd, 250-325v, 3in x 1 1/2in, 2/6; 200mfd, 275-350v, 3in x 1 1/2in, prong, 3/-; 250mfd, 25v, 2 1/2in x 1 1/2in, 1/-; 250mfd, 150v, 3in x 1 1/2in, prong, 2/6; 500mfd, 6v, 2in x 1 1/2in, clip, 1/3; 500mfd, 25v, 2in x 1 1/2in, clip, 2/6; 1,000mfd, 6v, 2in x 1 1/2in, clip, 2/-; 1,000mfd, 25v, 3in x 1 1/2in, clip, 1/6; 2,000mfd, 12v, 2in x 1 1/2in, W/E, 3/6; 2,000mfd, 25v, 3in x 1 1/2in, clip, 3/6; 2,000mfd, 50v, 4 1/2in x 1 1/2in, clip, 5/-; 3,000mfd, 25v, 3in x 1 1/2in, clip, 4/-; 4,000mfd, 6v, 3in x 1 1/2in, clip, 5,000mfd, 25v, 4 1/2in x 1 1/2in, clip, 5/6; 8+8mfd, 450v, 2in x 1 1/2in, W/E, 4/-; 15+15mfd, 450v+20mfd, 25v, 3in x 1 1/2in, prong, 4/-; 16+16mfd, 275v, 2in x 1 1/2in, clip, 2/6; 20+10mfd, 450-525v, 3in x 1 1/2in, clip, 3/6; 20+20mfd, 350-425v, 2in x 1 1/2in, prong, 4/-; 20+20mfd, 150v, 2in x 1 1/2in, clip, 2/-; 20+20mfd, 150v, 2in x 1 1/2in, W/E, 2/3; 20+20mfd, 350-425v, 2in x 1 1/2in, W/E, 3/9; 20+20mfd, 450v, 3in x 1 1/2in, prong, 3/9; 30+30mfd, 150v, 2in x 1 1/2in, clip, 2/6; 32+16mfd, 300v, 2in x 1 1/2in, prong, 1/6; 32+16mfd, 275-350v, 2in x 1 1/2in, clip, 3/-; 32+32mfd, 275-350v, 3in x 1 1/2in, prong, 3/9; 32+32mfd, 350-425v+50mfd, 25v, 2in x 1 1/2in, prong, 4/3; 40+40mfd, 150v, 2in x 1 1/2in, clip, 2/6; 40+40mfd, 350v, 3in x 1 1/2in, clip, 3/6; 40+40mfd, 450v, 3in x 1 1/2in, prong, 4/-; 50+20mfd, 150v, 2in x 1 1/2in, clip, 2/-; 50+30mfd, 450-525v, 3in x 1 1/2in, clip, 4/6; 50+50mfd, 150v, 2in x 1 1/2in, W/E, 2/6; 50+50mfd, 275-350v, 3in x 1 1/2in, clip, 3/6; 50+50mfd, 300-350v, 3in x 1 1/2in, clip, 4/-; 50+100mfd, 275-350v, 3in x 1 1/2in, prong, 5/-; 60+100mfd, 275-350v, 3in x 1 1/2in, clip, 4/6; 60+200mfd, 275-350v, 4 1/2in x 1 1/2in, clip, 5/-; 60+250mfd, 275-350v, 4 1/2in x 1 1/2in, clip, 4/6; 60+250mfd, 275-350v, 3in x 1 1/2in, clip, 5/-; 100+65mfd, 275-350v, 3in x 1 1/2in, prong, 4/8; 100+200mfd, 275-350v, 4 1/2in x 1 1/2in, clip, 5/6; 150+200mfd, 350-425v, 4 1/2in x 1 1/2in, clip, 7/-; 200+100mfd, 275-350v, 4 1/2in x 1 1/2in, clip, 6/6; 200+200mfd, 275-350v, 4 1/2in x 1 1/2in, clip, 7/6; 1,000mfd+1,000mfd, 6v, 3in x 1 1/2in, clip, 3/6; 12+12+24mfd, 275-350v, 2in x 1 1/2in, prong, 3/6; 16+8+4mfd, 275-350v, 2in x 1 1/2in, prong, 3/6; 16+24+8mfd, 2in x 1 1/2in, clip, 5/-; 20+20+10mfd, 275-350v, 2in x 1 1/2in, prong, 3/6; 20+20+20mfd, 150v, 2in x 1 1/2in, prong, 2/9; 20+25+20mfd, 150v, 2in x 1 1/2in, clip, 2/9; 32+32+2mfd, 275-350v, 3in, 3/-; 32+32+8mfd, 275-350v, 2in x 1 1/2in, clip, 3/-; 32+32+8mfd, 350-425v, 2in x 1 1/2in, clip, 3/6; 40+30+20mfd, 275-350v, 3in x 1 1/2in, prong, 3/6; 40+30+20mfd, 275-350v+25mfd, 25v, 3in x 1 1/2in, prong, 4/-; 50+50+8mfd, 275-350v, 3in x 1 1/2in, prong, 4/6; 50+50+50mfd, 350v, 3in x 1 1/2in, clip, 5/6; 200+250+250mfd, 275-350v, 4 1/2in x 2in, clip, 8/-; 40+20+10+10mfd, 350-425v, 2in x 1 1/2in, clip, 5/-.
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NEW GRAMOPHONE AND SOUND EQUIPMENT

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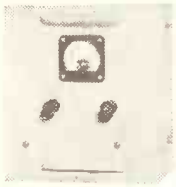
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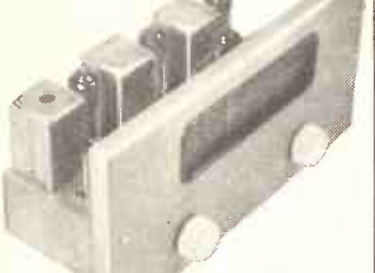
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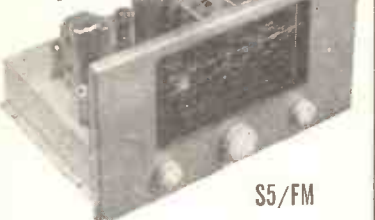
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12 x 4 x 2 1/2	6/10	13 x 8 x 2 1/2	8/10	17 x 10 x 2 1/2	11/3
8 x 8 x 2 1/2	7/6	12 x 9 x 2 1/2	8/11	17 x 9 x 3	11/6
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THE Research Laboratories of the General Electric Co. Ltd., North Wembley, Middlesex, have several vacancies for technical assistants.—Please apply in writing to the Staff Manager (Ref. RLB/137), giving full details of qualifications, experience and age. [7153]

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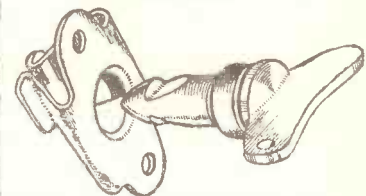
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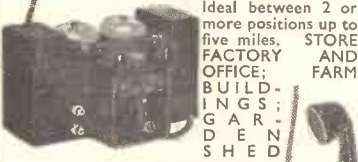
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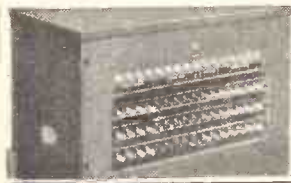
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LABORATORY STEWARD required for Advanced Radio and Electronics Laboratory; should have practical experience in connection with electronic equipment, O.N.C. in Electrical Engineering, or C. & G. Intermediate Certificate in Tele-communications or Radio Servicing would be an added qualification; part-time day release granted (under 21) for approved students; Salary: Under 21: £215 (at 16) to £317 10s (at 20). 21 and over: £424-£552 according to age, qualifications and experience.—Apply to the Clerk to the Governors, South East Essex Technical College, Longbridge Rd., Dagenham. [7289]

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 or an equivalent certificate issued by an Administration of the Commonwealth or of the Irish Republic; selected candidates will be considered later for permanent pensionable posts.—Applications should be made to the Director of Wireless Telegraphy, Radio Service Department, Wireless Telegraphy Section, Union House, St. Martins-le-Grand, London, E.C.1. [7100]

ELECTRONIC mechanics required at Royal Aircraft Establishments, Aberporth and Bedford. Bakers of similar entry for 4 hrs per 5-day week. Aberporth 194/4+30/- merit lead. Bedford 182/4+38/- merit lead; prospects of reassessment of rate within one to three months with any increase back-dated to date of entry; merit lead can rise to 62/- (Aberporth) or 70/- (Bedford); two weeks (80 hours) paid annual leave; paid sick leave scheme.—Apply, giving full details of apprenticeship, training (including Forces training) and experience to Superintendent (W.W.), Royal Aircraft Establishment, Aberporth, Cardiganshire; or Superintendent (W.W.), Royal Aircraft Establishment, Bedford. [7269]

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0.45 Ω , 1.8 Ω , 4 Ω , 7 Ω , 11 Ω , 16 Ω , 22 Ω and 30 Ω to handle 50 watts.

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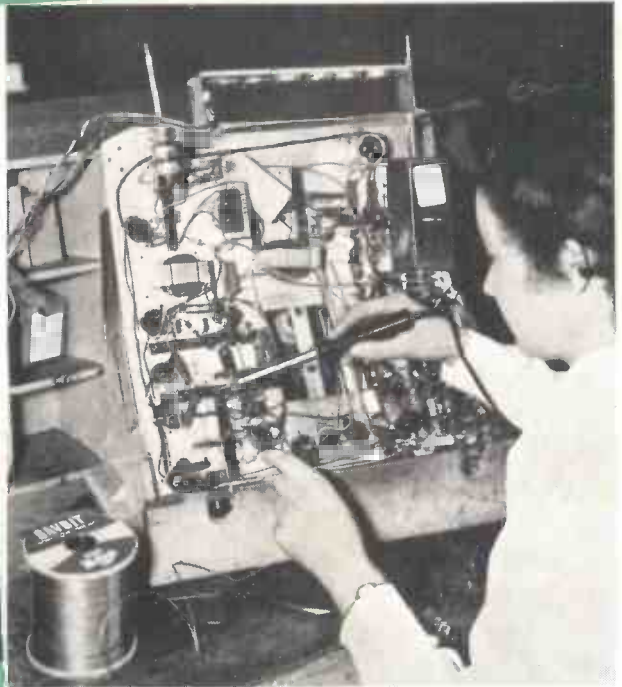
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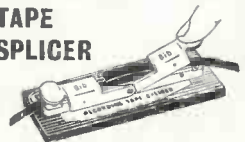
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