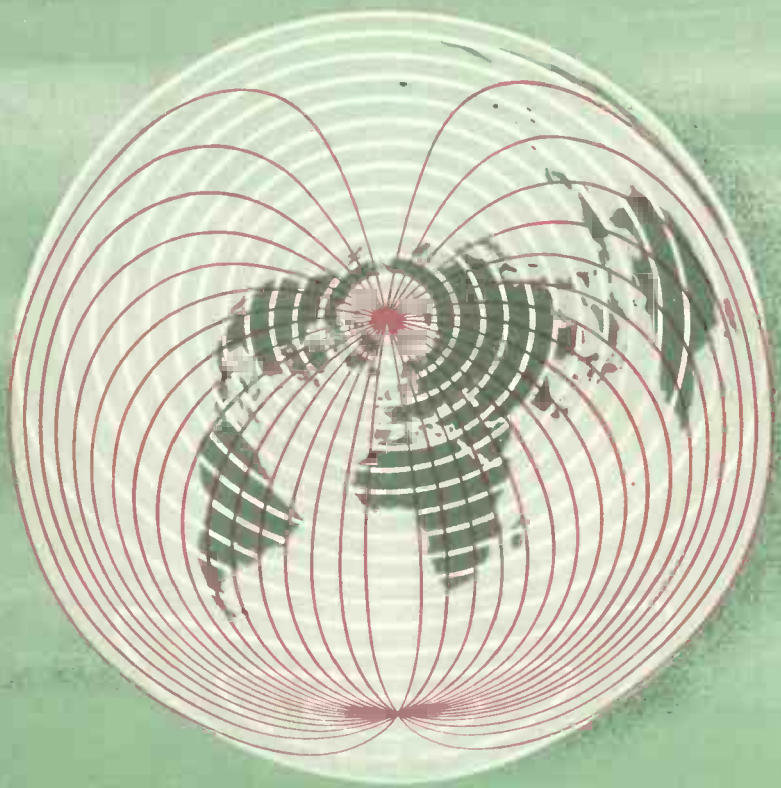
MARCH 1955

TWO SHILLINGS

Wireless World

Radio · Electronics · Television



FORTY-FOURTH YEAR OF PUBLICATION

Wireless World

RADIO, ELECTRONICS, TELEVISION

Managing Editor:
HUGH S. POCOCK, M.I.E.E

Editor:
H. F. SMITH

MARCH 1955

In This Issue

Editorial Comment .. 101
Does the Tape Characteristic Matter? .. 102
More About Radio Training .. 103
World of Wireless .. 105
Spurious Line Scan Resonances. *By K. G. Beauchamp* .. 109
Voltage-Multiplying Rectifier Circuits. *By "Cathode Ray"* 115
I.T.A. Transmitters .. 120
Transistor Radio Receiver. *By D. Nappin* .. 123
Letters to the Editor .. 125
Russian Colour Television .. 127
The Slot Aerial. *By B. L. Morley* .. 129
Band III Pilot Transmitter .. 131
Short-wave Conditions .. 132
Introduction to Transistor Electronics—2. *By H. K. Milward* 133
Recovering Hidden Signals. *By James Franklin* .. 137
Commercial Literature .. 140
Direct-Reading Capacitance Tester. *By O. E. Dzierzynski* .. 141
Manufacturers' Products .. 144
Two-Valve Superhet. *By R. C. Lever* .. 145
Books Received .. 146
March Meetings .. 147
Random Radiations. *By "Diallist"* .. 148
Unbiased. *By "Free Grid"* .. 150

VOLUME 61 NO. 3
PRICE: TWO SHILLINGS

FORTY-FOURTH YEAR OF PUBLICATION

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

VALVES, TUBES & CIRCUITS

27. RECOMMENDED PCF80 TELEVISION APPLICATIONS

Advertisement No. 26 in this series discussed the use of the Mullard PCF80 in applications other than its primary application as additive mixer. Three of the recommended circuits are given below. Details of line multivibrator and line timebase coincidence detector circuits will be given in the *Additional Notes*.

Fig. 1: Pentode as Video Amplifier.

The composite video output is 80V pk—pk. with a 3.0Mc/s bandwidth (6.0db) and a gain of 12. Additional drive will produce excessive g_2 dissipation. To avoid hum the following limitations of a.c. heater-to-cathode voltage must be observed, $R_{g\text{-}k}$ being 100kΩ:

$V_{h\text{-}k}$	R_k
200V	150 Ω
100V	300 Ω
50V	600 Ω

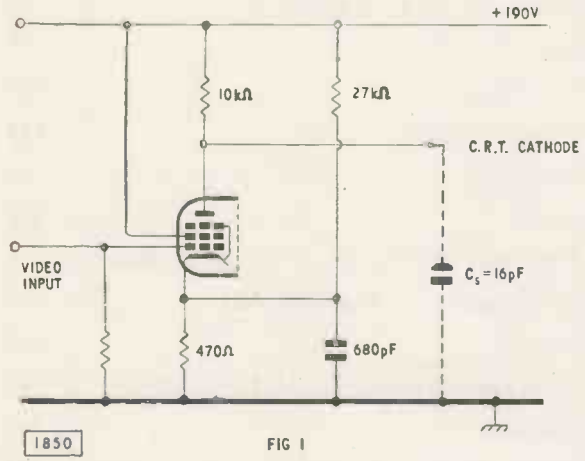


Fig. 2: Pentode as Sync. Pulse Separator; Triode as Frame Pulse Clipper.

For optimum operation of the pentode, $V_{g2} = +40V$. The frame pulse clipper is conventional but economical. Sync. pulses from the pentode are integrated by R1, C1 (27μsec) and are d.c. coupled to the triode grid, holding it in grid current. Integrated frame pulses drive the grid negative, cut off the triode, and produce 140V, 400μsec frame sync. pulses with a fast front edge and a non-interlaced back edge —corresponding to odd and even frames. To ensure that only the front edge is significant, the frame oscillator, coupled via a short time constant circuit, should complete its flyback before the end of the pulse.

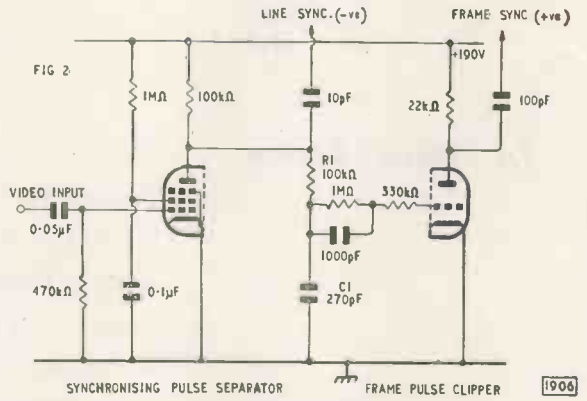
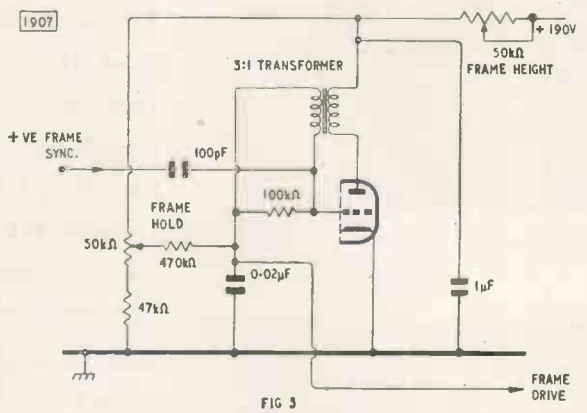


Fig. 3: Triode as Frame Blocking Oscillator

The output sawtooth amplitude is 200V for 200mA peak I_k (150μsec pulse). A step-up transformer into the grid circuit is used. There is sufficient output for a variety of linearization methods.



The following relevant reprints of "Valves, Tubes, and Circuits" are available free:

No. 15: Valves for VHF Television Reception, with PCF80 and PCC84 data.

No. 16: PCF80: a Frequency Changer for Band I and Band III Television, with notes on conversion conductance "contour analysis".

No. 26: Additional Applications of the PCF80, with a comprehensive applications chart.

No. 27: this number.

Wireless World

MARCH 1955 VOL. 61 No. 3

Second Thoughts on Television Distribution

COMPETITION in the distribution of programmes by television has been decided by democratic processes to be a good thing, and, anyway, it is no business of ours to discuss it. But competition in the technical distribution of television signals now appears to be not so good, and to make some of the natural and inevitable problems even more difficult. Rugged individualism in the choice of station sites may work well in the wide open spaces of the United States, but there is less scope for it in these small islands.

When it was first proposed last summer that the Independent Television Authority should share the B.B.C.'s masts, the idea was hailed by everyone (not excluding this journal) as technically an excellent one. A more detailed consideration of the problem now shows we were over-optimistic in thinking that co-siting of B.B.C. and I.T.A. stations would provide a solution of all the problems and would at the same time ensure an early start of the new service. As an article on another page of this issue will show, the projected Band III transmitters of the I.T.A. are not necessarily good neighbours of the existing Band I stations. Sites that are best for high-power stations working at some 50 or 60 Mc/s may be far from ideal for transmitters of necessarily lower radiated power operating at a frequency nearly four times greater. Indeed, we have in the Holme Moss station an example of highly successful siting for a Band I transmitter that would be a very bad choice for Band III.

Apart from factors arising out of the different propagation characteristics of the two bands, it now appears that insufficient thought was given to purely mechanical considerations when the idea of shared masts was first mooted. Is there sufficient space on the "standard" B.B.C. masts to support a multi-element Band III aerial of the high gain that is now thought to be essential? And, even if room could be found, would the windage of such an aerial be greater than that which the masts were designed to withstand?

In planning a Band III service for this country, we are still working very largely in the dark, from insufficient and sometimes irrelevant data. Such data as is available from the United States and the Continent relates to horizontally polarized transmissions with negative modulation. Some of the gaps in our practical knowledge will no doubt be filled in when the Belling-Lee experimental station on the I.T.A. London site starts to radiate a test pattern in April.

The original proposal that the B.B.C. should allow its competitors to share its television masts has always seemed mildly Gilbertian. But even more Gilbertian is the situation that would seemingly now arise if the best engineering principles are to be followed: the position should be reversed, and the B.B.C. should seek the hospitality of the I.T.A. for siting its projected Band III transmitters! We will leave this delicate matter by saying there seems to be a moral somewhere in favour of an integrated distribution service.

Receiver Oscillator Radiation

THE need for integration, discussed in the preceding paragraphs in relation to television transmission, spreads through the whole field of broadcasting, and, of course, affects receiver design. A case in point is the standardization of intermediate frequency for television receivers, recently agreed upon by the industry.

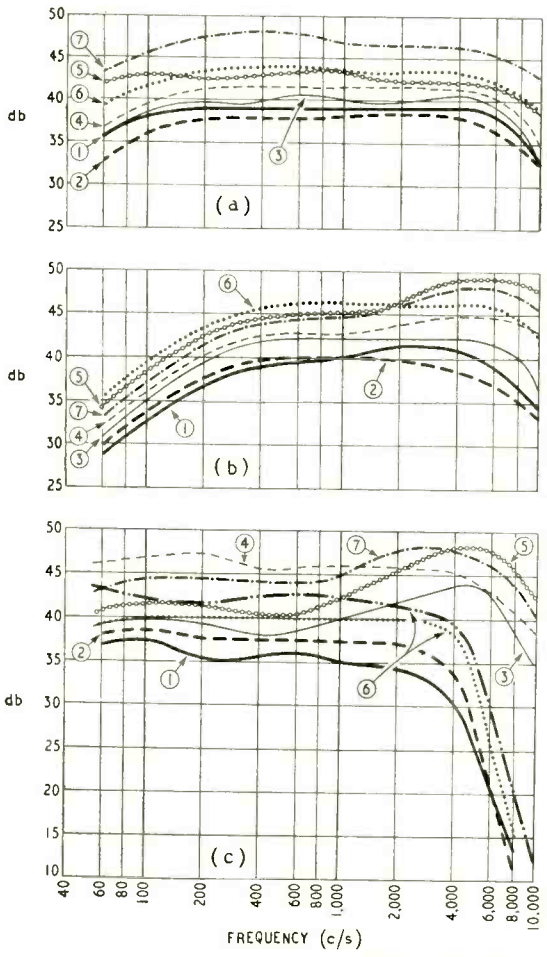
Our sister journal, *Wireless Engineer*, commenting in considerable detail on this matter in the February issue, makes the point that the choice of i.f. decided upon will give only full immunity from interference due to oscillator radiation if transmitter station channels are carefully allocated geographically. With the present uncertain position on Band III, coupled with the shortage of available channels, this is likely to be a problem of some difficulty.

The *Wireless Engineer* editorial also stresses the possibility of interference in both directions between television and f.m. sound receivers. Here prevention lies partly in the proper geographical allocation of transmitting channels and partly in the hands of receiver designers.

Does the Tape Characteristic Matter?

MOST manufacturers of tape recorders specify a given brand of tape for use with their machines. If a tape has a "characteristic" (and there can be no denying that the ratio of coercivity to remanence determines the self-demagnetizing effect and the available induction at high frequencies) this seems a not unreasonable precaution. Other factors affecting the combined performance of tape and machine could be the design of the heads and the degree of penetration of flux into the tape coating.

The results of some measurements of seven brands of tape on three different makes of recorder by Dr. Ing. M. Ulner, of the Technical University of Berlin, published in the Spanish journal *Electronica* (December, 1954) provide a useful starting point for speculation on the relative merits of tapes and machines. In reproducing these curves the machines have been labelled (a) (b) and (c) and the makes of tape are given numbers.



Courtesy *Electronica*

Clearly the different low-frequency responses are qualities of the machines and the high-frequency variations are caused by the tapes. The transposition of some of the curves on a sensitivity basis may be due to differences in the levels of the individual specimens used, but this does not explain the jump of tape 4 from fourth place on machines (a) and (b) to first place on (c) for which, incidentally, it was recommended by the makers.

If the evidence of the group of curves in (a) is to be believed, the machine is dominant and the make of tape of secondary importance. Why then does the performance at high frequencies vary so widely on machine (c), and to a lesser degree on machine (b)? One possibility is that variations of the mechanical properties of the tape (curling, flexibility, etc.) may contribute conflicting modifications of the output in the form of modulation noise and reduced sensitivity, and that these are ironed out in machine (a) by more efficient pressure pads.

Of one thing we can be sure: there is still much to be learned about "the way of a tape in a recorder" and that until more evidence of this kind is presented it is foolhardy to attempt sweeping generalizations. Nevertheless we will step in to the extent of countering the question at the head of this note with the qualification that "it depends on the machine," and of adding a rider to the effect that if a figure of merit is ever evolved it should include the mechanical as well as the magnetic qualities of the tape.

"Hansard" Magnetic Recorder

THE House of Assembly of West Nigeria will shortly have one of the most up-to-date systems for reporting the debates and the proceedings of the legislative body. As the most highly skilled shorthand writer might find it difficult to cope with the various languages and dialects employed, the Crown Agents have decided to install magnetic tape recorders.

Essential requirements of a system for a purpose like this are compactness, reliability, unskilled operation, flexibility and ease of maintenance. Equipment to meet these special needs has been designed and built by E.M.I.

A single console houses all the control equipment and the amplifiers. On the control desk are seven microphone switches positioned on an outline plan of the floor of the House and corresponding to the location of seven fixed microphones. Five spare microphone inputs are also provided to meet future needs.

The control operator, watching through a window of the soundproof room, switches on the appropriate microphone whenever a member of the Assembly rises to speak. Mixing the various microphone outputs and the control of volume are entirely automatic. Each microphone has a separate amplifier and these are mounted in a form of rack, with quick-release fittings for ease of servicing, which is assembled into one of the cubicles of the control console. From this console the speech signals go to 12 headphone sets in the Press gallery, each with a separate volume control, and also to four E.M.I. type TR50 tape recorders in a separate room, and each gives one hour's recording per reel of tape.

More About RADIO TRAINING

Technical Schools : Further Education : Specialization

In this article an official of the Ministry of Education criticizes Francis Reece's contribution "Education and Training" published in our January issue. He also outlines the plans being made to reduce the number of students who do not complete the long telecommunications courses

"CAN we be satisfied with the results achieved by our present method of technical education?" was the question posed by Francis Reece at the end of his article. Whilst there is rightly much cause for concern about the shortage of technical manpower in the radio industry the general picture is not as black as that painted in the article, which, incidentally, included a number of somewhat misleading statements.

General Education.—From the secondary modern schools the radio industry can expect to recruit its unskilled labour, a high proportion of its potential craftsmen and a large number of trainee technicians, but, contrary to Mr. Reece's claim, it will not get "many of its engineers of the future" from this source. It is the exceptional boy from the modern school who will ultimately achieve professional engineer status, through a technical college or a training scheme operated by a firm. The curricula of secondary modern schools are designed primarily for the greatest educational good of the greatest number. This rules out a policy which would make "the General Certificate of Education even in two or three subjects" a general objective for such schools. The question of suitable examinations for those leaving the modern school is being widely discussed, and some schools have instituted an extra year with, in some cases, the G.C.E. as the objective. But these are, in general, schools in large urban areas, recruiting into this final year selected children from a number of schools. This is not a solution having wide application, and the existence of only a small number of such schools is not "a deplorable fact," as Mr. Reece states, but a sober admission of what is reasonable and practicable for the type of child concerned. The best solution of the problem as it affects the radio industry will probably be the wider provision of secondary technical schools—which is proceeding—and a greater use of the mechanism of transfer between the different types of secondary school.

The secondary technical school is underrated by Mr. Reece. Almost all its students may be expected to obtain employment as trainees for skilled technical jobs in industry. Many will become craftsmen; a high proportion will qualify for technicians' posts; and the best—not just the odd one or two, but a good number—should ultimately reach professional engineer standard. On leaving a secondary technical school at 16 a boy may enter directly into the first year of the National Certificate course, whereas the ex-secondary modern school boy has to qualify for entry by taking a one- or two-year course of part-time study. Further, recommended ex-secondary technical school boys who have remained at school for a further year may enter directly into the second year of a National Certificate course, a privilege otherwise reserved for ex-secondary grammar school boys with G.C.E. Ordinary Level passes in four subjects, including mathematics and a relevant science subject.

Although, as Mr. Reece says, figures showing how many grammar school boys enter the engineering profession are not available, one very large engineering concern has given the following analysis of its craft and engineering apprentice entry. From grammar schools, 70 per cent; from technical schools, 17 per cent; from modern schools, 13 per cent. Several major engineering firms are now restricting their intake of engineering apprentices—as distinct from craft apprentices—to ex-grammar and ex-technical school boys.

Further Education.—Entrants to the radio industry may follow part-time courses leading to the various certificates in telecommunications engineering of the City and Guilds of London Institute; or they may aim at the Graduateship of the British Institution of Radio Engineers; or they may attempt the Ordinary National Certificate course in electrical engineering, followed by the Higher National Certificate course. After further study, these last students may satisfy the examination requirements for Associate Membership of the Institution of Electrical Engineers.

The figures quoted by Mr. Reece concerning these examinations are rather misleading. The "30,000 candidates" for City and Guilds Certificates should be "30,000 subject-entries." As most candidates take two or three subjects at each examination, the actual number of candidates concerned is about 12,000. Despite the high rate of failure of overseas candidates, and of those who enter without organized preparation, over 60 per cent of the 30,000 subject-entrants pass. Over three-quarters of these entries are from students taking first- and second-year subjects; and of these about 70 per cent are employees of the General Post Office, seeking to obtain the lowest qualification the G.P.O. expects of them. For many it may possibly be the maximum; for in the third year, the standard rises sharply, with a view to providing a course suitable in standard for those wishing to qualify for higher-grade employment. Many of the City and Guilds candidates taking fourth- and fifth-year subjects are university graduates in physics or electrical engineering who, having entered the radio industry, take a single-subject course as a suitable way of obtaining, fairly quickly, a knowledge of the subject in which they are going to specialize. They do not qualify for Final or Full Technological Certificates. Thus to compare the 88 who obtained a Full Technological Certificate in 1953 (67 in radio) with the 30,000 subject-entries is to ignore the fact that the vast majority of the entrants do not have the Full Technological Certificate as their objective. Indeed, relatively few are concerned with grouped course certificates at all.

Similarly, the 1,000 entries quoted for the Brit.I.R.E. examination refer to individuals taking any

part of the examination, and not to those who are taking the whole examination, or such parts as, if passed, would complete the whole.

Further, both the C. & G. and Brit.I.R.E. examinations suffer from the disadvantage that they may be taken without attendance at specific courses. This inevitably leads to many hopeless entries.

Candidates for National Certificates, on the other hand, must have satisfied specific requirements in respect of attendance, classwork and homework, as well as laboratory work, before being permitted to take the examination. About 50 per cent who take the O.N.C. examination in a given year pass it; the corresponding figure for the H.N.C. is over 70 per cent. Of those at present achieving the Graduateship of the I.E.E. some 40 per cent are university graduates; and only 8 per cent qualify through the Institution's own examination.

Mr. Reece complains that few technical colleges offer Higher National Certificate courses including radio subjects, and quotes the 1950 figure of 20. This number is now 46; and this does not include those colleges providing courses which, although not specifically for radio engineers, have a considerable light current content which has to be taken by all students, whether "light" or "heavy." Also, many colleges offer electronics as an extra, either in the Higher National Certificate year, or subsequently. One cannot help wondering whether Mr. Reece's information on teachers and equipment also relates to 1950.

Reference is made to the alleged reluctance of technical colleges to provide suitable courses for radio trainees. Where a reasonable demand exists, and there is evidence that a "flow" of students can be maintained, principals of technical colleges are invariably willing to provide courses. Because of the importance of radio and electronics to our national economy and to defence, considerable latitude has been permitted to colleges in respect of small classes. In fact, if rigid considerations of economy were insisted upon, many radio and electronics classes up and down the country would be closed.

Degrees of Specialization.—Occasionally one finds that complaints of lack of special provision arise because of the impossibility of arranging in groups of economic size separate classes for those who favour early specialization, as in the City and Guilds courses, and also for those who favour a broader basis of electrical engineering, such as is provided in Ordinary National Certificate (Electrical Engineering) courses, with later specialization. The greater numbers of students are usually those wanting National Certificates; those students preferring early specialization must therefore either rest content with the National Certificate course or make arrangements to go to a neighbouring college where numbers make separate classes possible. All technical colleges cannot be all things to all men.

Mr. Reece asks if the examining bodies demand too high a standard. At one time the only way to professional engineer status was through the university. If the engineers of this country are to retain their international standing it would be unwise to reduce the standard of academic attainment in electrical subjects to below about degree level; and a comparable standard in scientific and mathematical studies is surely essential also. Hence it would appear that the Higher National Certificate course followed by those post-H.N.C. studies necessary to fulfil the I.E.E. requirements is not too high a standard to demand, if the prestige of British radio engineering qualifications is to be maintained.

The Brit.I.R.E. examinations and those of the City and Guilds both involve earlier specialization. Both reach high standards in their specialist subjects, but neither requires the stringent attendance, classwork, homework, and laboratory conditions of the National Certificate course. An examination of the advertisements for engineers in radio journals will show that most firms ask for university degrees; the commonest other qualification specified is the Higher National Certificate. This may, perhaps, indicate that employers value a qualification which implies five years of supervised and directed study more highly than others which, however high their examination standards, do not.

Mr. Reece refers to the "various bodies reconciling their differences of opinions" and suggests that if they did technical colleges would be helped in the arrangement of their courses. The advocates of early specialization, namely, the City and Guilds and the Brit.I.R.E., are sufficiently agreed for it to be possible for common courses leading to both qualifications to be organized, as is done in some colleges. The National Certificate course does not permit of early specialization. The difference here is fundamental, and a compromise appears unlikely—except perhaps in the first year. The question of whether or not early specialization is desirable is one on which opinions may reasonably differ, and it is therefore a good thing that the choice exists.

Future Development.—Although the general picture is rather brighter than Mr. Reece's article would make it appear, there is much cause for concern in the "wastage" which occurs in the courses referred to above. Whilst the examination results are reasonably good, a high proportion of the young entrants do not get as far as attempting the examinations. One reason for this is that the National Certificate and the City and Guilds courses go too far and too fast for some students; and there is as yet no less ambitious alternative. A committee representative of the interests concerned—such as Mr. Reece suggests—has existed for some time and is planning courses specifically for electrical technicians; that is, there will be no attempt to make the first three years equally suitable for both technicians and would-be professional engineers. It is possible that the first year of the technicians' courses will be similar to that of the National Certificate course so that students may progress up whichever ladder seems more appropriate in the light of their initial performance. A measure of specialization may be introduced into the technicians' courses earlier than in N.C. courses.

Another committee, acting in co-operation with the first, is considering the structure of the present City and Guilds telecommunications courses with a view to providing in the earlier years a technicians' course less arduous than the present one, whilst maintaining in later years an adequate selection of specialist and more advanced studies. The existence of these easier courses, less exacting academically than present ones, may help to close a gap in the present system. Transfers between National Certificate and these new courses may be possible at certain levels and this arrangement may do much to reduce the present "wastage." It is not possible to say when the new courses may come into being, for it is more important to get a right solution than a quick one.

WORLD OF WIRELESS

Balance of Trade • Writing Prizes • Television News

Growing Exports

LAST year's direct exports of British radio equipment were valued at over £30M—an increase of more than 12 per cent on the 1953 figure.

Two-fifths of the total (over £12.6M) came from the export of capital goods—transmitters, navigational aids and industrial electronics—an increase of over £1.4M during the year. Incidentally, the direct exports of capital goods in 1946 totalled only one million pounds. The value of last year's indirect exports, such as installations in ships and aircraft built in this country for eventual export, is estimated at £5M.

Exports of components increased from £5.3M to £6.8M, batteries and accumulators for radio from £1,6M to £2.4M and sound recording and reproducing equipment from £2.7M to £3.3M.

The receiver and valve sections of the industry again showed decreases; receivers from £3.9M to £2.6M and valves and c.r. tubes by £80,000 to £2,113,210. There was, moreover, an adverse balance of trade on valves and tubes; imports totalled £3.3M, an increase of over £1.4M during the year. Imports of all radio equipment, components and accessories totalled £7.9M compared with £5M the previous year.

Encouraging Technical Writers

THREE years ago the Radio Industry Council introduced a scheme to award annual premiums of 25 guineas each to encourage the writing for the public technical press of technical articles deserving of commendation by the radio industry. The panel of judges, now headed by Professor H. E. M. Barlow, has commended nine articles published in 1954. For the purpose of the awards some of the articles have been grouped together as they cover similar subjects.

Two premiums are to be shared by J. M. M. Pinkerton, E. J. Kaye, E. H. Lenaerts and G. R. Gibbs for three articles on LEO: Lyons' Electronic Office, which appeared in the July, August and September issues of *Electronic Engineering*. For his *Wireless World* articles on i.f. amplifiers (February and December) H. S. Jewitt receives a premium, as does A. E. Maine for two articles on high-speed magnetic amplifiers in *Electronic Engineering* (May and December). J. F. Field and D. H. Towns receive 25 guineas for their article "A Torquemeter for Testing Gas Turbine Components" (*Electronic Engineering*, November and December), and W. R. Cass and R. M. Hadfield jointly receive a premium for their article "Dip-Soldered Chassis Production" which appeared in *Wireless World* last November.

The premiums will be presented to the authors at a luncheon in London on March 10th.

Our contemporary *Research* is again organizing a "Science in Industry" essay competition to encourage scientists and technologists to take greater interest in the problem of presenting results of research work to the industrialist and the general public. Details of the competition, which is in two parts and includes awards totalling £350, are obtainable from *Research*, 436, Strand, London, W.C.2.

Television Developments

AN order has now been placed by the B.B.C. for the aerial arrays for the new London television station at the Crystal Palace. It will consist of two arrays of four bays each, with a branch feeder system. The complete aerial has 32 dipoles.

There will be two main transmission lines having outer conductors of 5in diameter. Each line will carry the combined outputs from a 15-kW vision transmitter and a 4.5-kW sound transmitter to half the aerial. If one transmitter develops a fault the station will continue to operate at reduced power.

The aerials, transmission lines, transmitters and control and monitoring equipment are being supplied by Marconi's.

Sir George Barnes, speaking at Birmingham recently, said that test transmissions on various colour television systems will be conducted by the B.B.C. this year. It is thought that the system most likely to be finally adopted will be a scaled-down version of the American N.T.S.C. system, such as that demonstrated by Marconi's last year. This uses the existing black-and-white signal with a sub-carrier of 2.66 Mc/s which is modulated by two colour-information signals in phase quadrature, one occupying a bandwidth of 1 Mc/s and the other about 0.4 Mc/s.

European V.H.F. Broadcasting

ACCORDING to figures issued by the European Broadcasting Union there were, in Europe, at the beginning of the year, 69 television stations and 177 sound broadcasting stations operating in Bands I, II and III. The distribution of the stations in the European broadcasting area is given below.

	Television Band I	Television Band III	Sound Band II
Austria	—	—	10
Belgium	2	2	1
Denmark	1	—	2
Finland	—	—	17
France	1	5	1
German Federal Republic	2	23	114
Israel	—	—	7
Italy	2	7	14
Monaco	—	1	—
Morocco	—	2	—
Netherlands	1	1	3
Norway	1	—	1
Saar	1	—	1
Sweden	1	1	1
Switzerland	2	1	1
United Kingdom	12	—	2
Vatican State	—	—	2
	26	43	177

During the last six months of 1953 the number of stations in Bands I, II and II increased by 53, 10 and 30 per cent. respectively.

Components on Show

ADMISSION to this year's Components Show, to be held at Grosvenor House, Park Lane, London, W.1, from April 19th to 21st, is restricted to holders of an official badge, issued only to eligible applicants who have previously filled in an application card.

The exhibition, at which there will be the record number of 142 exhibitors, is intended primarily for engineers and technicians in all the "user" industries and the Services. The list of those eligible for admission covers research and education and the manufacturing, wholesale (not retail) and export sides of the radio and electronic industries.

Application cards can be obtained by written request to the organizers, the Radio and Electronic Component Manufacturers' Federation, 22, Surrey Street, Strand, London, W.C.2.

PERSONALITIES

H.R.H. the Duke of Edinburgh has accepted the invitation of the Institution of Electrical Engineers to become an honorary member. Only once in three years is honorary membership granted to a distinguished person who is not a member of the institution.

Colonel G. W. Raby, C.B.E., M.Brit.I.R.E., has been appointed deputy director (engineering) to the research group of the Atomic Energy Authority at Harwell, of which Sir John Cockcroft is director. In 1941 Col. Raby was attached to the Ministry of Supply and as superintendent engineer assisted in the development of radar. He was later appointed chief superintendent of the Signals Research and Development Establishments at Christchurch and Woolwich.

Dr. A. R. A. Rendall, Ph.D., B.Sc., M.I.E.E., has joined the editorial advisory board of our sister journal *Wireless Engineer* in succession to **P. A. T. Bevan** who was the B.B.C. representative on the board until his appointment as chief engineer of the Independent Television Authority. Dr. Rendall, who joined the B.B.C. Lines Department in 1935, has been head of the Designs Department since 1950. Before joining the B.B.C. he was a development engineer with Standard Telephones and Cables. Other members of the board are Prof. E. B. Moullin (Cambridge University), A. H. Mumford (G.P.O.) and Dr. R. L. Smith-Rose (D.S.I.R).

W A. Turner, B.Sc., M.I.E.E., principal of the school of electronics which the Automatic Telephone and Electric Co. is establishing at Liverpool, has been head of the Electrical Engineering Department, Brighton Technical College, since 1951. He received his technical training with the B.T-H. company. From 1940-43 he was deputy head of the Services Training Department at the Rugby College of Technology and has also been a lecturer at Burnley Municipal College and Northampton Polytechnic, London.

E. N. B. Hammond, engineer-in-charge of the Norwich Home Service transmitter since 1950, is also to be responsible for the new East Anglian television transmitter. The temporary transmitter at Tacolneston, which was brought into service recently, will be replaced by a permanent 5-kW transmitter next year. Mr. Hammond was engineer-in-charge of the Home Service transmitter at Clevedon, near Bristol, from 1943-47, and had previously served as a maintenance engineer at a number of other stations since joining the B.B.C. in 1934.

K. E. Harris, Cossor's director of development, is visiting the U.S.A. at the invitation of the American Air Navigation Development Board and the Airlines Electronic Engineering Committee to discuss airborne navigation and traffic control equipment. His itinerary includes New York, Washington, Indianapolis, Chicago, and—across the Canadian border—Ottawa and Montreal.

R. H. Kelsall, B.Sc.(Eng.), Grad.I.E.E., who joined Metrovick as a college apprentice in 1939 after graduation at Manchester University, has been appointed assistant chief electrical engineer of the company's Electronic Control Department. From 1943 to 1946 he served as an electrical officer in the R.N.V.R. and after completing his training with Metrovick he joined, in 1947, the department of which he now becomes assistant chief electrical engineer.

OUR AUTHORS

O. E. Dzierzynski, contributor of the article on page 141, graduated at Warsaw Polytechnic school and was later in charge of the radio remote control section of the Institute of Telecommunications, Warsaw. He came to this country in 1939 and joined B. I. Callender's Cables condenser factory, after which he became a lecturer in radio servicing at the Polish training centres in Scotland. He has latterly been working with Sargrove Electronics and Grundig as designer of electronic measuring apparatus.

K. O. Beauchamp, who writes on spurious line scan resonances in this issue, has been on the staff of the G.E.C. television laboratory at Coventry since 1947. During the war he was a wireless mechanic in the R.A.F. and on coming out of the Service took the course for the City and Guilds Full Technological Certificate at the Coventry Technical College, where he is now teaching the C. & G. "Radio IV" class in the evenings. He is 31.

OBITUARY

Frank Murphy, who, in 1929, was co-founder with E. J. Power (the present chairman and managing director), of Murphy Radio, died in Toronto on January 26th at the age of 65. In 1936 he severed his association with Murphy Radio, of which he was managing director, and in recent years lived in Canada, where he had a business and did some lecturing. The news of his death was telegraphed to us by P. G. A. H. Voigt, now resident in Canada.

IN BRIEF

Sweden is to erect a network of Decca Navigator stations—a master and three slaves in the usual "star" formation. The stations will be brought into service next year. Six chains—three in this country and one each in France, Germany and Denmark—are already in operation; another is planned for the south of France and yet another to cover the Orkney, Shetland and Faroe area.

Submerged Repeaters for the recently laid Aberdeen-Bergen submarine coaxial cable were built and tested at the new North Woolwich factory of Standard Telephones and Cables. A brief description of them appeared in "Transatlantic Telephone Cable" in our January issue (p. 40).

Standard Sizes for "manufacturers' trade and technical literature" are laid down in B.S.1311:1955 which the British Standards Institution has issued (price 2s 6d). It is designed to facilitate the handling of instruction sheets issued by sub-contractors and suppliers of equipment and also the filing of catalogues, brochures and pamphlets.

Airborne Radar Research.—Pershore Airfield, Worcestershire, has been taken over by the Ministry of Supply for radar research. It will be used by the Radar Research Establishment for the flight testing of radar equipment.

Closed-circuit television demonstrations were provided by British manufacturers during the four-day radio and electrical exhibition held at Kampala, Uganda, at the end of January. It was organized by the recently formed Uganda Radio and Electrical Traders' Association.

Railway Radio.—According to the latest available figures the American railways are operating some 15,000 radio stations—four times as many as were in use four years ago—and nearly 2,000 carrier-telephone installations. Incidentally, the only mention of the use of radio in the British Transport Commission's report on the modernization and re-equipment of this country's railways is an oblique one—"The existing telecommunication and telephone systems must be considerably modernized and advantage taken of all available developments in telecommunications."

University Within Industry.—The five-year sandwich course now provided by the General Electric Co. in conjunction with the Birmingham College of Technology is described in the company's brochure "Professional Training in the G.E.C." as a university within industry. Designed for boys leaving public and grammar schools, it provides alternate six-monthly sessions at college and works with integrated training for an engineering diploma. College fees are met by the company and students receive a subsistence allowance during the course. The brochure, which also outlines training schemes for graduates, is available from the Education and Personnel Services, G.E.C., Magnet House, Kingsway, London, W.C.2.

End-of-the-year figures for sound and television **Receiver Production in Canada,** quoted by a correspondent of the *Financial Times*, show that 22 per cent of Canadian homes have television and 96 per cent sound receivers. With the opening of 19 new television stations, making 24 in all (seven C.B.C. and 17 privately owned) the percentage of television equipped homes doubled during last year. The percentages of homes having refrigerators, telephones and cars are 71, 69 and 55 respectively. Canada's 23 receiver manufacturers produced 612,000 television sets and 450,000 sound receivers last year.

Cumulative Figures for the production and sales of equipment during the nine years of television in the States are given in the 20th semi-annual edition of "Television Factbook." Retail sales of sets are valued at $9,000 M, components and aerials $1,500 M, tube replacements $435 M and valve replacements $518 M. It is estimated that $2,000 M has been spent on television servicing during the nine years. The 33,500,000 sets now being used by American viewers are estimated to represent an aggregate cost of $13,500 M.

Automatic Computing.—A summer school in programme design for automatic digital computors will again be held in the University mathematical laboratory at Cambridge from September 12th to 23rd. A detailed syllabus and form of application for admission may be obtained from G. F. Hickson, secretary of the Board of Extra-mural Studies, Stuart House, Cambridge.

Diversity of interest is the key-note of the 1955 **National Convention** of the American Institute of Radio Engineers, which is being held in New York from March 21st to 24th. Among the subjects to be covered by the 250 papers being presented are instrumentation, telemetering, nucleonics, ultrasonics, industrial and medical electronics, colour and monochrome TV and aerials and propagation.

The **Golden Jubilee** of the Electrical Industries' Benevolent Association will be celebrated at a luncheon in the Connaught Rooms, London, W.C.2, on April 19th. Tickets, price 1 guinea, are obtainable from the E.I.B.A., 32, Old Burlington Street, London, W.1.

R.C.E.E.A. Council.—At the annual general meeting of the Radio Communication and Electronic Engineering Association on January 28th the council was re-elected. The member-firms and, in parentheses, their representatives forming the council, are: B.T-H. (V. M. Roberts), Decca Radar (C. H. T. Johnson), E.M.I. (S. J. Preston), G.E.C. (M. M. Macqueen), Kelvin & Hughes (C. G. White), Marconi's (F. S. Mockford), Metrovick (L. H. J. Phillips), Mullard (T. E. Goldup), Murphy (K. S. Davies), Plessey (P. D. Canning), Redifon (B. St. J. Sadler) and S.T.C. (L. J. I. Nickels). The new chairman and vice-chairman are S. J. Preston and C. H. T. Johnson, respectively.

The **Soviet Union** now has six television stations—Moscow, Leningrad, Kiev, Riga, Kharkov and Omsk—according to *Soviet News*. Transmitters are also being erected at Tallinn, Baku, Tashkent, Minsk and Sverdlovsk. A booster station—the first in the U.S.S.R.—has been brought into operation at Kalinin which receives and re-radiates the Moscow transmissions.

THE LATEST in the series of engravings of "Great Men of Telecommunications" which has been published by the International Telecommunication Union over the past 20 years is this one of Edwin H. Armstrong, the pioneer of frequency modulation. Measuring approximately 6in × 9in the engraving costs 3 Swiss francs and is obtainable from the I.T.U., Palais Wilson, 52, rue des Pâquis, Geneva.

Three experimental v.h.f. stations have been used by the **British Forces' Network** in Germany for some time. Now a chain of ten stations is to be brought into regular service. The first of these were opened on February 1st at Langenberg and Bonn, operating respectively on 89.1 Mc/s and 96.55 Mc/s with effective radiated powers of 60 and 3 kW. The six medium-wave stations operating on 1,214 and 1,367 kc/s at present used for the service will eventually close down.

The television service of the six broadcasting organizations in **Western Germany** are now co-ordinated. Approximately 60 per cent of West Germany's population is within the service areas of the 22 transmitters which are linked by radio.

The production of 21in **Tri-Colour Tubes** at the rate of 100 a day is announced by R.C.A. The price to set manufacturers is $175, the same as that charged for the 15in colour tube.

Instrumentation.—The third British Instrument Industries' Exhibition will be held at Earls Court from June 28th to July 9th. The Scientific Instrument Manufacurers' Association is one of the five organizations sponsoring the exhibition.

Snow-plough Radio.—A plan for four snow-ploughs to be fitted with radio-telephones has been approved by the Inverness-shire County Council. They will operate on the main North Road between Perth and Inverness with the control centre at Dalwhinnie.

TV and Crime.—We learn from our German contemporary *Radio Mentor* that the Dortmund police are conducting experiments with television equipment installed in patrol cars. The transmitter is installed in the police headquarters.

Transistor Bibliography.—A ten-year bibliography of semi-conducting materials and transistors including nearly 1,200 references has been prepared by N. L. Meyrick and G. Roman of the Research Department of Pye, Ltd., Cambridge. A limited number of copies are available from Pye Industrial Electronics, Ltd., of Exning Road, Newmarket, the recently formed subsidiary engaged in the manufacture of transistors.

BUSINESS NOTES

E.M.I. Electronics, Ltd., is the new title adopted by Emitron Television, Ltd. It will be concerned with the design, development and marketing of the E.M.I. group's electronic devices, other than those for the Government, and television equipment, including film scanners, microwave links, transmitting tubes, etc. It will control and co-ordinate the activities of three subsidiary companies—E.M.I. Engineering Development, E.M.I. Factories and E.M.I. Research Laboratories.

Resin Cast Transformers and chokes, which Ferranti have been developing in Edinburgh for some considerable time, have now received a Limited Type Approval Certificate from the Radio Components Standardization Committee. This range of resin cast components, which has been named the Pentland series, is stated to withstand temperatures considerably beyond the range of −40° to 110°C specified by the Services

A new grade of **P.V.C. Compound** is now being used by Associated Technical Manufacturers, Ltd., of Vincent Works, New Islington, Manchester, in the manufacture of Permanoid Grade VO insulated wire and sleeving. Diolplated p.v.c. retains its flexibility and does not suffer from "embrittlement" at temperatures ranging from −35° to 150°C.

Products of **Rothermel, Ltd.,** have been manufactured at the works of N.S.F., Ltd., at Keighley, Yorks, for some time and we learn that it has now been decided to integrate the activities of the two companies under N.S.F., Ltd. The head office of N.S.F. is at 9, Stratford Place, London, W.1 (Tel.: Mayfair 4234).

Extruded P.T.F.E.—Equipment for the extrusion in substantial quantities of p.t.f.e. (polytetrafluorethylene) rod and tube up to 4in external diameter has been installed by Crane Packing, Ltd., of Slough. In addition to the standard grade of p.t.f.e. a special high grade, possessing exceptionally good electrical properties, is available.

Metal Industries, Ltd., Universal House, 60, Buckingham Palace Road, London, S.W.1, are taking over that side of the Rheostatic Company's business relating to the manufacture and sale of unbreakable resistors. **Igranic Electric Company,** a member of the Metal Industries group, will handle the sale of resistances for the group.

Electric and Musical Industries have purchased a controlling interest in Capitol Records Inc., of California, U.S.A.

Three senior members of the staff of the **Armstrong Wireless and Television Company** have been appointed directors—A. Adams, sales manager, T. Nikolin, production manager, and G. Tillett, chief engineer. Before joining Armstrong Mr. Adams was with Masteradio, Mr. Nikolin with E.M.I. and Mr. Tillett with Pye Telecommunications.

Transistorized Telephone.—The noise-cancelling telephone handset illustrated in the note on a transistorized telephone on page 90 of our last issue is manufactured by Lustraphone, Ltd., St. George's Works, Regent's Park Road, London, N.W.1.

Crater Products, Ltd., of The Lye, St. Johns, Woking, Surrey, manufacturers of rotary and other types of switchgear, have introduced a switch mechanism which is operated by a barrel-type key and can be fitted to their existing range of rotary switches.

FOREIGN TRADE

A 5-kW **Redifon** short-wave transmitter installed in Grenada is being used to provide a broadcasting service to the four Windward Islands—Grenada, St. Lucia, St. Vincent and Dominica—strung out over a distance of some 250 miles. H.R.H. Princess Margaret performed the opening ceremony during her Caribbean tour.

In compliance with regulations for the re-organization of maritime radio beacons Portugal is duplicating its existing installations. Eight **Marconi** 20-W m.f. beacon transmitters are to be installed at four lighthouses and the single installations at these points are to be installed at other lighthouses to provide duplicate equipment there also. Designed for automatic working the RB109 beacon has a normal range of up to 75 miles.

Despite the fact that the date of the **St. Erik's Fair** (Stockholm, August 27th to September 11th) clashes with our own National Radio Show the organizers of the British Pavilion at the fair hope that the prospect of a television service starting in Sweden next year will spur manufacturers to exhibit equipment. We understand from the organizers (Thirza West Publicity, Ltd., of 141, New Bond Street, London, W.1) that no British television equipment was shown at last year's fair.

Mobile radio equipment for 50 taxis in Singapore is being supplied by **Marconi's.** The fixed station has a power of 50 W and the mobile sets 3-5 W.

Agencies for British "hi-fi" amplifiers, pickups, loudspeakers and tuners are being sought by two more American firms—Gordon Agencies, 1506 N. Western Avenue, Hollywood, 27, California, and Morris F. Taylor Company, 9431, Georgia Avenue, Silver Spring, Maryland. The latter firm is particularly interested in record changers.

Intelec, S.A., Edificio Industria, Puente Republica, Caracas, who are the **Venezuelan Representatives** for one Canadian and three American firms, are interested in representing U.K. manufacturers of radio communications equipment and radio components. Manufacturers should write direct to the company and are invited to send a copy of their initial correspondence to the British Embassy, Commercial Secretariat, Edificio Titania, Plaza Estrella, San Bernardino, Caracas, Venezuela.

CHANGES OF ADDRESS

A.W.F. Radio Products, Ltd., who manufacture chokes, transformers, loudspeaker diaphragms, etc., have moved to 10, Sackville Street, Bradford, 1 (Tel.: Bradford 24008).

The new London branch sales office of **British Insulated Callender's Cables** is 10-14, White Lion Street, N.1 (Tel.: Terminus 8696).

Radio and Electronic Engineering, of 34, Stoke Abbott Road, Beaminster, Dorset (Tel.: Beaminster 372), has opened new works at Greenham Mills, Crewkerne, Somerset.

Spurious Line Scan Resonances

Common Types and Their Remedies

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

THE output valve used in a line scanning circuit is a non-linear power amplifier operated under pulse conditions and as a result is liable to give rise to several types of unwanted harmonic and resonance oscillations. These will be exhibited as distortion of the picture displayed on the cathode-ray tube screen, usually in the form of vertical striations of varying light intensity.

It is the purpose of this article to show how the different forms of distortion are produced and to summarize the methods that can be applied to reduce or eliminate their effect in modulating the picture information.

When these resonances are due to shock excitation of a tuned circuit the phenomenon is often known as "ringing" and this expression will be often used hereafter as a convenient identifying term.

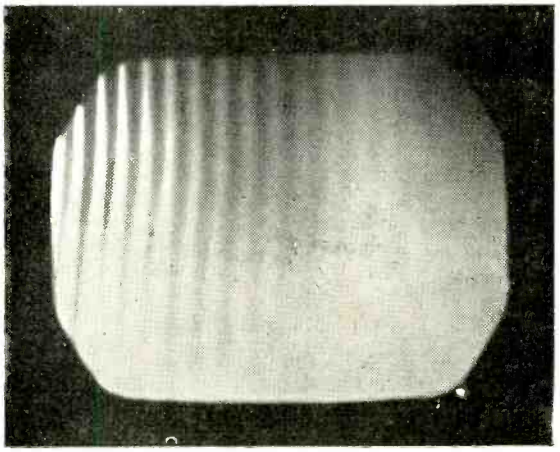
The use of resonant-return or efficiency diode line scanning circuits is now universal in domestic television apparatus and a simplified circuit of the output stage is shown in Fig. 1. Here the leakage inductances and stray capacitances associated with the transformer windings are shown as L_2 C_2, L_3 C_3, etc.

The operation of efficiency diode circuits has been fully described elsewhere[1,2,3] but a brief description of one simple mode of operation is given here in order to make the subsequent explanations intelligible to those not conversant with this type of scanning circuit.

Referring to Fig. 1, we may commence the sequence of events by assuming capacitor C to be charged and the scanning spot to be situated at the screen centre, i.e., zero current in coils L_y.

V1, previously rendered cut-off by a large negative bias applied to its grid, now commences to conduct. The potential at a point 4 will rapidly fall to the low "knee" potential for V1 and that of points 2 and 3 will fall in proportion to the transformer turns ratio. This ratio is so arranged that point 3 falls to a potential slightly in excess of V2 anode potential (h.t. volts) in order to keep the valve non-conductive during this part of the cycle. The constant potential difference between terminals 1 and 2 will cause an increase of current in L_y and the spot will move from the centre to the right-hand side of the screen. This may be termed the first part of the scanning period.

V1 is now cut-off by the negative-going excursion of the controlling grid potential and with both V1



Severe "ringing" of the line scanning circuit.

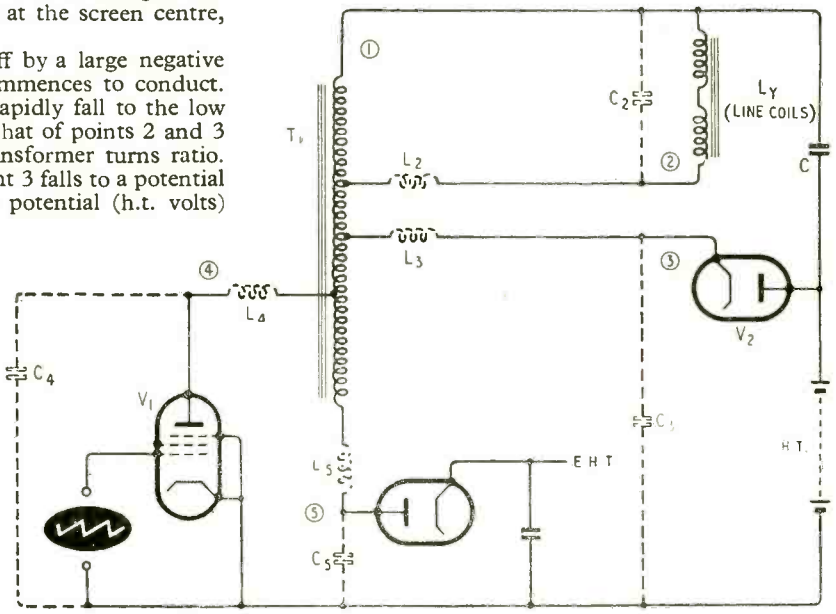


Fig. 1. Line scan output stage and transformer, showing leakage inductances and stray capacitances in broken lines.

* The General Electric Co., Radio and Television Works, Coventry

[1] E. Jones. "Scanning and E.H.T. Circuits for Wide Angle Picture Tubes." *J. Brit I.R.E.*, January, 1952.

[2] O. H. Schade. "Characteristics of High Efficiency Deflection and High Voltage Supply Systems for Kinescopes" *R.C.A. Review*, March, 1950.

[3] W. T. Cocking. "Efficiency Line Scan Circuits." *Wireless World*, August, September, and October, 1951.

and V2 cut-off the oscillatory circuit formed by L_y and C_2 becomes free to resonate at its natural resonant frequency (about 50 kc/s). During this oscillatory period the current in the magnetic system falls to zero, reverses in direction, and builds up to a maximum in the opposite sense, so that the spot travels rapidly to the left-hand side of the screen (the retrace period).

The potential at point 3 now reverses in polarity and V2 commences to conduct. This valve has a low impedance and will hold point 3 constant at about h.t. potential. The constant potential drop across terminals 1-2 will cause a linear decrease of current to take place in L_y, and with proper circuit design this will be of the same slope as the rise of current described earlier. This will cause the spot to complete the scanning cycle by travelling from the extreme left-hand side to the centre of the screen during the second half of the scanning period.

During the conduction period for V2 the boost storage capacitor C will be charged and its potential added to the h.t. supply for V1. This is an important feature enabling operation to be secured from a fairly low value of h.t. potential (180-200 volts).

The scanning circuit in Fig. 1 is capable of oscillation at several resonant frequencies simultaneously. The main magnetic flux around the circuit will resonate, during the retrace period, at a frequency of about 50 kc/s as previously described. Superimposed on this, however, will be smaller oscillations of a much higher frequency which are due to resonances between the leakage inductances and stray capacitances. These may modulate the constant potential required across L_y during the scanning period and so affect the scanning current through it.

E.H.T.-Coil Leakage Inductance

The e.h.t. winding in particular has a large number of turns, and as one of its requirements lies in having a small self-capacitance, it is usually constructed as a narrow wave-wound coil. Consequently, its leakage inductance is large, giving rise to a large storage of energy in L_5 during the retrace period. When V_2 conducts during the second half of the scanning period it should hold the potential of terminal 3 constant to enable a linear rise of current to take place in coils L_y. However, the energy previously stored in L_5 will cause oscillations to take place around the circuit C_5, L_5, L_3, V_2 and an alternating voltage is developed across L_3 which will have the effect of modulating the current in L_y.

In addition, when V1 anode current is cut-off at the commencement of the retrace period the stored energy in L_4 will flow into C_4 and cause oscillation between these two components. Oscillations between L_3 and C_3 are also possible in a similar manner when V2 is cut-off. The leakage reactance L_2 is not important as it forms part of the scanning coils resonant circuit, and will resonate with L_y and C_2 at the main resonant frequency.

As ringing is initiated by the switching action of the two valves some alleviation is possible if both valves are kept conducting during the entire scan period. This can, however, lead to inefficient modes of operation for the scanning circuit and it is better to obviate ringing by other methods.

It has been seen that the leakage inductance L_2 in series with the scanning coils plays no part in producing this velocity modulation of the scanning waveform. Consequently, by increasing the impedance of the line scanning coils until they may be placed across terminals 1-3, the leakage inductances L_2 and L_3 become coincident, and as terminal 3 (now the lower end of scanning coils 2) is held constant by V2 during the first part of the scan, irrespective of modulation of the potential across $L_{2/3}$, then ringing due to this cause is avoided[1]. Unfortunately, the the voltage pulse developed across these higher inductance scanning coils, $L_y \cdot \frac{di}{dt}$ becomes greater, and the coil insulation must be expected to withstand a peak pulse potential of some 3-4kV. Difficulties in designing scanning coils of this nature have led to other solutions to the problem being sought.

From Fig. 1 it is seen that no modulating voltage can be developed across the transformer if L_3 is not present and the diode resistance is reduced to zero during the second half of the scanning cycle, even though the current flowing around the e.h.t. circuit may be quite large. The type of valves now available for V2 have a resistance of about 100Ω during their conduction period and unless special valves with small electrode clearances and large cathodes are used very little improvement upon this figure is possible.

However, by using auto-transformer connection and core materials of low-loss and high permeability[2] high coupling factors of the order $k = 0.998$ are now possible and leakage inductances L_3 and L_4 can be reduced to a minimum. Unfortunately, owing to the other design requirements previously mentioned, it is not possible to obtain such high coupling factors with the e.h.t. overwind, and k figures of 0.88 are often obtained. This leads to a high leakage inductance of the order of 100mH, so that with an auto-transformer design this leakage inductance will be found to be responsible for almost all the ringing experienced with the completed transformer design.

It is necessary, therefore, to investigate alternative methods of ringing suppression which allow this order of leakage inductance for L_5 to be present.

As previously stated the energy stored in L_5 during the retrace period causes a current to flow around the circuit C_5 L_5 L_3 V2 during the first half of the scanning period. If the impedance around this path can be increased then these current ripples will be reduced and hence their effect in modulating the steady potential set up across L_y. It will not be of any use inserting a high impedance between terminal 5 and V3 as this will not lie in the discharge path for the stray C_5.

It can be shown, however, that the e.h.t. winding 4-5 is equivalent to an infinite number of tuned circuits connected in cascade, each possessing a high mutual inductance to its neighbouring coils. If the Q of each elementary tuned circuit is reduced by introducing series resistance, then the overall Q of this winding, and hence the Q of the leakage inductance L_5, will be reduced by the same amount. This effect can be achieved by winding the e.h.t. overwind with resistance (Eureka) wire giving the completed coil a resistance of 5 to 10Ω per turn. The Q factor can in this way be reduced by a factor of 40 to 100, which is sufficient to reduce the ringing to negligible proportions.

Although this method is quite effective it has two attendant disadvantages. First, a certain amount of power is dissipated within the high impedance e.h.t. overwind and this has the effect of reducing the overall

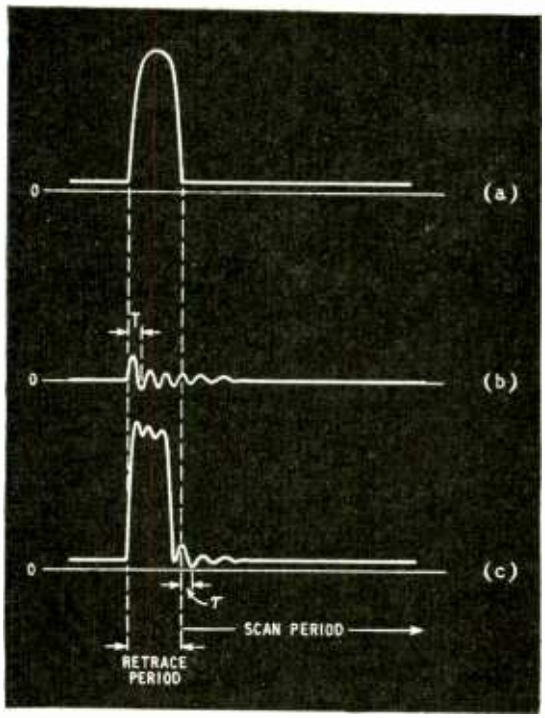


Fig. 2. Voltage waveforms in V1 anode circuit of Fig. 1: (a) potential across V1 anode transformer windings; (b) across leakage inductance L_4; (c) combined potential applied to V1 anode.

Q factor and hence efficiency of the scanning circuit. Secondly, owing to this power dissipation in the form of heat within the winding, the temperature of the coil is increased and may be sufficient to soften or even melt the protective wax covering over this winding.

Another solution to this ringing problem has been described by Telefunken[4] in which a strip of ferromagnetic material is inserted between windings 1-4 and 4-5 in a somewhat similar manner to the electrostatic copper screen often used between primary and secondary of some mains transformers. This screen should not form a complete turn of material as otherwise the shorted turn so formed will absorb a large amount of energy from the circuit. A gap of 1/16in between the two ends may be allowed in order to prevent this. As the added ferromagnetic strip will be situated within a strong magnetic field it will localize the flux near the strip and energy will be required to enable the flux within the material to go through a cycle of magnetization.

This energy is expressed by the well-known formula due to Steimetz:—

Hysteresis power loss $= n.V.f.B^{1.6} \cdot 10^{-7}$ watts.

Where n = hysteresis coefficient and depends on the material used; V = volume of material in cubic centimetres; f = frequency in c/s. B = maximum flux density during the cycle.

Now as n also increases with frequency then the power loss becomes quite large as the frequency is raised, so that the losses at the ringing frequencies 200 to 600 kc/s will be large compared with those at the fundamental resonant frequency. As hysteresis losses can be represented by a series resistance the Q of the leakage inductances can be considered to be decreased at these higher frequencies and thus reduce the magnitude of discharge currents through them. In this way only the energy stored in the leakage inductances is dissipated as heat losses within the added magnetic strip, and as these are relatively small little loss of efficiency is obtained compared with the Eureka-wire method previously described.

The requirements for the magnetic material are bound up with the relative hysteresis losses at the fundamental and ringing frequencies, and a suitable material will be found in the range of nickel-iron alloys such as Radiometal, Rhometal, Permalloy and Mumetal, of which the last named is particularly suitable.

It may be as well to mention at this point that the reduction of resonance in the transformer winding, to a level insufficient to cause velocity modulation of the scanning current, does not mean that such resonances are entirely eliminated. With certain types of receiver layout it may be quite possible for the resonance ripples to be induced in the r.f. circuit wiring or the video lead to the cathode-ray tube from the magnetic field surrounding the transformer windings.

In order to distinguish between ringing caused by this intensity modulation and the more usual velocity modulation, it is only necessary to supply the cathode-ray tube modulation electrode directly with a source of d.c. potential enabling only the last-mentioned type of ringing to be visible on the screen.

Before dealing with other sources of ringing, mention must be made of the high frequency oscillations which are due to the presence of L_4 in series with the V1 anode circuit. As shown in Fig. 2, it is possible for the potential at the anode of V1 to become negative at the commencement of the scanning period, when the resonance of this leakage inductance is taken into account.

It has been shown elsewhere[5] that this may give rise to high frequency oscillations in one of two ways. The valve may behave as a Barkhausen oscillator. This type of v.h.f. oscillation is possible in a triode valve when operated with a positive grid and a negative anode potential. The frequency of oscillation is given by:—

$$f \simeq 10^7 \cdot \frac{\sqrt{V_g}}{d_1 + d_2} \text{ c/s}$$

where V_g = grid potential, and d_1 and d_2 are cathode-grid and anode-grid spacings.

For a typical line output valve the frequency of these oscillations will be found to be very high, and of the order of 1,000 Mc/s, so it is hardly likely that they will cause any visible effect on the picture.

A second type of high frequency oscillation may be generated if the anode voltage of V1 is modulated in such a way that the knee of the I_a-V_a characteristic is passed. The anode current will then contain high order harmonics of the modulation frequency, especially when the anode potential reaches negative values, as is shown in Fig. 2. The maximum frequency of these harmonics will be dependent on the steepness of the flanks of the modulating voltage oscillations and hence on their amplitude. With large values of modulation voltage, τ may easily become 1% of the period T of the leakage inductance resonance,

[4] Brit. Pat. No 710,629. Telefunken, 1952.

[5] G. Diemer. "Interference in Television Pictures." *Wireless Engineer*, June. 1952.

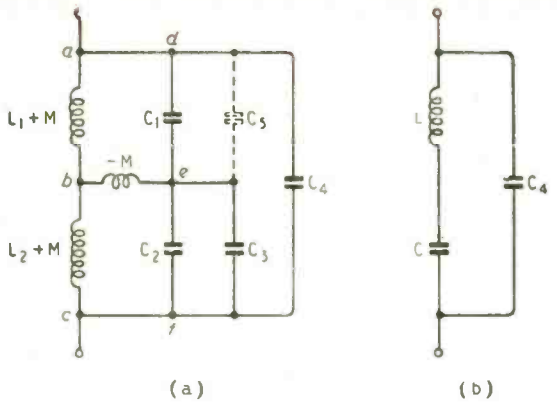


Fig. 3. Equivalent circuits of scanning coils.

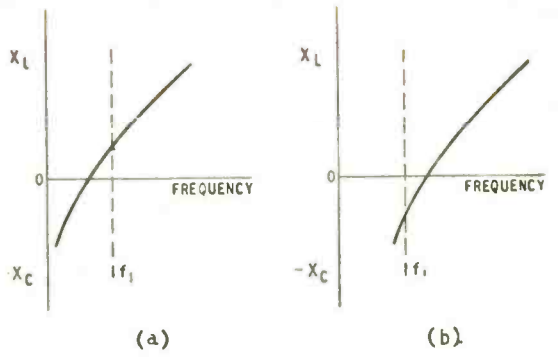


Fig. 4. Reactance sketches for equivalent circuits in Fig. 3: (a) circuit abed and (b) circuit bcfe.

giving rise to oscillations of the order of 50 Mc/s. These may be picked up by the r.f. section of a television receiver and become evident as vertical lines towards the left-hand side of the screen.

This form of interference will, of course, be due to intensity modulation of the cathode-ray tube electron stream as distinct from the velocity modulation of the current flowing in the scanning coils previously described.

High-order harmonics may also arise from the nature of the I_a-V_a characteristic for V1 at low anode potentials. With certain tetrodes it is possible to have a region in this characteristic where the valve behaves as a negative resistance. Dynatron oscillations will be set up with the tuned circuit L_4C_4 representing the anode load, and as the I_a-V_a characteristic is far from linear over this region considerable harmonics may be produced. These can extend into the television bands and give rise to intensity modulation indistinguishable from that described above.

Lower order oscillations can also be responsible for the " ragged edges " of vertical lines seen on the screen, due to modulation of the sawtooth scanning current by these parasitic oscillations. As this distortion will only be present whilst V1 is conducting, it is possible with efficiency-diode arrangements to find this raggedness extending only over the right-hand side of the screen, this being the portion of the scan controlled by the conduction period of V1. The effect can be readily distinguished from that of high voltage corona, which can also cause line raggedness, as with the last-mentioned line the displacement extends over the entire screen area.

Both these types of dynatron oscillations may be avoided by including a resistance, at least equal in value to the negative slope of the I_a-V_a characteristic, in series with the valve anode. A small resistor of about 100 Ω is often included in the anode circuit of V1 for this reason.

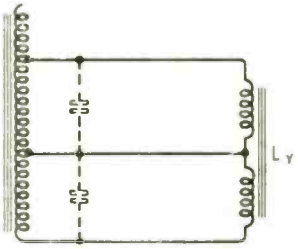
When the various sources of ringing due to the line scanning transformer have been located and either removed or minimized, some velocity modulation of the scan may remain and can be attributed to resonance within the line scanning coils. This form of ringing occurs on the extreme left-hand side of the screen at a frequency of the order of 300-800 kc/s and may be removed by tuning one of the scanning coils as shown in Figs. 7 and 8. A description of the mechanism of this type of resonance has been given by Cocking.[6]

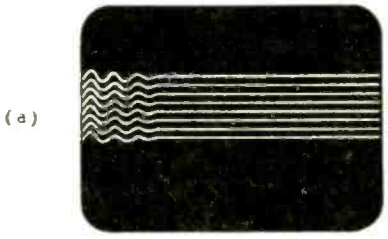
[6] W. T. Cocking. "Simple Line Scan Circuit." *Wireless World*. August, 1952.

Consider the equivalent circuit for the scanning coils shown in Fig. 3(a). Here the leakage inductance for the two coils is shown as M whilst the stray and self capacitances are given by C_1, C_2, C_3 and C_4 respectively.

Reactance curves for the two resonant circuits *a b e d* and *b c f e* are shown in Fig. 4 and at a frequency f_1 one branch of the circuit may behave as an inductance whilst the other will be capacitive, so that the equivalent circuit may be expressed as Fig. 3(b) for this frequency. At this frequency f_1 the series

Fig. 5. Centre-tapped scanning coil connections.





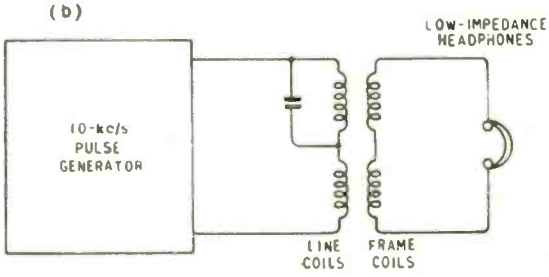


Fig. 6. At (a) is shown the effect of velocity modulation of the frame scanning current waveform, while (b) shows a method of null adjustment for minimum coupling between the line and frame coils.

tuned circuit will resonate and a variable potential will be set up across C_4 and cause the unwanted velocity modulation of the scan.

This effect may be avoided by adding an extra capacitor C_5 (shown dotted in Fig. 3(a)) across the non-earthy coil L_1. This capacitor is adjusted until the resonant frequencies of the two branches of this equivalent circuit are identical and no variation of potential occurs across C_4. In view of the high-potential pulse appearing across the scanning coils during the retrace period, C_5 will have to be designed to withstand peak potentials of up to 2 kV.

Beiser[7] has suggested a further method of obviating this ringing by connecting together the junction of the two series-connected scanning coils to a centre tape of the transformer scanning coil winding (Fig. 5). This method achieves balance by the swamping action of the added transformer capacitances and the improved top to bottom coupling, reflecting more nearly equal capacitances across each half of the scanning coil circuit. However, the electrical centre of the transformer winding is required and this is not easy to determine as the effect of any series coil such as those used for width and linearity tend to unbalance the arrangement. The effect of such unbalance is to introduce a trapezium raster distortion which can be quite serious.

Resonance of the frame scanning coils is also possible when these are magnetically coupled with the line coils. The pulse appearing across the line coils at the end of the scanning period will shock excite the frame coils at their natural resonant frequency and velocity modulation of the frame scanning waveform appears. This takes the form of a "waviness" of the horizontal picture lines at the left-hand side of the screen as shown in Fig. 6(a). To reduce this effect the coupling between line and frame coils may be reduced by orientating the pair of frame coils relative to the line ones, until a minimum voltage is induced in the former from a 10-kc/s pulse generator connected across the line coils (Fig. 6(b)).

This may not always be possible, however, or completely effective, as capacitive coupling will exist between the pairs of coils. An alternative remedy is to damp the individual frame coils with a resistor of the order of 1,000 Ω so as to increase the decrement of this resonant circuit and reduce the amplitude of oscillating potential developed across it. It is necessary to damp each frame coil individually, as a common resistor across the pair of frame coils will leave the leakage inductance relatively undamped (see Fig. 3(a)) and free to resonate.

From the remarks previously made regarding leakage reactances it will be clear that any inductive elements added to the circuit may be shock excited into resonance with their stray and self capacitances, and set up alternating potentials which may modulate the steady potential difference across the scanning coils during the scanning period. Thus the coils incorporated in the complete receiver (see Fig. 7) to provide control over picture width, L_1, and form, L_3, can give rise to resonances at the commencement of the scan.

To reduce this shock excitation of L_1 and L_3 a damping resistor may be connected across the coils. The resistor, by increasing the decrement of the tuned circuit prevents these ocillations from extending into the scan period. However, the value of resistance required sufficiently to reduce the amplitude of ringing will usually be such that an appreciable amount of energy is dissipated within the resistor.

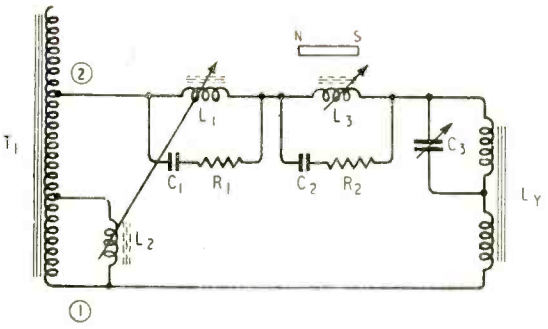


Fig. 7. Width and form controls added to scanning coil circuit.

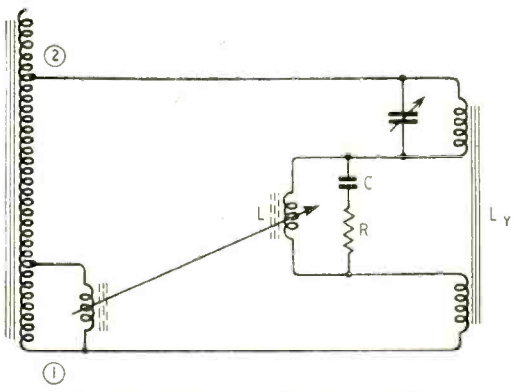


Fig. 8. Alternative position for series width coil.

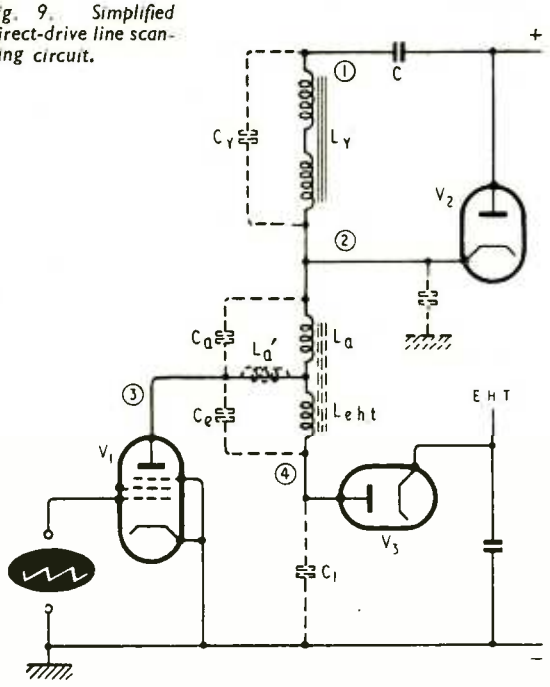
A better arrangement is to shunt L_1 and L_3 by a series combination of C_1R_1 and C_2R_2 as shown in Fig. 7. Such a parallel combination of CR and LR can be made aperiodic or non-resonant if the relationship $L = C.R^2$ is maintained. In practice L_1 and L_3 are usually made variable quantities so that new values of R_1 and R_2 are required for each setting of the width and form controls. As the ringing is usually most objectionable at the maximum inductance setting for L_1 and L_3 it is sufficient to adjust R_1 and R_2 for this condition.

Although an added inductive circuit may be made non-resonant in this way it will behave as a capacitance at certain frequencies of the order of 500 kc/s. This capacitance in series with leakage inductance L_2 (Fig. 1) can form a tuned circuit having this order of resonant frequency. Consequently, ringing of the series-tuned circuit so formed may become possible. A solution to the problem lies in placing the coil, together with its associated CR damping circuit, between the two line scanning coils as shown in Fig. 8. The transformer leakage inductance is now no longer directly associated with the circuit LCR and this source of ringing is obviated.

Recently a type of line scanning circuit has been developed where the transformer of Fig. 1 has been removed and scanning coils of a higher impedance than is usual with a transformer circuit are included directly in the anode circuit of V1. This circuit has become known as the direct-drive system [6, 8, 9] and one form of ringing is possible which is peculiar

[7] L. Beiser. "How to Handle Ringing in Television Design." *Electronics*, May, 1954.

Fig. 9. Simplified direct-drive line scanning circuit.



to this circuit. This occurs towards the end of the first half of the scanning period, i.e., on the *right*-hand side of the picture.

A simplified circuit for this arrangement is shown in Fig. 9, where the stray circuit capacitances and leakage reactance of the coil L_a are shown dotted. It is a condition of normal operation with this circuit hat V2 must remain conductive during the entire can period in order to hold the potential across the scanning coils L_y constant. Should V2 cease to conduct at any point, then as the scanning coils are not magnetically coupled to the inductance L_a in the anode circuit there is noth ng to prevent resonance of either L_y or L_a with their associated shunt capacitances from varying the potential across L_y and hence the scanning current through it.

It will be seen from the circuit diagram that this condition may occur if the potential at terminal 2 exceeds the h.t rail voltage. This may happen through several design maladjustments, one of the most prevalent being an excessive value of inductance for L_a compared with that of L_y, causing too great a portion of energy supplied from the h.t. supply to be stored within it. As this energy becomes greater towards the end of the scanning stroke so the potential across L_a increases in value. This may prevent V2 from conducting and resonance ripples appear towards the right-hand side of the screen.

[8] U.S. Pat. No. 255,931. C. E. Torsch.
[9] E. Jones and K. Martin. "A Direct Drive Scanning Circuit." *J. Television Society*, January/March. 1954.

It is now common practice in commercial television receivers to supply a blanking pulse to the cathode-ray tube such that the beam current is cut off during the period of the frame flyback. This enables the half-line pulses, present in the transmitted waveform during this period, to be placed below black level in the receiver. As a result the user is given some latitude in the setting of the brightness and contrast controls before these objectionable lines appear, and in addition it guards against the effects of variation in the black level as transmitted by the B.B.C.

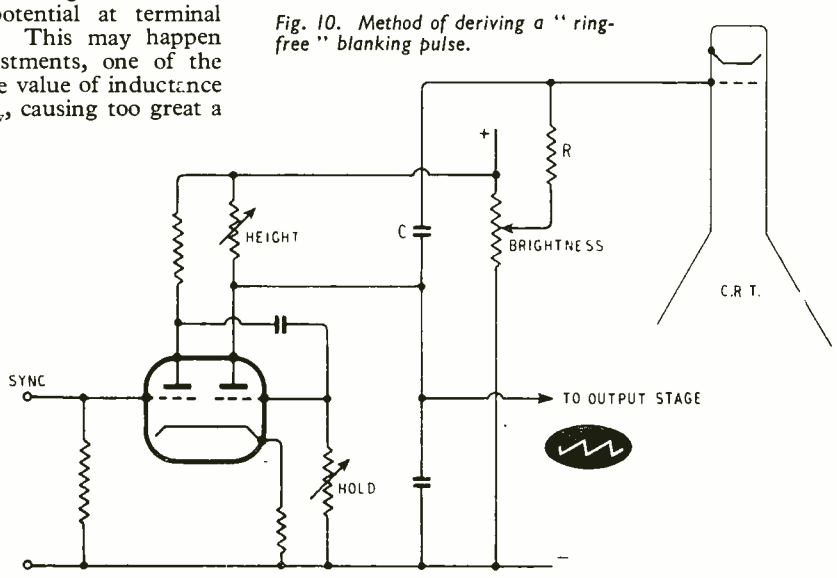
This blanking pulse is usually derived from the frame scanning circuit and, unless care is taken, can give rise during the scan period to intensity modulation of the tube at the electrode controlled for blanking purposes (usually the grid). This is especially true if the negative pulse existing across the frame scanning coils is transferred to the tube grid for this purpose.

The high frequency ringing oscillations present in the line scanning coils are induced in the frame coils by the small coupling existing between them and serve to modulate the intervals between the pulses, resulting in the intensity modulation mentioned above. Although the effect can be mitigated by the connection of a capacitor of about 0.02μF to 0.1μF across the frame coils, this can introduce an undesirable low frequency resonance in the frame scanning waveform.

A better solution is to derive the blanking pulse from the frame oscillator circuit. The sawtooth potential waveform developed by this circuit may be differentiated by a time constant of about 100μsec to produce a suitable negative blanking pulse. A circuit for this is shown in Fig. 10, where the coupling time constant is given as CR.

The preceding summary has shown some of the methods that can be applied to remove the many sources of spurious resonances inherent in modern television receiver design. A small amount of ringing can often be tolerated in a completed design, but when colour television reaches this country very stringent precautions will have to be taken to avoid unwanted velocity modulation. The colour misconvergence due to this cause should have a noticeable if not unpleasing effect!

Fig. 10. Method of deriving a "ring-free" blanking pulse.



Voltage-Multiplying Rectifier Circuits

"CATHODE RAY" Explains How They Work

NOT long ago* I uttered a warning about rectifier circuits always being more difficult than they look, and then proceeded to demonstrate some of the complexities of the very simplest possible rectifier circuit. So now, if I announce as the subject a class of rectifier circuits that even *look* complicated, you may perhaps suspect a very sticky session indeed and promptly remember a more important engagement. But I assure you that their very complication is going to make the lesson easier. The explanation of this paradox is that the full treatment of such circuits would be fit only for that Third Programme of radio journals, the *Wireless Engineer*, so I am bound to keep to the simple outline. In fact, all who already understand even roughly how voltage-multiplying circuits work are advised to turn to something more worthy of their intellectual status and not waste any more time here.

Voltage-multiplying circuits are all built up of the

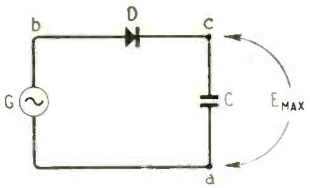


Fig. 1. The basic unit of all voltage-multiplier circuits.

elementary circuit unit shown in Fig. 1. G is the a.c. generator (usually a transformer winding), D a rectifier (which of course may be a diode valve or alternatively copper oxide, selenium, germanium, or what have you) and C a capacitor. We shall assume throughout that G produces voltage of sine waveform, as in Fig. 2(a). And let us also assume at first that there is no load to draw off any power, and that D has zero resistance in one direction and infinite resistance in the other. So what happens is that the first quarter-cycle from G that makes the arrow-head side (or anode) of D positive passes current through it, charging up C as long as the voltage is growing. It charges it up to the peak voltage E_{max}, as shown at the beginning of Fig. 2(b). Directly the G voltage passes its peak it becomes less than the voltage of C, so the cathode of D becomes positive and D ceases to conduct. C is therefore completely isolated, so retains its full charge while G declines to zero and then performs its negative half-cycle. At the peak of its next positive half-cycle its voltage momentarily equals that of C, and D is brought to the point of conduction, but there is no excess of voltage on the G side to do any more charging. If there had been a load resistance across C things would have been different, because C would have been discharging all the time since the last peak, and each successive peak would have had some topping up to do. In practice, too, D would have some forward resistance which would prevent C from receiving its full charge in the first cycle, and several further cycles would be required to finish the job.

We now have a steady positive voltage V_{ac} (reckoning that as the voltage from *a* to *c* so that *c* is positive with with respect to *a*). Obviously we have an equal negative voltage, V_{ca}, if we look from *c* to *a;* Fig. 2(c). And if we add this negative V_{ca} to the alternating voltage V_{ab} the result (Fig. 2(d)) is the voltage V_{cb} from *c* to *b*, that is to say across the rectifier. This voltage alternates from a displaced level, for the steady voltage across C biases the alternating voltage from G by an amount equal to E_{max}, so the peak V_{cb} (called the peak inverse voltage or p.i.v. of the rectifier) is double E_{max}. This is where we begin to see how voltage doubling can be done. Looking from *c* to *b* we have a negative voltage, so of course looking in the opposite direction, Fig. 2(e), it is positive.

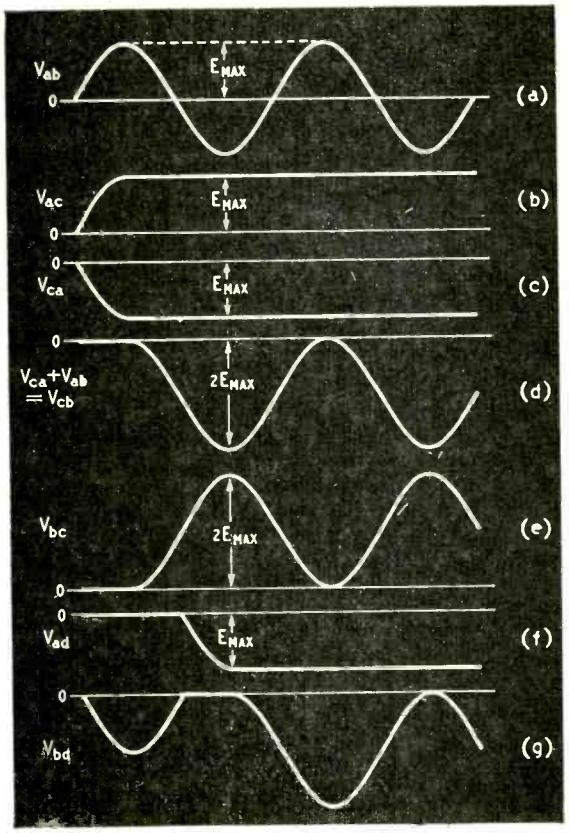


Fig. 2. Starting-up waveforms of the various voltages in Figs. 1 and 3 on no load.

* October and November 1954 issues.

If, as I hope, all this seems almost (or quite) painfully obvious, then there should be no difficulty in seeing how voltage multiplying circuits work. Before going on to these, we just pause to glance back at Fig. 1 and note that the output terminals are *a* and *c*, and the unloaded voltage between them is equal to E_{max}.

First Voltage Doubler

The first composite circuit is probably the commonest of all, being found in the power packs of many receivers and other gear. It is formed from Fig. 1 by adding another rectifier and capacitor, as in Fig. 3. To make it look a little more practical a transformer winding is shown as the generator, but the principle is the same. The important feature is that the second rectifier is connected the other way round so that, relative to *a*, *d* is negative instead of positive. Relative to either *c* or *d* these two voltages add up in series to give a steady voltage equal to twice E_{max}. This is therefore a voltage doubler. The appropriate output terminals are of course *c* and *d*.

It is easy enough to arrive at this explanation by adding together V_{ca} and V_{ad}, the steady voltages across the capacitors. V_{ca} we have in Fig. 2(c), and V_{ad} is the same, so the sum of the two is the same as Fig. 2(c) except that its voltage dimension is $2E_{max}$ instead of E_{max}. It is a universal rule that the voltage between any two points is bound to be the same whatever route is taken, and fatal curiosity may lead one to try to see how the foregoing result could be found by adding V_{bd} to V_{cb}. For both these voltages are very far from steady, yet the sum of the two must be dead smooth if it is (as it must be) the same as $V_{ca} + V_{ad}$. We already have a graph of V_{cb} (Fig. 2(d)), and it might be supposed that V_{bd} was the same and therefore V_{cd} was twice V_{cb}, which certainly has the correct *average* value ($2E_{max}$) but fluctuates violently from zero to $4E_{max}$. Can you see the fallacy? It is in assuming that because V_{ad} is the same as V_{ca}, V_{bd} must be the same as V_{cb}. Even $V_{ad} = V_{ca}$ is not *strictly* true, because during the first quarter-cycle of the generator voltage, when V_{ca} is building up, D_2 is non-conducting, so V_{ad} doesn't start building up until the second half-cycle (Fig. 2(f)). Except at the start, however, the relative phase of the two rectifier circuits makes no difference to these steady voltages; but it is otherwise with the voltages across the rectifiers, and to get at the graph of V_{bd} (Fig. 2(g)) it is necessary to add V_{ba} (Fig. 2(a) *reversed*) to V_{ad}. After the first three-quarters of a cycle needed for it to get under way, it exactly fills up the troughs in V_{cb} (Fig. 2(d)), giving a perfectly steady $2E_{max}$ as we knew it ought.

Many of us find actual typical values more helpful than symbols, so let us suppose that the alternating voltage available is 200, that being of course its r.m.s. value. The peak value is $\sqrt{2}$ (or 1.414) times as great, namely 282 volts. So the steady voltage at the output terminals is 564—getting on for three times the a.c. supply voltage.

A practical point about this circuit is that the cathodes (represented by the plain strokes in the rectifier symbols) have between them the voltage V_{bc}, which has a peak value $2E_{max}$; equal to 564 in the example just considered. If hot-cathode diodes were used, their heater-to-cathode insulation would be quite unable to stand this, so it would be necessary to use separate well-insulated heater voltage windings on the supply transformer. What in this way is awkward for vacuum rectifiers suits metal rectifiers admirably, for (as Fig. 3 shows) they point in the same direction all the way from *d* to *c*, so one "stick" of rectifier disks does for both halves of the system, only a centre-tap needing to be provided for attachment to the h.t winding. Compared with the centre-tapped h.t. winding required in the usual valve full-wave rectifier circuit, this winding is lower-voltage and higher-current, so needs fewer turns of thicker wire, and this is an economy in first cost and is less likely to break down.

But I must stop talking like a salesman and get on with the job. Before passing to the next circuit we had better just see what happens to the so-tar ideal behaviour of Figs. 1 and 3 when they get on with *their* job, which is to supply current. The thing that takes the current—the load—can be represented as a resistance joined to *ca* or *cd* as the case may be. We have seen that with the load disconnected, so that no current is drawn, the capacitors hold their full voltage

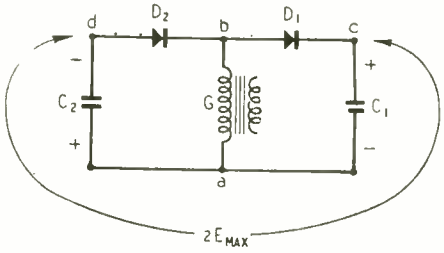


Fig. 3. First kind of voltage doubler circuit, formed by working a second rectifier unit in parallel with the same source.

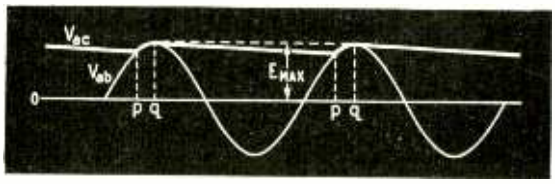


Fig. 4. Fluctuation of output voltage V_{ac} in Fig. 1 when current is drawn from C.

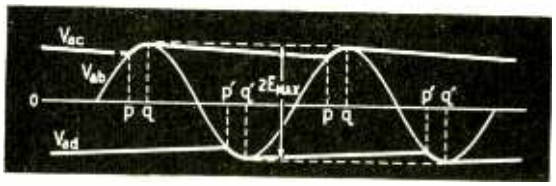


Fig. 5. Corresponding diagram to Fig. 4 for the Fig. 3 voltage doubler, with a as a zero-potential point.

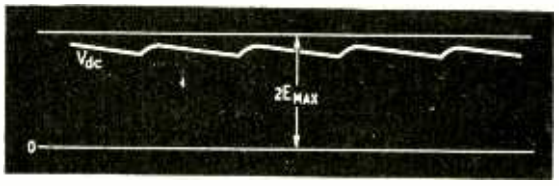


Fig. 6. The total output voltage of Fig. 3, derived from Fig. 5 but reckoned from d instead of a.

constantly, so that after the preliminary charging there is no call for G to provide any current. But that if a load resistance exists across C in Fig. 1 its voltage falls until the supply voltage meets up with it and carries it to the peak once more. This is seen more clearly when input and output voltages, V_{ab} and V_{ac}, are graphed together, as in Fig. 4, which I hope explains itself. The capacitor C supplies current almost steadily all the time, whereas current can flow from the source to replenish it only during the periods p to q, the whole process being closely analogous to the maintenance of a continuous supply of wind in playing the bagpipes. C is the bag, the load resistance is the pipes, and G is the intermittently breathing Scot. (If you didn't know before you now know how bagpipes work).

On our assumption that the rectifiers have no forward resistance, q coincides with the peak of V_{ab}, but in practice, owing to rectifier resistance, V_{ac} lags a little below V_{ab} and input current continues to flow a little beyond the peak. The heavier the load (i.e., the less the load resistance, so that the more current is taken) the faster V_{ac} falls and the sooner p occurs in the cycle. Usually we don't want V_{ac} to fall very much —not only does it mean reduced output volts, but more unsteadiness of output to be smoothed out—which means that p to q must be only a small fraction of a whole cycle, and in that fraction the input has to supply enough current to keep the output going all the time. As we saw in the November issue, this means that the peak value of current through the rectifiers is many times greater than the load current (so make sure the rectifiers can carry it without premature decease!) and the r.m.s. value is several times greater (so make sure the h.t. winding can carry it without overheating!).

All this, in relation to Fig. 1, is old stuff. Having refreshed our memories on it we can next see what happens to Fig. 3 in the same circumstances. Since D_1 and D_2 work on opposite voltage peaks, it is easy to adapt Fig. 4 to the voltage-doubler simply by chalking in V_{ad} on the lower half, as in Fig. 5. The output voltage, V_{dc}, is represented by the vertical distance between the V_{ad} and V_{ac} graphs. This would be very appropriate if the circuit were being used to supply equal positive and negative voltages, with a as the earthed point; but more likely d is the earthed point, so to show more clearly what one is getting from this arrangement V_{dc} in Fig. 5 has been redrawn in Fig. 6 with d at zero. Compared with the half-wave system, the voltage falls twice as fast between peaks, but the frequency is twice as great, so the ripple voltage (for equal current) is the same. Since the output voltage is doubled, the percentage ripple is halved; and with its higher frequency it is easier to smooth. Note that although (with our perfect rectifiers) the output voltage in the half-wave system reached E_{max} once every cycle, the full-wave doubler never reaches $2E_{max}$.

Second Voltage Doubler

This kind of voltage doubler, although it is very good in itself, is something of a blind-alley—it cannot be developed to give greater voltage multiplication. But there is a voltage doubler that can. Fig. 7 shows the basic circuit.

My impression is that some who have no difficulty in seeing how the first doubler works find this second one a little obscure. Perhaps the capacitor C_1 in series with the whole issue looks not quite right. One wonders how the d.c. can flow. The circuits

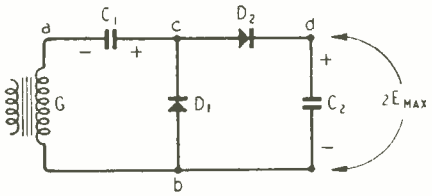


Fig. 7. Second type of voltage doubler circuit, formed by adding another rectifier unit to D_1 as generator instead of G.

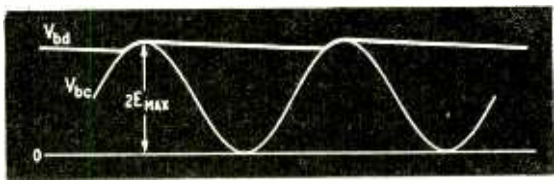


Fig. 8. Corresponding diagram to Fig. 4 for the Fig. 7 voltage doubler under load, but making the rather unjustifiable assumption that the V_{bc} waveform is the same as under no load.

we have seen so far would work after a fashion if the capacitors were entirely removed, but obviously this one couldn't. However, the first half of the system, consisting of G, D_1 and C_1, is absolutely identical with Fig. 1, and as we have studied that at length and drawn every possible voltage graph both ways up it oughtn't to hinder us now. The basic difference between the two doublers is that in Fig. 3 a second rectifier is simply added to the first, run in parallel off the same supply in such a way that the two outputs are series-assisting. They could quite well be used independently. Whereas in Fig. 7 the first rectifier doesn't contribute directly to the output at all, but only through the second. Its role is to double the peak voltage for the second.

That is why the voltage across D_1 (V_{bc}) rather than that across C_1 (V_{ac}) is used. Both contain the rectified component, equal to E_{max}; in V_{ac} it is pure, or nearly so, ready for use; in V_{bc} it is required not for direct use but to bias the alternating voltage so that the peak voltage in the direction that D_2 can use is double E_{max}—see Fig. 2(e) again. This much of the circuit takes the place of G in Fig. 1; the rest is identical, save for the doubled input peak voltage, giving doubled output. Note, as another practical point, that D_1 and D_2 can consist of a single centre-tapped stick.

We hardly need bother to draw any voltage graphs, but just to prevent any complaints of short measure Fig. 8 repeats Fig. 2(e), and then shows how V_{bd}, the output, is derived from it. To save it from complete fatuity, some load current is assumed. And that is perhaps where we may come a little unstuck. Our V_{bc} graph is one that was constructed on the assumption of no load, but obviously if the output stage (as we may aptly call it) is loaded the doubling stage must also feel this load somehow. But the loading effect differs in two respects from that experienced by Fig. 1 when a resistance is connected across C: instead of being a continuous load, it is concentrated entirely in the portion of cycle when D_2 conducts; and instead of being across C_1 it is across D_1. Perhaps you are beginning to see how we could easily get bogged down if we allowed ourselves to become involved in the

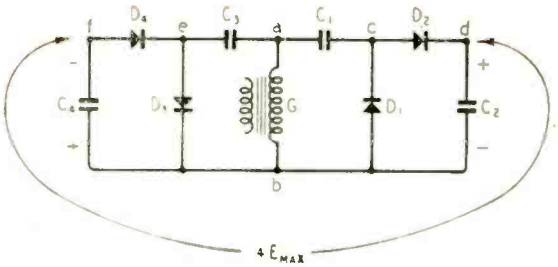


Fig. 9. Voltage quadrupler, combining the Fig. 7 and Fig. 3 techniques.

details of this type of circuit. Roughly, what is happening is that a partly discharged capacitor (C_2) is connected across D_1 every time the voltage there is near its peak. That is the middle of the time when D_1 is not conducting, so during this part of the process D_1 can be ignored. The current required to replenish C_2 must come straight from C_1 and unless its capacitance is large compared with that of C_2 its voltage will fall so much that it will be unable to raise the output voltage anywhere near $2E_{max}$. So even the peak output voltage is bound to be less than $2E_{max}$, and then there is the drop due to the discharge of C_2. Without going into involved calculations we can see that unless C_1 and C_2—especially C_1—are quite large the output voltage of this type of doubler is likely to fall rather badly as current is drawn from it.

Higher Multiplication

If we did go into those calculations we wouldn't leave time for the higher multipliers, but having seen how Fig. 7 works by considering each half separately and then putting them together let us just see if we can follow it as a whole. During the half-cycle when G makes *a* negative with respect to *b* it charges up C_1 through D_1, making *c* positive with respect to *a* (and therefore the same potential as *b*, which is natural when D_1 is conducting). The opposite half-cycle swings *a* $2E_{max}$ volts more positive than it was ($-E_{max}$) and because of C_1 *c* also becomes $2E_{max}$ volts more positive than *it* was (0 volts), charging C_2 up to that voltage, for use by the load. But the heavy current required to do this discharges C_1 to a lower voltage, so that when G swings back to its negative peak the potential of *c* becomes more negative than that of *b* and current flows through D_1 to restore the charge on C_1. And so on.

If you find this comprehensive view of Fig. 7 muddling (a working mechanical model would make it so much clearer) forget it and go back to the two-step method of looking at it, for the multiple-stage circuits will be much more muddling to visualize as wholes but just as easy step by step.

Before adding more stages to Fig. 7, however, let us note that it lends itself to Fig. 3 treatment to convert it into a voltage tripler or quadrupler. For the tripler, a third rectifier and capacitor can be run in parallel off G, in exactly the same way as Fig. 1 was developed into Fig. 3. The E_{max} output thus created is in series with the $2E_{max}$ output we already have. And instead of adding just a single stage we can add a second doubler stage of the kind we have in Fig. 7, giving an output (on no load) of $4E_{max}$ volts (e.g., 1,128 volts from our 200 r.m.s.) between *f* and *d* in Fig. 9.

Next, the two-stage Fig. 7 can be extended to more stages. In Fig. 7 we used the voltage across D_1 to drive D_2 and C_2, because its peak value is double that provided by G alone. What about the voltage across D_2?. It is not, as one might suppose without thinking, double that across D_1. The voltage provided by G alone, although it gives a peak consisting of only E_{max}, swings from $+E_{max}$ to $-E_{max}$, so has a total swing of $2E_{max}$. It is this, when biased by C_1, that gives a $2E_{max}$ peak across D_2 which is used to charge C_2 to $2E_{max}$. This voltage doesn't swing back to $-2E_{max}$ but only to 0, so its total swing, developed across D_2, is no greater than that of G. However, it can be used to charge another capacitor up to $2E_{max}$, as in Fig. 10. Unfortunately, the only way it can be arranged to do this (the way in which D_2 and C_2 were arranged relative to D_1 and C_1) puts the output (across C_3) not only not directly joining on to the previous output but in the wrong polarity, so is not particularly useful. But if we press on regardless and add yet another unit (Fig. 11) we find this comes right and gives us a total nominal output of $4E_{max}$. A third pair of units can be stuck on to D_1, just as the second was stuck on to D_2, raising the total output to $6E_{max}$; and so on. Of course the output voltage goes down directly any current is taken, and if we guess that it will go down a lot if much current is taken and the capacitances are not correspondingly large, we shall not be wrong.

The Fig. 11 quadrupler circuit is an alternative to Fig. 9. Note that the same components are used in both (one rectifier and capacitor for each E_{max} in the output); only their arrangement differs. If

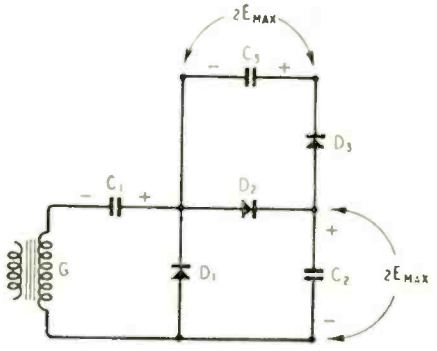


Fig. 10. First stage in the extension of the Fig. 7 technique to higher voltages on its own.

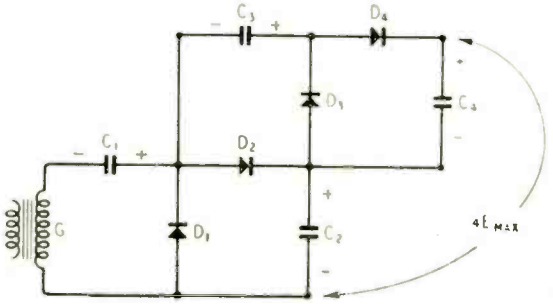
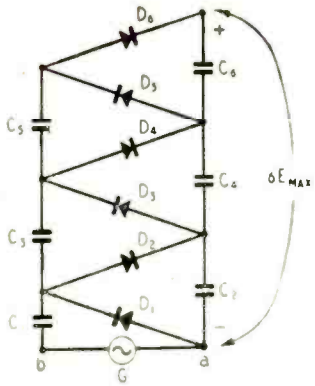
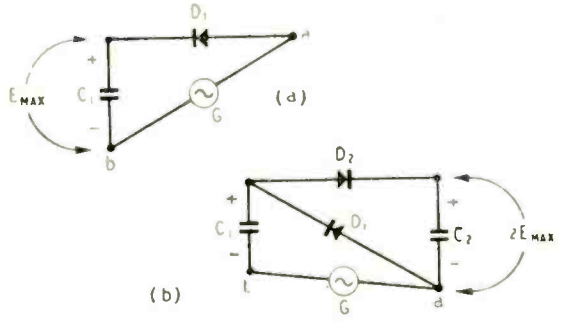


Fig. 11. Second stage in the extension of Fig. 7, completing the second kind of voltage quadrupler.

Right : Fig. 12. A voltage sextupler of the same type as Fig. 11, but in a neater style of circuit drawing.



Below : Fig. 13. The first two half cycles of operation of a "working model" based on Fig. 12.



one wants the h.t. winding to be at one end of the output, then Fig. 11 is the choice; otherwise I should vote for Fig. 9, at least if substantial current is to be drawn. For either I would use metal or crystal rectifiers, for obvious reasons.

I have drawn Fig. 11 in such a way as to bring out how the second pair of units is identical with the first, except only for using the $2E_{max}$ swing across D_2 as source instead of the total swing of $2E_{max}$ supplied by G. But it is certainly not the neatest layout; the circuit can be more tidily drawn in the form of a vertical ladder, such as Fig. 12, which shows a sextupler (I hope that is the right word!). An advantage of this form is that it can be used as a sort of working model that helps one to visualize the voltage stepping-up action, which otherwise is apt to seem rather an improbable trick like lifting oneself by one's shoe laces.

The idea is that distance upward is voltage positive. Point *a* is fixed, to represent zero potential. The length of each link containing a C represents the voltage to which it is charged, so, as it is drawn, the diagram represents the system giving its full $6E_{max}$ across the output terminals, every C being charged to $2E_{max}$, except C_1, which is charged to E_{max}. Current can flow through the rectifiers only in the direction of their arrow head, and as it can only flow to a lower potential (unless driven upwards by an e.m.f.) it can only flow through the rectifiers when the arrow heads are not pointing along an upward slope. In the positions shown their "doors" are all closed.

The e.m.f. of the generator is represented by the link hinging on *a*, so that *b* moves up and down a distance representing $+E_{max}$ and $-E_{max}$ respectively. At the start, all the capacitors are uncharged, so the whole structure is "deflated", with all the D links lying flat on the ground on top of G. Let us start G off on a negative half-cycle. Point *b* goes down, which starts to make D_1 tilt downwards; but directly it does current "falls" from *a* into C_1, charging it, until at the negative peak the model looks like Fig. 13(a). (As we have assumed the rectifiers to have zero forward resistance, their downward tilt when passing current is imperceptible.) Next, *b* starts pushing C_1 upwards, and this closes D_1 so C_1 cannot discharge through it, but by pushing the left-hand end of D_2 up it partially discharges through it into C_2, which thereby holds up the right-hand end of D_2 (Fig. 13(b)). During the next downward swing, C_2 partially discharges through D_3 into C_3, and C_1 is filled up again to E_{max} by G so that on the next upward swing, while C_3 is putting something into C_4, it can raise C_2 nearer $2E_{max}$. And so the ladder gradually rises, stroke by stroke, until it reaches virtually the $6E_{max}$ shown in Fig. 12. The practical limit to the voltage that can be developed in this way is chiefly the size of the capacitors, especially C_1, which bears the brunt of the work. For a given load current and resulting terminal voltage drop, reckoned as a percentage of the theoretical no-load output voltage, the required capacitance goes up as the square of the number of pairs of rectifiers.

In modified form, a sextupler like this was developed by the Westinghouse Brake & Signal Co. for providing the e.h.t. for television sets from the ordinary valve power-unit transformer. It was described fully in the May 1948 issue of *Wireless World*. Incidentally, this firm made a very cunning mechanical model to demonstrate its action—some of you may have seen it at an exhibition—with the rectifiers represented by little one-way swing doors, through which steel balls (representing current) are caused to climb up the sloping "ladder" against gravity by rocking the structure from side to side to represent the alternating e.m.f. The original idea of this kind of voltage multipler is due to Cockcroft and Walton, who invented it to produce 800,000 volts for their atomic research.

STANDARD FOR RESISTANCE WIRE

A WAR emergency standard (BS1117) was prepared in 1943 to meet the requirements for fine resistance wires with considerably closer tolerances than those prescribed in BS115, which deals in general with metallic resistance materials for electrical purposes. A revision of BS1117 has now been issued by the British Standards Institution; it covers wires of from 0.0005 to 0.012 inches in diameter and embraces four classes of metallic resistance materials based on the requirements of temperature coefficient of resistance, working temperature and non-tarnishing characteristics.

Maximum values for the temperature coefficient of resistance over given temperature ranges are specified for each of the four classes of resistance materials.

The standard does not include resistance tables but does lay down the tolerances of resistivity, resistance and uniformity of resistance. "Fine Resistance Wire for Telecommunication and Similar Purposes" (BS1117 : 1955) is obtainable from the British Standards Institution, 2, Park Street, London, W.1, price 2s.

I.T.A. Transmitters

PROBLEMS OF SITING

FOR some time it has been tacitly assumed that the Independent Television Authority's Band-III television stations will be sited with the B.B.C. Band-I stations and even that its aerials will be carried by the existing B.B.C. masts. At first sight, this seems to be obviously the correct thing to do. The B.B.C., as the first in the field, has, presumably, chosen the best sites, and only if the alternative programmes are radiated from the same place is the simplest form of receiving-aerial installation practicable.

The obvious thing is not always the right thing, however, and when one examines the matter in detail it becomes plain that the use of a common site is by no means always desirable. The conditions differ so much between Bands I and III that what is a good site for one may be a bad one for the other.

As pointed out in the June 1954, *Wireless World* (p. 255), there is one definite advantage from the receiving point of view in having co-sited transmitters. At every receiver both aerials will point in the same direction and so all the aerial assemblies for a particular area can be the same, while there are some, perhaps small, possibilities of simplifying aerial construction. It may, for example, be possible to design combined aerials in which parts of the one function as certain parts of the other.

Considerable importance must be attached to anything which simplifies and cheapens the receiving side, whether it be in the aerial or in the receiver itself, because the number of receivers is so great that the total cost involved can be enormous. There are now roughly 4 million receivers in use. If only one-half are converted to Band-III operation, a saving of only 10s per aerial means a total saving to the viewing public of £1,000,000. One can do quite a lot on the transmitting side with a million pounds, but not everything.

If one makes the reasonable assumption that the use of co-sited transmitters will cheapen the receiving aerial then, from the national point of view, it may be economical to adopt such stations. This is in spite of the possibility that such transmitters may, in themselves, be more costly. Therefore, one does naturally start to consider the problems involved in the siting of the I.T.A. stations with a strong bias in favour of co-siting.

Power v. Aerial Gain

What is there against co-siting? Actually, there are a number of things which are inter-related in rather a complex way, so that it is not so easy to present as clear-cut a case against co-siting as it is for it. Nevertheless, there is quite a good case.

Most present-day Band-I transmitters have an output of 50 kW and an effective radiated power (e.r.p.) of 120 kW, which means a transmitting aerial gain of 3.8 db. On Band III, however, it is not yet practicable to build a television transmitter of more than about 10-kW output. Obtaining an e.r.p. of 120 kW on Band III thus entails using an aerial system of 10.8-db gain. Such an aerial system is, in fact, quite practicable but requires a 16-tier array, so that its physical size and weight would almost certainly be considerably more than that of the existing low-gain Band-I type of aerial.

The existing B.B.C. masts are designed to carry only the present low-gain Band-I aerials and the Band-II sound-broadcasting aerials. It seems to be accepted that they are capable of carrying, in addition, a low-gain Band-III aerial. Contrary to the view expressed in the June *Wireless World*, however, it is most unlikely that they could safely carry the load of a Band-III aerial of the high gain that now seems necessary, or that room could be found for the many elements which it would need.

If, in fact, they will not, there is no possibility of a Band-III station radiating the same effective power as a Band-I station until such time as a much higher power Band-III transmitter can be developed. This is not a thing which can be done quickly and is likely to prove more expensive than a low-power transmitter with a high-gain aerial. It seems, therefore, that the only way in which a high e.r.p. can be obtained at present is with the aid of a high-gain aerial, but this cannot be supported by the existing Band-I masts. A Band-III aerial thus needs a separate mast and such a mast could hardly be erected on an existing site without serious interaction effects. It would seem, therefore, that if the e.r.p. is to be the same on Band III as it is on Band I the use of common sites for the transmitters is impracticable.

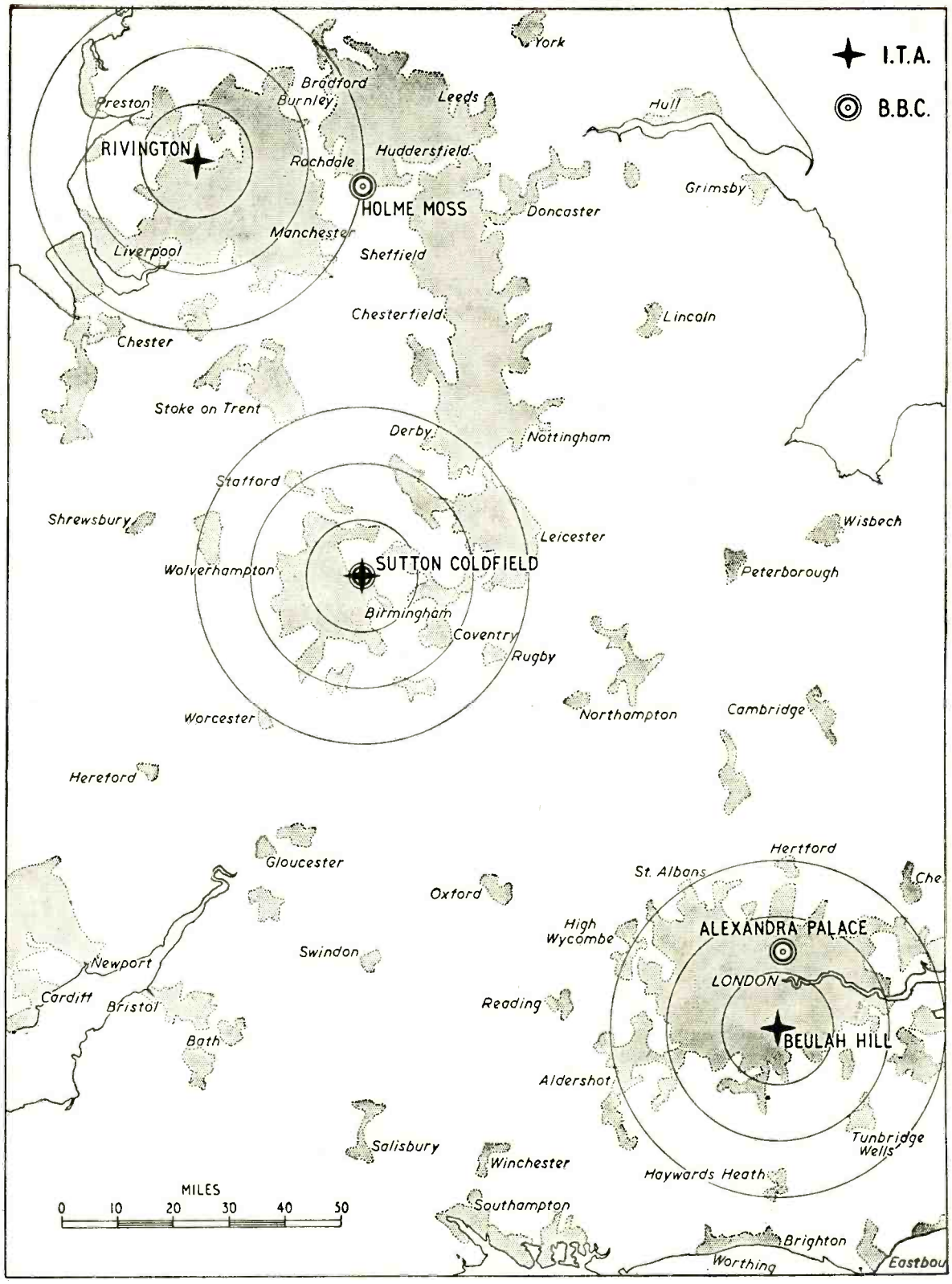
Even if the same e.r.p. could be used on the same site, the coverage of the two stations would not be the same, for the propagation conditions are different. Here we are on distinctly uncertain ground, for so little is known about propagation conditions on 200 Mc/s in this country in so far as they affect broadcasting. It is generally considered that the attenuation will be greater than on Band I, especially in built-up areas, and that much more trouble from reflections and blind spots will occur.

Receivers are unlikely to have such a high signal/noise ratio on Band III as on Band I and the aerial rods are much shorter so that the pick-up for a given field strength is less.

Of course, some of this difference can be made up at the receiving end, for it will be practicable to use higher-gain aerials on Band III than on Band I. Such aerials will inevitably cost a good deal more than a simple H or X type, however, and while they will certainly have their place, they may well be too costly for general use.

It seems certain that, for an equivalent performance, Band III will need a much higher field strength than Band I. This obviously entails a higher e.r.p. from the transmitter and, at the present time, it looks hard enough to provide even the same e.r.p.

It is, therefore, as nearly certain as anything can be, that the service area of a Band-III transmitter



This map shows some of the suggested sites for I.T.A. television stations; also B.B.C. main Band-I stations in the area. Circles 10 miles apart have been drawn around the I.T.A. stations as an indication of scale. Densely populated areas are shown shaded.

must at present be a good deal smaller than that of a Band-I station. If the I.T.A. decides that it is desirable for its transmissions to be receivable over the same area as the B.B.C. ones, therefore, it may be necessary to use more transmitters to do it.

In the initial stages of Band-III operation, at least, the important thing is to cover the most densely populated areas and it may well be possible to do this adequately from a Band-I site if an existing Band-I station is within, or on the edge of, a densely-populated area like London or Birmingham. It may then be quite satisfactory to adopt co-siting. In such cases, the Band-I signal usually extends with adequate strength well beyond the densely-populated area, and the weaker Band-III signal may cover this quite well and fail only in the relatively unimportant outside area. Although the service area of the Band-III station may be much smaller than that of Band I, it may still give a useful signal to the bulk of the population.

Matters may be very different where the Band-I station is situated in a sparsely-populated district. Holme Moss is a case in point. It is situated on the moors and serves the populated areas of Lancashire and Yorkshire which form, very roughly, a ring around the transmitter. The centre of the ring adjacent to the transmitter contains few people, and this area of high field strength is largely wasted. However, since an adequate field is maintained in the surrounding ring, it forms the most economical way of covering the populated area.

It would be very different if a co-sited Band-III transmitter were to be installed, however. Because of the reduced service area, it might well happen that the outer populated ring would not get an adequate signal and that the bulk of the useful field was wasted on the moorland centre.

Northern Area

There is a distinct possibility, if not a probability, therefore, that co-siting may be quite wrong in the case of a site like Holme Moss, but that it may be satisfactory or desirable for London and Sutton Coldfield. It does seem that one cannot enunciate, as a general principle, that co-siting is inherently good or bad; each case must be considered on its merits.

To return to the Holme Moss example, what is the alternative to co-siting? It is fairly plain that no single Band-III station can hope to cover the bulk of the population which falls in the Band-I service area. To get a good coverage, a Band-III station must be sited close to an area of dense population and it looks as though two Band-III stations, one in Lancashire and one in Yorkshire, will be needed. Even two such stations are unlikely to provide such a great coverage as that of the Holme Moss Band-I transmitter, but they would probably serve the greater part of the population.

Recent Press reports show that the I.T.A. is, in fact, thinking on these lines. It seems probable that the London and Midland stations will be at, or near, Crystal Palace and Sutton Coldfield, although little has been said to indicate whether or not the aerials will be on the B.B.C. masts. The one at Crystal Palace has not yet been erected, of course, and the I.T.A. station which is expected to open in the autumn will be only a temporary one at Beulah Hill. For the Northern area, a station at Rivington in Lancashire has been suggested, to be followed by a Yorkshire one.

If anything like full coverage of the country on Band III is considered necessary, it seems clear that it is impossible to carry it out without using more transmitters than are necessary for Band I. At present, I.T.A. has only two channels allocated, as compared with the five on Band I of the B.B.C. If more transmitters are needed, some further channels will obviously be required.

The whole matter of Band-III television is beset with difficulties and not the least of these is the time factor. Political and advertising circles press for everything quickly, without much regard for hard technical and economic facts. The choice of a suitable site takes months rather than weeks, for testing with a mobile transmitter is not a quick business. When a site has been found, its acquisition may take some months, even if it is possible at all, in these days of Town and Country Planning, etc. Not until all matters of this kind have been completed is it possible to start building and providing drainage, water and electricity supplies. Transmitters, masts and aerials all have to be designed and constructed.

One point in favour of co-siting is that it does reduce the time required in that the site is an existing one. It does not necessarily save the building time, however, for the existing buildings, water and electricity supplies may not be sufficient.

The great danger for Band-III television is that the I.T.A. will be pushed into moving too quickly and, in order to get some transmitters operating, will make too great sacrifices in performance. That is a thing which it should resist.

Even where it has a transmitter operating, it will be a considerable time before many people are able to view it. Most sets now in use will need conversion and all will need Band-III aerials. Their manufacture, supply and installation will take a long time. Many people will not, of course, consider having them installed until a Band-III transmitter is actually operating; if they do wait until then, they may have to wait another six months or a year, for the man-power available is very limited. It would be more sensible to start fitting now and give the transmitter people another year.

In conclusion, it should be pointed out that all the comments that have been made here about co-sited transmitters apply to the sharing of a site by a Band-I and a Band-III transmitter. It may be that, in the future, the B.B.C. will develop its own Band-III service. It is important to realize that the operation of two Band-III transmitters from a common site is quite a different problem. It may very well be that it is right to co-site a pair of Band-III alternative-programme stations, but not a Band I and a Band III.

MERCHANT SHIPPING R/T

WE find that the Merchant Shipping (Radio) Rules 1952 were in some respects misinterpreted in our February issue. First, they did not come into force last November but in November, 1952. There were, however, provisions covering the transitional period which ended on November 19th last.

Whilst the rules make it compulsory for cargo vessels between 500 and 1,600 gross tons (the previous minimum tonnage) to carry radio gear, it does not necessarily have to be R/T; owners may fit W/T equipment if they wish. Incidentally, fishing vessels are excluded from the provisions of these rules.

The Marconi Marine Company draws our attention to the fact that its Albatross equipment, which meets the specification prescribed in the rules, was awarded the G.P.O. Certificate of Type Approval in September, 1952.

Transistor Radio Receiver

Four-Stage Circuit with R.F. Amplifier and Push-Pull Output

By D. NAPPIN*

MANY articles have appeared on the subject of transistors and other semi-conductor devices, but most of those describing transistor circuits have involved either selected production or developmental types. The receiver described in this paper uses five GET1 or GET2 point contact transistors; four of these are production samples and only one transistor needs to be specially selected for a particular characteristic. Alternatively, a transistor with very close point spacing such as a type now being developed experimentally for high frequency use, may be employed. Some of the advantages and economics of transistor circuits became very apparent during the development of this receiver.

A block diagram of the final receiver is shown in Fig. 1. The first receiver circuit used was simply a detector followed by two audio-frequency amplifiers, but it was not possible to obtain an adequate output in the loudspeaker without exceeding the collector dissipation specified for the transistor. It was therefore decided to use a conventional push-pull output stage and to limit the h.t. supply to −22.5 volts. In this way a sufficiently high output could be obtained.

Detector. A common-base amplifier arrangement is used as a detector. The output from the r.f. amplifier stage is coupled into the emitter circuit of the detector stage by means of a matching transformer. The emitter/base circuit can be regarded as a point-contact diode. Thus when a negative voltage is applied to the emitter the diode is cut off and no appreciable current flows; as a result the collector current remains unchanged. However, when the voltage is made positive, emitter current flows; this is amplified by the transistor and hence a signal is developed at the collector of the detector stage.

The output from the collector of the detector stage is transformer coupled with the emitter of an audio-frequency amplifier stage *via* a radio-frequency filter. It is found, in this receiver, that adequate overall gain can be obtained even if the detector is coupled to the audio-frequency amplifier by an R—C coupling network.

The detector, which is known as the emitter-bend detector, is in many ways analogous to the cumulative grid detector using a thermionic valve. Thus when a radio-frequency signal is applied a positive emitter current is built up which may be compared with the building up of negative grid voltage in the cumulative grid detector.

Audio Amplifier. The audio-frequency amplifier V3 operates as a linear amplifier. The necessary positive emitter bias is easily obtained by adding resistance in series with the base lead. If this resistance, R_6 of Fig. 2, is less than the optimum value it is possible that the emitter bias current will be too low for linear amplification; if it is made higher than the optimum value, however, relaxation type oscillation can

*Research Laboratories of the General Electric Company, Ltd., Wembley, England.

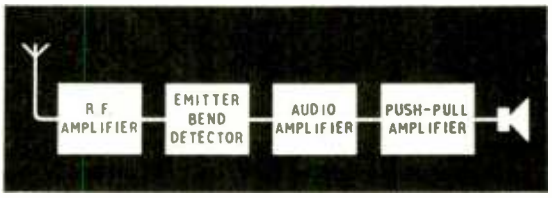


Fig. 1 Block diagram showing sequence of functions adopted

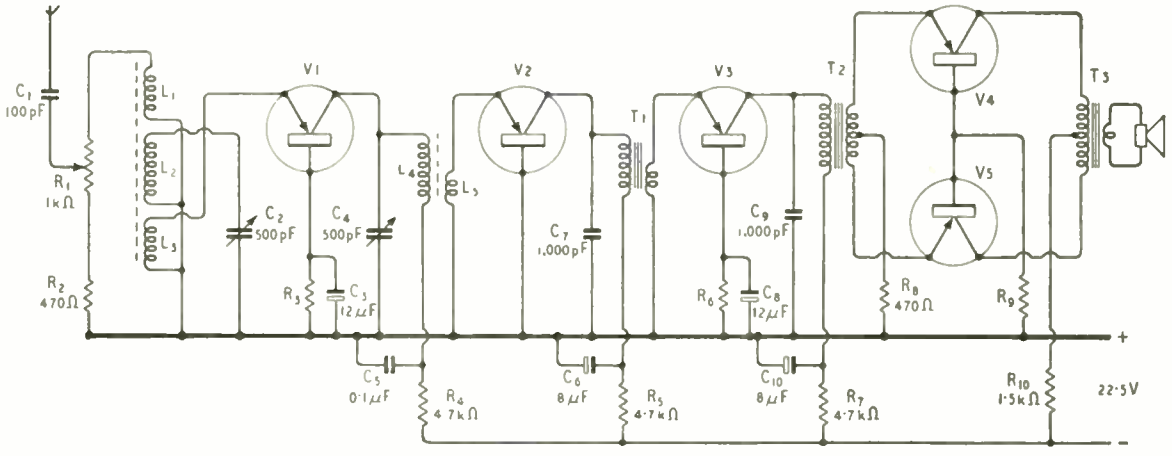


Fig. 2 Circuit diagram of transistor receiver. Details of coil and transformer windings are given in the table on the following page

COMPONENT SPECIFICATIONS

Coils Wave Wound On S34 Alladin Formers	Resistors	Transformers	Transistors
Turns (40 s.w.g., s.s.e.) L_1 50 L_2 70 L_3 50 L_4 70 L_5 20	R_1 1kΩ potentiometer Others ¼-W Carbon **Condensers** All over 25 V.W. C_4 C_2 500 pF ganged variable.	Using No. 21 M. and E.A. stampings. **Turns** (40 s.w.g., s.s.e.) T_1 P. 1,600 S. 400 T_2 P. 1,600 S. 800 centre tapped T_3 P. 1,600 centre tapped S. 28 24 s.w.g. (For 3Ω speaker)	V1-V5 G.E.C. Type GET 1

occur. The optimum value of R_6 depends upon supply voltages, transistor characteristics and circuit constants; its value is best determined empirically using a 1000-ohm variable resistor. A fixed resistor of the nearest lower preferred value is then substituted in the circuit. The adjustment is not very critical.

Push-Pull Amplifier. The collector load of the audio amplifier is that associated with the primary winding of the transformer T2. Resistance R_7, which is bypassed, is to limit the collector current that can flow. T2 steps down the output of V3 to the emitters of V4 and V5, which form a push-pull output stage. R_8 prevents the flow of excessive emitter current.

Emitter bias is derived by means of the common-base resistor R_9, while collector bias is provided via the centre-tapped output transformer T3 and the current limiting resistor R_{10}. No special precautions need be taken to balance the transistors in this circuit.

Normally no signal currents should flow in R_8, R_9 and R_{10} and they are not decoupled; it may be seen that if the circuit tends to become unbalanced, the 'unbalance current' flows around the circuit via R_8 and R_9 in the case of the emitter circuit, and via R_9 and R_{10} in the case of the collector circuit. These resistors tend to prevent the flow of 'unbalance currents' and thus to maintain the circuit balanced. Resistance R_9 is adjusted in a similar way to R_6.

The gain does not show a sharp maximum but increases to a certain value and then remains constant. The collector current, however, continues to increase as R_9 is increased and it is therefore not desirable to increase R_9 beyond the value corresponding to maximum gain.

Although it is possible, for example by the push-pull arrangement described by Missen†, to obtain greater powers from point-contact transistors, it was decided to use this simple push-pull amplifier because it requires only one voltage supply, is more economical on components and power consumption, and gives an adequate output for a "bedside" or "personal" type radio. The output power obtainable is about 50 milli-watts.

Radio-frequency Amplifier. This is the only stage that requires a selected transistor. The reason for this is that the band covered is 600-1500 kc/s, and most GET1 and GET2 transistors have a greatly reduced frequency response towards the upper end of this range. The transistor cut-off frequency is defined as that frequency at which the current gain has dropped to 0.7 of its low-frequency value. For existing GET1 and GET2 transistors this usually occurs at about 300-500 kc/s although about 5% of the product have cut-off frequencies greater than 1 Mc/s. A transistor now being developed experimentally has a cut-off frequency of about 10 Mc/s, and this more than adequately meets the requirements of this amplifier stage.

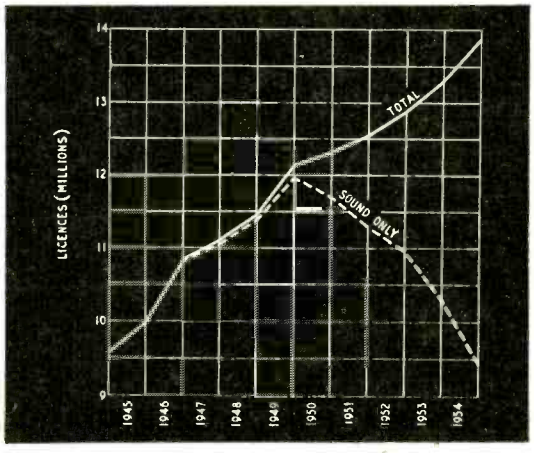
The circuit for coupling from the aerial into the low impedance input circuit of a transistor is shown in Fig. 2. L_2 C_2 provides a parallel-tuned circuit which is allowed to "float." L_1 couples the aerial into this tuned circuit, whilst L_3 provides the necessary step down from the tuned circuit to the transistor. L_1 and L_3 are disposed on opposite sides of L_2 which ensures that energy is transferred only at the resonant frequency of L_2 C_2. The emitter bias is obtained by means of a decoupled base.

† "Push-pull Transistor Amplifiers," by J. I. Missen. *Wireless World*, Oct. 1953, p. 467.

Broadcast Receiving Licences

THE steady growth in the number of television licences in the United Kingdom is shown by the divergence of these two curves. The full line plots the increase in the total number of broadcast receiving licences over the past ten years and the dotted line the number of sound-only licences. It was not until 1946 that separate licences for sound and television receivers were introduced.

The latest available figures show an increase during December of 156,365 television licences. The end-of-the-year figures were sound 9,463,475, television 4,155,989, and car radio 253,169, giving an overall total of 13,872,633.



LETTERS TO THE EDITOR

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

"As She is Spoke"

IN your February issue you accuse the B.B.C. of lack of zeal in its guardianship of the language of broadcasting. The B.B.C. is conscious of its responsibilities in this matter, and has set up a Committee to define terms that are widely used within the broadcasting service. This Committee, of which the writer is a member, has attempted to encourage the use of words that are clear and of untarnished lineage. There comes a point, however, in the history of a new term when resistance is useless and the earnest lexicographer must resign himself to his proper function of recording usage and give up any attempt to guide it. You, Sir, will not over-estimate the power of committees, or even of Editors, to stem the ever-advancing tide of dubious neologisms. "Television" itself is a hybrid that cannot be kept down, but our Committee is fighting a rear-guard action against "TV." It seems hardly more necessary than "TP," "TG," "TM" or "TA," but we notice that you yourself put your "TS" to your blind eye when your contributors write "TV." We share your horror at the expression "radio and television."

You refer in pejorative terms to "pre-recorded" and "telerecording." "Telerecording" seems to us to be a reasonable contraction of "television recording"; i.e., a recording of a television programme; it is a portmanteau word perfectly analagous to the established "telefilm" (=television film, i.e., a film made for television broadcasting). If you know of a better word, we should be glad to hear of it. You will be shocked to learn that a telerecording made on closed circuit is known as a "pre-telerecording."

In sound recording applied to broadcasting we have to distinguish between (1) a "live" repetition of a programme, (2) a repetition, from a recording, of a programme that has been simultaneously broadcast and recorded, (3) a repetition, from a recording, of a programme that has been recorded on closed circuit before transmission, and (4) the playing of a commercial gramophone record. We call (1) a "live repeat," (2) a broadcast from a recording, (3) a broadcast from a pre-recording and (4) the broadcasting of a record. Numbers (2) and (3) are together known as "recorded repeats." There can also be a "re-recording." Perhaps it has escaped your notice that "pre-" and "post-" each have two distinct meanings, as in (a) pre-arrange, post-date, (b) pre-war, post-graduate. "Pre-recording" is a legitimate example of (a), since it refers to a recording made before it is required for transmission.

You may still think that we are misguided or that our efforts are vain, but I hope I have refuted the charge of lack of zeal.

E. L. E. PAWLEY.

Engineering Division, B.B.C., London, W.C.

TO the examples you give of the misuse of the English language for technical purposes, may I add the curious tendency to refer to a record as "a recording"? I have been unable to find any justification for this either in the dictionary or in common sense. The word "recording" surely means the process of making a record, not the record itself. Thus, if someone says he listened to a recording of so-and-so, he must either have attended an original performance while it was being recorded, or be confusing his terms (and his hearers). But perhaps "recording" sounds more impressive than "record," and I can only conjecture that its misuse springs from technical snobbery.

Bromley, Kent. M. G. SCROGGIE.

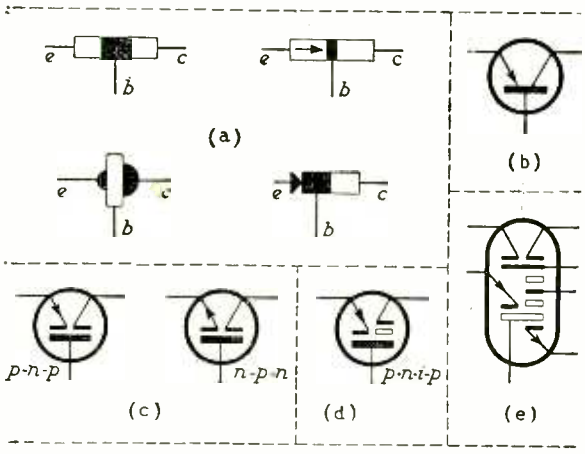
YOUR criticism of B.B.C. jargon (February issue) is out of date and rather unfair. The deplorable "pre-recorded," of which you complain, surely disappeared some time ago; at least, I have not heard it lately in programme announcements.

Judging by the current *Radio Times* (January 28th) the B.B.C.'s scribes are more successful in maintaining a reasonable terminology than most others who write on programme matters. In that issue I can find only two objects for complaint: the indefensible "telerecording" and "National *Radio* Awards." But the Awards scheme was sponsored by the *Daily Mail*; my guess is that the Corporation, left to themselves, would have chosen "Broadcasting" instead of "Radio."

Birmingham, 21. ALEX. GOLDSMITH.

Transistor Graphical Symbols

LIKE ourselves you have often commented on the wide variety of symbols used for the transistor in the technical literature (for examples see (a) in the accompanying diagram). Since these cause regrettable confusion, it



occurs to us that we might get together on this matter.

The accompanying sketches put forward a proposal in which you will observe:—

(b) Symbol already adopted for point transistors.

(c) Proposed representation of junction transistors.

(d) The same as (c) with the addition of an intrinsic layer (the *p-n-i-p* transistor).

(e) Symbol for a multi-electrode junction transistor (of the year 1960. . . .).

We feel sure you will wish to participate in the advantages which would accrue from the adoption of uniform symbols by the technical press of the world.

Editor, *Toute la Radio*, Paris. E. AISBERG.

Transistor Letter Symbol

A GROWING need exists for a reference letter to represent the transistor in technical descriptions and circuit diagrams. We have V for valve, and we number the valves V1, V2, V3, etc.. so that we can identify them in the tables and the text, but we have no recognized letter for the transistor.

It is important that the letter should be acceptable to all technical people, and it must not conflict with any existing references. Derivation should be recognizable, so that the symbol is easily associated with the object.

The first proposal that springs to mind is T, but that already belongs to transformer. X is another possibility, but it is used freely for so many purposes, such as X-

mitter, X-ceiver. Possibly two letters might be necessary to obtain a distinctive reference; say, SC (semi-conductor), TV (transistor valve) or VT (valve transistor).

A sign of some kind is bound to evolve soon, because hardly a technical journal appears without some reference to transistors, and it must become necessary to refer to them individually, which means that they must be numbered. It would be a pity if another case developed under our very noses of the casual adoption of an inappropriate or ambiguous reference, or the general use of two or three terms, as has happened in the past. It is probable that a cross-section of the opinions held by your readers would be as good an indication as any of what reference should belong to the transistor.

London, S.E.1. E. A. W. SPREADBURY.

[The symbol V is used tentatively in an article appearing in this issue.—Ed.]

"*Anarchy in the Ether*"

THE second Editorial in your February issue touches on a matter which is vital to the future of broadcasting in Europe.

It is likely that during the next few years most of the major countries will develop f.m. networks as a supplement to their existing transmissions. Quite apart from the desire to provide interference-free reception, I imagine that many countries are keen to develop an f.m. service for security reasons.

Unless their use is reorganized, we shall then find that the medium and long wavebands are being wastefully employed. I suggest that their use should in fact be confined to the following purposes:

1.—Providing the main service in countries which are unable to use v.h.f., either because of their large area, or because they cannot afford the cost involved.

2.—Providing a service in mountainous areas, for which v.h.f. is unsuitable.

3.—For "international" services.

No. 3 requires some explanation; what I propose is that a part of the medium waveband should be reserved for international programmes, one channel being allocated to each country, with a 15-kc/s spacing and no sharing. Each channel would be used by a single high-power transmitter, carrying the pick of its country's programmes. As these should each be audible (at night) over a large part of the Continent, the ordinary listener's choice of programmes would be tremendously increased. Without some scheme of this kind, we may arrive at a situation in which few listeners ever hear anything other than their local programmes. G. H. STURGE.

Welwyn Garden City.

Vector Addition and the Slide Rule

THE following method for finding $\sqrt{(x^2+y^2)}$ with an ordinary slide rule is, I think, even quicker than that of A. G. London given in the February, 1955, issue. x is taken as the larger number, and the standard scales of the rule are called A, B, C and D from top to bottom:

1. Set the cursor to x on scale D.
2. Set either 1 or 10 of scale C opposite y on scale D.
3. Increase the reading on scale B under the cursor by 1 by moving the cursor.

The answer is now under the cursor on scale D.

London, S.W.16. G. J. PHILLIPS.

Education and Training

I SHOULD like to make some brief comments on the article by Francis Reece in your January issue. He implies that entrants to secondary technical schools are of the lowest range of ability. These schools, in fact, require a standard of intelligence and aptitude equal to that required by the grammar school and prepare boys for the General Certificate of Education at 16+ and, in a few cases in London at least, for subjects at advanced level at 18+.

Boys from these schools not only secure apprenticeships in industry leading to skilled artisan posts but also continue their education by part-time release or evening classes to Ordinary and Higher National Certificate level and to associateship or membership of professional institutions. The results obtained by part-time day release students are better than those indicated by Mr. Reece.

HAROLD C. SHEARMAN.
Vice-Chairman of the Education Committee,
County Hall, London, S.E.1.

Electronics on The Farm

MOST of the electric fencers on the market work off a standard 120-volt h.t. battery, and these are fairly big and bulky items to store away, even in so-called "portable units;" these are, as far as I can find, the highest voltage type on the market.

I have made and operated quite a few fencers on the resistance-capacitance principle, and found them very satisfactory and reliable. With neon types, one is up against snags at once. The major one is that the striking voltage is far too high for the standard battery to give any length of service; with the RC type I have still had the fence working with the battery reading 45 volts on load. The ideal is, of course, the cold-cathode trigger type, but I have only used these on mains-operated units, extensive searchings having failed to find a manufacturer who makes one that can strike or be triggered as low as 60 volts.

Incidentally, H. G. P. Taylor (your February issue) will find that a piece of grass about six inches long (if wearing boots, and shorter if in wellingtons) will only give a slight tingle in the fingers if held to the fence. Much cheaper than neons or having to walk the full length of a twenty-acre field to see if the unit is on or off.

Truro, Cornwall. D. A. BOND.

Tape Terms

AS a complete layman in electronic matters, I can confirm W. D. Arnot's warning (your February issue) of the danger of using "azimuth" to mean something that is not azimuth.

In advertisements I had noticed that certain tape-deck manufacturers advertise their products as having "azimuth adjustment." Until reading Mr. Arnot's letter I had assumed this to mean adjustment in azimuth; to wit, rotation about an axis perpendicular to the deck. The purpose or even desirability of such a movement was not clear, but that is true of most electronic gear so far as I am concerned.

Evidently the word "azimuth" was chosen because it looked and sounded well. What matter that is misleads the layman and hampers the student, who finds that the word means something quite different in electronics to what it does in geometry and navigation?

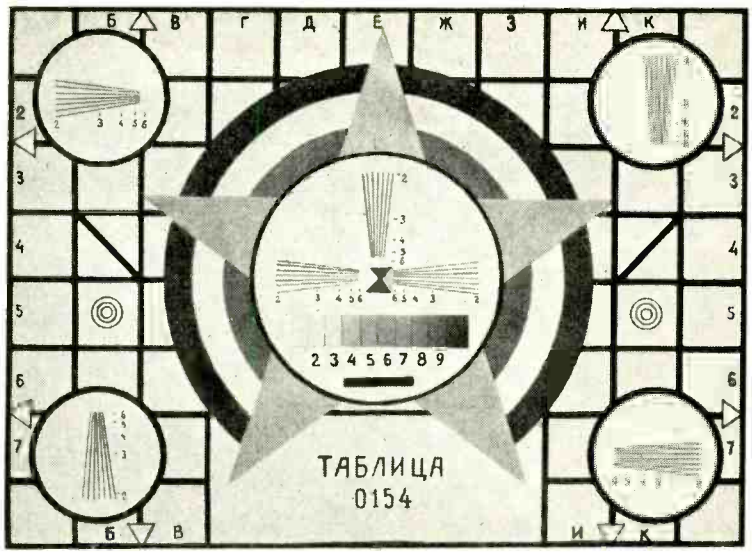
This is but one more symptom of the unpleasant and childish tendency to make everything sound more important than it is. It is not confined to electronic engineering ("Cathode Ray" very justly denounces it in the pseudo-mathematical field), but it is certainly made to feel at home there. The harm goes more deeply than is realized. Not only is the student confused by having to learn a new language as well as a new subject but the new language uses the same vocabulary, with different meanings, as the old. Thus the technical terms often call up false or misleading mental imagery which distorts insight into fundamentals. Computor jargon has many examples of this.

The achievements of electronics, during its short life, are solid enough to stand on their own feet. They need not be boosted by the undignified and illiterate methods of the huckster.

Farnborough, Hants. R. A. FAIRTHORNE.

Russian Colour Television

EXPERIMENTAL STATION IN MOSCOW



Colour test card for the experimental station. The five-pointed star is red, while the three circles are blue, yellow and green respectively. The quartered square in the middle is also made up from these four colours. (Reproduced from the Soviet journal Radio.)

THE frame-sequential system of colour television may be dead (at least from some points of view), but it is obviously not going to lie down. As reported in our last issue, transmissions on this system have recently been going out from the Moscow television centre. Rotating discs are used at both the transmitter and receiver. The name of the station is MOSTsT (formed by the initial letters, transliterated into English, of the Russian words for Moscow Experimental Colour Television Station) and it operates in the Soviet third television band of 76-88 Mc/s, which is situated roughly in the gap between our Bands I and II. (The Kiev television station is also in this band, while Moscow and Leningrad are in the equivalent of our Band I.)

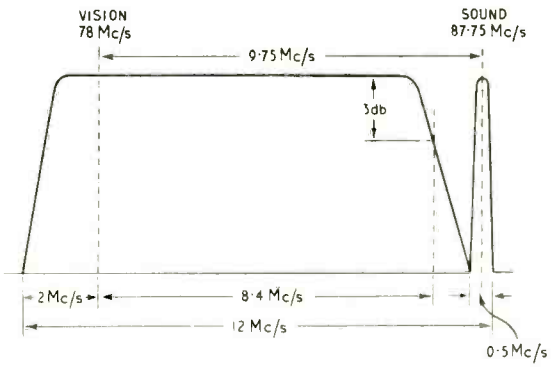


Fig. 1 (above). Idealized frequency characteristic of the transmitting channel.

As can be seen from Fig. 1, the vision carrier frequency of the experimental colour station is 78 Mc/s while the sound carrier, which is frequency modulated, is 87.75 Mc/s. The lower sideband of the vision signal is partly suppressed, giving a video bandwidth of about 8.4 Mc/s and an overall channel width of 12 Mc/s. This fairly wide bandwidth is necessary because of the high rate at which the picture information has to be transmitted, compared with a conventional black-and-white system. In fact, for every frame scan in a black-and-white system the frame-sequential colour system has to transmit three single-colour frames, red, blue and green, in the same time—or three times the amount of information.

The MOSTsT station puts out 25 complete colour pictures per second, and each picture consists of six single-colour frames, red, blue, green, red, blue, green, on alternate odd and even sets of lines—so that in the complete picture there is a full set of interlaced lines for each colour. Thus there are 150 single-colour frames per second, or three times the normal rate for black-and-white television. The number of lines adopted for the transmissions is 525 (as distinct

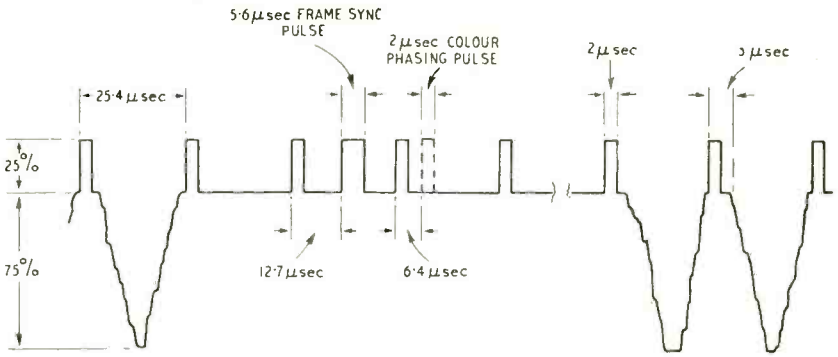


Fig. 2 (right). The transmitted waveform, showing sync pulses during an even frame. The colour phasing pulse is shown dotted as it occurs only in each red frame.

from the normal 625 lines used in Russia) so the line scan frequency works out to 39.375 kc/s, or roughly 25 microseconds per line.

The waveform of the transmitted signal is shown in Fig. 2. Negative modulation is used and the picture waveform occupies 75% of the total signal amplitude, the remaining 25% being taken by synchronizing pulses. A fairly narrow pulse is used for frame synchronizing, as can be seen, and it is intended that this shall be separated in the receiver by means of the delay-line technique. (The sync pulses are all delayed by an amount greater than the duration of a line pulse, then the delayed versions are added to the corresponding non-delayed pulses. As a result the broad frame pulses add up to twice the normal amplitude and can be separated by a "chopper" circuit while the line pulses, not being coincident, do not add at all.) The colour phasing pulse in Fig. 2 has the same duration as the line pulse but is transmitted only once per three colour frames—actually during the red frame. It appears that this colour phasing pulse may not be necessary in some receivers as the rotating colour disc can be kept in correct synchronism by being driven by a synchronous self-phasing motor working from the mains—the transmitting disc being similarly locked to the mains. If, however, the receiver is working from a different mains supply to the transmitter the phasing pulse is, of course, necessary.

Programmes for the colour transmissions originate from a studio with three cameras and an equipment for scanning colour films and slides. A special kind of film scanner has to be used because the ordinary type of equipment is useless when each film frame has to be scanned three times, once for each colour component. The studio is lighted by fluorescent lamps to give the required spectral distribution and low infra-red content (also, incidentally, reducing the working temperature inside the studio). Incandescent lamps are used, however, in conjunction with correction filters, for lighting adjustment purposes. Apart from the studio equipment, all other apparatus is installed in a central control room and here each of the three-colour component signals can be controlled separately. The vision and sound transmitters are generally similar to those used in Russia for monochrome transmissions except that the colour vision transmitter and aerial have a wider bandwidth than normal.

A typical receiver for the colour transmissions gives a picture measuring approximately $5\frac{1}{2}$in × 4in (the standard aspect ratio being actually 11 : 8). The colour-filter disc has a diameter of about $15\frac{1}{2}$in and rotates at 1,500 revs per minute. Six colour filters are cemented on to it, two for each colour, so that one revolution corresponds to a complete colour picture of six frames and in one second the disc revolves the 25 times corresponding to the picture repetition frequency. The colour phasing is adjusted by turning the armature of the synchronous driving motor, which can be moved through 180 degrees. The colour test chart shown at the beginning of the article is used for adjusting the receiver, and the first step, apparently, is to check that the five-pointed star comes out red!

A superhet circuit is used for the receiver, with one r.f. stage, a pentode mixer, three i.f. amplifiers, an anode-bend detector and a two-valve video output stage. There are two sound i.f. stages, an f.m. discriminator and two audio amplifier stages. Blocking oscillators are used for the scanning waveform generators. Altogether there are 23 valves, all miniature types except the power amplifiers and rectifiers, and the total power consumption is about 300 watts. The receiver has a vision channel sensitivity of about 350 μV and a pass-band of not less than 8.3 Mc/s, while the sound channel has a sensitivity of 200 μV.

Readers will note that this Russian frame-sequential system is somewhat similar to the American CBS system which was operating for a short while in the United States before the present N.T.S.C. compatible system was officially adopted. The CBS system, however, worked at a lower scanning speed, the complete colour-picture frequency being 24 per second and the colour frame frequency 144 per second, while the number of lines (for colour as distinct from black-and-white) was 405, which gave a line frequency of 29.16 kc/s. A video bandwidth of about 4 Mc/s was required and a channel width of 6 Mc/s.

The above information on the Russian experimental colour system was abstracted from recent issues of the Soviet journal *Radio* with the help of B. Zacharov.

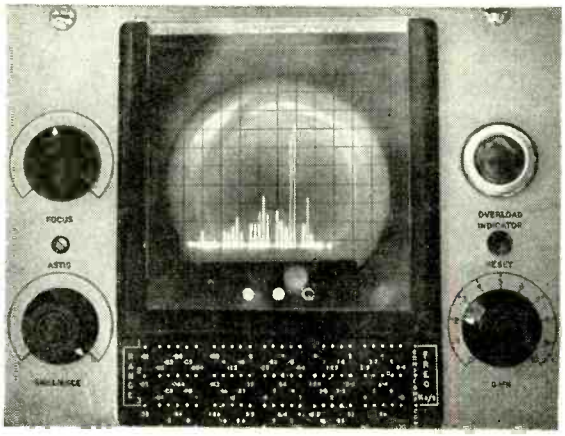
NOISE MEASUREMENT

FOR the examination of the complex noise and vibration phenomena, particularly those associated with jet engines, a wide frequency range is necessary. In general a spectrometer in which the energy in adjacent bands is displayed as a series of vertical deflections on a cathode-ray tube provides the most convenient form of instrument for use in a works, as it gives instantaneous readings which are readily interpreted.

A versatile instrument of this type has been developed by Salford Electrical Instruments in which a frequency coverage of 10 c/s to 100 kc/s is provided in three ranges (10 c/s-6.4 kc/s, 30 c/s-10 kc/s and 320 c/s-100 kc/s). The input from an appropriate transducer is amplified and applied through a cathode follower to 38 filters adjusted to cover contiguous bands each 1/3 octave wide. A mechanically driven time base is coupled to a rotary switch arranged to select each filter in turn, and to display the outputs as vertical deflections. Time-constant circuits associated with the filters provide persistences of 0.1 or 1 second according to the requirements of the work. Frequencies are conveniently identified by an engraved scale immediately below the tube face, while pilot lights show which range is in use.

A useful feature is an overload relay which disconnects the input and at the same time shows whether the overload peak is positive or negative. The relay remains in operation until the input is reduced.

The photograph shows a typical display on the 30 c/s-10 kc/s range from the exhaust of a marine diesel engine with peaks in the region of 3.2 kc/s.



THE SLOT AERIAL

By B. L. MORLEY

Its Characteristics and Relationship to the Familiar Dipole

GHOST reception is one of the serious problems encountered in TV reception and in certain parts of the country it is almost impossible to receive satisfactory pictures because of the reflections. Various methods have been devised for countering ghosts mainly by the development of the aerial system and one of the most effective forms of aerial for this purpose has been found by the writer to be a slot aerial

With the inception of Band III the ghost problem is likely to become more severe; the higher the frequency the more the radio waves behave like light waves and the greater becomes their absorption and reflection. Because of the reduced dimensions of aerials for Band III the slot becomes a practical proposition and we are likely to see some development of this form of aerial in the commercial field.

To those who are more accustomed to the normal dipole form of aerial the slot presents some interesting features, not the least of which is its polarization which is at 90° to that of the dipole. For vertically polarized transmissions the slot aerial is mounted horizontally while for horizontal polarization the slot aerial is mounted vertically.

Basic Conceptions of the Slot:—As the frequencies used in radio work become higher their behaviour becomes more like that of light waves and we find ourselves turning more and more to the optical field in the study of the behaviour of these high frequencies.

A principle of Babinet's in optics can be applied to the slot aerial as was demonstrated by Booker in his paper (*Journ. I.E.E.* Vol 93 Part IIIA No. 4, March-May 1946).

The principle may be stated by considering an array of dipoles having an electromagnetic wave incident upon it. The field around the array will be modified by the array.

Consider the array has boundaries and so forms a screen, then we shall have spaces forming the screen interrupted by the solids of the dipoles (Fig. 1).

Imagine now that the screen is replaced by a complementary screen having space where the other had solids and solids where the other had space. In this case we have a kind of metal negative, the dipoles being replaced by slots and the surrounding media by metal (Fig. 2).

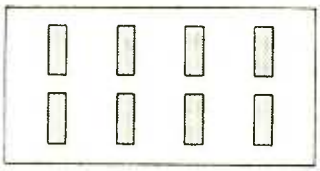
Babinet's principle suggests a definite relationship between the two; this is so; the incident wave is affected and the resultant field distribution is very similar to the previous field distribution.

A dipole may be energized by a generator connected at the centre (Fig. 3a); a slot may also be energized by a generator placed at its centre (Fig. 3b). In the case of a dipole an electric field will be built up between the two halves and in the same plane, i.e., a vertical dipole produces a vertical electric field (Fig. 4a).

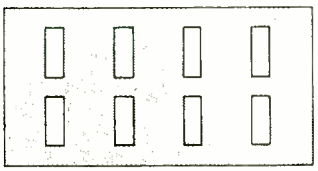
The field is not static, of course, as shown in the diagram; the diagram merely represents the field at one particular moment of time.

In a vertical slot the electric field is built up across the edges of the slot as shown in Fig. 4b. The current field in the metal surrounding the slot is shown by the thick arrows.

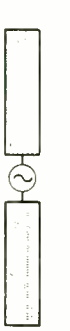
The direction of polarization of an electromagnetic field is that in which the electric field lies. It is clear



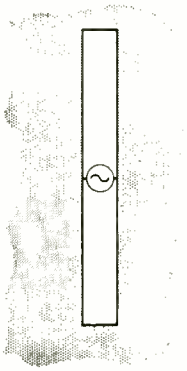
Right: Fig. 1. An array of dipoles within a finite screen.



Left : Fig. 2. An array of slots in a screen complementary to Fig. 1.

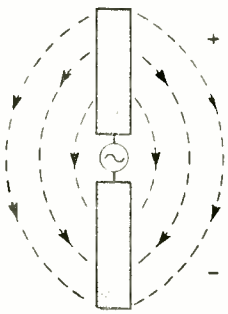


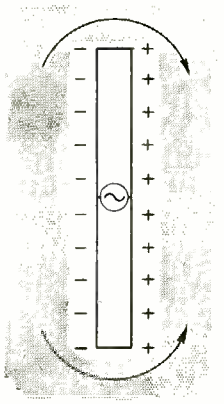
Right : Fig. 3. Both a dipole and a slot can be energized by a generator at its centre.



(a) (b)

Below : Fig. 4. Electric field about (a) a dipole, (b) a slot.





(a) (b)

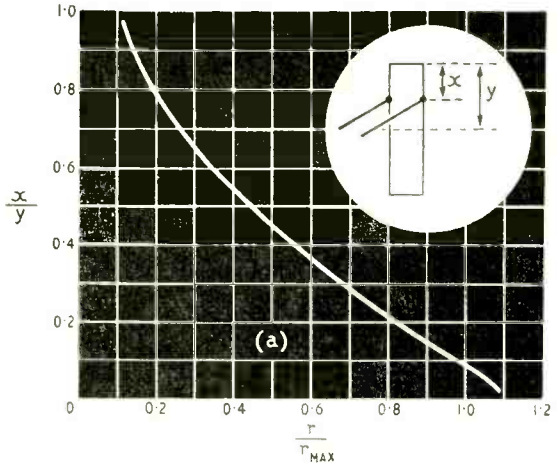
that while a vertical dipole produces a vertically polarized field the vertical slot produces a horizontally polarized field.

It is obvious that the electric and magnetic fields have been interchanged when changing from a dipole to a slot. For this reason the slot aerial is often referred to as a magnetic dipole.

The area of the screen surrounding the slot would be such that it is large enough to embrace the inductive and electric fields which would normally exist around the equivalent half-wave dipole in the form of a strip. The screen should extend for a minimum of 0.2 λ around the slot.

It is not necessary for the screen surrounding the slot to be completely solid; wire mesh serves the purpose quite well.

The interchange of electric and magnetic fields



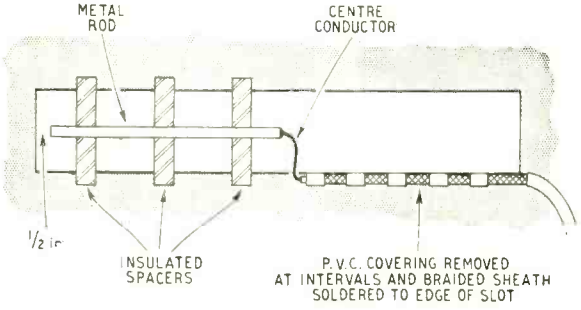


Fig. 5. Matching a low-impedance feeder to a slot, (a) by tapping down, (b) by means of a matching stub.

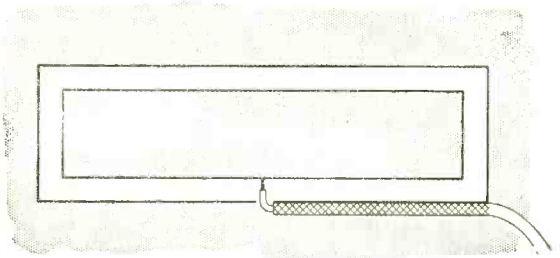


Fig. 6. Folding a slot reduces its impedance. The method of attaching a low-impedance feeder is shown here.

makes the slot extremely useful for reception from vertically polarized transmitters where the erection of an outdoor array is not permitted. The slot, made out of wire netting, can be conveniently mounted in the loft as, being mounted horizontally, it does not require a great deal of headroom.

Impedance:—The intrinsic impedance (Z_i) of plane waves in free space may be taken as:—

$$120\ \pi \text{ ohms.}$$

For a half-wave dipole at resonance we have an impedance (Z_d) of:—

$$0.194\ Z_i \text{ ohms.}$$

The relationship between the impedance of the half-wavelength slot (Z_s) and the half-wavelength dipole may be given as:—

$$Z_d.Z_s = 0.25\ Z_i^2$$

Therefore $$Z_s = \frac{0.25\ Z_i^2}{Z_d}$$

whence $$Z_s = \frac{0.25\ Z_i^2}{0.194\ Z_i}$$

$$= \frac{0.25 \times 120\ \pi}{0.194}$$

$$= 500 \text{ ohms (approx.).}$$

From this it will be seen that the slot can be used by feeding the centre with 600-Ω line. The standing wave ratio with the slight mismatch will be very small and for practical purposes could be ignored.

Where it is desired to use 80-Ω cable, however, some method of overcoming the mismatch must be employed. A popular method is to use a matching transformer in the form of a $\lambda/4$ section of line.

To calculate the characteristic impedance of the matching section the following formula can be applied:—

$$Z_a = \sqrt{Z_b.Z_c}$$

where Z_a = impedance of the matching section
Z_b = impedance of the aerial
Z_c = impedance of the transmission line.

In this particular case we find that we shall require a $\lambda/4$-section of 200-Ω cable. This is not a convenient size but it would be reasonable to employ 150-Ω balanced twin cable.

One point which must not be overlooked is that the velocity factor of the cable must be used to calculate the actual physical length, at the frequency of the aerial system. The physical length then becomes:—

$$V_o\ \lambda/4$$

where V_o is the velocity factor.

A more convenient method of matching is to utilize another property of the slot. This property is the variation of impedance along the length of the slot. In the case of the half-wavelength dipole the impedance increases from the centre to the ends; in the case of a half-wave slot, however, the reverse is the case, the impedance decreasing from the centre towards the ends of the slot. It is therefore possible to find a point along the length of the slot where the impedance will match the cable. Fig. 5a shows the relationship between the slot impedance and the point of attachment. The precise judgment of the point of attachment becomes rather tricky for an 80-Ω cable but it is perfectly practical with a 300-Ω line. The final position is best located experimentally in order to avoid the introduction

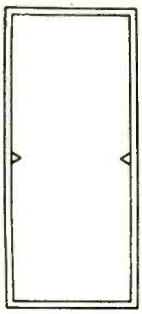


Fig. 7. The skeleton slot is derived from the slot aerial.

of any reactive component. One of the best methods of matching low-impedance cable to a slot is that shown in Fig. 5b.

The impedance of the slot can be lowered considerably by folding it (Fig. 6). This is the complementary of the folded dipole; in the latter case the impedance is stepped up by n^2 times where "n" is the number of elements in the fold. For the folded slot, however, the impedance is altered by $\frac{1}{n^2}$ times. A simple folded dipole will therefore have its impedance stepped up 4 times while a simple folded slot will have its impedance decreased by 4. The slot with a single fold will therefore have a centre impedance of 500 $\times$ $\frac{1}{4}$, or 125 Ω, which is a reasonable match to 150-Ω cable and *could* be used with an 80-Ω cable.

When a coaxial cable is used a convenient method of feeding the folded slot is to join the outer of the feeder half-way along the bottom edge of the slot and the inner conductor to the centre of the remaining half of the slot, as shown in Fig. 6. The method effects a balance-to-unbalance matching device and gives a centre impedance of about 150 Ω. With an 80-Ω cable the standing wave ratio is rather less than 2 giving a loss of only about 1 db. The system works remarkably well in practice.

Bandwidth:—In the television field we are very interested in bandwidth. With the slot aerial we have similar conditions to that existing in the half-wave-length dipole. In the latter case, increasing the ratio of diameter to length increases the bandwidth; in the case of the slot, increasing the ratio of the width of the slot to its overall length also increases the bandwidth.

Exact figures are not available but a slot width of 12 in should be adequate for the TV channels.

Adding a Reflector:—A slot has its responses at 90° to the plane of the frame and the polar diagram takes the form of a figure-of-eight in both the azimuth and the vertical planes. It can, however, be made uni-directional by the addition of a suitable reflector. This can be in the form of another slot mounted in the same plane and of equivalent half-wave reflector length, or it can be a simple screen erected vertically behind the slot. A distance of $\lambda/4$ is normally quite effective.

The most efficient method of making the slot directional is to box it in on one side. The best method is to make a cavity in the form of half a sphere, the radius being concentric around the centre of the slot.

The reflector introduces fresh matching difficulties as the centre impedance of the slot is increased. With the normal dipole, a reflector *decreases* the centre impedance of the dipole, but with a slot the reflector *increases* the centre impedance. A box reflector will raise the impedance to about 1,000 Ω.

A reasonable match to a 300-Ω line can be made by folding the slot in the manner already described, which then brings the centre impedance to just under 250 Ω.

The Cavity Resonator:—It is but a short step from a boxed slot aerial to a cavity resonator and indeed the slot so treated can be fed on similar principles, the slot being energized by the introduction of a probe; it is doubtful if such a method is of any real benefit in the TV field—at least until Band IV is opened up.

Slot aerials can also be erected in what might be termed complementary Kooman arrays, and for those interested in this aspect, reference should be made to the recent work done in this field by W. H. Watson (*The Physical Principles of Wave-guide Transmission and Antenna Systems.* Oxford University Press).

Skeleton Slots:—The skeleton slot was derived from experiments in an attempt to find the minimum dimensions of the media surrounding the slot: in the course of experiments the media were trimmed away until only the slot was left surrounded by air, yet the slot continued to exhibit the characteristics of the slot aerial! An interesting account of this work was given recently in these pages by H. B. Dent (August 1954). This type of slot may have a good future as it seems particularly suitable for Band III television.

It is clear that there is a great deal of work to be done in this field; herein lies useful work for the inventive mind!

Band III Pilot Transmitter

Vision Signals for Testing Receivers and Aerials

As reported in last month's issue Belling & Lee are erecting a temporary Band III transmitter on a site in south London for the purpose of providing a vision signal for testing aerials and receivers prior to the commencement of the regular service from the proposed I.T.A. station.

Although considerable data are available in the U.S.A. on reception conditions of 200-Mc/s signals in built-up areas using horizontally polarized waves practically nothing is known of the conditions likely to prevail with vertical polarization, which will be used largely in this country on Band III. These pilot transmissions are intended to redress for this lack of knowledge and so provide valuable data for the design of aerials for Band III.

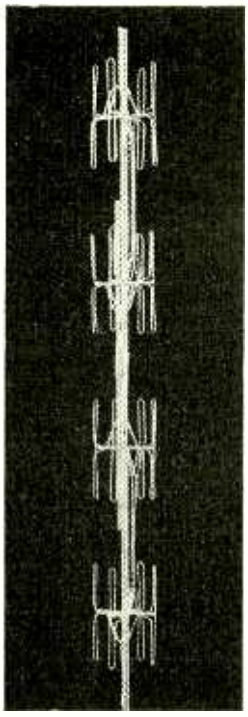
Tall, narrow objects such as chimneys, cooling towers, cranes and possibly metal flagpoles, while not generally troublesome on Band I, may prove far from innocuous on Band III, where to the signal they look four times as large and any reflections may be expected to be four times as troublesome.

It might be found that while a simple dipole will, in a given location, provide an adequately strong signal, a more elaborate aerial system may have to be used solely to minimize pickup of reflections and the attendant interference by ghost images. The transmissions may help to decide what is a normal con-

dition in a built-up area on Band III; is it with or without attendant ghosts? These, and many other, questions are expected to be answered before the regular I.T.A. service commences, so that manufacturers can concentrate with confidence in advance on the production of aerials for the various districts and conditions likely to be encountered.

The pilot transmitter is to be housed in a temporary hut, 24 ft × 10 ft, in the corner of the actual site of the I.T.A. London station on Beulah Heights, South Norwood.

A self-supporting tower of at least 50 ft will carry an aerial system comprising four stacked bays each of four vertical half-wave folded dipoles spaced equidistant around a 16-ft topmast. There are thus 16 dipoles in the system, which by its design gives an all-round coverage and an anticipated power gain of four. As the transmitter power output will be of the order of 250 watts the effective radiated power will be approximately 1 kW.



Scaled-down version of the omni-directional aerial designed by Belling and Lee for the Band III pilot transmitter in South London.

The r.f. output from the transmitter is fed to the aerial by about 110 ft of 50-ohm air-spaced aluminium-sheathed coaxial cable having the exceptionally low loss at the operating frequency of about 0.3 db per 100 ft. A balun coupler converts the unbalanced feeder system to balanced output at the aerial.

The vision frequency of channel 9, which is 194.75 Mc/s, will be used and a series of static patterns will be transmitted initially, but it is envisaged that a standard type of test card and captions will ultimately be provided. No sound will accompany the vision signal except, perhaps, after the temporary service is well under way, when it may be possible to introduce some form of tone modulation.

Present plans are for morning and afternoon transmissions of two hours each on weekdays, but excluding Saturday. These periods, however, await approval and subject to the terms of the G.P.O. licence.

The pilot transmitter is being designed, built, installed and operated solely by Belling & Lee, but the project has the blessing of the Radio Industry Council and the I.T.A. as well as the Post Office, all of whom have been, we are told, most co-operative.

B.B.C. SOUND QUALITY

FEW subjects have provoked more sustained and often heated controversy than the quality of sound reproduction dispensed by the B.B.C. Since the days of 2LO there has been a steady stream of praise, blame, conjecture and correspondence.

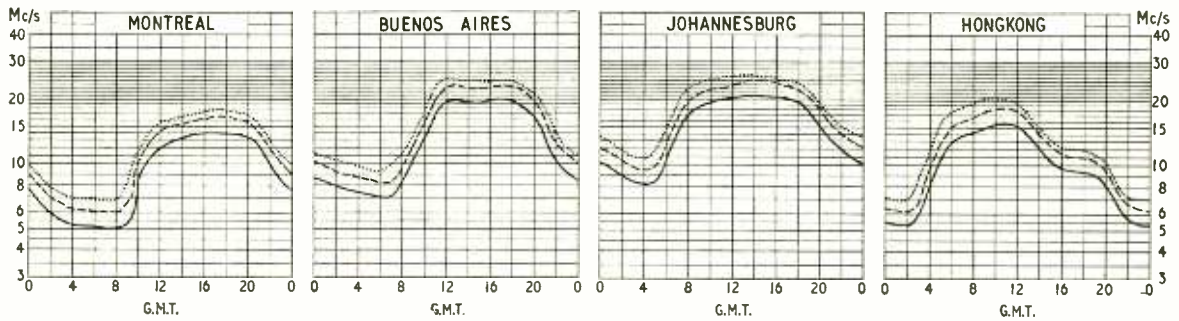
So many factors are involved and precise information has in the past been so scarce and scattered, that it is small wonder that the controversy occasionally assumes a somewhat unrealistic air. The publication of the B.B.C. Engineering Training Manual "Studio Engineering for Sound Broadcasting" should do much to bring the subject into perspective.

It is written by senior members of the B.B.C. Engineering Division and states unambiguously and in detail how the B.B.C. chooses its studio acoustics, places its microphones, amplifies and monitors the output, what characteristics are specified in hiring distribution lines from the G.P.O., the kinds of distortion that are met with and how they are corrected. For instance, it may not be generally known that the temperature of the ground has an appreciable effect on quality due to the change of capacitance as well as resistance of Post Office lines. Curves of the change of attenuation with frequency are prepared, routine measurements of temperature are made and equalization applied. There are, in fact, few details of the chain between microphone and transmitter about which there is any longer any need to guess.

Copies of this new book cost 25s (or 25s 6d by post) from our publishers, Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

SHORT-WAVE CONDITIONS

Predictions for March



THE full-line curves given here indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during March.

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

INTRODUCTION TO Transistor Electronics

(Concluded from p. 65 of the February issue.)

2.—*Potential Gradients and Current Carriers in Junction and Point Transistors*

By H. K. MILWARD, B.Sc., A.M.I.E.E.

UNDER certain conditions a pair of junctions in a crystal separating the two types of impure germanium or silicon already discussed shows some very special and interesting effects. The most important condition is that the two junctions should be close together. In other words a thin layer of *p*-type material separating two portions of *n*-type material, or vice versa, constitutes such a double junction. Transistors are known as *p-n-p* or *n-p-n* according to the type of layer embodied. In this article *p-n-p* junctions are considered in detail, but the explanations given apply equally well to the other type provided that proper attention is paid to the directions of bias and current flow, and to the fact that free electrons rather than holes become the main carriers of the current.

A *p-n-p* junction is shown in Fig. 16 and the electrodes are named. The base is seen to be sandwiched between the emitter and collector electrodes.

Under conditions of thermal equilibrium, and with all electrodes disconnected, the potentials of the *p*- and *n*-layers are different, for the same reasons as was given for the single junction. This is shown in Fig. 17.

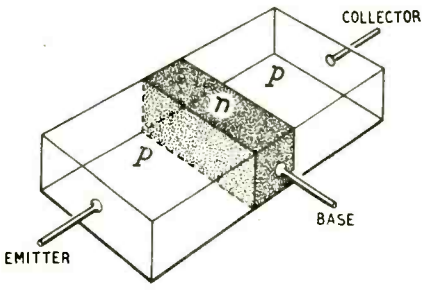


Fig. 16. Sketch of p-n-p junction transistor showing electrodes.

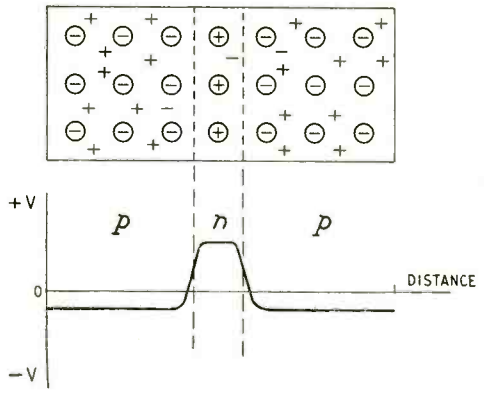


Fig. 17. In an unbiased transistor a potential difference exists between layers.

If the junctions are biased so that the base-collector junction has reverse bias and the emitter-base junction forward bias, the potential levels are altered to those shown in Fig. 18. Examination of this graph shows that because the emitter-to-base gradient is decreased the diffusion current of holes is increased, but the gradient for the base-collector junction is much increased, stopping altogether—or very nearly so—the diffusion hole current from collector to base. The generation currents, which are due mainly to thermal effects, remain much the same as before. The important point, however, is that the diffusion current of holes from the emitter crosses the junction to the base, but much of it, before it can find its way to the actual base electrode, tumbles over the "precipice" to the collector. Consequently the base current is small compared with the emitter current, the greater part of which goes to the collector. This is a most important fact when the effect of altering the base potential is considered.

The dotted line (*c*) in Fig. 18 shows the effect of reducing the base potential, that is, making it less positive; and the broken line in the same diagram

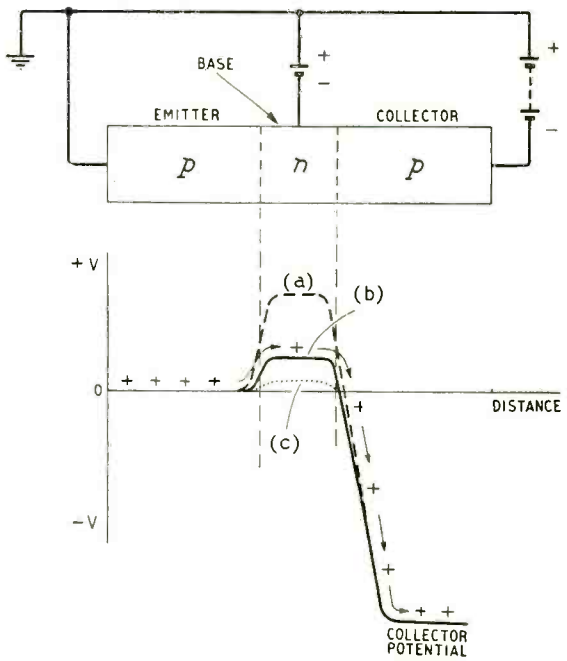


Fig. 18. Biased transistor. The full line (b) represents the normal d.c. negative bias on the base. The broken line (a) shows the effect when that bias is removed and the dotted line (c) shows what happens when the bias is increased.

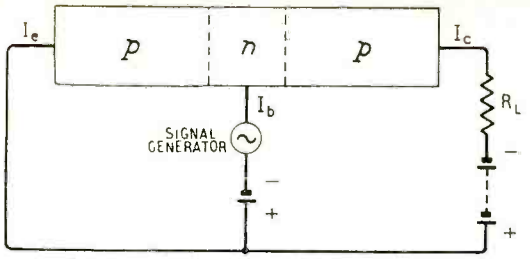


Fig. 19. Simple amplifier circuit using a p-n-p junction transistor.

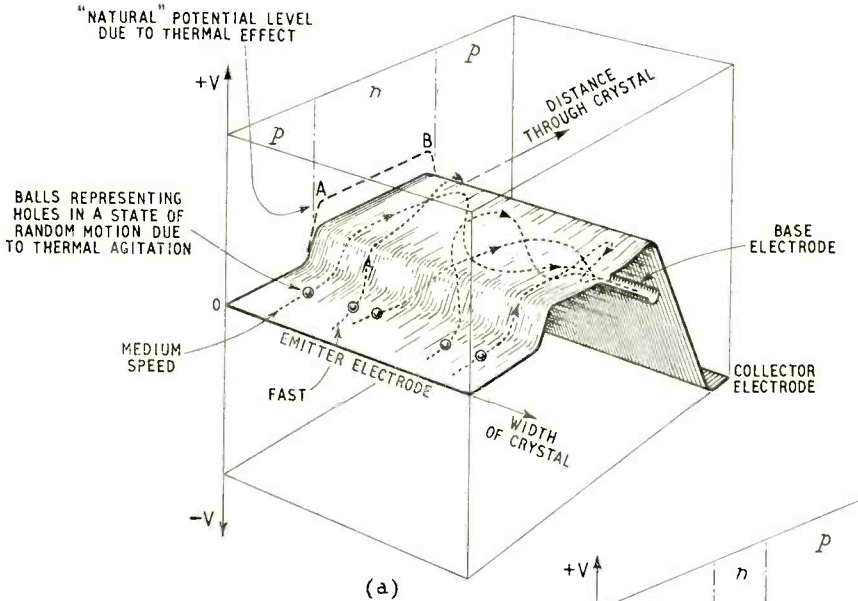
represents the effect of increasing it. The + signs represent free holes, most of which are in the *p*-layers: some of these holes, however, diffuse into the centre layer, as is shown by the arrows. The effect of applying negative bias to the base is to decrease the adverse potential gradient from emitter to base, and this allows the hole diffusion current to increase. But as we have already seen only a small proportion of this current actually goes to the base electrode, most of it finishing up at the collector.

A change of base potential in the other direction increases the potential gradient, and hence reduces the emitter current. In effect, therefore, the change of base potential has much more effect upon the emitter-collector current than upon the base current. Since, too, the base-collector junction is back-biased and therefore of high resistance, the change of current through it causes a large change of potential across it. A small change of power input to the base thus causes a large change of power output from the collector. In other words there is amplification.

The current amplification ratio α may be defined as the ratio of the change of collector current to the change of base current*. This factor may be very high, particularly if the base layer is very thin. The thinner it is the greater the factor α becomes.

A fact which enhances the power gain is that the emitter-base junction is working in a forward-biased state. Its resistance is therefore low so that the power dissipated by the small base current is made still less. This means that the power gain may be considerably greater than the current gain.

An example shows this fact clearly. Fig. 19 shows a possible circuit for a junction transistor. If we assume that the resistance of the emitter-base junction is 500 ohms and that the collector-base junction is 20,000 ohms (not unusual figures), that α_{cb} is 50, and that the transistor is connected to a load of 20,000 ohms, then the power taken from the generator is $I_b^2 \times 500$ watts and that given to the load is $I_c^2 \times 20{,}000$ watts. (I_b and I_c represent alternating currents.) But since $\alpha_{cb} = 50$, $I_c = 50\ I_b$



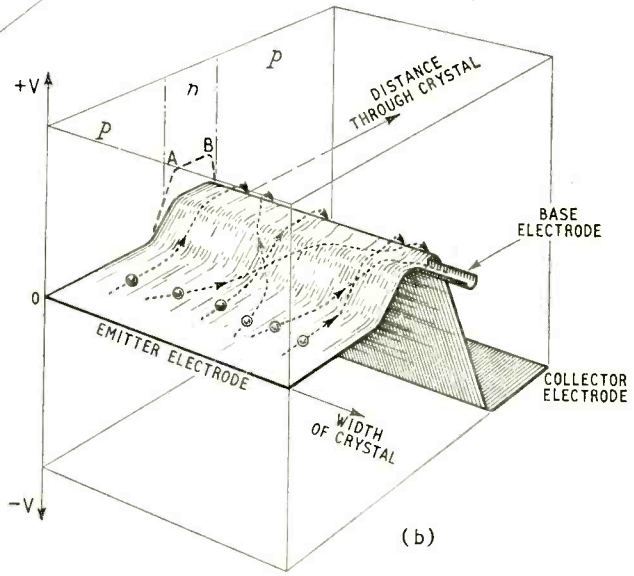


Fig. 20. Potential levels throughout the crystal represented by surfaces, the vertical dimension representing potential. In each case the unbiased potential levels for thermal equilibrium are drawn in as a broken line and marked AB. Diagram (a) shows the effect of a wide intermediate layer. The probable paths of the holes are shown and it can be seen that most of them are likely to end up at the base electrode. Diagram (b) shows the effect of a narrow layer. In this case the chance of a ball (representing a hole) arriving at the base electrode is quite small. Most, even slow ones which are able to surmount the gradient, fall over to the collector.

* It is also defined as the ratio of the change of collector current to the change of emitter current, and the possibility of confusion exists. This may be avoided by using the suffixes "cb" or "ce" to denote either collector-base ratio or collector-emitter ratio, α_{ce} is always less than unity, whereas α_{cb} may be quite large: which factor is used depends upon the type of circuit.

$$\therefore \frac{\text{Power out}}{\text{Power in}} = \frac{(50 \times I_b)^2 \times 20{,}000}{I_b^2 \times 500} = 100{,}000$$
$$= 50\text{db}$$

This simple calculation neglects the effect of feedback due to the generator internal impedance and to the common internal impedance of the transistor, and is given only as an indication of the order of gain to be expected. The detailed effects and capabilities of transistors in conjunction with their circuits do not come within the scope of the title of this article.

Now that a general idea of the working of a junction transistor has been given, it is possible to examine the reasons for the base potential having so marked an effect on the collector current. This is best done with a pictorial representation of a surface, the height of which is made to be equivalent to the potential in different portions of the crystal. This surface could be constructed as a mechanical model, using a flexible membrane supported on a solid structure.

Fig. 20 shows such a surface; the vertical dimension represents voltage and the horizontal dimensions represent the length and breadth of the crystal. The "spout" representing the base electrode can be moved up and down and this causes the whole "potential" surface of the *n*-layer to rise and fall. Being flexible the surface becomes slightly convex or concave as the spout forces it to rise above or be pushed below its natural level. Its natural level is shown dotted and marked AB, and represents the equilibrium state of the unbiased crystal. Fig. 21 shows a possible potential gradient within the intermediate *n*-layer illustrated in exactly the same way as contours on a map indicate height.

The emitter-base junction is forward biased for amplification of an a.c. signal, so that in our pictorial analogy the base "platform" is concave. This is shown in Fig. 20. In the emitter part of the crystal the holes are rushing about in a random way due to thermal agitation and the faster ones are able to surmount the slope up to the base region. The dotted lines in Fig. 20(a) show possible paths of fast holes over a wide layer. It will be seen that most of them are likely to end up at the base electrode, only the fastest being able to get up to and over the edge of the precipice into the collector region.

But this is not the whole picture. It is complicated by the fact that the probable length of path which a hole can traverse without deflection or collision is quite short. The effect of the base region being wider than this "diffusion length"† is to make it rather more likely for the holes to finish up at the base electrode.

For a narrow layer, however, the story is quite different. The platform is so narrow that the effect of the slight gradient towards the base electrode is almost negligible, and any hole having the energy to surmount the first gradient can scarcely avoid falling over the edge of steeper gradient the other side. In addition, if the width of the layer is less than the diffusion length, as is just possible, the collision effect is much less likely and the majority of holes are able to cross the platform without interference. The diffusion length may be in the region of 1 mm while the thickness of the layer can be less than this. In any case, provided that the width is not very much greater than the diffusion length a fair proportion of the emitter current still goes to the collector.

† Those with some knowledge of the kinetic theory of gases will realize the similarity of the "diffusion length" with "mean free path."

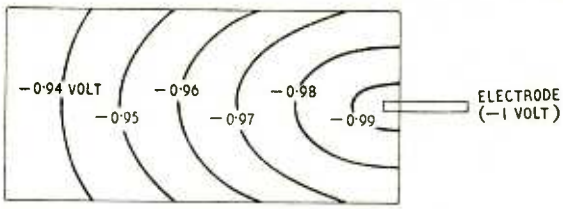


Fig. 21. Potential "contours" in a crystal layer biased negatively when the natural potential level is assumed to be positive.

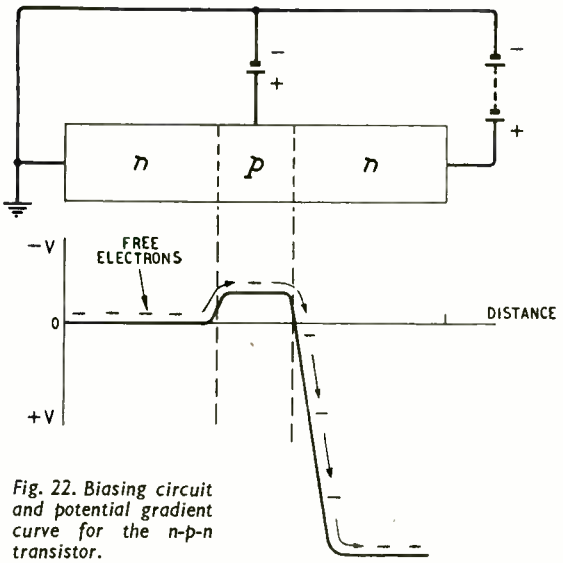


Fig. 22. Biasing circuit and potential gradient curve for the n-p-n transistor.

The width of the layer is thus a critical factor in deciding the intrinsic gain of a transistor. Control of the width of this layer to such very small dimensions is one of the most difficult problems which manufacturers have to solve.

In this pictorial analogy the generation current of holes and electrons within the *n*-type layer has been left out of the argument, but it can be included without invalidating it. It represents a steady flow of holes from the base to both collector and emitter, and provided that the gradient on both sides falls away it does not matter by how much. The effect of an a.c. signal on the base is, therefore, not interfered with by a steady d.c. flowing from base to both the other electrodes. It will be clear that the a.c. must not be too large if distortion is to be avoided.

It is as well to remember that any pictorial analogy is somewhat crude and cannot explain all the effects. It cannot, for example, deal with both hole and electron behaviour at the same time. But provided that its limitations are realized it can be helpful for an elementary understanding.

The *n-p-n* junction operates in very much the same way as *p-n-p*, except that it must be oppositely biased. As Fig. 22 shows, the potential gradient diagram is like that of Fig. 18, except that the polarity of the vertical axes is reversed. What was said of the behaviour of holes in the *p-n-p* transistor now applies to free electrons. In the *n-p-n* transistor then, the amplifying action is explained wholly in terms of free electrons.

The amplifying action may be summed up gener-

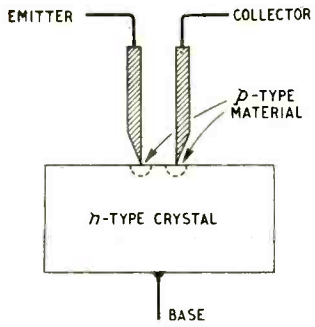


Fig. 23. Sketch of a point transistor. In practice the emitter and collector electrodes are very close together.

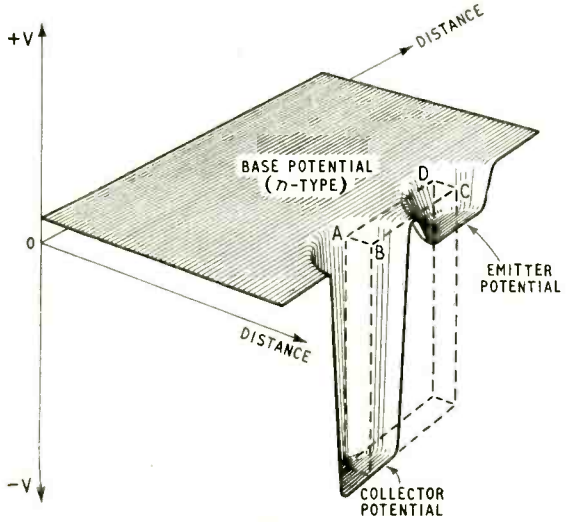


Fig. 24. A surface representing potential levels in the point transistor. Provided that the points are very close together the "barrier" between the emitter and collector is somewhat lower than the general potential level of the base as a whole. This makes it more likely for most of the emitter current to find its way to the collector.

ally by imagining the base layer to be a barrier separating the two different levels of emitter and collector, the height of which is varied by the signal. The free electrons or holes in the emitter (electrons if *n-p-n*; holes if *p-n-p*) are swirling about in a state of violent agitation. The rate at which they spill over the barrier is dependent on its height. When it is low they spill over in great quantities; when high only a few can manage it—the fast ones. The signal, therefore, in controlling the height of the barrier, effectively controls the collector current, and in doing so consumes only a fraction of the power which can be dissipated by the collector circuit. Thus there is power gain, and amplification is then possible.

Point Transistors

Junction transistors have been explained first because point transistors operate in exactly the same way, though constructed and formed differently. Fig. 23 shows a diagram of a point transistor. The two points, which are the emitter and collector, are close together, being usually only a few thousandths of an inch apart. It is possible to construct such a transistor from a germanium diode by placing a third electrode close to the original contact. If a suitable spot is found it then acts as a transistor.

In the commercial production the transistor is "formed," and this process produces a small hemisphere of *p*-type material around each point in an *n*-type crystal. This is indicated in the diagram by the dotted lines. Thus there are junctions between the different materials exactly as in the previous case. The difference here is that the junction areas are small and the effective part of them even smaller, for only those portions which are very close have an effective transistor action. It will, therefore, be realized that the power handling capacity of the point transistor is very much less than that of the junction type.

Fig. 24 shows a three-dimensional representation for the point transistor similar to that in Fig. 20 for the junction type. The action takes place mostly within the area represented by the dotted rectangle ABCD, the rest of the crystal being unnecessary. This is in effect a junction transistor in miniature.

REFERENCES

[1] Shockley, W.: "Transistor Electronics." *Proc. I.R.E.*, Nov., 1952.
[2] Morton, J. A.: "Present Status of Transistor Development." *B.S.T.J.*, May, 1952.
[3] Conwell, E. M.: "Properties of Silicon and Germanium." *Proc. I.R.E.*, Nov., 1952.
[4] Roddam, T.: "Transistors." *Wireless World*, Feb.-Dec., 1953.

"Consol" Beacon Receiver

THE introduction of a compact receiver designed especially for receiving the "Consol" radio beacons in small ships focuses attention on a long-range navigational aid of which little has been heard recently. One advantage of this system is that it can be utilized by seafaring people unskilled in operating radio equipment, and in the case of this new set its operation is further simplified by employing pre-set station selection.

Consol beacons radiate rotating patterns of dots, dashes and equi-signal areas and taking a bearing merely resolves itself into counting the dots and dashes that precede the arrival of the continuous note signal. Charts then give the exact bearing, but it requires at least two stations, suitably positioned on land, to provide a position or "fix." The two giving coverage over home waters generally are Bush Mills in Northern Ireland and Stavanger in Norway. The range of a beacon is about 1,000 miles over sea and 700 miles over land in daylight and about half as far again at night. Consol is a c.w. beacon and operates in the 250-500-kc/s beacon band.

In the receiver developed by The Great Grimsby Coal, Salt and Tanning Co., Fish Dock, Grimsby, for fitting in a number of the smaller North Sea fishing craft, there are two r.f. stages, a detector/oscillator, one audio amplifier and an output tetrode embodying an audio filter.

The received c.w. signal is heterodyned by the internal oscillator and the beat note is heard in a pair of headphones. Alternatively, the signals can be read visually on a built-in milliammeter.

To meet the requirements of smaller ships the receiver is normally operated from a 12- or 24-volt d.c. supply by means of a rotary converter, but it can be supplied for other operating voltages if necessary. Apart from its use in fishing craft, it would seem to be well suited for use in private yachts and motor cruisers requiring an easy-to-operate navigational aid in the waters around these islands. The overall size of the receiver is only 13 × 9 × 9in. A 50- to 60-ft aerial, which should have as much of its length as possible vertical, is required for best results.

Information on the method of obtaining a "fix" with the Consol beacons is given in Section VI of the "Complete Weekly Edition of Admiralty Notices to Mariners" and also in the 1953 edition of the "Admiralty List of Radio Signals."

Recovering Hidden Signals

Use of Correlation Techniques

By JAMES FRANKLIN

ONE of the latest methods of analysing electrical signals—or indeed variations in time of almost any kind—is by means of a somewhat fearsome-sounding thing called the "correlation function." Actually it was invented by G. I. Taylor as long ago as 1920, but only recently has it come into real prominence and been used in a practical sort of way. This is probably due to the current interest in information theory and the modern habit of looking at signals in terms of statistics and probabilities. The correlation function is, in fact, a statistical property of a signal, and it means exactly what it says. It measures the extent by which one part of a signal is proportionately related to an earlier part—or, alternatively, the extent by which one signal is related to another signal. For example, if the signal (or time function) consists of completely random variations, like noise, there is practically no correlation between one part of it and another. One cannot say that the present fluctuations are in any way controlled by or related to those which have occurred earlier. But if the signal is periodic in nature, like a sine wave, there is a very strong relationship between present and past variations. There is, in fact, a definite law connecting them, and what happens at the present moment is completely controlled by what has happened previously.

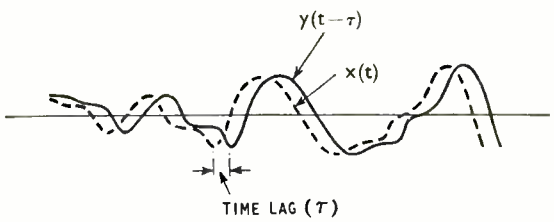


Fig. 1. Two signals with a delay time τ between them. As y(t−τ) is actually a delayed version of x(t), a comparison of values at any point is, in effect, a comparison of past and present values of x(t).

This measure of correlation is obviously of great value in making predictions. From a knowledge of how present variations in some physical phenomenon are related to earlier variations one can guess with a fair degree of certainty what will happen in the future. We all tend to use this principle intuitively for predicting the weather, and, in fact, meteorologists do the same thing, but more precisely on a numerical basis, by deriving the correlation function from data on graphs which record such things as temperature and humidity variations.

In the communication field, however, the main use of the correlation function is in analysing signals to detect periodic components which may be heavily masked by random variations or noise. If one has a signal which appears on the surface to be all random noise, but one suspects that a certain periodic component is present, then the correlation function will either confirm or deny that suspicion. Actually, the degree of correlation turns out to be a measure of the power of the periodic component.

But how does one perform the measurement of correlation in practice? One way is to tabulate values of the signals or time functions and perform a series of calculations on them. This is extremely laborious, however, and most people nowadays use an analogue computor to do the job. If the analogue computor can be made to work almost instantaneously it is possible to do away with the tabulation and feed the signal or time function into it directly. The answer, however, still comes out in the form of a slowly plotted graph. A device which responds in a completely instantaneous way to correlation in a signal is the correlation detector. This has been used in radar receivers, and it gives a steady output proportional to the power of the periodic component, rather as an a.m. detector in a conventional receiver gives an output proportional to the amplitude of an incoming carrier wave.

When correlation measurements are made to find the degree of relationship between present and past values of one particular signal, the result is known as the "auto-correlation function." When the measurements are made between two different signals which may be related it is the "cross-correlation function" that is being investigated. Thus, in practice, an "auto-correlation detector" is a device in which the incoming signal is compared with a slightly delayed version of itself, while in a "cross-correlation detector" the incoming signal is compared with a separate locally generated signal which is arranged to have the same frequency as the wanted periodic component.

In the minds of most people the idea of correlation is rather vague and imprecise. We recognize the relationship between things of similar pattern or form by an intuitive process and we are not very conscious of the mechanism by which this similarity is detected. It is therefore rather difficult to understand how correlation between physical variables can actually be measured in numerical terms. As was mentioned above, the correlation function is a measure of the extent by which the value of a signal at a time t is proportional to the value of another signal at an earlier time, t-τ. Fig. 1 shows two such signals, $x(t)$ and $y(t\text{-}\tau)$. They can be entirely separate signals, or, as appears from the diagram, $y(t\text{-}\tau)$ can be simply a delayed version of $x(t)$, which enables the correlation to be found between some present value at time t and a previous value at time t-τ of the same waveform. In what follows the symbol x will be used to denote the instantaneous value of $x(t)$ at some arbitrary instant of time while y will denote the value of $y(t\text{-}\tau)$ at that

same instant and therefore corresponds to the value of signal $x(t)$ at a time earlier by τ. The question is then: to what extent is $x(t)$ proportional to $y(t-\tau)$, as distinct from being affected by other possible components?

One way of considering the matter is this. If $x(t)$ is really to some extent proportional to $y(t-\tau)$, when x is large the more likely it is to be related to large values of y than to be the result of other causes not connected with $y(t-\tau)$. At the same time, if y is large it is more likely to be associated with a large value of x than if it is small. Thus the two waveforms have a greater probability of being related when x and y are both large together than when x is large and y is small, or when y is large and x is small. When they are both small one can draw no conclusions.

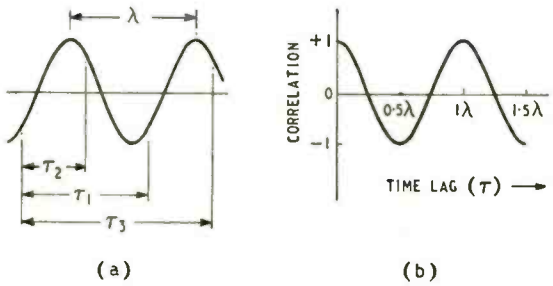


Fig. 2. At (a) is a sine wave showing possible time lag intervals for auto-correlation, while (b) is the associated auto-correlogram plotted with the time lag in terms of the sine wave period λ.

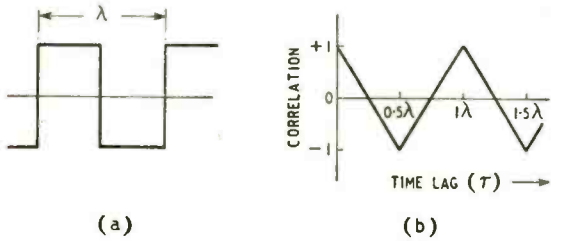


Fig. 3. At (a) is a square wave and at (b) is its auto-correlogram.

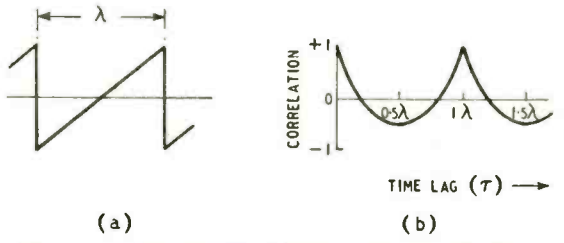


Fig. 4. Another example of auto-correlation, showing a sawtooth waveform at (a) and its auto-correlogram at (b).

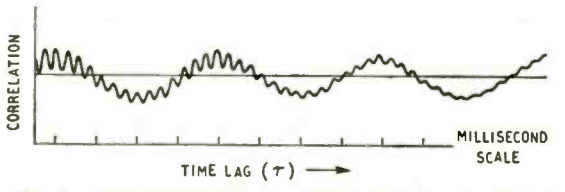


Fig. 5. Auto-correlogram of a speech waveform produced by a male speaker saying "ee" as in "feed." The two main periodicities are at 250 c/s and 3.5 kc/s.

Thus, one can say that the correlation at any single point is proportional to the product of x and y, which is only large and positive when both x and y are large (either positive or negative) together. It is necessary, however, to take the average of a large number of such products to be able to decide the degree of correlation between the complete waveforms. Thus the correlation function finally turns out to be the average of the product $x(t).y(t-\tau)$, and it is expressed mathematically as

$$\frac{1}{2T}\int_{-T}^{+T} x(t)\,.\,y(t-\tau)\,dt$$

In principle the averaging should be performed over all time, but in practice it is only necessary for the averaging time to be large compared with the period of the slowest variations in $x(t)$ and $y(t-\tau)$ or lowest frequency components.

When expressed in this way the value of the correlation function is obviously affected by the amplitude of either of the two signals, although the form of the relationship between x and y is not changed. It would clearly be better to express the function in a form which depends only on the shape of $x(t)$ and $y(t)$ and not on the amplitude of either signal. Correlation between many different types of signal could then be measured on the same scale. This can, in fact, be done by replacing $x(t)$ and $y(t-\tau)$ in the formula by the ratios $x(t)/\sqrt{\overline{x^2}}$ and $y(t-\tau)/\sqrt{\overline{y^2}}$, in other words, by dividing both signals by their r.m.s. values. The result is then known as the "normalized correlation function" and its values always lie between the limits -1 and $+1$. If the normalized value is $+1$ then $y(t-\tau)$ is exactly proportional to $x(t)$. If it is -1 then $y(t-\tau)$ is proportional to $-x(t)$. If the normalized value is zero, there is no linear relationship between $x(t)$ and $y(t-\tau)$ for that value of τ or time lag.

The extent of the time lag is, of course, important in determining the correlation values, and to get a complete picture or "correlogram" the measurements have to be made with a large number of values of τ. For example, supposing we are finding the auto-correlation function of the sine wave in Fig. 2 (a), the time lag τ_1 will clearly give maximum correlation $(+1)$ because it corresponds to the period of the sine wave. A time lag of either τ_2 or τ_3, however, will give maximum negative correlation (-1) because here the points compared are 180° out of phase.

If the amount of correlation (in normalized values) is plotted for a large number of different values of time lag τ the result comes out as shown in Fig. 2(b) which is the "auto-correlogram." It can be seen that the auto-correlogram is a sine wave like the original signal, and, in fact, it is a general rule that where the signal is periodic the correlogram is too. Some other examples of signals with their auto-correlograms are shown at Figs. 3 and 4. It will be noted that where the time lag τ is zero the signal is being compared with itself, so that obviously the correlation must be a maximum.

When the auto-correlation function is measured for more complex signals, but which contain various periodic components, the result is usually something like Fig. 5, which shows an analysis of an audio signal produced by the continuous sound "ee" as spoken by a man. From this auto-correlogram it is possible to do a frequency analysis. It will be noticed, for example,

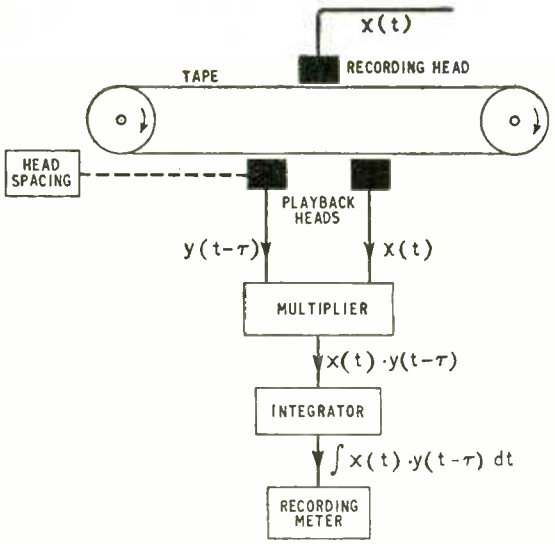


Fig. 6. Simplified schematic of an auto-correlation analogue computor using a magnetic tape system to obtain the necessary time lags. The recording meter prints the values of successive integrals (one for each time lag) as a series of vertical lines of varying height.

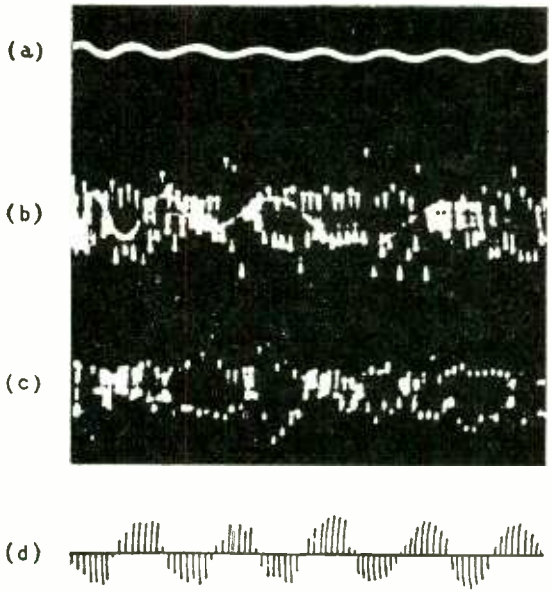


Fig. 7. Example of detecting a periodic signal in noise by means of an auto-correlation computor. At (a) is the signal while (b) is the noise and (c) the mixture of signal and noise. The auto-correlogram, indicating the periodicity, is shown at (d), the line heights being proportional to the values of successive integrals as the time lag τ increases in steps along the horizontal axis. (Courtesy E.E.G. Journal.)

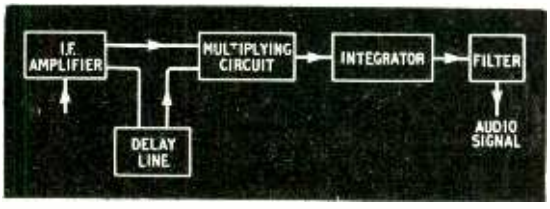


Fig. 8. Block diagram of an auto-correlation detector.

that the principal maxima are produced with a time lag, τ, of 4 milliseconds, and this period corresponds to a frequency of 250 c/s. One might argue that this type of measurement does not give any more information than an ordinary spectrum analysis, which is quite true. The form of presentation does, however, bring out the less obvious relationships and periodicities which would not be shown up by other means. For this reason correlation techniques have been used on complex signals such as speech waveforms, television signals and electrical brain rhythms in an effort to discover any significant relationships which are not normally apparent.

It was mentioned earlier that an analogue computor could be used to calculate the correlation function automatically. One example of such a device is shown in Fig. 6 in very simplified form. Supposing we are concerned with auto-correlation for the moment, the necessary delayed version of the signal is obtained by recording the waveform on magnetic tape and then taking it off by two playback heads, one displaced slightly from the other. The first head to encounter the signal then gives $x(t)$ while the second one gives the delayed version $y(t-\tau)$. These two signals are multiplied by an electronic circuit to give $x(t).y(t-\tau)$ and finally integrated by another circuit to give $\int x(t).y(t-\tau)dt$. The time lag τ is varied in steps by an automatic mechanism which alters the distance between the playback heads for each successive revolution of the tape, and for each particular value of τ the value of the averaged product is plotted by a recording meter.

With cross-correlation between two separate signals it is necessary to use two recording heads, one for each signal, working on adjacent tracks on the tape. The two pick-up heads are similarly arranged with one on each track.

As was mentioned earlier, one of the important applications of correlation techniques is in recovering signals from noisy backgrounds. Fig. 7 is an example of what can be done in this direction with an auto-correlation computor (such as in Fig. 6) indicating the periodicity by its plotted measurements. The original periodic signal is shown at (a) while (b) is the noise—very much greater in amplitude—and (c) is the mixture of signal and noise. It is almost impossible to detect the presence of the signal in (c) by ordinary methods, but the auto-correlation computor gives the result of (d). This shows that the periodic component has been correlated but the random fluctuations of the noise have not. Thus the auto-correlation computor operates in the time domain to achieve a result that only an extremely narrow-bandwidth filter could give in the frequency domain, and in certain applications this can be a definite advantage. Moreover, the computor is not restricted to working at one particular signal frequency whereas the filter is.

For producing an instantaneous output signal there is (as was mentioned above) another device—the correlation detector. A typical arrangement for one working on the auto-correlation principle is shown in Fig. 8. From the i.f. amplifier of the receiver two identical output signals are obtained, one of them being passed through a delay line. The i.f. signal and its delayed version are then applied to the two grids of a multiplying valve, which gives an output proportional to the product. This is then integrated in a capacitor over a sampling interval which is short compared with one half-cycle of the highest modulation frequency but long compared with the carrier fre-

quency. The capacitor is discharged at the end of each sampling interval, so the waveform across it consists of a series of sawteeth rising to different amplitudes—which represent successive integrations corresponding to the lines of varying height in Fig. 7 (d). The sawteeth are then passed through a filter and the original modulating frequency is recovered.

The auto-correlation function is often quoted as being "the Fourier transform of the power spectrum." This means that if one does a frequency analysis of $x(t)$ and the normalized correlation function one finds that they both have exactly the same frequency components, but that the amplitudes of the components of the correlation function are proportional to the power of the corresponding components of $x(t)$, that is, proportional to the squares of the amplitudes. One might expect from this that it would be no easier to frequency analyse a signal from the correlation function than from $x(t)$ itself, but it is easier in fact because in $x(t)$ the frequency components have widely differing phase relationships, whereas in the normalized correlation function they are all in phase when $\tau = 0$.

To end on a practical note, one interesting example of correlation techniques being applied to industrial purposes occurs in the textile industry. An auto-correlogram computor has been developed by the British Rayon Research Association for analysing periodic components in the irregularities which occur in the cross-section of yarn. These periodic components can produce highly objectionable patterning in a fabric when it is woven at cloth widths bearing some relationship to the wavelength of the component. In order to characterize the yarn output from a set of spindles it is necessary to take a large number of yarn samples, so a comparatively cheap computor is needed to analyse the output signal from a yarn irregularity measuring instrument in as short a time as possible.

The computor used actually works on the principle shown in Fig. 6. The electrical signal corresponding to the variations in yarn cross-section is obtained from a Fielden-Walker yarn-irregularity tester, and is recorded on the tape in the form of frequency variations. Two demodulators following the playback heads then convert the frequency variations back into amplitude variations before they are applied to the computing circuits.

Commercial Literature

Band I/Band III Television Aerials, for chimney mounting, with both aerials consisting of a dipole and reflector and feeding into a single 70-Ω downlead. Performance figures given on a leaflet from Wolsey Television, 43-45, Knight's Hill, West Norwood, London, S.E.27. Also a leaflet discussing the reception problems created by Band-III stations which are not co-sited with Band-I stations.

R.F. Cables; coaxial solid and air-spaced types for general purposes and various types of twin and coaxial for television feeders and transmission lines. Tables of characteristics in an illustrated catalogue from W. T. Henley's Telegraph Works Company, 51-53, Hatton Garden, London, E.C.1.

Coil-winding Bobbins of synthetic resin-bonded paper for use with standard laminations and "C" type cores. Booklet giving types, dimensions and prices from Associated Electronic Engineers, Dalston Gardens, Stanmore, Middlesex.

"Silver Plating," a booklet describing in a practical manner the various processes involved in preparing the work, plating and finishing, from Johnson, Matthey & Co., Hatton Garden, London, E.C.1.

Carbonyl Iron Powders; their properties, manufacture, testing and use in magnetic cores and waveguides described in a well-produced illustrated booklet from The Mond Nickel Company, Sunderland House, Curzon Street, London, W.1.

Sonic and Ultrasonic Testing. Determination of elasticity, compressive strength and porosity of materials and detection of flaws; methods and electronic equipment described in a booklet from A. E. Cawkell, 6-7, Victory Arcade, The Broadway, Southall, Middlesex.

Miniature Stud Switches (Painton Winkler), one- to four-pole and one to six banks operated from common shaft. Various numbers of positions are available up to 29 and the action can be make-before-break or break-before-make. Leaflet from Painton & Co., Kingsthorpe, Northampton.

Miniature Transistor Transformers; a range of two input, one output and two interstage types, all measuring (in Mumetal screening cans) $\frac{9}{16}$in × $\frac{1}{2}$in × $\frac{25}{64}$in. Leaflet giving impedance ratios, d.c. resistances and frequency responses from John Bell & Croyden, 117, High Street, Oxford.

Audio Amplifier with output power of 25 watts and frequency response of ±1db between 10c/s and 100kc/s. Distortion at 26 watts output less than 0.2 per cent. Specification and test report from Southampton University on a leaflet from Cape Electrophonics, 43-45, Shirley High Street, Southampton.

Printed Circuit Preservative. A liquid which can be sprayed or brushed on to printed circuits to prevent oxidation during storage and also to act as a flux for dip soldering. Descriptive leaflet from Multicore Solders, Multicore Works, Hemel Hempstead, Herts.

Anti-corrision Bolts; made of Monel alloy to prevent corrosion of threads under nuts. Mentioned in a bulletin "Wiggin Nickel Alloys" from Henry Wiggin & Co., Wiggin Street, Birmingham, 16.

Silicone Insulated Transformers (power types) with resistance to fire and moisture. There is little change in the dielectric strength of the insulant over a period of time at temperatures in the 200-250°C range. Brochure from Brentford Transformers, Kidbrooke Park Road, Kidbrooke, London, S.E.3.

Point-to-point Communications Station consisting of transmitter and receiver working on frequencies between 1.6 and 14 Mc/s. The 60-watt transmitter is a crystal-controlled, four-channel type with push-button channel selection, and the receiver also has four pre-set crystal controlled channels. Leaflet from Pye Telecommunications, Newmarket Road, Cambridge.

Portable Wheatstone Bridge with measuring range of 0.01Ω to 1MΩ, using internal battery and galvanometer, and an accuracy of ±0.1Ω. Leaflet from the Croydon Precision Instrument Co., 116, Windmill Road, Croydon, Surrey.

Solderless Connections; a system for attaching tags, pins and other connectors to wires and cables by a crimping process. Booklet describing the process and various crimping tools from The Plessey Company, Ilford, Essex.

Printed Circuits; application to various equipments such as audio amplifiers, power supplies, television i.f. amplifiers and filters, with notes on dip soldering, discussed in a bulletin from The Telegraph Condenser Co., Special Products Division, North Acton, London, W.3.

Wide-range Oscilloscope (for testing advanced equipment) with provision for incorporating sub-units for specialized requirements. Includes facilities for instantaneous voltage and time measurement, sweep delay (with respect to sync) and control of tube e.h.t. and bias, while the Y amplifier can be switched to high gain and 9Mc/s bandwidth or low gain and 25Mc/s width. Leaflet from E.M.I. Factories, Hayes, Middlesex.

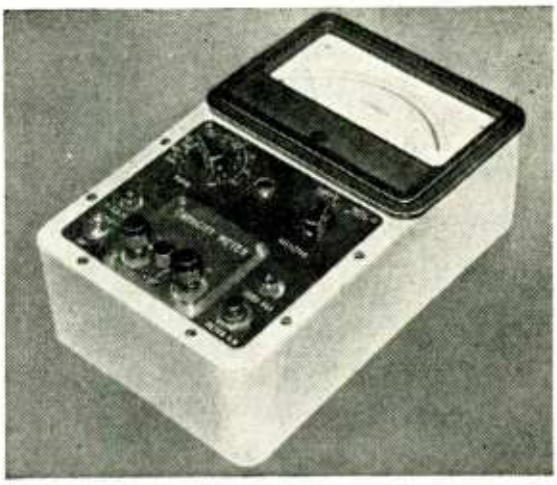
Combined Television Tester, covering Bands I and III and incorporating a pattern generator, wobbulator, a.m. signal generator, l.f. oscillator, oscilloscope, e.h.t. voltmeter and a.c. and d.c. valve voltmeter. Portable instrument measuring 15½in × 9½in × 8½in and weighing 25lb described in a leaflet from Airmec, High Wycombe, Bucks.

Airfield Radio Communications, for traffic control, and public address equipment; their application described briefly in an illustrated booklet "Airport Electrification" from The General Electric Company, Magnet House, Kingsway, London, W.C.2.

Direct-Reading Capacitance Tester

Range 10pF to 1,000 μF with Insulation Resistance 0.3 to 2,000 MΩ

By O. E. DZIERZYNSKI



Direct-reading capacitance and insulation meter made by Sargrove Electronics Ltd.

THE conventional method of measuring capacitance is to compare the unknown with a standard in a bridge circuit. The method is accurate and provides a wide range of measurement. It is simple and inexpensive. When large numbers of capacitors of different values require checking, however, the time taken in setting and balancing the bridge is a disadvantage, and a direct-reading method is much to be preferred.

The instrument to be described, gives direct readings of capacitance on a moving-coil milliammeter. The scale is linear (1 to 10) and gives readings from 10pF to 1,000 μF in eight decades. Insulation tests can also be carried out at voltages close, in most cases, to the rated working voltages of the capacitors. Three overlapping ranges give direct readings of resistance from 2,000 MΩ to 0.3 MΩ the scale calibration law is similar to that of the conventional ohmmeter.

Capacitance Circuit.—The basic circuit for measuring capacitance is given in Fig. 1. A 50-c/s source drives a current through C_x and R in series. Provided that the reactance of C_x is at least 10 times greater than R, the current is almost proportional to the value of C_x when decreasing from $C_x$max to the minimum value $\frac{C_x\text{max.}}{10}$

The voltage developed across R will be

$$V = IR \approx V_0 \Big/ \frac{1}{\omega C} R = V_0 R \omega C$$

As V (as will be discussed later) is of the order of a fraction of a volt, amplifier A is necessary between V and the linear-scale a.c. instrument. Consequently, the reading of the instrument is $V_1 = k V_0 R 2\pi f C$, where k is the gain of amplifier A.

In the above formula k, V_0, R and f are constant, hence instrument readings in a.c. volts are proportional to the capacity C. An important fact to emphasize here is, that the voltage V_0 must be sinusoidal, and the maximum permissible distortion should be less than 5%.

Capacitance Ranges.—From the last formula, the capacitance reading can be expressed as:

$$C = \frac{V_1}{kV_0 R 2\pi f}$$

The values of k and V_0 are normally constant, irrespective of range (with the exception of highest and lowest range—see later in text), the frequency (50 c/s) is constant; so the range of the instrument can be varied only by the value of R.

On the second range (100-1,000 pF) the impedance of the capacitance under test varies from about 3 to 30 MΩ, so the resistance R should be of the order of 300 kΩ. For the following five ranges (0.001-0.01μF, 0.01-01μF, 0.1-1μF, 1-10μF and 10-100μF) the value of R is successively divided by 10 for each range.

The input voltage V_0 was chosen to give a maximum voltage across R of 250 mV. The output meter gave full-scale deflection for 25 volts a.c. input, so the required gain in the amplifier was 100. This could be comfortably provided by an ECC81 double triode connected as an R-C coupled cascade amplifier with negative feedback (Fig. 2).

The highest range (100-1,000μF), which is used primarily for electrolytic condensers, must be given separate treatment. The impedance of 1,000-μF at 50 c/s is about 3 ohms, and with the standard input a current of the order of 1 ampere would flow, with detrimental results not only to the condenser, but to the stability of the input voltage. The value of R is therefore reduced on this range. In practice the

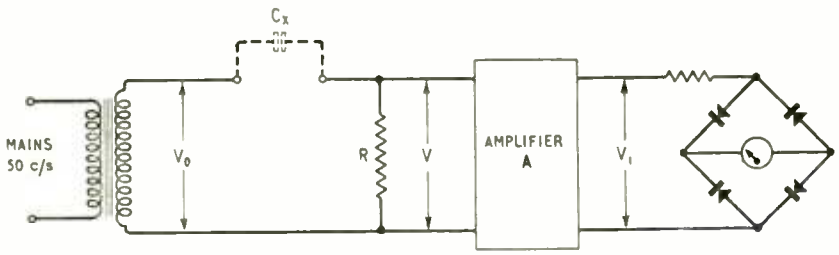


Fig. 1. Basic circuit for capacitance measurement.

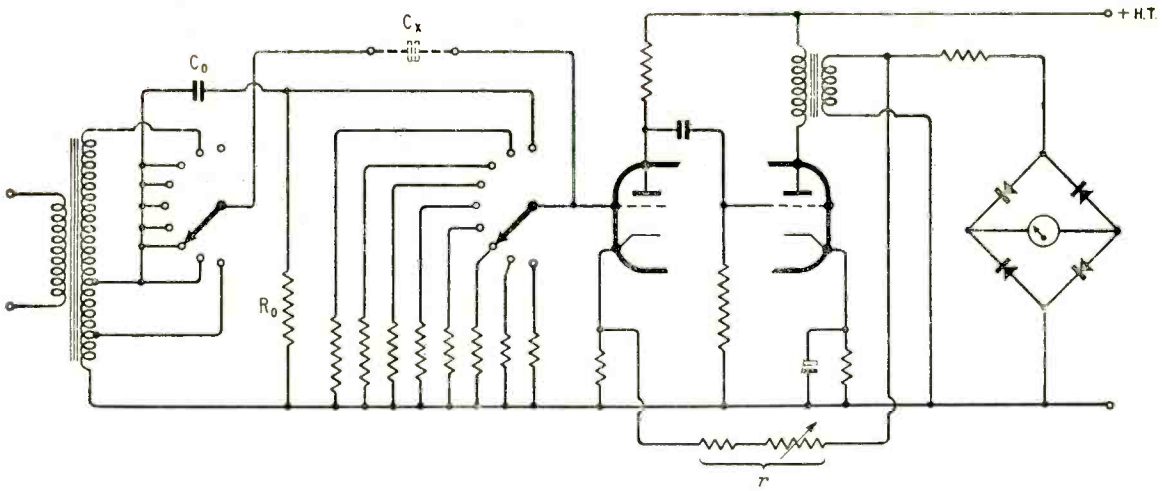


Fig. 2. Capacitance range switching and amplifier circuit.

use of raw a.c. for testing electrolytics proved to be quite successful.

On the first range (10-100pF), the impedance of the condensers under test are of a very high order (approximately 300-30 MΩ respectively) and resistor R should be 2 MΩ. For practical reasons (hum pick-up, stray capacitances, etc.) it is advisable to keep R as low as possible. Consequently, on this range V_0 was increased 10 times with R remaining the same as in the 100-1,000 pF range.

Amplifier.—The R-C coupled amplifier incorporates negative feedback derived from the secondary of the output transformer and applied through *r* to the cathode of the first stage. Part of resistor *r* is variable and in this way it is possible to control the gain of the amplifier. This control is used only when the calibration of the instrument is being checked.

The amplifier—owing to considerable negative feedback (approximately 10 db) has good stability and the principal reason to introduce control of gain is to compensate for the effects of mains supply voltage variations on the input voltage V_0.

When the range switch is set to the first (calibration) position, the standard condenser C_0 (0.001μF) combined with resistor R_0 (of the same value as R on the range 100-1,000 pF) is connected in the normal way for capacity measurement. Exactly full-scale deflection should be then obtained, and if not, resistance *r* controlling the gain of the amplifier must be adjusted accordingly.

Accuracy.—In general this should be better than 5% with good and medium quality condensers. Condensers with excessive leakage should give higher readings for capacity, as the effective impedance would fall and larger currents would appear in resistor R. To keep readings correct on range 10-100 pF requires not only good internal insulation of condenser, but also that outside dirt, and particularly moisture around the terminals and on the body of the condenser, should be reduced to the minimum. A series of tests and measurements has been carried out on this subject and the results obtained are summarized in Fig. 3. Assuming that errors should not exceed 5%, values of maximum permissible leakage have been determined, depending on the value of capacity.

This curve shows that leakage in the very great majority of tested condensers would not affect the capacity reading. The normal insulation resistance of a 0.1 μF condenser, for instance, is of the order of at least hundreds of megohms. Generally speaking, normal insulation in the first three ranges is of the order of 1,000 MΩ and moisture and dirt on the body of the capacitor, or poor insulation in the meter itself are more likely to be the limiting factors.

Insulation Measurement—Fig. 4 gives a general

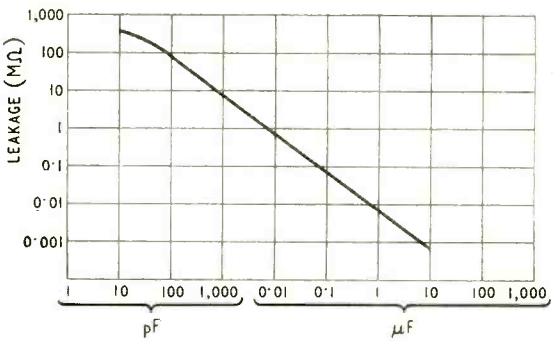


Fig. 3. Permissible leakage resistance for reading accuracy up to +5% in capacitors of different values.

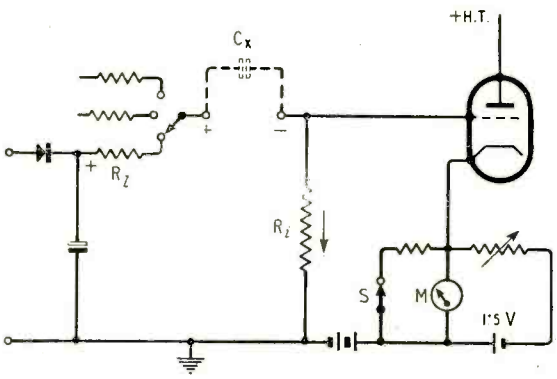


Fig. 4. Basic circuit for insulation test.

idea of the circuit used in the insulation test. To the condenser C_x under test a voltage of the same order as the rating of condenser is applied in series with resistances R_l and R_i. Leakage in the condenser would produce a voltage drop in resistor R_i which would apply a positive potential to the grid of the valve, causing an increase of anode current, measured by meter M (0-1 mA).

Resistor R_l serves to limit this voltage drop in the case of very low insulation or a short circuit between the condenser terminals; also to improve the calibration law. Meter M is connected in a simple backing-off circuit. Initial anode current is approximately 3 mA and this current is reduced to zero in the meter by means of the 1.5-V battery. Under these conditions an ECC81 valve will still work on the linear part of its characteristic, and, with negligible load in the anode circuit, maximum sensitivity is obtained (theoretically equivalent to the mutual conductance).

Insulation Ranges.—Three ranges have been employed: 2,000—30 MΩ, 200—3 MΩ and 20—0.3 MΩ. Test voltages and limiting resistance have been chosen so that for simplicity of calibration, 2,000, 200 and 20 MΩ on the various ranges are approximately 1/10 of full-scale deflection (same spot) and 30, 3 and 3 MΩ are at about 85% of f.s.d. The calibration law is similar to that of an ordinary ohmmeter with this difference, that no f.s.d. adjustment is necessary (ranges are also much more spread than in an ohmmeter).

Owing to the fact that the current in the meter is compensated, the initial zero indication has to be adjusted.

When testing a condenser for insulation the initial surge current could be quite considerable (particularly in electrolytics) and to prevent overloading the meter, provision has been made to reduce sensitivity 10 times (while switch S remains closed).

Test voltages (according to range) are 500V, 50V or 5V d.c.; limiting resistances range from several megohms to a fraction of a megohm. Resistor R_i is fixed and incidentally is equal to R in capacity measurement circuit (second range).

Insulation Precautions.—When testing high insulation, particularly in the low-capacitance range, special precautions must be taken, not only to prevent leakage across terminals, but also leakage from the positive terminal to earth. Leakage to earth would bypass the tested condenser and resistor R_i, decreasing the reading considerably. Consequently the positive terminal and associated components (such as switches) must be very well insulated from earth (ceramic wafers); also kept in dry, warm conditions.

The condenser itself, during the test should not be touched, being suspended between terminals or resting on a special insulating base (see photograph).

High accuracy of insulation measurement is not normally required, but in this system ±10% can be achieved. From time to time, using an external standard, say 20 MΩ, calibration should be checked, as, if the valve emission deteriorates, readings become high, and this cannot be compensated, as it is by feedback in the a.c amplifier in the capacity meter.

Constructional Notes.—When developing the final circuit and layout of components, several factors had to be taken into consideration. Regarding the circuit itself, switching over from insulation to capacity test and *vice versa* presented the main problem. This was solved by using an 8-way, 2-position ceramic selector switch.

In the insulation position, the first section of the ECC81 works as the d.c amplifier, the second section being disconnected.

The range switch is of the 3-way, 9-position type, also with ceramic wafers.

Important factors when designing the mechanical layout were:

1. Negligible hum pick-up from internal and external sources.
2. Low internal capacitance and good insulation between terminals and between associated components.
3. Compactness.
4. Necessary controls on front panel.
5. Easy access for servicing.
6. Layout convenient for wiring in sub-assemblies.
7. Provision for testing condensers *in situ*.

An interesting details in the design is that the negative return is connected to the chassis through 0.1 μF. Laboratory tests of residual capacity between terminals gave a figure less than 0.5pF, and consequently capacitors of the order of 1—10pF could be tested on this equipment after extending the range by increasing the parameter V_oR ten times with reference to the first range (0.0001 μF f.s.d.).

The photograph shows the two switches (selector and range), two small pre-set knobs for adjusting zero and f.s.d. when setting for insulation and capacity tests respectively, main switch and meter switch—the latter chiefly for use when testing electrolytic condensers (to prevent overloading of the meter by the first surge). As, on the capacity test position, a.c. voltages are exposed between the live terminals and earth (middle terminal connected to the negative return), the appropriate circuits are protected by fuses in the event of an accidental short circuit. Fuses are located on the underside of the case.

Compact Tape Recorder

A SINGLE tape speed of 3¾ in/sec has been adopted in the new Philips "Recordergram" Model AG8105, which, with twin tracks on 600 ft (5-inch) reels, gives one hour's playing time. The circuit employs a single ECC83 double triode, followed by an EL84 which functions alternatively as output valve or h.f. oscillator; the level indicator is the new DM71 with "dot and line" display. There are separate volume controls for recording and reproduction in addition to the main function-control knob.

A crystal microphone is supplied and there are facilities for using the amplifier for disc record reproduction.

The dimensions of the case are 13¾ in × 10 in × 7 in, the weight is 21 lb and the price £36 15s.

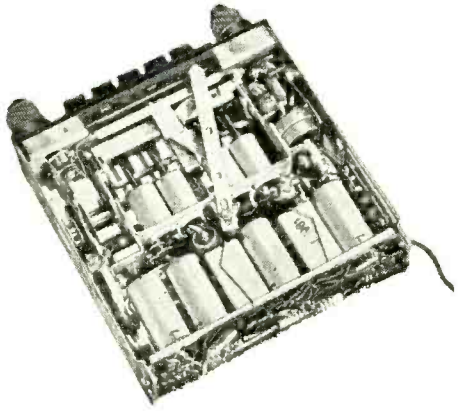
Philips portable tape recorder Model AG8105.

Manufacturers' Products

NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

Car Radio Units

AN entirely new range of car radio sets has been introduced by Radiomobile to replace the units brought out in 1950. The new sets are again made in three separate units; a control unit, an amplifier and a loudspeaker system. But in the new models much re-arrangement of parts and circuit has been effected, with the result that greater sensitivity is afforded, the electrical link between units offers greater freedom from external interference and the power output is increased.



Inside of the new de luxe Radiomobile control unit, model 200X. Note the compactness and orderly layout.

The four basic units comprise a standard radio control unit (model 220X), containing the first three valves of a superhet receiver, a standard amplifier with 2 valves, one of which is a rectifier; a *de luxe* amplifier with 2 valves plus a metal rectifier. The standard amplifier operates one loudspeaker while the *de luxe* model gives sufficient output for two speakers.

Push-button selection of five stations plus free-tuning facilities are provided by the *de luxe* radio control unit, but the standard unit has free-tuning provision only. The makers claim that the new standard model is some four times more sensitive than the old one.

Prices of the new sets are: model 220X, £24 9s 1d; model 200XA with standard amplifier, £30 3s or with the *de luxe* amplifier (200XB) £33 10s. Inclusive of U.K. purchase tax and loudspeaker.

The makers are S. Smith & Sons (Radiomobile), Ltd., Goodwood Works, North Circular Road, London, N.W.2.

"Cascap" Capacitors

RECENTLY introduced by Plessey is a new range of miniature ceramic capacitors known as "Cascaps" for working voltages up to 500 d.c. or 300 a.c. They are suitable for use over a wide temperature range and are especially applicable where precision of capacitance value is not of primary importance.

"Cascaps" are made in two basic types, one for purposes such as r.f. by-passing and decoupling and the other for use in radio interference suppressors.

The normal types are in capacitances ranging from 0.0005 to 0.01 μF and made in the form of small discs. A 0.003-μF "Cascap" for example measures 0.5in only in diameter and is about $\frac{1}{16}$in thick. The breakdown voltage is 4,000 d.c. and the insulation resistance of the order of 10^{7} ohms. In general the suppressor types are a fraction larger than the normal variety and comply fully with BSS613 for this class of component.

The capacitors are distinguished by their protective coating of a specially developed green paint having very high insulation resistance and being impervious to moisture.

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

Record Cleaning Material

THE strong electrical charges which attract dust to the surface of vinyl long-playing records are effectively dissipated by the application of minute traces of a chemical cleaning liquid compounded by E.M.I. Sales and Service Ltd., Hayes, Middlesex. To ensure that the liquid is sparingly used it is supplied as an impregnant in a cleaning "cloth" of folded crepe paper which will be known as "Emitex." Each cloth, which costs 1s 6d, will treat an average of 100 record sides.

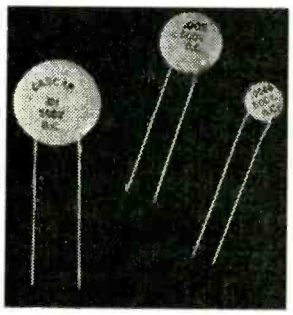
A single application was found to be sufficient to disperse deliberately induced charges which were strong enough to lift the record envelope off the table. Some curious effects were noticed during the cleaning process, due to uneven distribution of the charge, a few particles appearing actually to be repelled by the disc. When the film has penetrated to the bottoms of the grooves, the surface becomes electrically inactive and this process is usually complete after a single playing. Thereafter the treatment should not require to be repeated for several months.

The makers state that the treated surface reduces the friction between stylus and groove by about 20 per cent.

Tape Eraser

PROVISION for erasure is often omitted from small portable tape recorders in the interest of battery economy, and there are many office dictating machines using small spools for which a separate eraser would be convenient.

To meet this demand Leevers-Rich Equipment Ltd., 78 Hampstead Road, London, N.W.1, have introduced a "Junior" version of their bulk eraser in which a strong 50-c/s alternating field is used to bring the tape back to a magnetically neutral state as the spool is rotated over an electro-magnet in the base. The new model is designed to take spools up to 5 in diameter and can be operated from any a.c. lighting point (consumption approximately 1.5 A at 200-250 V). The price is £6 5s.



Plessey "Cascap" miniature ceramic capacitors and (right) Leevers-Rich bulk eraser for small magnetic tape reels.

TWO-VALVE SUPERHET

Simplicity and Economy Without Sacrifice of Performance

By R. C. LEVER*

IN the design of a new type radio receiver, the designer has many problems to overcome, possibly most important of all being the total cost of the finished product. To-day the cheapest domestic receiver available on the open market resolves itself into the popular t.r.f. type. This receiver, which no doubt justly fulfills its obligations in sensitivity, invariably falls by the way when judged from the aspects of selectivity and ease of manipulation. It is for this reason then that the standard four- or five-valve superhet receiver with all the advantages of selectivity and sensitivity is generally favoured. However, the cost of this type usually exceeds that of the t.r.f. receiver. With economy the overriding factor the author decided to combine some of the advantages of both the t.r.f. and superheterodyne receiver principles.

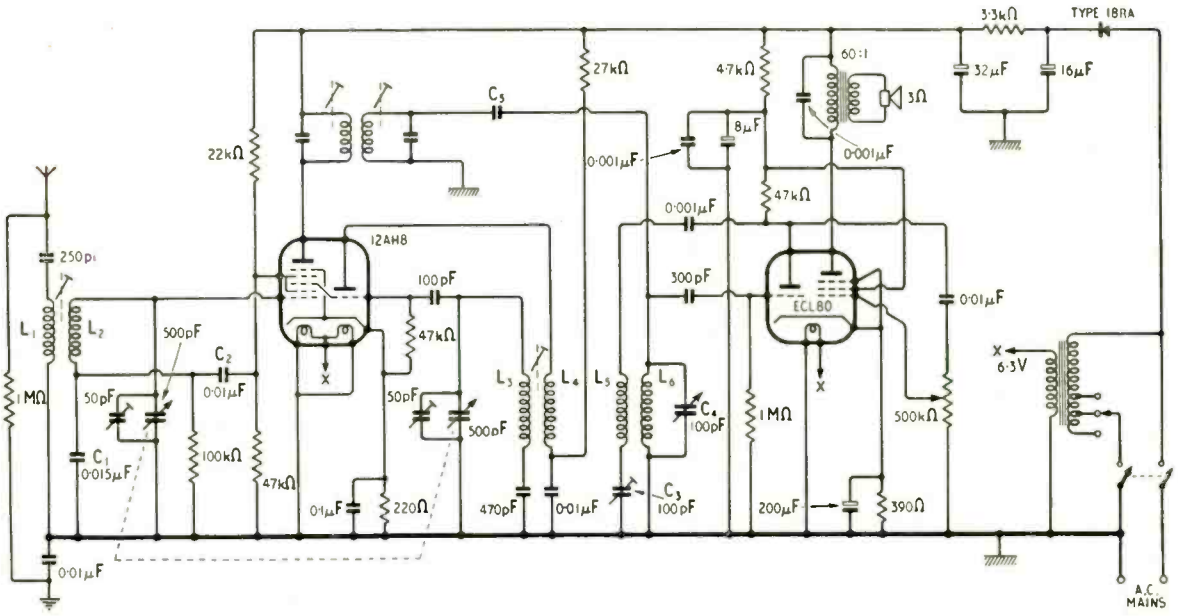
Inspection of the circuit reveals that two valves only are used, a 12AH8 triode-heptode as frequency changer and an ECL80 triode-pentode as detector and audio amplifier. It will be noticed that the normal conventional i.f. amplifier has been omitted, the i.f. output being fed directly into the triode section of the ECL80 which is acting as a leaky grid detector, tuned to the i.f. frequency by L_6C_4.

To overcome the obvious loss in gain due to the omission of an i.f. amplifier stage, regeneration is applied to the grid detector by L_5C_3, the amount of feed-back being adjusted by C_3. The adjustment of this circuit certainly goes a long way to overcome loss of gain and at the same time the selectivity can be made very sharp, again depending on the amount of feed-back. However, it was found that the receiver was still below par as far as sensitivity was concerned and it was decided to look further into this matter.

It is possible to use controlled regeneration in a frequency converter stage to give improved gain, image rejection and signal-to-noise ratio. It will be seen that the screen by-pass condenser, C_2, is returned to ground through the 0.015-μF condenser C_1. The signal-frequency voltage from the screen circuit developed across C_1 is injected into the grid circuit in the correct phase to give positive feed-back at signal frequencies.

Regeneration obtained with this arrangement is proportional to the reactance of C_1 and is, therefore, inversely proportional to frequency. An improvement of about 4 db in sensitivity and image ratio and 2 db in signal-to-noise ratio is obtained at the low frequency end of the broadcast band. At the high frequency end of the band these figures do not hold good but considerable and useful gain is still experienced. C_1 has a critical value; a reduction in its value will result in possible self oscillation of the mixer at the lower frequencies, and conversely if C_1 is increased the overall regeneration is reduced, resulting

* The Trevor-Johnstone Co., Ltd.



Circuit diagram of the 2-valve Superheterodyne receiver described in the text. C_5 is a small capacitor to be found experimentally.

in loss of gain. The value of C_1 (0.015 μF) seems to be the best choice for operation on the medium-wave band; it will have to be increased if the receiver is intended to be used on long waves.

Regeneration always has the disadvantages that variations in gain, e.g., with different valves, are emphasized, but this need not be serious so long as moderate amounts of regeneration are used, sufficient, for instance, to give an improvement of the order outlined above.

The aerial, oscillator coils and i.f. transformer are standard types; in the original receiver Osmor coils were used very successfully, their type QA8 as aerial coil and QO8 as oscillator. For the detector coils L_5L_6, an Osmor long-wave coil type QA12 is used, the iron dust core being removed and the normal aerial coupling coil included in the grid circuit, and the normal grid winding used as the feed-back coil. This arrangement produces the smoothest controllable regeneration, with the grid circuit tuning nicely between 450 and 480 kc/s.

For the d.c. supply a Westalite contact cooled rectifier is used, and as the name suggests dissipates its heat by conduction to the chassis on which it is mounted. The maximum current available from the Westalite type 18RA.1-1-16-1 is 60 mA. In view of the fact that the total d.c. current of the receiver is no more than 32 mA this unit is most suitable, and due to its very small size can be located at any convenient point on the chassis.

The sensitivity of the receiver is approximately 100 μV at the signal grid for 50 mW output.

Although no form of a.g.c. is used, no severe overloading of the detector occurs even on strong local stations. However, no difficulty should be experienced in arranging some form of a.g.c. if it is required.

The circuit shown caters only for medium-wave reception, but the inclusion of a long-wave band is quite straightforward, the only alteration required would be to increase C_1 in value, as already stated, and, of course, fit the appropriate coils and switching in the mixer and oscillator circuits.

BOOKS RECEIVED

Mass Spectrometry by A. J. B. Robertson, M.A., Ph.D. Introduction to the method of analysis in which atoms and molecules are identified and their quantities measured by the position and strength of positive ion beams, after deflection by a magnetic field. Pp. 135+vi; Figs. 30. Price 8s 6d. Methuen and Company, Ltd., 36, Essex Street, London, W.C.2.

Fundamentals of Radar by Stephen A. Knight. Revised second edition of textbook introducing radar circuit principles as an extension of ordinary radio techniques. Pp. 150+ix; Figs. 113. Price 15s. Sir Isaac Pitman & Sons, Parker Street, London, W.C.2.

Unit Constructed TV Receivers by E. N. Bradley. Circuits and wiring plans of units from which a variety of specifications for receivers of different sensitivity and picture size can be met. Pp. 92; Figs. 42. Price 6s. Norman Price (Publishers), Ltd., 283, City Road, London, E.C.1.

Circuits Electroniques by J. P. Œhmichen. Description of typical waveforms, their generation, amplification, measurement and application in selected practical problems. Pp. 256; Figs. 195. Price 1,200 fr. Société des Editions Radio, 9 rue Jacob, Paris 6.

Picture Book of TV Troubles; Vol. 1, Horizontal AFC-oscillator Circuits. Typical faults and their associated circuit waveform and picture distortions. Pp. 80; Figs. 50. Price $1.35. John F. Rider Publisher, 480, Canal Street, New York 13.

How to Use Test Probes by Alfred A. Gerhardi and Robert G. Middleton. Auxiliary probes for use in conjunction with meters, oscilloscopes and valve voltmeters for fault tracing in television and other electronic circuits. Pp. 176; Figs. 127. Price $2.90. John F. Rider Publisher, 480, Canal Street, New York 13.

The Inventor of the Valve by J. T. MacGregor-Morris, D.Sc. (Eng.), M.I.E.E.—A biography of Sir Ambrose Fleming against the background of electrical history, with many personal anecdotes by his contemporaries. Pp. 141; Figs. 22. Price 7s 6d. The Television Society, 164, Shaftesbury Avenue, London, W.C.2.

World Radio-Television Handbook. Edited by O. Lund Johansen.—1955 edition of this directory of broadcasting stations, their wavelengths, interval signals, times of transmission, etc. Pp. 160 with numerous illustrations. Price 9s 6d. Surridge Dawson and Co., Ltd., 136, New Kent Road, London, S.E.1.

Table of the Gamma Function for Complex Arguments.—National Bureau of Standards Applied Mathematics Series 34. Including an introduction on the properties of the gamma function and methods of interpolation, and a bibliography. Pp. 105. Price $2. Government Printing Office, Washington 25, D.C., U.S.A.

Magnetic Alloys and Ferrites.—Survey of recent developments, contributed by six authors and edited by M. G. Say, Ph.D., M.Sc., M.I.E.E. Sections deal with ferromagnetic theory, soft and hard materials and alloys, permanent-magnet ferrites, powder cores, non-magnetic ferrous and magnetic compensating alloys, recording materials and magnetostrictive alloys. Pp. 200+vii; Figs. 115. Price 21s. George Newnes, Ltd., Souhampton Street, London, W.C.2.

Basic Television; Principles and Servicing by Bernard Grob.—Revised second edition of a descriptive analysis of television circuits written by an instructor at the R.C.A. Institutes. Chapters are included on the principal colour television systems and on "trouble-shooting" techniques. Pp. 660+xv; Figs. 462. Price 64s. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4.

Test Scope Traces, by John F. Rider.—Waveforms and their interpretation; circuits and test procedure for use in the production and maintenance of electronic equipment. Pp. 186+v; Figs. 186. Price $2.40. John F. Rider Publisher, 480, Canal Street, New York, 13.

TV Manufacturers Receiver Trouble Cures, Volume 6, in a series dealing with receivers of American origin. Pp. 120+viii; Figs. 75. Price $1.80. John F. Rider Publisher, 480, Canal Street, New York, 13.

TV Field Service Manual with Tube Locations. Edited by Harold Alsberg.—Volume 3 of a series giving typical faults and the components most likely to be involved. This issue deals with American Emerson and Fada receivers. Pp. 120+vi; Figs. 53. Price $2.10. John F. Rider Publisher, 480, Canal Street, New York, 13.

Advanced Television Servicing Techniques by the teaching staff of the Radio, Electronics, Television Manufacturers' Association pilot training course. Prepared with the participation of the American radio industry, to improve the skill and proficiency of service technicians. Pp. 163+xi; Figs. 123. Price $3.60. Complementary *Laboratory Workbook*. Pp. 46 including work sheets. Price $0.95. John F. Rider Publisher, 480, Canal Street, New York, 13.

MARCH MEETINGS

Institution of Electrical Engineers

London.—March 2nd. "Some Comparative Directional Measurements on Short Radio Waves over different Transmission Paths" by E. N. Bramley; "Some Aspects of the Rapid Directional Fluctuations of Short Radio Waves reflected at the Ionosphere" by E. N. Bramley; "On the Rapidity of Fluctuations in Continuous Wave Radio Bearings at High Frequencies" by Dr. W. C. Bain; and "Sources of Error in U-Adcock High-Frequency Direction Finding" by K. C. Bowen.

March 9th. "Artificial Reverberation" by Dr. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter.

March 21st. Discussion "Materials for Valves" opened by Dr. R. O. Jenkins.

All the above meetings will be held at 5.30 at Savoy Place, W.C.2.

North-Eastern Radio and Measurements Group.—March 7th. "Standard Frequency Transmissions" by Dr. L. Essen; "The Standard Frequency Monitor at the National Physical Laboratory" by J. McA. Steele; and "Standard Frequency Transmission Equipment at Rugby Radio Station" by H. B. Law at 6.15 at King's College, Newcastle-upon-Tyne.

North Midland Centre.—March 15th. "Colour Television" by Dr. G. N. Patchett at 6.30 at the Technical College, Bradford.

North-Western Centre.—March 16th. "Artificial Reverberation" by Dr. P. E. Axon, C. L. S. Gilford and D. E. L. Shorter at 6.45 at the Engineers' Club, Albert Square, Manchester.

March 22nd. Discussion on "The Servicing of Electronic Measuring Instruments and its Effect on their Design" opened by Dr. Denis Taylor at 6.15 at the Engineers' Club, Albert Square, Manchester.

South-East Scotland Sub-Centre.—March 15th. "The Genesis of the Thermionic Valve" by Professor G. W. O. Howe; "Thermionic Devices from the Development of the Triode up to 1939" by Sir Edward Appleton, F.R.S.; and "Developments in Thermionic Devices since 1939" by Dr. J. Thomson at 6.30 at the Carlton Hotel, North Bridge, Edinburgh.

March 22nd. Faraday Lecture "Courier to Carrier in Communications" by T. B. D. Terroni at 7.0 at the Central Halls, Edinburgh.

South Midland Radio Group.—March 28th. "Plastics for the Radio Engineer" by M. Jones at 6.0 at the James Watt Memorial Institute, Great Charles Street, Birmingham.

Rugby Sub-Centre.—March 2nd. "Developments in Thermionic Devices since 1939" by Dr. J. Thomson at 6.30 at the Rugby College of Technology.

Southern Centre.—March 9th. "The Manchester-Kirk o' Shotts Television Radio Relay System" by G. Dawson, L. L. Hall, K. G. Hodgson, R. A. Meers and J. H. H. Merriman at 6.30 at the College of Technology, Portsmouth.

Oxford District.—March 9th. "Some Aspects of the Design of V.H.F. Mobile Radio Systems" by E. P. Fairbairn at 7.0 at the Electricity Demonstration Room, George Street, Oxford.

London Students' Section.—March 28th. "An Introduction to the Transistor" by A. V. Bryant at 6.30 at Savoy Place, W.C.2.

British Institution of Radio Engineers

London.—March 30th. Discussion on "The Maintainability of Service Equipment" by Capt. (L) A. J. B. Naish R.N., Maj. R. B. Brenchley, R.E.M.E., Wing Commander G. C. Godfrey, Technical Signals Branch, R.A.F., and G. W. A. Dummer, R.R.E. Malvern, at 6.30 at the School of Hygiene and Tropical Medicine, Keppel Street, W.C.2.

West Midlands Section.—March 9th. "Electrical Standards in Electronics" by P. M. Clifford at 7.15 at the Wolverhampton and Staffs. Technical College, Wulfruna Street, Wolverhampton.

North-Eastern Section.—March 9th. "The Application of Negative Feedback to Electrical Measuring Instruments" by F. J. U. Ritson at 6.0 at Neville Hall, Westgate Road, Newcastle-upon-Tyne.

Merseyside Section.—March 3rd. Symposium on "Electronics in Industry" at 7.15 at the College of Technology, Byrom Street, Liverpool, 3.

North-Western Section.—March 3rd. "Computing Circuits in Flight Simulators" by Dr. A. E. Cutler at 7.0 at the College of Technology, Manchester.

March 31st. "Industrial Applications of Electronic Control" by J. A. Sargrove at 7.0 at the Reynolds Hall, College of Technology, Manchester.

Scottish Section.—March 10th. "Computing Circuits in Flight Simulators" by R. A. Marvin at 7.0 at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow.

British Sound Recording Association

London.—March 25th. "High Fidelity Reproduction in the Home Using the Metal-Cone Loudspeaker" by F. H. Brittain at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

Manchester Centre.—March 14th. "Piezo-Electric Crystals" by J. N. Adams at 7.30 at the Engineers' Club, Albert Square, Manchester.

Television Society

London.—March 10th. "Distributed Amplifiers" by W. S. Percival (E.M.I. Research) at 7.0 at the Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, W.C.2.

North-Western Centre.—March 30th. "The Television Coverage of Gt. Britain" by R. A. Rowden (B.B.C. Research) at 7.30 at the College of Technology, Sackville Street, Manchester.

Radio Society of Great Britain

London.—March 25th. "The Historical Development of Wireless Communication" by Maurice Child at 6.30 at the I.E.E., Savoy Place, W.C.2.

Royal Society of Arts

March 23rd. "Radio Astronomy" by Professor A. C. B. Lovell at 2.30 at John Adam Street, London W.C.2.

Society of Instrument Technology

London.—March 10th. "Information, Feedback and the Human Senses" by Dr. E. C. Cherry at 7.0 at Manson House, Portland Place, W.1.

March 29th. "Design and Applications of an Electronic Simulator for Control Systems," Part 1, Design, by H. H. Idzerda and L. Ensing; Part 2, Application, by J. M. D. Janssen and R. F. Offereins at 7.0 at Manson House, Portland Place, W.1.

RANDOM RADIATIONS

By "DIALLIST"

Erect in Haste, Repent at Leisure?

QUITE a few people, eager not to lose a moment of the I.T.A. programmes, are hastening to order Band III aerials to be put up as soon as the job can be done. The usual reason they give, if you ask them why, is that there will be such a rush as the opening day draws nearer that dealers will be snowed under and some of their customers may have to wait for weeks. I, personally, prefer to wait. When a Band III test signal is available in London manufacturers will be able to verify the effectiveness of their products and servicemen will have a proper chance of finding out by actual trials what kind of array is needed in their particular locality. One of the biggest problems is likely to be "ghosting," which may often make it necessary to use much more elaborate aerial systems than many had expected.

Ghost-Laying

Speaking of ghosts reminds me that there's a simple and quite useful way of getting some idea as to whether a directional aerial array is likely to be able to lay them and, if so, roughly what degree of directivity will be needed. The scanning time for the "active" part of each line on the screen is 83.5 microsecs. Thus with a 17-inch tube giving a picture about 12 inches wide the speed of the spot, if we neglect imperfections in linearity, is approximately 6.9 microsecs per inch. Suppose that the ghost is displaced a quarter of an inch from the main image; then the reflection causing the ghost takes approximately 1.72 microsecs longer than the wanted signal to make the journey from transmitting to receiving aerial. The speed of wireless waves through air being 5.4 microsecs per mile, that quarter-inch displacement means that the path of the reflected signal is longer by 0.32 mile than that of the wanted signal. The distance between transmitting and receiving aerials being known approximately, a rough idea can be formed of how far the reflecting object is from the receiving aerial. The more distant it is the more likely is a directional aerial of some kind to be successful in eliminating it but ghosts cannot always be laid as easily as that. There are many factors to be considered, as Cocking points out in "Television Receiving Equipment."

Anglo-French Vision

IT'S GOOD NEWS that we shall soon have a permanent television link with France. Considering how much of a makeshift the whole thing has so far had to be, the results obtained in relaying programmes from France, Italy, Switzerland and other European countries, have been astonishingly good. Once the permanent link between London and Cassel is completed good and reliable two-way transmissions between this country and France should be ensured. There is already an extensive network of co-axial cable connections between most of the European capital cities but they were installed primarily for telephone services, and are not suitable for TV. The temporary links used so far have been by radio, but television will no doubt have its own system of inter-capital links before long. And there seems to be no particular reason why we shouldn't reach out much farther afield as time goes on. When Baird produced his first scanning-disk televisor there was what then seemed wild talk about our being able to watch test matches played in Australia. Well, some who read this paragraph may live to see that come true.

North Hessary Tor

THE B.B.C.'s estimate of the service area of the temporary low-power television station at North Hessary Tor, S. Devon, has proved in the event to have been very much on the conservative side. A number of my friends in the West Country who live outside those parts of Devon and Cornwall which the B.B.C. had expected the station to cover have reported good, steady pictures. Perhaps the most surprising case is that of one who lives near Liskeard. Expecting nothing, and purely for the fun of it, he retuned his receiver to Channel 2 and turned his 4-element channel-5 aerial array towards N. Hessary Tor. To his entire astonishment he received an excellent picture, far better than he had ever had from Wenvoe. Many people, I'm told, who live within the Tor's predicted service area are finding that their Wenvoe aerials give them as good a picture as they want. If

the signal is strong, the dimensions and spacing of the aerial elements don't seem to matter all that much.

Too Many Valve Types

SOME YEARS AGO an attempt was made to reduce the number of thermionic valve types to reasonable size, for it was felt (and rightly) that the thousand kinds of receiving valves then on the market were several hundred too many. The attempt wasn't successful. How many types there now are I don't know, for I gave up some time ago the hopeless struggle to keep pace with them. It seems a pity that equipment manufacturers and the B.V.A. can't get together and agree on doing some ruthless pruning of the lists. The vast number of types that we now have is utterly uneconomical, for it must prevent those long runs which mean good profits to manufacturers and low prices to the public. One of the very first steps should be to cut the number of different kinds of valve base, for this has now reached fantastic proportions.

Exploring Band III

I EXPECT some of you wondered, when you read my note in the last issue, why the B.B.C. should be using an I.T.A. frequency for its experimental square-wave transmissions from Sutton Coldfield. Mr. Pawley, head of the B.B.C.'s Engineering Services Group, tells me that the frequency is actually 180.4 Mc/s, which is below Channel 8 allocated to the I.T.A. for its Midland Service. These test transmissions are being radiated for the purpose of making propagation measurements both within and beyond the range corresponding to the service area of an actual station.

CLUB NEWS

Barnsley.—At the meeting of the Barnsley and District Amateur Radio Club on March 25th, J. Ward (G4JJ) will speak on "Transistor Transmitting." The club meets in the King George Hotel, Peel Street, Barnsley, at 7.0 on the 2nd and 4th Fridays of each month. Sec.: P. Carbutt (G2AFV), 33, Woodstock Road, Barnsley, Yorks.

Birmingham.—Meetings of the Birmingham and District Short Wave Society continue to be held on the 2nd Monday of the month at 7.45 at the Y.M.C.A., 20, Soho Road, Hockley, Birmingham, 19. At the March meeting H. Burdett will deal with power supplies. Sec.: R. Yates, 28, Daimler Road, Yardley Wood, Birmingham, 14.

UNBIASED

By FREE GRID

Hi-Pri Hi-Fi

NOW that so-called "hi-fi" receiving and reproducing equipment is being supplied by more and more manufacturers people will have the opportunity of discovering what poor quality they have been putting up with all these years.

I shall, however, be extremely surprised if the revelation leads to such a mad rush to the local dealers that people get their clothes torn off their backs as I had the misfortune to do a few weeks ago; I accidentally got caught up in a queue of struggling women fighting their way in to one of the January sales.

I hold this opinion because, for one thing, "hi-fi" is rather "hi-pri" although it will probably get cheaper as the demand increases. But my main reason is that the average listener has not a very high musical standard—and I say this despite the demand for seats at the Festival Hall for May 21st. The ordinary set really gives him all he wants in the way of quality.

The state of affairs in the world of wireless is, so far as fidelity is concerned, much the same as it is in the world of amateur photography where the seaside and wedding snapshotter is quite content with his miserable-looking, under-exposed,

"Caught up in the January sales"

badly-posed and out-of-focus efforts. There are, of course, the elite of amateur photographers with their "hi-fi" and "hi-pri" cameras, and they certainly produce marvellous results. But the ordinary soot-and-whitewash snapshotter still remains the backbone of the photographic industry and I think the "mellow bellow" type of listener will always fulfil the same role in our own industry. This is another way of saying that in my opinion, "hi-fi" reproduction, whether it be gramo., radio or photo, will always be for the elite and, therefore, "hi-pri." I sincerely hope time will prove me wrong.

Vive La Manx

A KINDLY READER, evidently guessing my catholic tastes in literature, has sent me a copy of *Islam A. E. F.*, a journal having its offices in Brazzaville, the capital of French Equatorial Africa. I only wish I were permitted to tell you of the many interesting things to be found therein, ranging from an intriguing article entitled "La Femme dans L'Islam" ("Elles sont si délicieuses que nous les gardons jalousement pour nous!" says the author) to a lively account of the modern way of doing the pilgrimage to Mecca, namely, by plane.

I must remember, however, that this is *Wireless World* and so confine myself to that part of *Islam A. E. F.* dealing with radio matters. My interest was at once aroused when I saw that the same problem exists there as it does here, namely, the deliberate ignoring of minority languages. In this sun-baked corner of Africa broadcasting is carried on in French and in six native tongues, all these latter being important ones in the sense that collectively they cover the majority of the population.

There is, however, a "couldn't-care-less" attitude about minority languages which the editor of *Islam A. E. F.* deplores. That is exactly the state of affairs existing over here where the majority of people speak English, or so-called English. There are, however, four other languages in use in the United Kingdom, two of which, Welsh and Gaelic, are extensively spoken, and the two others, Manx and Cornish, less so. We do, of course, get some Welsh and Gaelic from the B.B.C., but of the others absolutely nothing.

I feel particularly sore about Cornish, as Cornwall, the home of the pioneering Poldhu and of the Marconi memorial at Mullion Cove, is really the cradle of long-distance wireless. The home of the originator of the famous directories has a rather more nebulous link with radio, but the P.M.G. and *W.W.* are both focal points of liaison (work that one out).

If anyone is with me in this I would ask them to write a strongly worded letter to the Editor, and I will use all my influence to get him to find space for it; it should, of course, be written in Cornish or Manx, as the case may be.

"La femme dans l'Islam"

The Editor demands an illustration for this item, and I have, therefore, dug out an old photograph of two Islamic maidens which I took many years ago in A.F. but not A.E.F.

As She is Spoke

IN the February issue the Editor quite rightly took to task the general public for jungle-izing Shakespeare by using such strange and uncouth expressions as "the wireless"; he also had a tilt at the B.B.C. for indulging in similar barbarities.

I do, however, feel that those of us who are outside the pale of the oxonocantabrigian educational atmosphere which prevails at Broadcasting House have been rather harshly dealt with. It is a long time since some of us were at school, and we look to the B.B.C. to correct our faulty pronunciation; in this it has failed us lamentably.

We are a little bewildered when one B.B.C. pronouncer speaks of "fine-ants" with the accent on the "fine" and another shortens the first vowel and puts the stress on the second syllable. This is but one of many instances where announcers differ, but on the pronunciation of one word they never fail to agree. Although they, with their "eddication," ought to know better, all the announcers continue to turn my hair as grey as the word "polio" by pronouncing it as though it rhymed with "folio"; yet they never try to manhandle in this way polygamy, polytechnic, politics or police, all of which like "polio" are of Greek derivation and have an omicron and not an omega in their first syllables. Perhaps the announcers think that two omicra make one omega, for, of course, unlike the other words I have quoted, "polio" does have two omicra in it.

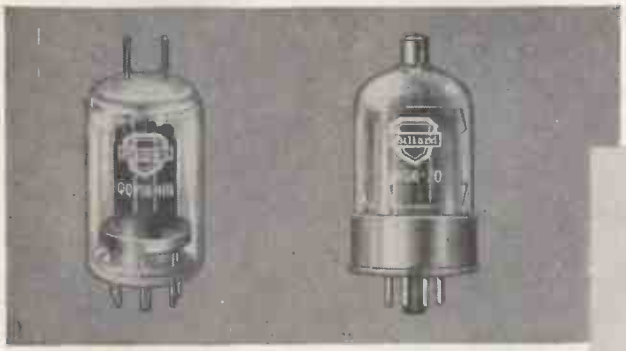
V.H.F. POWER TETRODES

FOR F.M. & TELEVISION TRANSMITTERS

Transmitter designers are now offered a complete range of V.H.F. tetrodes by Mullard.

These high efficiency, high gain tetrodes make possible the design of transmitters with fewer valves and, consequently, reduced initial cost.

The higher overall efficiency of equipments fitted with Mullard tetrodes results in lower running expenses—a factor in the growing popularity of these valves in the world market. Further details of these tetrodes and other Mullard valves and tubes may be readily obtained from the address below.



PRINCIPAL CHARACTERISTICS

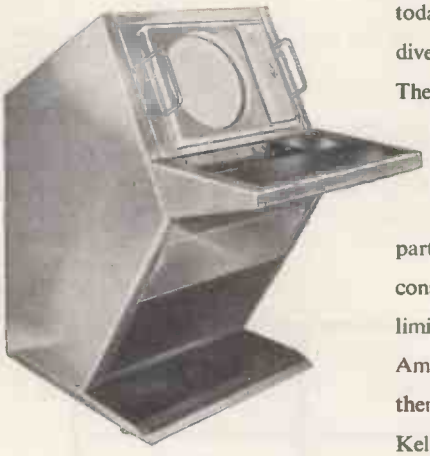
MULLARD TYPE No.	AMERICAN TYPE No.	CV TYPE No.	DESCRIPTION	BASE	HEATER (V)	HEATER (A)	V_a max. (V)	p_a max. (W)	TYPICAL LOAD POWERS AND FREQUENCIES (W)	TYPICAL LOAD POWERS AND FREQUENCIES (Mc/s)
QV06-20	6146	CV3523	V.H.F. Power Tetrode	Octal	6.3	1.25	600	20	42 20	60 175
QQV03-20A	6252	CV2799	V.H.F. Power double Tetrode	B7A	6.3 12.6	1.3 0.65	600	2x10	39 15	200 600
QQV06-40A	5894	CV2797	V.H.F. Power double Tetrode	B7A	6.3 12.6	1.8 0.9	600	2x20	72 45	200 500
QY3-125	4-125A	CV2130	V.H.F. Power Tetrode	B5F	5.0	6.5	3000	125	300	120
QY4-250	4-250A	CV2131	V.H.F. Power Tetrode	B5F	5.0	14	4000	250	800	75
QV1-150A	4X-150A	CV2519	V.H.F. Power Tetrode	B8F	6.0	2.6	1250	150	156 112	165 500
QY5-3000A	6076	—	V.H.F. Power Tetrode	Special 4-pin	6.3	32.5	5000	3000	3300 *3500	75 220

* 2 Valves in push-pull. Television service.

Mullard MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT., CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C.2

MVT.169

...but for specialised production in electronics...



Radar display console manufactured for Marconi's Wireless Telegraph Company Ltd.

In its most advanced form, specialised production in electronics today calls for the combined skill, knowledge and experience of a diversity of techniques.

These requirements necessitate not only first-class research and development laboratory facilities, but competent production, engineering and planning staffs.

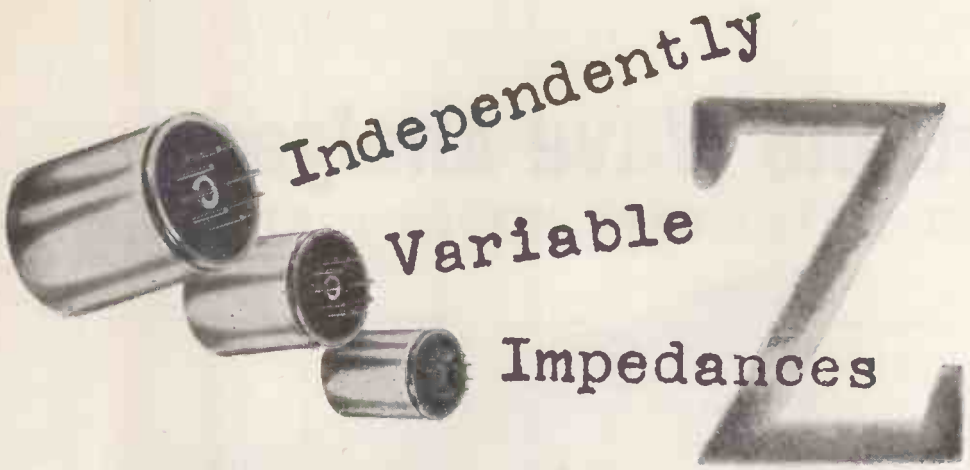
Plessey have these facilities, and many others, as closely integrated parts of a single division—the Electronics Division—and are, in consequence, able to offer a unique service to manufacturers for the limited or quantity production of their products.

Among those renowned organisations which have recently availed themselves of these services are included BTH, Decca, I.A.L., Kelvin Hughes, Marconi's Wireless Telegraph Company Ltd., and Laurence Scott & Electromotors Ltd.

...you should see Plessey

ELECTRONICS DIVISION · TELEPHONE: VALENTINE 8855
THE PLESSEY COMPANY LIMITED · ILFORD · ESSEX

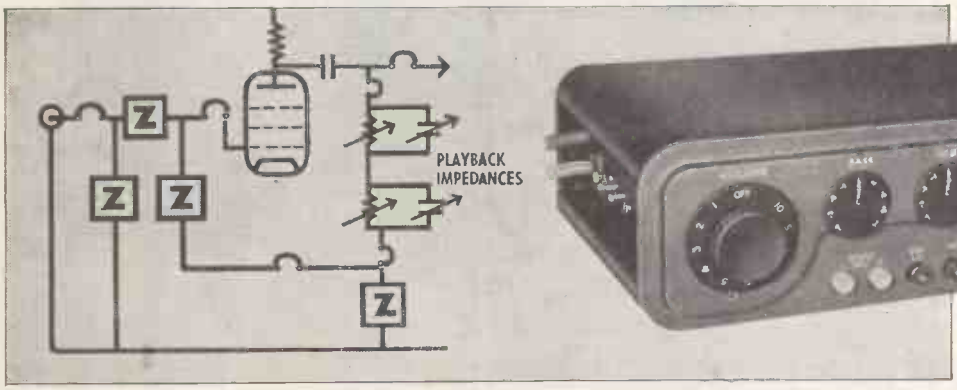
PE 3a



When a designer contemplates the input stage from a gramophone pickup he can (a) amplify and then compensate, (b) compensate before amplification, (c) compensate over the first stage by feedback.

No single method is acceptable over a wide range of impedances if the requirement is low distortion and low noise. His choice and the circuit impedances used will depend upon the output level of the pickup, its source impedance, its load impedance and its characteristic.

In the QUAD 11, the first stage circuit connections and their impedances are contained within a detachable plug unit. A range of units covers optimum design requirements for all types of pickups.



ONLY THE QUAD 11 GIVES PERFECT MATCHING AND OPTIMUM INPUT CIRCUIT ARRANGEMENTS. ONE OF THE REASONS WHY THE QUAD 11 GIVES THE CLOSEST APPROACH TO THE ORIGINAL SOUND.

ACOUSTICAL MANUFACTURING CO LTD

The Acoustical Manufacturing Co. Ltd
Huntingdon, England

Portable Wave Analyser

THE WAYNE KERR MODEL A.321

An audio frequency analyser of the heterodyne type to measure the relative levels of the components of a complex waveform down to —75 db below fundamental.
It is light, compact and simple to operate and can be supplied either in a transportable case or for standard 19" rack mounting.

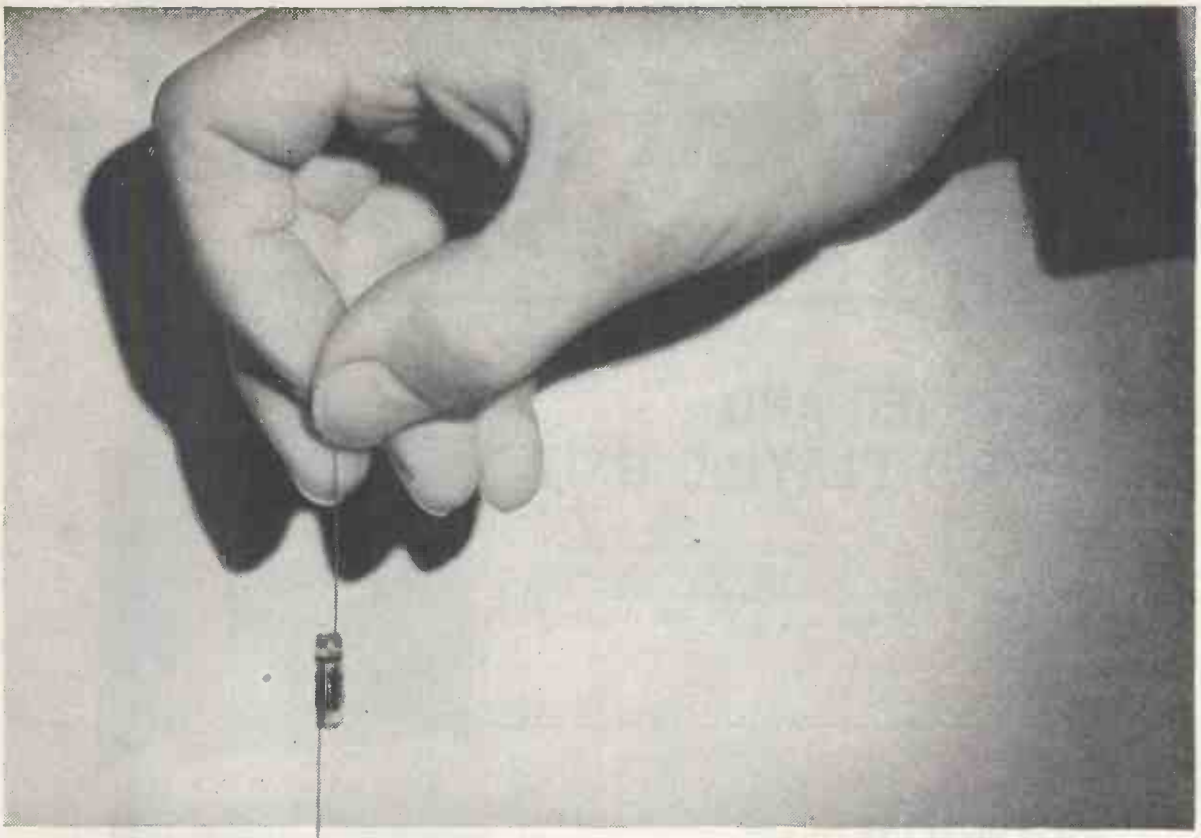
Specification

FREQUENCY COVERAGE:	*50—20,000 c/s in two ranges*
FREQUENCY STABILITY:	*Better than ±1%*
INPUT LEVEL:	*Between —20 and +20 db relative to 1mV into 600 ohms adjusted by a 5 step attenuator and fine control of 0—10 db*
FREQUENCY RESPONSE:	*Flat to within ±1 db over the whole working range.*
LEVEL STABILITY:	*±1 db if mains supply voltage remains within ±5%*
ACCURACY OF HARMONIC MEASUREMENTS:	*Harmonics below fundamental to —55 db ±5% to —75 db ±10% or ±1 db whichever is the greater.*
INPUT IMPEDANCE:	*100,000 ohm unbalanced (greater than 25,000 ohm, balanced, can be supplied to order)*
SELECTIVITY:	*Constant over the frequency range. 2 stage crystal filter, mid band frequency 100 Kc/s. Flat top (±1 db) pass band extending over 10 c/s ±1 c/s.*
HUM LEVEL:	*—55 db*
POWER SUPPLY:	*110/115 and 200/250 volts 40/60 c/s*
POWER CONSUMPTION:	*Approx. 60 watts*
DIMENSIONS:	*In case 20" × 9" × 8½"*
WEIGHT:	*31 lbs. approx.*

PRICE £250 NETT
Early Delivery

Wayne Kerr

THE WAYNE KERR LABORATORIES LIMITED · NEW MALDEN · SURREY · MALDEN 2202



More pF per in *

Suflex Polystyrene Capacitors

put a quart of capacitance into a pint of space.
If you have a problem which demands
a capacitor of excellent electrical performance
and the smallest possible size,
you may well find the solution if you
contact Suflex

SUFLEX *Limited*
LONDON

* for example, 100 pF in a capacitor ½" long, about 3/16" dia.

The Suflex range of good electrical products includes
Polystyrene capacitors • Silicone/varnished insulating sleeving • Plastic sleeving • Plastic covered wire • PVC/Nylon lacing cord • Glass/Nylon dial drive cord • Copper wire braids • Cotton braids

35 BAKER STREET, LONDON W.1. *Telephone: WELbeck 0791 Cables: Suflex, London*

B

And NOW — a *COMPLETE* Television Servicing Instrument

Incorporating:-

- ★ WOBBULATOR
- ★ PATTERN GENERATOR
- ★ A.M. SIGNAL GENERATOR
- ★ C.W. SIGNAL GENERATOR
- ★ L.F. OSCILLATOR
- ★ OSCILLOSCOPE
- ★ E.H.T. VOLTMETER
- ★ A.C. & D.C. VALVE VOLTMETER

THE AIRMEC *TELEVET TYPE 877* illustrated above, provides every facility needed for completely CHECKING, REPAIRING, OVERHAULING and ALIGNING Television Sets. It has the following features:—

- ● *CRYSTAL CALIBRATION*
- ● *COVERS BANDS I & III*
- ● *CAN BE USED WITH BOTH A.C. & A.C./D.C TYPE SETS*
- ● *COMPLETELY PORTABLE—WEIGHT 25 LBS.*

£66-10-0
LIST PRICE

Write now for full details to

AIRMEC
LIMITED

HIGH WYCOMBE — BUCKINGHAMSHIRE

Telephone: High Wycombe 2060 *Cables:* Airmec, High Wycombe

And NOW—a range of 'CERAMICAPS' for your LAB Storage Unit!

The LAB Continuous Storage Unit is widely acknowledged as the most efficient and convenient method of storing and selecting resistors. Now its usefulness is still further extended with the introduction of LAB pak'd 'Ceramicaps'. With the LAB Unit, research and experimental laboratories and small production groups have to hand immediately, a complete range of resistors and 'Ceramicaps', easily selected with card index simplicity from some 700 sorted and carded components. Empty cards are merely replaced with full ones from stock.

The LAB unit is supplied FREE with initial purchase to your specification. Standard assortments available. Each LAB Unit can be used to store one type of component exclusively, or quantities of the complete range of resistors and 'Ceramicaps'. Full details and illustrated list will be sent on application.

Ref.	Type	Loading	Max. Volts	Range	Dimensions
RESISTORS					
T	½ watt	½ watt	250	10 ohms to 10 megohms	⅜" x ⅛"
R	½ watt	1 watt	500		½" x ¼"
Tolerance available ±20%, 10%, 5%					
HIGH STABILITY RESISTORS					
HS3	½ watt	½ watt	750	1 ohm to 500 megohms	1.1" x 0.1"
Tolerance available ±5%, 2%, 1%					
WIREWOUND RESISTORS 5 ohms to 100K ohms — 5 - 10 watts					
'CERAMICAPS' Tubulars 3 - 470 pf, 500 - 5000 pf. Tolerances ±2%, 10% Hi-K					

The Lab Continuous Storage Units are available from your normal source of supply, but more detailed information can be obtained from

THE LAB TESTED CONTINUOUS **STORAGE UNIT**

★ **Continuous Storage for Resistors and 'Ceramicaps'**

★ **Values separately carded**

★ **Finger-tip Selection**

THE RADIO RESISTOR COMPANY LTD

50 ABBEY GARDENS · LONDON · N.W.8 · Telephone: Maida Vale 5522

VISUAL VALVE TESTER

This equipment displays on a cathode-ray tube a family of Ia/Vg curves for any receiving type thermionic valve. Eleven curves corresponding to eleven different grid voltages are presented simultaneously and a calibrated graticule permits rapid comparison with published data.

Nine standard valve bases are provided, with facilities for connecting others, and the various valve electrodes are connected to the requisite supplies by a multi-button switching board.

This permits any electrode to be connected to any supply without damage and also enables electrodes to be paralleled for test purposes.

All external parameters Va, Vs, Vh, Vg, are continuously variable over a wide range and current and voltage values are metered.
Full technical data is available on request.

CINEMA TELEVISION LTD

A COMPANY WITHIN THE J. ARTHUR RANK ORGANISATION

WORSLEY BRIDGE ROAD · LONDON · S.E.26
HITHER GREEN 4600

SALES AND SERVICING AGENTS:
Hawnt & Co. Ltd., 59 Moor St. Birmingham, 4
Atkins, Robertson & Whiteford Ltd., 100 Torrisdale Street, Glasgow, S.2
F. C. Robinson & Partners Ltd., 122 Seymour Grove, Old Trafford, Manchester, 16

BE READY FOR TOMORROW — TODAY!

WITH THESE TWO *NEW* COSSOR INSTRUMENTS

COSSOR Model 1322

Telecheck and Marker Generator for Bands I and III

Model 1322 — used in conjunction with a cathode ray oscillograph — provides equipment for the display, measurement and correct adjustment of RF and IF response curves of television receivers. This entirely new instrument comprises a swept oscillator covering the Television BANDS I and III (5-75 Mc/s. and 155-255 Mc/s.) and a frequency marker oscillator so that precise calibration of the oscillograph display may be made; accuracy of the frequency of the marker pips being verified by reference to an internal crystal. The alignment oscillator is set to the video carrier to which the receiver is tuned and the sweep (either 1 Mc/s. or 10 Mc/s.) is automatically derived from the time base voltage of the display oscillograph. The response of the "strip" under test to the frequency band applied is then presented on the screen of the cathode ray tube. The RF output of Model 1322 is available at 75 ohms and is adjustable from a maximum of 40 millivolts to a minimum of 10 microvolts through a coarse and fine attenuator.

TELECHECK CONVERTER FOR BAND III Model 1321

This adaptor provides owners of Model 1320 "Telecheck" with an extension of the frequency range of the original instrument into the BAND III television channel. Thus, alignment procedures adopted for BAND I RF/IF "strips" are available also for BAND III receivers. A selection of the desired BAND is made by means of a switch. Pattern generator facilities for picture time base linearity checks have been retained. Model 1321 Adaptor is designed for permanent attachment to the standard "Telecheck" providing a neat, light and compact unit. Mounting is effected by four screws and the inter-connecting wiring is carried in a single insulating sleeve.

COSSOR ELECTRONIC INSTRUMENTS

Write for illustrated leaflets about both these instruments:

CI.60

A. C. COSSOR LTD · INSTRUMENT DIVISION (Dept. 1) HIGHBURY GROVE · LONDON · N.5

Telephone: CANonbury 1234 (33 lines) *Telegrams: Cossor, Norphone, London* *Cables: Cossor, London*

ACCLAIMED for BETTER performance and modest cost

THE

Concertone

MAGNETIC RECORDER

Meticulously recording *every tonal facet* with *complete mastery*, the "Concertone" tape recorder will give you the *ultimate listening pleasure* that comes from superb music *faultlessly* recorded and reproduced.

The "Concertone" will re-create, in the home, the *true image* of the *original performance*. Whether it be Solo Violin, or Oboe, or a Full Organ with its demanding power and range, the "Concertone" with its *wide frequency response*, and *extended dynamic range*, will satisfy the *connoisseur* of fine music.

Simple, absolutely reliable, rugged, compact, lightweight, and easily portable, the "Concertone" will, wherever there are sounds to be recorded, *serve faithfully*, earning, justly *unqualified praise* for its *faultless performance*.

Manufactured by the company in its *own* precision machine shop, the tape mechanism employs three motors and a special design servomatic brake. The brake not only locks the spools *securely* during transit, but of greater importance, it is *completely free from fade*, being *self-compensating* for wear. Unique is the provision of a *mechanical interlock* which prevents faulty operation.

SEE YOUR DEALER TODAY AND JUDGE THIS FINE MACHINE FOR YOURSELF. IN THE EVENT OF DIFFICULTY SEND DIRECT FOR A COMPREHENSIVE SIX-PAGE LEAFLET (please enclose a s.a.e.).

Abridged Specification

Tape speeds, 7½in. and 3¾in./sec. Fast Forward and Rewind. Self-compensating Servomatic brakes. Single slot loading. Position scales. Inputs Mic., Rad. and Gram. Frequency response 7½in./sec. 50-12,000 cps. within 3db. 3¾in./sec. 50-6,000 cps. within 5db. Bias freq., 51 kc/s. Half track recording. Interlocked controls Wow .02% max. Recording to International Standard. Cabinet—Blue and Grey rexine. Storage for Mic. and Mains lead. Detachable lid. Gross weight, 26 lbs. For 210/250 v. A.C. ONLY.

48 GNS COMPLETE

Trade enquiries cordially invited

FISHER ELECTRONICS COMPANY LTD.

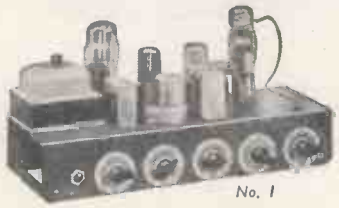
70, BREWER ST., LONDON, W.1. Phone: GER 3376

EXPORT ENQUIRIES TO :— THE BARNETT SHIPPING & EXPORT CO. LTD., 25 MONMOUTH ST., LONDON, E.C.3

REAL HIGH FIDELITY *at modest cost . . .*

•*Manufacturer-to-Consumer policy saves you at least one-third cost!*

We are now specialising in the supply of units for making up high-fidelity Radio and Record-reproducing Equipments for use in the Home, small Halls, Schools and Gramophone Societies and single items for replacing in existing equipments and radiograms.
Our Chief Engineer, who is operating a Technical Guidance Service, is available daily, including Saturdays, from 10 a.m. to 6 p.m., or will deal with enquiries by return of post. Our new illustrated Catalogue and Supplement will be a great boon to those desiring high quality equipment for modest expenditure. Send two 2½d. stamps for your copy now. It may well save you pounds.



No. 1

No. 1 "SYMPHONY" AMPLIFIER is a 3-channel 5-watt Gram/Radio Amplifier with astonishingly flexible tone control. You can lift the treble, the bass, or—and here is the unique feature—the middle frequencies to suit your own ear characteristics and the record or radio programme being heard. It is thus possible to arrange the frequency-response of the amplifier to a curve equal and opposite to the resultant curve of the other items in the chain so that what finally registers in the brain is as per original. This flexibility of control is far more important than mere nominal linear response of the amplifier, as the pick-up, speaker, etc., are not linear. Independent Scratch-Cut is also fitted and special negative-feedback circuit employed. The Amplifier can accommodate a wide variety of records from old 78's to new L.P.'s. Input is for all types of pick-up of 0.1 v. output or more and there is full provision (and power) for Radio Tuner. It is available to match 2/3 or 15 ohms speakers. Price: 10 gns. (carriage 5/-). Fitted in portable Steel Cabinet, 35/- extra.

No. 2

No. 2 "SYMPHONY" AMPLIFIER as No. 1 but with 10-watt Push-pull triode output and triodes throughout. Woden mains and output transformers and choke. Full provision and power for Tuner. Output tapped 3, 7.5 and 15 ohms. Competes with the most expensive amplifiers on the market yet costs only 15 gns. (carriage 5/-). Fitted in portable Steel Cabinet 2 gns. extra.

"SYMPHONY" AMPLIFIERS with REMOTE CONTROL. Both the above model Amplifiers are available with all controls on a separate Control Panel with up to 4 feet flexible cable which simply plugs into the amplifier. Enables the Amplifier proper to be sat in the bottom of a cabinet whilst the controls are mounted conveniently higher up. Extra cost 2 gns.

"STUDIO SYMPHONY" AMPLIFIERS, Models 1 and 2, new models specially designed to get the maximum out of the revolutionary new Collaro Studio pick-ups and heads type "P" or Transcription. Specification as per our Standard Symphony models but with high-gain, low-noise, built-in Pre-amplifier stage with separate switched correctors for Std. and L.P. Third position on switch provides input matching for Acos and similar output pick-ups. These remarkable new models thus provide all the facilities and matching of our Standard Symphony Amplifiers PLUS the specialised Collaro matchings. Send for copy of "The Gramophone" review of these instruments. Price: No. 1, 12 gns; No. 2, 17 gns. Carriage 5/-.

CURRENT GARRARD PRODUCTS AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK AT PRESENT.

MODEL TA 3-speed unit, but with plug-in turnover head Type G.C.2, £10/16/-, or with Acos HGP 33 or 37 heads, £10/14/-, or with two separate high fidelity Acos HGP35 heads, £12/17/-. Unit less heads, £8/11/-. post 2/6. Heads, 42/3 each, post 1/-.
MODEL TB as above, but with long pickup arm. Less heads, £8/11/-, post 2/6.
Heads to fit this unit: Decca XMS, 54/6, Decca Crystal, 33/-, Garrard Standard Magnetic. 28/-, miniature magnetic low impedance, 28'-, miniature magnetic high impedance, 38/-. Post on heads 1/-. Unit can be supplied with any combination of above heads and is carefully adjusted for stylus pressure on despatch.
MODEL RC80M, less heads, £15/5/-, with new turnover head, £17/9/6, with two separate Acos HGP35 heads, £19/9/-, carriage 5/-.
COLLARO PICKUPS AND HEADS. Studio Pickup Arm, 13/10. Studio Pickup head type "O" or "P," £3/0/9. Pickup complete £3/14/7. Studio Transcription Pickup Arm with Studio "P" head, £4/15/9. Ditto with Transcription head, £5/2/5.
TRANSCRIPTION MOTORS IN STOCK.
NEW CONNOISSEUR variable speed on all 3 speeds £25/15/5.
GARRARD Model 301 £25/3/6. Cabinets available to house these motors together with pick-up.

SNIP NO. 1

GARRARD LATEST MODEL RC80M AUTO-CHANGER. Fitted with full-length Pick-up Arm to take 3-pin plug-in heads, manufactured end of Oct. 1954. PRICE LESS HEADS, £15/5/-, carriage paid. These extraordinarily versatile units can be supplied fitted with the following combinations of Pickup Heads at the following prices:
With two Decca XMS ffrr Magnetic Heads, £20/15/-.
With two Decca Crystal Heads, £18/10/-.
With Decca Crystal for L.P. and Garrard Miniature Mag. for Std. Takes minlature fibre or steel needles. £18/13/-.
With adaptor and two Acos HGP39-1 Heads, £20/5/-.
With adaptor and one Acos HGP39-1 Head for L.P. and Garrard Miniature Mag. High Impedance for Std. Takes miniature fibre or steel needles. £19/17/-.
The above combinations of heads are matched for output and stylus pressure carefully adjusted before despatch. Carriage paid.
Above mounted in Portable Cabinet 90/- extra.
IMMEDIATE DELIVERY FROM STOCK

SNIP NO. 2

Very latest Model **"MONARCH" 3 speed AUTO-CHANGER** fitted with latest ACOS HGP37 turnover Pickup Head for Std. and L.P. Plays 12in., 10in., and 7in. records mixed in any order. Capacity 10 records. Operates on 100/125 and 200/250 v. A.C. 50 c/s. Unit plate measures 12¼in. x 10¾in. Height above plate required 5¼in.; depth below required 2¼in.
PRICE COMPLETE £13/10/-. Carriage 5/-.
IMMEDIATE DELIVERY. Leaflet 2½d.
Above mounted in Portable Cabinet, 16 gns., plus carriage 7/6.

"SYMPHONY" BASS REFLEX CABINET KITS. 30in. high, consist of fully-cut ¾in. thick, heavy, inert, non-resonant patent acoustic board, deflector plate, felt, all screws, etc., and full instructions, 8in. speaker model, 85/-; 10in. speaker model, 97/6; 12in. speaker model, £5/7/6. The design is the final result of extensive research in our own laboratory and is your safeguard of optimum acoustic results. Carriage 7/6. Ready built, 10/6 extra.

HIRE PURCHASE FACILITIES
NOW AVAILABLE on orders of £15 or over.
Send one-third deposit with order, balance over 6 or 12 monthly instalments. *State which required.*

NORTHERN RADIO SERVICES

11, KINGS COLLEGE RD., ADELAIDE RD. LONDON, N.W.3. *Phone: PRImrose 8314*
Tubes: Swiss Cottage and Chalk Farm.
Buses: 2, 13, 31, 113, 187.

"SYMPHONY" BASS REFLEX CABINETS, fully finished in figured walnut, oak or mahogany to our own design and to match our Console Amplifier Cabinet, enabling the housing of a whole equipment in a two piece suite; cost: 12in. speaker model, £11/10/-; 10in., £11; 8in., £10/10/-. Carriage according to area. The 10in. model is ideal for the WB HF 1012 (see "The Gramophone" review March).

CONSOLE AMPLIFIER CABINETS (above), 33in. high, lift-up lid with piano hinge, take Tape Deck, Gram Unit or Auto-changer, Amplifier, Pre-Amplifier, and Radio Feeder Unit, finished medium walnut veneer. De Luxe version, price 10 gns. Carriage according to area. Oak or Mahogany veneers 10/- extra. Special finishes to order.

NORTHERN RADIO SERVICES contd.

SYMPHONY RADIO FEEDER UNITS

No. 1 Symphony Tuner. A T.P.F. model designed for the quality reception of local stations. Quality is adequate for amplifiers of the highest fidelity class. Infinite impedance detection. Controls: gain, wave-change and radio/gram switch. Illuminated engraved glass dial. Latest miniature valves. Overall dimensions: 9in. wide x 6in. deep x 6in. high. Power required: 6.3 v. at 1 amp. and 250/300 v. at 15 m/a. Price **£7-7.**

No. 2 Symphony Superhet Tuner. Three wave-bands, advanced circuit, very newest valve types, floodlit glass dial with bronze escutcheon provided. Suitable for use with the best amplifiers. Overall dimensions: 12in. wide x 8¼in. high x 7in. deep. Controls: on/off/gain, radio/gram, wave-change and tuning. Dial cut-out: 8in. x 4¼in. either horizontally or vertically (state which required). Tuner can be readily mounted at any angle. Requires 6.3 v. at 1.5 amp. and 250/300 v. at 20 m/a. Price **£11-11.**

Symphony No. 2/VS Superhet Tuner. As No. 2 but incorporating on the wave-change switch an extra position for radio, thus making two radio positions. One is the standard one with 9 kc. separation and the extra one providing virtually T.R.F. band-width and quality on local stations. Price **£13-13.**

All above tuners are made to plug in to any of our Symphony Amplifiers in a matter of seconds by means of the octal plug fitted at the end of a flexible multi-cable. They are ideal for providing in conjunction with our Symphony Amplifiers, the same high quality on radio as is obtained from these amplifiers on gramophone, but they are equally suitable for use with other high fidelity amplifiers. And where the output circuit requires modification to match a given amplifier this can be carried out for a small extra cost on request. Either of the two Superhet models can be fitted with a magic eye tuning indicator for **£2-2** extra. Furthermore, they can be fitted with a pre-amplifying stage to match the Decca Magnetic Pickups or the Collaro Studio type "P" pickup head for use with amplifiers which would not otherwise have enough gain for these comparatively low output pickup heads. In these cases, two separate correction circuits—one for standard and one for LP as recommended by the pickup manufacturers—are incorporated in the radio/gram switch. Please send for our catalogue giving further details and illustrations.

SYMPHONY AMPLIFIERS FOR DECCA XMS HEADS

Nos. 1 and 2 for 5 watt and 10 watt Output. These two special models are exactly the same as the Studio Symphony Amplifiers except that instead of having the extra switchable pre-stage for the Collaro Studio type "P" pickup heads, they have the switchable pre-stage matched to the Decca XMS heads with appropriate standard and long-playing correction circuits. These are ideal for getting the very best out of these famous pickup heads. The price is **12 gns.** and **17 gns.** respectively plus 5/- carriage.

FREQUENCY MODULATION TUNER UNITS

Chapman Model FM81. Tuneable model with attractive facia panel and dial: will provide amazing degree of realism with complete absence of background noise when working with one of our Symphony Amplifiers or other high-grade amplifier. Price **£21.** Suitable power pack to operate this model **£4.**

Model FM82. As above but switched-stations model without dial and having built-in power supply and having a higher audio output suitable for plugging into the pickup terminals of the average wireless set. Price complete **£24.** Call for a demonstration or send for leaflet.

TAPE DECKS AND AMPLIFIERS

Elpico Tape Deck as per "Impresario" Recorder, push-button controls, high-fidelity heads. Price **19 gns.** Illustrated leaflet 2½d.
Tape Amplifier as per "Impresario" Recorder. Separate Treble and Bass controls, neon level indicator. Price **19 gns.**
Truvox Tape Deck Mark III. TR2/U. Latest version to take pre-recorded tapes. Price **22 gns** Illustrated leaflet 2½d.
Tape Amplifier Type C, expressly designed by Truvox to work perfectly with their Deck, 3 valves plus rectifier and Magic Eye level indicator. Price **16 gns.**
Portable Tape Recorder Cabinet to house Truvox Tape Deck and Amplifier together with speaker. Very strongly made and attractively finished in rexine. Price **£5** carriage paid.

NEW MODEL PORTABLE RECORD PLAYERS

We are pleased to announce the entry on to the market of two Symphony Record Players designed to represent the greatest value in this line ever offered. Model No. 1 will contain the Collaro 3-speed single record playing unit AC3/554 and model No. 2 will contain the Collaro Autochanger RC54. They will be available either in the plain wood or rexine covered and with either "O" insert, "P" insert or transcription insert. Prices (in attractive Rexine case), No. 1 **£10-19-6,** No. 2 **£14-19-6.** Carr. 7/6d.

Goodmans Corner Cabinets (right) for the AXIOM 150 Mark 2 manufactured by us to Messrs. Goodmans' specification and approved by Messrs. Goodmans. Height, 44in. Price: complete kit in plain board with 1in. thick felt, 8 gns. Price: ready built, 10 gns. Finished in figured walnut, 16 gns. Other veneers to order. Carriage extra according to area.

60 Watt H.F. FIXED STATION

This completely new Pye equipment has been specifically designed for point-to-point communication and will fulfil equally well a ground-to-air role in air traffic control systems.

Push button control brings any one of four preselected channels into immediate operation; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with 'break-in' facilities on telegraphy.

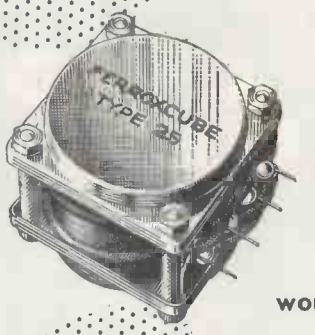
The equipment is suitable for unattended operation in the tropics.

Telecommunications

CAMBRIDGE ENGLAND

Pye (New Zealand) Ltd. Auckland C.I., New Zealand	Pye Canada Ltd. Ajax, Canada	Pye-Electronic Pty., Ltd. Melbourne, Australia	Pye (Ireland) Ltd. Dublin, Eire
Pye Radio & Television (Pty.) Ltd. Johannesburg South Africa	Pye Limited Plaza de Necaxa 7 Mexico 5	Pye Limited Tucuman 829 Buenos Aires	Pye Corporation of America 5th Avenue Building 200, 5th Avenue, New York

PYE LIMITED . . CAMBRIDGE . . ENGLAND



High Q inductance coils

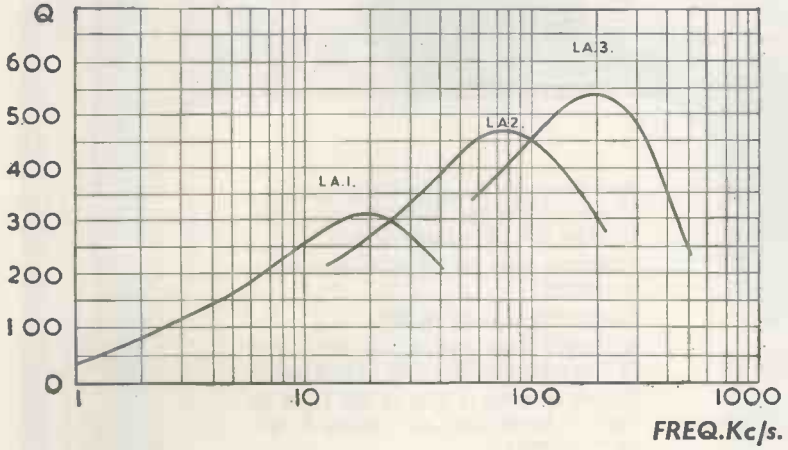
wound on Ferroxcube cores

DESIGNERS of compact and efficient tuned circuits and wave filters are making ever-increasing use of Mullard high Q inductance coils.

Based on Ferroxcube, the world's most advanced magnetic core material, these coils combine small size with an inductance of up to 30 henries over a wide frequency range. Furthermore, their convenient shape and self screening properties facilitate either individual mounting or stacking.

Full details of these and other high grade components now available from Mullard will be gladly supplied on request.

TYPICAL Q VALUES



Special Features

Small size

Low hysteresis loss factor

High value of inductance

Low self capacitance

Controllable air gap facilitating inductance adjustment

Self screening

Controlled temperature coefficient

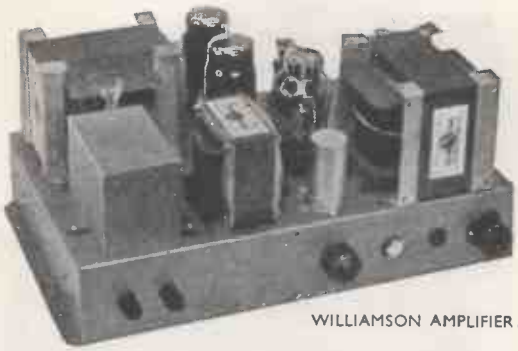
Operation over a wide frequency range

Easily mounted

Mullard

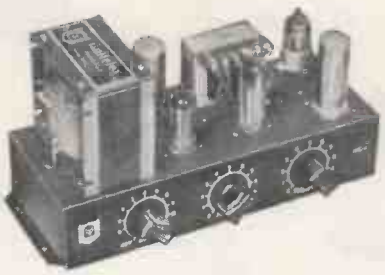
'Ticonal' permanent magnets,
'Magnadur' ceramic magnets,
Ferroxcube magnetic cores.

MULLARD LIMITED · COMPONENT DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · W.C.2
(MM450)



WILLIAMSON AMPLIFIER

P.A.1 PRE-AMP



SPEAKERS

G.E.C. Metal Cone		£8	15	0
WHARFEDALE Super 5 CS/AL		£6	13	3
„	Bronze 8 AL	£3	10	8
„	Super 8	£5	13	3
„	Super 8 CS	£6	6	7
„	Super 8 CS/AL	£6	13	3
„	Golden 10	£7	13	3
„	Golden CSB	£8	6	7
„	W.12	£9	5	0
„	W.12 CS	£9	15	0
„	Super 12 CS/AL	£17	10	0
„	W.15	£17	0	0
„	W.15 CS	£17	10	0
GOODMANS Axiom	101	£6	12	1
„ „	102	£9	18	2
„ „	150 Mk. II	£10	5	6
„ „	22 Mk. II	£14	14	0
„ Audiom	60	£8	12	6
„ „	70	£13	15	0
„ „	80	£22	10	0
„ „	90	£28	0	0
W.B. HF.810		£3	5	6
„ HF.1012		£3	17	6

AMPLIFIERS

OSRAM 912
This renowned amplifier complete—with drilled chassis—front panel. Brand new B.V.A. Valves. All transformers approved by G.E.C. Everything included.
Partridge Kit £22/6/3. Wired and Tested £4 extra.
Haddon Kit £21/19/3. Tele-Radio Kit £18/18/6.

WILLIAMSON
This amplifier justly celebrated all over the world. Absolutely complete with all parts.
Partridge Kit £22/1/-. Wired and Tested £26/15/6.

P.A.1. PRE-AMP FOR WILLIAMSON AMPLIFIER
The P.A.1 pre-amp. especially designed by us—for use with the Williamson. Up to a standard—Down to a special price.
Kit £6/16/6. Wired and Tested £8/18/6.

MULLARD 5-10
This clever new amplifier is offered complete to last nut and bolt. Brand new B.V.A. Valves. First quality components throughout.
Kit Price £12/10/-.

LEAK
TL.10 £17/17/-. Point 1 Pre-Amp. £10/10/-.
Vari-Slope Mk. II £16/16/-. TL 12 £28/7/-. TL.25 £34/7/-.

UNITELEX MG4
Designed to meet the need for a low-cost but flexible medium-power, general purpose amplifier, £8/18/6.

QUAD
Quad II £22/10/-. Quad II Control Unit £19/10/-.

PICK-UPS

ACOS GP.20 Arm	£1	6	1
ACOS HGP39 Head Std. & L.P. ea.	£2	2	3
COLLARO Standard Magnetic P.U.	£1	17	0
COLLARO Studio O or P. Pick Up	£3	14	8
COLLARO Transcription Arm Studio "P" Pick up	£4	15	9
COLLARO Transcription Arm Studio (Super) PX	£5	2	5
B.J. Arm	£2	19	11
DECCA XMS Heads Std. or L.P. ea.	£2	14	8
DECCA XMS P.U. with 2 heads	£6	9	5
CONNOISSEUR P.U. with 2 Heads	£9	5	6
CONNOISSEUR Transformer		13	0
CONNOISSEUR P.U. Heads. Diamond Stylus. Std. or L.P. ea	£7	8	11
LEAK Dynamic P.U. with Diamond Stylus	£11	9	6
LEAK Dynamic Extra Head	£7	15	3
Mu-Metal Transformer	£1	15	0

GRAM MOTORS

COLLARO 3/554 3 Speed Motor and Pick up	£8	18	4
COLLARO 2000 3 Speed Transcription Motor	£13	9	6
COLLARO 2010 3 Speed Transcription Motor and "P" Pick up	£18	4	9
GARRARD 301 3 Speed Transcription Motor	£25	3	6
GARRARD RC.80M 3 Speed Autochanger with 45 R.P.M. Post	£18	12	9
CONNOISSEUR 3 Speed Transcription Motor (Latest Model)	£25	15	5

OCTAGONAL SPEAKER CABINET
Designed for the G.E.C. Metal Cone Speaker.
Price £12 10 0

R.J. SPEAKER CABINET
The sensational new miniature speaker Cabinet by Wharfedale.
Price £9 10 0

TUNER UNITS

CHAPMAN S4. Four Stage Feeder Unit	£16 0 0
Ditto. S5. Five Stage Feeder Unit	£21 6 8
F.M.81 V.H.F. FM/AM Feeder Unit	£21 0 0

Postage and Packing extra.

TELE-RADIO (1943) LTD

189 EDGWARE ROAD, LONDON, W.2. Phone: PAD 4455/6

Shop hours: Monday-Saturday, 9 a.m. to 6 p.m. Thursday 9 a.m. to 1 p.m.

a new
STABILISED POWER SUPPLY UNIT FOR PHOTO-MULTIPLIERS

Ediswan now have available a new stabilised power supply unit which has been specially designed to feed Photo-Multipliers. It is particularly suitable as a supply unit for Ediswan Mazda Photo-Multipliers type 27.M1, 27.M2 and 27.M3.

BRIEF SPECIFICATION				
INPUT	OUTPUT	STABILITY	OUTPUT RESISTANCE	RIPPLE
200–250 v., 40–100 c.p.s.	High stability low ripple D.C. supply variable between 300 and 1,100 volts. Max. current 2 mA. Pos. or neg. may be earthed.	A 10% change in mains input voltage results in a change of less than 0.1% between 1,100 volts and 600 volts output.	Approximately 1,500 ohms.	Less than 0.01% R.M.S.
MOUNTING The Unit is suitable for standard rack mounting or for bench use. Bench Stands are available.				

PRICE — £48

Further information is available on request

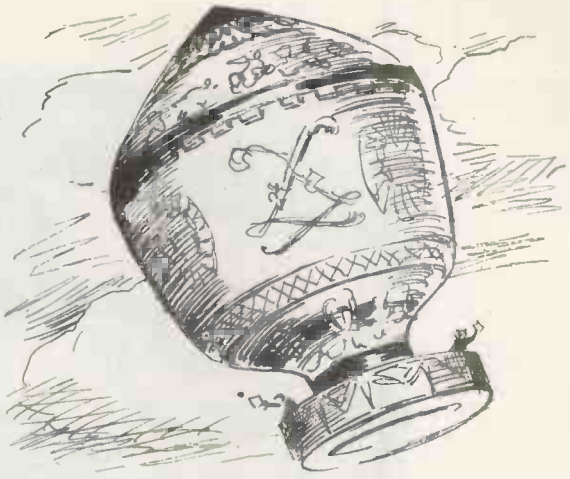
EDISWAN

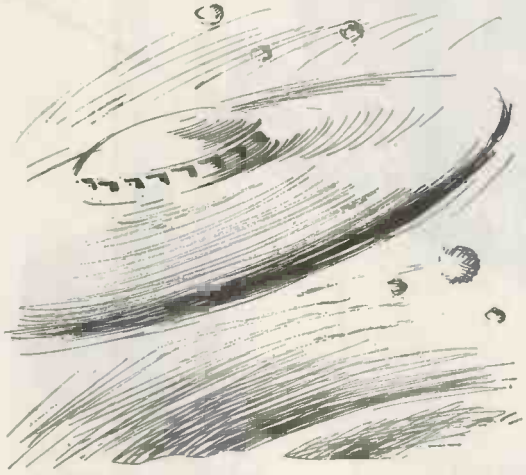
RADIO DIVISION · THE EDISON SWAN ELECTRIC COMPANY LIMITED
155 Charing Cross Road, London, W.C.2. *Telephone:* Gerrard 8660. *Telegrams:* Ediswan, Westcent, London
Member of the A.E.I. Group of Companies

SP115

HOT AIR...

It was the discovery that paper bags filled with hot air would ascend that encouraged the brothers Montgolfier to experiment with balloons, and led to the successful ascent of their first hydrogen balloon in 1783. This practical demonstration of aeronautics was the forerunner of air travel as we know it today.





HOT AIR...?

Recurring reports of sightings of strange flying objects ranging from glowing discs to fully-manned space ships help to popularise the idea that space travel is a forthcoming certainty—only a matter of time.

COLD FACTS

Here at Classic we are more down to earth—no hot air—no futuristic fantasies. We only deal with established facts. And we spend a lot of our time keeping our facts right up to date. Every new development in the radio or gramophone field, F.M. to Hi-Fi is given careful comparative tests, to ensure that the advice we give is as reliable and up-to-the-minute as the equipment we supply.

The new Classic comprehensive two colour sixteen page catalogue, is now available free (please send 6d. in stamps to cover postage). Also Special Export Catalogue (only available to overseas customers—please send 1/- to cover postage—air-mail extra.)

CLASSIC ELECTRICAL CO LTD

THE HI-FI, T.R., F.M. SPECIALISTS

352-364 LOWER ADDISCOMBE ROAD, CROYDON, SURREY

Telephone : ADDiscombe 6061-2

C

Pre-recorded tapes can now be replayed on the proved

TRUVOX

TAPE DECK NEW MODEL MK. III U

Incorporates BSS sense of tracking.

Price Still Remains at

22 GNS.

A TRUVOX PRODUCT

Manufactured in Gt. Britain by

TRUVOX LTD

Sales Office : 15 Lyon Road, Harrow, Middx. (Harrow 9292)

Tech & Sales Depts.: 328 The Broadway, Station Road, Harrow, Middx. (Harrow 4455)

TX1106

The popular TRUVOX Radio Jacks can now be used with Grundig and other Continental Tape Recorders for listening to and recording Broadcast Programmes.

Model TA7 (with Continental Plug).

Model TA3 (BSS Model)
£2/10/- + 18/4 P.T.

The Light Programme can now be received and recorded with the new SENIOR RADIO JACK which adds the 1500 m. wavelength to the two Medium Wave stations.
Model TA.8 (BSS Plug).
Model TA.9 (Metric Plug), for Grundig or Continental Recorders.

£3/9/6 + £1/5/5 P.T.

9 Octave realism... from a single unit

The G.E.C. metal cone loudspeaker gives lifelike reproduction of any type of sound over a range of 9 octaves. This includes the entire musical fundamental range together with overtones which give tonal quality and character to the performance of each musical instrument.

The sound engineer will appreciate the simplification and improvement in performance which has been achieved by combining the following attributes in a single unit.

- **Smooth response over a range of nine octaves with extremely good low frequency response**
- **Negligible inter-modulation**
- **Unequalled transient response due to special coil and cone construction**

£8.15.0
TAX PAID

For the Home Constructor

This is a professional instrument and must be used under the correct conditions to obtain the optimum results. Cabinets have been specially designed for use with this loudspeaker, details of which are available

G.E.C.

Metal Cone Loudspeaker

THE GENERAL ELECTRIC COMPANY LTD., MAGNET HOUSE, KINGSWAY, W.C.2

KLYSTRONS

by ENGLISH ELECTRIC VALVE COMPANY LIMITED

The valves tabulated below are examples from our standard range. The frequency coverage can be varied, within certain limits, to suit the requirements of equipment designers. Further particulars are available on request.

Tube Type	C.V. No.	Minimum Mechanical Frequency Range (Mc/s)	Typical Operation		Type of Tuner
			R.F. Power Output (mW)	Electronic Tuning Range (Mc/s)	
K.300†		9320-9500	25·0	30	Micrometer
K.328†		9550-9700	25·0	30	Micrometer
K.302*	2164	9320-9500	25·0	30	Micrometer
K.305*	2263	9250-9500	25·0	30	External Pin
K.312*	2273	9430-9650	25·0	30	Micrometer
K.313*		9645-9775	25·0	30	External Pin
K.335*	2343	9555-9685	25·0	30	Micrometer
K.308*	2282	8800-8900	30·0	30	Micrometer
K.315*		9105-9205	30·0	30	Micrometer
K.317*		8200-8300	30·0	30	Micrometer
K.311*		8500-9500	40·0	25	Shaft
K.324*	2304	9000-10000	40·0	25	Shaft

† Operate into Standard British Waveguide (1·0″ × 0·5″ Inside Dimensions).
* Operate into Standard American Waveguide (0·9″ × 0·4″ Inside Dimensions).

All valves are supplied with an integral resonant cavity.

ENGLISH ELECTRIC VALVE CO. LTD.

Waterhouse Lane, Chelmsford
Telephone: Chelmsford 3491

AP 300-10

SENSITIVE AND STABLE
VALVE VOLTMETERS
by Mullard

E.7556

SENSITIVE

F.S.D. readings range from 10mV to 300V r.m.s. a.c.

LEVEL FREQUENCY RESPONSE

Only 2% (0.2dB) variation between 20 c/s and 1 Mc/s.

ACCURATE

Absolute error is less than 4% over whole range.

NEGATIVE FEEDBACK

The calibration accuracy is precisely maintained in this valve voltmeter, and in the E.7555 series described below.

BUILT-IN CHECK VOLTAGE

A stable 10mV supply provides a quick and easy check of calibration.

E.7555/2

WIDE RANGE

0.5V F.S.D. to 15kV, peak a.c. or d.c. (an alternative model, **E.7555/3**, with a range of 0.5V to 500V is also available.)

BROAD BANDWIDTH

Low level response constant within 2% from 30 c/s to 100 Mc/s using probe.

EXTREME STABILITY

The high degree of feedback employed minimizes the effects of ageing and supply fluctuations.

DIFFERENTIAL MEASUREMENT

Provision is made for differential measurement of direct voltages and, at the same time, for the input resistance to be balanced to earth.

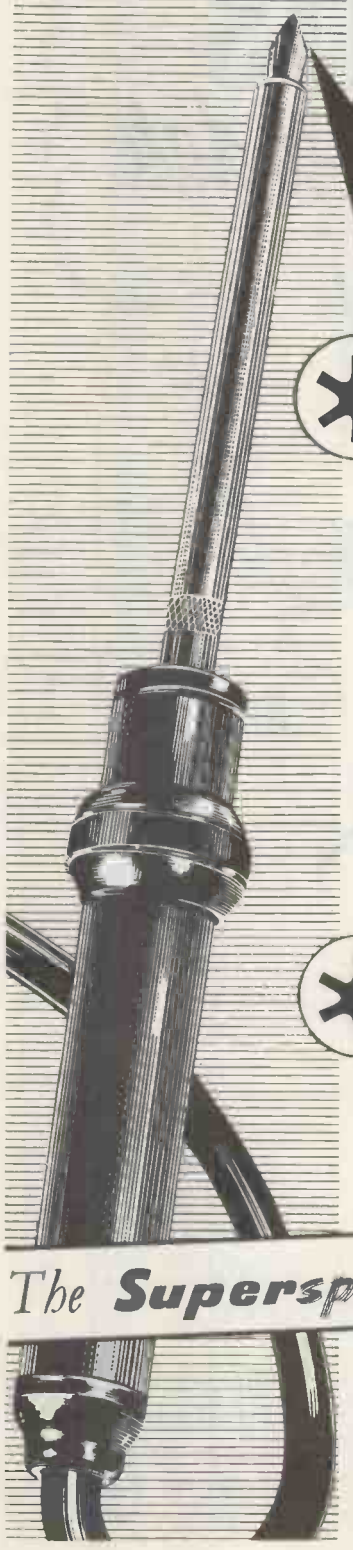
Mullard Mullard

SPECIALISED ELECTRONIC EQUIPMENT

Write today for full information on valve voltmeters and other instruments in the Mullard range

MULLARD LIMITED · EQUIPMENT DIVISION · CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · WC2
(M1455 REV.)

m-i-n-u-t-e-s *into seconds...*



with the brilliant NEW

Superspeed SOLDERING IRON

MANUFACTURED FOR ENTHOVEN SOLDERS LTD. BY SCOPE LABORATORIES, MELBOURNE, AUSTRALIA

STAR FEATURES

★ Heats up from cold in 6 seconds—by a light thumb pressure on the switch ring.

★ When not in use, current is automatically switched off—thus, greatly reducing wear of copper bit. Electricity consumption is correspondingly reduced.

★ It is 10" long, weighs 3½ ozs., can be used on 2·5 to 6·3-volt supply. 4-volt transformer normally supplied.

★ More powerful than conventional 150-watt irons and equally suitable for light wiring work or heavy soldering on chassis.

★ Simple to operate, ideal for precision work. Requires minimum maintenance at negligible cost. Shows lowest operating cost over a period.

★ Can be used from a car battery.

★ It is by far the most efficient and economical soldering iron ever designed for test bench and maintenance work.

STAR APPLICATIONS

Designed on an entirely new principle, this light-weight, versatile iron is eminently suitable for soldering operations in the RADIO, TELEVISION, ELECTRONIC and TELECOMMUNICATION industries, particularly for all SERVICE work. For general purpose work the Superspeed Iron is the ideal stand-by soldering tool.

The **Superspeed** *soldering iron is available* NOW

Write for full particulars, including guarantee terms and free trial facilities, to the sole concessionaires in this country—

ENTHOVEN SOLDERS LIMITED

(Industrial Equipment Division), 89 Upper Thames St., London, E.C.4. Telephone: MANsion House 4533

Panton

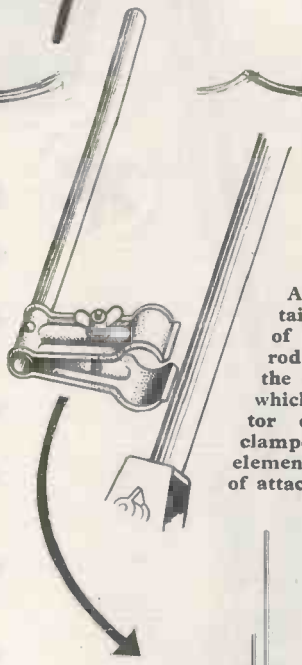
"ADDEX" UNITS

bring Band I Aerials up-to-date

" ADDEX " units are easily fitted, economical and efficient, providing a combined aerial to receive Band 1 and Band 3 transmissions. From our wide experience of North American transmissions at Band 3 frequencies and the preliminary information regarding the radiated power of the coming I.T.A. transmitters, we anticipate the " Addex " will provide adequate signal strength at distances up to 15-20 miles from the transmitter, depending upon local conditions. Beyond 15-20 miles an interim range of Band 3 aerials for attachment to existing aerial masts or with separate mountings is immediately available.

Descriptive literature, which also includes details of indoor Band 3 aerials as well as indoor and outdoor FM aerials can be obtained from your usual ANTIFERENCE wholesaler or from Aylesbury direct.

A completely new range of lightweight Band 3 aerials will be available in April.



At left is a detailed illustration of the 'grip-on' rod unit showing the simple way in which the Snapacitor coupling is clamped over the rod element at the point of attachment.

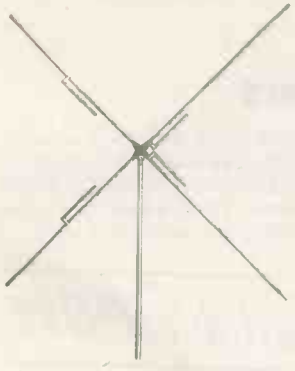


Illustration shows the " Addex " Type 'X' fitted to a Band 1 aerial and suitable for Channels 1 and 2. This kit comprises 4 'grip-on' rod units for attachment to aerials of ⅜in. or ½in. dia. rod elements.

" ADDEX " Type 'X' List Price **15/-.**

" ADDEX " Type 'BX' (for Channel 4) 2 units only. List Price **7/6.**

This is the " Addex " Type 'D' for Channels 8 and 9 for use on single Dipole aerials, comprising two 'grip-on' units. Suitable for all Dipoles with ⅜in. or ½in. dia. rods " ADDEX " Type 'D' List Price **7/6.**

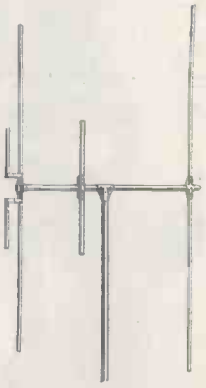


Illustration shows the Type 'H' " Addex " for Channels 8 and 9; comprising two 'grip-on' rod units and one 'reflector' unit with universal boom fitting. Suitable for all 'H' aerials with ⅜in. or ½in. dia. rods in Channels 1, 2 and 4. " ADDEX " Type 'H' List Price **15/-.**

ANTIFERENCE AERIALS
LTD.

DHB/A/2099

Antiference Limited,
Sales Division,
Bicester Road,
Aylesbury, Bucks.
Tel: Aylesbury 1467/8

Simon is *Sound* recording

When you listen to a Simon Portable you're hearing Sound Recording at its lively best. Ask your dealer for a demonstration. Try its simple controls. Hear its faultless reproduction of speech and music—remember that for P.A. or record reproduction you can use the high quality amplifier independently of the recorder.

The SP/I is precision built to top standards. All electronic components are of the highest quality. All mechanical parts are plated.

- ★ *Monomaster Finger-tip control.*
- ★ *2-stage capstan.*
- ★ *Three motor drive.*
- ★ *Fast rewind and wind-on.*
- ★ *10 watts push-pull output.*
- ★ *Simple loading.*

Simon **PORTABLE TAPE RECORDER MODEL SP/1 79 GNS.**

H.P. FACILITIES AVAILABLE.

SIZE:	18in. × 15in. × 10in
LOUDSPEAKER:	6½in. built-in Monitor.
POWER SUPPLY:	200/250 v. 50 cycles A.C
INPUT CHANNELS:	High impedance for microphone: low or high impedance for radio
POWER CONSUMPTION:	100 watts approx
RESPONSE:	50-12,000 c.p.s. ± 3 db

Ask for illustrated literature and Information Sheet T1/6

SIMON SOUND SERVICE LTD. (Dept. W.),

48-50 GEORGE ST. · LONDON · W.1 · *Phone: WELbeck 2371 (5 lines)*

An outstanding general purpose communication receiver

Justly acclaimed as Britain's finest post-war communication receiver the BRT 400 D is in widespread use by Military, Post and Telegraph and Broadcasting authorities throughout the world.

Combining first-class performance with a wide range of facilities, the BRT 400 D is equally suitable for both narrow-band telegraphy and wide-band telephony reception—with a very high standard of reliability.

It is available in either cabinet or rack mounting form, with a 500 kc/s crystal calibration unit as an optional extra. Normal operation is from an A.C. mains supply: an auxiliary power unit is available for 12 volt battery operation.

G.E.C.

BRT 400D

SHORT SPECIFICATION

BAND COVERAGE

0.150—0.385 Mc/s } in 6 bands
0.510—30.0 Mc/s }

SENSITIVITY

Better than 1.0 μV for 1.5 watts output, over the whole band.

SIGNAL/NOISE RATIO

Standard input for 20 db:—

1.3—30.0 Mc/s	< 7.0 μV
0.150—1.3 Mc/s	< 10.0 μV

SELECTIVITY

Six switched bandwidths:—

0.5 kc/s	1.0 kc/s	2.0 kc/s
5.5 kc/s	9.0 kc/s	13.0 kc/s

OVERALL FIDELITY

Less than 2 db down at 50 c/s
Less than 6 db down at 5,500 c/s

A.G.C. CHARACTERISTICS

Output constant within 3 db for 100 db change in signal input.

OUTPUT CIRCUITS

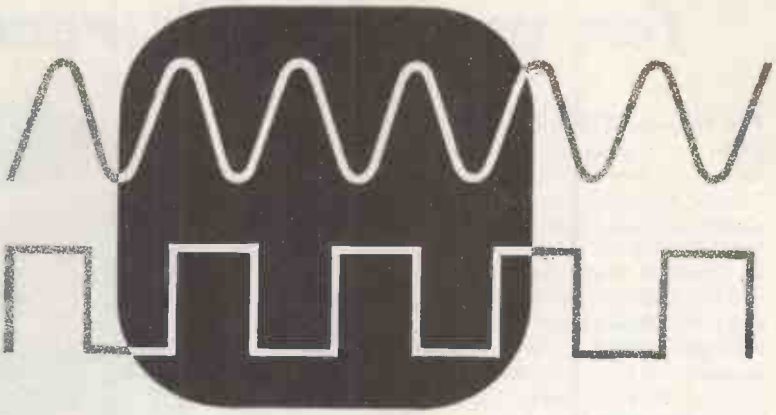
At 2.5 or 15 ohms	2.5 watts
At 120 ohms	0.05 watts
At 600 ohms	0.2 watts

POWER SUPPLY

95—130 and 195—250 volts, 40/80 c/s. Also from 12 volt battery, using BRT 401 auxiliary power unit.

For the full specification please send for a copy of publication BC2084.

THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2



NO INTERACTION

Identical Amplifiers
20 mV/cm at 4 Mc/s

dual-trace oscilloscope

BY MULLARD

After considerable research and development Mullard introduce the L.101 oscilloscope—a well-engineered and reliable instrument with dual trace facilities, and accurate time and voltage calibration.

Two separate amplifiers and a high speed electronic switch operating during the fly-back cycle are used to display two input signals on a conventional cathode ray tube. This arrangement provides a complete uninterrupted sweep on each channel alternately, and ensures freedom from interaction between the two amplifier channels.

The two amplifiers are identical and have a constant bandwidth of 4 Mc/s irrespective of sensitivity. They are aligned for good transient response and have a rise time of 0.1μsec. Each amplifier has a maximum sensitivity of 20 mV peak-to-peak/centimetre.

A Miller time base is employed, which may be free-running, synchronised or triggered. Its velocity is continuously variable between 0.1μsec/cm and 10msec/cm. Both time and voltage may be measured by the nul method and a well-regulated power supply preserves calibration accuracy.

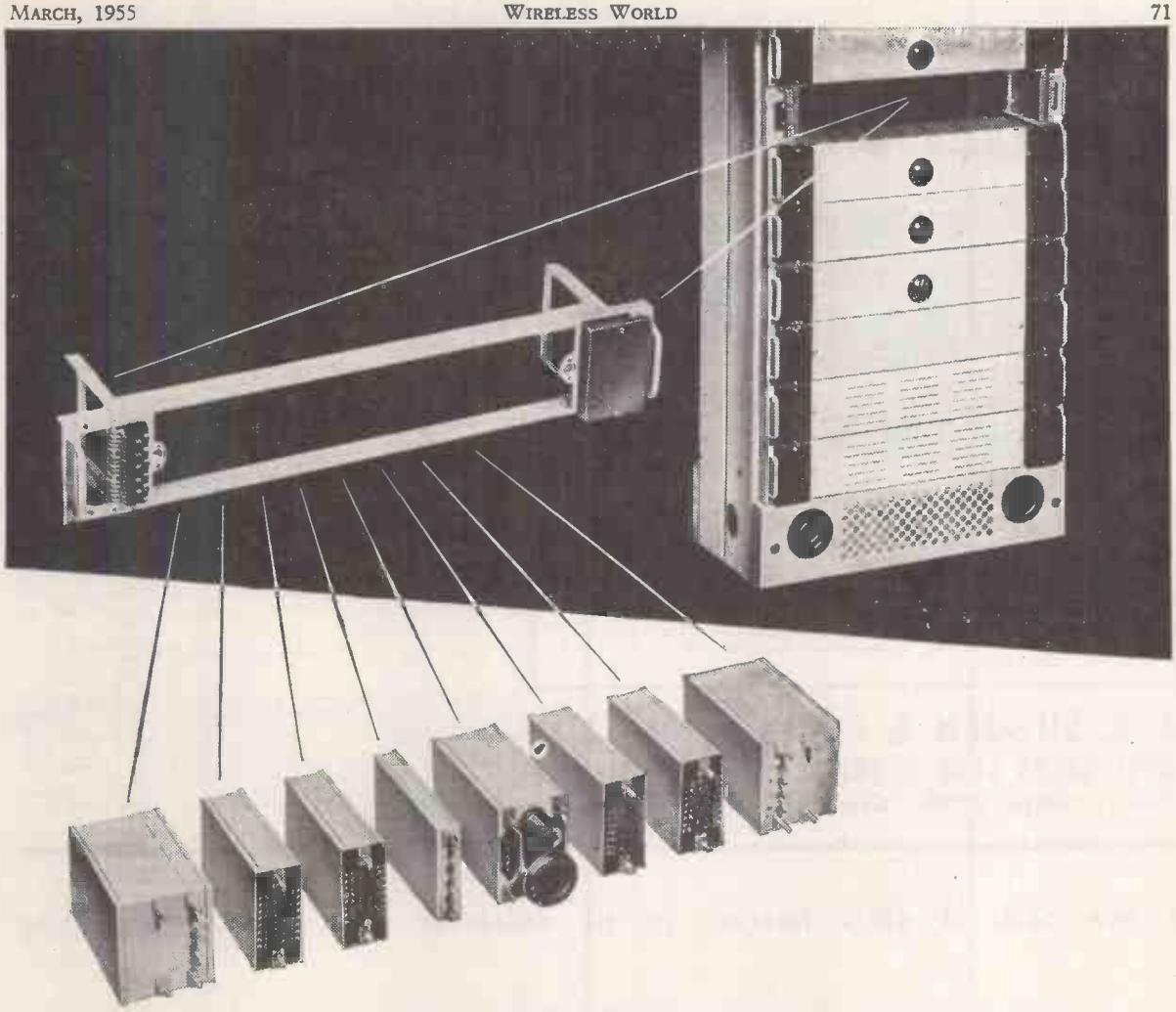
Further information on the operation and performance of this new oscilloscope and other Mullard instruments is readily obtainable from the address below.

Mullard

SPECIALISED ELECTRONIC EQUIPMENT

MULLARD LIMITED · EQUIPMENT DIVISION
CENTURY HOUSE · SHAFTESBURY AVENUE · LONDON · W.C.2

(MI456)



Designed for Continuous Service

ATE/TMC transmission equipment is designed to offer an operating administration the maximum facility in installation and in subsequent maintenance routines. A bayside can be unpacked, carried, erected and equipped by one man if necessary. Panel frames, fitted with quickly detachable functional units, are of the "jack-in" type, an arrangement which ensures the most rapid form of servicing yet devised. Further information is contained in the brochure "Unit Construction Practice" a copy of which will be forwarded on request.

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

Radio and Transmission Division, Strowger House, Arundel Street, London, W.C.2. *Telephone:* TEMple Bar 9262. *Cables:* Strowgerex London. *Manufacturers:* AUTOMATIC TELEPHONE & ELECTRIC CO. LTD., Liverpool and London, TELEPHONE MANUFACTURING CO. LTD., St. Mary Cray, Kent.

AT 8531-BX 105

PREMIER RADIO COMPANY

Limited supplies of C.R. TUBES

VCR517C
6½in. picture. This tube is a replacement for the VCR97 and VCR517. Guaranteed full size picture.
Price 35/-. Plus 2/6 pkg., carr., ins.

VCR516
9in. blue picture. Heater volts 4 anode 4 kV. In manufacturer's original carton. £1/19/6, plus 5/- pkg., carr., ins.

ALL BRAND NEW

CABINETS—PORTABLE

Model PC/1
Brown Rexine covered 22/6
Overall dimensions 15in. × 13½in. × 5in.
Clearance under lid when closed 2½in.

Model P2/C
Grey Lizard Rexine covered 45/-
Overall dimensions 15in. × 13in. × 6in.
Clearance under lid when closed 3in.

Model PC/3
Rexine type covering in various cols., 69/6.
Overall dimensions 16½in. × 14½in. × 10½in.
Clearance under lid when closed 6½in.

All the above Cabinets are supplied with Panel, Carrying Handle and Clips.
Packing and Postage 2/6.

UNITELEX 5-watt Amplifier Type MG4/MG4A

For Gramophone and Microphone operation, enclosed in metal case, output suitable for 15 and 3 ohms Speakers, switched input BVA miniature Valves, separate treble and bass tone controls, for A.C. mains 200/250 v.
Price, enclosed in metal case, £9/19/6.
Price, less metal case, £8/18/6.
Packing and Postage 7/6.

E.A.R. MULLARD 510 AMPLIFIER

Based on the Mullard circuit. Combined change-over switch for standard, L.P. records and radio. Plug-in filter network. 18 gns. Postage and packing 7/6.

RECTIFIERS

E.H.T. Pencil Type S.T.C.

Type K3/25	650 v.	1 mA.	4/7
,, K3/40	3.2 kV.	1 mA.	6/-
,, K3/45	3.6 kV.	1 mA.	8/2
,, K3/50	4 kV.	1 mA.	8/8
,, K8/100	8 kV.	3 mA.	14/8
,, N3/160	12 kV.	1 mA.	21/6
,, K3/180	14.4 kV.	1 mA.	24/6

H.T. Type S.T.C.

Type RM1	125 v.	60 mA.	4/-
,, RM2	125 v.	120 mA.	4/8
,, RM3	125 v.	125 mA.	5/6
,, RM4	250 v.	250 mA.	18/-

L.T. Type Full Wave

6 v. 1 amp.	4/-
12 v. 1 amp.	8/-
12 v. 2 amp.	10/9
12 v. 4 amp.	15/-

BATTERY CHARGERS

200-250 v. A.C. Will charge 2 v. 6 v. and 12 v. Car Battery at 1 amp. Housed in strong metal casing. Finished in Green hammered enamel. Size 6in. long, 3½in. wide, 3½in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain Ex-Govt. components. Plus 2/6 P. and P. **39/6**

BATTERY CHARGER KITS

All incorporate metal rectifiers. Transformers are suitable for 200-250 v. A.C. cycle mains.

Cat. No.
2002 Charge 6 volt accumulator at 1 amp. Resistance, supplied to charge 2 volt Accumulator 13/6
2004 Charges 2, 6 and 12 v. accumulators at 1 amp. 19/11

ALUMINIUM CHASSIS 18 s.w.g.

Substantially made from Bright Aluminium with four sides:

7 × 5½ × 2in.	4/-	10 × 9 × 3in.	7/-
7 × 3½ × 2in.	3/9	12 × 10 × 3in.	7/9
9½ × 4½ × 2in.	4/3	14 × 10 × 3in.	7/11
10 × 8 × 2½in.	5/6	16 × 10 × 3in.	8/3
12 × 9 × 2½in.	7/-	16 × 8 × 2½in.	8/-
14 × 9 × 2½in.	7/6		

ALUMINIUM PANELS 18 s.w.g.

7 × 6in.	1/3	7 × 4in.	1/-
9½ × 6in.	1/8	9½ × 4in.	1/5
10 × 9in.	2/2	10 × 7in.	1/11
12 × 9in.	2/8	12 × 7in.	2/5
14 × 9in.	3/2	14 × 7in.	2/11
16 × 9in.	3/8	16 × 7in.	3/5
20 × 9in.	4/8	20 × 7in.	4/5
22 × 9in.	5/2	22 × 7in.	4/11

STOP PRESS

First release of the Famous COMMUNICATION RECEIVER TYPE RA-1B manufactured by the BENDIX RADIO CORP. OF AMERICA, valve line-up 6K7, R.F.Amp., 6L7 1st det., 6K7 Osc., 6K7 1st IF. Amp., 6K7 2nd IF. Amp., 6K7 CW. Osc., 6B7 2nd det., AVC and 1st Audio. 6K6 Audio output. Frequency coverage 0.15 to 1.5 Mcs. (2,000-200 metres) in three bands. 1.8 to 15.0 Mcs. (166-20 metres) in three bands. The frequency coverage on each band is approximately 2/1 giving EXCELLENT BAND SPREAD TUNING. Power requirements are 1.5 amps. at 12 volts and approximately 70 mA. at 225 volts. WRITE FOR FULL DETAILS.

GRAMOPHONE PRE-AMPLIFIER

Power requirements 200-250 v., 2 mA., and 6.3 v. .3 a., this may be taken off existing radio.
All the components to build the above unit, 22/6, plus 1/6 pkg. and postage.

Famous Manufacturer's Surplus of

ANTI-INTERFERENCE AERIALS

offered at a fraction of original cost

The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms long/medium waves and 150 ohms short waves. The installation discriminates against locally generated electrical interference, especially on the short wavebands. The equipment enables the installation of an 8.3 Mc/s flatly-tuned dipole which operates as a "T" aerial on medium and long waves. The aerial and receiver transformers are intended to be interconnected with a 70 ohms co-axial cable.

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising one each: Aluminium transformer, Transformer clip rubber sucker, ¼in. × ¼in. brass screw, 4AB × ¼in. brass bolt, 4BA nut.
Receiver Transformer. Complete with insulators, clips, etc.; porcelain insulators, 2 each, 60ft. insulated aerial wire, 60ft. screened co-axial down lead.
Installation instruction leaflet included.
LESS CO-AXIAL CABLE & AERIAL WIRE, 15/-, plus 1/6 pkg. and carr.
COMPLETE, 35/-, plus 1/6 pkg. and carr.

★QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 26/- Plus 1/6 Pkg. and Carr.

The New

"PREMIER PORTABLE"

TAPE RECORDER

USING THE NEW LANE 2-SPEED TAPE UNIT MARK 6

COMPLETE 39 GNS CASH

Packing & Carriage 1 gn.

(Including Reel of Scotch Boy Tape and Microphone)

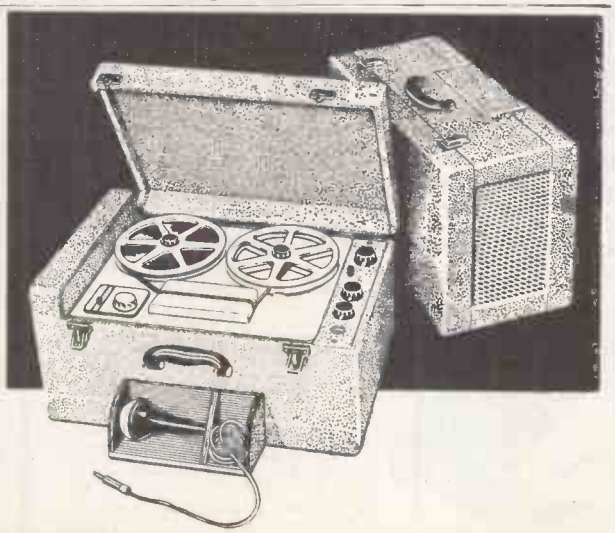
H.P. Terms: Deposit £10.4.9 and 12 monthly payments of £2.16.11,

or **Complete Kit** Including All Parts, Valves, Speaker Cabinet, Tape Unit, Reel of Scotch Boy Tape, Rewind Spool and Microphone at **£37.4.0** plus pkg. & carr. 15/-.

H.P. Terms: Deposit £9.6.0 and 12 monthly payments of £2.10.0.

SPECIFICATION

★ TWO SPEEDS 7½in. AND 3¾in. PER SECOND.
★ THREE SPECIALLY DESIGNED RECORDING MOTORS.
★ 1,200ft. TAPE REELS PROVIDING PLAYING TIMES OF 1 HR. AND 2 HRS.
★ DROP-IN TAPE LOADING.
★ EASY FORWARD OR REWIND WITHOUT REMOVING TAPE.
★ ONE KNOB DECK OPERATION.
★ 7-VALVE HIGH QUALITY AMPLIFIER.
★ INDEPENDENT TREBLE AND BASS CONTROLS.
★ MAGIC EYE RECORD LEVEL INDICATOR.
★ AMPLIFIER MAY BE USED FOR RECORD REPRODUCTION OF HIGH QUALITY.
★ COMPARTMENT FOR HOUSING MICROPHONE.
★ SPECIALLY DESIGNED MICROPHONE BY A LEADING MANUFACTURER.



SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW:—

Amplifier (built, wired and tested with Speaker). £14/15/-, plus postage and carriage 7/6.
Hire purchase terms, Deposit £3/13/9 and 12 monthly payments of £1/0/6.
Amplifier Kit (including Speaker). £11/-/- plus packing and carriage 5/-.
Hire purchase terms, Deposit £2/15/- and 9 monthly payments of £1/0/7.
New Lane 2-speed Tape Unit Mark 6, £18/10/- plus packing and carriage 7/6.
Hire purchase terms, Deposit £4/12/6 and 12 monthly payments of £1/5/9.
Portable Cabinet (rexine covered). £4/19/6, plus postage and carriage 5/-.
Microphone, £2/15/-, plus postage and carriage 1/-.
Reel Scotch Boy Tape MC2-111 (1,200ft.), £1/15/-, plus packing and carriage 1/-.
Instruction Booklet, 2/6. Post free.

Rigorous inspection

ensures faultless performance

One of a line of testing booths where the final electronic test is carried out.

Continual, exacting inspection is an important routine at the B.S.R. factories. Throughout the entire production cycle, each Monarch Autochanger is submitted to the most stringent tests for quality, accuracy and performance. Here, the inspector's word is final.

Tests carried out by independent authorities further prove the high standard attained by B.S.R. inspectors. In one such test recently, over 90 years' normal usage was condensed into a few weeks.

The Monarch performed faultlessly throughout the entire period! This exhaustive testing and re-testing is the buyer's finest safeguard, and his guarantee of a lifetime's trouble-free, superlative performance from the Monarch Automatic Record Changer. *B.S.R. are today the world's largest manufacturers of autochangers and players outside the U.S.A.*

MONARCH

AUTOMATIC RECORD CHANGER

BSR

BIRMINGHAM SOUND REPRODUCERS LTD., MONARCH WORKS, OLD HILL, STAFFS

Wireless World

RADIO, ELECTRONICS, TELEVISION

Managing Editor:
HUGH S. POCOCK, M.I.E.E

Editor:
H. F. SMITH

MARCH 1955

In This Issue

Editorial Comment 101
Does the Tape Characteristic Matter? 102
More About Radio Training 103
World of Wireless 105
Spurious Line Scan Resonances. *By K. G. Beauchamp* .. 109
Voltage-Multiplying Rectifier Circuits. *By "Cathode Ray"* 115
I.T.A. Transmitters 120
Transistor Radio Receiver. *By D. Nappin* 123
Letters to the Editor 125
Russian Colour Television 127
The Slot Aerial. *By B. L. Morley* 129
Band III Pilot Transmitter 131
Short-wave Conditions 132
Introduction to Transistor Electronics—2. *By H. K. Milward* 133
Recovering Hidden Signals. *By James Franklin* 137
Commercial Literature 140
Direct-Reading Capacitance Tester. *By O. E. Dzierzynski* .. 141
Manufacturers' Products 144
Two-Valve Superhet. *By R. C. Lever* 145
Books Received 146
March Meetings 147
Random Radiations. *By "Diallist"* 148
Unbiased. *By "Free Grid"* 150

VOLUME 61 NO. 3
PRICE: TWO SHILLINGS

FORTY-FOURTH YEAR
OF PUBLICATION

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

VALVES, TUBES & CIRCUITS

27. RECOMMENDED PCF80 TELEVISION APPLICATIONS

Advertisement No. 26 in this series discussed the use of the Mullard PCF80 in applications other than its primary application as additive mixer. Three of the recommended circuits are given below. Details of line multivibrator and line timebase coincidence detector circuits will be given in the *Additional Notes*.

Fig. 1: Pentode as Video Amplifier.

The composite video output is 80V pk—pk. with a 3.0Mc/s bandwidth (6.0db) and a gain of 12. Additional drive will produce excessive g_2 dissipation. To avoid hum the following limitations of a.c. heater-to-cathode voltage must be observed, $R_{g\text{-}k}$ being 100kΩ:

$V_{h\text{-}k}$	R_k
200V	150 Ω
100V	300 Ω
50V	600 Ω

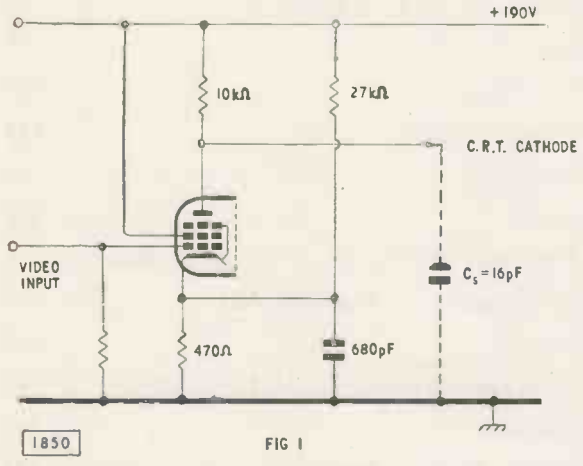


Fig. 2: Pentode as Sync. Pulse Separator; Triode as Frame Pulse Clipper.

For optimum operation of the pentode, $V_{g2} = +40V$. The frame pulse clipper is conventional but economical. Sync. pulses from the pentode are integrated by R1, C1 (27μsec) and are d.c. coupled to the triode grid, holding it in grid current. Integrated frame pulses drive the grid negative, cut off the triode, and produce 140V, 400μsec frame sync. pulses with a fast front edge and a non-interlaced back edge —corresponding to odd and even frames. To ensure that only the front edge is significant, the frame oscillator, coupled via a short time constant circuit, should complete its flyback before the end of the pulse.

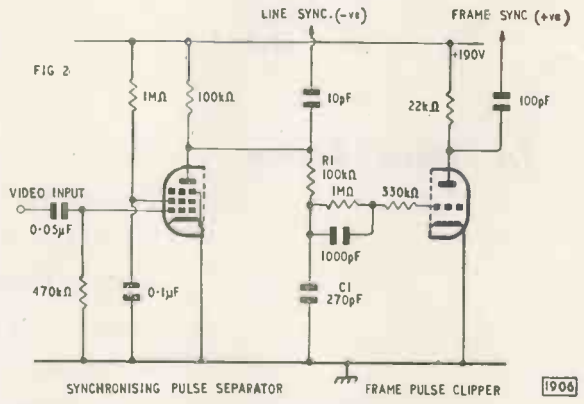
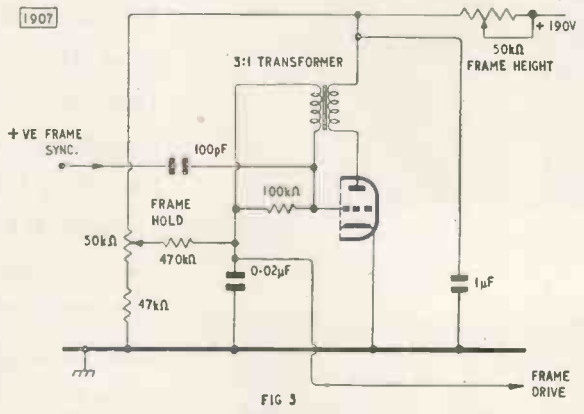


Fig. 3: Triode as Frame Blocking Oscillator

The output sawtooth amplitude is 200V for 200mA peak I_k (150μsec pulse). A step-up transformer into the grid circuit is used. There is sufficient output for a variety of linearization methods.



The following relevant reprints of "Valves, Tubes, and Circuits" are available free:

No. 15: Valves for VHF Television Reception, with PCF80 and PCC84 data.

No. 16: PCF80: a Frequency Changer for Band I and Band III Television, with notes on conversion conductance "contour analysis".

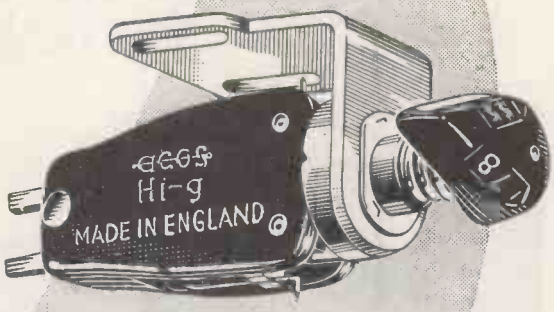
No. 26: Additional Applications of the PCF80, with a comprehensive applications chart.

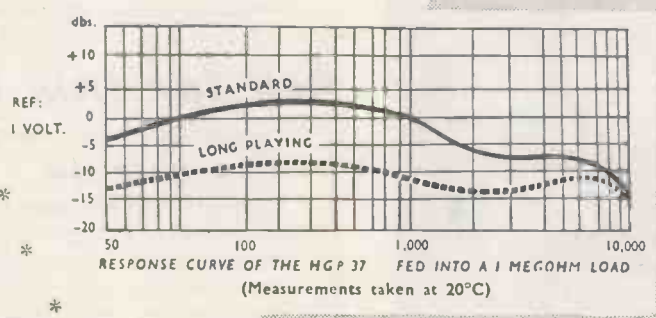
No. 27: this number.

Turnover crystal pick-up cartridge in the ACOS Hi-g series

HGP 37-1

with outstanding independent standard and microgroove characteristics





RESPONSE CURVE OF THE HGP 37 FED INTO A 1 MEGOHM LOAD
(Measurements taken at 20°C)

This cartridge utilises an entirely new method of crystal drive, a bi-sectional control element achieving independent standard and microgroove characteristics. The easily replaceable sapphire styli are of a cantilever design with considerable vertical compliance, thus virtually nullifying "pinch effect" and needle talk. In addition to the introduction of vertical compliance in the design, the lateral compliance has been greatly increased, enabling the heaviest of modulations to be traced with ease. The high output is sufficient for the average domestic radio.

. . . always well ahead

NUMBER PLEASE! *The new restricted form of London Telephone Directory no longer includes subscribers, like Cosmocord, in "fringe" areas. Please note therefore that our number is* **ENFIELD 4022.**

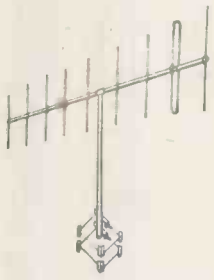
ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

GD **COSMOCORD LIMITED ENFIELD MIDDLESEX**

"BELLING-LEE" NOTES

"Belling-Lee" Band III Pilot Transmitter

First mooted by "Belling-Lee" in November, 1954, and the subject of many discussions since, the question of a pilot transmission on a band III vision frequency has occupied a lot of our time. It is not generally appreciated that nowhere in the world has a vertically polarised band III vision signal been radiated.



L905/9/9

As "Belling-Lee" manufacture about half of the total number of television aerials installed, we are naturally anxious to prove our designs before offering them for sale in large numbers. After all, we do guarantee them for three years.

All arrangements were completed, but before we had time to let people know about it, we found there had been a leakage of information and journalists were on the scent. So it was agreed that, rather than have ill-informed or irresponsible statements appearing in the press, an official statement should be issued from the Press office of the Radio Industry Council. Here it is:

"For industry purposes only, a vision signal on a commercial television frequency is to be radiated on a temporary mast on the I.T.A. site near Croydon some months in advance of the opening of commercial television." This was stated on Friday, 14th January, by the Radio Industry Council co-ordinating body of the Industry.

"The transmissions will be carried out by Belling & Lee Ltd., well known aerial manufacturers who, working in close co-operation with the industry and I.T.A., are to be given permission by the G.P.O. to radiate a 1 kilowatt band III (channel 9) vertically polarised vision signal, such as a test pattern.

It is expected that the low power transmissions will start about April 1st. Details regarding times of transmissions will be announced later."

An R.I.C. spokesman says:

"The purpose of the signal is mainly to supplement by practical means the aerial manufacturers' technical appreciation of the problems of band III reception.

It will also provide useful additional data for receiver manufacturers and it will help retailers to make initial installation of receivers and aerials, but only within a very small area, as compared with that which will be covered on the opening of the I.T.A. transmitting station in the late summer."

We would like to add that "Belling-Lee" are building the transmitter and the aerial and all costs are being borne by the company. Although all T.V. aerial manufacturers will reap some benefit, we, as the manufacturers of by far the greatest number of aerials, will gain the most, which is only fair and proper.

By the time this is published, "Belling-Lee" independent band III aerials will be available, together with certain adaptors. One of these adaptor kits is particularly cunning and is covered by a very strong patent. Where the field strength is such that a band III picture is obtainable on a Channel 1 aerial, say within 10-15 miles of the Croydon Transmitter, the addition of the adaptor L924 will improve the picture very considerably, often greater than 10 d.B. This particular adaptor can be applied to a dipole or an "H." Another adaptor L926, consisting of a band III dipole and director kit, can be added to a dipole or an "H" and should bring in a band III signal up to 15-20 miles. A somewhat similar arrangement may be applied to a "Lofrod" loft aerial with a range of 5-6 miles. None of these adaptors will require a second feeder.

The distance quoted for these adaptors applies to their use on the I.T.A. transmitters and not on the "Belling-Lee" pilot transmissions.

We will be using only 1 kW, and although we expect to obtain some kind of a signal here in Enfield with an ambitious aerial, we would not care to say that there would be complete coverage over the whole of the London area.

Advertisement of
BELLING & LEE LTD.
Great Cambridge Rd., Enfield, Middx.

Written 17th Jan. 1955

Modern Television Technique
HIGH LEVEL CONTRAST CONTROL

In recent years the normal method of obtaining contrast control in television receivers has been to adjust the signal drive to the cathode ray tube by controlling the gain of the R.F. or I.F. amplifiers. Now that receivers have to cater for Band III reception this system is no longer entirely satisfactory. As was shown in an earlier article of this series, A.G.C. is necessary on two-band receivers to counteract the differences in strength likely to be encountered between Band I and Band III signals. In these circumstances the relative gains of the R.F., vision I.F. and sound I.F. stages should be automatically controlled for optimum signal to noise ratio and freedom from cross modulation at any reasonable signal input. Equally important is the need for auxiliary circuits that operate as a function of signal amplitude—the sync. separator, the A.G.C. circuit and the interference limiter and inverter — to receive a constant signal for consistent performance.

The conventional form of contrast control outlined above does not allow these requirements to be met, and so "His Master's Voice" engineers have developed a method of High Level Contrast Control which is incorporated in the latest "His Master's Voice" "Highlight" models. In this system the contrast control operates directly on the modulating electrode of the cathode ray tube. The output signal to the auxiliary circuits is therefore obtained before the contrast control, and consequently the A.G.C. circuit maintains a pre-determined optimum characteristic in respect of both gain and delay.

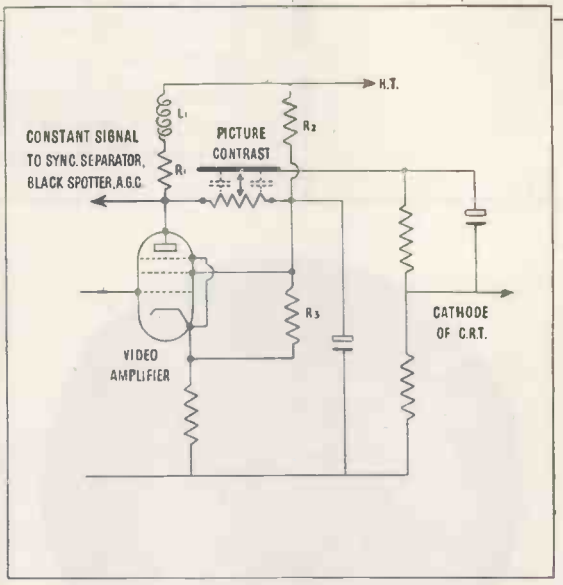
Apart from this consideration, High Level Contrast Control has other important advantages: Sound output is independent of contrast setting; the sync. signal is constant; the picture interference limiter is not affected by alterations in contrast setting and can therefore be pre-set on installation, and finally, the mean brightness of the picture remains sensibly level when the contrast is expanded or contracted.

Potentiometers of the conventional type are unsuitable for controlling video signals, because at mid settings severe integration of the high frequency signal components occurs, due to the input capacity of the cathode ray tube and the associated wiring.

It is necessary, therefore, to arrange that the contrast control is not only a resistive but also a capacitive potentiometer.

NEW SPIRAL POTENTIOMETER

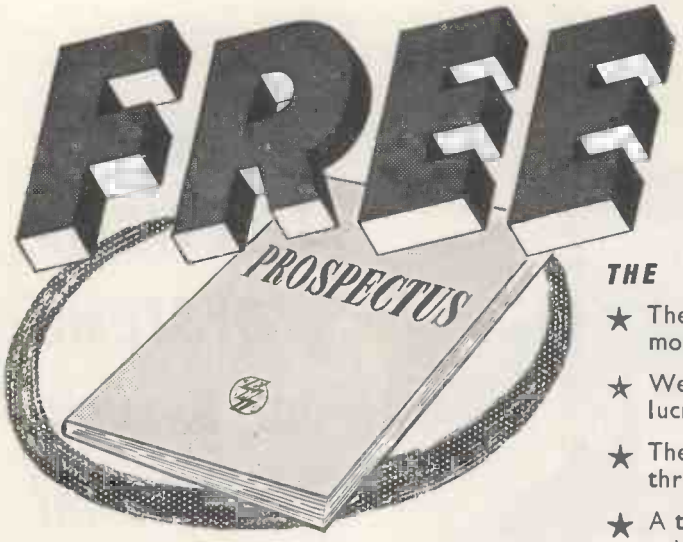
The high level contrast control used in "His Master's Voice" "Highlight" television receivers is a new SPIRAL POTENTIOMETER consisting of a wirewound resistive element having distributed inductance, located in proximity to a metal plate. Distributed capacity occurs between each portion of the element and the plate, which is electrically connected to the wiper contact.



Skeleton circuit diagram of "His Master's Voice" High Level Contrast Control.

By suitable design of the inductive, resistive and capacitive elements, a picture of correct contrast, possessing a frequency characteristic which is flat or slightly boosted at 3Mc/s, is obtained at the mid-way setting of the potentiometer, and ample scope is provided for obtaining an over-contrasted picture, useful for shop window display purposes.

From the circuit diagram it will be seen that the constant signal for the auxiliary circuits is obtained at the anode load (R_1 L_1) of the video amplifier, while the drive to the cathode ray tube is taken from the picture contrast potentiometer. The values of R_2 and R_3 are adjusted so that the mean potential of the cathode ray tube electrode varies with the contrast potentiometer setting and provides substantially the correct black level setting for the desired contrast.



POST THE COUPON TODAY FOR OUR BROCHURE ON THE LATEST METHODS OF HOME TRAINING FOR OVER 150 CAREERS AND HOBBIES

THE ADVANTAGES OF E.M.I. TRAINING

★ The teaching methods are planned to meet modern industrial requirements.

★ We offer training in all subjects which provide lucrative jobs or interesting hobbies.

★ The student is taken carefully and thoroughly through his chosen subject.

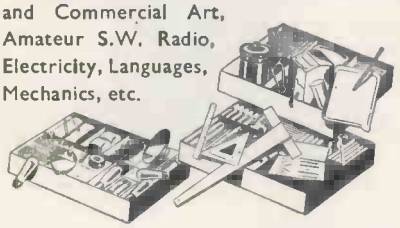
★ A tutor is personally allotted by name to ensure private and individual tuition.

★ Free advice covering all aspects of training is given to students before and after enrolment with us.

NEW

LEARN THE PRACTICAL WAY — COURSES WITH EQUIPMENT

With many courses we supply actual equipment thus combining theory and practice in the correct educational sequence. The equipment, specially prepared and designed, remains your property. Courses include: Radio, Television, Electronics, Draughtsmanship, Carpentry, Photography and Commercial Art, Amateur S.W. Radio, Electricity, Languages, Mechanics, etc.



Equipment supplied upon enrolment and remains your property.

PRIVATE AND INDIVIDUAL TUITION IN YOUR OWN HOME

Accountancy
Advertising
Aeronautical Engineering
Automobile Engineering
Banking
Book-keeping
Building
Business Management
Carpentry
Chemistry
Civil Service
Civil Engineering
Commercial Subjects
Commercial Art & Drawing
Customs & Excise Officer
Draughtsmanship
Dressmaking
Economics
Electrical Engineering
Electronics
Fashion Drawing
Heating & Ventilating Engineering
Industrial Administration
Journalism
Languages
Marine Engineering
Mathematics
M.C.A. Licences
Mechanical Engineering
Motor Engineering
Photography
P.M.G. Licences
Police
Production Engineering
Public Speaking
Radar
Radio & Television Servicing
Radio Engineering
Refrigeration
Retail Shop Management
Salesmanship
Sanitation
Secretaryship
Shorthand & Typing
Sound Recording
Structural Engineering
Tele-communications
Television
Time & Motion Study
Tracing
Welding
Writing
Workshop Practice
Works Management
and many others.

Also courses for University Degrees, General Certificate of Education, B.Sc.Eng., A.M.I.Mech.E., L.I.O.B., A.C.C.A., A.C.I.S., A.M.Brit.I.R.E., A.M.I.I.A., City & Guilds Examinations, R.S.A Certificates, etc.

Courses from 15/- per month

EMI INSTITUTES

THE ONLY POSTAL COLLEGE WHICH IS PART OF A WORLD-WIDE INDUSTRIAL ORGANISATION

POST THIS COUPON TODAY

Please send without obligation your FREE book.

E.M.I. INSTITUTES Dept. 127k,
Grove Park Road, London, W.4.

NAME .....

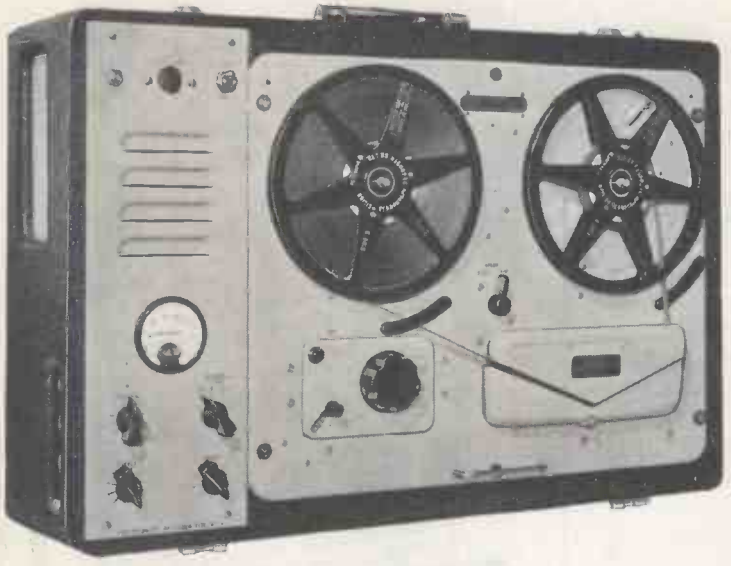
ADDRESS .....

.....

SUBJECT(S) OF INTEREST .....
(We shall not worry you with personal visits) MARCH IC38a

VORTEXION

HIGH QUALITY TAPE RECORDER



★ The total hum and noise at 7½ inches per second 50-12,000 c.p.s. unweighted is better than 50 dbs.

★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.

★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.

★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.

★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.'s, microphone or radio inputs.

The amplifier, speaker and case, with detachable lid, measures 8¼in. x 22½in. x 15¾in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK **£84 0 0**

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.

★ The unit may be left running on record or play back, even with 1,750ft. reels, with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. **PRICE £18 0 0.**

TYPE C.P.20A AMPLIFIER

For A.C. Mains and 12 volt working giving 15 watts output, has switch change-over from A.C. to D.C. and "Stand-by" positions. Consumes only 5½ amperes from 12 volt battery. Fitted with mu-metal shielded microphone transformer for 15 ohm microphone, provision for crystal or moving iron pick-up with tone control for bass and top. Outputs for 7.5 and 15 ohms. Complete in steel case with valves. **PRICE £30 16 0.**

Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London"

Sales up 300%!

with the NEW

LEAK

TL/10 AMPLIFIER & "POINT-ONE" PRE-AMPLIFIER

27 GNS COMPLETE

A price made possible only by WORLD-WIDE SALES

★

Make this THE HEART of your HI-FI EQUIPMENT

and this is why

From long experience and by extreme attention to design details during development work on the pre-production models, we enable our labour force to achieve a high output per man-hour. The labour costs thus saved offset the increased costs incurred for high-grade materials, components and finishes, and this together with quantity production (made possible only by a world-wide market) explains how quality products may be sold at *reasonable prices*. The results obtainable with the new Leak TL/10 and "Point One" are indistinguishable from those obtained with the TL/12 model—a fact easily proved by an instantaneous changeover test. The new TL/10 has been used since its introduction for *all* our public demonstrations, including those at the New York Audio Fair. These are some of the reasons why sales of the TL/10 and "Point One," since their introduction in April last year, are three times as great as for the famous TL/12 in the corresponding months of 1953—and why the size of our factory has been more than doubled to cope with this increased demand.

TL/10 POWER AMPLIFIER

This 10 watt amplifier maintains, in every respect, the world renowned Leak reputation for precision engineering, fine appearance and fastidious wiring.

SPECIFICATION

Circuitry

A triple loop feedback circuit based on the famous TL/12. The output transformer is the same size as in the TL/12.

Maximum power output: 10 watts.

Frequency Response: ± 1 db 20 c/s to 20,000 c/s.

Harmonic Distortion: 0.1%, 1,000 c/s, 7.5 watts output.

Feedback Magnitude: 26 db, main loop.

Damping Factor: 25.

Hum: — 80 db referred to 10 watts.

Loudspeaker Impedances: 16 ohms, 8 ohms, and 4 ohms.

"POINT ONE" PRE-AMPLIFIER

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

★ **Pickup**
The pre-amplifier will operate from any pickup generally available in the world. A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

★ **Radio**
The radio input sockets at the rear permit the connection of the LEAK V.S. tuner unit. An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.

★ **Distortion**
Of the order of 0.1%.

★ **Hum**
Negligible, due to the use of recently developed valves and special techniques.

★ **Input selector**
Radio, tape, records; any and all records can be accurately equalised.

★ **Treble**
Continuously variable, + 9 db to — 15 db at 10,000 c/s.

★ **Bass**
Continuously variable, + 12 db to — 13 db at 40 c/s.

★ **Volume Control and Switch**
The switch controls the power supply to the TL/10 power amplifier.

★ **Tape Recording Jacks**
An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

★ *Write for leaflet W* ★

H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

'Phone : SHEpherds Bush 1173/4/5 *Telegrams : Sinusoidal, Ealux, London* *Cables : Sinusoidal, London*

CHASSIS ASSEMBLY

3 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 14½in. × 3½in. Chassis size 15in. × 5in. × 2in. deep. Price 15/-, plus 1/6 post. Note.—This is the one that fits our 39/6 table cabinet.

RADIO SCALES, 4/- DOZEN

An exceptional bargain this month is our assorted parcel of radio scales. A most useful collection for all who make up experimental or other radios. We offer twelve assorted scales mostly in two or three colours for 4/-, plus 9d. post and packing. Limited quantity only.

RESISTORS

50 assorted ½ and ¼ watt resistors. Ranging between 10 ohm. and 10 megohm. (Our selection.) Price 5/- pkt. Ditto, 1 watt, 7/6.

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 are used together will indicate which one is being called. Size 7½in. × 9in. × 7½in., wall mounting, designed for ships' use, but very suitable for home, office, warehouse, factory, garage, etc. Price 57/6 each, plus 4/6 carriage.

INSTANT HEAT CONVECTOR

The heater with the lowest possible thermal capacity, 4ft. long; made from heavy gauge sheet steel (galvanised), 1 kW., suitable A.C. or D.C. Price only £2, or with thermostat £3/15/-. Note.—The thermostat mounts separately and will control up to three heaters.

CLEVELAND CAR BATTERY CHARGER

Gives 1½ amp. charge—uses everlasting metal rectifier and robust double wound mains transformer in metal carrying case with leads and croc. clips. Price, 6 volt, 29/6; 6 and 12 volts, 39/6, post 2/6.

1in. MICROMETER

Exceptional purchase enables us to offer a 1in. precision micrometer at the very low price of 10/-. A micrometer is an essential part of an engineer's equipment. You will have found the need for one on many occasions in the past for measuring wire gauge, etc. Price 10/-, post free. Note.—We now have a waiting list for this, orders in rotation.

OSRAM 912

The constructional data for this Hi-Fi amplifier is available, price 3/6 which amount will be credited to you if you buy the components later. One "912 Shopping List" will be included with the booklet.

GENUINE HALF-PRICE OFFER

BEETHOVEN CHASSIS

Extremely well built on chassis size approx. 9½ × 7½ × 8½, using only first-class components, fully aligned and tested, 110-240-volt A.C. mains operation. Three wave bands covering medium and two shorts. Complete with five valves, frequency changer, double diode triode, pentode output and full wave rectifier. Special cash-with-order price this month, £5/19/6, carriage and insurance 7/6.

GRAMOPHONE AUTO-CHANGER

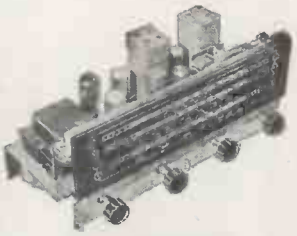
The latest model by very famous manufacturers. 3 speed with crystal turn-over pick-up brand new and perfect in original cartons. Price £11/10/-. Carr. etc. 12/6.

BARGAIN FOR CONSTRUCTORS

Modern style cabinet in contrasting veneers, with metal chassis, three knobs, coloured scale, and pointer. Price 29/6, post, etc., 2/-. All other components to build 2-waveband superhet. Price £5. Data, 1/6 (free with components.)

COILS—T.R.F. AND SUPERHET

T.R.F. long and medium wave with circuit diagram, 5/6. Superhet long, medium, and short wave, aerial and oscillator coils, e.g., set of six coils with circuit, 10/6.



THE "WINDSOR 5"

This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15in. × 6in. × 6in. Price £9/19/6 complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms if required.

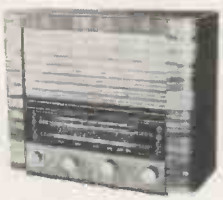


TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 15½ × 14 × 6½in. Walnut veneered and satin finished, 39/6, carriage and packing 3/6. Note.—This cabinet is the correct one for the Windsor chassis above with 6½in. speaker.

HEATING TRANSFORMER

2½ volts at 400 amps. Continuous rating; suitable for unfreezing water pipes setting of resins during casting, setting of glues during cabinet making, edge veneering, etc., etc. Complete in metal case with carrying handle, price £12, carriage and packing 5/-.

LIGHTWEIGHT REFLECTORS

Ideally suitable for all purposes where the intensification of electric illumination or Infra Red is required. The material used is lightweight aluminium, highly polished. All are pierced for Standard Lampholders.

STAR. 7½in. dia. by 6in. deep. Price 7/6 each. Post, etc., 1/3.

SENIOR. 11½in. dia. by 4in. deep. Price 13/6 each. Post, etc., 1/9.

JUNIOR. 6½in. dia. by 3½in. deep. Price 7/3 each. Post, etc., 1/3.

BIJOU. 5½in. dia. by 2in. deep. For 40-60 watt lamps. Price 6/6 each. Post, etc., 1/3.

BELL. 5½in. dia. 5in. deep. Price 6/3 each. Post, etc., 1/3.

TERRIFIC NEW CIRCUIT

OCCASIONAL 55—we have evolved a new T.R.F. circuit and have had really amazing results, equal in fact to many superhets. You really should try this circuit. All parts including valves (6K7, 6J7, 6SG6, and 6X5) and Bakelite case with back cost only £5/10/-, plus 2/6 post and insurance. Data included with the parts is also available separately price 2/-.

TRANSFORMER 100 WATTS

These are transformers with a wound primary tapped 200, 220, 240, but no secondary. There is ample window space, however, for the hand winding of secondary to suit your own requirements. Approximately two turns per volt are required. The amps. taken out will depend upon volts, e.g., 10 amps. at 10 volts, 50 amps. at 2 volts, etc. etc. Price 10/-, post and packing 2/-.

DECCA CRYSTAL PICK-UP

A snip for the connoisseur—turnover head suitable all records—limited quantity 29/6, plus 2/- post and packing.

G.E.C. METAL CONE SPEAKER

This fine speaker is coming to the front rapidly—price £8/15/-. Octagonal cabinet made to maker's specification, £11/10/-, walnut or oak.

HIRE PURCHASE TERMS.—Any goods costing £5 or more may be purchased by extended payments—deposit 10% (or more)—balance spread over 12 months.

BARGAINS TO CLEAR

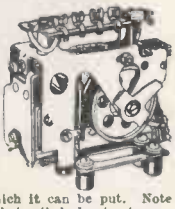
2-VOLT ACCUMULATORS

Made for the Forces by one of the most famous firms in the world. 15 amp.-hour, size approx. 6 × 1¾in. square in ebonite case, pre-charged, only need filling with acid, 2/9 each, plus 1/- post and insurance.

PORTABLE CABINET

This is ultra-modern, two-tone, bakelite with integral moulded handle. We can supply, where required, the metal chassis, dial, and all other parts necessary to make a Mains or Battery portable. Note: All of these cabinets have slight imperfections; these are hardly noticeable however, and will not impair the performance or safety of the set. Price 7/6 each, post and insurance 3/6.

REMOTE CONTROL



With only one pair of wires and a simple push button you can select any one of four stations. This is just one of the many applications of our impulse relay. There are many other purposes to which it can be put. Note they are somewhat soiled, due to storage, but mechanically O.K. Price 1/9, post 6d.

5-AMP. SURFACE SWITCHES—HICRAFT

Oblong Brown 1-way 1/- each. Oblong White 1-way 1/- each. Oblong Brown 2-way 1/3 each. Oblong White 2-way 1/3 each. Round Brown 1-way 10d. each. Round White 1-way 10d. each. Round Brown 2-way 1/- each. Round White 2-way 1/- each.

WAVE-CHANGE SWITCHES

One dozen assorted wave-change switches, ideal for experimentors. Note, these are unused and not removed from equipment. Our assortment. Price 5/-, post and packing 1/-.

110-VOLT 2½-AMP. RECTIFIER UNIT

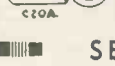
This is an excellent unit suitable for driving 110 v. D.C. equipment from 230 v. A.C. mains or for charging batteries for stand-by lighting, etc. Made for the Government—new and unused, with switchgear. Price £17/10/- each.

NAIL INSULATORS

Suitable for electric fences. indoor aerials, etc., 3/- per dozen. post and packing 1/-.

WESTINGHOUSE RECTIFIER

Full wave—suitable for up to 80 volts at 15 milliamps Ideal for relays, meters, etc. Price 2/6, post 6d.



SPADE TERMINALS

Heavy duty type made for M.O.S. Price 7d. each, 6/- per dozen.

SEE OVER

MAKE A CONVECTOR

Almost any metal case can be converted into a useful convector type electric heater if you use our porcelain mounted element 250 watts small size. Price **2/6**, post 6d.

SENSITIVE ALTIMETER

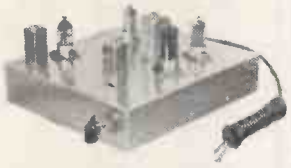
These contain aneroid barometer movement and useful gears. Price **7/6** each. Post 1/-.

Note.—Also a few Mk. XVIIa. unused and in good working order, available at **22/6**.

THE TWIN 20

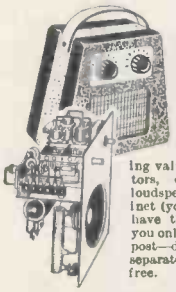
This is a complete fluorescent lighting fitting. It has built-in ballast and starters—stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench, and in similar locations. It uses two 20-watt lamps. Price, complete less tubes, **29/6**, or with two tubes, **39/6**. Post and insurance, 2/6. Extra 20-watt tubes **7/6** each.

THE F.M. FEEDER UNIT



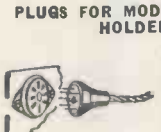
All the parts necessary to make the Denco F.M. Unit are now available. The unit gives an A.F. output suitable for feeding in at the pickup sockets of any standard broadcasting receiver and superior results can be expected. The full constructional details as prepared by the Denco technicians are available—price **1/6** post free. Alternatively, they will be given free to those ordering all the parts which come to £6/7/6, plus 2/6 post and packing. Note: Four valves and everything including a prepared metal chassis is supplied. Approximate chassis measurements are 6×6×1½. Demonstrations at our branches.

ALL MAINS THREE



A handy midget A.C./D.C. 3-valve mains receiver giving powerful reception over long and medium waves. All component parts, including valves, coils, resistors, etc., but not loudspeaker and cabinet (you may already have these) will cost you only **19/6** plus 1/6 post—data available separately 2/- post free.

PLUGS FOR MODERN VALVE HOLDERS



Each is fitted with a rubber shroud. For B7G button base and type 2 for B8A. Price **1/4** each, discounts for quantities.

10/- SECURES THIS BARGAIN

The set, a product of one of our famous manufacturers, has H.F. stage tuning indicator, and all modern refinements, covers 5 wavebands including short waves to 11 metres. Offered less valves, power-pack, scale and drive, otherwise complete and unused—price £5, or 10/- deposit, balance over 12 months, carriage 7/6 (uses octal range valves).

COMPLETE TOOL KITS—THE ELECTRICIAN'S

This is as illustrated and contains 55 fine tools arranged on 5 trays in an automatic steel tool-box. The box opens under slight pressure of the hand and closes automatically when lifted. The tools are all that a practical electrician needs, including tenon saw, ratchet brace, hack-saw, chisels for wood, brick and steel, pliers, side cutters, hammers, spanners, socket wrenches, pad-saw, etc. Price £15/10/-, or H.P. if required.

RADIO ENGINEER'S

This again is fitted into an automatic tool-box and contains 50 tools including pliers, side cutters, screwdrivers, side and straight snips, hammers, spanners and socket wrenches, hand-drill, B.A. taps, drills, etc. Price £11/10/-. H.P. terms if required.

COIL PACK 19/6

3-wave Coil Pack, incorporates a gram position and Long, Medium and Short wave band, designed for 465 kc/s I.F. Brand new and fully guaranteed. Several types. Complete with circuit, only **19/6** plus 9d. post.

KNOBS

Set of four brown knobs ½in. dia. Engraved tone, volume, tuning, waveband. Push on type. Post 6d. Reg. 2M46. Price per set **1/3**.

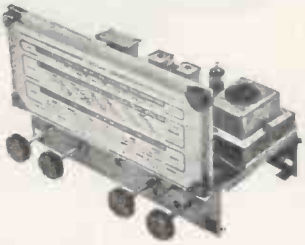
THIS MONTH'S SNIP!

3-speed record player with pick-up using the famous Acos "Hi-G" turnover crystal—motor also by very famous maker—speed selection is by bakelite knob. All on unit board ready for installation. A wonderful bargain at £7/10/- plus 5/- carriage—Hire Purchase 15/- deposit.

SCRAMBLER — TELEPHONE EQUIPMENT

As used by Ministries and Forces for holding secret conversations. Works in conjunction with normal telephone equipment.
Items available, all new and unused, are:—Frequency Changer, Type 6AC, Ref. No. YBO2700, price £20. Standard G.P.O. desk type instrument with scrambler switch, complete with lead and junction box, price £2/10/-. Hand-ringing generator in wooden box, 15/-. Junction box with three multiple relays and cable strips, 35/-. Bank of three drop indicators in box, 15/-. Instruction book £1, refunded if returned within 14 days.

THE CLEVELAND "ORGANTONE"



The Cleveland "ORGANTONE" is a 5-valve 3-wave band superhet covering long, medium and short wave. Built to a very stringent specification.
Osram miniature valves are employed and low loss iron cored coils account for an excellent signal to noise ratio. Full A.V.C. is applied to both frequency changer and I.F. stages, and particular care has been taken to ensure freedom from frequency drift.
The output stage utilises variable negative feedback for tone control, and, but for standard pentode correction, no cut in the ordinary sense is applied. A gram. position is provided and reproduction of records is particularly good. An amply proportioned power transformer with a primary tapped for 110-280 volts gives complete isolation from the mains.
Chassis size is 12in. × 7in. × 7in.—Scale size is 10½in. × 4½in.
This receiver has been tested in particularly difficult areas and its stability and noise rejection have produced exceptional results.
Price £11/10/- or £1/5/- deposit—carriage, etc., 7/6.
A circuit diagram and photograph available price 2/- post free.

ANOTHER CLEVELAND CHASSIS—THE "TREMENDO"

The first Cleveland chassis was good, but this one is really superb. It has a 7-valve circuit with 6 watts output, fitted with independent bass and treble controls. It is really an efficient R.F. circuit coupled to a high-fidelity amplifier. The chassis size is the same as the Organtone, namely 12×7×7 with the 10½×4½ multi-coloured scale, and it is built to the same exacting specification as the Organtone. Price £14/10/-, carriage and packing, 7/6. H.P. terms if required.

SOMWEAVE

This really lovely loudspeaker fabric we offer at approximately a third of to-day's cost. It is 42in. wide and our price is **12/-** per yard, or panels 12in.×12in., **1/9** each. This is also very suitable for covering plain wooden cases, for portable radio amplifiers, etc.

CONNECTING WIRE SNIP

P.V.C. insulated 23 s.w.g. copper wire in 100ft. coils, 2/9 each. Various colours available: 4 coils assorted colours for **10/-**.

H.T. RECTIFIERS FAMOUS SELENIUM "SENTERCEL"

All are this year's stock—for higher voltages joint two or more in series.

R.M.1	125 v.	60 mA.	3/9
R.M.2	125 v.	100 mA.	4/2
R.M.3	125 v.	120 mA.	5/9
R.M.4	250 v.	250 mA.	16/-

FLUORESCENT LIGHTING

Complete kit comprises 40-watt control unit, starter lamp, lamp holders, clips and wiring diagrams. Price, less tube, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 carr.

EVERLASTING GRAMOPHONE NEEDLES

Jewel (Sapphire) pointed suit any type of pick-up precision made — improves quality, eliminates record wear. Stylus or Trailer type, 2/6 each.

AMPLIFIER A1134a

This is a 2-stage intercom. and Tx pre-amplifier with transformers, etc. Easily modified as gram amplifier or dictaphone, etc. Complete with 2 2-v. valves, QPP and Triode. Price only 9/6, plus 1/6 post and packing. Circuit diagram, free with unit, or separately, **1/6**.

THE CONTEMPORARY

In the modern trend is this very stylish contemporary console. Veneered in oak with contrasting mouldings, and is ideal for use with modern furniture or with other contemporary fittings or furnishings. The radio and motor board is uncut and its size, 30in. × 15½in., provides ample room for all equipment. Price £8/15/-, carriage, etc., 12/6.

E.P.E. LTD.

SEE OVER →

POTTED MAINS TRANSFORMERS

These are of really superior construction fitted in cast metal cases and compound filled. Terminals come to ebonite baseboard. All are upright mounting and have 220/230 normal 50 cycle mains input and fully screened primary.

Type 5F1. 265-0-265 at 300 m.a.; 6.3 v. at 7 amp.; 4.4 v. at 2.5 amp.; Price 35/- plus 3/6 carriage.

Type 5F2. 365-0-365 at 150 m.a.; 4 v. at 2.5 a.; 6.9 v. at 4.2 a Price 32/6, carriage and packing 3/6.

Type 5F3. 1540 v. 2 v. at 2 a.; 4 v. at 1 a.; This is an ideal transformer for televisors and scopes using V.C.R. 97, etc. Price 25/- carriage 2/6.

POTTED CHOKES

These chokes are in similar type cases and therefore match the above transformers.

Type 5F4. 5 H. at 300 m.a. Price 10/-, carriage and packing 2/6.

Type 5F5. 10 H. at 150 m.a. Price 12/6, post and packing 2/6.

HIGH POWER TRANSFORMERS

For R.F. Heaters, transmitters, etc., etc. These are open wound type for maximum cooling and have the normal 200-250 primary fully screened.

Type 5F8. 1,000 v. at ½ amp., e.g. .5 K.V.A. Price £8/10/-, carriage and packing 5/-.

Type 5F7. 1,500 v. at 1 amp e.g., 1.5 K.V.A. Price £15, carriage and packing 7/6.

Type 5M1. 1000-0-1000 v. at 1.5 amps. e.g. 1½ KVA. Price £12/10/-, carriage and packing 7/6.

Type 5M2. 1000-0-1000 v. at 500 mA. and 4 v. at 4 a. Price £7/10/-, carriage and packing 4/6.

Type 5M3. 375-0-375 v. at 250 mA. and 4 v. at 4 a. Price 37/6, carriage and packing 3/6.

POWER FILAMENT TRANSFORMERS

Type 5M4. 4 v. at 4 a. 2-0-2 v. at 10 a. Price 18/6, carriage and packing 3/6.

Type 5M5. 3.15-0-3.15 at 10 a. 4-0-4 at 10 a. 4-0-4 at 2 a. 4 at 4 a. 2.5-0-2.5 at 3 a. Price 27/6, plus carriage and packing 3/6.

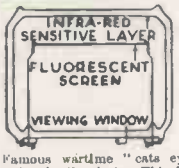
Type 5M6. 34 v. at 2 a. tapped 32 v., 30 v. and 28 v., for relays etc., 22/6, plus 3/6 carriage and packing.

POWER CHOKES. Open wound type and feet with clamps.

Type 5M7 30 Henry at 500 ma., 35/-
Type 5M8 20 Henry at 500 ma. 32/6
Type 5M9 15 Henry at 500 ma. 27/6
Type 5M10 10 Henry at 500 ma. 22/6
Type 5M11 25 Henry at 250 ma. 18/6
Type 5M12 3 Henry at 10 amps. 18/6
Type 5M13 200 Henry at 5 ma. 15/-

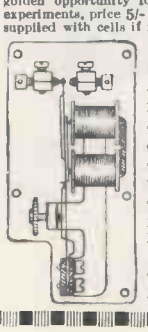
AUTOMATIC MOTOR STARTER

For remote control of D.C. motor between 1 and 3 kw., adjustment for 100 v. or 230 v. Unused and in first-class condition, complete with metal and wired glass cover. Price £10, carriage 5/-.



"SNIPER-SCOPE"

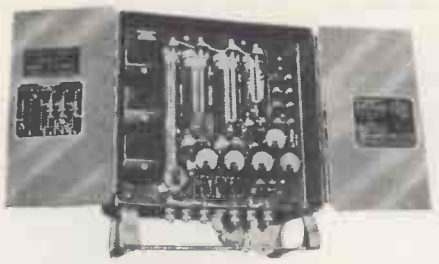
Famous wartime "cats eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. It follows that as light from an ordinary lamp is rich in infra-red these cells will work: burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price 5/- each. Data will be supplied with cells if requested.



RELAYS

Extra light weight, extra sensitive for high speed or radio control work, weight only 1½ oz., closes on 2 mA., solid platinum change-over contacts, adjustable pressure. Price 12/6.

Post Office type 2000 ohm from 8/6, 800 ohm 7/6.



CHARGING SWITCHBOARD

Feed this Switchboard through a Mains Transformer and Rectifier giving 24 volt D.C. up to 50 amps. and you have an excellent multi-circuit charger for simultaneously charging several batteries at different currents. This is an ex. Government switchboard rated at 550 watts 18 volts fitted into steel cases with doors. It contains three reverse current relays, one voltmeter, one main ammeter, two secondary ammeters and three variable resistors for controlling circuits. These are brand new, in original cases. Price £4/10/-, carriage 10/-.

We can supply a 12 volt, 50 amp Mains Transformer at £4/5/-, plus 5/- carriage.

AMERICAN RADAR

We have brand new, still in original unopened packing cases as shipped from America, three items of equipment which form the major parts of the radar system RC-184.

Item 1 known as Tower TB24a is in fact the aerial base and motor driven gear box which rotates the antenna.

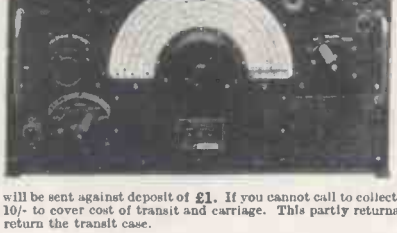
Item 2 known as the Indicator I-221-A incorporates a magslip device and appears not only to control the Tower but also to follow it.

Item 3 is known as Control Unit BC" 1268-A, incorporates a cathode ray tub[e] as well as a control equipment.

We shall be glad to negotiate with intended purchasers of this equipment and would also like to hear from any reader able to give any more information about it.

YOURS FOR £1 ONLY

COMMUNICATION RECEIVER R1155,



This set, as most will know, is considered to be one of the finest communications receivers available to-day. The frequency range is 75 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case. Made for the R.A.F., so obviously a robust receiver which will give years of service Slightly used but completely overhauled and guaranteed in perfect working order. PRICES Grade 2 £7/19/6, Grade 1 £9/19/6, or new and unused £11/19/6. or will be sent against deposit of £1. If you cannot call to collect please include an additional 10/- to cover cost of transit and carriage. This partly returnable to you if and when you return the transit case.

MAINS POWER PACK FOR R1155

With Pentode ouput stage. Plugs into socket on receiver so no internal modifications are required. Price £5/10/- complete with speaker ready to work, carriage 3/6. If bought with receiver deposit is 11/-.

MAGNETRONS

Precision made for RADAR type Nos. CV.186 and CV.64. Unused, guaranteed. Any not functioning correctly will be replaced. Price £2/10/-. Post and insurance 10/-.

POWER FOR TR1154/55

We can offer brand-new, and unused, the two rectifier units for mains operating the transmitter TR1154 and its associated receiver R1155. Both rectifier units are completely enclosed in metal cases and operate directly from normal 50 cycle A.C. mains. Price £17/10/- the pair, carriage and packing £2 extra.

TRANSMITTER 1131

This is a high powered transmitter for operating over the same frequency range as the Receiver 1132, i.e., 70-130 megacycles. It is a very bulky transmitter and probably contains around £300 worth of equipment. As far as we know these have never been used but of course have been in store for a long time and therefore they will need attention before being put into operation. We offer these less valves £37/10/-. Buyer collects. We also have a quantity already stripped so if you are needing spares for this transmitter please get in touch with us now.

R1132

We have a small quantity of these receivers still available less valves. Their condition unfortunately is not good but they appear to be repairable, and, of course, contain a multitude of spare parts. At 30/- each they represent a real bargain. If not collecting, please include 5/- for packing and carriage.

RECEIVER TRANSMITTER 38

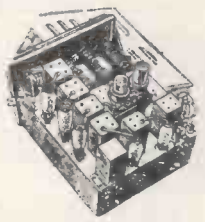
This is the British equivalent of the walkie-talkie. It operates on the frequency range 7.4-9 mc/s. It has many novelty applications in the home and can eventually be turned into a useful little portable receiver. Complete and with valves unused but not guaranteed, price 37/6, post 2/6 extra.

STABILAVOLT

This is a valve designed and constructed to facilitate the taking off of several voltages, each of which will be stabilized These are brand new and unused. Price 10/6 each, post 1/- extra.

IMPORTANT NOTE

Owing to the bulkiness of many of the items listed on this page it may not be possible to keep stocks at all branches, therefore please telephone confirmation that the item is actually at the branch before journeying specially to see it.



RESPONSER UNIT 10-VALVE 1½-METRE

Ideal for Commercial T.V. These contain 6 valves type SP61, and one each RL7, RL16, and EA50. 8½ IF transformers 12 Mc/s. band, and hundreds of other useful components. Price 39/6, plus carriage and packing 7/6. These receivers are unused.

BLOCK CONDENSERS

New and unused. .5 mfd. at 2,500 v., 3/6; 4 mfd. at 750 v., 3/6; 8 mfd. at 500/600 v. 5/-. 4 mfd. at 500 v. 2/6; 4 mfd. at 1500 v. 6/6

BREAKDOWN PARCEL

Unit for breaking down—offered at only a little over the price of the Aladdin Coil Formers it contains. Note. All parts can easily be removed as they are all bolted together. The unit contains:—

6 Aladdin ⅛in. Coil Formers with dust cores.
6 metal cans for above coil formers.
1 4-position 12-pole switch.
6 miniature R.F. chokes.
2 25-mfd. 25-v. electrolytics.
30 paper tubular condensers. .002 to .1 mostly for 450 v.
56 carbon resistors, values from ½ watt to 2 watt.
2 medium-size R.F. chokes.
7 moulded octal valve-holders.
1 moulded diode valve-holder.
20 mica condensers (moulded, silver and ceramic).
7 insulated top caps for valves.
4 components strips (one 40-way, one 11-way, one 5-way, and one 3-way).
1 very useful chassis, size 18×5×3½in.

Plus dozens of nuts, bolts, screws, washers, and other useful items such as ¼in. spindle extenders, etc.

Price only 7/6, post and packing 2/6.

GREATLY REDUCED CATHODE RAY TUBES

VCR97. Brand new and unused, "cut off type," ideal for 'scope, etc. Price 12/6. Ditto but full picture type for T.V. 39/6. Carriage and insurance 5/- extra.

VCR517. 6¼in. guaranteed full picture. 29/6, plus 5/- carriage and insurance.

VCR139A. 2¼in., 32/6, plus 2/6 carriage, etc.

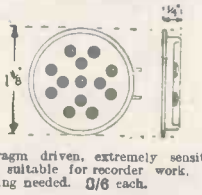
VCR138. 3¼in. electrostatic short persistence suitable for T.V. and ideal for 'scope work, 37/6 plus 3/6 carriage, etc.

VCR112. 5in. electrostatic, persistence not known, 15/- each, plus 5/- carriage, etc.

CV996. 6in. electrostatic persistence not known, 15/- each, plus 5/- carriage, etc.

CV1140, CV1500, CV1548. All 12in. magnetic long persistence, £4/10/-, plus 10/- carriage.

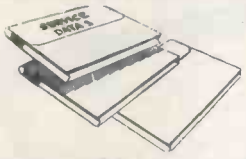
CRYSTAL MICROPHONES



Diaphragm driven, extremely sensitive, highly suitable for recorder work. No matching needed. 6/6 each.

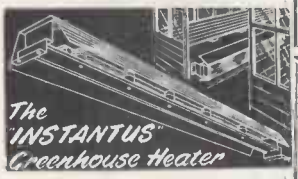
VACUUM PUMP

Type B3 new in makers cartons—many applications in home or factory—22/6 post 1/-.



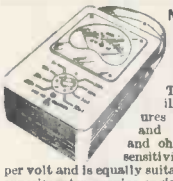
SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities, and which every service engineer is ultimately bound to meet. The following makes are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Koister-Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder. Our Folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry" etc., which have been imported into this country. Names include Sparton, Emmerson Admiral, Crossley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1. Post free.



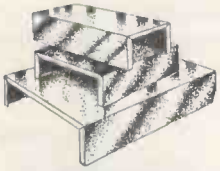
INSTANT HEAT CONVECTOR

The heater with the lowest possible thermal capacity, 4ft. long; made from heavy gauge sheet steel (galvanised), 1 kw., suitable A.C or D.C. Price only £2 or with thermostat £3/15/-. Note: The thermostat mounts separately and will control up to three heaters.



NOW— A.C./D.C. MULTI-METER KIT

The Multi-meter illustrated measures A.C./D.C. volts and D.C. m/amps and ohms. It has a sensitivity of 200 ohms per volt and is equally suitable for the keen experimenter, service engineer or student. All the essential parts including 2in. moving coil meter, selected resistors, wire for shunts, 8-point range selector, calibrated scale, stick-on range indicator and full instructions for making are available as a kit, price 19/6 plus 9d. post and packing.



BLANK CHASSIS

18 S.W.G. Aluminium

7 × 3½ × 2	3/9
9½ × 4½ × 2½	5/-
10 × 8 × 2½	5/6
10 × 5½ × 2½	5/-
12 × 9 × 2½	7/-
14 × 9 × 2½	7/6
14 × 10 × 3	7/9
16 × 10 × 3	8/3
16 × 12 × 3	8/8
19½ × 9 × 2½	8/3
20 × 10 × 3	10/-

CABINETS FOR ALL

We confidently believe we carry the best stock of cabinets in London. The one illustrated is The Bureau, a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board is revealed when the front is dropped. Both radio board and motor board are left uncut to suit your own equipment. Price is 16 guineas, carriage 12/6. We have many other types in stock. Pay us a visit, or send for Cabinet List

BATTERY 3-VALVER 19/6

This employs a modern circuit which ensures good reception on both medium and long waves—all the parts including valves, resistors, tuning condensers, in fact everything except loudspeaker, cabinet, and metal chassis (you may already have something suitable, from an old receiver for instance), will cost you only 19/6. Data available separately price 1/6.

ALL-DRY BATTERY BARGAIN

90 volt 3-pin plug type layer built battery by famous maker—recent manufacture—approximate dimensions 2¾in. × 2in. × 3¼in.—price 5/-. e.g. approximately half list—post and packing 9d.

CABINETS 19/6

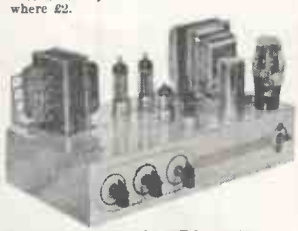
You can make an excellent bass reflex cabinet with this well made veneered and polished walnut cabinet. Limited quantity offered at 19/6. Carriage, etc., 3/6.

NOBLEMAN GRAM

A 70 Gn. RADIOGRAM direct from makers for only 40 Gns. Or £4 deposit. A beautiful piece of furniture yet a most up-to-date radiogram—figured walnut lined sycamore—radio raised to comfortable level—compartment for records—5-valve A.C. mains superhet, covers long, medium and short waves—all latest refinements, negative feed-back tone control, etc.—large multi-coloured edgiet dial—latest Collaro three-speed auto-changer with the famous "Studio" pick-up—plays all types of records perfectly. Free Delivery in London Area. Elsewhere £2.

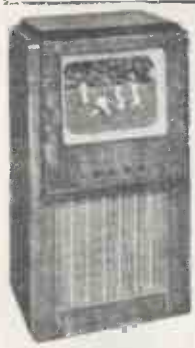
THIS CABINET FREE

This month we are giving free a very fine modern portable cabinet to all purchasers who buy both the Truvox Tape Deck and the Cleveland Wide Band Amplifier. These three items will all fit together and make an extremely good tape recorder. Prices are as follows:—Truvox Tape Deck Mark IIIU, the very latest model, price £23/2/-. Cleveland Wide Band Amplifier, designed in conjunction with Truvox engineers to get the very best results from their fine deck, price £15, or £38 the two. Hire Purchase terms, send deposit of £4 or over, balance will be spread over twelve months—carriage, packing, and insurance 12/6 on the two items.



MULLARD AMPLIFIER "510"

A High Quality Amplifier designed by Mullard engineers Robust high fidelity, with a power output exceeding 10 watts and a harmonic distortion less than .4% at 10 watts. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 C.P.S.—three controls are provided and the whole unit is very suitable for use with the Collaro Studio and most other good pickups. The price of the unit completely made up and ready to work is £12/10/- or 25/- deposit, plus 10/- carriage and insurance. Alternatively, if you wish to make up the unit yourself we shall be glad to supply the components separately. Send for the Mullard amplifier shopping list.



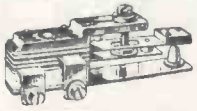
SENT FOR 15/- ONLY

This cabinet is offered below cost. It is suitable for a televisor using tube sizes varying from 12in. to 17in., its overall dimensions being 3ft. 5in. high, 1ft 4in. deep, 1ft. 10in. wide. It is complete with plywood back and "Bowler Hat." Originally made for a very expensive televisor and really good quality. Unrepeatable. Offered at £7/5/-, carriage, packing, etc., 12/6. Note: These are cut for 12in. tubes, but the holes for the controls are not drilled.

PRICE CORRECTION

We regret that an error occurred in our January advertisement—the Elpreq Tape Recorder was incorrectly priced, it should read 39 guineas, not 35 guineas.

NEW 5 AMP. THERMOSTAT (MINIATURE)



2¾" × 1" × 1¼" high.

Useful for the control of appliances such as convectors, gluepots vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F., fitted with heavy (5 amp. A.C.) silver contacts size 1¼in. long × ¼in. wide, price 8/6, post 6d.: 1 amp. type, 3/6, 2 amp. type 5/6.

NEW YEAR BARGAIN

MINI-MAINS FOUR

Uses a 4-valve circuit with high-efficiency coils—covers long and medium wave bands and fits into the neat white or brown Bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything, £3/19/6 plus 2/- post. Constructional data free with the parts or available separately 1/6.

ELECTRONIC PRECISION EQUIPMENT LTD.

249, Kilburn High Road, Kilburn. (Now Open.)

42-46, Windmill Hill, Ruislip, Middlesex. Phone: RUISLIP 5780 Half-day Wednesday.

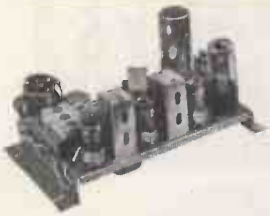
152-153, Fleet Street, E.C.4. Phone: CENTRAL 2833 Half-day Saturday.

29, Stroud Green Road, Finsbury Park, N.4. Phone: ARCHWAY 1049 Half-day Thursday.

Post orders should be marked "Dept. 2" and addressed to our Ruislip dept.

EVERYTHING FOR HOME CONSTRUCTOR & SERVICEMAN

LASKY'S RADIO



COMPLETE 5-VALVE RADIO CHASSIS

Completely wired and ready for use with the addition of a speaker and output transformer. Two controls: Volume and Station switch. Valves used: 10C1, 10F9 or UF41, 10LD11 or UBC41, 10P14, U404 or UY41.
LASKY'S PRICE, less valves, Post 3/6. **69/6**
Complete with valves, £5/19/6.

- ★ I.F. 465 kc/s.
- ★ A.V.C.
- ★ 4 watts output.
- ★ 3 Station Pre Set.
- ★ Frame aerial.
- ★ Fully aligned.
- ★ Chassis size only 10in. x 5½in. Max. height 5½in.

ANOTHER LASKY SUPER SCOOP!

THE SCOPHONY-BAIRD CINE "SOUNDMASTER" New & Unused

A COMPLETE TAPE RECORDER WITH THE EXCEPTION OF THE MOTOR DRIVE—CAN ALSO BE USED AS A STRAIGHT AMPLIFIER

LIST PRICE 72 GNS.

LIMITED NUMBER ONLY. Full operating instructions and circuit diagram supplied with each Recorder. Write for further details.

Originally designed for connecting to a cine projector for synchronising sound to silent films, this superb equipment with the addition of a motor becomes a Complete Tape Recorder of 5 watts undistorted output, and it can also be used as a straight Amplifier. Two Inputs for use with Crystal Mike and radio or gram. Permanent magnet Erase. Amplifier uses five valves:—2-6SN7, 2-6V6, 1-5Z4. For 200/240 A.C. mains.

LASKY'S PRICE
£17.13.0
(Carriage 12/6 extra)

Comprising the "SOUNDMASTER" complete with 5 valves, cover incorporating 8in. Loud Speaker with 24ft. of cable, Spare Input Plug, one empty Tape Spool, Mains Lead. Dimensions: 13½ × 16 × 11in. Nett weight 32lbs.

ROTHERMEL CRYSTAL MIKE complete with lead and plug. 25/- extra (Listed at 5 gns.)

ARMOUR PLATE GLASS

16in. Actual size 17½in. × 15½in. × ¼in.	7/11
15in. Actual size 16½in. × 13in. × ¼in.	6/11
12in. Actual size 13in. × 10¼in. × ¼in.	4/-
9in. Actual size 9in. × 8in. × ¼in.	3/-

TRIPLEX DARK SCREEN FILTERS

14 × 12½ × ⅛in.	7/6
15½ × 13½ × ⅛in.	9/6

Postage and packing 5/- per piece extra. (This charge is necessary owing to extra packing required.)

PERSPEX IMPLOSION GUARDS, incorporating escutcheon and filter plate.

12in.	7/6
12in. de Luxe	15/-
16in. de Luxe	17/6

C.R.T. MASKS. Brand New LATEST ASPECT RATIO

9in.	7/-
10in.	7/6
12in. Rubber	15/-
12in. Old Ratio	9/6
12in. Escutcheon mask, with Perspex filter	12/6
14in. Rectangular	12/6
15in. Cream rubber	17/6
16in. Plastic, white	12/6
17in. Rectangular	15/-

TELESCOPIC AERIAL MASTS

As previously advertised Complete. **LASKY'S PRICE** 25/-. Carriage 2/6 extra.

AERIAL ROD SECTIONS

Steel, heavily copper plated. 12in. long, ¼in. diameter. Any number may be fitted together. 2/6 per doz. Post free.

SPECIAL TRANSFORMER

Secondary tapped as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24 and 30 volts at 2 amps. **PRICE 17/6.**

CRYSTAL DIODES

Glass type, wire ends. Each 1/6 Higher grades, 12 assorted for 30/-, post free.

CYLDON 5-CHANNEL SWITCHED TELETUNERS

Brand new. Instant and positive selection of any one of the 5 B.B.C. television channels, by a single control knob.
LASKY'S PRICE **12/6**
Post Free.
With valves 37/6.

3-WATT MIDGET AC/DC AMPLIFIERS PUSH PULL, VERY HIGH GAIN.

4 valves: 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 AC/DC. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size:—9 × 4 × 4 inches. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships record players, tape recorders, home record players, baby alarms, etc., etc. Supplied complete fully assembled and wired, with 4 valves.
LASKY'S PRICE, 85/-, carriage free.

CO-AXIAL CABLE

75-80 ohms impedance.

Single Core, per yard,	8d.
Twin Core	1/-
Twin Balanced Feeder	6d.

CHOKES

40 m/a.	3/3	120 m/a.	7/3
60 m/a.	3/11	200 m/a.	12/6
80 m/a.	4/11	250 m/a.	14/-

DULCI RADIO CHASSIS

Full range stocked. 6 types to choose from.

ALUMINIUM CHASSIS.

18 S.W.G., undrilled, with 4 sides, reinforced corners. Depth 2½in.

6 × 4in., 4/-	12 × 8in., 7/-	16 × 10in., 8/3
8 × 6in., 5/-	14 × 9in., 7/6	12 × 3in., 4/9
10 × 7in., 6/-	16 × 9in., 8/-	12 × 6in., 6/6

Post 1/- per chassis extra.

METAL RECTIFIERS

6 or 12 v.

F.W. Bridge.

2 amp.	11/3
4 amp.	15/-
6 amp.	23/6
1 amp.	6/6
10 amp.	32/6
½ amp., 6 v.	2/6
½ amp., 12 v.	3/11
3 amp., 12 v.	12/6

R.1155 RECEIVERS

Now available on H.P. terms

5 Frequency ranges: 18.5-7.0 Mc/s; 7.5-3.0 Mc/s; 1,500-600 kc/s; 500-200 kc/s; 200-75 kc/s. Supplied in maker's original wood transit case.
LASKY'S PRICE, brand new £11/19/6
Secondhand, Grade 1, ... £9/19/6
Secondhand, Grade 2, ... £7/19/6
Carriage 17/6 extra, including 10/- returnable on packing case.

ASSEMBLED POWER PACK/OUTPUT STAGE for R.1155 RECEIVER. For use on 200-250 v. A.C. Complete with 2 valves. In metal case, size 12 × 7 × 5½in., 79/6. Carriage 5/- extra.

POWER PACK as above, fitted with 6½in. P.M. Speaker, £5/5/-. Carriage 5/- extra.

POSTAGE & PKG. CHARGES

(unless otherwise stated)
Orders value £1, 1/- extra.
Orders value £5, 2/- extra.
Orders value £10, 3/6 extra.
Over £10 carriage free.
All goods fully insured in transit.

LASKY'S RADIO

LASKY'S (HARROW RD.) LTD.

TWO ADDRESSES FOR PERSONAL CALLERS
Open all day Saturday. Early closing: Thursday.

370 HARROW ROAD, PADDINGTON, W.9.
(Opposite Paddington Hospital)
CUNningham 1979/7214.

42 TOTTENHAM COURT ROAD, W.1.
Between T.C.R. and Goodge St. Stns.
MUSeum 2605.

ALL MAIL ORDERS TO HARROW ROAD PLEASE

OUR NEW "POPULAR" AMPLIFIER. A.C. Mains 2/3 ohms. 4 watts output. Suitable for either crystal or magnetic pick-up. Valve line-up, 6V6GT, 6S17GT, 5Y3GT. Provision for radio feeder unit. Volume and tone controls. Built in crackle-finished steel box, with chrome carrying handle. Attractive bakelite engraved front panel. Box measures 9¼in. × 7¼in. × 6¼in. Price only **£6/12/6** carriage paid. Ready for use.

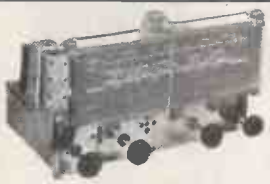
We have in stock the very latest "Elpico" Feeder Unit type RP720. Superbet for L., M., Short and Trawler Bands. Very attractive illuminated black and gold dial for immediate use with any amplifier. **15** gns. tax paid.

HIRE PURCHASE

We are pleased to announce advantageous hire purchase facilities on any single item over **£5**. Ask for details, mentioning what you are interested in.

LATEST 3-SPEED AUTO-CHANGER, long arm model complete with C. and D. high fidelity heads. Limited quantity at **£17/10/-** plus 5/- P. & P. H.P. terms available.

THE R.C. 3/4 WATT AMPLIFIER KIT—Just released! Compare the advantages! Treble, bass, AND middle tone controls! For crystal or magnetic pick-up! A.C. Mains. 200/250 v. Valve line-up, 6V6GT. 6SG7 metal, 6X5GT. Negative feed-back. Built on Stove enamelled steel chassis, measuring only 8in. × 4in. × 1¼in. Four engraved cream knobs are included in the price of the complete Kit with all necessary practical and theoretical diagrams, at **£3/19/6 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!



SUPER-QUALITY 6 VALVE RADIOGRAM CHASSIS.

Very limited quantity by Britain's leading quality manufacturers, 3 waveband, superhet, valve line-up, 6V6G, EZ40 ECH42, L63, EF41 and EBC41. Combined pick-up amplifier and A.F. amplifier on Radio and Gram. Employs a special circuit for gramophone pre-amplification. Large glass dial horizontal tuning measuring 11in. × 3¼in. Chassis measurement: 14¼ × 9in. × 8in. This is a superior chassis designed to sell originally in a Radiogram costing £79. Our price is **£12/19/6 only,** tax paid, plus 5/- packing and carriage. We will gladly demonstrate this chassis or any other working item from our stocks, to personal callers!

DECCA LIGHTWEIGHT PICKUPS. Complete with either standard or L.P. Crystal Cartridge Insets. Complete with Rest and Tracking Instructions, **32/6** plus 1/6 P. & P. Also their very latest type, as above, but with turn-over head **47/6** only! Plus 1/6 P. & P.

Carrying cases in black leatherette finish. An extremely well-made case with chrome locks and corner pieces for extra strength. This cabinet will house any 12in. Hi-Fi speaker, but can be put to a number of uses. Front panel and lid are removable, and the cabinet is packed in a strong cardboard container for carrying purposes. Size: **18¼in. × 10¼in. × 16¼in. high, 55/-,** plus 5/- post and packing.

F.M.!! (Frequency Modulation)

We are pleased to announce our complete Kit for the "Denco" F.M. Feeder Unit. This unit provides an A.F. output suitable for feeding into the audio section of a standard broadcast receiver where triode/pentode output are available. Within an average of 30 miles from a V.H.F. transmitter one I.F. stage should be adequate, but our complete Kit supplied includes all components and valves for an extra I.F. stage if necessary, or if the unit is used at greater distances. Full Constructional details, theoretical circuit and point-to-point wiring diagram can be supplied for **1/6** post free, or the complete Kit right down to the last nut and bolt, at only **£6/7/6,** plus 2/6 packing and postage. This unit can be supplied if desired, ready assembled, aligned and tested, at **£8/10/-** plus 2/6 packing and postage.

If required we shall be pleased to align this unit for constructors not possessing the necessary equipment, for a charge of 7/6. N.B.—Valve line-up is 6AM6, 12AH8, 2-6BA6 and 6AL5. Chassis measures only 6¼ × 5¼ × 1¼in.

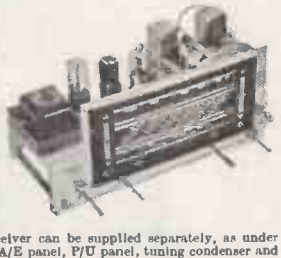
Demonstrations at 18, Tottenham Court Road!!

THE "SUPERIOR" FOUR KIT. Our new four-valve receiver. A.C. mains, 200/250 v. M. and Long waves. As with our very successful "Economy Four" all required components are supplied. Valve line-up: 2 6SG7, 6X5GT and 6V6GT. Chassis ready drilled. Cabinet size, 10¼in. × 10in. wide. Maximum depth at base, 5in. tapering to 3¼in. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete instruction booklet with practical and theoretical diagrams is provided. Booklet available at **1/6**, post free. Our price for complete kit, **£6/9/6!!!** Please add 2/6 packing and carriage. If preferred, we can supply Cabinet Assembly only, comprising Cabinet and bracket wavechange switch, dial, pointer, drum pulleys, drive spindle, drive spring and knobs, at **45/-,** plus 2/6 packing and carriage.

N.B.—Our kits are even supplied with sufficient solder for the job.

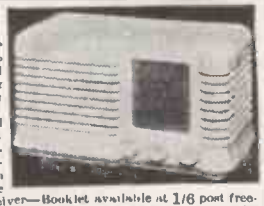
THE R.C. GRAM REPLACEMENT CHASSIS KIT

To meet the very great demand for this type of receiver, we have produced this unit. For Long, Medium, and Short Waves. Valve line-up: 6K8 Frequency changer, 6K7 I.F. Amplifier, 6Q7 1st Audio, Detector and A.V.C. 6V6 Output, 6X5 Full-wave rectifier. For A.C. mains 200/250 volts. 4 watts output. Excellent quality. High sensitivity. Provision for gram. Attractive illuminated black, red, green and gold dial for horizontal tuning. Four controls are: Tuning, L/M/S/Gram. Vol./on/off, Tone (variable). Chassis size: 13¼in. × 5¼in. × 2¼in. Dial size: 10in. × 4¼in. Assembly is simplified by the use of a 3-waveband coil pack, and pre-aligned 465 Kc/s. I.F. transformers—high-grade drop-through half-shrouded Mains Transformer, with voltage adjuster panel. This chassis can easily be assembled in one evening. Illustrated pamphlet with full assembly instructions, practical and theoretical wiring diagrams and itemised price list, **1/6**, post free. The main items for this receiver can be supplied separately, as under Drilled chassis, complete with valve-holders, A/E panel, P/U panel, tuning condenser and ready-assembled dial and drive at **39/6**. 3 waveband coil pack with gram position. **39/6**, tax paid. Pair of 465 Kc/s. I.F. Transformers, **9/6** pair. Half shrouded drop through Mains Transformer, **22/6**. The total cost of ALL items purchased separately is nearly £10, but we shall be pleased to supply all the required components right down to the last nut and bolt, at a special inclusive price of **£8/8/-,** plus 2/6 packing and postage. A set of four small brown and cream engraved knobs to suit is available at **1/2** each knob. This chassis is a professional job in every respect and can be seen and heard at our premises. This chassis can also be supplied, ready assembled, in very limited quantities at **£9/19/6,** plus 5/- carriage and packing.



THE "ECONOMY FOUR" T.R.F. KIT

A three valve plus metal rectifier receiver. A.C. mains 200/250 v. Medium and Long waves. We can supply all required components right down to the last nut and bolt. Valve line-up, 6K7, 6J7, and 6V6. Chassis ready drilled—Cabinet size 12in. long by 6in. high by 5in. deep—Choice of ivory or brown bakelite, or wooden, walnut finish cabinet Complete instruction booklet with practical and theoretical diagram. Each component brand new and tested prior to packing. Our price **£5/10/-** complete—Remember this set is being demonstrated at our shop premises! We proudly claim that our fully illustrated instruction booklet is the most comprehensive available for this type of receiver—Booklet available at **1/6** post free. This is allowed if kit is purchased later—Please, 2/6 packing and carriage for complete kit.



DULCI RADIO/RADIOGRAM CHASSIS

This very popular range of superior chassis can be supplied from stock. We will gladly demonstrate any to personal callers. All incorporate latest type valves 6BE6, 6BA6, etc. Flywheel tuning, negative feedback over entire audio section. Engraved knobs—3 tone position for Radio and Gram. All are built on chassis size 14¼in. × 7in. × 8¼in. high. All A.C. 100/110 and 200/250 v.—Dial size 8¼in. × 4¼in. for horizontal tuning. Attractive appearance.

Model B.3. Long, Medium, Short Waves (5 valves). Cash Price **£12/12/-**. H.P. Terms. **£3/4/-** deposit, 12 months at **17/8.**

Model B.3 Plus Push Pull Stage. (6 valves). Cash Price **£15/15/-**. H.P. Terms, **£3/19/-** deposit, 12 months at **£1/2/2.**

Model B.3 Double Feature Push Pull and R.F. Stage (7 valves). Cash Price **£18/18/-**. H.P. Terms. **£1/13/-** deposit, 12 months at **£1/6/9.**

Model B.6. (Medium, Long and Four Short Wavebands, band-spread.) Cash Price **£15/15/-**. H.P. Terms. **£3/19/-** deposit, 12 months at **£1/2/2.**

Model B.6 plus Push Pull Stage (6 valves). Cash Price **£18 18/-**. H.P. Terms **£4/13/-** deposit, 12 months at **£1/6/9.**

Model B.6. Double Feature Push Pull Plus R.F. Stage (7 valves). Cash Price 22 gns. H.P. Terms **£5/15/6** deposit, 12 months at **£1/12/6.**

All chassis fully guaranteed 12 months. Please include 7/6 packing, carriage and insurance. Illustrated leaflet available. Suitable speakers available. Ask for speaker list.

THE R.C. RAMBLER ALL-DRY PORTABLE KIT.

Full assembly details with practical and theoretical diagrams can be supplied at **1/6** post free This is a truly professional 4-valve superhet—all dry—for medium and long waves. A cream plastic top panel, with dial engraved in red and green, adds to the very imposing appearance of this model which is housed in an attractive cream and grey leatherette covered attache-case type cabinet; measuring only 9in. × 7in. × 5¼in. Weight less batteries, 4¼lb. with batteries 6¼lb. This set really has everything! Built-in frame aerial, high quality, extremely sensitive, and very adequate volume from the 5in. speaker. Valve line-up: 3V4, 1R5, 1S5, 1T4. Also the required components, exactly as specified, including cabinet, can be supplied from stock at the special inclusive price of **£7/7/-** plus 2/6 P. & P. (less batteries). Uses Ever-Ready 90 v. H.T. type B126 at **9/3.** Also L.T. 1.5 v. A.D.35 at **1/4.**

RAMBLER MAINS UNIT!—At last we are able to offer our special mains units kit for using our popular all-dry "Rambler" on A.C. Mains. Complete kit, which when assembled fits snugly into battery compartment, can be supplied at **47/6,** plus 1/6 packing and postage. Price includes all required components, and full assembly instructions. N.B. This unit is completely self contained in a metal box measuring 7in. × 2¼in. × 1¼in. and is ideally suitable for ANY all-dry battery portable requiring 90 v. H.T. and 1.5 v. L.T.

THE R.E.P. ONE-VALVE BATTERY RECEIVER KIT. Simple one-valve all-dry battery receiver for headphones, easily built in one evening. All required components including headphones, can be supplied at inclusive cost of **42/-** plus 2/- p. & p. Operated by Ever-Ready B114 type battery available at **7/9.** Full assembly details available separately at 9d. plus 3d. post.

THE NEW R.C. HIGH-FIDELITY AMPLIFIER. P.P. 6V6 output. Freq. 25—18,000 cps—60 db at 6¼ watts. Treble boost and cut—Bass boost—L.P. correction. Provision for Feeder Unit Max. UNDISTORTED OUTPUT 8¼ watts. Price 14 gns. plus 7/6. NOW AVAILABLE—Kit of Parts, complete with fully illustrated instructions, **£11/19/6,** plus 5/- carriage. Illustrated booklet available separately at **1/6.** Attractive metal cover, now available, with built-in carrying handle **19/6.**

STUPENDOUS HALF-PRICE OFFER!! DECCA SINGLE SPEED RECORD PLAYING DESKS 33A. Easily converted to either standard or L.P. Price with one crystal cartridge of either type, **£4/19/6**; or with both cartridges, **£5/19/6.** Plus 5/- P. & P.

F.C.1. 10 WATT AMPLIFIERS. Measure 12in. × 6in. × 6in. Valve line up—6AM6, 6AM6, 6SN7, 5Z4, 6F6s Push Pull. Separate Bass and Treble controls. multi-ratio output transformer for 3 ohm or 15 ohm speakers. Fully guaranteed!! **£10/15/-** plus 5/- P.P.

We also have in stock—Connoisseur 3-speed motors, pick-ups. Pick-ups and heads by Garrard, Decca, Collaro, Acos, Chancery, etc., etc., at current prices.

AMPLIFIER BARGAIN. "THE EMPRESS" Super quality push-pull 4 valve 4 watt amplifier, ideal for record or radio tuner reproduction. Measures only 7¼in. × 7¼in. × 3¼in. Valve line-up EL42, EL42, EZ41, EC83, for use with one or two 3-ohm speakers. Price **£7/7/-** plus 3/- P. & P.

CLYNE RADIO LTD.

18, Tottenham Court Road, London, W.1.

Introducing The Stern's "Fidelity" Tape Recorder

!! A NEW DESIGN OF OUTSTANDING QUALITY !!

- WILL PLAY THE NEW PRE-RECORDED TAPES
- WILL TAKE ALL STANDARD TAPES UP TO 1,200ft.
- WILL PROVIDE 2 HOURS PLAYING AT 3¾in. or 1 hour at 7½in. per second.
- INCORPORATES AN ELLIPTICAL P.M. SPEAKER 8in. × 5in., with EXTENDED FREQUENCY RANGE.
- We will supply it COMPLETE & READY FOR USE or YOU CAN ASSEMBLE IT AT HOME.

We have long delayed producing a Tape Recorder until we were completely satisfied that not only could we supply it at a genuinely low price, but also it had to be completely dependable and in addition it had to provide absolute fidelity recordings. !! THIS WE HAVE DONE !! and we offer our "Fidelity" model with the utmost confidence and with the knowledge that its performance equals Recorders marketed at a far higher price. It incorporates the Tape Deck and Amplifier described below both of which are so arranged that the "home assembly" of the Recorder is quickly and easily achieved.

SEND S.A.E. FOR DESCRIPTIVE LEAFLET.

YOU CAN ASSEMBLE IT YOURSELF FOR £40

H.P. Terms are shown below. THE DECK AND AMPLIFIER ARE ASSEMBLED AND TESTED WHEN SUPPLIED.
The actual assembly of the Recorder is extremely simple and only involves a few connections. The Truvox Tape Deck and the Amplifier are supplied tested and ready for use, all that is required is to connect the two together (a connection chart is supplied) and secure them in the Attache Case.

THE NEW TRUVOX MODEL TR7U TAPE DECK

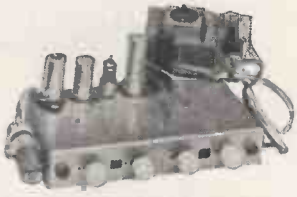
THE NEW TRUVOX MODEL TR7U TAPE DECK. 3 Shaded-Pole motors. Drop-In Tape Loading. Push Button Control. Separate Push Button Brake. Fast forward and fast reverse. Silent drive eliminating Wow and Flutter. Half Track working and 2 speeds, 3¾in. and 7½in. per sec. Positive Azimuth Adjustment. Overall size only 14¼in. × 12¾in.

ACOS CRYSTAL MICROPHONE MODEL MIC-33-1. A highly sensitive mike which accurately matches the input arrangement of the amplifier.

SCOTCH BOY MAGNETIC RECORDING TAPE. Supplied with a 1,200ft. reel of Scotch Boy plastic tape famous for its true brilliant quality. The Recorder will take all standard makes of tape.

BRIEFLY:

MODEL TRIF QUALITY AMPLIFIER. Expressly designed to correctly operate with the above Truvox Deck for recording and playback. Supplied complete with Elliptical Speaker and has level response from 60-10,000 c.p.s. Hum level 50 db down at 4 watts. Incorporates efficient tone control arrangement and MAGIC EYE LEVEL INDICATOR. Valve line-up: EF86, ECC83, EL84, 5Y3, EM34, provides 4 watts undistorted.



MODEL TRIF AMPLIFIER

THE ATTACHE CASE illustrated is attractively finished and covered with Rexine and is only 18in. × 14in. × 8½in. It has a concealed pocket to accommodate the Mike and Mains lead and also a pocket to carry a spare reel of tape.

GUARANTEED FOR 12 MONTHS (B.V.A. VALVES 90 DAYS)

PRICE SUMMARY

EACH UNIT IS AVAILABLE SEPARATELY AS FOLLOWS:

	CASH PRICE	DEPOSIT	12 monthly payments of
(a) TRUVOX Mk. TR7U TAPE DECK	£23 2 0	£5 17 0	£1 12 4
(b) AMPLIFIER MODEL TRIF WITH SPEAKER	£14 14 0	£4 16 6	£1 0 5
(c) PORTABLE ATTACHE CASE	£5 0 0	—	—
(d) ACOS CRYSTAL MIKE "33"	£2 10 0	—	—
(e) REEL OF TAPE 1,200ft.	£1 15 0	—	—

Please include £1 when ordering (a), (b) or (c) for packing charge, this whole amount will be refunded if case is returned to us intact.

WE WILL SUPPLY ALL FIVE UNITS LISTED ABOVE, i.e., THE COMPLETE BUT UNASSEMBLED RECORDER FOR £40/-/-. H.P. Terms: Deposit £10 and 12 monthly payments of £2/15/10 or in two parts as follows:—

	CASH PRICE	DEPOSIT	12 monthly payments of
(a) TRUVOX Mk. TR7U TAPE DECK MODEL TRIF AMPLIFIER WITH SPEAKER, 1,200ft. REEL OF TAPE..	£33 10 0	£8 10 0	£2 6 8
(b) ATTACHE CASE AS ILLUSTRATED.. LACOS CRYSTAL MICROPHONE ..	£6 10 0	—	—

See note below re packing charge

NOTE: Please send 30/- to cover cost of packing, carriage and insurance. We will refund £1 if the packing case is returned to us intact.

SUPPLIED COMPLETE AND READY FOR USE £50

FOR USE ON A.C. MAINS
H.P. Terms: Deposit £12 10 0 and 12 monthly payments of £3 10 0
Including mike and 1,200ft. reel of tape.

STERN RADIO LTD.

109 and 115 FLEET STREET, LONDON, E.C.4 Phone: CENtral 5812-3-4

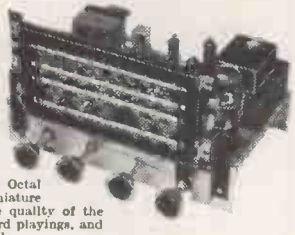
RECEIVER CHASSIS — *Modernise your old Radiogram* — RECORD PLAYERS

COMPLETE RADIOGRAM EQUIPMENT—QUALITY AT LOW COST

STERN'S DESIGN FOR HOME CONSTRUCTORS

The "SUPER-SIX"

A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.



YOU CAN BUILD IT FOR £10/7/6

Including the OCTAL VALVE LINE-UP

(£12/7/6 with the miniature valves)

Incorporating the new B.V.A. Miniature Valve Line up. This receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both Radio reception and Record playings, and excellent clarity of speech and music is obtained.

A few brief details.

- Covers 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operation on both Radio and Gram.
- Has independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. × 8in. × 8in. Dial aperture 8¼in. × 4¼in.
- For operation on A.C. mains 200-250 volts 50 cycles.

THE INSTRUCTION and ASSEMBLY MANUAL is available for 2/-. It contains very detailed practical drawings and circuit diagrams and a complete Component Price List.

!!!THE LATEST!!!

RADIO-RADIOGRAM CHASSIS

Model F3PP. A 7-valve 3-waveband Superhet Chassis with Push-Pull Stage. This Chassis has been designed with particular regard to the quality of reproduction. It incorporates SEPARATE BASS and TREBLE CONTROLS thereby ensuring the utmost flexibility of Tone on both Radio and Gram.

Briefly:

- Waveband coverage 16-50, 190-550 and 900-2,000 metres.
- Valve line-up X79, 6BA6, 6AT6, ECC83, GZ30 and two 6AQ5's in push-pull for approx. 6 watts output.
- Negative Feedback and delayed A.V.C.
- Has independent mains supply socket for gram. connection.
- Overall size of Chassis 12in. × 8in. high × 7in. with dial size 11¼in. long × 4¼in.

For use on A.C. Mains 100/110 volts and 200/250 volts.

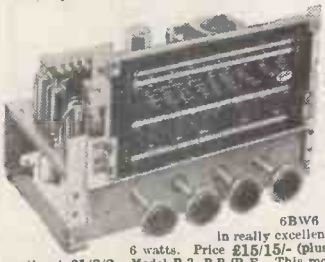
Cash Price, tested and ready for use **£17/17/0** (plus 7/6 carr. and ins.)

H.P. Terms: Deposit £4/7/- and 12 monthly payments of £1/5/4.

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

- Model B.3. A 5-valve 3-waveband receiver.
- Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.
- Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The three Receivers are for operation on A.C. mains 100/110 volts and 200/250 volts, and employ the very latest miniature valves. They were designed to the most modern specification, great attention having been given to the quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.



Brief specifications: Model B.3.—Valve line-up, 6BE6, 6BA6, 6AT6, 6BW6, 6X4—waveband coverage short 16-50, medium 187-550, long 900-2,000 metres. Controls: (1) volume with on/off; (2) tuning (flywheel type); (3) wavechange and gram.; (4) Tone Control (operative on gram. and radio). Negative feedback is employed over the entire audio stages. Chassis size: 11 × 7½ × 8½in. high. Dial size 8½ × 4¼in. Price complete and READY FOR USE, excluding speaker £12/12/- (carr. and ins. 7/6 extra).

H.P. Terms £3/4/- deposit, 12 months at 17/8.

Model B.3.P.P. This model is the B.3 Receiver but incorporates two 6BW6 VALVES in PUSH-PULL, resulting in really excellent quality reproduction up to approximately 6 watts. Price £15/15/- (plus 7/6 carr. and ins.) or £3/19/- deposit, 12 months at £1/2/2. Model B.3. P.P./R.F. This model is similar in appearance and has same waveband coverage the Model B.3, but in addition it incorporates an R.F. STAGE together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6BW6 in Push-Pull. This makes for a really sensitive receiver with genuine quality reproduction. Price £18/18/- (plus 7/6 carr. and ins.) or £4/13/- deposit, 12 months at £1/6/9.

STERN RADIO LTD.

109 and 115 FLEET ST., LONDON, E.C.4.

'Phone: CENtral 5812/3/4

This 3-SPEED AUTOCHANGER is by a Famous Manufacturer and is offered for

£11'10'0 (Plus 7/6 carr. & ins. Normal Price £16/10/0

Hire Purchase Terms £2/17/6 Dep. and 12 months at 16/4.

- These units will autochange on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in. 10in. and 12in. records.
- They have separate sapphire for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14in. × 12in., with height above 5¼in. and height below baseboard 2¼in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

WE HAVE THE LATEST 3-SPEED AUTOCHANGERS IN STOCK

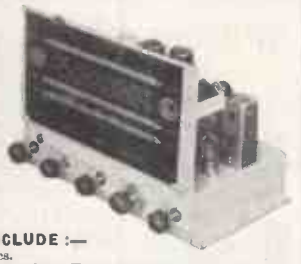
SEND S.A.E. FOR DETAILS

WE CAN ALSO OFFER THE LATEST 3-SPEED NON-AUTOCHANGE UNIT

THE NEW ARMSTRONG F.C. 48

A high quality replacement Radio or Radiogram Chassis having provision for an F.M. Feeder Unit.

PRICE ASSEMBLED and READY FOR USE **£23'18'0**



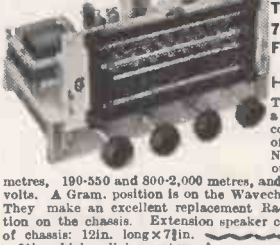
(Plus 7/6 Carr. and Ins.)

H.P. Terms £5/18/- Deposit and 12 months at £1/13/9.

OUTSTANDING FEATURES INCLUDE :—

- 8 Valves including 2 double Triodes.
- 8 Watts output from push-pull tetrodes. Heavy negative feedback is used, resulting in negligible distortion and high damping factor.
- Provision for using F.M. adaptor to receive the present high quality transmissions from Wrotham and the new B.B.C. V.H.F. stations.
- An accessible socket at rear provides the power supply for this unit.
- Independent controls give BASS and TREBLE lift and cut with unique Thermometer visual indicator.
- Gram. position on wavechange switch.
- 4 Wavebands Coverage 16-51, 50-120, 190-550, 1,000-2,000 metres.
- Large four-colour illuminated dial.

AN OUTSTANDING OFFER



A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER For only £12/19/6 (Carr. & ins. 7/6 extra.)

H.P. — £3/4/6 Dep. 12 mths. at 18/4.

These receivers Models AW3-7 are made by a well-known set of manufacturers and incorporate the latest Osram Valve Line-up of X79—W77—DH77—H77—U78 and two N78's in Push-Pull for approx. 7 watts output. They cover 3 wavebands 18-50 metres, 190-550 and 800-2,000 metres, and are for operation on A.C. mains 200-250 volts. A Gram. position is on the Wavechange Switch. They make an excellent replacement Radiogram Chassis having a P.U. connection on the chassis. Extension speaker connection is also provided. Overall size of chassis: 12in. long × 7¾in. × 6¼in. high, dial aperture 8¼in. × 4¼in. (Dial Escutcheon available for 4/9).

THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY—Select a RECEIVER CHASSIS and we will supply it TOGETHER WITH THE ABOVE 3-SPEED CHANGER AND AN 8-inch or 10-inch P.M. SPEAKER as follows:—

THE £11/10/- AUTOCHANGER WITH A SPEAKER AND:—

		Cash Price	Deposit	Monthly
(a)	With Model B3 chassis	£24 15 0	£6 4 0	12 of £1 14 10
(b)	" " B3PP	£28 0 0	£7 0 0	12 of £1 19 5
(c)	" " B3PP/RF	£31 2 0	£7 15 0	12 of £2 3 9
(d)	" " Armstrong F.C.48	£36 4 0	£9 1 0	12 of £2 10 11
(e)	" " AW3-7	£25 5 0	£6 7 0	12 of £1 15 5
(f)	" " F3PP	£30 2 0	£7 10 0	12 of £1 17 3

An additional charge of 10/- is made in each case to cover Carriage and Insurance.

"Hi-Fi" EQUIPMENT and KITS
TO SUIT ANY BUDGET

TWO COMPLETE "Hi-Fi" AMPLIFIER KITS

"STERNS" HIGH QUALITY 8-10 WATT AMPLIFIER

Having a front panel which is very attractively finished in deep gold, and on which the controls are clearly identified. The ideal amplifier for general home use and for small halls, etc.

Price of COMPLETE KIT including Valves and Drilled Chassis, etc. **£7/10/-** (Plus 2/6 Carr. & Ins.)

We will supply it Completely Built for **£9/10/-** (Plus 5/- Carr. & Ins.)

Designed for high quality reproduction up to an output level of 10 watts, having 6V6s in Push-Pull and incorporating negative feedback. It is suitable for use with all types of Pick-ups and most types of microphones and the output transformer provides for use of 3 and 15 ohm speakers.

BRIEF FEATURES

- Valve line up 6Z5, 6SN7, 5Z4, with 6V6s in push pull.
- The undistorted output level of up to 10 watts is produced from an input of .25 volts.
- First class reproduction of Radio (where a Tuning Unit is used) and Record Playing.
- Separate Bass Boost and Treble Controls provide an excellent range of frequency control.
- Very satisfactory results are obtained with an average type of high impedance Moving Coil or Crystal Microphone, a clear speech level of approx. 5 watts output being obtained.
- Power supplies (HT and LT) are available for a Tuning Unit.
- For operation on A.C. Mains 200-250 volts 50 cycles.

THE ASSEMBLY MANUAL is available for 1/- and includes detailed layouts and component Price List.

"STERNS" 12 Watt "HIGH FIDELITY" Push-Pull AMPLIFIER

A very high quality Unit attractively finished in deep gold with each control clearly identified on the front panel. Comprising a Main Amplifier Chassis and a Remote Control Pre-Amplifier-Tone Control Unit. The remote control unit measures only 9in.x4in.x2½in. and contains four controls, being: Bass-Treble-Volume and a Radio, Gram, Microphone Switch control. It incorporates its own feedback circuit on the Bass Channel. Loop negative feedback is employed on the Main Amplifier which has a valve line up of 6J5-6N7-5U4 with two PX25's in push-pull and 6J5 and 6SN7 are used in the remote control unit.

THE COMPLETE KIT IS AVAILABLE FOR **£14/-/-** (Carr. & Ins. 6/- extra.)
THE COMPLETE UNIT ASSEMBLED AND READY FOR USE **£17/-/-**
H.P. Terms £4/5/- Deposit, 12 Months at £1/3/11. (Carr. & Ins. 7/6 extra.)

The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It can be seen, therefore, that ample correction is provided to suit any type of pick-up with any type of recording. Input voltage for maximum output is 70 mV and 6.3 volts at 2 amps, and 30 mA. H.T. is provided for tuning unit, etc. This Amplifier compares well with the Williamson and similar designs at a fraction of their cost. The complete set of assembly instructions is available for 2/-.

SPECIAL PRICE REDUCTIONS
FOR COMPLETE EQUIPMENT

SELECT A TUNING UNIT and AMPLIFIER or TUNING UNIT, AMPLIFIER and RECORD PLAYER (and a SPEAKER if required) and we will supply at a REDUCED PRICE. H.P. TERMS ALSO QUOTED.

WE CAN SUPPLY . . . COMPLETE KIT or ASSEMBLED CHASSIS FOR THE OSRAM 912 AMPLIFIER. Designed by General Electric Co.

A modern high quality 12 watt Amplifier for the HOME CONSTRUCTOR, having a Valve line-up of U709, B309, Z729 and two N709's in Push Pull.

The Assembly instructions include five "easy stage-by-stage" diagrams and is available for 3/6.

Price of COMPLETE KIT **£23/10/-** (Plus 7/6 Carr. and Ins.)

WE WILL SUPPLY THE COMPLETELY ASSEMBLED AMPLIFIER for **£25/-/-** (Plus 7/6 Carr. & Ins.)

H.P. Terms: £6/5/-. Deposit and 12 months at £1/15/2.

WE HAVE IN STOCK . . . THE DENCO F.M. FEEDER UNIT

Consisting of a 5 valve Superhet design incorporating R.F. (6AM6) and F/C (12AH8) Stages followed by Two I.F.s. (6BA6's) and Ratio Descriminator 6AL5. the coverage provided being 88-100 Mc/s.

THE COMPLETE KIT including VALVES and DRILLED CHASSIS is available for £6/13/6

It is suitable for use with any type of High Fidelity Amplifier. (Plus 4/- Carr. & Ins.) The descriptive manual, including circuit and Component, Layout, etc., is available for 1/6.

THE COMPLETELY ASSEMBLED CHASSIS, ready for use, aligned and tuned £8/17/6 Plus 6/- Carr. & Ins.

EACH PRICE INCLUDES TWO I.F. STAGES.

We have a comprehensive range of P.M. SPEAKERS in stock at REDUCED PRICES. State requirements for quotation.

"STERNS" MODEL CP3G 3 WAVEBAND SUPERHET TUNING UNIT

A highly sensitive tuning unit providing for excellent reception of stations on the short waveband (16-50 metres), medium waveband (200-550 metres) and the long waveband (800-2,000 metres).

We can supply this tuner to correctly operate with each of the amplifiers.

- Valve line-up—6K8G (Frequency Changer), 6SK7g (I.F. Amplifier), 6Q7g (Detector, AVC and 1st A.F. Amplifier), and 5Z4g (rectifier).
- A gramophone position is incorporated with the wavechange switch and the 6Q7g valve becomes the 1st A.F. Amplifier for the gramophone pickup
- Volume control and tone control operative in both radio and gramophone positions of the wavechange switch.
- This unit is precisely similar in appearance to the AM/FM unit illustrated, but the overall chassis dimensions are 12in. x 8½in. x 8in. including the full vision dial. Size 8½in. x 4½in.
- For A.C. Mains only, power supply required—H.T. 250 volts 30 mA., L.T. 6.3 volts 1½ amp.

Price, completely assembled and including built-in power supply **£10/10/-**. H.P. Terms. Deposit £2/12/6. 12 months of 15/-.

Price completely assembled exoluding power supply £9/-/-. Carriage and insurance 7/6 extra.

The NEW "LEAK" TL/10 AMPLIFIER and "Point One" PRE-AMPLIFIER

This Amplifier has a maximum output of 10 watts and maintains in every respect the world renowned LEAK reputation for precision engineering; fine appearance and fastidious wiring. The Pre-Amplifier will operate from any make or type of pickup. A continuously variable input attenuator at the rear of the Pre-amp. permits the instantaneous use of crystal, moving iron and moving coil pickups. H.T. and L.T. supplies are available for a Radio Tuning Unit. An input attenuator is fitted. S.A.E. for descriptive leaflet.

PRICES :

(a) The COMPLETE AMPLIFIER WITH PRE-AMPLIFIER, £28/7/-, or £7/2/- Deposit and 12 months at £2.

(b) The TL/10 MAIN AMPLIFIER ONLY: £17/17/-, or £4/7/- Deposit and 12 months at £1/5/4.

(c) The "POINT ONE" PRE-AMPLIFIER ONLY: £10/10/-, or £2/12/6 Deposit and 12 months at 15/-.

WILLIAMSON AMPLIFIERS BY GOODSELL

These Amplifiers hardly need enlarging upon, it being sufficient to say that they have now become the accepted standard for quality reproduction by which all others are judged. Two Models are available:

MODEL G.W.18. Built completely to specification and giving 15 watts output.
Price **£33/15/-** Plus 7/6 Carriage and Insurance) H.P. Terms. Deposit £8/9/-. and 12 months at £2/7/5.

MODEL GW.12. Uses slightly lower H.T. voltage to produce 10-12 watts output but otherwise is built completely to specification.
Price **£27/10/-** (Plus 7/6 Carriage and Insurance). H.P. Terms Deposit £6/17/6 and 12 months at £1/18/8.

THE MODEL P.F.A. TONE CONTROL UNIT

This Control Unit has established a reputation for its excellent quality of reproduction, and ability to give adequate gain for any type of pick-up.
Price **£20/-/-** (Plus 7/6 Carriage and Insurance). H.P. Terms. Deposit £5/-/- and 12 months at £1/8/2.

WE HAVE THEM IN STOCK AND WILL BE PLEASED TO DEMONSTRATE
or send S.A.E. for illustrated and descriptive leaflet.

The DENCO M.T.O.I. Modulated Test Oscillator
£3/15/0

(Plus 2/- Carr. and Ins.)
Has Frequency range continuously variable from 170-475 Kc/s. and 550-1,600 Kc/s. Battery operated and thereby completely self-contained.

BRAND NEW C.R.T. MASKS

Latest aspect ratio for 12in. "Round" tubes, finished Ivory.

(plus 1/- postage) **12/6**

WE CAN SUPPLY . . . COMPLETE KIT or ASSEMBLED CHASSIS THE MULLARD HIGH QUALITY AMPLIFIER

A design by Mullard Ltd. of a quality 5 valve 10watt Amplifier incorporating the latest Mullard valve line-up with two EL84's in push-pull.

PRICE COMPLETELY ASSEMBLED TO SPECIFICATION **£18/10/-**

(Plus 7/6 Carr. and Ins.)

H.P. Terms. Deposit £4/12/-. 12 months of £1/6/1. Price of complete kit £17/10/-. (Plus 7/6 Carr. and Ins.). The Mullard Assembly Manual is available for 2/6.

When submitting orders, please include postage and packing.

STERN RADIO LTD.

CONSTRUCTORS say "IT'S STILL THE BEST MAINS or BATTERY PORTABLE SET"

A Midget 4-valve Superhet Portable covering medium and long wavebands. Designed to operate on A.C. mains 200/240 volts or by an "Alldry" battery. The set is designed so that the main section can be supplied as a separate unit, and can be added at any time. The set supplied as an "Alldry" battery Superhet can be accommodated in the attache case illustrated (size 9½in. × 4½in. × 7in.). This is attractively finished in lizard, maroon, dark green or blue rexine. As a combined Mains/Battery Superhet Portable a polished cabinet is available to accommodate both Mains Unit and Batteries. Circuit incorporates delayed A.V.C. and pre-selective Audio Feedback. The Set is complete in every detail and includes ready-wound frame aerials, fully aligned I.F. transf. and drilled chassis, etc. Overall size of assembled chassis 9in. × 4in. × 2½in. This receiver, as illustrated, can be completely built for £8/16/3 (plus Mains Unit if required). Send 1/3 for the fully descriptive Assembly Book which includes Practical Layouts and complete Price List of Components. Attache case available separately, 37/6.

"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build at Midget "Alldry" Battery Eliminator, giving approx 69 volts and 1.4 volts. This eliminator is for use on A.C. mains and is suitable for any 4-valve Superhet Receiver, requiring H.T. and L.T voltage as above, or approx. to 69 volts. The Kit is quite easily and quickly assembled and is housed in a light-aluminium case size 4½in. × 1½in. × 3½in. Price of complete Kit with easy-to-follow assembly instructions, 42/6. In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and 1.4 volts. Size of assembled unit 7in. × 2½in. × 1½in. Price 47/6.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR

11½in. × 4½in. × 3½in.

A design of a complete 5-VALVE SUPERHET RECEIVER employing an R.F. Stage, and incorporating a separate VIBRATOR PACK size 4½ × 2½ × 6½in. for use on 6 or 12 volt D.C. supplies. We can supply all components to build this complete Receiver and Vibrator Pack including a Metal Case, Valves, Drilled Chassis and 5in. P.M. Speaker for £13/9/6. (Carr. and Ins. 5/6 extra.) Or the Receiver Components for £9/19/6 and the Vibrator Components for £3/10/-. This is NOT an EX-GOVT. Receiver, it as a new design employing new Components. Send 2/8 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and PRACTICAL LAYOUTS, including a complete individual Component Price List.

A BULK PURCHASE ENABLES THIS SPECIAL PRICE REDUCTION OF THE FAMOUS SHAFTESBURY PORTABLE AMPLIFIER

Suitable for home use and small Halls. Has matched inputs for both Record Players and Microphone. Also provides for the "mixing" and "fading" of both Gram. and speech as requested.

COMPRISING

(a) A 4-Valve High Gain Amplifier for use on A.C. or D.C. mains 200-250 volts with 5 watts output. Incorporating independent Volume Controls for Mike and Gram., either of which can be faded at will, a variable Tone Control and independent input sockets for Mike and Gram.
(b) A Transverse Carbon microphone which obtains its polarizing current from the amplifier—no batteries are necessary.
(c) An 8in. Goodmans P.M. Speaker with the "Ticonal" magnet for first-class reproduction.

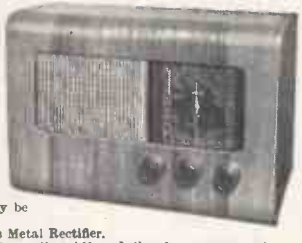
THE COMPLETE EQUIPMENT is all contained in the **PORTABLE CARRYING CASE £18'0'0**

Having been reduced from £30/9/-. HIRE PURCHASE TERMS. DEPOSIT £4/1 /- and 12 monthly payments of £1/5/4 ● Light in weight ● Easy to CARRY ● GENUINELY PORTABLE. An illustrated leaflet containing free data is available on receipt of S.A.E.

THE "MINI TWO-THREE"

An "Alldry" Battery Portable of midget size, 6½in. × 4½in. × 3½in. designed to cover medium waveband 190-559 metres, with use of short trailer aerial.
The simple design of this Receiver is so arranged that either a 3-valve set or a 2-valve (afterwards easily converted to the 3-valve) can be made.
Consists of a T.R.F. circuit using a regenerative detector with H.F. stage and a high gain output pentode. Valve line up IT4—IT4—DL94.
The 2-valve set can be completely built for £4/3/6 (less case) and the 3-valve for £5/3/- (less case). Each price includes valves, speaker, and drilled chassis.
Send 2/- for the assembly instructions; they include simple and complete practical component layouts and diagrams.

!! CONSTRUCTORS !! A NEW SUPERHET TRANSPORTABLE THE "SUPER THREE"



Designed for local station reception without the use of an external aerial. This design provides for a 3-valve (plus Metal Rectifier) Superhet Receiver incorporating a Frame Aerial for "room to room" use, provision is also made for a short external aerial, if required, for the reception of Continental stations.
Briefly the features are as follows:—

- For use on A.C. Mains 200-250 volts.
- This set includes a Mains Transformer and Chassis is NOT live to mains (as many other sets of this type are) and consequently the Receiver can safely be used in the Kitchen, etc.
- Valve line up 6K8—6J7—KT61, plus Metal Rectifier.
- The I.F. Transformer is supplied "pre-aligned" and thereby ensures extreme simplicity of Tuning—in fact, more simple than most T.R.F. Receivers.
- Compact and easy to build simple "point to point" practical diagrams are supplied with a completely drilled chassis.

The complete Receiver Chassis can be built to cover the Medium Waveband only for **£6 . 6 . 6**
Or to cover both Long and Medium Waves for **£6 . 16 . 3**
The attractive Polished Wood Cabinet 11½ inches wide, 8½ inches high and 6 inches deep illustrated above is **£1 . 1 . 0**
The CONSTRUCTOR'S MANUAL is available for 1/-, this shows the component prices, which are all available for separate purchase.

A DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT

Attractively finished in "Old Gold" and providing full control of BASS and TREBLE in conjunction with a main volume control.
It can be used with any amplifier and with any pick-up, the range of frequency control provided by the unit affording ample compensation for all types of pick-ups and all natures of recordings, i.e., English, American and long-playing without recourse to pick-up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier at 1vt. The unit measures only 9in. × 4in. × 2½in., including self-contained power supply and can be accommodated either on or away from the main amplifier, i.e., on the front panel of a cabinet or any other position. Price including drilled chassis, valves (6SN7 and 6J5), £3/16/9. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, £5/5/-.

BATTERY CHARGER KITS

All kits are for A.C. Mains 200-250 volts. They comprise a Metal Rectifier and Transformer, tapped for 6 or 12 volt charging, and a tapped Resistor, with Selector Switch, to enable the charging rate to be varied. A M/coil meter 5 amp. max., 13/6 extra.

For 6 or 12 volt batteries at max. 1 amp.	£1/17/6
For 6 or 12 volt batteries at max. 2½ amp.	£2/5/3
For 6 or 12 volt batteries at max. 4 amp.	£3/2/6

An easily followed Wiring Diagram is included with each kit.

SPEAKER BARGAINS

PLESSEY, 10in. 3 ohm V/coil	£1/5/0
GOODMANS, 10in. 3 ohm V/coil	£1/13/6
TRUVOX, 12in. 3 ohm V/coil	£2/7/6
ROLA, 12in. 3 ohm V/coil	£3/19/6
BAKERS, 12in. 15 ohm V/coil	£4/19/6
GOODMANS, 12in. 15 ohm V/coil	£5/19/6

(Carriage and Ins. 1/6 extra.)

THE NEW W.B. "STENTORIAN" HI F SPEAKERS ARE IN STOCK

Model H.F. 6-inch	£2/10/6
Model H.F 8-inch	£3/0/6
Model H.F. 9-inch	£3/7/0
Model H.F. 10-inch	£3/13/6

These speakers are of the very latest design and provide quality reproduction for the lower-price range. 3 or 15 ohm models are available.

A COMPLETELY ASSEMBLED 4 VALVE T.R.F. CHASSIS £6'9'6

Including a 5 in. P.M. SPEAKER and VALVES

(Plus 7/6 carr. and Ins.)

This receiver is of the very latest design and is for use on A.C. or D.C. Mains. It covers both Long and Medium Wavebands, and includes the modern 8VA miniature valves The line up being 12BA6 — 12AT6 — 12A8—35W4. It incorporates Permeability Tuned Coils thus ensuring excellent selectivity and sensitivity The overall size of the complete chassis including speaker is 10½in. × 4½in. × 6½in An attractive Cabinet size 11½in. × 5½in × 8½in. is available for 16/6 (plus 2/6 carriage and insurance).

109 and 115 FLEET ST.

LONDON, E.C.4. *Phone:* CENTRAL 5812-3-4

SELENIUM RECTIFIERS

L.T. Types		H.T. Type H.W.	
2/6 v. ½ a.h.w....	1/9	120 v. 40 mA....	3/9
6/12 v. ½ a.h.w.	2/9	250 v. 50 mA....	5/9
F.W. Bridge Types		250 v. 80 mA....	7/9
6/12 v. 1 a.	4/11	250 v. 150 mA. RM4 250 v. 250 mA.	9/9
6/12 v. 1.5 a. ...	7/9		
6/12 v. 2 a.	9/9		11/9
6/12 v. 3 a.	12/3	300 v. 275 mA.	12/11
6/12 v. 4 a.	14/9	**F.W. (Bridge Type)**	
6/12 v. 6 a.	19/9	250 v. 80 mA....	11/9
6/12 v. 10 a. ...	29/9		

CO-AXIAL CABLE. 75 ohms ¼in., **7d.** yard. Twin screened feeder, **9d.** yd.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001μF), .002 mfd. (2,000 pfd.). All at **5d.** each, **3/9** dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., **5/9** doz.; 6.5 v. 0.15 a., **6/9** doz.; 4.5 v. 0.3 a., **6/9** doz.

ELECTROLYTICS (Current production) NOT ex Govt.

Tubular Types		Can Types	
8μF 450 v.	1/11	16μF 450 v.	2/9
8 mfd. 500 v. ...	2/6	24μF 350 v.	2/11
16μF 350 v.	2/3	32μF 350 v.	2/11
16μF 450 v.	2/9	32 mfd. 450 v. ...	4/9
16μF 500 v.	3/9	64 mfd. 450 v. ...	4/9
32 mfd. 500 v. ...	5/9	100 mfd. 450 v....	4/9
8-16μF 500 v. ...	4/11	8-8μF 450 v.	3/11
25μF 25 v.	1/3	8-8 mfd. 500v. ...	4/3
50μF 12 v.	1/3	8-16μF 450 v. ...	2/11
50μF 50 v.	2/3	16-16μF 450 v. ...	4/11
Can Types		16-32μF 350 v. ...	4/9
8 mfd. 350 v. ...	1/3	32-32μF 350 v. ...	4/9
8 mfd. 450 v. ...	2/3	32-32μF 450 v. ...	5/11
16 mfd. 350 v. ...	1/11		

VOLUME CONTROLS with long spindles, all values, less switch, **2/9**; with S.P. switch, **3/9.**

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., Midget type, 2½-3-3in.	16/9
350-0-350 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
250-0-250 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a.	23/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
250-0-250 v. 100 mA., 6.3 v. 6 a., 5 v. 3 a., for R1355 conversion	29/6
300-0-300 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., 5 v. 3 a.	22/9
350-0-350 v. 100 mA., 6.3 v.-4 v., 4 a. c.t., 0-4-5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	31/6
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.	47/9
450-0-450 v. 250 mA., 6.3 v. 6 a., 6.3 v. 6 a., 5 v. 3 a.	69/6

TOP SHROUDED DROP THROUGH TYPE

250-0-250 v. 70 mA., 6.3 v. 2.5 a.	12/11
260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	15/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	21/9
300-0-300 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 v. 3 a.	21/9
350-0-350 v. 100 mA., 6.3 v. 4 a., c.t., 5 v. 3 a.	21/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	29/11
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9

E.H.T. TRANSFORMERS. 2,500 v. 5 mA., 2-0-2 v. 1.1 a., 2-0-2 v. 1.1 a., for VCR97, VCR517 ..... 36/6

FILAMENT TRANSFORMERS

Primaries 200-250 v. 50 c/s.

7.3 v. 1.5 a.	5/9	0-4-6.3 v. 2 a.....	7/9
6.3 v. 3 a.	8/11	6.3 v. 6a.....	17/6
12 v. 1 a.	7/9		
0-2-4-5-6.3 v. 4a....	16/9	12 v. 3 a. or 24 v. 1.5 a.	17/6
6.3 v. 2 a.	7/6		

CHARGER TRANSFORMERS

All with 200-230-250 v. 50 c/s Primaries: 0-9-15 v. 1½ a., **11/9**; 0-9-15 v. 3 a., **16/9**; 0-9-15 v. 4 a., **18/9**; 0-9-15 v. 6 a., **22/9**; 0-9-15 v. 15 a., **45/-.**

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s. 120 v. 40 mA.	7/11
120 v. 40 mA., 5-0-5 v. 1 a.	14/9

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
Standard Pentode, 10,000 ohms to 3 ohms	4/9
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull	5/6
Push-Pull 8 Watts 6V6 to 3 ohms	8/9
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω	15/9
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-Pull 20 Watts high-quality sectionally wound 6L6, KT66, etc., to 3 or 15Ω	47/9
Williamson type, exact to spec.	85/-

SMOOTHING CHOKES

250 mA., 3 H., 50 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
50 mA., 40 H. 1,000 ohms. Potted	10/9
20 mA., 30 H., 1,000 ohms	4/9

WIRE WOUND POTS: 20 ohms, 500 ohms, 5K, 20K, 50K, 100K (medium length spindles), **2/9.** 220 ohms, 2K, 10K, 20K, Preset type, **1/9** each.

AMMETERS. Ex Govt. Moving coil. G.E.C. 0-5 amps., 2in. scale, **11/9.**

EX-GOVT. E.H.T. SMOOTHING CONDENSERS

.25 mfd., 4,000 v. Blocks	4/9
.5 mfd., 2,500 v. Blocks	3/9
.5 mfd., 3,500 v. Cans	3/3
.1 mfd. plus 1 mfd. 8,000 v., large blocks (common negative isolated)	9/6
1.5 mfd., 4,000 v. Blocks	5/9

EX-GOVT. ACCUMULATORS with non-spill vents. Unused and guaranteed. 2 v. 16 A.H., **5/9** each.

EX-GOVT. BLOCK PAPER CONDENSERS

2 mfd. 800 v. ...	1/9	4 mfd. 2,000 v. ...	6/9
4 mfd. 500 v. ...	2/9	6-6 mfd. 450 v....	5/9
4 mfd. 730 v. ...	3/9	8 mfd. 500 v. ...	5/9
4 mfd. 1,000 v....	4/3	8-8 mfd. 500 v....	6/11
4 mfd. 1,500 v....	4/9	15 mfd. 500 v. ...	7/9

4 mfd. 500 v. plus 2 mfd. 250 v., **1/11.**

EX-GOVT. BLOCK ELECTROLYTICS. Small size 2,000 mfd. 12 v. for L.T. smoothing, **1/11** ea. **M.E. SPEAKERS.** All 2-3 ohms, 8in. R.A. field, 600 ohms, **11/9.** 10in. R.A. field, 1,500 ohms, **23/9.** 10in. R.A. field, 1,000 ohms, **23/9.**

HEAVY DUTY BATTERY CHARGER

For normal 200/250 v. A.C. mains input. To charge 12 v. battery. Variable charge rate of up to 10 amps. Fitted Meter and Fuses. Guaranteed 12 months. Carr. **7/6. £6/19/6.**

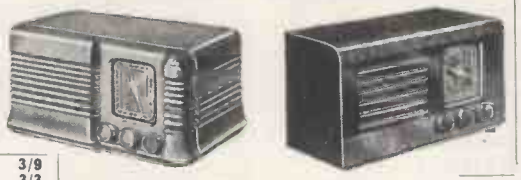
HEAVY DUTY BATTERY CHARGER KIT

For normal 200/250 v. A.C. mains. Comprises mains Transformer, 2 F.W. Metal Rectifiers, 2 variable resistors, 4 insulated terminals, 2 meters, 4 fuses and circuit. Total output 18 amps. Separate outputs for 6 v. and 12 v. Will make ideal Charger for Garages. Carriage **15/-. £9/19/6.**

DRYDEX HANDLAMPS, suitable for garage lights, etc. (Normal price 29/6). Limited number. Brand new boxed, fitted with bulb, **19/6.**

SPECIAL OFFERS. EX-GOVT. Mains Trans. Primary 200-250 v. 50 c/cs. secs., 300-0-300 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a., half shrouded drop through, **21/9.** P.M. Speaker, 3½ in. Goodmans (ex-equip) with output trans. for matching to battery pentode, **14/9.** Filament Transformer, 230 v. input 6.3 v. 1 a. output, **4/9.**

THE SKY CHIEF T.R.F. RECEIVER



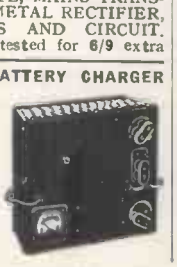
A design of a 4-stage, 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in either of cabinets illustrated above. It consists of a variable Mu high gain H.F. stage followed by a low distortion grid detector triode. The next stage is a further triode amplifier with tone correction by negative feedback. Finally comes the output stage consisting of a parallel connected double triode giving ample output at an extraordinary low level of distortion. Point-to-point-wiring diagrams, instructions, and parts list, **2/6.** This receiver can be built for a maximum of **£4/19/6** including cabinet.

P.M. SPEAKERS. All 2-3 ohms. 6½in. Plessey, **16/9.** 8in. Plessey, **15/9.** 10in. R.A., **26/9.** 10in. Plessey, **18/9.** 10in. Rola with Trans., **29/6.**

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/s. To charge 6 v. accumulator at 2 amps., **25/9.** To charge 6 v. or 12 v. battery at 2 a., **31/6.** To charge 6 v. or 12 v. battery at 4 a., **49/9.** ABOVE KITS CONSIST OF BLACK CRACKLE LOUVRED STEEL CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. Any type assembled and tested for **6/9** extra

R.S.C. 6 v. or 12 v. BATTERY CHARGER

For normal A.C. mains input 200-230-250 v., 50 c/s. Selector panel for 6 v. or 12 v. charging. Variable charge rate of up to **4 AMPS.** Fused, and with 5 amp meter. Well ventilated metal case with attractive crackle finish. Guaranteed for 12 months, **69/6.** Carr. 2/6.



EX-GOVT. MAINS TRANSFORMERS

All 230 v. 50 c/s. input 8.8 v. 4 a. **9/9** 48 v. 1 a. **9/9**

365-0-365 v. 150 mA.	8/9
300-0-300 v. 80 mA 5 v. 3 a.	8/11
278-0-278 v. 100 mA. Carr. 5/- on following types.	8/9
460 v. 200 mA., 6.3 v. 5 a.	27/9
0-11-22 v. 15 a.	35/9
0-11-22 v. 30 a.	72/6
16-18-20 v. 35 a.	79/6
7.7 v. C.T. 7 amps 4 times	25/9
300-0-300 v. 150 mA., 610-0-610 v. 150 mA., 1,220 v. 350 mA.	29/9
40 v. C.T. 150 mA. 4 v. 6 a., 6.3 v. 6 a., 6.3 v. 0-6 a., 4 v. 6 a., 4 v. 3 a., 4 v. 3 a., 4 v. 3 a., 5 v. 2 a.	22/9

EX-GOVT. AUTO. TRANSFORMERS

15-10-5-0-195-215-235 v. 500 watts	27/9
Double wound 10-0-200-220-240 v. to 10-0-275-295-315 v. 1,000 watts	69/6
Double wound 0-230 v. to 0-230 v. in steps of 11 volts from 57.5 5 KVA (21 amps)...	£6/15/-
Double wound 0-110-240 v. to 0-130-140-150-160-170 v. 1,500 watts	69/6

Carriage on any of above 5/- extra.

EX-GOVT. SMOOTHING CHOKES

250 mA., 10 H. 50 ohms	14/9
250 mA. 10 H. 100 ohms	14/9
250 mA. 3 H. 50 ohms	8/9
150 mA. 10 H. 50 ohms	10/11
150 mA.. 6-10 H. 100 ohms Tropicalised	6/9
100 mA. 10 H. 100 ohms, Tropicalised	5/9
100 mA. 5 H. 100 ohms, Tropicalised	3/11
50 mA. 50 H., 1,000 ohms. Potted	8/11
90/100 mA. 10 H. 100 ohms. Potted	8/9
50 mA. 5-10 H.	2/9
L.T. type 1 amp.	2/9

CHASSIS

18 s.w.g. undrilled aluminium amplifier type (4-sided)

14in. × 9in. × 2½in. **6/11**
14in. × 10in. × 3in. **7/11**
16in. × 10in. × 3in. **8/3**

18 s.w.g. aluminium receiver type.

6in. × 3½in. × 1½in. **1/11**
7½in. × 4½in. × 2in. **2/9**
10in. × 5½in. × 2in. **3/3**
11in. × 6in. × 2½in. **3/11**

16 s.w.g. aluminium, receiver type.

12in. × 8in. × 2½in. **5/3**
16in. × 8in. × 2½in. **7/6**
20in. × 8in. × 2½in. **8/11**

16 s.w.g. aluminium, amplifier type, 4-sided.

12in. × 8in. × 2½in. **7/11**
16in. × 8in. × 2½in. **10/11**
20in. × 8in. × 2½in. **13/6**
14in. × 10in. × 3in. **13/6**

R.S.C. HIGH FIDELITY 25 watt AMPLIFIER A 4

A NEW DESIGN FOR 1955

HIGH GAIN "PUSH PULL OUTPUT." BUILT-IN PRE-AMP. TONE CONTROL STAGES. INCLUDES 7 valves, sectionally wound output transformer, block paper reservoir condenser, and reliable small components. AN INPUT OF ONLY 20 millivolts IS REQUIRED FOR FULL OUTPUT. THIS MEANS THAT ANY TYPE OF MICROPHONE OR PICK-UP IS SUITABLE. Two separate inputs controlled by separate volume controls allow simultaneous use of "Mike" and Gram., or Tape and Radio, etc., etc. Individual controls for Bass and Treble "lift" and "cut." Six negative feedback loops giving total of 24 D.B. Frequency response ± 3 D.B. 30-20,000 c/s. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, DANCE HALLS, etc., etc. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS. Size approx. 12in. × 10in. × 9in. Weight 20 lb. Power consumption 175 watts. Outputs for 3 and 15 ohms speakers. The kit is complete in every detail. Chassis is fully punched. Easy to follow point-to-point wiring diagrams, are supplied. EXTRA HIGH SENSITIVITY, HIGHEST QUALITY for **9 Gns.** Or assembled ready for use 50/- extra. plus carr. 7/6.

H.P. Terms now available on request. Cover as illustrated if required, price 17/6 extra.

W.B. "STENTORIAN" High fidelity P.M. Speaker, HF1012, 10 watts, 15 ohm (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required we highly recommend this unit with an amazing performance. £3/13/6.

MICROPHONES. Crystal, hand or Desk type, good quality Acos, 50/-. Stand type with base and adjustable stand, £6/19/6. Both suitable for use with our amplifiers.

PLESSEY 3-SPEED MIXER AUTOCHANGERS with high impedance magnetic pick-up with duo point alloy stylus for long playing or standard records (Will play 2,000 records before replacement stylus required.) Brand new, cartoned, guaranteed. Limited stocks at only 10 gns., plus 5/- carr.

H.M.V. LONG PLAYING RECORD TURNTABLE COMPLETE WITH CRYSTAL PICK-UP (SAPPHIRE STYLUS). Speed 33⅓ r.p.m. BRAND NEW, CARTONED. Only £3/19/6 (approx. half price). Carr. 5/-. (For 200-250 v. A.C. Mains).

COLLARO HIGH FIDELITY MAGNETIC PICK-UPS. High Impedance. For Standard, 78 r.p.m. records. Brand new, boxed. Limited number at only 35/-.

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. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit, or Tape Deck preamplifier. For A.C. mains input of 200-230-250 v. 50 c/s. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate), with green crackle finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/-, or assembled ready for use 25/- extra, plus 3/6 carr.

A PUSH PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/7/6.

For mains input 200-250 v. 50 c/s. Complete kit of parts including point-to-point wiring diagrams and instructions. Amplifier can be used with any type of feeder unit or pick up. This is not A.C./D.C. with "live" chassis but A.C. only with 400-0-400 v. Trans. Output is for 2-3 ohm speaker. (We can supply a very suitable 10in. unit by Rola at 27/9.) The amplifier can be supplied ready for use for 25/- extra Full descriptive leaflet, 6d.

R.S.C. MASTER INTERCOMM. UNIT, with provision for up to 4 "Listen-Talk Back Units" individually switched. A high gain amplifier enables speech and other sounds emanating from the rooms containing remote control units to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Brown Bakelite cabinet is included. Mains input is 200-250 v. 50 c/s. H.T. line 300 v. CHASSIS IS NOT "ALIVE." Ideal for use as "Baby Alarm" Sound amplification 4 watts. Price only £5/19/6. "Listen—Talk Back Unit" in bakelite or walnut veneered cabinet, can be supplied at 35/- each. Full descriptive leaflet 9d The Master Unit can be supplied assembled and tested for 30/- extra.

PERSONAL SET BATTERY SUPERSEDER KIT.

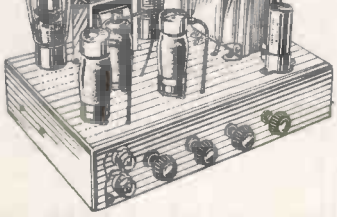
All parts for an "All Dry" Battery Eliminator. Complete with case. For 4 valve receivers requiring 90 v. 10 mA. and 1.4 v. 250 mA. Fully smoothed, Outputs from normal. 200-250 v. 50 c/s mains. Price with circuit, 35/9. Or ready for use, 42/6. Size of units 5½-4-1½in.

BATTERY SET CONVERTER KIT. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only 48/9. Supplied ready for use for 8/9 extra.

H.T. ELIMINATOR AND TRICKLE CHARGER KIT with case, Mains input 200-250 v. Output 120 v. 40 mA. and 2 v. ½ a. Price with circuit. 29/6. Or in working order. 37/3.

R.S.C. A3 10 WATT "PUSH PULL" HIGH FIDELITY AMPLIFIER.

With Self Contained Pre-amplifier and Tone Control.



This amplifier, whilst having sufficient output to fill a small hall, is the ideal amplifier for the quality enthusiast who knows that though the average listeing level is less than one watt it is necessary, for the very highest quality, to have an output of at least ten times this figure in order to obtain completely distortionless reproduction of sudden loud sounds.

The layout of the components has been planned to give the very maximum of performance with the minimum of constructional effort. Large safety factors in every component, A.C. and H.T. fuses, punched chassis with baseplate, screened input plugs, valves and with easy-to-follow point-to-point wiring diagrams. Everything is supplied down to the last nut and bolt.

Two independent inputs are provided with two associated independent volume controls so that programmes can be mixed together if desired, such as microphone announcements superimposed on a musical programme, or two independently controlled microphones, or even just gramophone/radio, fading over from one to the other. Variable base lift and cut with variable treble lift and cut tone controls are fitted, giving full long playing record equalisation for uncorrected pick-ups. They are also provided so that the user can alter the tonal values to suit his personal taste and surroundings. Because of the large negative feedback employed the output transformer can be so designed that it provides all the specified power even with large variations of loudspeaker impedance. Terminals are provided for 3 ohm and 15 ohm loudspeakers.

H.T. and L.T. available for the supply of a Radio Feeder Unit.

Six Negative Feedback Loops.
Max'mum input for full output 130 millivolts.
Frequency response ± 3.DB 50-20,000 cycles.
Negligible hum and distortion.
For A.C. mains input 200/230/250 v. 50 c/s.

COMPLETE Kit of Parts, **7 GNS.** (carriage 5/-).

Supplied assembled and tested for 45/- extra.

H.P. TERMS AVAILABLE ON ASSEMBLED UNITS.

FOUR STAGE RADIO FEEDER UNIT.

Design of a **HIGH FIDELITY**, L. and M. wave **T.R.F.** Unit with self-contained heater supply and thorough H.T. decoupling. Only 250-400 v. 15-20 mA. H.T. required from main amplifier. Three valves and Low Distortion Germanium Diode Detector. Flat topped response characteristic. Loaded H.F. coils. Two variable Mu controlled H.F. stages. 3 gang condenser tuning. Cathode follower output stage. Switch position for Gram. and Gram. input and output sockets. Performance comparable with the best in Feeder Units. For A.C. mains 200-230-250 v. operation. Size 11-6-7½in. Illustration, full set of easy-to-follow wiring diagrams and instructions and individually priced parts list 2/6. This unit can be built for only £3/15/-. including Dial and Drive Knobs and every item required.

RECORDING TAPE. Good quality, 1,200ft. reels. New, boxed, 19/6.

Radio Supply Co. (LEEDS) LTD.

32 THE CALLS. — LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-. 1/6 extra under £2, 1/11 extra under £3. Full Price List 6d. Trade List 5d.
Open to Callers: 9 a.m. to 5-30 p.m. Saturdays until 1 p.m.

MAINS TRANSFORMERS

Primary, 200-250 v. P. & P. 2/-. 300-0-300, 100 mA., 6 v. 3 amp., 5 v. 2 amp.. 22/6.

Drop thro' 350-0-350 v. 70 mA., 6 v. 2.5 amp., 5 v. 2 amp., 14/6.

Drop thro' 250-0-250 v. 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.

280-0-280, drop through, 80 mA., 6 v. 3 amp., 5 v. 2 amp., 14/6.

250-0-250 80 mA., 6 v. 4 amp., 14/-.

Drop thro' 270-0-270, 80 mA., 6 v. 3 amp., 4 v. 1.5 amp., 13/6.

Drop thro' 270-0-270 60 mA., 6 v. 3 amp., 11/6.

250 v. 350 mA., 6.3 v. 4 a., twice 2 v. 2 a. 19/6.

Auto-trans. Output 200/250, H.T. 500 v. 250 mA., 6 v. 4 a., twice, 2 v. 2 a., 19/6.

250-0-250, 60 mA., 6.3 v. 1.5 a., 0-5-6.3 v. 1.5 a., 10/6.

Auto Trans. Input 200/250. H.T. 350 v. 350 mA. Separate L.T. 6.3 v. 7 a., 6.3 v. 1½ amp., 5 v. 3 amp., 25/-. P. & P. 3/-.

Heater Transformer. Pri. 230/250 v. 6 v. 1½ amp., 6/-; 2 v. 2½ amp., 5/-. Pri 200/250. Secondary 9 v. 3.5 amp., 6.3 v. 3 amp., 12/6

Pri 200 v. Sec. 500-0-500 and 500-0-500 250 mA. both windings. 4 v. 3 amp. 4 v. 3 amp.. 39/6. P. & P. 5/-.

Mains Transformer, fully impregnated, input 210, 220, 230 and 240. Sec. 600-0-600, 275 mA., and 200 v. at 30 mA., complete with separate heater transformer. Input 210, 220, 230, 240. Sec., 6.3 v. 2 amp. three times, 0, 4, 6.3 v. at 3 amp. and 5 v 3 amp., 45/-. P. & P. 5/-.

Mains Transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350 100 mA., with separate heater transformer. Pri. 210, 220, 230, 240 Sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp., and 5 v. 2 amp., 30/-. P. & P. 5/-.

MAINS TRANSFORMERS, chassis mounting, feet and voltage panel. Primaries 200/250.

350-0-350 75 mA. 6.3 v. 3 a. tap 4 v. 6.3 v. 1 a.. 13/6.

500-0-500 125 mA. 4 v. C.T. 4 a., 4 v. C.T. 4 a., 4 v. C.T. 2.5 a., 27/6.

500-0-500 250 mA. 4 v. C.T. 5 a. 4 v. C.T. 5 a. 4 v. C.T. 4 a., 39/6.

9in. T.V. Cabinet, front in constrasting walnut veneers, size 16½in. long, 11½in. high, by 12½in. wide. Complete with two pieces expanded aluminium in gold, 12 x 9in. and 5in. speaker baffle and chassis, 20/-, post paid.

6½in. M.E. Speaker, 1,000 ohm. field. 15/-.

R. & A. T.V. energised 6½in. speaker with O.P. trans., field coil 175 ohms 9/6. P. & P. 2/6.

R. & A. 6½in. M.E. speaker with O.P. trans., field 440 ohms 10/6. P. & P. 2/6.

Volume Controls. Long spindles less switch, 50K, 500K 1 meg., 2/6 each. P. & P. 3d. each.

Volume Controls. Long spindle and switch. ¼, ½, 1 and 2 meg., 4/- each 10K and 50K. 3/6 each. ¼ and 1 meg., long spindle double pole switch, miniature. 5/-. P & P. 3d. each.

Trimmers, 5-40 pf., 5d. 10-110, 10-250 10-450 pf., 10d.

Twin-Gang .0005 Tuning Condenser, 5/-. With trimmers, 7/6.

Twin Gang, .0005, with feet, size 3½ x 3 x 1½in., 6/6.

3-gang .0005, with feet, size 4½ x 3 x 1½in., 7/6.

T.V. Coils, moulded former, iron-cored would for re-winding purposes only. All-can 1½ x 1½in., 1/- each. 2 iron-core All-can 2½ x ½in., 1/6 each.

Used Metal Rectifier, 250 v. 150 mA. 6/6.

Metal Rectifier, 230 v. 45 mA. 6/-.

Metal Rectifier. RM2, 125 v., 100 mA. 3/6.

PERMABILITY TUNED T.V. UNIT

Input 300 ohm balanced line, coverage 54 Mc/s—89 Mc/s and 174 Mc/s- 217Mc/s. Vision I.F.:—45 Mc/s., sound 40.5 Mc/s. Uses 6AK5 RF valve, 6AK5 as mixer, and 6C4 oscillator. Provision for auto-gain control. Dimensions 9in wide, 6½in. deep. 4in. high, 9in. blank-scale. Width including scale-overlap 14in. Four stages permability tuned. Complete with 3 valves. Post & Pkg. 3/-. £2/19/6.

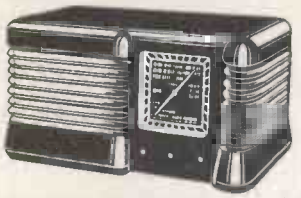
T.V. CONVERTER for the new commercial stations complete with 2 valves. Frequency:—can be set to any channel within the 186-196 Mc/s. band. I.F.:—will work into any existing T.V. receiver designed to work between 42-68 Mc/s. Sensitivity:—10 Mu/v with any normal T.V. set. Input:—arranged for 300 ohm feeder 80 ohm feeder can be used with slight reduction in R.F. gain. Circuit EF80 as local oscillator. ECC81 as R.F. amplifier and mixer. The gain of the first stage, grounded grid R.F. AMPLIFIER 10 db. Required power supply of 200 v. D.C. at 25 mA. 6.3 v. A.C. at 0.6 amp. Input filter ensuring complete freedom from unwanted signals. 2 simple adjustments only. £2/10/-. P. & P. 2/6.

USED 12in. TUBE, aluminized, heater cathode-short, 10KV max. 2 v. heater complete with line and E.H.T. transformer 9 KV with ferrocart core, line and width control, EY51 rec. winding frame O.P. scan coils and 12in. perspex escutcheon. £6/17/6. P. & P. 7/6.
As above but with 12in. non-aluminized tube 8KV max. £5/17/6. P. & P. 7/6.

GENERAL PURPOSE 3-IN-1 MAINS TRANSFORMER. Input 200/250. Sec. 250 v. 350 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. 500 v., 350 mA., 6.3 v. 4 amp. twice, 2 v. 2 amp. Auto-transformer, 140. 250 v., 250 watt. 19/6. P. & P. 3/6.

HIGH-IMPEDANCE PLASTIC RECORDING TAPE, by famous manufacturer. 600ft. on aluminium spool. 8/-. 1,200ft. on aluminium spool, 17/6, post paid.

PLASTIC CABINET, as illustrated, 11½ × 6½ x 5½in., in Walnut, Cream and Green, also in polished Walnut complete with T.R.F. chassis, 2 waveband scale, station names, new wave-band, back-plate, drum, pointer, spring, drive spindle, 3 knobs and back. 22/6. P. & P. 3/6.
AS ABOVE, with superhet chassis. 23/6. P. & P. 3/6.
Used metal rectifier, 230 v. 50 mA., 3/6, gang with trimmers, 6/6; M. & L. T.R.F. coils, 5/-; 3 obsolete ex-Govt. valves 3 v/h and circuit, 4/6; heater trans., 6/-; volume control with switch, 3/6; wave-change switch, 2/-; 32 x 32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-.

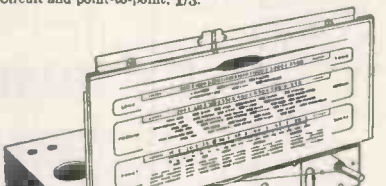


Cyldon 5 channel T.V. Tuner, less EF80 and 12AT7 less valves, 12/6, post paid.
Radiogram Chassis, 5 valve A.C./D.C. 3 wave-band superhet 195-255 v., 19-49, 200-550 and 1,000-2,000 metres, I.F. 470 Kc. size of chassis 13 x 6½ x 2½in., size of scale 7½ x 3½in. Valve line-up 10C1, 10F9, 10LD11, U404 and 10P14. Twin mains filter input. 2 dial lights and 8in. P.M.. 28/17/6. P. & P. 5/-.

CR100 Coil packs in first-class condition less oscillator section, complete with 4-gang tuning condenser. 19/6. P. & P. 3/6.
CR100 465 Kc. I.F.s, types 3, 4 and 5 and F.B.O., new condition, 7/6 each.
465 Kc. Xtal for CR100, 12/6.
4-gang tuning condenser for CR100, 9/6.

CONSTRUCTOR'S PARCEL, medium and long wave A.C. mains 230/250 2-valve plus metal rectifier, comprising chassis 10½ x 4½ x 1½in., 2 wave-band scale, tuning condenser, wave-change switch, volume control, heater trans., metal rectifier, 2 valves and v/holders, smoothing and bias condensers, resistors and small condensers, and medium and long wave coil fitz wound. 22/6. P. & P. 2/6 extra. Circuit and point-to-point. 1/3.

CONSTRUCTOR'S PARCEL comprising chassis 12½ x 8 x 2½in., cad. plated, 18 gauge, v/h., I.F. and trans. cut-outs, back-plate, 2 supporting brackets, 3 wave-band scale, new wavelength stations names. Size of scale 11½ x 4½in., drive, sp., drum, 2 pulleys, pointer, 2 bulb holders, 5 pax. I.O. v/h., 4 knobs and pair of 465 I.F.s, twin gang, 16 x 16 mfd, 350 wkg., mains trans. 250-0-250 60 mA., 6.3 v., 2 amp., 5 v. 2 amp. and 6½in. M.E. speaker with O.P. trans. 39/6. P. & P. 3/6.



Battery charger, input 239/250 v. output 6 and 12 volt 1 amp. Black crackle finished case size 10 x 6 x 4in. Incorporating metal rectifier, main on-off switch, and output switch 21/-. P. & P. 3/-.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/9; 42-1 with extra feed-back windings, 4/3. Miniature 42-1, 3/3. Multi-ratio 3,500, 7,000 and 14,000, 5/6. 10-watt push-pull 6V6 matching, 7/-. 90-1 3 ohm speech coil, 6/6.
PUSH-BACK CONNECTING WIRE, 2 Doz. yds., 1/6. Post paid.
STANDARD WAVE-CHANGE SWITCHES 4-pole 3-way, 1/9; 5-pole 3-way, 1/9; 3-pole 3-way 1/9; 9-pole 3-way, 3/6; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. 2-pole 11-way twin wafer 5/-; 1-pole 12-way single wafer 5/-. P. & P. 3d.

POTATO AND VEGETABLE PEELER

By famous manufacturer. To suit models A290 and A700. Capacity 4½lb., complete with water pump All aluminium construction, white stove-enamelled finish Originally intended for adaption on an electric food-mixer, can be easily converted for hand operation. 39/6. P. & P. 3/-.

Mains Droppers. 0.3 amp., 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms vitreous, 1/9; 0.3 amps. 950 ohms, tapped 700 and 825 2/6; 0.2 amp., 1,000 ohms, vitreous, tapped 2/6; vitreous, 0.3 amp., 700 tapped 680 640, 600, 3/6. P. & P. on each 3d.

T.V. Width Controls 3/6.

PERSONAL SHOPPERS ONLY. 9in. Enlarger, 17/6: 12in., 27/6.

Germanium Crystal Diode, 1/6, post paid

Used 9in. Tube with ion burn, 17/6. post paid.

Line O.P. Transformer in aluminium can mounted in rubber, 12/6.

Crystal Set, medium and long wave, in plastic cabinet, 16/-.

Headphones, per pair, 8/-.

Speaker Matching Unit on aluminium chassis, 3-15 ohms reversible, 12/6.

Line and E.H.T. Transformer, 14 Kv., using ferrocart core, complete with line and width control, and corona shields U37 rectifier winding. 35/-

Line and E.H.T. Transformer, 9 Kv., using ferrocart core, complete with built-in line and width control. Mounted on small all-chassis. Overall size 4½ x 4½in. EY51 rec. winding, 27/6.

Scan coils, low line low impedance frame, complete with frame transformer, to match above, 27/6. P. & P. 2/-.

Line and E.H.T. Transformer, 9 Kv. ferrocart core, EY51 heater winding, complete with scan coils and frame output transformer, and line and width control. £2/5/-. P. & P. 3/-.

As above, but complete with line and frame blocking transformers. 5 Henry 250 mA. choke, 100 mfd. and 150 mfd. 350 wkg. 380 mA. A.C. ripple. £2/19/6 P. & P. 3/-.

Valve Holders, moulded octal Mazda and loctal, 7d. each. Paxolin, octal Mazda and loctal, 4d. each. Moulded B7G, B8A and B9A, 7d. each. B7G moulded and B9A with screening can 1/6 each.

32 mfd., 350 wkg.	2/-
16 x 24, 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 400 wkg.	3/6
16 x 8 mfd., 500 wkg.	4/6
16 x 16 mfd., 500 wkg.	5/9
16 x 16 mfd., 450 wkg.	3/9
32 x 32 mfd., 350 wkg.	4/-
32 x 32 mfd., 350 wkg., and 25 mfd., 25 wkg.	6/6
25 mfd., 25 wkg.	11d.
250 mfd., 12 v. wkg.	1/-
16 mfd., 500 wkg., wire ends	3/3
8 mfd., 500 v. wkg., wire ends	2/6
8 mfd., 350 v. wkg., tag ends	1/6
50 mfd., 25 v. wkg., wire ends	1/9
100 mfd., 350 wkg.	4/-
100 mfd., 450 v. wkg., 280 mA., A.C. ripple	3/11
150 mfd., 350 v. wkg., 280 mA. A.C. ripple	4/6
100 + 200 mfd., 350 wkg.	9/6
16 + 16 mfd., 350 wkg.	3/3
50 mfd., 180 wkg.	1/9
65 mfd., 220 wkg.	1/6
8 mfd., 150 wkg.	1/6
60 + 100 mfd., 280 wkg.	7/6
50 mfd., 12 wkg.	11d.
32 + 32 mfd. min. 275 wkg.	4/-
50 mfd., 50 wkg.	1/9

Miniature wire ends moulded, 100 pf. 500 pf., and .001. each 7d.

T.V. Filter in lightly tinted Perspex size 13¼ x 11 x 3/16in. 4/6.

Combined 12in. mask and escutcheon in lightly tinted Perspex. New aspect, edged in brown Fits on front of cabinet. 12/6. As above for 15in. tube. 17/6.

Frame Oscillator Blocking Trans., 4/6. Line Osc. Blocking Trans., 4/6.

Tube Mounting Bracket, size 9½ x 4½in. 12in. tube clamps, 2/-.

CHOKES:
2-20 Hen. 150 mA., 15/-. P. & P. 3/-. 6 Hen., 275 mA., 15/-. P. & P. 3/-. 100 Hen., 40 mA. 15/-. P. & P. 3/-. 2 henry 150 mA., 3/6; 250 mA. 10 henry 10/6; 5 henry 250 mA., 60 ohms., 8/6.

P.M. Focus Unit for any 9 or 12in. tube except Mazda 12in. with Vernier adjustment 15/-.

P.M. Focus Unit for Mazda. 12in., less Vernier adjustment, 15/-.

Wide Angle P.M. Focus Units, Vernier adj. state tube 25/-.

Energised Focus Coil, low resistance mounting bracket, 17/6.

Ion Traps for Mullard or English Electric tubes 5/- post paid

Standard 465 Kc iron-cored I.F.s, 4 x 1½ x 1½in. per pr.. 7/6. Wearite standard iron-cored, 465 Kc. I.F.s, 3½ x 1½ x 1½in. per pr. 9/6.

Iron-Cored 465 Kc. Whistle Filter, 2/6.

465 KC. MIDGET I.F.s. Q-120 size 1½in. long 1in wide ½in. dee by very famous manufacturer. Pre-aligned adjustable iron-dust cores per pair 12/6

HOUR METER (10A/12531) for recording number of hours equipment is running. Contains Sangamo Weston synchronous motor. 50 cycles 200-250 volts. Registers up to 10,000 hours in 6 minute divisions. Revolutions as low as 1¼ revs. per hour. This motor is worth at least 30/-. Our price **17/6**, plus 1/6 post.

FILAMENT TRANSFORMERS. Input 210-240 volt A.C. Secondary 6.3 v. 6 a.; 6 3 v. 4 a., 2 v. 2 a., 30 v. 60 mA., at **14/6** each, plus 1/6 post. Also Transformers with secondary windings, 6.3 v. 6 a., 4 v. 4 a., 2 v. 2 a. and 30 v. 60 mA., at **14/6** each. plus 1/6 post. These Transformers are brand new.

TRANSMITTER/RECEIVER, TYPE ZC1 Mk.II. Covers 2 to 8 Mc/s in two wavebands, viz., 75-150 metres (2-4 Mc/s) and 37.5-175 metres (4-8 Mc/s.). Contains ½—6V6GT, 7—6U7G, 6K3G and 6Q7GT valves. I.F.'s 465 kc/s. and built-in 12-volt vibrator pack. Limited number only available at **£6/19/6**, plus 10/- carriage. Instruction Booklet supplied free to each purchaser of this unit.

HAND GENERATOR POWER SUPPLY UNIT No. 7 (ZA17571). With hand generator and cut out, but less accumulator. Can be used as a wind generator or as ordinary hand-operated charger for 6-volt batteries. Will give sufficient current to a "flat" battery to start a car. Complete in case (17in. x 10in. x 7½in.), with full working instructions. Brand new in original cartons, **19/6**, plus 3/6 carriage.

LONDEX RELAY UNIT. Containing 2,000Ω relay (1 break, 1 changeover), with heavy duty contacts, and slight delay chain of 50Ω wire wound resistor, 1,500Ω slider resistor, and a 250 mfd. 12 v. condenser. Mounted on Bakelite base. Will operate on 24-30 v. D.C. Brand new in original cartons. Price **8/6** each, plus 1/- post.

1355 RECEIVER. The well-known receiver for TV conversion. Brand new and complete with all valves. A few only at **22/6** each, plus 3/6 carriage.

R.F. UNITS, TYPE 26. Covering 50 to 65 Mc/s. Complete with all valves. Brand new in cartons. Price 35/-, plus 2/6 post. Also R.F. UNITS, TYPE 24. Complete with valves. Slightly soiled on outside. Price **14/6**, plus 2/6 post.

194 I.F. STRIP. The well-known I.F. strip for TV conversion. Complete with 6—VR65, 1—VR92(EA50), VR53 valves. Brand new at **32/6**, plus 2/6 postage.

"GRIMES" LANDING LAMP. Complete with bulb, and motor for deflection of beam. Brand new and boxed, **17/6**, plus 2/6 post and packing.

P.M. SPEAKERS. 5in. less transformer, **13/6**, plus 1/6 post. 6in. less transformer **15/6**, plus 1/6 post. 5in. available with output transformer at **3/6** extra.

ELECTRO-MAGNETIC COUNTERS. Solenoid type. Operates on 1.5 volt dry cell. 3 ohm. coil. 0-9999. Price **4/6**, plus 9d. post.

FOR THE 2-METRE FANS. 2-METRE TX TANK TUNERS. Consisting of butterfly condenser, silver-plated tank coil, H.T. choke and mounting base. Brand new and boxed, **1/6** each.

VALVES. EF50 at 5/- each, 54/- doz. EF50 Red Sylvania, 6/-; 66/- doz. SP61(VR65), EA50 Diodes, at **1/9** each; **18/-** doz. VS70 at **3/6** each. American 807 at **12/6** per pair. Please add postage.

GERMANIUM CRYSTAL DIODES. Wire-ended, **1/6** each; **13/6** doz.

HIGH-RESISTANCE HEADPHONES, with headband, **6/-**.

LOW-RESISTANCE HEADPHONES, with headband, **4/-**.

MIDGET CARBON MIKE INSERTS. Size 1¼in. dia. Brand new and boxed at **1/3** each, post free,

MOVING COIL HANDMIKES (No. 7), at **7/6** each,

CARBON HANDMIKES (No. 3), at 5/- each,

MOVING COIL HEADPHONES, at **10/6** per pair.

TANNOY POWER MICROPHONE INSET, for Tele L.S. No. 1, 2 and 3 (YA2815). Brand new in sealed tins. Price **2/6** each.

VALVEHOLDERS. Ceramic B9A, with screen cans, **1/3** each; **12/6** doz. Ceramic B7G with screen cans, **1/3** each; **12/6** doz. Ceramic B9G(EF50) at 9d. each; **8/6** doz.

TUNING CONDENSERS. .0003 mfd. (300 pF), 3 gang, at **3/6**, post free.

CONDENSERS, R.1 TYPE. .02 mfd. 5 kV wkg., at 2/- each; .03 mfd. 2.5 kV. wkg., at 2/- each; .05 mfd. 2.5 kV. wkg., at 2/- each; .25 mfd. 1.5 kV. wkg., at **1/3** each; .1 mfd. 1.2 kV wkg., at 1/- each; .05 mfd. 800 v. wkg., at 6d. each.

MANSBRIDGE BLOCK CONDENSERS. 4 mfd. 1,000 v. wkg., 3/9 each, plus 1/- post; 4 mfd. 350 v. wkg. (Type 62), at **1/6** each.

AMERICAN SPRAGUE METAL TUBULAR WIRE ENDED .1 mfd. 350 v. wkg. CONDENSERS, at **5/6** per doz., post paid.

ELECTROLYTIC CONDENSERS. Brand new current stock. 20 mfd. 500 v. wkg., 2/6 each; 5 for **10/-**. 100 mfd. 450 v. wkg., 2/6 each; 5 for **10/-**. Please add 1/3 postage.

I.F. TRANSFORMERS. 465 kc/s, at **3/9** per pair.

POTENTIOMETERS. 100 kΩ carbon with S.P. or D.P. switch. Fair length spindle. **1/6** each; **12/-** doz. 20 kΩ wire wound ¼in. spindle, at **1/6** each; **15/-** doz. 2 kΩ wire wound ¼in. spindle, at **1/6** each; **15/-** doz.

YAXLEY SWITCHES. 8-way single pole. Midget type with 1¼in. spindle. Brand new at **1/6** each; **15/-** doz.

TOGGLE SWITCHES, D.P. D.T., at **1/6** each.

SELENIUM RECTIFIERS. 6 v. or 12 v. 3 amp., full wave bridge, at **13/6**, post paid.

PILOT LAMP HOLDERS. Screw-type, at **3/-** doz.

OCTAL PLUGS (with covers). Fits into int. octal holder to make a useful 8-way plug and socket, 9d. each; **8/6** doz.

12-PIN PLUG AND SOCKET at 9d. per pair; **8/6** doz. pairs.

.15-AMP. DROPPER RESISTANCES. 745Ω-280Ω, 3in. long, at **1/-** each. Also 520Ω-143Ω, 3in. long, at **1/-** each; 900Ω-280Ω, 3in. long, at **1/-** each.

CERAMIC 100PF TRIMMERS (Postage Stamp Type), at 3/- doz.

MAINS TRANSFORMERS, 425-0-425 v. 200 mA., at **32/6**, plus 2/6 post. 320-0-320 v. 80 mA., 6.3 v. 3 a., 5 v. 2 a., at **13/6**, plus 1/6 post.

MAINS TRANSFORMER (Slightly Sub-standard) Input 200-250 v. Output 250-0-250 v. 60 mA., 6.3 v. 1.5 a., 6.3 v. 1.5 a., (tapped 5 v.). Price **7/6** each plus 1/6 post.

SMOOTHING CHOKES. 16 henries 60 mA., size 3in. x 2in. x 1¾in. Ideal for small receivers, power packs, etc., **4/6** each, plus **1/-** post. 6 henries 70 mA. (140Ω), at **6/6** each, plus 1/- post.

R.F. MONITOR TYPE 114, with 2 EF50 valves and EA50 Diode, mounted on neat chassis, 4in. x 4½in. Price **12/6**, plus 1/6 post.

PLEASE WRITE NAME AND ADDRESS IN BLOCK LETTERS

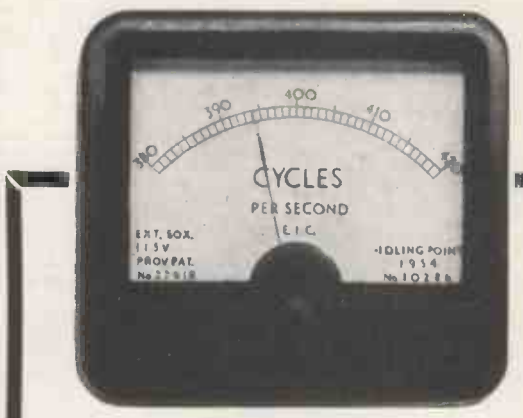
C. MARKS & CO.,

90 COMMERCIAL ST., NEWPORT, MON.

Telephone: Newport 4711

Also at 25 Wyndham Arcade, Cardiff

All mail orders and enquiries to Newport branch please.



FREQUENCY METERS

2½-8" up to 10,000 cycles

ACTIVE CURRENT METERS

(I × cos φ)

A full range of switchboard and portable instruments, including four types of Millirange Meters.

THE ELECTRICAL INSTRUMENT CO. (HILLINGTON), LTD.

Boswell Square Industrial Estate, Hillington, Glasgow, S.W.2. Halfway 1166 and 2194

HANNEY of BATH offers:—

OSRAM 612 Erie resistor-pot, kit with ceramic tube resistors, very highly recommended, **29/6**; Lab resistor kit, **32/4**; T.C.C. condensers, **55/-**. **PARTRIDGE** Components, with loose lead terminations, Mains trans., **44/-**; Smoothing Choke, **29/6**; Output trans., **76/9**. Price includes Partridge carriage/packing charge. Printed panel, **14/6**. W.B. chassis, **28/6**. DENCO 16 S.W.G. All-Chassis with beautiful Bronze Front Panel, **21/-**. (Printed.) S.A.E. List.

MULLARD 5 VALVE 10 WATT AMPLIFIER. T.C.C. Condensers, **45/-**; Erie resistor-pot kit, **37/6**; Elstone Mains trans., **36/-**; Elstone Output trans., **45/-** (both types); Denco chassis, **14/6**; Printed bronze panel 14in. x 5in., **6/6**. Small parts as per our list. Matched valves available for both the above designs.

WILLIAMSON AMPLIFIER. Woden potted components. Output trans. **WOT.25** (1.7Ω), **130/-**; PTM 14 a. mains trans., **87/6**; PCF.12 150 mA. choke, **44/-**; PCF.22 30 H. 20 mA. choke, **30/-**; PIM 23 (mains trans. for pre-amp.), **47/6**. Resistor (RK and Condenser kits (CK) available, RK, main amplifier, **29/6**; RK figs. 13 and 27, **12/6**; RK fig. 15, **28/9**; RK fig. 19, **36/-**; RK fig. 29, **29/3**; CK fig. 13, **15/-**; CK fig. 15, **47/-**; CK fig. 19, **54/6**; CK fig. 27, **19/-**; CK fig. 29, **54/6**. 12 1% silver micas (fig. 19), **15/-**; 7 5%, **7/-**. Elstone output trans., **90/-**; mains trans., **57/6**; 1 0H 150 mA. choke, **20/-**; 30 H. 20 mA. choke, **10/-**.

FREQUENCY MODULATION. For Wrotham high fidelity transmissions. **DENCO** technical bulletin giving circuit and point to point wiring diagram for building an F.M. Feeder unit, **1/9**, post free. We have all components available. Priced parts list on application.

COILPACKS. DENCO, CP 4/L and CP 4/M, **33/4**; CP 3/370 pf. and CP 3/500 pf., **42/8**. OSMOR "Q" HO. **48/-**; LM, **40/-**; Batt., **50/-**; TRF, **40/-**; HF stage for HO pack, **20/-**; ETA 4-station pack, **43/8**. We stock COILS by Weymouth, Osmor, Wearite, Denco, Teletron and R.E.P.

WIDE ANGLE COMPONENTS. ALLEN. Teleking Chassis, **50/-**; Coilsets (TK and Super-Visor), **44/6**; LO.308, **40/-**; FO.305, **21/-**; DC.300c., **39/6**; FC302, **31/-**; GL.16 and 18, **7/6** each; SC.312, **21/-**; AT.310, **30/-**; OP.117, **9/-**; BT.314, **15/-**; DENCO Chassis Magnaview, **37/6**; Chassis, Super-Visor, **51/6**; Coilsets Magnaview, **41/2**; WA/DCA1, **43/-**; WA/FCA1, **31/-**; WA/LCI and WCI, **7/6** each; WA/FMA1, **21/-**; WA/LOT1, **42/-**; WA/FBT1, **16/-**.

Send 6d. stamps for our General List of components for Viewmaster, Soundmaster, Williamson Amplifier, Teleking, Magnaview (Brimar and English Electric large screen TV), Super-Visor, Mullard Universal, Close tolerance Silver Micas, etc., etc. Please add 1/- postage to orders under £2.

L. F. HANNEY

77 LOWER BRISTOL ROAD, BATH

Tel.: 3811

Best Buy at Britain's

TEST SET TYPE 87. Ex-R.A.F. corresponds to TF796. Incorporates a signal generator covering 150 to 300 Mc/s. Also pulse generator. Operates from standard A.C. mains. Contained in handsome grey instrument case size 23in. × 10in. × 8½in. Basis of the audio signal generator described in "W.W." Aug./Sept. 1949. Complete with all valves and in brand new condition. Price £4/19/6.

U.H.F. SIGNAL GENERATORS by R.C.A. TYPE 710A. Covers 370 to 560 Mc/s. Large directly calibrated dial. Carrier level and 400 c/s. modulation monitored by large 200 micro-amp. meter. Precision piston attenuator. For A.C. mains operation 117 volts 50/60 c/s. Complete with instruction manual. BRAND NEW. £35.

3 CENTIMETRE TEST SET. Type 205A. In brand new condition. £17/10/-.

HOUR METERS. 200-250 volts 50 c/s. 4½in. diam. Direct reading 1/10 to 10,000 hours in five scales. Indicates the time any A.C. mains operated apparatus has been in use. Ideal for life testing, process timing, etc. BRAND NEW and BOXED, 39/6 each.

E.M.I. OUTPUT METER. Desk type incorporating a 2½in. 1 mA. meter together with instrument rectifier, etc. 2 ranges 0-500 milliwatts and 0-5 watts and decibel scale. Brand new in original manufacturers' boxes with instructions. Price 35/-, post 1/6.

METER BARGAINS, ALL BRAND NEW

15 v. (50~) mov. iron 2½in. pnl. mtg...	8/6
20 volt moving coil 2in. sq. pnl. mtg....	7/6
3,500 volts moving coil 3½in. projection	10/-
50 milli-amp. 2in. sq. pnl. mtg.....	7/6
20 amp. moving coil 2½in. dia.....	7/6
1 mA. 2½in. barrel flush pnl. mtg.	22/6
1 milli-amp. 2½in. barrel desk type.....	25/-
100 micro-amps. barrel pnl. mtg. scaled 0-1,500 in 15 clear divisions. Only.....	42/6
500 mA. Thermo Couple 2in. sq. pnl. mtg.	5/-

METER RECTIFIERS. 1 mA. Salford Instruments, 8/9. 5 mA. Salford Instruments, 6/9. 2 mA., S.T.C. as used in E.M.I. Output Meter, 5/6. All are full wave bridge and brand new.

METAL RECTIFIERS. RM4, 250 volts, 250 mA. Only 12/6. RM2, 4/3 each or 2 for 8/-. Selenium 300 volts, 100 mA. Brand new ex-W.D., 6/9 each.

X'TALS

465 kc/s S.T.C. ½in. pins suitable for crystal, gates, IF checking, etc. Brand new, boxed 10/- each.
200 kc/s American G.E.C. ½in. pins suitable for crystal calibrators, etc. Brand new, boxed, 10/- each.
100 kc/s ½in. pin spacing. British, ex new units, 15/- each.

ROTARY POWER UNIT TYPE 104. Input 12 v., Output 230 volt 60 mA. and 6.3 v. at 2.5 amp. Fully filtered and smoothed and noise suppressed. Ideal for car radio, etc. Only 15/- each. Rotary Generator only 5/- each, plus 2/6 postage.

POWER UNIT TYPE 285. A.C. mains input 230 v. 50 cps. Outputs E.H.T. 2 kV. @ 5 mA., H.T. 450 volts @ 200 mA., L.T. 6.3 v. @ 17 amps., fully smoothed. 2 chokes, paper condensers, etc., complete with valves 5U4G, VU 120 and EF 50. This was the ground power unit for the "Gee" equipment and should be very useful for T.V., etc. A REAL BARGAIN AT ONLY 69/6.

RACKS. 6ft. "U" channel P.O. type for 19in. panels, heavy angle base. Price 79/6, plus carriage at cost.

MODULATOR TYPE 67. This unit is a pulse modulator with pulse width of 1, 2 and 5 micro-seconds. The pulse amplitude is also variable. It is a particularly useful instrument as it contains a heavy duty power pack suitable for 230 volt 50 cps. mains supply. The mains transformer outputs are 6.3 volts twice, 5 volts for the rectifier and the H.T. winding is 345-0-345 volts. Also included are 5 SP61, one VR116, 2 EB34, and 3 EA50. Size of case 18 × 9 × 7 inches. These units are brand new in original packing cases. Price 47/6 plus 7/6 carriage.

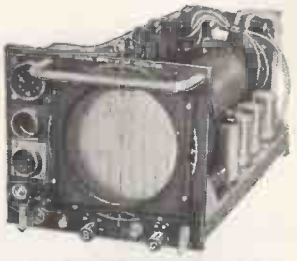
COMMUNICATIONS RECEIVER ADMIRALTY TYPE B.28 (MARCONI CR.100). Valve line up 2 RF, F.C. separate local Osc., 3 I.F.'s, 2nd Det., Output, B.F.O. and rectifier. Self contained power supply 200/250 volts A.C. 50 c/s. Variable selectivity (crystal filter). 6,000, 3,000, 1,200, 300 and 100 cycles. Frequency coverage 60 kc/s to 30 Mc/s in six ranges, continuous except for gap between 420 to 500 kc/s. Size 16in. × 13½in. × 12in. Weight 82lb. The set for the serious operator. Thoroughly overhauled and in good condition, complete with new valves and air tested prior to despatch. A real bargain at only £27/10/- plus £1 carriage.

VALVE VOLTMETERS. Ex-R.A.F. Operates from standard A.C. mains, stabilised H.T. supply. Three ranges:—50/200/500 volts D.C. Meter employed 2½in. 1 mA. F.S.D. Contained in handsome wooden instrument case size 14in. × 8½in. × 9in. Complete with all valves and tested prior to despatch. In brand new condition and a real bargain at only 79/6 plus 5/6 carriage.

COMMUNICATIONS RECEIVER R.1155
World-wide reception is ensured by the R.F. and 2 I.F. stages. Five wavebands, 2 L.W. M.W. and 2 S.W. Magic-eye, large dial and vernier make tuning simple. Contained in attractive black crackled cabinet, its handsome appearance does justice to its superb performance. Supplied with FREE BOOKLET giving circuit data and details of the power pack required for A.C. mains operation. Fully aerial-tested before despatch. Gladly demonstrated to callers.
BRAND NEW. "MINT" condition, in ORIGINAL MAKER'S TRANSIT CASES, £11/19/6. Shop soiled models, as new, £9/19/6. A few only used models, £7/19/6, 10/6 carriage on each. Send S.A.E. for full details of power packs and receivers, or 1/3 for booklet.
"N" MODELS. Cover Trawler and shipping bands. Excellent condition, £17/19/6, plus 10/6 carriage. D.F. Loops and Visual indicator Meters available.
A.C. MAINS POWER PACKS AND OUTPUT STAGE. Enable the R.1155 to be used to operate speaker from 200/250 volts A.C. without ANY MODIFICATION WHATEVER. All our power packs have heavy duty transformers, are complete with leads and Jones plugs and are guaranteed for 6 months
Type A. In smart black metal case, size 8½in. × 4½in. × 6½in., less speaker, price £4/10/- plus 3/6 carriage.
Type B. With built in 5in. speaker in black metal case size 13½in. × 5½in. × 7½in. Price £5/5/- plus 3/6 carriage.
Type C. With an 8in. speaker in specially designed beautiful black crackle cabinet speaker to match receiver, size 11½in. × 10½in. × 6in. A de Luxe job. Price £6/10/- plus 3/6 carriage.
NOTE: 10/- REDUCTION WHEN PURCHASING ANY OF THE ABOVE POWER PACKS WITH RECEIVER.

TRANSFORMER BARGAINS. Brand new ex-manufacturer's surplus drop through. Primary 200/250 volts 50 cps. Secondary 310-0-310 v. 70 mA., 6.3 v. @ 3 a., 4 v. @ 2 a. Can be used with either 4 v. or 6.3 v. rectifier. Only 9/6 plus 1/6 post. A similar type transformer, 325-0-325 100 mA., 6.3 v. 4 a., etc., can be supplied to callers only at 12/6.
Filament transformer, standard tapped primary, 12 v. 1½ a. and 6 v. 1½ a. secondary. Only 7/6.

HEAVY DUTY SLIDING RESISTORS. 250 watts rated to carry 25 amps., resistance 0.4 ohms, suitable for physics labs, charging board, etc. Laboratory type with worm drive, on metal stand, size 9in. × 4in. × 6in. high. Price 7/6 each. BRAND NEW.



INDICATOR TYPE 182A
Indicator contains 3 EF50, 1 5U4G, 4 SP61 and a 6½in. C.R.T. Type VCR 517, complete with Mu Metal-screen, 9 wire wound pots, with large assortment of resistors and condensers. Can be converted to Oscilloscope (as described in "Radio Constructor."). Circuit supplied. Tubes have no "Cut Off" and can be demonstrated to callers. BRAND NEW (less relays). In original transit case, 67/6 plus 7/6 carriage.,

INDICATOR UNIT TYPE 95. Exactly the same as the 62 indicator unit but is 50 cycle version. Double decker chassis, containing loads of components, 16 SP61, 2 EB34, 4 EA50, etc., etc. Brand new condition (less VCR97). Only 45/- plus 7/6 carriage.

45 Mc/s PYE STRIPS. Vision unit for London frequency. Complete with 6 EF50 and EA50. Circuit provided. Brand new. £3/10/- each.

E.H.T. TRANSFORMER. For VCR97, etc. Mains input, output 2,500 volts, 4 volts at 2 amps. and 2-0-2 volts at 2 amps. Fully guaranteed at 35/- plus 1/- post.

VALVE BARGAINS
New and in original boxes. 6AG5, VR53 (EF39), VR56 (EF36), 6K7G, 6C5Met, 6SH7-Met, VT510 (TT11), all at 6/6. 12SC7met, 5/6. RK34, E1148, 954, 2X2, VU120A, all at 2/6. Replacement bargain EL50, 5/-.
New, ex units, 6AK5, VR91 (EF50), Sylvania, VT52 (EL32), 807, 7/6. VR65 (SP61), 3/6. VT501 (TT11), 3/6. CV6, VR78. VR92 (EA50), 1/6 each, 15/- dozen.

U.S.A. BLOWER MOTOR for 105 volts A.C. operation. Outlet 2½in. diameter, extremely powerful. Snip for only 22/6 plus 2/- post.

R.F. UNITS. ALL BRAND NEW and BOXED. RF24, 20-30 Mc/s, 12/6. RF25, 40-50 Mc/s, 17/6. RF26, 50-65 Mc/s, 29/6 and RF27, 65-85 Mc/s, 32/6.

NITROGOL CONDENSERS. With ceramic insulating terminals. 8 mfd. 2 kV. wkg. size 5in. × 3¾in. × 4¼in., at 12/6 each. 4 mf. 2 kV. wkg. size 3¼in. × 2½in. × 4¼in. at 7/6 each. 4 mf. 1.25 kV. wkg. size 3¼in. × 2½in. × 4¼in. at 5/6 each.
BLOCK CONDENSERS. 40 mfd. 450 v. wkg. metal cased, paper insulation, size 4½ × 5½ × 4¼in. Weight 5½lb. For power factor correction, etc. Brand New Price 15/- plus 2/- post. 8 mfd. 600 v. D.C. wkg. at 71°C. size 4 × 2 × 4¼in. high. Very suitable for all good quality amplifiers, etc. Brand new. Price 5/- each.

COMMAND RECEIVERS. BC455. Covers 6-9 Mc/s (33-50 Metres), 12SK7, 12K8, 12SK7, 12SK7, 12SR7, 12A6. Brand new. Black crackled, 69/6 plus 2/6 post.

BARGAINS, BARGAINS, BARGAINS, HUGE STOCKS OF COMPONENTS, RECEIVERS, VALVES, AT SPECIAL REDUCED PRICES FOR CALLERS.

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 day Saturday*

Volume Controls

Midget type. Long spindles. Guaranteed 1 year. All values 10,000 ohms to 2 Meg-ohms.

No Sw.	S.P.Sw.	D.P.Sw.
3/-	4/-	4/9

COAXIAL PLUGS	1/2
SOCKETS	1/-
LINE CONNECTOR	1/2
OUTLET BOXES	4/6

80 ohm CABLE COAXIAL

STANDARD ¼in. diam. Polythene Insulated.
GRADE "A" ONLY

8d. yd.

SPECIAL—Semi-air spaced Polythene. 80 ohm Coaxial ¼in. diam. Stranded core. Losses cut 50% (Just released) **9d.** yd.

BALANCED TWIN FEEDER per yd. 6d.
TWIN SCREENED COAXIAL FEEDER 1/- yd. { 80 ohms

50 OHM COAXIAL CABLE, 8d. per yd. ¼in. dia.

TRIMMERS, Ceramic, 70 pf., 9d. 100 pf., 150 pf., 1/3; 250 pf., 1/6; 600 pf., 1/9.

RESISTORS.—All values: 10 ohms to 10 meg., ½ w., 4d.; ¼ w., 6d.; 1 w., 8d.; 2 w., 1/-.
High Stability, ½ w. 1% 2/-. Preferred values 100 ohms to 10 Meg.

WIRE-WOUND RESISTORS.—Best Makes Miniature Ceramic Type—5 w., 15 ohm to 4 K., 1/9; 10 w., 20 ohm to 6 K., 2/3; 15 w., 30 ohm to 10 K., 2/9; 5 w. Vitreous, 12 K. to 25 K., 3/-.

WIRE-WOUND POTS. 3 WATT FAMOUS MAKE.

Pre-Set Min. T.V. Type Knurled Slotted Knob. All values 25 ohms to 30 K., 3/- ea. 50 K., 4/- Ditto Carbon Track 50 K. to 2 meg., 3/-.

Standard Size Pots, 2½in. Spindle High Grade. All Values. 100 ohms to 50 K., 5/6; 100 K., 6/6.
W/W EXT. SPEAKER CONTROL 10Ω, 3/-.

O/P TRANSFORMERS.—Heavy Duty 70 mA., 4/6. Ditto tapped primary, 4/9. Tapped small pentode, 3/9.

L.F. CHOKES, 10 h. 65 mA., 5/-. 20/25 h. 100/150 mA., 12/6, 15 h., 100 mA., 10/6. SIMPLEX. 10 h. 150 mA., 10/6. MAINS TRANS. 350-0-350, 80 mA., 6.3 v., 4 a., 5 v., 2 a., ditto 300-0-300 ditto 250-0-250, 21/-. AMPLIFIER TRANS. 250-0-250v. 50 mA. 6.3 v. 2 a., 17/6. Simplex. 35/-.

ELECTRODYNAMIC MIKE INSERT.—U.S.A. make, precision engineered. Size only 1in., diam. by ¼in. Bargain Price 3/9. Matching Trans. 3/9.

SPEAKER FRET.—Expanded anodised metal, 14in. by 9in., 3/-. EXT. L.S.—Switched Socket, on-off and parallel switching, complete with plug, 2/-.

COPPER PLATED AERIAL RODS. ¼in. x 12in. push fitting, 2/6 doz., p. & p. 9d. MAINS LEAD—3 yds. Twin Twisted Maroon Flex. Top Quality 23-0076 Core, 1/-. 2 yd. Non-kink Appliance Leads. Suitable irons, etc., braided ends. Bargain 1/3.

TYANA.—Midget Soldering Iron, 200/250 v. or 230/250 v. 14/11. TYANA TRIPLE THREE.—Complete with detachable bench stand, 19/6.

NEW SOLON MIDGET IRON.—25 w., 19/6. IDEAL FOR RADIO CONSTRUCTORS.

C.R.T. HEATER ISOLATION TRANSFORMER.—Low leakage winding with 25% sec. boost. Ratio 1 : 1.25, 2 v., 10/6; 4 v., 10/6; 6.3 v., 10/6; 10.8 v., 10/6; 13.3 v. 10/6.

MIKE TRANSF.—Ratio 50 : 1, 3/9 ea., new and boxed.

V'HOLDERS.—Pax: Int. Oct., 4d.; EF50, EA50, 6d.; B12A CRT, 1/3. Moulded: Int. Oct. 6d.; B7G, 9d.; with screening can, 1/6; B8A, B8G, B9A, 1/-; VCR97, 2/6. Ceramic: EF50, B7G, 1/-. Paxolin ENG. and AMER. 5-, 7- and 9-pin, etc., 1/-.

Nuts, Bolts and Washers, 12 of ea. 1/- packets, 2, 4 or 6 BA.

TAG STRIPS.—2- or 3-way, 2d.; 4- or 5-way, 3d.; 6-way, 4d.; 9- or 10-way, 6d. etc.

T/V PRE-AMP.—Channel 1. Easily modified for other Channels or Converter use. Midget Chassis, 4¾ × 2¾ × 1¾. Complete with EF42 valve, coaxial lead and plug. Ready for use. Brand New Mfrs. Surplus. Listed £3/15/-. Special Clearance Price, 21/-. Buy Yours Now.

TOGGLE SWITCHES EX-GOVT.—"On-Off," 9d. Ersin M'core solder 60/40, 16 g. or 18 g., 5/6; ½ lb., 4d. yd. T.C. wire, 18 to 22 s.w.g., 2/-; ½ lb. P.V.C. Connecting wire, 8 colours. Single or Stranded, 2d. yd. 2 K. 5 w. H.D. w/w Pots, 4/6. 10 K., 25 K., Colvern w/w Pot. 1in. spindle, 3/6.

SCREENED GRID CAPS 1. Oct. or Mazda, 6d. ea.

BULGIN HIGH VOLTAGE VALVE CAPS, 1. Oct., 1/-.

FUSES.—1¼in. all values 60 mA. to 10 a., 6d.

ALADDIN FORTMRS and cores, ¾in., 8d.; 1in. 10d.

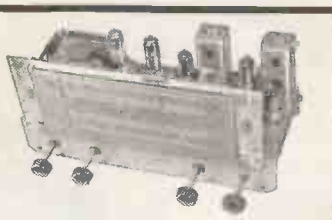
SLOW MOTION DRIVES.—Epicyclic ratio 4 : 1, 2/3.

INT. OCTAL CABLE PLUG (8-pin), with cover, 1/3.

200-250 Volt SELECTOR SOCKET (2in. × 1in.) with Plug 1/-. PILOT LAMPS.—6.3 v. .3 a., 8d.

MAINS DROPPERS. 3in. × 1½in. Adj. Sliders, .3 amp. 750 ohms. 4/3, .2 amp., 1,000 ohms, 4/3.

LINE CORD.—.3 amp., 60 ohms per foot, .2 amp., 100 ohms per foot, 2 way, 1/6 a yard; 3-way, 1/8 a yard.



ALL WAVE RADIOGRAM CHASSIS
THREE WAVEBANDS FIVE VALVES

S.W. 16 m.—50 m. LATEST MULLARD
M.W. 200 m.—550 m. ECH 42, EF41.
L.W. 800 m.—2,000 m. EBC 41, EL 41, EZ40

Brand New and Guaranteed, with 10in. P.M. Speaker. A.C. 200/250 v. Four position Wavechange Switch. Short-Medium-Long-Gram. Slow Motion Tuning. Speaker and Pick-up connections. High Q iron-dust cored coils, 465 kc/s I.F. Latest circuit technique delayed. A.V.C. and Negative feedback. Output 4.2 watts. 3 ohms output transformer on chassis. Chassis size 13½ × 5½ × 2¼in., Glass Dial—10in. × 4¼in., horizontal or vertical type available, lit by 2 Pilot Lamps. Colour Black Station names, L.W. Green, M.W. Red, S.W. White. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated. Chassis isolated from mains. PRICE £10/15/-. Carriage and Insurance, 4/6. (Without 10in. Speaker, £9/15/-. Carr. & Ins., 4/6.)

Plessey
Multi Speed
Changer

PRICE Carriage Paid **£9 . 19 . 6**

GREAT REDUCTION

Brand New Plessey 3-speed Autochanger Mixer Unit for 7, 10 and 12in. Records. Twin Hi-Fi Xtal Head with Duopoint sapphire stylus. Plays 4,000 records sprung mounting. Superb Quality. Bargain.

This Changer will play:—

8 mixed 78 r.p.m. 10" and 12" records
8 45 r.p.m. 7" records
10 33⅓ r.p.m. 7" records
10 33⅓ r.p.m. mixed 10" & 12" records

★ MIXER TYPE MECHANISM
★ DUAL POINT TURNOVER HEAD

WOODEN WALNUT CABINET.—12in. × 7in. × 5in. TRF or superhet, punched chassis, dial, back-plate, drive, pointer, etc., 28/6.

PYE Aerial Plug and Socket, 1/6 pr.
5in. RADIO SCREWDRIVERS.—Sheffield made blade 2¼in. × ¼in. Ins. handle 5,000 v. 4½d. each.
CONDENSERS.—New Stock .001 mfd. 6 kV. T.C.C., 5/6. Ditto, 12.5 kV., 9/6; 2 pf. to 500 pf. Mica, 6d.; .001. Mica or Tub. 500 v. .01 Sprague 500 v., .02 500 v., .1 mfd. 350 v. Micramould Tub., 9d.; Hunts Moldseal 500 v. .005, .01 mfd., 9d.; .05 mfd. and .1 mfd., 1/-. .25 mfd. 1/6; .1 mfd., 600 v., 1/3; Tubular .5 mfd. 350 v., 1/9.
SILVER MICA CONDENSERS.—10%.
5 pf. to 500 pf., 1/-. 600 pf. to 3,000 pf., 1/3.
DITTO 1% (ex stock).
1.5 pf. to 500 pf., 1/9. 515 pf. to 1,000 pf., 2/-.

ELECTROLYTICS ALL TYPES NEW STOCK.

Tubular Wire ends		50/25 v.	1/9
8+16/500 v.	5/6	50/50 v.	2/-
16+16/500 v.	6/-	Can Types, Clips, 3d. ea.	
1/275 v.	2/-	32+32/350 v.	4/6
2/450 v.	2/3	32+32/275 v.	4/6
4/350 v.	1/6	16/450 v.	3/6
4/500 v.	2/-	32/350 v.	4/-
8/450 v.	2/3	60/350 v.	6/6
8/500 v.	2/9	250/350 v.	9/6
10/500 v.	2/6	8+16/450 v.	5/-
16/500 v.	4/-	8+16/500 v.	5/6
8+8/500 v.	4/6	16+16/450 v.	5/6
32/350 v.	4/-	16+16/500 v.	6/-
32/500 v.	5/-	16+32/350 v.	4/6
32+32/350 v.	5/6	32+32/450 v.	6/6
32+32/500 v.	7/6	60+100/350 v.	11/6
25/25 v.	1/9	100+200/275 v.	12/6

SPECIALS. Can Types. 500 mfd. 12 v., 3/-; 1,000 mfd. + 1,000 mfd., 6 v., 6/6; 1,500 mfd. 6 v., 4/6; .1 mfd. 1.5 kV. T.C.C., 3/6.
SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK VOLTAGES. K3/25 2 kV., 4/3; K3/40 3.2 kV., 6/-; K3/45, 3.6 kV., 6/6; K3/50 4 kV., 7/3; K3/100 8 kV., 12/6; K3/160 14 kV., 18/-. MAINS TYPE.—RM1, 125 v., 60 mA 4/-; RM2, 100 mA., 4/9; RM3, 120 mA., 5/9; RM4 250 v. 275 mA., 16/-.
TV. AERIALS. Aerialite, etc., full range all channels in stock. Indoor loft type Inv. T., 13/6, etc., etc.

KNOBS, GOLD ENGRAVED.—Walnut or Ivory, 1¼in. diam., 1/6 each. "Focus," "Contrast," "Brilliant," "Brilliance—On-Off," "On-Off," "Volume," "Vol.-On-Off," "Tone," "Tuning," "Treble," "Bass," "Wavechange," "Radio-Gram," "S., M., L., Gram.," "Record-Play," "Brightness," Ditto not engraved, 1/- each.

POINTER KNOBS,—Brown with white marking line, small 9d., large 1/-.
COILS — "P" type, 2/6 each. Midget "Q" Type adj. dust core, 3/6 each. All ranges in stock.
REACTION COND.—.0001, .0003, .0005 mfd., 3/6 ea.

BANKRUPT STOCK

PEN TORCHES.—Drydex, chromium plated with vest pocket clip. Complete. Brand new with battery and bulb. Listed 3/4. Our Price 2/6.
HANDILITE.—Drydex, pocket or handbag flashlight. Complete. Battery and bulb. Listed 3/5. Our Price 2/6.

ALUMINIUM CHASSIS.—18 s.w.g. Plain, undrilled, folded 4 sides and riveted corners lattice fixing holes. Strong and soundly constructed with 2¼in. sides. 7in. × 4in., 4/6; 11in. × 7in., 6/9; 13in. × 9in., 8/6; 14in. × 11in., 10/6; and 18in. × 16in. × 3in., 16/6.

FULL WAVE BRIDGE SELENIUM RECTIFIERS,—6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6; 6 a., 23/6. Ditto F.W. only 6 v., 1 a. (9 v.-0-9 v. A.C.), 5/6.
ACID HYDROMETER.—New ex-Govt. Unbreakable. Packed in metal case, 7in. × 1¼in. dia., 4/6.
H.F. MIDGET CHOKES.—14 M.H., 2/6 each.
BRIMISTORS.—CZ1 for 3 a. heater chains, 3/6. CZ2 for .15 a., or .2 a., 2/6. CZ3, 1/6.
COPPER ENAMEL WIRE.—¼ lb. 16 to 20 s.w.g., 2/-; 22 to 28 s.w.g., 2/6; 30 to 40 s.w.g., 3/6.
SWITCH CLEANER Fluid, squirt spout, 3/9 tin.
TWIN GANG TUNING CONDENSERS.—.0005 mfd. midget with trimmers, 8/6; 375 pf. midget less trimmers, 6/6; .0005 Standard size with trimmers and feet, 9/-; less trimmers, 8/-; ditto, solied, 2/6.
SLEEVING.—Various colours, 1, 2 mm., 2d.; 3, 4 mm., 3d. yd.; 6 mm., 5d. yd.
LOUDSPEAKERS P.M. 3 OHM. 3in. Plessey, 12/6. Goodmans 4in. square, 15/6. 5in. 14/6, 6½in., 16/-, 7in. Elliptical 18/6. 8in. R. & A., 17/6. 10in. R. & A., 25/-. 6½in. Goodmans with trans., 19/6.
CRYSTAL DIODE. — Very Sensitive. G.E.C., 3/6.
H. R. PHONES. —(Hi-grade Amer.), 15/6 pr.
S. G. BROWN'S, 4,000 ohms, 15/6 pr.

VCR97 £2
TESTED FULL PICTURE
P. & P. 2/-.

I. F. TRANSFORMERS
465 Kc/s Slug tuning Miniature Circular Can, 2½in. by 1½in. diam. Fits octal V-holder cut out. High Q and good bandwidth. By Pye Radio. Two mounting feet.
BRAND NEW, 6/9 PAIR

CHANGE OF NAME SAME ADDRESS We have no connection with any other firm. Please address all correspondence correctly as below.

RADIO COMPONENT SPECIALISTS

307 WHITEHORSE RD., WEST CROYDON
OPEN ALL DAY SATURDAY.

Phone THO 1665, after 6 p.m. 4198. Buses 133 or 68 pass door. 48-hour postal service. P. & P., 6d. £1 orders post free. Lists free.

Wireless World Classified Advertisements

Rate 7/- for 2 lines or less and 3/6 for every additional One or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day: April 1955 issue, Thursday, February 24th. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components and valves which may be offered for sale through our 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.

NEW RECEIVERS AND AMPLIFIERS

R1132 V.H.F. receiver, modified for Wrotham, £3.—Tel. Speedwell 4696, after 6 p.m. [4177

C.J.R. ELECTRICAL & ELECTRONIC DEVELOPMENT, Ltd., Bickford Rd., Witton, Birmingham, 6, Tel. East 0822, SPECIALIZE in the manufacture of High Fidelity Sound Reproducing equipment, including:—
WILLIAMSON Amplifiers, Tone Control Stages with variable Steep Cut Filters, Crossover Units, High Fidelity Portable Tape Recording equipments. Ideally suitable for replaying the new EMI pre-recorded tapes, Professional Recording Amplifiers, Microphone Mixing Units, etc. Send for details and leaflets. [0105

LANCASTER Hi-Fidelity for all audio requirements; full range of equipment stocked and demonstrated.—The North's Reproduction Specialists, 29, Lancaster Ave., Manchester, 4. Deansgate 2503. [0066

UNUSED Hallicrafters S38A communication receiver, black, complete with 60-watt mains auto transformer; first sensible offer secures.—Taffler, 529d, Finchley Rd., N.W.3. Hampstead 2467. [4175

SHIRLEY LABORATORIES, Ltd., 125, Tarring Rd., Worthing, Sussex, announce the superb "Jupiter" amplifier, type SB/1-15E. with pre-amplifier incorporated on same chassis; 15 watts output, response 15 c/s to 60,000 c/s extending to 130,000 c/s; bass lift 18 db, cut 18 db, treble lift 14 db, cut 20 db. hum and distortion almost immeasurable; 230v @ 20 ma, 6.3v @ 2 amps at octal socket; beautifully constructed to instrument standards, B.V.A. valves; price complete with engraved panel, £18/18. Also the "Mullard" 10-watt amplifier with tone-control system, £18/5; and the E.S.2 square-wave generating unit for converting your sine-waves to square-waves, £9.—Write for full details. Tels. 513, 3571. [3579

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

SALE! Sale! Sale!
OUR annual clear-our of surplus and excess stock is now in progress. Our window display will amaze you, never have prices been so low. Send a s.a.e. to-day for our special sale list, there is bound to be something for you. but don't delay, our stocks cannot last long at these prices.
HERE are just a few example of the value we offer:—
R.1155 receivers. all brand new and air-tested, usual price for these sets £11/19/6. our special price £7/10 plus 10/- carriage.
R.1426 receivers (R.1355 less power pack), this well-known unit is in new condition with nine valves, only 15/-, plus 5/- carriage.
INDICATOR unit type 233 complete with brand new VCR97, 3 EF50, 3 SP61, 2 EA50, 3 VR54: ideal for TV or scope; our special price 59/6, plus 7/6 carriage.
SPECIAL offer in high-quality components, ex units: valve holders, Amphenol, all types. 3d each; B7A with skirt and brass screening can, 1/-; 20 different pots, our selection. 15/- post free.
WAVECHANGE switches, our selection, 20 different for 15/-. post free.
SUPER potted mains transformers.
A: 365-0-365, 120 m/a, 6-volt .42 amp. 4-volt 2.5 amp, 5/-. plus 2/- carriage.
B: E.H.T. 1.540v 1.75 m/a for VCR 97, etc., 2.05v 2 amp, 4.1v 0.8 amp, 7/6 plus 2/- carriage.
RESISTORS, etc., on tag panels, 100 items for 10/6, panels free. post free.
WALTON'S WIRELESS STORES, 48, Stafford St., Wolverhampton. [0147

ULTRA T24 12in console TV, for 45/41mc/s. 220/250v a.c.; £19, carr. paid.—Box 1093. [4095

R1155N plus p/pack and o/p stage, £15; Magnegraph tape recorder, £25; 5CP1, VCR97, 139A, 517C, 15/- ea.—Box 1584. [4214

HRO Rx's and coils in stock. also AR88. BC348R, CR100, etc.—Requirements please to R. T. & I Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0053

RECEIVERS, AMPLIFIERS—SURPLUS AND SECONDHAND

TV including 1355, two RF25s, VCR97, working; £7/10.—12, Fairfield Ave., Whitton, Middlesex. [4073

R.F. units types 26 at 27/6, 25 at 15/-, 24 at 11/-, brand new in original cartons, with valves; postage 2/6.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [3393

EDDYSTONE 750 receiver, anti-interference aerial, 8in speaker, first-class condition; £39; owner going abroad.—Flat E, 27, Longridge Rd., S.W.5. [4139

WIRELESS WORLD 2 R.F. 3-valve quality tuner, M.W. and L.W., unused, ideal for use with all high fidelity amplifiers; £6/10, including valves, limited number; bargain.—Box 0892. [4035

NEW LOUDSPEAKERS

GOODMANS loudspeakers. also supplied in polished cabinets, write for list. easy payments.—Stamford (Dept. D.21). 20, College Parade, Salusbury Rd., London, N.W.6. [3997

LOUDSPEAKERS—SURPLUS AND SECONDHAND

SENSATIONAL offer.
15IN P.M. loudspeaker units, by leading Hi-fi manufacturers, 30 watt handling capacity, high flux, rugged construction, reconditioned as new; £5 each or offers for quantities.
FRAMES and magnets for above, 2in voice coil; £3 each or offers for quantities.
MAGNAPHONE, 356, Norwood Rd., S.E.27. Tel. Gipsy Hill 5394. [4099

SPEAKERS: 8in 12/9; P.M. standard 3-5 ohms or with O.P. transformer, 15/9; used but guaranteed tested perfect most makes; post 1/9. baffle board 9d extra.
EXTENSION speaker cabinets, 9/9, to fit 8in speaker, repolished. baffle board fitted; post 1/9.
DUKE & Co., 621, Romford Rd., London, E.12. Gra. 6677. [4089

GOODMAN'S 12in twin cone Axiom 22 Mark II high fidelity, high power reproducer. 30 to 15,000 cps, as new, still unmounted; cost 14gns; take 8gns; (Farnborough area).—Box 1488. [4171

LOUDSPEAKERS WANTED

INDUCTOR Dynamic speaker wanted.—Stourmead, Chartham, nr. Canterbury. [4066

TRANSMITTING EQUIPMENT

AMATEUR transmitter giving up, disposing equipment; s.a.e. lists.—Box 1585. [4215

NEW TEST EQUIPMENT

TV signal intensity meter (S.I.M.) for aerial checks and installation, etc.: send for full details.—Radio-Aids. Ltd., 29, Market St., Watford. Tel. Watford 5988. [4195

TEST EQUIPMENT—SURPLUS AND SECONDHAND

COMPLETE 9-valve Bradley oscilloscope, £6/10.—Tel. Speedwell 4606, after 6 p.m. [4178

MARCONI B.F.O. 195A and Q. meter 329F; also range of other test equipment.—Box 1583. [4211

ELLIOTT sub-standard DC/VM 0/1.5/15/50 6in mirror scale, £10; Cossor 3339 CRO, £27; both perfect; Marconi TF.144G attenuator, coil turret, variable capacitor, as new.—Box 1586. [4216

MURPHY T/V pattern generator type TPG11, perfect condition, Cossor type 339 CRO, Marconi signal generator type TF144G, both excellent order.—Reasonable offers to Gerry, Bank St., Newquay. [4204

SIGNAL generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters in stock; your enquiries are invited.—Requirements to R.T & I. Service, 254, Grove Green Rd., London. E.11. Ley 4986. [0056

NEW DYNAMOS, MOTORS, ETC.

WARD rotary converters for radio, television amplifiers, etc.
ALSO, rotary transformers, alternators, DC generators etc.
SPECIAL offer.—Revolving armature alternators, 2 pole, ball bearing, 3,000 r.p.m., with direct coupled 24-30v exciter, and voltage control components; output 230v, 50 cycles, 3.25 k.v.a., 8 power factor; price with Vee rope pulley, £42 each, nett, ex-works.
WARD, 75, South St., Bishops Stortford, Herts. Tel. 1694. [0039

FOR SALE AND WANTED ADVERTISEMENT FORM

TURN TO PAGE NO. 173

NEW DYNAMOS, MOTORS, ETC.

SPECIAL television rotary converters, guaranteed interference free, fitted radio and television filters, wt. 60lb, d.c. input 12v 200va, out. 24v. 32v, 50v, 110v, 230v d.o., to 230v out. 250va, £28/10 del., also converters for radiogram and general use, inputs, outputs and prices as above; the above also supplied without smoothing, £25 del. immediate despatch; trade supplied.
AT a purchaser's home 60 mls. S.W. of Sutton Coldfield a 24v
TELEVISION converter was tested on Ekco television, 12in tube, stated consumption 135 watts d.c. current from battery only 9½ amps, picture and sound were perfect and completely free of interference or flutter.
THE above is the latest product of British manufacture and is guaranteed for one year J.A.P. No. 2A 1.2hp petrol engine, air-cooled 4-stroke, starting rope, tools; £17/10 delivered. T. W. PEARCE, 66, Great Percy St., W.C.1 (near Angel). [0013

DYNAMOS, MOTORS, ETC.—SURPLUS AND SECONDHAND

ROTARY converter for TV, by Electro Dynamic Construction, d.c. volts 100/110, a.c. 220/240, a.c. amps 1.08, condition as new; £15.—Weston Estate Office, Shipston-on-Stour. [4168

NEW GRAMOPHONE AND SOUND EQUIPMENT

T./R. amplifiers for Truvox, Lane Decks, etc.: 5 watt £14, 10 watt 19gns.
F.M. tuners, Denco £8, ready built.
U./L. 14 watt amps, with pre-amp, £24.
HARDING ELECTRONICS, 120a, Mora Rd., London, N.W.2. [0032

FERROGRAPH tape recorders for high-grade sound; Emidiscs, Emitape 88, Microphones, Stentorian 1012 speakers (3 impedances), handy tape splicer 8/6 post free.
"EROICA" RECORDING SERVICES (see "Miscellaneous"). [0122

TAPE recorders and record players, several hundred models at reduced prices in warehouse clearance sale; write for details stating model required.—Arcade Recording Circuit, 23, Arcadian Gdns., Wood Green, London, N.22. [4142

TAPE recorders for sale, exchange, or hire in Greater London, good quality tape recorders wanted for cash, all types of repairs, mechanical and electronic, carried out by specialists, all accessories available, we deal exclusively in magnetic recording equipment.
THE MAGNEGRAPH RECORDING Co., Ltd., 1, Hanway Place, London, W.1. Tel. Langham 2156. [3396

CLEARANCE sale, all items new, unused, and in makers' packing; 1 tapedeck, £30; 2 tapedecks, 19gns each; 2 Lane Mk III tapedecks, 11gns each; 1 Elpico AC/54 tape R/P amplifier, £13; all plus 15/- each carriage, etc.—Anglin, 160, Cleethorpe Rd., Grimsby. [4096

CINE-VOX disc recording equipments, type C7J for high-quality recordings from existing microphone equipment; price from 28gns; also available as a complete channel inclusive of mic., amplifier and playback equipment, at 70gns; type C7, for highest quality professional requirements—recorder mechanism at 48gns, or complete channel at 110gns; demonstrations arranged in London.
PLEASE write for details to K.T.S., Ltd., "Coplow," Park Rd., Braunton, N. Devon. Tel. Braunton 224. Callers by appointment only. [0209

GRAMOPHONE AND SOUND EQUIPMENT —SURPLUS AND SECONDHAND

SIMON 2B recorder, single track, with microphone, 1,200 feet tape; £35.—Box 1512. [4180

SOUNDMASTER tape recorder, as new, with many high quality extras; £40.—Box 1513. [4183

L.H.F. Exchange Mart for used quality equipment; send s.a.e. for lists.—31, Lancaster Ave., Manchester, 4. [0067

TWIN disc recorder complete with amplifier; £25.—J. Miles, 25, Alloway Rd., Bow, London, E.3. Advance 1923, evenings. [4130

£75.—Superb H.M.V. 8-valve auto-radiogram, 8 wave bands, cost £140 new, excellent condition.—Tel. Park 7988. [4221

CANCELLED Ferrograph No. 2A model in unopened original packing, £74; tapes, Resto microphones for emergency sale.—Box 1608. [4220

PUBLIC address system, control panel, 21 speakers, auto starter, 5 microphones, record player and spares, etc., offers invited; ex-"Queen Mary," large electric fans; 15/-.—Lewis, 44, High St., Whitechapel, E.1. [4145

M.S.S. professional recording unit, comprising two disc cutters 78-33, tape recorder, etc., etc.; immaculate appearance and condition, will separate if required; £250, real bargain.—ALB. 4016 after 7 p.m. [4181

QUALITY record reproducer with local station tuner comprising Decca 2-speed turntable XMS/H heads, Rogers minor amplifier, crystal tuner, Wharfedale W10/CS Weyroc bass reflex cabinet, £20; Rogers baby-de-luxe amplifier with junior preamplifier, £14; Decca 2-speed turntable, £2/10; W.B. H.F.812 in Weyroc B/R cabinet, unused, £6/10.—Tel. Speedwell 4696, after 6 p.m. [4179

NEW COMPONENTS

TRANSISTORS and associated parts, types up to 50 M/cs, outputs of avg. speech power.—Bel, Marlborough Yard, N.19. Arc. 5078. [0185

COMPONENTS—SURPLUS AND SECONDHAND

AMATEURS; 2,000 components; s.a.e. for list to: Turner, Poult House, Tonbridge. [4138

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport Street, London, W.C.2. See our displayed advertisement, page 165. [0016

A QUANTITY of new ex-W.D. and surplus EF50s resistors, condensers, battery amplifiers, rectifiers, air conditioners, etc., to clear. —Inglis, 185, Westgate Rd., Bury St. Edmunds. Tel. 817. [4167

WANTED, EXCHANGE, ETC.

WANTED, receivers A.P.R.4, also T.N.16, 17, 18, 19, etc., and any radio test gear. LESLIE DIXON & Co., 214, Queenstown Rd., Battersea, S.W.8. Macaulay 2159. [0176

WANTED, tuning units, TN17, TN18, TN19, for R54/APR4; £50 each offered.—Box 4963. [0261

GOOD quality 2-speed disc cutter, preferable connoisseur or M.S.S., condition and reliability essential.—Box 1514. [4182

BAXENDALL Partridge output trans., 40db feedback.—Write Taylor, 3, Oast Cottages, Davington, Faversham. [4114

WANTED, Aerial tuning units B.C. 939a,—P.C.A. Radio, Beavor Lane, Hammersmith, W.6. [0080

WANTED, HRO coils, Rxs, etc., A.R.88s, BS348s, S27s, etc.—Details to R.T. & I. Service, 254, Grove Green Rd., London, E.11. Ley. 4986. [0163

WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components.
LOWE BROS., 9a, Diana Place, Euston Rd., N.W.1. Eus. 1636/7. [2703

WANTED, BC 610 hallcrafters, ET 4336 transmitters, AR 88 Ds and LFs receivers and spare parts for above, also BC 221 frequency meters; best prices.—P.C.A. Radio, Beavor Lane, Hammersmith, W.6. [0079

WANTED, signal generators types TF146, TF390G, TF762A, frequency meters BC221, TS174, TS175; also receivers types AR88, etc., APR4 or similar.—Send price and details to Hatfield Instruments, Ltd., 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779/9857. [0037

ALL U.S.A. V.H.F. test and communication equipment; TS174, TS175, TS47, B.C.221 freq. meters; receivers 1294, 1359, Hallicrafters S.27, S 27CA, U.S.A.; APR4 and tuning units TN16, 17, 18 and 19, RCA AR88D-LF, Hallicrafters SX28; valves 707A-707B, 2K28, 2K39, 2K33, 2K41; highest offers given by return.—Ger. 8410 and 4447. Universal Electronics, 22, Lisle St., Leicester Sq., London, W.C.2. [0229

VALVES

RADIO valves, most types available; immediate delivery, postage free.—R. W. Camp, 71, Sudbourne Rd., Brixton Hill, London, S.W.2. [4079

VALVES WANTED

MAZDA V503, PA40, Osram PX25, VR40, DA30, or similar.—Box 1175. [4122

ALL types of valves required for cash; state quantity and condition.—Radio Facilities, Ltd., 38, Chalcot Rd., N.W.1. Primrose 9090. [4074

CABINETS

LEWIS RADIO have the best selection and finest finish.—See page 167. [0224

CABINETS made to order.—Bass Reflex Speaker Cabinets, all types and finishes.—See display advertisement on page 171.
A. DAVIES & Co. (Cabinet Makers), 3, Parkhill Place, off Parkhill Rd., Hampstead, N.W.3. Gulliver 5775. [4127

WALNUT radiogram and television cabinets, soundly constructed; stamp for details.—R. Shaw, 69, Fairlop Rd., Leytonstone, E.11. [3193

TWO matching cabinets, solid oak, for 15in speaker and audio equipment respectively.—Partics. R. E. Hale, 23, Peel Close, Hampton-in-Arden, Warwicks. [4184

METERS WANTED

WE urgently require meters of all types, meter components test equipment, etc.; any quantity, large or small; prompt cash.
ANDERS ELECTRONICS, Ltd., 91, Hampstead Rd., London, N.W.1. Euston 1639. [3738

REPAIRS AND SERVICE

MAINS transformers rewound, new transformers to any specifications.
MOTOR rewinds and complete overhauls; first-class workmanship; fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 47898. [0113

LOUDSPEAKERS repaired promptly.—Model Loudspeaker Service, Bullingdon Rd., Oxford. [4141

MAINS transformers, E.H.T.s. chokes, field coils, etc., promptly and efficiently rewound or manufactured to any specification.
LADBROKE REWIND SERVICE, LTD., 820a, Harrow Rd., London, N.W.10. [0222

TRANSFORMER rewind service, mains, E.H.T. transformers and chokes, prompt delivery, range of replacement types ex-stock or manufactured to your specification
METROPOLITAN RADIO SERVICE Co., 75, Kilburn Lane, London, W.10. Ladbroke 2296. [0200

SERVICE sheets for hire or sale over 2,000 models, radio and television; list 1/-; s.a.e. enquiries.—W. Gilbert, 24, Frithville Gardens, London, W.12. Tel. She. 3052. [3515

REPAIRS AND SERVICE

REWINDS and conversions to mains and output trans, pick-ups, fields, clock coils, etc., from 4/6; PP equipment a speciality; all work guaranteed.—N.L. Rewinds, 173, High Rd., Willesden Green, N.W.10. Tel. Wordsworth 7791. [4170

24-HOUR service, 6 months' guarantee, any transformer; rewind, mains outputs and i.f.s., etc.; all types of new trans., etc., supplied to specification; business heading or service card for trade prices.—Majestic Winding Co., 180, Windham Rd., Bournemouth. [2526

ELECTRICAL test instruments repaired and recalibrated, all makes, ammeters, voltmeters, multi-range test meters; meters supplied or converted to any range.—Electrical Instrument Repair Service, 329, Kilburn Lane, W.9. Ladbroke 4168. [4016

D.C. BOULTON for repairs to any loudspeaker; specialists on heavy and P.A. types; cone assemblies, field coils, repair accessories, pressure units, microphones; transformers rewound and to specification; motor rewinds.—Lumby St., Manchester Rd., Bradford. Tel. 22838. [0171

REWINDS, mains transformers, chokes, E.H.T.s, outputs frame and line opt's fields solenoids, R.F., E.H.T. coils, etc.; new types including "C" cores, designed or to specification; your enquiries will receive prompt attention.—Melton Metallurgical Laboratories, Ltd., Transformer Section, 387-9, Ashley Rd., Parkstone, Poole, Dorset. [3998

ARMATURE rewinding service to the trade, vacuums, drills, grinders, hood dryers, dental motors, vacuum cleaner armatures replaced from stock; 24 hours' service; every job guaranteed; we also specialize in complete overhauls and rebuilds of vacuum cleaners; all vacuum cleaner parts, hoses, bearings, fans, brushes for any make in stock.—Regam Electric, 95, Park Lane, Leeds, 1. [0028

PAINTS, CELLULOSE, ETC.

PAINT spraying handbook, 3/6 post free, cellulose and synthetic paints and all spraying requisites supplied; catalogues free.—Leonard Brooks, 53, Harold Wood, Romford. [0207

BUSINESS AND PROPERTY

CAMBRIDGE, main Newmarket Rd.—Valuable freehold industrial premises for sale, suitable for light engineering works, etc., comprising factory accommodation of about 3,700 square feet and adjoining site of over half an acre, with wide road frontage, railway facilities nearby.—Agents: Gray, Son & Cook, 29, St Andrew's Street, Cambridge. [4157

WORK WANTED

A.I.D.-APPROVED contractors seek model-room or short run work; comprehensive test gear and machine capacity.
BEL SOUND PRODUCTS Co., Marlborough Yard, London Archway, N.19. Arc. 5078. [0183

CAN we help? Your development or production; assembly and wiring service at your disposal.—R.A.E. Mfg. Co., 135a, Kentish Town Rd., N.W.1. Gul. 7011. [0219

CAPACITY AVAILABLE

VACUUM impregnation capacity available. Hadfields Solventless to RCS214 Specification.—Enquiries to. Avis & Baggs, Ltd., Gosbrook Rd., Caversham, Reading. Tel. 71763. [0094

MISCELLANEOUS

DISKS, 78 and L.P., and tape from your tapes.
FULL professional standards; handy tape splicer, 8/6, post free.
"EROICA" RECORDING SERVICES (Regd. 1949),
31, Peel St., Eccles, Manchester.
ECCLES 1624. Director: Thurlow Smith, A.R.M.C.M. [0121

40lb enam. copper wire, 16 to 48 swg; details on request; offers.—Box 1565. [4202

PROFESSIONAL tape-to-disc transfer service for trade and the public; 10in disc 15/6, 12in 18/6 inc. needles; also L.P.s.
SOUND NEWS PRODUCTIONS, 3, Clover Mews, London, S.W.3. Flaxman 3706. [4191

METALWORK, all types cabinets, chassis, racks, etc., to your own specification; capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd. (G4BI), Chapman St., Loughborough. [0208

COPPER winding wires, most gauges, leading manufacturers, enamelled, synthetic and textile covered; keen prices; immediate delivery.—Box 1490. [4173

YOUR own tape recording transferred to disc.—Write, call or 'phone Queensway Private Recording Studios, 123, Queensway, W.2. Tel. Bay. 4992. Studio recordings, tape recording service. [4008

BUILD your own TV and learn about its operation, maintenance and servicing; qualified engineer-tutor available whilst you are learning and building.—Free brochure from E.M.I. Institutes, Dept. WW.58, London, W.4. (Associated with H.M.V.) [0180

COPPER wires enamelled, tinned, Litz, cotton, silk covered, all gauges; B.A. screws, nuts, washers, soldering tags, eyelets, ebonite and laminated bakelite panels, tubes, coil formers; Tufnol rod, headphones, flexes, etc.; latest radio publications, full range available; list, s.a.e.; trade supplied.—Post Radio Supplies, 33, Bourne Gardens, London, E.4. [0138

NOTICES

THE UNIVERSITY OF SOUTHAMPTON.

DEPARTMENT of Electronics.
THE department of electronics gives an advanced course at honours degree standard in electronics; the course is full-time for one academic year and the university grants a diploma by examination to students who successfully complete the course; entry qualification is a university degree in physics or electrical engineering, or its equivalent; the next course will commence in October, 1955, and application for admission should be made now to the Academic Registrar, from whom further details may be obtained. [4133

BRITISH SOUND RECORDING ASSOCIATION. Details of membership, open to the professional sound recording engineer and all others interested in recording high quality reproduction and other branches of audio engineering, together with details of the London lecture programme and the Manchester, Portsmouth and Cardiff Centres, may be obtained from the Hon. Membership Secretary, H. J. Houlgate, A.M.I.E.E., 12, Strongbow Rd., Eltham, S.E.9. [0031

SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order, 1952.

DRAUGHTSMEN.

SENIOR and Junior Draughtsmen required for mechanical design and detailing of radio, electronic and telecommunication equipment; varied and interesting work in a rapidly expanding industry, and whilst vacancies are mainly for men with electro/mechanical experience, applications from Draughtsmen wishing to transfer to this type of work will be considered.
PERMANENT and progressive positions, with pension scheme, sports and canteen facilities, and housing accommodation if required.—Apply, giving full details of training and experience, and salary required, to Chief Draughtsman, A.T. & E. (Bridgnorth), Ltd., Bridgnorth, Shropshire. [4197

SALES liaison engineer

A vacancy exists for a keen engineer (aged 20 to 30) to join expanding division dealing with commercial electronic instrument and equipment sales; duties include technical liaison with design team, production unit and customers, also preparation of technical literature; salary commensurate with ability, experience and qualifications.
APPLY to the Personnel Dept., E.M.I. Factories, Ltd., Blyth Rd., Hayes, Middlesex. [4156

RADAR and electronic

ENGINEERS are invited to apply for a number of posts as area maintenance engineer with a leading company in the radar field; the positions are of senior status, and call for men of considerable experience in micro-wave equipment to work without supervision; successful candidates will be given specialized training in the company's works, and then based in various parts of the country; a salary and allowances commensurate with qualifications and responsibility will be paid, and a car will be provided; a pension scheme is in operation.—Applicants should write, giving full details, to Box 3S N2098, A.K. ADVG., 212a, Shaftesbury Ave., London, W.C.2. [4069

INDUSTRIAL electronics.

DUE to the continued expansion of the Industrial Electronics Division of The English Electric Company, Limited, the chief engineer of that division now wishes to make several further appointments in connection with the development of motor control systems; it is desirable that applicants have a knowledge of magnetic amplifiers, electronics and servo-calculations; whilst a degree or corporate membership of the I.E.E. is preferred, this should not deter applicants who have good sound practical experience in these fields; these positions are of a responsible nature, and successful candidates will be expected to work with the minimum of supervision; houses will be available to successful applicants.—Please reply giving full details to Dept. C.P.S., 336-7, Strand, W.C.2, marking envelopes "Attention Chief Engineer, I.E.D." and quoting Ref. 1329A. [4160

INDUSTRIAL electronics.

A technical writer is required by the chief engineer of the Industrial electronics Division of The English Electric Company, Limited, this vacancy has come into being because of the programme of expansion now being pursued by the company in this field of engineering; it is desirable that the successful candidate has experience of writing with particular reference to the electronics industry; this is a position of no mean responsibility and he will be expected to produce results with the minimum of supervision, this is an excellent opportunity for an ambitious man in an expanding field of engineering.—Please reply giving full details to Dept. C.P.S., 336-7, Strand, W.C.2, marking envelopes "Attention Chief Engineer, I.E.D." and quoting Ref. 1377. [4161

RADIO and television engineer (improver) wanted.—Write W. L. & F. M. Jones, Ltd., High St., Cobham, Surrey. [4155

SITUATIONS VACANT

ULTRA ELECTRIC, Ltd.,

WESTERN Ave., Acton, London, W.3.
RADIO & television development engineers.
(a) APPLICATIONS are invited from senior development engineers with experience and academic qualifications for important work on new development projects.
THE posts are permanent and pensionable and offer scope for the right men to work in ideal conditions in modern, well-equipped laboratories.
PLEASE write in strict confidence to the Personnel Manager for an interview appointment.
(b) JUNIOR engineers (aged 21/29) are also required, and applicants for these posts should have some technical training and preferably previous experience. Please write as above. [3572

ULTRA ELECTRIC, Ltd.,

WESTERN Ave., Acton, London, W.3.
ELECTRONIC development engineers are required in all grades for work on: (a) subminiaturisation of VHF, radio and audio circuitry; (b) transistor applications; (c) VHF communication; (d) pulse techniques; (e) radar and radio navigation.
APPLICATIONS are invited from:—
(a) SENIOR development engineers with degree or equivalent qualifications, and more than five years' experience in one or more of the above fields.
(b) JUNIOR engineers with degree or HNC with or without experience for work in the above fields.
(c) TEST equipment development engineers with experience of design of test equipment to meet production requirements.
THE posts are permanent and pensionable, and offer scope for the right men to work in ideal condition, in modern, well-equipped laboratories.
PLEASE write, in strict confidence, to the Personnel Manager for an interview appointment. [3573

ELECTRONICS Engineers.

VACANCIES exist in the expanding electronics division of Saunders-Roe, Ltd. The range of work is unusually wide and interesting, covering design and development of analogue and digital computers, electro-mechanisms, measuring apparatus, strain gauging equipment and techniques, etc. Salaries offered are commensurate with qualifications and experience. Assistance will be given with accommodation.
WRITE stating age, experience, etc., or send P.C. for application form to the PERSONNEL Department (Ref. WW/17), Saunders-Roe, Ltd., East Cowes, I.o.W. [3929

MURPHY RADIO require:—

(1) SENIOR radio designer with wide experience to be responsible for the development of V.H.F., short wave and more conventional radio receivers for the home and export market.
(2) SENIOR television engineer with sound theoretical knowledge and previous experience of time base design.
(3) VERSATILE components designer with thorough knowledge and experience of radio component development, application and test, knowledge of quality control and life test methods an advantage.
APPLICATIONS stating which vacancy referred to and giving details of age, experience, qualifications and salary should be addressed to Personnel Department (A.L.), Murphy Radio Limited Welwyn Garden City. [4207

UGANDA ELECTRICITY BOARD.

APPLICATIONS are invited for an overseas appointment as Communications Technician.
CANDIDATES should have sound technical training and experience in the installation and maintenance of private automatic systems and shortwave radio equipment; experience with power line carrier equipment installations would be an advantage.
COMMENCING salary according to age and experience in scale £990×£30 to £1,260.
FREE partly-furnished accommodation, medical and dental treatment according to regulations.
THREE-YEAR contract in the first instance with free passages. Leave on full pay.
APPLICATIONS must be made on forms obtainable from the Board's London Representative, 27, Regent Street, London, S.W.1. Forms to be returned to London office by March 14th, 1955.
C. R. WESTLAKE, Chairman. [4120

A. H. HUNT (CAPACITORS), Ltd.

REQUIRE engineers for design and development of
PAPER, mica and ceramic capacitors.
APPLICANTS should have previous capacitor experience, or training in electrical engineering at least to intermediate B.Sc. standard.—Apply Personnel Manager, A. H. Hunt (Capacitors), Ltd., Bendon Valley Garratt Lane, Wandsworth S.W.18 [0057

RADAR and Electronics.—Senior, intermediate and junior development engineers required. Salaries according to experience and ability.
ALL-POWER TRANSFORMERS, Ltd., Chertsey Rd., Byfleet, Surrey [3973

RADIO and/or television engineer required for bench and outside repairs, driver; references, age, experience, salary expected.—Field's Radio, Ltd., 52, Hall Gate, Doncaster. [3542

SITUATIONS VACANT

RADIO Technicians required by the GOVERNMENT OF KENYA for service as Inspectors of Police Grade 1 (Supernumery) for one tour of two years, extending to three years by mutual consent, and with possibility of permanency. Commencing salary (including present temporary allowance of 35% of salary) according to previous experience in scale £796, rising to £1,134 a year. Gratuity (at least £162 after two years' service). Outfit allowance £30. Uniform allowance £10. Separation allowance payable to married men under certain conditions. Free passages. Liberal leave on full salary. Candidates, aged 20-35, should be at least 5ft 7in without footwear, and be of good education. They must hold City and Guilds Certificates in Radio and/or Telecommunications, or have had at least 4 years' experience with the technical radio branches of the Services or with a reputable firm or Government Department. Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M1/36753/WF. [4119

ELECTRONICS development engineer. RAPIDLY expanding company located near Aylesbury, offers outstanding opportunity to a development engineer with a wide experience of electronics design; applicants must have a sound knowledge of communications/pulse techniques; be qualified by degree or equivalent and experience of aerial design would be an advantage; the post offers great scope for future advancement to a man with a good background of industrial or establishment experience; full details of age, experience, qualifications and salary expected to—Airtech, Ltd., Aylesbury and Thame Airport, Haddenham, Bucks. [0006

DEPARTMENT of Physical Chemistry. A VACANCY will occur, in the Research Laboratory for the Physics and Chemistry of Surfaces, for a laboratory assistant, Grade B; duties will include the construction under supervision of electronic apparatus required by the laboratory; the appointee will be expected to be able to perform both the mechanical and electrical work involved in the assembly of electronic gear, working from circuit diagrams and rough sketches; the position is unestablished and the wage will be in the range £5/16/3 to £8 p.w., depending upon age and ability; applicants should apply by letter, enclosing a brief resume of their experience and qualifications, to the Secretary, P.C.S. Laboratory, Department of Physical Chemistry, Free School Lane, Cambridge. [4126

THE DISTILLERS COMPANY, LIMITED. TECHNICAL assistant, Inter-B.Sc. or Higher National Certificate, having some years' experience in electronic circuitry, is required for instrumentation work in connection with chemical problems at the company's research and development department at Epsom.—Apply: Staff Manager, The Distillers Co., Ltd., 21, St. James's Sq., London, S.W.1. Ref. Res.255. [4159

A FIRM of established reputation requires TRANSISTOR Circuit Engineers for design and development work in their research laboratory; experience in this field desirable but not essential; applicants should possess a physics or engineering degree or equivalent qualification; a sound basic knowledge of circuit analysis is essential; pension scheme; applicants must be of British Nationality; location S.W. London. W.W., Box No. 8671, 15, Hill St., London, W.1. [4190

TEACHER of electricity (including radio) required for GOVT. OF CYPRUS Technical Trades School and Institute for one tour of three years in the first instance. Salary £1,068 a year with gratuity at rate of £100 a year. Free passages. Liberal leave on full salary. Candidates must hold C. & G. Full Technological Certificate in Telecommunication and/or Radio and be capable of undertaking both theoretical and practical instruction.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/40497/WF. [4091

AN international light engineering company in West London has a vacancy for a SENIOR engineer to develop specialised processes for the manufacture of magnetic recording heads; applicants must have development and production experience on magnetic recording equipment and be qualified to exploit new materials and methods of manufacture; preference will be given to applicants with metallurgy qualifications; the post is pensionable and the salary will be commensurate with ability.—Apply Box 1450. [4165

METHODS development section of Pye, Limited, has VACANCIES for senior and junior television circuitry engineers and mechanical development engineers to work on printed circuit and other new system developments, this is work in a new and expanding field and offers almost unlimited scope for engineers with drive and initiative; salaries dependent on qualifications and experience.—Apply to Chief Television Engineer, Pye, Ltd., Cambridge. [3994

SENIOR electronic test gear engineer required by component manufacturers in London; would also be appointed chief inspector (A.I.D.); write fullest particulars of qualifications, experience and present salary.—Box 1135. [4107

SITUATIONS VACANT

A SENIOR Electronics Draughtsman is required by the "ENGLISH ELECTRIC" for work in their West London Design Office.
THE work is connected with an advanced type of Digital Computor now being developed in conjunction with the National Physical Laboratory at Teddington.
THE post is permanent, and pensionable after a qualifying period. Please apply, giving fullest details, to Dept. C.P.S., 336-7, Strand, W.C.2, quoting Ref. 1243C. [4115

HONOURS graduates in physics or electrical engineering are required for advanced work in a quartz crystal laboratory.
THE positions offered afford excellent opportunities for young men to specialize in the study of piezoelectric materials, from both the theoretical and practical viewpoints; an interest in mathematics and electronics would be an advantage for this work.
HOUSES can be made available to successful applicants.
APPLY in writing to the Personnel Manager, Standard Telephones & Cables, Ltd., Crystal Division, Industrial Estate East, Harlow, Essex. [4134

SALESMAN wanted for radio and television components; good hours; permanent position; good prospects.
LASKY'S Radio, 42, Tottenham Court Rd., W.1. Museum 2605. [4140

A. V. ROE & Company Limited have the following vacancies for electronic and mechanical engineers in their Weapons Research Division at Woodford:
(a) SENIOR Engineer with Honours Degree and considerable experience of development of electronic computors or simulators to take charge of a group developing guided weapon simulators.
(b) SENIOR Engineer with Honours Degree and considerable development experience to take charge of a group developing hydraulic and pneumatic servo and precision mechanical devices.
(c) A number of engineers with either Honours Degree in Physics or Engineering or appropriate research or development experience to work on guided weapon computing navigation and control systems.
SALARIES will be commensurate with ability and experience. Applications, giving full particulars of age, qualifications and experience, etc., should be addressed to: The Chief Designer, Weapons Research Division, A. V. Roe & Company Limited, Woodford, Cheshire. [3792

ELECTRONIC Engineers required by The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry, in their Development Laboratories for work on the following items:—
(a) Development of Pulse Circuitry Techniques for Guided Weapons.
(b) Microwave Development.
(c) General Radar Circuit Development.
(d) Trials Team in connection with Guided Weapons.
(e) Servo-mechanisms.
(f) Test Equipment.
(g) Magnetic Amplifiers.
(h) Power Units including Electronic Stabilizers and Rectifier Systems.
(i) Application and Circuit Theory of Transistors.
(j) Design of R.F. Modulators.
(k) Investigation into Valve Parameters.
(l) Design of Valve Test Apparatus associated with (k) above.
APPLICANTS, preferably with a degree or an equivalent qualification should have had at least 2 years' experience in the development and engineering of Service equipment as well as experience in one of the above; reply, stating age, qualifications and experience to —The Personnel Manager, Ref. RG. [4131

RADIO and TV engineer required for King's Lynn, house available, permanency, good wages.—Apply S. Fell & Sons, Ltd., Nene Quay, Wisbech, Cambs. [4205

BURGLAR alarm company require wireman with telephone experience for small works in Paddington: some experimental work.—Amb. 6623. [4194

SALESMAN required, technical knowledge an asset, salary and commission, large turnover, permanency and prospects.—Radio Centre, 33, Tottenham Court Rd., London, W.1. [4192

EXPERIENCED television aerial development engineer, test and design to production stage; write fully, experience, salary, etc.—Box 1406. [4151

AIRCRAFT Radio Mechanics skilled in workshop practice are urgently required by Skyways, Ltd., at Standsted Airport, Essex.—Please write to Personnel Manager. [4083

APPLICATIONS are invited for trainees as studio installation and maintenance engineers for home and overseas service with well-known television company.—Apply Box 0483.

TELEVISION engineers able to drive required by leading and progressive dealers; good salary, conditions and prospects.—Singer's, 350, Edgware Road, W.2. Pad. 7915. [4213

ELECTRONIC engineer required for development and service work on electro-mechanical industrial equipment.—Write full details, age, experience, wage required. Box 1030. [4068

ELECTRONICS technician required; should have completed National Service and have electronics or signals experience; salary in range £315-£450, plus London Weighting and superannuation; canteen available.—Apply in writing to Mr. Brett, Chemical Engineering Department, Imperial College, London, S.W.7. [4136

SITUATIONS VACANT

PERSONAL assistant of high ability and integrity required by owner of retail radio and electrical business of good standing; state age and full details of career.—Box 1562. [4199

AN expanding instrument firm pioneering new developments in the field of radiation physics has vacancies on its research staff for Electronic Engineers or Physicists with an electronic background.
APPLICANTS should have a sound theoretical training and considerable practical experience. The posts would be of particular interest to those who wish to obtain experience in new fields of electronic technology.
THE laboratory is pleasantly situated in Surrey and a Pension Scheme exists.—Box 0635. [3969

ASSISTANT to the Chief Engineer required by an established instrument company in the Home Counties, now pioneering new developments in the field of electronic technology.
WHILE academic qualifications are not essential, applicants should have a sound theoretical training and considerable
PRACTICAL experience. The salary will be according to experience—£1,200 per annum is envisaged. There is a pension scheme.—Box 1540. [4193

AN expansion of the English Electric Co.'s guided weapons division at Luton has created further vacancies for all grades of senior and junior staff for the electronics department, particularly the following:—
SENIOR engineer—with experience of production engineering of prototype electronic equipment coupled with a working knowledge of electronic circuitry.
SENIOR engineer—to lead a large group of engineers and junior engineers in the development of specialised electronic test gear for factory and field use.
SENIOR engineer—with sound fundamental knowledge of electronics coupled with an ability to apply it to general circuit development.
SENIOR instrumentation engineers—with either a degree or H.N.C. together with experience of the design of transducers for use with electronic or bridge measuring systems.
SENIOR engineer—to lead a small group concerned with the development and field trials of ground radar equipment; applicants should have had considerable previous experience of similar work.
SENIOR engineer—for radar experiments and maintenance, applicants should have a wide experience of services radar equipments.
SENIOR engineer—for missile telemetry installation planning; applicants must be familiar with existing telemetry systems and measuring techniques; although no trials work is involved this post would suit a man with trials experience.
JUNIOR engineers and laboratory assistants are also required to assist in the above work.
HOUSING assistance will be given in some cases.
ALL of the above posts are permanent and progressive and attractive salaries are offered to the successful applicants; a staff pension scheme is in operation.—Applications to Dept. C.P.S., 336-7, Strand, W.C.2, quoting ref. S.A.38b. [4109

T/V service engineer, fully experienced, old-established business, lovely seaside resort, finest test gear, every encouragement to keen man; state qualifications and salary required.—Gerry, Bank St., Newquay. [4203

A VACANCY exists for an engineer to take charge of an expanding department engaged on the testing of a wide range of electronic equipment. Applicants should have the following qualifications:—
(A) Ability to organise and control staff.
(B) A sound technical background with, preferably, a H.N.C.
(C) Experience of V.H.F. and pulse technique.
(D) Experience of A.I.D. and I.E.M.E. procedure an advantage.
SITUATED within 30 miles London.—Apply Box 1439. [4154

DECCA RADAR, Ltd., have a small number of new appointments to make in their Research and Development Microwave Division; one appointment is senior. All applicants must have some sound training in this type of work.
DECCA RADAR, Ltd., have a small number of new appointments to make in their Electronic Circuit Research and Development Divisions; of primary interest are engineers interested in subminiature equipment design principally concerning receiver and display systems.
ALL posts are permanent and pensionable, and carry excellent prospects for progressive careers in the company's fast expanding programme.
British Nationality essential.—Write, quoting reference RLA/71, to Decca Radar, Ltd., 2, Tolworth Rise, Tolworth, Surbiton, Surrey. [4100

DEVELOPMENT engineer with experience and qualifications for electronic work required; progressive post with well-known electronic test equipment makers; pension scheme; full details.—Box 1379. [4143

ENGINEERS required for installation and operation of television transmission equipment.—Apply in first instance by letter, to Engineer-in-Charge, Pye, Ltd., 11, Hinde St., London, W.1. [3885

McMICHAEL RADIO, Ltd., Slough, Bucks, have vacancies from time to time for electronic engineers to be engaged on Government projects; those wishing to be considered are invited to write fully to the Chief Engineer, Equipment Division. [0198

SITUATIONS VACANT

ELECTRICAL or electronic engineer with an interest in automatic welding required as assistant to electrical and welding engineer of a large industrial concern in the Midlands, interesting job with prospects for the right man. APPLY, stating experience and salary required, to Rubery Owen & Co., Ltd., Employment Office, Booth St., Darlaston, S. Staffs. [4174

ENGLISH ELECTRIC Co., Ltd., wish to extend their present laboratory facilities for study of the effect of environmental conditions on guided weapons and their components. Applications are therefore invited from SENIOR and Junior Engineers to direct and carry out this work. A wide variety of electrical, mechanical and physical testing is under consideration, and although previous experience of guided weapons is desirable, it is by no means essential: the possession of an engineering or Physics Degree, H.N.C., or similar qualification, coupled with some experience in designing and handling ingenious electrical and mechanical test contrivances would form a satisfactory qualification. Housing assistance can be given if required. Please write, stating age, experience and qualifications, to Dept. C.P.S., 336-7, Strand, W.C.2, quoting Ref. 1000F. [4116

RADIO service mechanics required by Smiths (Radiomobile), Ltd., for many parts of the country.—Write details of experience and qualifications to Personnel Officer, Goodwood Works, North Circular Rd., London, N.W.2. [0342

AIRCRAFT electrical design draughtsmen required, excellent opportunities for advancement.—Apply Personnel Department, Vickers-Armstrongs, Ltd., Hursley Park, nr. Winchester. [4176

DESIGNERS of special purpose machinery are urgently required by a large and up-to-date firm of light electrical and mechanical engineers. A good salary will be paid to the selected persons who would also be recommended for housing.
A PENSION Scheme is operative and applicants should, in the first instance, write, giving particulars of their experience and technical qualifications, to Box 1095, quoting D.2. [4101

SKY-MASTS are rapidly expanding and will be needing new men from time to time and invite applications from men with knowledge of V.H.F. who are interested in travelling; must be experienced drivers, able to climb and prepared to work long hours.—Apply SKY-MASTS, Beadon Rd., Hammersmith, London, W.6. giving age and full details of experience. [4198

EXPERIENCED radio testers and inspectors required for production of communication and radio apparatus, also instrument makers, wirers and assemblers, for factory test apparatus.—Apply Personnel Manager, E. K. Cole, Ltd., Ekco Works, Malmesbury, Wilts. [0238

BERRY'S (SHORT WAVE), Ltd., have vacancies for Sales Assistants with good general radio knowledge. Interesting work, permanency.—Write giving details of experience, age and salary required to 25, High Holborn, London, W.C.1. [4084

TRAINEE television service engineer required by old-established London retail radio and electrical business; good opportunity for keen man with aptitude for this work; driving experience essential; state age and full details of career.—Box 1563. [4200

TELEVISION engineer for dealer with chief exclusive agencies, good salary and conditions, modern complete equipment and workroom, able drive, permanent, progressive job; experience essential, full details to—Fowler, 331, Vicarage Farm Rd., Heston, Middx. [4153

APPLICATIONS are invited for posts in a development laboratory located in Northamptonshire; minimum qualification required is a degree in physics or the equivalent; experience in microwave work would be advantageous.—Box 0842. [4014

TECHNICAL engineer with degree or H.N.C. required for work on magnetrons, previous experience essential, senior pensionable post.—Write, giving full details, to Personnel Dept., M.O. Valve Co., Brook Green, Hammersmith, W.6, quoting Ref. MC/E. [4128

THE EDISON SWAN ELECTRIC Co., Ltd., require a service engineer for installation and servicing in the field of their electro-medical equipment.—Please send details of experience and salary required to 155, Charing Cross Rd., W.C.2. Ref.: Electro/Med. [4072

TOP grade television service engineer, sound theoretical background and practical experience, ability to train juniors an advantage, up to £15 p.w. to suitable applicant, accommodation could be made available.—Write Box 1451. [4164

QUALIFIED electronic engineer required by component manufacturers (London area) for senior position; applicant must have experience in laboratory concerned with capacitor or telecommunication cables; state experience, qualifications and present salary.—Box 1136. [4108

EXPERIENCED Fault-Finders wanted by Midland manufacturers of radio equipment; permanent post located in the Midlands are offered to men with experience of radar, radio control, V.H.F. equipment.—Write, stating fully experience and salary required, to the Personnel Manager, Box 0394. [3875

SITUATIONS VACANT

JUNIOR technical assistant required by London chartered patent agents with a view to training for qualifying as a patent agent; degree standard in electrical or mechanical engineering.—Write, giving details of age, experience, etc., to Box No. 5953, c/o White's, Ltd., 72-78, Fleet St., E.C.4. [4206

TV engineers required in all London districts by leading maintenance company; must be fully experienced, all leading makes; excellent salary, bonus and commission; £10/10 guaranteed.—Write T.V.M. (L.), L., 19/23, Oxford St., W.1. or 'phone Hounslow 3228 or Ilford 2961. [4121

SENIOR electronic inspectors required for special work in the radar field; men with good academic background and sound experience are invited to apply for these progressive posts.—Apply immediately, preferably in person, to the Personnel Officer, Decca Radar, Ltd., Shannon Corner, New Malden. [4063

SERVICE engineer required for South Wales dealer with leading agencies; top wages paid; permanent progressive position; accommodation provided if necessary; please apply giving full particulars and copies of any references held; also type of accommodation required to—Box 1378. [4146

TRANSFORMER Designer required for development projects involving audio-frequency power transformers, pulse transformers, oil-filled units, etc.—Apply stating age, qualifications and experience, to The Personnel Manager (Ref. R.G.), The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry. [0260

MECHANICAL Engineers with experience required for responsible positions in connection with development of electronic training aids and computing devices; accommodation available to suitable applicants.—Apply in writing to Personnel Officer, Redifon, Ltd., Kelvin Way, Crawley, Sussex. [4112

PHYSICIST required with wide experience of electronic devices and circuit design and who enjoys mathematical analysis, senior position offers wide scope, minimum salary £1,000 p.a.—Write Managing Director, Southern Instruments, Ltd., Frimley Rd., Camberley, Surrey. [4123

ACOUSTICAL engineer required for research and development of electro-acoustic and supersonic transducers. Essential qualifications are familiarity with basic measurements and ability to design for quantity production.—Write with full details of qualifications, experience and salary required to Box 1087. [4092

ELECTRONIC engineers with experience required for responsible positions in connection with development of electronic training aids and computing devices; accommodation available to suitable applicants.—Apply in writing to Personnel Officer, Redifon, Ltd., Kelvin Way, Crawley, Sussex. [4110

SENIOR Television Development Engineer with administrative experience required; capable of carrying out development projects with minimum supervision up to production stage, Kingston area; write giving full personal details stating salary required—Chief Engineer, Box 1582. [4208

RADIO and radar testers. First-class men required for work on V.H.F. communication gear and Government contracts for radio and radar equipment by Midland manufacturers; men with wide experience of fault finding in any of the fields mentioned should write, giving full details, to Box 0393. [3874

ASSISTANTS (scientific).—The Civil Service Commissioners invite applications for pensionable posts. Applications may be accepted up to 31st December, 1955, but early application is advised as an earlier closing date may be announced either for the competition as a whole or in one or more subjects. Interview Boards will sit at frequent intervals.
AGE at least 17½ and under 26 years of age on 1st January, 1955, with extension for regular service in H.M. Forces, but candidates over 26 with specialised experience may be admitted.
CANDIDATES must produce evidence of having reached a prescribed standard of education, particularly in a science of mathematical subject. At least two years experience in the duties of the class gained by service in a Government Department or other civilian scientific establishment or in technical branches of the Forces essential in one of the following groups of scientific subjects:—
(i) ENGINEERING and physical sciences.
(ii) CHEMISTRY, bio-chemistry and metallurgy.
(iii) BIOLOGICAL sciences.
(iv) GENERAL (including geology, meteorology, general work ranging over two or more groups (i) to (iii) and highly skilled work in laboratory crafts such as glass-blowing).
INCLUSIVE salary £262 (at 18) to £545 (men) or £457 (women). Starting pay up to £402 (men) or £357 (women) at 25. Somewhat less in provinces. Opportunities for promotion.
FURTHER particulars from Civil Service Commission, Scientific Branch, 30, Old Burlington Street, London, W.1, quoting No. S 59/55. [4090

RADIO technicians required by International Aeradio, Ltd for overseas service; permanent and pensionable positions, inclusive salary from £894 per annum to £1,373 per annum, tax free, according to marital status; free accommodation; kit allowance; free air fares; generous U.K. leave.—Qualified candidates to whom replies only will be sent please write quoting RT to Personnel Officer, 40, Park St., W.1. [0262

SITUATIONS VACANT

ELECTRO-MECHANICAL inspectors are required by a large and expanding company. Practical experience and sound knowledge of radio component manufacture is necessary. A good salary is offered to suitable applicants who should, in the first instance, write, stating qualifications and experience, to Box 1094, quoting E.M.1. [4097

PHYSICIST.—Young graduate required for research and development work on transistors and their applications, excellent opportunities and wide scope for man with initiative. —Applications, giving age, full details of qualifications, experience and salary required, should be forwarded to Personnel Dept., Murphy Radio, Ltd., Welwyn Garden City. [3990

APPARATUS Development Engineers required for design of electromagnetic devices. Experience of relays, contactors or switchgear an advantage. Good salary, pension scheme and excellent working conditions.—Apply in writing in first instance to Personnel Manager, Thorn Electrical Industries, Ltd., Gt. Cambridge Rd., Enfield, Middx. [4087

ENGINEERS (radio valves) are required for all grades of work on development, production and pre-production—minimum qualifications H.N.C. or B.Sc. for senior positions—O.N.C. or inter for junior—some experience necessary for senior appointments.—TA/5 Personnel Dept., M.O. Valve Co., Brook Green, Hammersmith. [4070

DEVELOPMENT engineers with experience required to work on the application of electronic methods to the solution of aeronautical and/or training problems; university degree or equivalent standard; accommodation available to suitable applicants.—Apply in writing to Personnel Officer, Redifon, Ltd., Kelvin Way, Crawley Sussex. [4111

SOUND SALES, Ltd., require production engineer to take charge of amplifier department expansion; practical production experience on similar type of equipment essential; service experience insufficient; 5-day week, 14 days holiday with pay.—Write stating all qualifications, salary required, etc., Managing Director, Sound Sales, Ltd., West St., Farnham, Surrey. [4144

ENGINEER required for expanding West London company; degree or equivalent with sound knowledge of electronics required; experience with production and application of miniaturised precision electro-magnetic relays or similar equipment essential; this position is an executive one and only those with ability to organise and supervise development and production will be considered.—Box 1539. [4196

TELEPHONE RENTALS, Ltd., require 1 or 2 assistant engineers for their technical dept., excellent opportunity for young men age 18-22 with technical ability and basic training in electrical work; permanent and progressive positions.—Write, detailing age, education, etc., and N.S. position, to Eng. Dept., T.R., Ltd., Kent House, Knightsbridge, S.W.7. [4137

QUALITY control engineer required for large radio and television factory at Bradford, Yorkshire; good technical knowledge of television and radio essential, able to maintain standard on coils, alignment tests and general technical problems, etc.—Write experience and salary required to Box No. M.R.G., c/o Messrs. Brockie Haslam & Co., 231, Strand, London, W.C.2. [4075

UNIVERSITY COLLEGE LONDON (Gower Street, W.C.1) has vacancy for ungraded Electronic Technician in Dept. of Phonetics, for research and development work in speech and hearing; interest in acoustics, and ability to work independently desirable; salary up to £620 dependent on experience and qualifications.—Application forms from Secretary, quoting Phonetics/4. [4132

RADIO and TV aerial engineer, must be able to install and set up radio and TV receivers and have had experience in installing TV aerials; 3/11 per hour, 44-hour week; regular employment; pension scheme; holiday and sickness benefits, etc.—Applications to Staff Office (WW), London Co-operative Society, Ltd., 54, Maryland St., Stratford, E.15. Envelopes endorsed "Radio." [4118

WINSTON ELECTRONICS, Ltd., have a vacancy for an engineer in their development laboratories: applicants should have H.N.C. or equivalent, and should have several years' experience on audio frequency circuits; a knowledge of line communication systems would be an advantage; this post calls for a reliable man who can work with a minimum of supervision, and the salary will be generous for the right man.—Apply in writing to the Chief Engineer, Winston Electronics, Ltd., 1, Park Rd., Hampton Hill, Middlesex. [4150

RADIO mechanic required for the Bermuda Police Force, in the rank of constable, for a tour of 5½ years with possibility of permanency, salary scale (including present temporary allowance of 10% of salary) £715 rising to £825 a year; free passages and uniform; no income tax; candidates must be unmarried, between 21 and 28 years of age, of sound physique and good education; they must be familiar with signal generator, valve tester, anometer and battery charger equipment and also VHF equipment similar to Pye series PTC 704 (fixed unit) and Pye series PTC 115 (mobile units).—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M1/36551/WF. [4125

SITUATIONS VACANT

DRAUGHTSMAN required, experienced in electrical installation planning, switchgear, power distribution and wiring. Radio knowledge not essential.—Apply personally or write to The Secretary, Marconi's Wireless Telegraph Co., Ltd., New Street, Chelmsford, Essex, stating age, training and experience. [4086

RADIO engineer for Bulawayo, Southern Rhodesia: design and development engineer with at least five years' experience on domestic radio; salary £1,200 per annum, with free air passage to Rhodesia.—Application should be made to Advertiser, 31, Burlington Ave., Kew Gardens, Surrey, with copy to P.O. Box 2096, Bulawayo, Southern Rhodesia. Successful applicant will be interviewed in London. [4076

A SALES and Service Engineer, young and adaptable, is required by Rocke International, Ltd., 59, Union Street, London, S.E.1. He will be required to travel, maintain, demonstrate and sell an extensive range of American and Continental electronic instruments. All applications, giving full details of qualifications, approximate salary required, etc., will be answered in confidence. [4080

WORKS study-methods engineer with time study experience, required for work on radar and electronic equipment; this appointment offers scope for advancement; a superannuation is in operation together with canteen and welfare facilities.—Applicants should apply in the first instance for a technical staff application form to the Personnel Manager, E. K. Cole, Ltd., Malmesbury [4158

RADIO and TV engineer with laboratory experience required by leading London firm of electrical component manufacturers for work in connection with printed circuits; H.N.C. standard; superannuation scheme.—Write, giving full details of education and experience, age and salary required, to Personnel Manager, Box 3M.L9248, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [3849

TELEVISION aerial riggers with ability to install all types of aerial from indoor to fringe models and capable of setting up receivers required by large and well-known department store organisation. Greater London area. Must be able to drive. Overalls supplied. Canteen. Non-contributory pension scheme. Liberal holidays. Age 21-40. Salary £9 to £10 per week.—Please telephone Mr. Chamberlain, North 3294. [4094

ELECTRICAL foreman, with wide production experience in radio industry of small and medium electrical control gear manufacture, test and installation, required by manufacturers of materials handling vehicles in pleasant country district, 1 hour London, good prospects of advancement; housing assistance; canteen and social facilities; please write giving details of age, past experience, present salary, salary required, married/single to—Box 1400. [4147

SALES representative required to cover and develop market for specialised lamp types and also possibly valves, with manufacturers of electrical equipment, instruments, etc. Knowledge of electrical machinery and appliance markets desirable. Some technical knowledge helpful. Salary and commission.—Apply in confidence to Chief Commercial Engineer, Hivac, Ltd., Stonefield Way, South Ruislip, Middx. [4113

SENIOR Electronic Engineers, Mechanical Designers, Draughtsmen and Detail Draughtsmen are required by a leading Midlands manufacturing concern engaged on the design, development and production of domestic radio and television and on Government contract work, an expanding programme will provide excellent opportunities for promotion; applicants should write to—The Personnel Manager (Ref. GLB), Box 0742. [3996

TECHNICAL Assistants required for investigational work in connection with radio valve manufacture; applicants should possess at least Higher National Certificate; five-day week, modern welfare facilities, staff pension scheme. —Apply, giving full personal details, including age, qualifications and experience, to Personnel Superintendent, The Edison Swan Electric Co., Ltd., Cosmos Works, Brimsdown, Enfield, Middlesex. [4189

SENIOR and junior development engineers required for responsible work in radio and television development laboratories, applicants for senior position should be able to undertake development work with minimum supervision; excellent conditions and salary available for applicants who are accepted.—Apply in first case to Personnel Manager (Dept. R.D.), McMichael Radio, Ltd., Wexham Rd., Slough, Bucks. [3880

ELECTRO-MECHANICAL engineers, senior (ref. W.W./56) and junior (ref. W.W./57) required for interesting work on the laboratory preparation and subsequent field trials of guided missiles; applicants should have experience of one or more of the following: small pneumatic servos, gyroscopes. D.C. amplifiers, electro-mechanical instruments and pick-offs; preferably together with H.N.C. or equivalent (elec. or mech.); there are excellent prospects of advancement in this rapidly developing field which offers very good salaries and bonus; pension scheme.—Apply, quoting reference above, to The Assistant Manager, The Fairey Aviation Co., Ltd., Weapon Division, Heston Aerodrome, Hounslow, Middx. [4163

SITUATIONS VACANT

JUNIOR Apparatus Technician required to assist in the building of scientific apparatus; applicants should be working for City and Guilds certificates or the Ordinary National certificate in electrical or radio engineering; salary scale £150 (age 16) to £393 a year; application forms, to be returned within 7 days, from—Secretary, Institute of Psychiatry, Maudsley Hospital, Denmark Hill, London, S.E.5 (MRC). [4212

THE PLESSEY Co., Ltd. (Swindon factory), require for their Resistor Laboratory, senior grade draughtsmen who have knowledge of the design of electrical components and who are accustomed to isometric layouts. The successful candidates should have reached at least Higher National Certificate standard.—Applicants should apply in writing, to the Personnel Manager, The Plessey Co., Ltd., Kembrey St., Swindon, Wilts. [4098

RADIO Engineer required with good knowledge of receiver circuits for work in the laboratory concerned with proving of new designs and preparation of test procedure. Good commencing salary and excellent prospects of advancement await the successful applicant.—Apply in writing giving details of age, experience and qualifications to Personnel Department (F.L.), Murphy Radio Ltd., Welwyn Garden City Herts. [4085

ELECTRICAL component manufacturers in N.W. London require keen and energetic man (30-35 years) to supervise small service department, applicants must be able to conduct correspondence, control manual and clerical staff and possess electrical engineering background; no Saturdays, superannuation scheme.—Write, stating age, full details of experience and salary required, to Box 3M, No. 5839, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [4129

ELECTRONIC Test Engineers are required by a leading Midlands manufacturing company for the maintenance of test equipment, alignment, testing and fault-finding on domestic radio and television receivers, and the testing of Radar Units and other electronic devices. Ex-Service technicians or men with similar experience are particularly suitable.—App.y giving details of car e to date, to the Personnel Manager (Ref. GLB), Box 1515. [4188

MARCONI INSTRUMENTS, Ltd., have an immediate vacancy at St. Albans in their Technical Literature (Telecommunications) Section; the applicants should have electrical engineering qualifications and/or experience in the design or development of electronic equipment; the duties are varied and interesting and the post provides a permanent and pensionable position in a well-established company.—Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [3894

TOP-GRADE television service engineers with first-rate practical experience of a wide range of makes required for large and well-known department store organisation. Able to drive, and must have real ability to diagnose faults and effect repairs quickly. Greater London area. Commencing salary £600 to £750 p.a. according to qualifications. Non-contributory pension scheme. Liberal holidays.—Only really first-grade men please apply to Museum 6888, ext. 201 or 202. [4093

BRITISH INSULATED CALLENDER'S CABLES, Ltd., have a vacancy with their Telecommunications Laboratory at Kirkby for an Honours Graduate in Physics or Electrical Engineering to take charge of a small but growing team engaged on the design of accessories for audio carrier and V.H.F. cables and the development of pneumatic protection for underground cables. — Applications, quoting reference P/58/54, should be submitted to: The Staff Officer, B.I.C.C., Ltd., Prescot, Lancs. [4064

TECHNICAL assistants required in radar development laboratory: preferably with Higher National Certificate or equivalent qualifications, also experience in electrical testing or construction of test equipment, or service experience on ground radar equipment; excellent working conditions; opportunities exist for upgrading; write stating age and experience to the Personnel Manager (Ref. R.G.), The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry. [4148

A VACANCY exists for a man with practical ability, under 30 years' old, for research and development work on scientific and industrial instruments and their application to a wide range of uses. Applicants should have some scientific, engineering or technical qualification and preferably some industrial experience; the post is permanent, progressive and pensionable; full particulars of education; experience and salary required should be sent to the Head of the Research Department, Cambridge Instrument Company, Ltd., Cambridge. [4149

ENGINEER, fully experienced in radio and television design and development, required to assist chief development engineer of leading London electrical component manufacturers in development of printed circuits; qualifications at least to A.M.I.E.E. standard; this position offers scope for the right man who must be capable of initiating and following projects to finality, including contacts with customers' superannuation scheme.—Write, giving full details of qualifications and experience, age and salary, required to Personnel Manager, Box 3M.L9242, A.K. Advg., 212a, Shaftesbury Ave., London, W.C.2. [3850

SITUATIONS VACANT

RADIO (Meteorological) Mechanics required by Meteorological Office: qualifications: basic knowledge of radio and radar and experience in maintenance/operation of radar equipment, including oscilloscopes; successful applicants serve in United Kingdom and overseas; commencing London salary £467/10 at age 25 or over, rising to £565, subject to deductions for each year below age 25. Provincial salary £20 to £30 lower; overtime, night duty allowance, etc.—Apply at any Employment Exchange, quoting Borough 881. [4117

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Allesley, Coventry, requires mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments for work on guided weapons and like projects; also required, senior and junior electronic development enginers, particularly in the field of microwave and pulse applications; salary according to age, qualifications and experience.—Apply by letter, stating age and experience, to the Personnel Manager, Ref. R.G. [0259

TELEVISION service engineers will be interested to know that one of the leading manufacturers in the industry have vacancies for television service engineers in South London; five-day week, contributory pension scheme and good conditions of employment; fully qualified man preferred, but a good radio service engineer with some television experience will be considered.—Reply, giving details of age, experience and present salary, to Box WW903, LPE, 55, St. Martin's Lane, London, W.C.2, quoting reference S.2. [4065

THE GENERAL POST OFFICE has vacancies for radio operators at its coast radio stations and applications are invited from men between 21 and 35 years of age who hold the Postmaster-General's first-class certificate of proficiency in radiotelegraphy. Selected candidates will be considered later for permanent pensionable posts.—Application should be made to The Inspector of Wireless Telegraphy, Radio and Accommodation Department, Wireless Telegraph Section, Union House, St. Martins le Grand, London, E.C.1. [3808

VACANCY exists for position as section head of test set development, design and construction group; age 25-38 years; Higher National or City and Guilds telecommunications certificate essential, plus detailed knowledge of radio and electronic equipment; experience of R.F. measurements and test equipment an advantage; house could be made available.—Apply in writing to the Personnel Manager, Standard Telephones & Cables, Ltd., Crystal Division, Industrial Estate East, Harlow, Essex. [4106

A VACANCY exists for an Electronic Instrument Development Engineer in the Telecommunications Laboratory of British Insulated Callender's Cables, Ltd., at Kirkby, Nr. Liverpool. Candidates should hold a degree in Physics or Engineering and have previous experience in the design and development of electronic instruments. Some experience of servo-mechanisms would be an advantage.—Applications quoting reference P/60/54 should be addressed to: The Staff Officer, B.I.C.C., Ltd., Prescot, Lancs. [4077

AN electronic or electrical engineer, between the ages of 25 and 35 years, of degree standard, is required to take charge of the engineering department of a factory engaged in the manufacture of frequency control equipment; the successful applicant will be responsible for the design and specification of all new items as well as routine engineering problems; the position offers a wide scope for a person possessing the necessary technical qualifications and initiative to expand the work along numerous channels.
HOUSES can be made available to successful applicants.
APPLY in writing to the Personnel Manager, Standard Telephones & Cables, Ltd., Crystal Factory, Industrial Estate East, Harlow, Essex. [4135

SENIOR Laboratory Technician at South-East London Technical College, Lewisham Way, S.E.4, for maintenance of the communication (line and radio) and electronic laboratories together with the appropriate stores; applicants should have a good knowledge of line or radio equipment and be capable of carrying out minor repairs; facilities are available for further education; salary scale £401/12/6 a year rising by annual increments of £25/10 to £503/12/6 and with certain qualifications to £580/2/6.—Application forms (returnable within 14 days) from Secretary. (1696) [4217

THE WAR DEPARTMENT requires an Assistant Electrical Engineering Officer (Recruitment Grade Professional) for No. 34 Base Workshops, R.E.M.E. Donnington, Salop. Duties involve organisation, control and supervision of a workshop sector employing 30-40 civilians engaged on the repair and calibration of electrical and electronic test equipment. Applicants must be British of British parentage and have A.M.I.E.E. or hold exemption from Sections A and B of membership examination, or have University Engineering degree. Salary on range £772 (slightly less if under 30 years of age)-£995: Provincial. Starting salary fixed according to age, qualifications and experience. Annual increases payable subject to satisfactory service. Post temporary but with long-term possibilities.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting Ref.: D680/54A. [4088

SITUATIONS VACANT

DEVELOPMENT Engineers (Senior) required with experience in development and design of light engineering electronic and mechanical projects such as magnetic recording, telecommunication and audio engineering equipment. Preference given to applicants with experience in magnetic recording. Previous experience in development work essential. Degree desirable. Please give full details in the first application stating experience, age and salary required in confidence. Quote Ref. ACD, Box 1065. [4081

ELECTRICAL/Electronic Engineer.—Vickers-Armstrongs, Ltd., Supermarine Works, require for employment at their experimental airfield, graduate with research and development experience in electronic and electro-mechanical devices and/or recording equipment for interesting work on ground and airborne measuring apparatus; the right man for this post will be keen to suggest and assess new techniques and to design and engineer suitable and workmanlike equipment; permanent pensionable post with good prospects for suitable engineer.—Apply Personnel Department, Hursley Park, Nr. Winchester. [4210

EXPERIENCED engineers are invited to apply for a position where energy, initiative and skill will be well rewarded; the work related to the development of television circuits, and the design of components for large scale production; experience of television receiver design is required in respect to means of scanning and focussing or the design of R.F. and I.F. circuits; the position is a permanent one which offers scope for advancement to a senior position; the commencng salary will be in accordance with experience, based on a generous and progressive scale.—Write, giving full personal particulars to the Personnel Manager, the Plessey Co,. Ltd., Ilford, Essex. [4071

MINISTRY OF SUPPLY requires engineers in London to help supervise inspection of all types electronic equipment. Qualifications: British of British parents; recognised engineering apprenticeship, or equivalent, and A.M.I.C.E. or M.E. or E.E. or exempting qualifications; sound knowledge modern inspection methods, experience planning inspection and directing staff essential. Salary: Within £675 (age 25), £1,035. Not established but opportunities to compete for establishment may arise.—Application forms from M.L. & N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D29/5A. Closing date, March 11, 1955. [4186

DEVELOPMENT engineers experienced in the handling of electronic equipment for the measurement of vibration; duties to issue instructions retesting and setting up of equipment and the interpretation of results after routine analysis has been carried out; experience in the design of electronic equipment would be an advantage but not essential as long as applicants have experience of mechanical development and of the operation of electronic equipment; degree or Higher National desirable.—Write stating age, qualifications, experience and salary required to Labour Manager (U), Rolls-Royce, Ltd., P.O. Box 31, Derby. [4102

WELL-ESTABLISHED component manufacturer is setting up manufacturing plant in the Portsmouth area. There will be several vacancies for draughtsmen and other technical staff who will be responsible for the technical service required by the production shops. The company's main development laboratories are situated in the London area and the successful applicants for these posts will be required to spend a training period in the laboratories before assuming their duties in the Portsmouth area. Future prospects in an expanding organisation will be excellent, and a subsistence allowance will be payable during the training period.—Applicants will be interviewed in the Portsmouth area and should write with full personal particulars to Box 1096. [4103

MINISTRY OF TRANSPORT AND CIVIL AVIATION.—Radio Technicians (men only) required at aerodromes and radio stations in various parts of U.K.; special training courses for keen technicians with basic quals.; interesting work providing and maintaining aeronautical telecommunications and electronic navigational aids; prospects of permanent pensionable posts and advancement; rates of pay (London) from £342/10 at age 19, to £467/10 at 25, rising (subject to qualifying test) to £565; rates slightly lower in provinces; shift and night duty allowances from 2/- to 5/- also payable; candidates aged 19 or over, with practical experience in maintenance of radio or radar equipment, should apply to any Employment Exchange, quoting Westminster 6627. [4062

MINISTRY OF SUPPLY requires Laboratory Technicians at Harefield, Middlesex, for precision laboratory measurements connected with applications of light current electrical engineering, radio and radar allied to aero instruments, materials, etc., and developing new measuring techniques. Qualifications: British of British parents; recognised engineering apprenticeship or equivalent, sound knowledge electricity and radio, appropriate practical experience, aptitude for experiments, O.N.C. or City and Guilds or equivalent desirable. Salary: Within £660 (age 30), £772; not established, but opportunities to compete for establishment may arise.—Application forms from AB.81, Ministry of Labour and National Service, London Appointments Office, 1-6, Tavistock Square, London, W.C.1. [4185

SITUATIONS VACANT

AERONAUTICAL inspection service radar, telecommunications and electrical divisions; vacancies exist for examiners (unestablished) at various provincial locations; City and Guilds Intermediate group certificate in telecommunications engineering or Ordinary National Certificate in electrical engineering (or equivalent theoretical knowledge) required, with experience in industry or Services; salary range £565-£695 (men); prospects of promotion and establishment; no age limits.—Details and forms from Air Ministry, S.2(q), Cornwall House (N.5), Stamford Street, London, S.E.1. [4162

TECHNICAL sales/service managers required for British West African branches of large British company distributing domestic radio receivers, V.H.F. radiotelephone equipment, intercommunication telephones, domestic and commercial refrigerators, air conditioners, and office equipment; good technical radio background essential; refrigeration experience desirable; familiarisation course arranged with U.K. manufacturers prior to departure for Africa; first-class passage, sea/air, free furnished quarters, full pay on leave after approximately 18-month tours, pension scheme; apply in own handwriting stating age (preferably between 21 and 30), whether married or single, full details education, qualifications, national service and business experience; original references should not be sent. —Apply T. S. D., Box 1134. [4105

WORKS Manager required for factory employing 700 engaged on the production of electronic equipment, radio components, etc.; must be experienced in flow production techniques for machine and assembly operations, and able to undertake the preparation of factory layouts for this class of work; experience is also essential in selecting, engaging and training labour and in handling labour negotiations; this is an opportunity for a man of drive and initiative, who is acutely cost-conscious to join an old-established company expanding its ranges of products; salary £1,500/1,700 per annum depending on experience and qualifications; there is a staff pension scheme in operation; write giving full personal details in confidence to—Secretary, The Edison Swan Electric Co., Ltd., 155, Charing Cross Rd., London, W.C.2. [4209

MURPHY RADIO, Ltd., have vacancies in the Electronics Division Laboratories for qualified engineers to design and develop the following: (1) V.H.F. and U.H.F. communications equipment; (2) airborne and ground radar equipment; (3) computing devices and servo systems; (4) nucleonic equipment and measuring instruments; (5) transistors and associated circuitry; the salary range is £600-£1,000 per annum depending upon experience; further posts are available to engineers of H.N.C. standard or equivalent having less experience, the salary range being £450 to £650 per annum; these vacancies are at Welwyn Garden City but one or two vacancies of a similar nature are available at the Ruislip works.—Applications, giving age, full details of qualifications, experience and salary required, should be forwarded to Personnel Department, Murphy Radio, Ltd., Welwyn Garden City. [3991

SITUATIONS WANTED

ATTENTION of directors.
EXECUTIVE engineer of exceptional initiative and organizing ability seeks post offering control of unit engaged in electronic project engineering; experienced development of prototype high grade laboratory equipment and works installations and small production runs; five years similar capacity; strong personality, able to conduct affairs at top level and accept maximum responsibility; the post must be permanent and offer prospects of advancement to high level.—Box 1564. [4201

TV Production/Maintenance Engineer, 4 years' experience OB/studio cameras, seeks commercial television appointment.—Box 1133. [4104

ELECTRONIC technical assistant seeks post involving work on medical electronics, especially interested electro-encephalography. —Box 1029. [4067

RESEARCH, development supervisor Ph.D. Physical Chemistry; metal film resistors, electronic components; U.S. citizen, 36, desires location in Great Britain.—Box 1613. [4222

RADIO mechanic in Leeds seeks travelling post, commercial or industrial electronics; young, married; holder driving and amateur transmitting licences; 8 yrs.' experience.—Box 1489. [4172

ELECTRONIC development and television service engineer seeks position abroad. C. and G. final cert., 2 years' industrial experience, public school and university education, age 24 and married.—A. P. A. Elliott, "Bracken Tops," Baddesley Rd., Chandlers Ford, Hants. [4061

TECHNICAL TRAINING

LEARN it as you do it—we provide practical equipment combined with instruction in radio, television, electricity, mechanics, chemistry, photography, etc.—Write for full details to E.M.I. Institutes, Dept. WW.47, London, W.4. [0001

CITY and Guilds (Electrical, etc.) on "No Pass—No Fee" terms over 95% successes. —For full details of modern courses in all branches of Electrical Technology send for our 144-page handbook, free and post free, B.I.E.T. (Dept. 388A), 29, Wright's Lane, London, W.8. [0117

TENDERS

THE Director-General, India Store Department, Government Building, Bromyard Avenue, Acton, London, W.3, invites tenders for the supply of:—
QUANTITY No. 1.
HIGH Power H.F. radio transmitter of about 30kW, peak envelope power for operation of SSB telephony or FSK/ON-OFF telegraphy complete with accessories and spares.
FORMS of tender, which are returnable by the 22nd March, 1955, may be purchased at the above address at a cost of 10s.
IN your application for tender forms, please quote reference 2481/54/CIV. [4187

TUITION

WIRELESS operating; attendance and postal courses.—Stamp for reply to Manager, The Wireless School, Manor Gdns., London, N.7. [0104

FULL-TIME courses for P.M.G. Certs., C.G.L.I. Telecommunications, Radar Maintenance Cert. and B.Sc.(Eng.): prospectus free.—Technical College, Hull. [0111

SEE the world as a Radio Officer. Short training period—low fees. Scholarships, etc., available. Boarding and day students. Send 2d stamp for prospectus.—Wireless College, Colwyn Bay. [0018

A.M.I.Mech.E., A.M.Brit.I.R.E., City and Guilds, etc., on "No Pass—No Fee" terms; over 95% successes.—For details of Exams. and courses in all branches of Engineering, Building, etc., write for 144-page Handbook—Free: B.I.E.T. (Dept. 387B), 29, Wright's Lane, London, W.8. [0118

T/V & Radio—A.M.Brit.I.R.E., City & Guilds, R.T.E.B. Cert., etc., on "No Pass—No Fee" terms; over 95% successes.—Details of Exams. and Home Training Courses in all branches of Radio and T/V, write for 144-page Handbook—Free. B.I.E.T. (Dept. 387A), 29, Wright's Lane, London, W.8. [0116

TUITION

NOTHING succeeds like success! What we have done a thousand times we can do again for you—see the B.N.R.S. advt. page 156. [0172

THE Institute of Practical Radio Engineers have available home study courses in every phase of radio and television engineering, specialising in the practical training of apprentices in the retail trade; enrolments limited, fees moderate.—The Syllabus of Instructional Text may be obtained post free from the Secretary, I.P.R.E., Fairfield House, 20, Fairfield Rd., Crouch End, London, N.8. [0088

FREE!—Brochure giving details of Home Study Training in Radio, Television, and all branches of electronics; courses for the hobby enthusiast, or for those aiming at the A.M.Brit.I.R.E., City and Guilds, R.T.E.B., and other professional examinations; train with the College operated by Britain's largest electronics organisation; moderate fees.—Write to E.M.I. Institutes, Dept. WW.28, London, W.4. [0179

WIRELESS telegraphy.—Merchant Navy offers to youths 16 upwards after qualification, lucrative positions as radio officers.—Apply British School of Telegraphy, 179, Clapham Rd., S.W.9 (Est. 1906). Recognised by Ministry of Education, moderate fees, modern equipment, day and evening tuition; also postal courses in theory of wireless telegraphy for P.M.G. Certs. and Amateur Transmitting Licence. [0124

OPPORTUNITIES in radio and television servicing; full-time theoretical and practical 1-year course at E.M.I. Institutes in London; successful completion ensures your future; next course commences on April 19th; early enrolment is advised.—Free brochures giving details of these and other courses from E.M.I. Institute, Dept. WW36, 10, Pembridge Sq., London, W.2. Tel. Bayswater 5131/2. [3972

WTD Exchanges, Etc

BOOKS, INSTRUCTIONS, ETC.

"WIRELESS WORLDS," 1946 to 1954 inclusive; offers.—34, Bush Elms Rd., Hornchurch, Essex. [4169

WIRELESS World 1944/54; first 7 years privately bound, remainder loose; offers?—Milsom, Winrush, Heathway, East Horsley, Surrey. [4219

I.P.R.E. technical publications, 5,500 Alignment Peaks for Superheterodynes, 5/9, post free, data for constructing TV aerial strength meter, 7/6; sample copy "The Practical Radio Engineer," quarterly publication of the Institute 2/-; membership and examination data, 1/-.—Sec., I.P.R.E., 20, Fairfield Rd., London, N.8. [0089

FOR sale.—J. Soc. Mot. Pic. Engrs., June, 1948-June, 1954; Tele-Tech., Mar., 1949-Nov., 1952; R.C.A. Rev., June, 1948-March, 1954; Bell Syst. Tech. J., Oct., 1948-Nov., 1952; Elect. Engineering N.Y., Jan.-Dec., 1952; odd copies Proc. I.R.E., 1941-1953; Wireless Engr., 1948-1954; B.B.C. Quart., 1946-1954.
OFFERS and requests to M.S.S. Recording Co., Ltd., Poyle Close, Poyle Rd., Colnbrook, Bucks. [4152

"ROADS of France: A Guide to Tourist Routes." By A. G. Douglas Clease. A handy-size book which enables the France-bound motor cyclist or motorist to find his way to the more popular tourist areas without worry or trouble. It also gives helpful information about hotel charges and tips and other valuable hints for the first-time visitor. 5/- net, from all booksellers. By post 5/2 from Iliffe & Sons Ltd., Dorset House, Stamford St., London, S.E.1.

BOOKS WANTED

WANTED.—"CQ," January, March, April, June, November, December 1945, May 1946; any "Radio" before 1936; any "R/9" before April 1935; any 'QST" before 1924.—G3IDG, 95, Ramsden Rd., London, S.W.12. [4078

CLASSIFIED ADVERTISEMENTS

Use this Form for your Sales and Wants

To "Wireless World" Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1

PLEASE INSERT THE ADVERTISEMENT INDICATED ON FORM BELOW

- **RATE: 7/- for TWO LINES. 3/6 every Additional Line. Average six words per line.**
- **Name and address to be included in charge if used in advertisement.**
- **Box No. Allow two words, plus 1/-.**
- **Cheques, etc., payable to Iliffe & Sons Ltd., and crossed "& Co."**
- **Press Day, February 24th for April issue.**

NAME .....

ADDRESS.....

.....

REMITTANCE VALUE.....ENCLOSED

Please write in block letters with ball pen or pencil.

NUMBER OF INSERTIONS.....

INDEX TO ADVERTISERS

	PAGE
Acoustical Mfg. Co., Ltd.	11
Acru Electric Tool Mfg. Co., Ltd., The	142
Adcola Products, Ltd.	104
A.D.S. Relays, Ltd.	146
Advance Components, Ltd.	6
Aerialite, Ltd.	103
Aero Research, Ltd.	2
Airmec, Ltd.	19
Alpha Radio Supply Co., The	153
Altham Radio Co.	146
Ambassador Radio & Television	70
Amplex Appliances (Kent), Ltd.	142
Anders Electronics, Ltd.	105
Anglo-American Vulcanised Fibre Co., Ltd.	94
Antex	75
Antiference, Ltd.	8
Appointments Vacant 154, 156, 169,	171
Arcolectric Switches, Ltd.	109
Ariel Sound	166
Armstrong Wireless & Television Co., Ltd. 66,	159
Army Emergency Reserve (Royal Signals)	108
Ashworth, H.	44
Associated Cine Equipments, Ltd.	108
Automatic Coil Winder & Electrical Equipment Co., Ltd., The	1
Automatic Telephone & Electric Co., Ltd.	71
Avionics	168
Bailey Bros. & Swinfen, Ltd.	114
Baker's Selhurst Radio	64
Barker Natural Reproducers	161
Barton's (Radio)	123
Beamish, V. W.	166
Bell, John, & Croyden	120
Belling & Lee, Ltd.	85
Bel Sound Products, Ltd.	116
Benson, W. A.	164
Berry's (Short Wave), Ltd.	74
Bird, Sydney S., & Sons, Ltd.	26
Birmingham Sound Reproducers, Ltd.	80
B. K. Partners, Ltd.	102
Blickvac	106
Blundell, G.	170
Borough Polytechnic	165
Boulton Paul Aircraft, Ltd.	24
Bradmatic, Ltd.	160
Britain, Chas., (Radio), Ltd.	141
British Communications Corpn., Ltd.	9
British Distributing Co.	166
British Institute of Engineering Technology 154,	166
British Insulated Callender's Cables, Ltd.	13
British National Radio School	116
British Physical Laboratories	35
British Sarozai, Ltd.	156
Brookes Crystals, Ltd.	108
Brown, S. G., Ltd.	100
Bulgin, A. F., & Co., Ltd. ..... Edit	149
Bull, J., & Sons	68
Bullers, Ltd.	52
Burne-Jones & Co., Ltd.	64
Burn Engineering	168
Candler System Co.	171
Cape Electrophonics, Ltd.	164
Chaffey Cabinet Co.	162
Champion Products	162
Chapman, C. T., (Reproducers), Ltd.	24
Cinema Television, Ltd.	26
City Sale & Exchange, Ltd.	121
Classic Electrical Co., Ltd.	49
Clydesdale Supply Co.	125
Clyne Radio, Ltd. 130,	131
Cohen, D. 138,	139
Cosmocord, Ltd.	84
Cossor, A. C., Ltd. 30,	87
Coventry Radio	154
Cranston, Alan	160
Daly (Condensers), Ltd.	122
Davies, A., & Co.	171
Davis, Jack, (Relays), Ltd.	122
Denco (Clacton), Ltd.	20
Dependable Radio Supplies	167
Direct T.V. Replacements	116
Dixon, L., & Co.	166
Drayton Regulator & Instrument Co., Ltd.	152
Dubilier Condenser Co. (1925), Ltd.	45
Duke & Co.	169
Dulci Co., Ltd., The	161
Dun-Sobieson Electrical Co.	170
Easco Electrical (Holdings), Ltd.	171
Edison Swan Electric Co., Ltd. Cover ii, 47, 91,	111
Edwards, W., & Co.	113
Egen Electric, Ltd.	103
Electrical Instrument Repair Service, The	166
Electric Audio Reproducers	113
Electrical Instrument Co. (Hillington), Ltd., The	140
Electro-Acoustic Developments	165
Electro-Acoustic Industries, Ltd.	4
Electronic Precision Equipment .. 96, 97, 98,	99
Electronic Tubes, Ltd.	48
Electro-Winds, Ltd.	122
Ellison Transformers, Ltd.	110
E.M.I. Institutes 31, 90,	118
English Electric Valve Co., Ltd.	54
Enthoven Solders, Ltd.	57
Eta Tool Co. (Leicester), Ltd.	112
E.W.A.	171*
Excel Sound Services, Ltd.	74
Ferranti, Ltd.	117
Filmer, J. T.	170
Fisher Electronics Co., Ltd.	33
Fluxite, Ltd.	160
Foyle, W. & G., Ltd.	118
Furzehill Laboratories, Ltd.	66
Galpins	163
Gardners Radio, Ltd.	106
Gee Bros., Radio, Ltd.	148
General Electric Co., Ltd. 53, 60,	101
Glaser, L., & Co.	170
Glover, W. T., & Co., Ltd.	109
Goodmans Industries, Ltd. 15,	61
Goodsell, Ltd.	62
Gramophone Co., Ltd., The	88
Gray, Arthur, Ltd	124
Greenlick, O.	160
Griffiths Hansen (Recordings), Ltd.	173
Grundig (Gt. Britain), Ltd.	112
Hall Electric, Ltd.	14
Hanney, L. F.	140
Harris, P. 158,	160
Hartley, H. A., Co., Ltd.	38
Harvey Electronics, Ltd.	154
Hatfield Radio	148
Henley's, W. T., Telegraph Works Co., Ltd.	163
Henry's	143
Hifi, Ltd.	144
Hilger & Watts, Ltd.	75
Hivac, Ltd.	73
Holley's Radio	150
Homelab Instruments, Ltd.	102
Household Electrix, Ltd.	51
H.P. Radio Services, Ltd.	112
Hunton, Ltd.	146
Iliffe Books 72,	102
Imhof, Alfred, Ltd.	52
International Correspondence Schools	106
Jackson Radio	163
Jason Motor & Electronic Co.	168
Kempner, S.	126
Kenroy, Ltd.	164
Keyswitch Co., The	70
Koskie, B.	124
Lafco Compounds, Ltd.	167
Lasky's Radio 127, 128,	129
Leak, H. J., & Co., Ltd.	95
Lee Products (Gt. Britain), Ltd.	68
Leevers-Rich Equipment, Ltd.	142
Lewis Radio Co.	167
Light Soldering Developments, Ltd.	160
Lockwood & Co.	173
London Central Radio Stores	166
Lowther Mfg. Co	110
L. R. Supply Co., Ltd.	105
Lyons Radio	162
Magnetic Coatings, Ltd.	73
Magnetic Devices, Ltd. 27,	65
Mail Order Supply Co	21
Malvyn Eng. Co.	170
Marconi Instruments, Ltd.	119
Marconi's Wireless Telegraph Co., Ltd. 86,	89
Marks, C., & Co.	140
Martin, J. H.	170
Massey, R.	170
McMurdo Instrument Co., Ltd.	64
Midland Instrument Co.	150
Modern Book Co.	154
Modern Electrics, Ltd.	118
Modern Techniques	104
Morley Transformers	170
M.R. Supplies, Ltd.	74
Mullard, Ltd. 3, 7, 41, 55, 62, 69,	82
Multicore Solders, Ltd. ..... Cover	iv
Multitone Electric Co., Ltd.	38
Murex, Ltd.	107
Northern Radio Services 34,	35
Oddie, Bradbury & Cull, Ltd.	171
Osmor Radio Products, Ltd.	28
Oxley Developments Co., Ltd.	158
Painton, Ltd.	63
Parmeko, Ltd.	37
Parsonage, W. F., & Co., Ltd.	166
Partridge Transformers, Ltd.	157
P.C.A. Radio	150
Pearce, T. W.	154
Peto Electrical Instruments, Ltd.	150
Pitman, Sir Isaac, & Son, Ltd.	158
Plessey Co., Ltd., The	8
Post Radio Supplies 160,	164
Power Controls, Ltd. 22,	23
Premier Radio Co. 76, 77, 78,	79
Proops Bros., Ltd.	138
Pye, Ltd. 18,	39
Quality Equipment Designers, Ltd.	125
Quartz Crystal Co., Ltd.	160
Radio & Electrical Mart, The	152
Radio Component Specialists	151
Radio Corporation of America	16
Radio Kits, Inc.	170
Radio Mailing	118
Radio Resistor Co., Ltd., The	25
Radio Servicing Co.	115
Radiospares, Ltd.	154
Radio Supply Co. 136,	137
Radio Traders, Ltd.	144
Reliance Mfg. Co. (Southwark), Ltd.	158
Reynolds, H.	173
Roding Laboratories	100
Rogers Development Co.	107
Roia Celestion, Ltd.	36
Rollet, H., & Co., Ltd.	170
Rudman Darlington (Electronics), Ltd.	123
Runbaken Electrical Products	170
Salford Electrical Instruments, Ltd.	42
Sallis, A. T.	170
Samsons Surplus Stores	152
Sangamo Weston, Ltd.	92
Savage Transformers, Ltd.	159
Service Radio Spares	142
Sherman's Supply Co.	155
Simmonds, L. E., Ltd.	114
Simon Sound Service	59
Smith, G. W., (Radio), Ltd.	147
Smith, H. L., & Co., Ltd.	171
Smith, W. H., & Son, Ltd.	104
Sound Sales, Ltd.	92
Southern Radio Supply, Ltd.	165
Specialist Switches	168
Spencer-West	162
Standard Telephones & Cables, Ltd. 29, 67,	85
Star Metal Plate Works	164
Stead, J., & Co., Ltd.	110
Steatite & Porcelain Products, Ltd.	32
Stern Radio, Ltd. 132, 133, 134,	135
Stewart Transformers, Ltd.	120
Stratton & Co., Ltd.	114
Sufiex, Ltd.	17
Sugden, A. R., & Co. (Engineers), Ltd.	72
Supacoils	161
Superior Radio Supplies	126
Sutton Coldfield Electrical Engineers	168
Tannoy Products, Ltd.	164
Taylor Electrical Instruments, Ltd.	56
Taylor Tunnicliff (Refractories), Ltd.	10
Tektronix Inc.	40
Telecraft, Ltd	162
Telegraph Condenser Co., Ltd. ..... Cover	iii
Telegraph Construction & Maintenance Co., Ltd.	121
Teleonics, Ltd.	142
Tele-Radio (1943), Ltd.	46
Teletron Co., The	170
Thorn Electrical Industries, Ltd.	43
Trianon Electric, Ltd	120
Trix Electrical Co., Ltd. ..... Edit.	147
Truvox, Ltd. 50,	51
Uncles, Bliss & Co., Ltd.	116
Universal Book Co.	168
Universal Electronics	149
University Electrical Instruments Corpn.	145
Valradio, Ltd.	144
Venner Accumulators, Ltd.	48
Verdik Sales, Ltd.	115
V.E.S. Wholesale Services, Ltd.	120
Vortexion, Ltd.	93
Watson Watch Co., The	168
Watts, Cecil E.	170
Wayne Kerr Laboratories, Ltd., The	12
Webber, R. A., Ltd.	122
Webb's Radio	154
Welwyn Electrical Laboratories, Ltd.	79
Westinghouse Brake & Signal Co., Ltd.	36
Weymouth Radio Mfg. Co., Ltd., The	44
Wharfedale Wireless Works	94
Whitaker, H.	124
White, S. S., Co. of Gt. Britain, Ltd., The	124
Wilkinson, L., (Croydon), Ltd.	165
Willesden Transformer Co., Ltd.	20
Wilson, R., & Co.	168
Woden Transformers, Ltd.	100
Woolleys Radio & Electrical Supplies	152
Wright & Weaire, Ltd.	5
Young, C. H.	148
Z. & I. Aero Services, Ltd.	126

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1 *Wireless World* can be obtained abroad from the following: AUSTRALIA AND NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service Ltd.: Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: The International News Co.