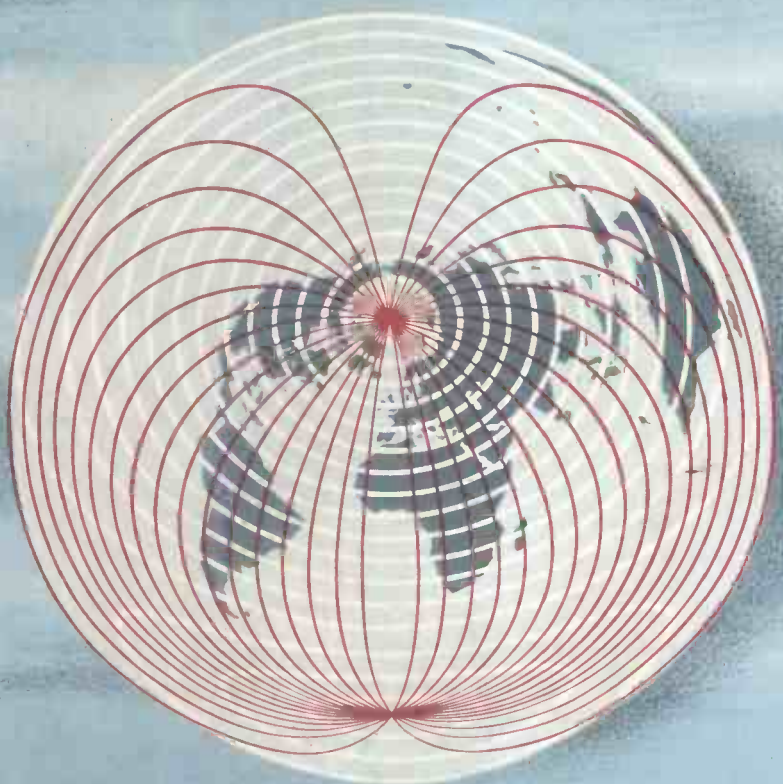
SEPTEMBER 1954 · TWO SHILLINGS

Show Guide

Wireless World

Radio · Electronics · Television



FORTY-FOURTH YEAR OF PUBLICATION

Photo-Electric Multipliers 27M1 and 27M2

for light operated relays, film scanning, facsimile transmission, and many Research and Laboratory investigations involving low light levels.

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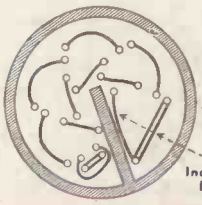

The secondary cathodes, or dynodes, of these multipliers are arranged in cylindrical formation so that they are exceptionally compact.

27M1 The 27M1 is a nine stage high vacuum photo cell with high response in the visible region. When operated at 100 volts per stage it is capable of multiplying very small currents produced under weak illumination by an average value of one million times. Under normal operating conditions the resultant output current is a linear function of the exciting illumination. The frequency response is flat up to the frequencies at which transit time of electrons within the valve becomes a limiting factor.

Because of its great sensitivity, low noise level, low dark current and freedom from distortion the 27M1 may be used for light operated relays, film scanning, facsimile transmission and in scientific research involving low light levels. In many applications its small size is an advantage. List Price: £15.

TYPICAL OPERATION

Voltage between anode and secondary cathode K10	50 volts
Voltage difference per stage	100 volts
Maximum anode dark current (with 100 volts between anode and cathode K10)	0.25μA
Luminous sensitivity (taken on the basis of a lamp colour temperature of 2700°K and a light area of 5 mm x 20 mm)	20A/lumen
Current amplification (ratio of anode sensitivity/cathode sensitivity)	10^6

27M2 The 27M2 is a nine stage high-vacuum photo-cell similar to the 27M1 except that it has wider tolerances on the anode dark current necessitating a lower anode supply voltage with a resultant reduction in the current amplification to approximately one quarter of that obtainable from the 27M1. It is capable of multiplying very small currents produced under weak illumination by an average value of 250,000 times when operated at 80 volts per stage.

The 27M2 is suitable for the same applications as the 27M1 wherever the reduced magnification is acceptable. List Price: £6.

TYPICAL OPERATION

Voltage between anode and secondary cathode K10	50 volts
Voltage difference per stage	80 volts
Maximum anode dark current (with 80 volts between anode and secondary cathode K10)	0.25μA
Luminous sensitivity (taken on the basis of a lamp colour temperature of 2700°K and a light area of 5 mm x 20 mm)	2.5A/lumen
Current amplification (ratio of anode sensitivity/cathode sensitivity)	0.25×10^6

Either the 27M1 or the 27M2 may be used as a plug-in replacement for the American type 931A.
A special stabilised power unit providing a highly stable H.T. supply for photo-multipliers is available.
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Wireless World

RADIO, TELEVISION AND ELECTRONICS

44th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
Editor: H. F. SMITH

SEPTEMBER 1954

In This Issue

PUBLISHED MONTHLY (last Monday 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.

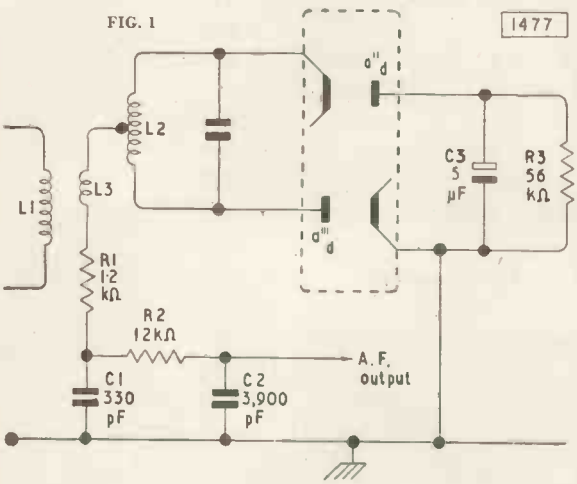
VALVES, TUBES & CIRCUITS

21. DETECTION IN F.M./A.M. RECEIVERS

For the detection of frequency modulated signals it is necessary to convert frequency changes into amplitude changes and to recover the intelligence contained in the original signals from the amplitude modulated carrier. The method most widely used for this purpose employs a form of phase discriminator known as the ratio detector. The particular advantage of the ratio detector is its excellent suppression of any amplitude modulation which may be present on the F.M. carrier as a result of noise or variations of gain in the earlier stages of the receiver. This type of circuit has good sensitivity and eliminates the expense of providing additional limiting stages.

A typical form of ratio detector circuit is shown in Fig. 1, and it will be noted that two diodes with independent cathode connections are necessary. The Mullard EABC80 is recommended for use in this type of circuit. This valve is a combined triple diode and voltage amplifying triode, with a heater rating of 6.3V, 0.45A, and it is mounted on the B9A (noval) base. One diod (a″d) is provided with a separate cathode (pin 3), the other two diodes and the triode sharing a second cathode (pin 7). The ratio detector circuit employs two of the diodes (a''_d and a'''_d) which have low impedances (about 200Ω) whose ratio never exceeds 1.5. The other diode (a'_d) is suitable for use in A.M. reception as a conventional detector and generator of A.G.C. voltage. The triode section is designed to be used as an audio amplifier following the detector during both F.M. and A.M. reception. Its electrical characteristics are similar to the triode section of the Mullard EBC41.

FIG. 1



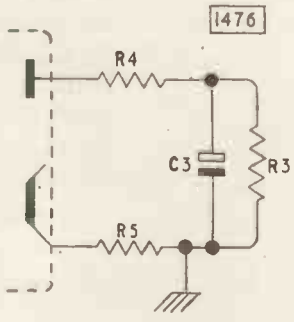
In the circuit illustrated, the primary winding L1 of the ratio filter is in the anode circuit of the final I.F. valve. The secondary coil, L2, is tuned to the intermediate frequency (10.7 Mc/s). The voltages in the two halves of L2 have a 180° phase difference, and their magnitudes depend upon the sweep frequency of the F.M. signal. The tertiary winding, L3, consisting of a few turns wound over the anode end of the primary, matches the anode circuit of the preceding I.F. stage into the diode circuit.

The ratio detector can take the form of a balanced circuit in which two equal capacitors are placed across the load resistor, R3, and their common connection taken to earth. In Fig. 1 the unbalanced type of circuit is given. Here only one capacitor, C1, has been retained, from which the audio output is taken. The 5μF electrolytic capacitor, C3, is then necessary to stabilise the voltage across R3.

The value of load resistance (56kΩ) is a compromise between that required for optimum gain and the necessary A.M. suppression. Good A.M. suppression is also achieved by using a relatively high resistance, 1.2kΩ, in series with the tertiary coil. Further increase in the value of load resistance (say, to 68kΩ), whilst resulting in larger ouput voltage, requires more satisfactory balancing in the preceding circuit in order to keep the rejection of A.M. to an acceptable value. Thus a trimmer capacitor could be connected from the centre-tap on the secondary to earth, and a small series resistance included in the lead from the centre-tap to the tertiary coil L3. These modifications will lead to a considerable improvement in suppression and some increase in sensitivity, but the preliminary adjustments to the trimmer are much more involved.

As a further refinement, some suppression can be sacrificed by connecting the stabilising capacitor across only a part of the total diode load (Fig. 2). With suitable values for R4 and R5 the suppression will depend to a much smaller extent on spreads in the forward resistance of the diodes and on variations in the amplitude.

FIG. 2



Wireless World

SEPTEMBER 1954 VOL. 60 No. 9

Authority and Independence

WE have now had ample time to study the new Television Act, which became law just after our last issue appeared. The Government's plan for an "additional" television service, though somewhat involved, is not on the face of it, difficult to understand, though we must admit to doubts as to how some of the details will work out in practice.

To us, the most interesting section of the Act is that in which the Postmaster-General is given what appears to be very wide powers over the technical activities of the Independent Television Authority. In this matter, at least, there appears to be little independence and no authority! Of course, it is a fact that in Great Britain the P.M.G.'s power over every form of radio activity is sweeping; he may make regulations prescribing "the things that are to be done or are not to be done" by any one of his licensees. Of course, he may intend to keep these powers up his sleeve, and allow the I.T.A. as much technical autonomy as is enjoyed by the B.B.C. If he does not, one is tempted to ask, what is the purpose of the I.T.A.? It would surely have been less wasteful of national resources and effort to leave the *technical* means of television distribution in the hands of the B.B.C. The Government's quarrel with the B.B.C. monopoly was that it represented a monopoly in the dissemination of ideas; that objection would have been overcome much more economically by setting up a chain of transmitters operated by the B.B.C. but fed with programmes under the control of a truly independent body getting its revenue from advertisements.

The Post Office decision, announced before the new Authority came into being, that the I.T.A. transmissions were to be polarized like those of the B.B.C. in the same areas, may or may not lend colour to the idea that the P.M.G. intends to make himself responsible, not only for controlling technical policy, but for shaping it as well.

Further support for the same idea comes from the fact that one of the members of the Authority has any radio-technical qualifications or experience, and so must depend entirely on the engineering staff they may appoint or on outside advisers. And, of course, there is still another body that comes into the picture: the P.M.G.'s decisions on technical policy for both the I.T.A. and B.B.C. will be affected by the recommendations of the Television Advisory Committee.

Fortunately, there is a good deal of flexibility in the Act, and plenty of room for second thoughts. The word "may" occurs much more often than "shall" and the P.M.G. can make new regulations at short notice. Throughout all the debates, the Government has wisely kept to the principle of leaving a loophole for subsequent changes.

It is wrong to shoot the pianist who is doing his best, and still worse to shoot him before he has played a single note. The I.T.A. needs the full support of everyone concerned with radio in implementing the complicated scheme laid down in the Act. *Wireless World's* only fear is that, with so many secondary problems to overcome, attention may be distracted from the primary task of planning the long-term technical development of television.

Radio Eavesdropping

A GOOD deal of publicity has been given in the daily Press to a recent case in a London magistrate's court, where two men were charged with contravening the section of the Wireless Telegraphy Act that forbids the interception and disclosure of messages. It was stated they had listened to police and fire-service v.h.f. transmissions and passed on information so gained to news agencies and fire assessors. The defendants, who pleaded guilty and said they had no idea they were acting unlawfully, were ordered to pay £8 8s and £2 2s costs, respectively.

Newspapers, in reporting the case, made play with the fact that this was the first prosecution of its kind. That may be true enough, but no new principle is involved. Lack of secrecy has always been a skeleton in the radio cupboard and for 50 years the Postmaster-General has rightly had the power (which he has used widely) to make regulations against unauthorized interception and disclosure of messages.

The Television Act

Summary of the Main Provisions

WELL over two years ago, the Government first declared their intention of establishing a new television service, alternative to that conducted by the B.B.C. Two basic principles for the proposed scheme were affirmed by Government spokesmen; it was to be competitive and was to be financed by advertisments. Since then, many methods of attaining the desired end have been debated, only to be abandoned or modified later; even the basic principles have been watered down to some extent. Now, at last, a cut-and-dried plan has appeared in the final form of an Act of Parliament. In view of all the changes that have taken place and in spite of the vast number of words that have been written in the Press, readers may like to have a summary of those provisions of the Act most likely to affect them.

The Television Act, 1954 (H.M.S.O., price 9d) makes "provision for television broacasting services additional to those provided by the British Broadcasting Corporation, and to set up a special authority for the purpose . . . to be called the Independent Television Authority." The I.T.A. is to provide, for the period of 10 years, television services "of high quality, both as to the transmission and as to the matter transmitted," and shall be composed of a chairman, deputy chairman and eight others. These under the chairmanship of Sir Kenneth Clark have now been appointed by the Postmaster-General. They comprise an assemblage of persons distinguished in the Arts, literature, industry and the world of affairs. It is stipulated that none of them shall have any interest in an advertising agency, in the selling of radio equipment or in programme contracts. The members are to be paid, and, in addition to membership, may perform other salaried work in the Authority.

The I.T.A. is to be a "body corporate" but not a body exercising functions on behalf of the Crown. It enjoys no special privileges under the Wireless Telegraphy Act, and will need the Postmaster General's licence for its stations. The aim is that the Authority shall be financially self-supporting as soon as possible, but it may be granted by the P.M.G. up to £750,000 a year. Initial capital expenditure is to be met by a grant of up to £2M, spread over five years.

First and foremost, the function of the I.T.A. is to build and operate television broadcasting stations. It must also arrange for studios to be provided, or if need be, itself provide them. By arrangement with the P.M.G., the I.T.A. may also arrange for wired distribution of programmes through relay companies.

Provision of programmes is primarily a matter for "programme contractors," but the Authority itself may when necessary transmit its own material, in which paid advertisements may be inserted. The programme contractors will, in effect, "buy time" from the I.T.A., recouping themselves by charging fees for advertisements which will be transmitted during the intervals between items or at natural breaks in the programmes. There is to be no "sponsoring"; advertisements must not be directly associated with the programmes.

The matter of the programme contracting companies is still somewhat obscure. From our point of view, virtually all we know from the Act is that it will be the duty of the I.T.A. to secure "adequate competition" between a number of them to supply programmes. It is not known how the time of the various I.T.A. stations is to be divided between the various contractors.

Wide powers of control over the contractors are conferred by the Act on the I.T.A., who may impose heavy penalties for breach of contract. They are bound by the Act to observe certain rules as to the pay and conditions of their staff.

The Authority, in its turn, is subject to pretty drastic Government control of their day-to-day activities. The P.M.G. or any other Minister of the Crown may require them to broadcast any announcement, while the P.M.G. may at any time impose a ban on the broadcasting of "any matter or classes of matter." He also has the power to determine the hours of broadcasting, both as to maximum and minimum hours per day and as to the actual times of the transmissions.

On the technical side the Authority is subject to equally rigorous control under the powers conferred on the P.M.G. by the Act. They may be required to use "such technical measures or processes as may be specified" or to set up additional stations thought to be necessary to extend coverage.

There are a number of secondary provisions, including permission for the I.T.A. to do various things arising out of its main function and to embark on ancillary business enterprises that may be found necessary. The I.T.A. must not, however, manufacture or sell radio equipment.

The rest of the Act—in fact, the greater part of it—is concerned with detailed control of broadcast matter. An obligation is put on the Authority to see that programmes do not offend good taste or decency, do not incite to crime or lead to disorder or offend public feeling. They also have the responsibility of ensuring balanced programmes, of presenting news accurately and impartially and of showing no political bias.

Resistor and Capacitor Preferred Values

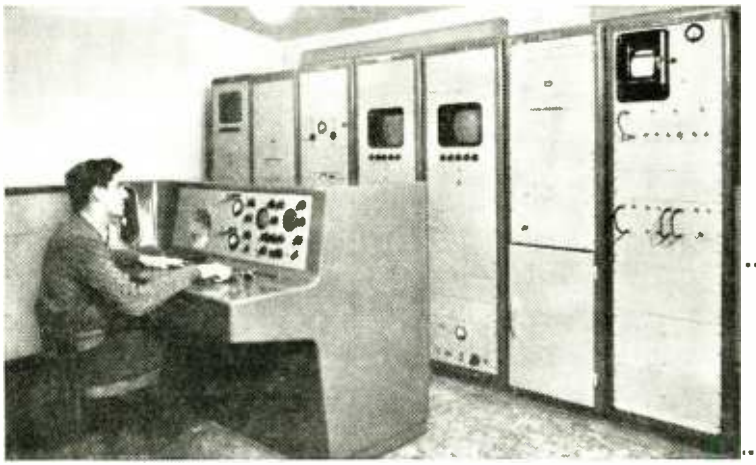
A British Standard for the preferred values and tolerances of resistors and capacitors used in telecommunications equipment is now obtainable from the British Standards Institution, 2, Park Street, London, W.1 (price 2s.)

The standard specifies a series of rounded values based on the 12th root of 10 system and with tolerances of 5, 10 and 20%. The 10% series is compiled by omitting alternate terms in the 5% series; likewise the 20% omits alternate terms in the 10% series.

While the 20% series is well known the other two are possibly not common knowledge and we give below the 5% series. Values are in ohms for resistors and in picofarads for capacitors.

Five per cent values: 1.0, 1.1, 1.2, 1.3, 1.5, 1.6, 1.8, 2.0, 2.2, 2.4, 2.7, 3.0, 3.3, 3.6, 3.9, 4.3, 4.7, 5.1, 5.6, 6.2, 6.8, 7.5, 8.2 and 9.1. The other two series start with 1.0 and are thus easily compiled from this list.

WORLD OF WIRELESS



Fleming Valve Jubilee

◆

Ionosphere Meeting

◆

U.S. Television

TELEVISION RELAY.—The operator-controlled diversity receiving station in Jersey where, as described last month, a wired service is distributed over the island by Rediffusion. The monitor tubes show London and Wenvoe pictures.

Jubilee of the Valve

IT WILL be fifty years on November 16th since Sir Ambrose Fleming took out the fundamental thermionic valve patent, No. 24850—"Improvements in Instruments for Detecting and Measuring Alternating Electric Currents." To mark the jubilee the I.E.E. has arranged an exhibition of historical apparatus and three lectures on the development of the valve will be given by Sir Edward Appleton, Professor G. W. O. Howe and Dr. J. Thomson.

The lectures will be given on the actual anniversary and the proceedings will be opened by the Lord President of the Council, the Marquess of Salisbury.

Ionospherists Meet

AS already announced a conference on "The Physics of the Ionosphere" is being organized by J. A. Ratcliffe, F.R.S., reader in physics at Cambridge University, in collaboration with the Physical Society. It will be held at the Cavendish Laboratory from September 6th to 9th, and will be devoted mainly to discussions of the following topics: (a) the lowest ionosphere; (b) irregularities and movements in the ionosphere; (c) the F2 layer; (d) the mathematics of wave propagation through the ionosphere.

As the conference follows the meeting of the International Scientific Radio Union at Amsterdam many foreign delegates will be among the 200 or more participating.

Abstracts of the sixty papers presented and the surveys summarizing the present position in each of the subjects discussed will be published later by the Physical Society.

U.S. Colour Television

THE cost, and more especially, the size of the three-colour tube have been cited as the main reasons for the slow "get-away" of colour television in the United States. So far colour tubes have had only comparatively small screens and have, therefore, been unacceptable to viewers who have become accustomed to 21-in and even larger monochrome screens.

Answers to both criticisms have been given by C.B.S.-Hytron who have produced a 19-in tri-colour tube at $175. The principle employed for the production of these tubes, which, it is stated, will be at the rate of 400 a day by the end of September, was briefly described in our January issue.

Radio Research

A START was recently made on the new building to be erected for the Radio Research Station of the D.S.I.R. at Ditton Park, Slough, Bucks.

Naturally everything is being done to reduce interference to a minimum. The building is over 200 yards from the nearest road, the adjoining 100 acres has been acquired to ensure isolation and as a further precaution to minimize disturbance with experimental work, the waste outlet from the building will be conveyed in a non-metallic pipe to the main district sewer.

The building has been designed specifically to meet the requirements of the Radio Research Station, of which Dr. R. L. Smith-Rose is the director with a staff of just over 100 who are at present in temporary accommodation.

Increased Exports

THE radio industry's exports during the first six months of the year increased by £2.25M compared with the same period in 1953. Of this figure £1.7M was accounted for by increased exports of communication and navigational equipment which totalled £5,974,841—approximately 46 per cent of the whole industry's exports. Increased exports are also recorded for components (£893,000), p.a. equipment and loudspeakers (£58,000) and sound reproducing gear (£38,000).

The six-months' total was £12,996,603.

Industrial Television

INCREASING use is being made by leading U.S. industrialists of closed-circuit television for nation-wide sales conventions. Instead of salesmen and distributors from all over the country travelling at considerable expense to a central meeting they merely

go to the studios of local television stations, which are linked with a central station where the company's executives are gathered to present their wares.

According to a report in the *Financial Times* on the activities of Box Office Television, Inc., which specializes in such "telecast conventions," Westinghouse Electric recently saved $375,000 by introducing its new receivers and appliances to 2,000 distributors through a television convention.

Valve Data

ELECTRICAL characteristics and base connections of over 2,000 British and American valves and British transistors and some 200 cathode-ray tubes are given in the latest edition of "Radio Valve Data."* The valves are classified under main headings according to their type—frequency changers, screened tetrodes, pentodes, etc. In each of these sections, they are listed under makers' names and are further classified as current, replacement or obsolete types.

Seventeen British valve manufacturers co-operated with *Wireless World* in ensuring that the information is accurate and up to date.

Additional features included in this edition are a list of equivalents, which is combined with an index, and special quality valves.

* "Radio Valve Data," fourth edition, 100 pages (11in×8¼in), published for *Wireless World* by Iliffe & Sons Ltd., price 3s 6d.

PERSONALITIES

Sir Ben Lockspeiser, F.R.S., secretary of the Department of Scientific and Industrial Research since 1949, is to receive the honorary degree of Doctor of Science at Oxford University. The presentation will precede the opening of the 116th annual meeting of the British Association for the Advancement of Science on September 1st.

E. P. B. Metcalfe, appointed engineer-in-charge of the Isle of Wight television station, which is coming into service in November, has been engineer-in-charge of the temporary Brighton station since May last year. He joined the B.B.C. in 1936 and was a maintenance engineer at various sound stations before becoming senior maintenance engineer at the Wenvoe television station in 1952.

E. J. Power, head of Murphy Radio, has been invited to become a member of the Council of the Royal College of Art. This may be taken as a tribute to the part played by his firm in industrial art; it was in the early thirties that Murphy first produced a receiver cabinet that set a new standard in functional external design.

J. P. Salter, the contributor of the article in this issue on the measurement of small voltage differences, is a senior engineer in the Armament Design Establishment of the Ministry of Supply. He served throughout the war in the Royal Artillery as an instructor in fire control (anti-aircraft radar). Before joining the Ministry of Supply for work on fuzes, on which he was engaged for six years, he was for a short time at R.R.D.E., Malvern.

C. E. Knight Clarke, who had been publicity manager for Decca Radar for two years, is now running his own business producing technical literature. Before joining Decca's he was with the G.E.C. publicity organization, where he handled the production of radio and valve technical literature. His address is 36, Denbigh Street, London, S.W.1. (Tel.: Victoria 5394.)

IN BRIEF

The increase in licensed viewers in the U.K. during the first six months of the year was 454,200. The June increase was 31,680, bringing the total to 3,411,046. The total number of **Broadcast Receiving Licences** at the end of June (including the above and 236,057 for car sets) was 13,512,275.

November 12th has been given by the B.B.C. as the date for the opening of the **Isle of Wight Television Station.** When this permanent station at Rowridge comes into service the temporary booster transmitter on Truleigh Hill, near Brighton, which has been in operation since May, 1953, will be closed down. The new station will operate in Channel 3 (56.75 and 53.25 Mc/s) and use vertical polarization as the Brighton booster has done.

The ninth **Electronics Course** covering the design, use and maintenance of electronic instruments used in nuclear physics, radio chemistry and in work with radio isotopes, will be held at the Isotope School, at Harwell, from November 1st to 5th. Physicists and electronic engineers, holding a degree or equivalent qualification, can obtain application forms from the Electronics Division, A.E.R.E., Harwell, Didcot, Berks. Attendance is limited and the fee is 12 guineas, excluding accommodation.

The operating frequency of the Lugo, Spain, **Consol Station** has been changed from 303 kc/s to 285 kc/s. The Seville station recently changed from 311 to 315 kc/s.

I.E.E. Students.—The new chairman and vice-chairman of the London Students' Section of the I.E.E. are M. C. Cubitt (Pye, Ltd.) and M. H. F. Collins (B.T-H.), respectively.

I.P.R.E.—At the inaugural meeting of the Yorkshire section of Incorporated Practical Radio Engineers (previously the Institute of Practical Radio Engineers), over 150 servicemen and traders were present. The local secretary is P. A. Senior, 5, Calverley Moor Avenue, Thornbury, Bradford, 3.

A miniature TV camera, manufactured by **Pye, Ltd.,** was used recently at the Hospital for Sick Children, Great Ormond Street, London, to enable 100 surgeons to watch a series of operations. The surgeons were attending the inaugural meeting of the British Association of Pedriatic Surgeons.

A new **Third Programme Transmitter** is to be built by the B.B.C. at Swansea, Glamorgan. Rated at 1 kW, it will operate on 1546 kc/s (194 metres).

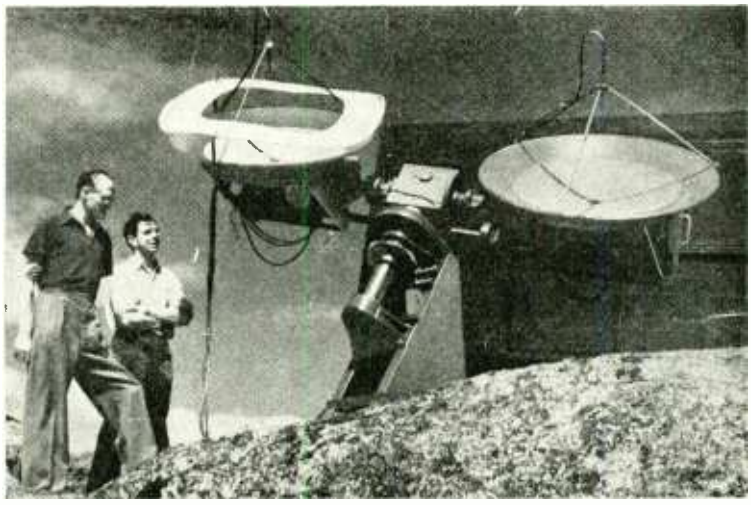
Tape Letters.—A miniature spool of 120ft of tape, weighing less than 1½ oz and, therefore, particularly suitable for recording messages for posting, has been produced by Grundig. The "Mailspool," which permits six minutes recording on each track at 3¾ in/sec, costs 6s 9d (export price 4s).

Hungarian TV.—Preparatory to planning the country's television service experimental transmissions are being radiated in Budapest. Some 200 foreign-made television receivers are said to be in use in the city for this investigation.

Indian Manufacturers.—A new class of membership—associate members—has been introduced by the Radio Manufacturers' Association of India to provide for smaller manufacturers. The member-firms constituting the R.M.A.I. committee are:—General Electric Company of India; Gramophone Company; International General Electric Company (India); Murphy Radio of India; National Ekco Radio & Engineering Company; Philips Electrical Company (India) and Radio & Electrical Manufacturing Company.

Glass being one of the many raw materials used in radio and electronics, we make no apology for drawing readers' attention to the information centre provided by the Glass Manufacturers' Federation at its new headquarters at 19, Portland Place, London, W.1.

Electronic Cooking.—The first electronic bakery in France is being set up by the French Ministry of Agriculture in Paris. It is planned to produce up to 30 tons of bread a day. Radio-frequency cooking has been used on a small scale in the United States for the commercial preparation of foodstuffs, but, according to our contemporary, *Electronics*, domestic r.f. cookers are being "home tested," and mass production at $1,000 each is planned for 1955.



ECHO OF THE ECLIPSE. Radio astronomers as well as optical astronomers were in Norway to observe the eclipse of the sun this year. The equatorially-mounted aerials shown here were set up on a peninsular near Sandefjord by an expedition from the M.o.S. Radar Research Establishment led by C. R. Ditchfield (right). Measurements of solar noise were made on a wavelength of 8 mm, the reflectors being arranged to follow the course of the sun.

"W.E." Editorials—The index to Dr. Howe's editorials in *Wireless Engineer* during the past twenty-eight years, to which we referred last month, has been prepared personally by Dr. A. J. Small, of the Department of Electrical Engineering, The University, Glasgow, W.2. We omitted to state that the index, which is obtainable direct from Dr. Small, costs 5s.

No fewer than **2,500 British Standards,** current at March 31st, are listed and briefly described in the 1954 edition of the "British Standards Yearbook." It also gives particulars of work in hand by the various Industry Standards Committees. The Yearbook is obtainable from the British Standards Institution, 2, Park Street, London, W.1, price 12s 6d.

Readers concerned with the **Transport of Goods** may like to know of the publication of the new "ABC Goods Transport Guide," published by *Motor Transport*. It includes a directory of operators of regular, long-distance road transport services and of specialist carriers. It costs 3s 6d (inc. postage).

Nottingham Central Library has issued a catalogue of some 200 books and periodicals on radio, television and radar which are available through its various branches. Journals are kept for three months, except in the case of *Wireless Engineer*, which is available from 1936, and *Wireless World* for the past six years.

EDUCATIONAL OPPORTUNITIES

The course of ten lectures on "**Crystal Valves and Transistors**" at the Borough Polytechnic, London, S.E.1, which proved so popular last year that it was run in triplicate with a total attendance of some 300, is being given in duplicate this year. The lectures, by members of the Mullard research and development staff, will be given on Tuesdays at 3.0 and 7.0 beginning on October 19th. The fee is 2 guineas. For the fourth successive year the Borough Polytechnic is also arranging a course of lectures on "The Fundamental Principles of Pulse Techniques."

A thirteen-week intensive **Course in Electronics,** designed to give those unable to take a long course an insight into the underlying principles and some of the applications of electronics, is provided by the Norwood Technical College, London, S.E.27. The college also provides a three-year full-time course in telecommunication engineering, one-year courses for the 1st and 2nd Class P.M.G. Certificates, and part-time day and evening courses in radar principles and techniques, radio and television servicing, television theory and for the Brit.I.R.E. Graduate examination.

The prospectus of **Evening Courses** arranged by the Electrical Engineering Department of The Polytechnic, Regent Street, London, W.1, includes approved telecommunications courses for the award of the Ordinary and Higher National Certificates and courses in radio and television servicing in preparation for the examination of the Radio Trades Examination Board.

Day and Evening Classes covering communication engineering (National Certificate courses), City and Guilds telecommunication engineering, and radio and television servicing, are listed in the prospectus of the Department of Electrical Engineering and Applied Physics of the South East London Technical College, Lewisham Way, S.E.4.

Amateur Classes.—We have been notified of a number of establishments providing classes during the coming session in preparation for the Radio Amateurs' Examination. Among them are the Wembley Evening Institute, Copland School, Wembley Hill, Middx. (Mondays); Ilford Literary Institute, Cranbrook Road, Ilford, Essex (Wednesdays); South East London Technical College, Lewisham Way, S.E.4 (Tuesdays); and the Grafton School, Eburne Road, Holloway, London, N.7 (Mondays). Courses commence on or after September 20th.

The recently formed Electrical Section of the **Wilmslow Guild** (Adult Education Centre), 1, Bourne Street, Wilmslow, Cheshire, is planning a series of classes of instruction in electronics. They will be held at 8.0 on Tuesdays beginning September 28th.

RADIO EXPORTS

Among the eight members of the new **Export Panel** formed by the British Standards Institution to advise on standards in relation to exports and how best B.S.I can assist export trade are J. W. Ridgeway, of Edison Swan, and Leslie Gamage, of the G.E.C.

Navigational radar equipment, radio transmitters, receivers and associated test equipment are to be supplied by **Marconi's** for five warships of the Egyptian Navy.

Radio-telephone equipment, including a 15-W fixed station, three smaller fixed stations and five mobile transmitter-receivers, has been supplied by **Pye, Ltd.,** to the Lisbon Tramway Company.

Radio equipment, including receivers, transmitters, teleprinters, terminal equipment and aerials, is listed among the products to be secured by the **Burma Purchasing Mission** to visit this country.

U.S. Enquiry.—Details of British-made industrial electronic equipment, inter-communication systems and p.a. gear are being sought by Warmington, Woodcock and Williams, Inc., 423, South 11th Street, Minneapolis, Minnesota, U.S.A. Interested manufacturers should send literature and c.i.f. prices in U.S. dollars by airmail.

Colombian Agency.—Casa Dyrma Ltda, Edificio Banco de Bogota, Oficina 632, Bogota, Colombia, have informed the British Embassy at Bogota that they are interested in

acting as agents for U.K. manufacturers of electronic equipment. A long list of equipment, components and accessories is given in the announcement of this enquiry by the Export Services Branch of the Board of Trade (Ref. ESB/15127/54).

King's Dock, Singapore, has recently been equipped with a public address system by the **G.E.C.** It comprises six horn loudspeakers mounted on the lighting pylons, which are fed by two 30-W amplifiers and have a range of a quarter of a mile. Microphone points are provided at intervals around the dock.

Ekco Electronics, Ltd., have secured an order from the Carborundum Company, of Niagara Falls, New York, for a thickness gauge installation for measuring Carborundum coated abrasive products during various stages of manufacture.

Decca Radar is to be fitted in ships of the South African Navy, which, it is understood, is the twenty-sixth navy to use Decca equipment.

INDUSTRIAL NEWS

Radio manufacturers participating in the **British Trade Fair** to be held in Baghdad from October 25th to November 8th include Pye (who are planning to demonstrate closed-circuit television), B.T-H., G.E.C. and S.T.C. The fair is being organized by British Overseas Fairs, Ltd., 21, Tothill Street, London, S.W.1, on behalf of the Federation of British Industries.

The new 20,000-ton Shaw Savill liner *Southern Cross*, the first passenger ship without any cargo space, is being equipped with **Marconi Marine** transmitters, receivers, sound reproducing equipment, radar, direction finders and echometer equipment.

Coaxial telephone cables and television camera cables and accessories will be shown by **B.I. Callender's Cables** at the International Trade Fair at Leipzig (September 5th to 15th).

Marconi Marine radio-communication equipment is to be fitted in the new 3,300-ton cable ship *Recorder* which is being built for Cable & Wireless.

What is believed to be the first installation of v.h.f. radio-telephone gear in British fishing craft has been completed by **Rees Mace Marine** in two vessels of the Claydeep Fishing Company, of Grimsby.

Standard Telephones & Cables, Ltd., have erected a new factory at Southampton New Docks for the production of submarine telephone cable and repeaters.

Leevers-Rich Equipment, Ltd., has moved from Wardour Street, London, W.1, to 78, Hampstead Road, London, N.W.1 (Tel.: Euston 1481). The studios of the associated company, Leevers Rich & Company, Ltd., professional recordists, are remaining at 80, Wardour Street, where Western Electric recording equipment has recently been installed to provide a sound-on-film transcription service.

Ferguson Service.—The Birmingham service depot of Thorn Electrical Industries, Ltd., has moved to 24, Sheepcote Street, Birmingham, 15 (Tel.: Birmingham, Midland 5291).

Pam (Radio & Television), Ltd., manufacturers of domestic sound and television receivers and sound reproducing equipment, have moved from North London to 295, Regent Street, London, W.1 (Tel.: Langham 7246).

Elesco Electronics, Ltd., has been formed to sell the electronic and electrical equipment handled by Land, Speight & Company, of 73, Robertson Street, Glasgow, C.2.

Anglo-Swiss Screw Company has opened a sales office at 12, St. Ann's Square, Manchester, 2 (Tel.: Deansgate 7552).

COMMERCIAL LITERATURE

Core Laminations made by Magnetic and Electrical Alloys are now available from H. W. Forrest, 349, Haslucks Green Road, Shirley, Birmingham, who are sole distributors in England. The latest catalogue of chokes and transformers from this firm includes isolating transformers for the heaters of c.r. tubes with heater-cathode shorts.

Transformers and Chokes as specified for the Osram 912 amplifier (see p. 430) are described in a leaflet from Partridge Transformers, Tolworth, Surrey.

"**Proc. L.L.L.**", described as a "journal of random frequency," gives frank opinions on electronic instruments and test gear of various makes for which Livingstone Laboratories are agents. Qualities of "handleability" are assessed. No. 1, Vol. 1, from Livingstone Laboratories, Retcar Street, London, N.19.

Powder Cores and Magnets; their production and use described in a booklet "Gecalloy Low Loss Cores and Micropowder Magnets" which also gives technical specifications, performance graphs and suitable core designs for various applications. From Salford Electrical Instruments, Peel Works, Silk Street, Salford, 3, Lancs.

CLUB NEWS

Birmingham.—At the meeting of the Slade Radio Society on September 3rd, A. B. Cape, M.B.E., will speak on "The Balancing of Rotors." The subject for the meeting on September 17th is "The Possibilities of Inter-Planetary Travel," introduced by W. E. Merrill. Meetings are held on alternate Fridays at 7.45 at the Church House, High Street, Erdington. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

QRP Exhibition.—Plans are being made by the QRP Society to hold an exhibition at Walton-on-Thames on October 30th. In addition to displays of amateur-constructed gear—including television—there will be exhibits of components and commercial sound and vision receivers. Provisions are being made for the demonstration of high-fidelity equipment and radio-controlled models. The exhibition will be held in St. Mary's Parish Church Hall, admission 1s. Sec.: J. Whitehead, 92, Rydens Avenue, Walton-on-Thames, Surrey.

South Shields.—The opening meeting of the winter programme of lectures and demonstrations for members of the South Shields and District Amateur Radio Club (G3DDI) will be held at 8 on September 10th in the Trinity House Social Centre, 134, Laygate Lane, South Shields. The club is installing transmitting equipment at the South Shields annual flower show (August 26th to 29th) which will be in operation in the 20-, 40- and 80-metre bands, using the specially allocated call-sign GB3SFS. Sec.: W. Dennell (G3ATA), 12, South Frederick Street, South Shields, Co. Durham.

MEETINGS

British Institution of Radio Engineers

London Section.—"Computing Circuits in Flight Simulators," by Dr. A. E. Cutler, B.Sc. (Redifon), at 6.30 on September 29th at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1.

British Sound Recording Association

London.—Presidential address by N. Leevers, B.Sc., at 7.0 on September 24th at the Royal Society of Arts, John Adam Street, London, W.C.2.

Manchester Centre.—"New Reproducing Equipment," by J. S. Holiday, at 7.30 on September 13th at the Engineers' Club, Albert Square, Manchester.

V.H.F. Broadcasting : B.B.C. Plans

COVERAGE OF FIRST NINE F.M. STATIONS

A ROUGH idea of the approximate areas to be covered by the first nine v.h.f. stations which the Government has at last sanctioned can be gained from this sketch map, based on information provided by the B.B.C. At each of the nine stations six transmitters will be installed—two in parallel for each of the three programmes to be radiated. The first station to be brought into service will be at Wrotham, Kent, where there are already two transmitters which have been used experimentally since 1950. It will be in operation next May. The other eight stations, which will be at the sites of the existing and projected television stations and will use the same masts, are to be completed by the end of 1956. Pontop Pike and Divis will be the second and third stations to be brought into operation.

Details of the frequencies to be used have not yet been announced by the B.B.C. It is, however, presumed they will be within the framework of the Plan for Band II drawn up at Stockholm in 1952, although, in fact, the U.K. was not a signatory to the Plan because at that time it was not known what method of modulation would be employed. The frequencies allocated to each of the projected transmitters in the Stockholm Plan are tabulated below. The figure in brackets is the effective radiated power in kilowatts.

The B.B.C. has already placed orders with Marconi's and S.T.C. for 64 transmitters varying from 1 to 10 kW.

	Mc/s
Wrotham, Kent [120]	89.1
	91.3
	93.5
Pontop Pike (Newcastle) [60]	88.5
	90.7
	92.9
Divis (Belfast) [60]	90.1
	92.3
	94.5
South Devon [60]	88.1
	90.3
	92.5
Meldrum, Aberdeenshire [60]	88.7
	90.9
	93.1
Holme Moss (Manchester) [120]	90.1
	92.3
	94.5
Sutton Coldfield (Birmingham) [120]	88.3
	90.5
	92.7
Norwich, Norfolk [120]	89.7
	91.9
	94.1
West Wales [60]	88.9
	91.1
	93.3

21st National Radio Show

STAND-TO-STAND PREVIEW OF TECHNICAL EXHIBITS

THE annual exhibition of British domestic radio equipment opens at Earls Court on August 25th. The preview of technical exhibits presented in the following pages differs from that given in the past few years in that it is a stand-to-stand report instead of a tabulated list of products. Prepared from information given to us by exhibitors, it will inevitably be incomplete in that there are bound to be a few manufacturers who will await the actual opening of the show to uncover their latest productions. Despite this, we feel that the following pages will provide a useful guide to visitors and a comprehensive survey for readers unable to attend the show.

The Radio Industry Council, which organizes the show, has again arranged for collective displays of electronic equipment. There are four such displays —two on the ground floor (marked E1 and E2 on the plan opposite) and two on the first floor (E3 and E4).

The exhibits will not, this year, be grouped together under "applications" except in the case of radio control gear. In all some twenty-five examples of applied electronics will be shown and demonstrated.

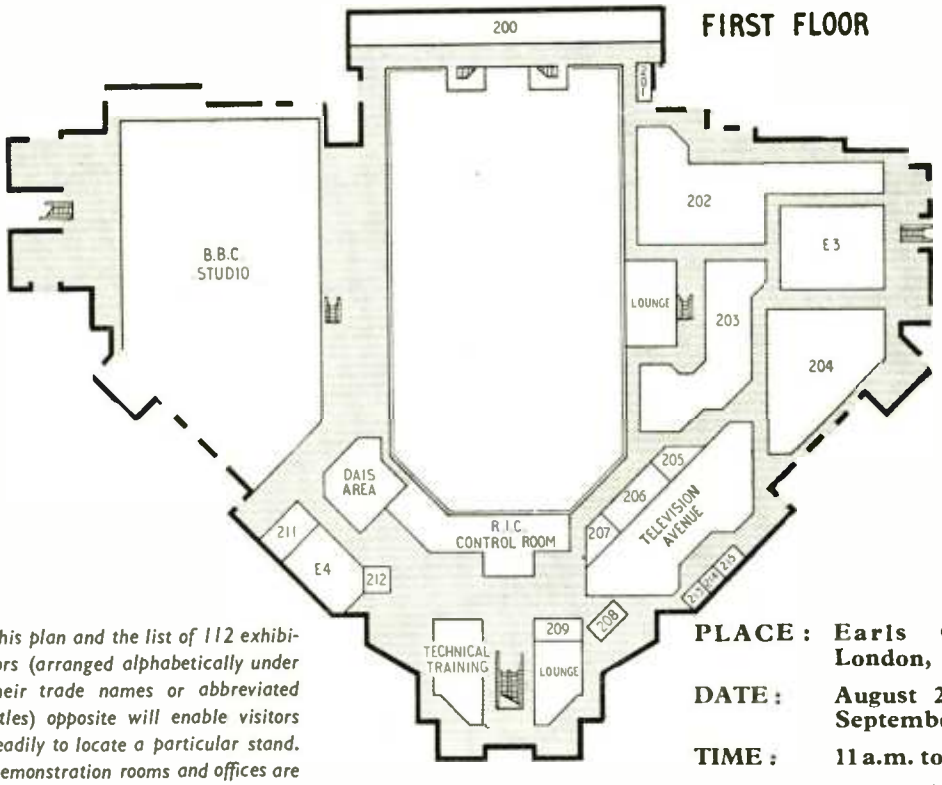
The industry, the Radio Trades Examination Board and some training establishments have co-operated in providing this year's Technical Training Display, located near the B.B.C. Studio, which, as usual, occupies a large part of the first floor. The focal point of the display is a 15-minute film on training in industry. To reach the cinema, which will hold about 50, one passes displays illustrating machine shop practice, glass manipulation, component manufacture, circuit testing, servicing and aerial techniques.

This year's television distribution system at the exhibition provides, in addition to a signal on Channel 4 (used to avoid interference from Alexandra Palace), a Band III signal superimposed on the same cable network. This signal will be a simple picture for demonstration purposes only.

ALPHABETICAL LIST OF EXHIBITORS AND GUIDE TO THE STANDS

Name	Stand
Acos	44
Aerialite	64
Alba	35
Ambassador	41
Antiference	34
Argosy	8
Army	202
Associated Technical Mftrs.	25
Avo	61
B.B.C.	200
Baird	88
Belling-Lee	67
Bernards	24
Bowmaker	47
Brimar	6
British Radio and Television	215
British Railways	43
Brown Bros.	91
Bulgin	99
Bush	86, 89 (D15)*
Chald	26
Champion	33
Channel Electronic Industries	214
Collaro	11 (D26)
Cossor	57 (D11)
Decca	39 (D28)
Defiant	106 (D13)
Domain	213
Dubilier	83
Dynatron	103
E.A.R.	49
E.M.I.	9, 73 (D21, D23)
Econasign	23 (D5)
Ediswan	37
Ekco	22, 92 (D6, D7)
Electrical and Radio Trading	32
English Electric	85 (D2)
Ever Ready	66
Ferguson	14 (D4)
Ferranti	58, 76 (D1, D30)
G.E.C.	68 (D8)
Garrard	71
Gibbs	20
Goodmans	63
H.M.V.	10 (D22)
Hobday	78
Hunt	90
Invicta	95
J.B. Cabinets	18
J-Beam Aerials	31
K.B.	70
Keith Prowse	1
Kerry's	19
Linguaphone	21
Lloyds Bank	48
Lugton	46 (D25)
M.o.S.	122
McMichael	72
Marconiphone	13 (D27)
Masteradio	62
Midland Bank	52
Mullard	56 (D3, D29)
Multicore	100 (D18)
Murphy	40 (D24)
National Provincial Bank	27
Navy	204
Nera	208
Pam	4, 84 (D19)
Peto Scott	60
Philco	36
Philips	96, 97 (D14)
Pilot	59
Plessey	28 (D9)
Practical Wireless	51
Pye	94 (D10)
R.A.F.	203
R.G.D.	93
R.S.G.B.	209
R.T.R.A.	206
Reflectograph	207
Regentone	38
Roberts	102
Rola Celestion	3
S.T.C.	82
Simon	104
Sky-Masts	30
Slingsby	50
Sobell	12
Star, The	211
Stella	55
T.C.C.	101 (D17)
Taylor	54
Telemax	81
Telequipment	80
Telerection	5
Television Society	205
Thompson, Diamond & Butcher	15
Times, The	42
Trix	65
Ultra	69
United Appeal for the Blind	201
Valradio	29
Vidor	87 (D16)
Waveforms	75
Wearite	74 (D20)
Westinghouse	2
Westminster Bank	7
White-Ibbotson	98
Whiteley Electrical	105 (D12)
Wireless & Electrical Trader	17
Wireless World and *Wireless Engineer*	45
Wolsey	16

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



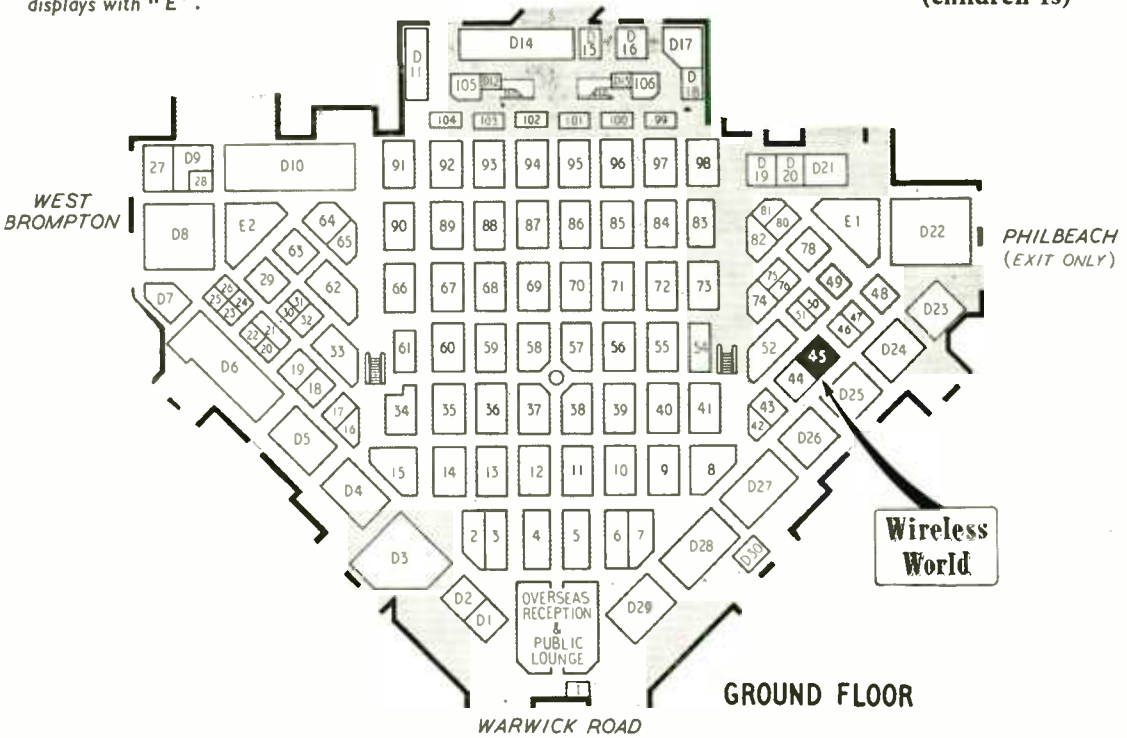
This plan and the list of 112 exhibitors (arranged alphabetically under their trade names or abbreviated titles) opposite will enable visitors readily to locate a particular stand. Demonstration rooms and offices are prefixed with "D" and electronic displays with "E".

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

DATE: August 25th to September 4th

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

ADMISSION: 2s 6d (children 1s)



Guide to the Stands

ACOS (44)

Components employing piezoelectric crystals have always been one of the principal products of this firm. This year the "Hi-g" pickup movement, designed to track the highest record groove accelerations which are, or can be, engraved on a record, will be seen in a wide variety of types, including plug-in heads for most well-known proprietary gramophone units.

A recent addition to the range of crystal microphones is the Type MIC36 which is adaptable to a variety of applications.

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

AERIALITE (64)

Aerials for sound and television broadcasting and cars, with a wide range of aerial accessories and cables of various kinds, will be found on this stand. There will be two new "Aerfringe" type television aerials, one a 3-element 7.5-db gain model and the other a 4-element 11-db model. Some specimens of Band III aerials will also be available, together with other v.h.f. types.

A new "Mastatic" aerial fitted with an 18-ft whip is of the anti-interference type. Another new item is a partially air-spaced 72-ohm coaxial cable of extra low-loss qualities to meet fringe area and Band III requirements.

Aerialite Ltd., Castle Works, Stalybridge, Cheshire.

ALBA (35)

Two completely new television receivers, T321 (14in) and T324 (17in) have been added to the Alba range. These are designed for Band I and Band III and employ special valves in a 19-valve circuit using turret tuning. The specification includes a.g.c. and interference suppression on both sound and vision, frame flyback suppression, built-in aerial attenuation and a forward-facing loudspeaker.

In addition to the C114 miniature all-wave superhet and the 707 mains/battery portable radio-gramophone, the sound receiver range will include a new moderately priced 5-valve a.c./d.c. table model (3122) with built-in aerial.

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

AMBASSADOR (41)

In all there will be five television models in the Ambassador programme, making use of completely redesigned chassis with turret tuners for Bands I and III stations. Sets will go out with Band I coils, and others will be supplied as additional programmes become available. The TV15CR is a combined television and sound receiver.

Four sound receivers will be shown, and two radio-gramophones, including the Viscount (Series III) with 8-waveband receiver, 3-speed record changer and storage for 200 records.

R. N. Fitton Ltd., Princess Works, Brighouse, Yorks.

ANTIFERENCE (34)

The range of television aerials made by this firm offers a wide variety of types for home and overseas requirements. Considerable emphasis is placed on the "Snapacitor" feature which permits virtual assembly at the factory and also does away with actual metal-to-metal contacts in the electrical circuitry of the aerial.

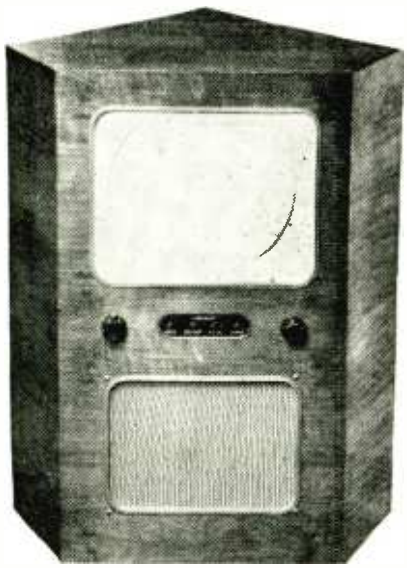
Of particular interest to overseas visitors will be the wide range of television and v.h.f. aerials for the particular frequencies and polarizations used in other countries. The pre-assembly feature is also embodied in these models.

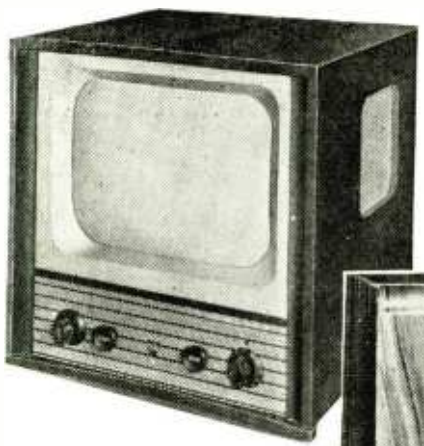
Antiference Ltd., 67 Bryanston Street, London, W.1.

ARGOSY (8)

Three-speed automatic record changers are used in all the latest radio-gramophones to be shown by this firm, while the receiver sections cover long, medium and short waves. In each model the 10in loudspeaker is fed from a pentode capable of giving 4 watts output at less than 5% distortion. Two superhet receivers will also be shown, the five-valve TR525 and the six-valve TR626/U.

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





Baird P2114 two-band receiver with 14-in tube.

Left: Ambassador corner console, TV15CC.

Right: Argosy 5-valve superhet TR525.

ARMY (202)

The space devoted to the Regular Army's exhibit is shared by the Royal Corps of Signals—the operators of its telecommunications system—and the Royal Electrical and Mechanical Engineers, responsible for the maintenance of the equipment.

An Air Support Signal Unit armoured vehicle, equipped with sets Nos. 52 and 62 and a v.h.f. transmitter-receiver, which provides direct communication between forward troops requiring air support and H.Q., will be on view. The supporting aircraft are "talked" on to the target through the v.h.f. set.

Some of the aids used in training telecommunication and radar mechanics and control equipment electricians will be displayed.

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

ASSOCIATED TECHNICAL MANUFACTURERS (25)

Manufacturers of cables, wires and sleevings for radio and industrial purposes. Special grades of heat-resisting sleevings will be shown in addition to standard p.v.c. and polythene coverings.

Associated Technical Manufacturers Ltd., Vincent Works, New Islington, Manchester 4.

AVO (61)

While basically the existing range of Avometers and test equipment will remain largely unchanged, usefulness is being extended by the introduction of some new multipliers to cover the higher voltages now encountered in television equipment. Expected to be shown will be one extending the range of the Model 8 Avometer and other 20-kΩ/V instruments to read up to 25 kV.

In addition to test equipment coil winding machines of various kinds will be available for inspection.

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

B.B.C. (200)

Working models illustrating operational processes and pieces of equipment in operation are again a feature of this stand. Among the "how it works" exhibits are a model television camera illustrating the operation of the "zoom" lens, equipment for measuring the characteristics of telephone lines, a representation of the reflection of radio waves by the ionosphere and sound recording equipment.

Developments in technical facilities for the production of studio and outside broadcast sound programmes will be illustrated by several new pieces of equipment and visitors will see some of the methods used in producing sound effects for programmes.

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

Avo 25-kV multiplier for extending the range of certain Avometers.

Alba Model 3122 a.c./d.c. receiver.

Acos Type GP20 "Hi-g" crystal pickup.

Bulgin "Domina" 2-pole plug and socket.

BAIRD (88)

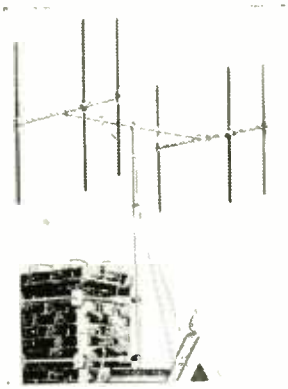
Some television receivers shown will have a turret tuner for Bands I and III. This tuner is normally fitted with coils for three Band-I channels and two Band-III channels, but up to seven further channels can be covered by extra coils. A 14-in table model and three 17-in models will be available. Single-channel sets will also be on view.

All sets can be supplied as fringe-area models, with flywheel sync and a form of vision a.g.c.

Hartley Baird Ltd., 37-39 Thurloe Street, South Kensington, London, S.W.7

BELLING-LEE (67)

Aerial equipment of all kinds, radio interference suppressors and a wide range of important items such as terminals, plugs and sockets and fuses, are the main exhibits to be found on this stand.



Belling-Lee double "Junior Multi-rod" for fringe areas.

Television aerials will include, on the one hand, simple designs for indoor use and on the other quite elaborate multi-element systems for extreme fringe-area conditions. An amplifier installed at the masthead and requiring no special cabling is another fringe-area aid to better reception. Distribution amplifiers will also be included.

There will be a new and almost miniature television interference suppressor for fitting in the mains leads of small domestic appliances; it will carry up to 2 A and is described as the "Telefilter."

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

BRIMAR (6)

Among cathode ray tubes on show will be a new 21-in tube, type C21HM, which has an improved tetrode gun assembly giving better focusing and minimum astigmatism. A 17-in self-focusing tube, type C17JM, will also be displayed. This incorporates an internal focusing electrode and so avoids the need for external focusing magnets and controls.

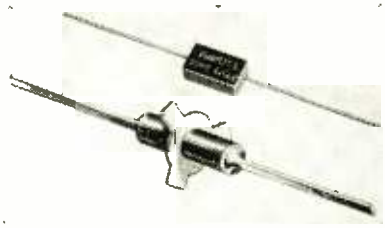
The range of valves will meet the requirements of both high-quality and economical a.m./f.m. receivers, and various circuits for these will be displayed. There will also be special quality valves at lower prices than hitherto and valves for Band III tunable television receivers.

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

BULGIN (99)

Connectors, signal lamps, knobs, switches and a host of other small, but quite vital, items in electronic and radio equipment comprise the main activities of this company. Among the newest items are a Lilliput lampholder no larger than a little-finger nail; miniature micro-switches which operate by almost a feather-weight touch and some new multi-pole connectors. One pattern is in the form of a strip with the plugs, or sockets, in line and self-centring;

Bush 14-in table model TV.43 with flyback suppression.



Dubilier "Hi-K" ceramic feed-through and midget moulded silvered mica Type SM22 capacitors.

another new design takes the form of a 2-pole unit (plug or socket) which can be mounted in line or stacked vertically to give almost any number of connections. They are mainly intended for inter-chassis or inter-unit connection, one part being on the chassis the other on the rack or cabinet, when the chassis is pushed home all the contacts, which are self-aligning, engage.

A. F. Bulgin & Co. Ltd., Bye-pass Road, Barking, Essex.

BUSH (86, 89)

Television receivers shown by this firm all include tuners for Bands I and III, tuning on each band being continuous with a band selector switch. All models, too, have a.g.c. on sound and a form of a.g.c. on vision, the control voltage in this case being derived from the sync-separator grid current. One model, the TV33, has flywheel synchronizing. All the sets are of the a.c./d.c. type.

Table models with 12-in, 14-in and 17-in tubes will be shown, a console with a 17-in tube and the Mobile 17, which is a floor model with a 17-in tube.

Sound-broadcast receivers will include the well-known DAC90A and a battery set introduced last year. A new set is the AC41 and an a.c./d.c. counterpart—the DAC41.

Champion "Midget" receiver, Model 825.

Collaro "54" 3-speed record changer.

A radio-gramophone with a three-speed motor and auto-changer will be shown. An exhibit of particular interest at the present time will be a v.h.f. broadcast receiver.

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

CHALD (26)

Shown by this firm will be a new indoor television aerial in the form of a single-turn square "loop" known as the "Sqarial." It is said to give a 20—% gain over a dipole, has a back-to-front ratio of 7 db and may be expected to give satisfactory reception up to 30 to 35 miles. It is less than 3 ft square.

Chald Products Ltd., 184 Low Road, Leeds, 10.

CHANNEL (214)

Television pattern generators will be shown, one model, 'T1, for Band I and another, T2, for Bands I and III. Also on view will be television pre-amplifiers, multi-outlet distribution amplifiers, and t.v.i. suppression units.

Channel Electronic Products, Ltd., Burnham-on-Sea, Somerset.

CHAMPION (33)

This year Champion are concentrating on sound receivers, and in particular small portable and "midget" table models.

Model 825, a "midget" table receiver for a.c./d.c. mains, is new and will be available in a plastic cabinet with a choice of colour. Ferrite rod aerials are used in the Model 822 battery suitcase portable and in the Model 820 "Radio Revler" transportable 3-speed radio-gramophone. The larger Model 781, which is a 7-valve superhet mains-battery portable of high sensitivity, is being continued. Record playing equipment includes the portable "Revler" with crystal pickup, amplifier and 5-in loudspeaker.

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

COLLARO (11)

A new record changer, Model 54, which mixes 7, 10 and 12-in records and has a constant change time, irrespective of the turntable speed, will be shown; also a new inexpensive 3-speed motor unit with turnover pickup cartridge (AC3/554).

"Transcription" units (Models 2,000 and 2010) fitted with the Collaro "Studio P" crystal pickup will be of special interest to high-quality enthusiasts.

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

COSSOR (57)

In sound broadcast receivers the most interesting exhibits on the stand will be two models capable of receiving v.h.f. as well as existing programmes. The model 523 covers three wavebands and uses seven valves, while the model 522 is a radio-gramophone with an automatic record changer.

Most of the television receivers on show will either be tunable to Bands I and III or will have facilities for the addition of a tuner unit.

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

DECCA (39)

Four television receivers with direct-viewing 14-in or 17-in tubes will be shown as well as a projection receiver (Model 1000). There will also be two television-radio-gramophones. The Model RG98 and 102 radio-gramophones have 3-waveband receivers and 3-stage audio amplifiers.

Record reproducers made by this firm include a new "Panatrope" which is an inexpensive console incorporating a Garrard RC/111 record changer with a 3-stage negative feedback amplifier giving 2½ watts. Another interesting model is the "Deccamatic II" portable player which employs a single pentode amplifier with a Collaro 3-speed motor and crystal pickup.

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

DEFIANT (106)

The five television receiver models exhibited cover both bands, being pre-set for any station in Band I and adjustable by the user to all eight channels of Band III. The

sets include a mains filter and the line time-base is completely screened.
Co-operative Wholesale Society Ltd., 1 Balloon Street, Manchester, 4.

DOMAIN (213)

Television receiver tables of metal tubular construction will be on show here. They have undershelves for carrying sound receivers or record players. Equipment for dealers' showrooms will also be displayed.
Domain Products Ltd., Domain Works, Barnby Street, London, N.W.1.

DUBILIER (83)

Capacitors, resistors, fixed and variable, and radio interference suppressors comprise the main radio parts in which this firm specializes. Miniaturization being an all-important requirement to-day, attention is being given to this aspect of design and some midget moulded silvered mica capacitors in a useful range of values are now available.

Among the ceramic dielectric capacitors interest will be focused on the "Hi-K" feed-through, stand-off and bushing styles in view of their particular suitability as r.f. by-pass capacitors in v.h.f. and Band III television receivers.

Dubilier will have one of the smallest insulated ½-W resistors made in the Type BTS and some pre-set "Q" type potentiometers with insulated knobs intended primarily for television sets.
Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.

DYNATRON (103)

A range of large radio-gramophones will be on this stand and among them the Ether Marshal, a new model, is noteworthy for its elaborate specification. It is a 5-band set with an earthed-grid r.f. stage on short waves. There is variable selectivity and provision for the connection of an f.m. tuner. The a.f. amplifier, on a separate chassis, has a push-pull triode output stage.

The model TV27C television receiver, for a.c. only, has a 17-in tube and a.g.c. on both sound and vision channels. There is a black-level stabilizing circuit, a black spotter, and an anti-flutter circuit.

A television "mast-head" pre-amplifier for fringe-area reception will be on view; also a range of nucleonic and electronic equipment.
Dynatron Radio Ltd., The Firs, Castle Hill, Maidenhead, Berks.

E.A.R. (49)

Portable electric gramophones are a speciality of this firm, and models are available, with three-speed turntable motors or record changers, all of which play with the lid closed. The Model A750 high-quality instrument is fitted with a 10-in × 6-in elliptical loudspeaker and separate bass and treble tone controls.

Other products of this firm include a console record reproducer with 8-watt push-pull output, a 12-watt portable a.c./d.c. amplifier for p.a. work, and a range of high-quality amplifiers for a.c. mains.
Electric Audio Reproducers Ltd., 17 Little St. Leonards, Mortlake, London, S.W.14.

E.M.I. (9, 73)

One of the chief exhibits on these stands will be the BTR/2 tape recorder, which is available in console or transportable form and with tape speeds of either 15 and 30 or 7½ and 15in/sec. Other tape recorders on show will be the transportable TR/50 with playing times of 64, 32 and 16 minutes (according to tape speed); the "Emicorda" domestic type and the portable battery-driven model L/2 which weighs 14½ lb.

Amongst test gear displayed will be a bridge for measuring resistive and capacitive impedance in situ and a signal generator covering the B.B.C. television channels.
Electric & Musical Industries Ltd., Hayes, Middlesex.

EDISWAN (37)

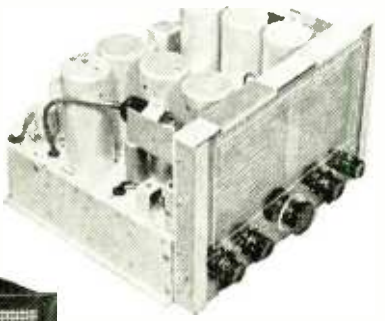
Aluminized cathode ray tubes will be the main feature of this stand and the range on show will include the latest 21-in rectangular type. A demonstration exhibit will show the 60 per cent increase in picture brightness obtained by aluminizing.

In valves, the 30L1 cascode double triode and the 30C1 triode pentode frequency-changer will be on view separately and as used in the Ediswan-Clix television turret tuner. This is a 12-position tuner, with pre-tuned r.f. and mixer stages, for multi-channel receivers operating in Bands I and III.
The Edison Swan Electric Co. Ltd., 155 Charing Cross Road, London, W.C.2.

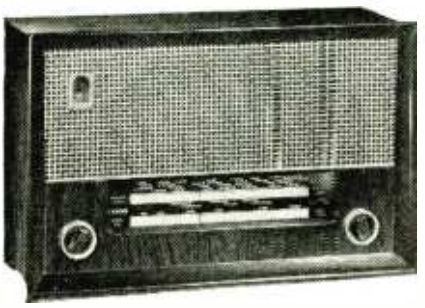
EKCO (22, 92)

The television receivers exhibited will be types having either a built-in 13-channel turret tuner for Bands I and III or provision for adding such a tuner when required. The tubes range in size from 12-in to 17-in; one of the larger models is the a.c./d.c. type TC209 with flywheel sync, and a form of vision a.g.c.; spot wobble is

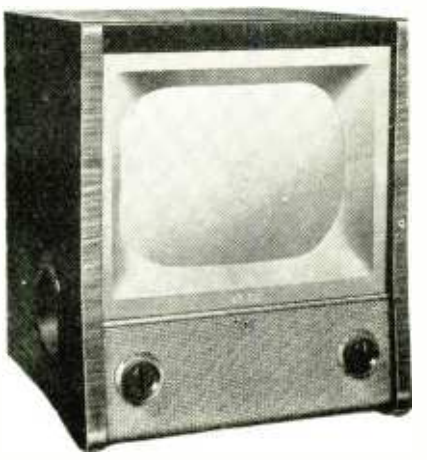
Defiant two-band receiver Type TR1755.



Chassis of Dynatron "Ether Marshal."



Left: Cossor Model 523 a.m./f.m. receiver.



Right: Ekco 14-in table model, Type T221.

included and the set is unusual in including an f.m. receiver for Band II.

Among the sound-broadcast receivers, the A239 is of especial interest because it provides for f.m. reception on Band II as well as the normal a.m. bands It has a built-in Band II aerial and provision is made for the use of a tape recorder.

The New Radiotime is an a.c. set, including an electric clock which can act as an alarm or be set to switch the set on or off at predetermined times.

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

ENGLISH ELECTRIC (85)

The "40" series of television sets have a 17-in rectangular tube operating at 14 kV and they are of the a.c./d.c. type with a barretter for the control of the heater current. A 12-channel turret tuner is included to cover Bands I and III, but, as the coils in it are changeable, it can also be used for Bands IV and V if required. There are three cabinet styles; the T40 and T41 are table models without and with doors and the C42 is a console with doors.

A tuner unit (the "Rotamatic") enables Band-III reception to be obtained on existing Band I sets. It is a 12-position turret tuner like that in the "40" series sets and it replaces the early valves in English Electric one-band sets. The output is at i.f. and connection is by plugs to the valveholders.

The English Electric Co. Ltd., Marconi House, 336-7 Strand, London, W.C.2.

EVER READY (66)

Layer-type batteries for portable receivers will be shown with miniature and sub-miniature layer types for hearing aids. There will also be a range of all-dry battery receivers, including portables and table models, and two tropicalized export receivers.

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

FERGUSON (14)

Television receivers with 12-in, 14-in and 17-in tubes will be shown. The 103T and 105T, using the larger tube sizes, have turret-switch tuners for Bands I and III; others are primarily Band I sets but have provision for the addition of a plug-in three-way tuner unit to cater for two Band III stations. Frame-flyback suppression is used on all sets and Halolight, an illuminated surround to the picture, is now fitted on four of the console models.

Among sound-broadcast receivers, there are three models which give f.m. reception on Band II as well as the normal long, medium and short wavebands. In addition to several radio-gramophones of console pattern, there is a new table model having a three-speed automatic record changer.

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

FERRANTI (58, 76)

An exhibit of considerable interest here will be a table projection television receiver giving a picture size of 16-in × 12-in. The receiver is permeability-tuned over the five channels of Band I. The front end of the receiver is detachable so that it can be replaced by a Band I/Band III tuner unit. Beam current a.g.c. is applied to the final vision i.f. amplifier and this ensures minimum peak white defocusing and enables the set to be operated at a high average brightness level.

Among the valves and cathode-ray tubes on view will be a new 21-in rectangular tube with a 90° deflection angle.

Ferranti Ltd., Moston, Manchester.

G.E.C. (68)

A range of new sound and television receivers will be on view. New Osram valves notable for their very high slope of 15 mA/V are the Z759 and Z359, both B9A pentodes intended as video amplifiers. The first has a 6.2 V heater and the second a 0.3 A heater. For Band III television tuners there will be the B319 double triode and the LZ319 triode pentode, while a new addition to the audio range of valves will be the N709 output pentode with an anode dissipation of 12 watts.

Among the c.r. tubes will be a development 21-in rectangular tube.

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

GARRARD (71)

The record changers and gramophone turntable units shown by this firm will be seen in the new standard colour scheme of cream and brown. From a comprehensive range the retooled Model 301 "transcription" motor, the new compact RC110 and RC111 three-speed record changers and the Type GC2 and GCE3 piezoelectric pickups may be selected as worthy of closer inspection. The GC2 is a Rochelle salt crystal turnover unit with a frequency range comparable with that of separate crystal heads, and the GCE3 employs a ceramic element for use under extreme conditions of heat and humidity.

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

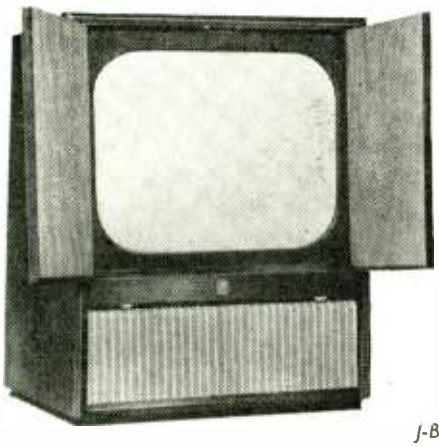
GIBBS (20)

This firm will be showing a record cabinet with a capacity of 170 records, and a range of tables suitable for television sets.

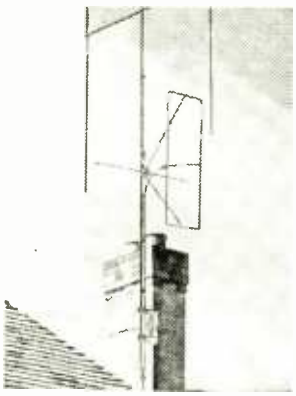
Herbert E. Gibbs Ltd., First Avenue, Montague Road, Edmonton, London, N.18.

GOODMANS (63)

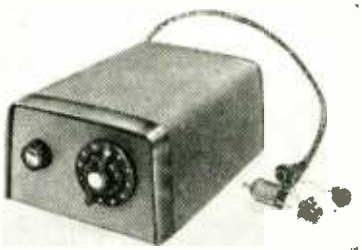
This stand will be virtually a sound-proof theatre for the demonstration of high-quality reproduction, and



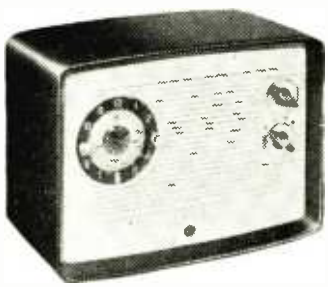
Tunable table projection receiver by Ferranti, Model 20T4.



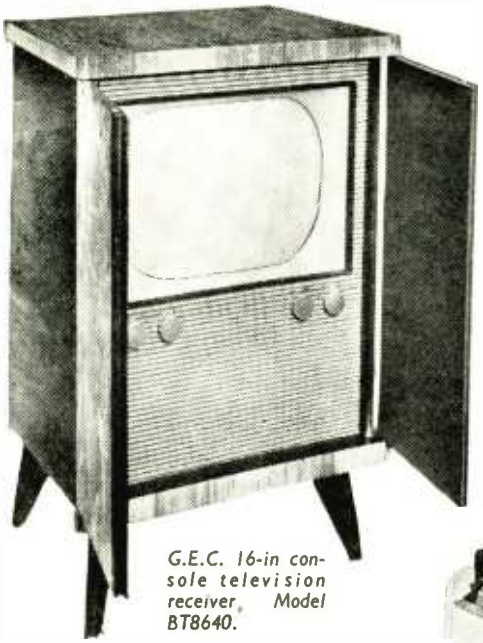
J-Beam 3-element Band I television aerial combined with a skeleton slot for Band III.



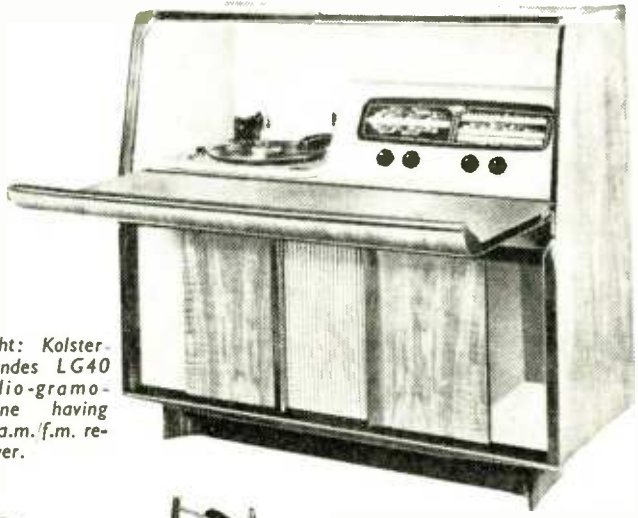
English Electric Rotamatic tuner for Band III television.



Ekco "New Radiotime" receiver.



G.E.C. 16-in console television receiver, Model BT8640.



Right: Kolster-Brandes LG40 radio-gramophone having an a.m./f.m. receiver.

Garrard RC80M 3-speed record changer.

Hunt 50-μF 350-V wkg Type L136 miniature electrolytic.

visitors will be able to compare the results obtained with a variety of loudspeaker types and systems, including multiple units wth crossover networks. A staff of specialists will be in attendance to answer questions.

A new 12-in, 12-watt reproducer, the "Orlin III," will be shown in which the top response can be modified to give optimum performance on inputs of varying quality.

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

H.M.V. (10)

An important feature of this stand will be a new projection television receiver, Model 1823, with a projection tube of twice the screen area of more usual types. This gives a brighter picture than normally obtainable from such receivers. The current range of 14-in and 17-in direct-viewing sets on show will be available either as two-band versions or as Band I versions which can be modified for Band III reception when required. Three fringe-area sets incorporate a.g.c. on vision and sound, dark-scene contrast expansion, fly-back suppression and interference inversion.

Among the radiograms will be a portable and a transportable, both with a 3-speed record player on a pivoted counterbalanced desk which swings into the back of the cabinet when not in use.

Two new sound receivers will be shown. Model 1360 is a transportable in a plastic cabinet while model 1126 is a 5-valve table receiver.

The Gramophone Co. Ltd., Hayes, Middlesex.

HUNT (90)

The Supermoldseal Type W96 is a new miniature metallized-paper capacitor having a tough cast resin case which is not easily damaged by accidental contact with a hot soldering iron. Working voltages are 200, 400 and 600 d.c. and capacitance values range from 50 pF to 100,000 pF.

A new miniature single-hole fixing dry electrolytic known as the Type L136 will be shown, together with a range of low-voltage miniature electrolytics measuring 1 in long and $\frac{3}{8}$ in in diameter, with working voltages of from 12 to 150 V d.c. and in capacitances of 1 to 50 μF.

A new development, described as the sprayed plate technique, is said to result in small bulk for a given capacitance.

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

INVICTA (95)

A 13-channel selector switch on the side of the cabinet will be a feature of three television sets to be displayed. These receivers, one 14-in and two 17-in, also incorporate automatic vision gain control (the black-level adjusting circuit), flywheel sync, a dark screen for daylight viewing and a built-in Band I aerial for areas of high signal strength.

A new console radiogram of small size is capable of playing L.P. records and has a receiver section covering the trawler waveband.

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

J.B. CABINETS (18)

This firm manufacture radio and and radio-gramophone cabinets for the trade and their exhibit will comprise a selection of the latest and most interesting types which have been recently produced.

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

J-BEAM AERIALS (31)

A special feature of this firm's television aerials is that the feeder is connected to one end of the main dipole via an impedance matching stub. The stub can be incorporated in the supporting mast which then becomes virtually an extension of the dipole. They will be showing also a "skeleton slot" aerial for Band III.

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

K.B. (70)

The television sets to be shown on this stand include a multi-channel turret tuner for Bands I and III. There is a table model with a 14-in tube and another with a 17-in, while the two console types have 17-in tubes. One of these has a tube with electrostatic focus, pre-set in the factory.

Adaptors to enable single-band K.B. receivers to be used on Band III are being produced.

A newcomer to the range of broad-

cast sound receivers is the KR20FM. This is a 6-valve set for a.c. operation which covers the usual medium and long wavebands and also the v.h.f. band. Some of the older models are still being retained, among them the FP151 a.c./d.c./battery portable.

Five radio-gramophones will be shown. Among the new types is the LG40AM/FM in which the receiver covers the f.m. band and has a push-pull output stage.

Kolster-Brandes Ltd., Footscray, Kent.

M.o.S. (212)

The main exhibit on this stand is a telemetering system for guided missiles.

Ministry of Supply, Shell Mex House' Strand, London, W.C.2.

McMICHAEL (72)

The new television receivers will be available with 14-in or 17-in rectangular flat-faced tubes and in table and console models, with or without sound radio receivers. One chassis is common to all the new sets.

Special attention has been given to reliability and service accessibility. The entire chassis can be taken out of its cabinet in 1¾min and the tube in 1¼min.

These new sets will be adequately supported by a comprehensive range of sound receivers including an a.c./d.c. mains/battery portable set with a self-contained ferrite rod aerial.

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

MARCONIPHONE (13)

Another addition to the "Companion" range of sound receivers will be model T37DA, a 5-valve a.c./d.c. transportable covering two wavebands. There will also be a new mains/battery portable, model T36AB, in attache-case form and a new table receiver, model T38A, covering three wavebands. New radio-gramophones on show will be the model ARG40A, the ARG41A in a "contemporary" style cabinet and the TARG39A table model, all with 5-valve 3-waveband receivers.

Television receivers will also be displayed.

The Marconiphone Co. Ltd., Blyth Road, Hayes, Middlesex.

MASTERADIO (62)

To be shown for the first time at the exhibition will be a new table radiogram in a distinctively designed walnut veneered cabinet. It incorporates a 3-speed automatic record changer and covers short, medium and long waves. Also entirely new will be a portable electric gramophone known as "The Harmony" which plays 12-in records.

Television receivers will include two 17-in models with built-in Band III converters; one is a multi-channel table model, the other a console type with full-length doors. Some car radio sets will conclude an interesting display.

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

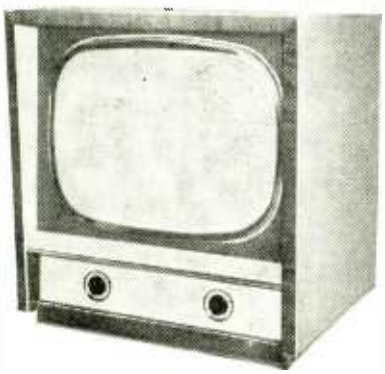
MULLARD (56)

For the amateur constructor this firm have produced a new design for a high-quality ten-watt amplifier, built around five Mullard audio valves—EF86 input, ECC83 phase-splitter, two EL84 output pentodes in push-pull and GZ30 rectifier. The response is almost flat from 10c/s to 20kc/s and harmonic distortion is below 0.4%. A booklet giving details will be available on the stand and the amplifier itself will be demonstrated in an associated room.

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

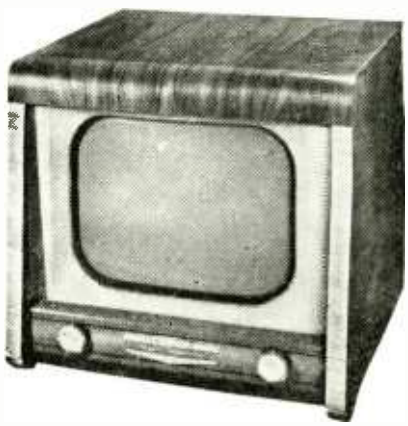
MULTICORE (100)

Designed to increase soldering speed, a 5-cored wire solder will be shown publicly for the first time. This contains a new flux (362) which in some applications permits the use of cheaper solder alloys containing less tin.

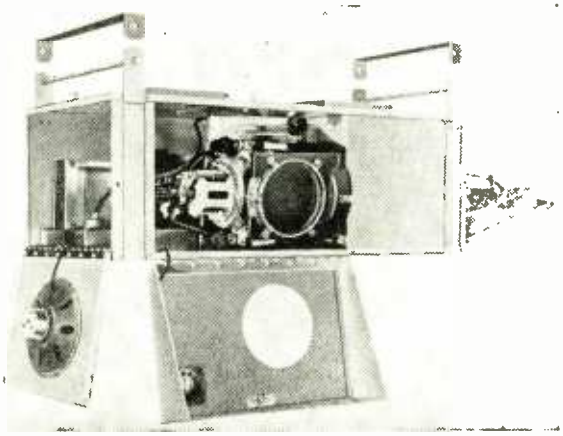


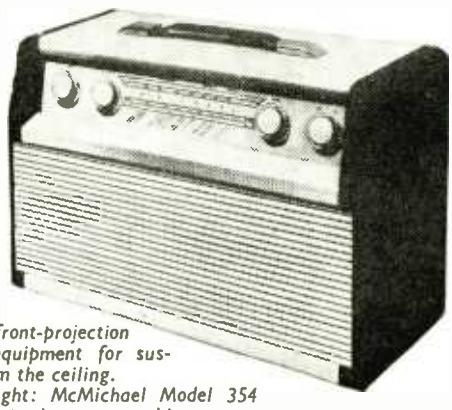
Murphy V250 two-band receiver with 17-in. tube.

Masteradio "Harmony" portable record player.



Philco 14-in. tunable television set, Model A1467.





Left: Nera front-projection television equipment for suspension from the ceiling.

Right: McMichael Model 354 mains/battery portable.

To demonstrate the large-scale use of Multicore solder in industry, the assembly and wiring of Ferguson television tuning units will be carried out.

Special soldering alloys to be shown include TLC, with a melting point of 145°C and "Consol" containing silver and having a melting point of 296°C.

Multicore Solders Ltd., Hemel Hempstead, Herts.

MURPHY (40)

This year's receivers are based on a chassis which is substantially the same for all models, the chassis differences between the 14-in V240 and the 17-in V250 being mainly the provision of higher voltages for the tube of the latter. Fringe-area models have flywheel sync, a gated a.g.c. circuit and a special noise limiter.

Provision is made in all models for Band-I and Band-III reception by means of a 12-channel turret tuner, the r.f. stage being of the cascode type. A direct-drive line-scan circuit is used.

Among sound-broadcast receivers, the new V198 and A212 will be shown. The V198 is an a.c./d.c. set with a built-in ferrite-cored aerial covering medium and long wavebands. The A212 is a larger table model for a.c. mains only and including one s.w. band. It has an internal plate aerial and provision for an external aerial.

Murphy Radio Ltd., Welwyn Garden City, Herts.

NAVY (204)

Operational conditions for underwater television are simulated by the provision of a large glass-sided tank on the ground floor, in which the camera is suspended, while the remote control and monitoring gear is in the gallery. Training exhibits are being provided by the two Naval electrical schools—H.M.S. Collingwood and H.M.S. Ariel—and the R.N.V.(W)R. Examples of radio communication equipment, electronic control and navigational gear and facsimile apparatus used in the Navy are being provided by Marconi's, Pye, Redifon, Muirhead, Decca, Murphy and G.E.C. for display and demonstration on this stand.

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

NERA (208)

This firm will be showing projection television equipment for picture sizes ranging from 30in to 84in. A projector for ceiling mounting is designed to give a picture 4ft by 3ft.

A 12-channel converter for Nera receivers will also be shown.

Nera of England Ltd., Jeffries Passage, High Street, Guildford, Surrey.

PAM (4, 84)

Five television models will be shown, all for a.c./d.c. operation and with 13-channel tuners. A form of a.g.c. is provided in all but the cheapest 12-in Model T954.

Two table model sound receivers (955a and 965) employ basically the same 4-waveband chassis, which is also used in the Model 966RG radio-gramophone.

The Model 610 wide-range record player has a push-pull output driving an 8-in loudspeaker. The table cabinet is designed to reinforce the bass response when the lid is closed and the loudspeaker aperture is designed to give wide-angle diffusion of high frequencies.

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

PETO SCOTT (60)

The television receivers shown by this firm are designed primarily as Band-I sets with a switch changeover to an alternative tuner, which is physically a separate unit, for Band III. The tuner has a cascode r.f. stage and tuning is continuous by the adjustment of ganged cores to the coils. The circuit arrangement avoids any switching in r.f. circuits.

Among the sound equipment to be shown is a table-model receiver including one s.w. band, the R54, an automatic 3-speed record changer radio-gramophone and a record reproducer with auto-changer.

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

PHILCO (36)

Among the new television sets to be shown is a 14-in table model incorporating a turret tuner for reception of Band-III programmes. It has a.g.c. and noise suppression on both vision and sound channels. Similar facilities are offered by a 17-in model, with the additional feature of a removable front to the cabinet which allows the tube and mask to be cleaned.

Three sound receivers on view are notable for having all metal parts and components fully tropicalized so that they can be operated in kitchens, etc., without fear of deterioration from steam and damp.

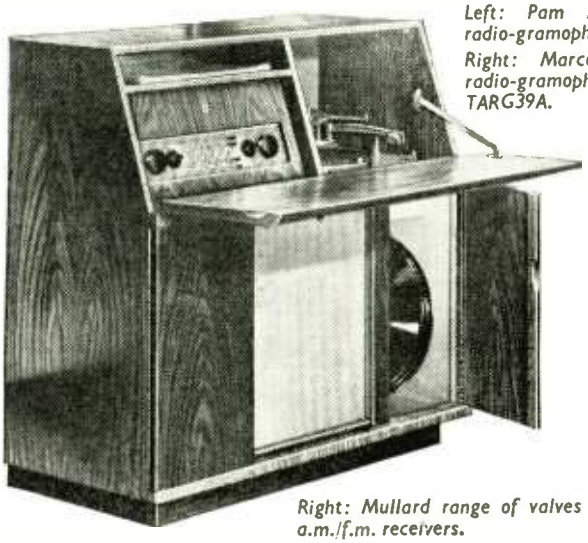
Philco (Great Britain) Ltd., Romford Road, Chigwell, Essex.

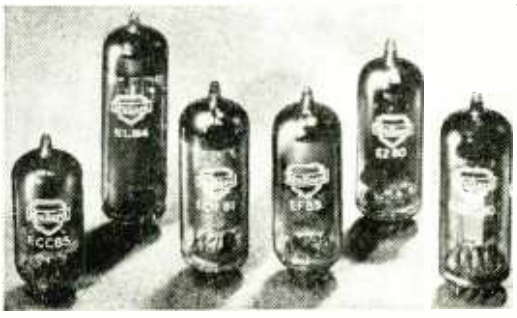
PHILIPS (96, 97)

Of most topical interest on these stands will be an a.m./f.m. table receiver, Model 543A. It uses 7 valves and is designed for a.c. mains only. Another new exhibit will be a 5-valve receiver which also acts as

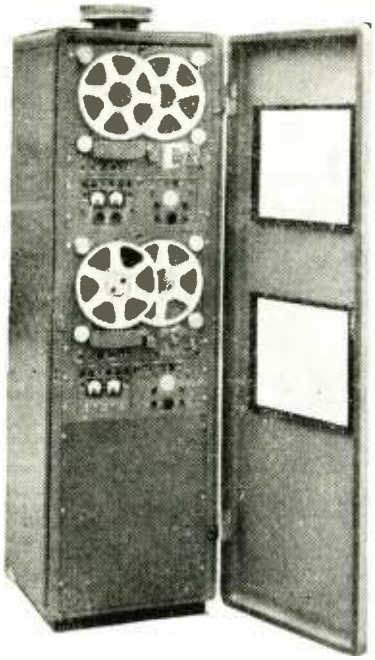
Left: Pam Model 966/RG radio-gramophone.

Right: Marconiphone table radio-gramophone, Model TARG39A.





Right: Mullard range of valves for a.m./f.m. receivers.



Simon dual tape monitoring equipment.

an alarm clock and will switch itself on and off at pre-set times. It is pre-set tuned for four stations, three medium-wave and one long-wave.

Amongst radio-gramophones and record players will be a new portable record player, Model AG2121, incorporating a 3-valve amplifier and, in the lid, a 7-in loudspeaker.

Two new table television receivers, one 14-in and the other 17-in, will incorporate a turret tuner for reception of B.B.C. and Band-III programmes.

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

PILOT (59)

Five television sets to be shown by this firm will all have provision for plugging in a tuner for reception of alternative programmes. Two are 14-in models and three are 17-in models. The 12-position tuner is a turret type covering 13 channels and costs 6 guineas. It has a dual control knob, with a numbered inner section for selecting the channel and an outer rim for fine oscillator tuning.

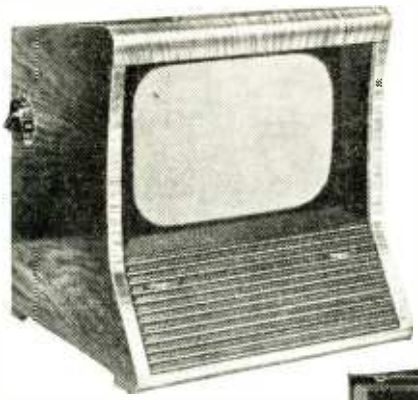
Among the sound broadcast receivers will be a new battery/mains portable (a.c./d.c.) in attaché-case form. It has a Ferroxcube built-in rod aerial and a 6in×4in elliptical speaker.

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

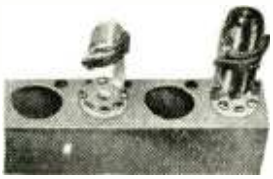
PLESSEY (28)

This firm manufactures an extensive range of components, accessories and complete radio assemblies for the trade; their exhibit will consist of some of the newer and more interesting items now in production. A novel development is some special clips for sub-miniature valves, one is for chassis mounting like a valveholder, the other holds two valves and can be fixed in any position. A strip switch for a.m./f.m. sets will also be shown.

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



Pye 13-channel receiver, Model VT4.



Plessey valveholder clip for mounting sub-miniature valves.

Germanium junction power rectifiers by S.T.C.

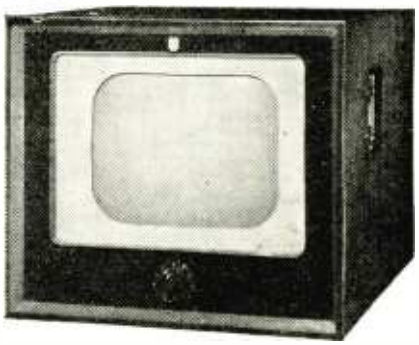
PYE (94)

One of the latest television receivers to be shown by this firm will be the 13-channel Model VT4. This is a 14-in table receiver with a tilted-forward screen, and the 12-position channel selection switch covers the five B.B.C. channels in Band I and channels 7 to 13 in Band III (channel 6 being brought in by oscillator trimmer tuning when required). The receiver also incorporates vision a.g.c., flywheel sync, vision interference inversion and frame fly-back suppression.

High-quality sound reproduction equipment will also be on view.

Pye Ltd., Radio Works, Cambridge.

Pilot 13-channel Turret Tuner.



Philips 14-in. tunable television set, Model 1446U.

R.A.F. (203)

Inspection and repair of v.h.f. airborne equipment as undertaken in the workshops of the Maintenance Command of the R.A.F. is to be demonstrated. Radio's part in weather forecasting will be illustrated in a typical Meteorological Forecasting Office set-up on the stand. Visitors will also see the complex assembly of radio and electronic equipment now carried in modern jet aircraft.

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

R.G.D. (93)

Four table-model and two console receivers comprise the R.G.D. television programme together with a combined television and radio-gramophone (Model C55). An improved synchronizing circuit ("Synchrolock") is a feature of the 17-valve circuit.

Twin 6½-in loudspeakers and a push-pull output stage are used in the "Two-Ten" table model radio-gramophone which takes its place with the R.G.D. console models. The "One-Ten" sound receiver is a 6-valve, 3-waveband model with push-pull output.

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

R.S.G.B. (209)

A wide variety of modern amateur-constructed sound and vision transmitting and receiving equipment will be seen on the R.S.G.B. stand. The emphasis is on equipment for use in the recently formed Radio Amateur

Emergency Network. V.H.F. and u.h.f. gear, some transistor transmitters and s.s.b. transmitting and receiving equipment will also be displayed. Historic amateur equipment and a clandestine receiver constructed in a prisoner-of-war camp will be seen.

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

REFLECTOGRAPH (207)

An ingenious continuously variable drive mechanism forms the basis of the magnetic tape recorders made by this firm. In addition to standard portable domestic recorders, a number of scientific and industrial machines will be shown. For some of these (Series P) a frequency response of 80 c/s to 15 kc/s ± 3 db is claimed at 7½in/sec.

Two systems of recording very low frequencies have been developed, one of which (Model PLF2), employing a differential pulse-code system, is capable of recording down to zero frequency and is independent of tape speed.

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

REGENTONE (38)

Sound receivers and radio-gramophones include the "Multi 99" table radio-gramophone incorporating a B.S.R. "Monarch" record changer. This model is also available in console form.

Three portable gramophones in tough-fibre cases are designed for hard use. They are the RP2 record player for feeding the pickup terminals of any broadcast receiver, the HG2 "Handy-Gram" with built-in amplifier and loudspeaker, and an automatic record changer version (AHG2).

Regentone television sets are being re-designed in detail and will be shown in new cabinets.

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

ROBERTS (102)

Portable sound broadcast receivers are associated with the name of this firm and in the current range Model RP4 (battery) and RMB (a.c. mains/battery) are now available in "rexine" covered cabinets. Models CR (a.c. mains/battery), BR (battery) and MR (a.c. mains) can be obtained in a wide range of colours.

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

ROLA CELESTION (3)

A loudspeaker designed to be operated under conditions of extremely high or low atmospheric pressure, and capable of surviving complete immersion in water is indicative of the wide field of activities of this firm. All sizes from 2½in to 18in diameter are available, including elliptical types and other special designs for receiver manufacturers. A wide range of output transformers, including hermetically sealed types for tropical climates will be shown.

Public address loudspeakers and line-matching transformers, under the Truvox marque, for powers from 3 to 120 watts also form part of this exhibit.

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

S.T.C. (82)

Asymmetric resistors (working on a rectifier principle) suitable for digital computors will be shown under construction and as used in an electronic accounting machine. Also on view will be metal rectifiers for h.t. and e.h.t. supplies; battery charging rectifiers; high voltage aluminium rectifiers for aircraft power supplies; germanium junction power rectifiers and a germanium junction photocell suitable for direct operation of relays.

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

SIMON (104)

Some fine examples of engineering construction will be seen in the professional and domestic magnetic tape recorders made by this firm. The long-duration tape monitors for recording air traffic control messages and the Model SP/1 portable recorder with 10-watt output are of great technical interest.

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

SKY-MASTS (30)

The design and erection of aerial masts and complete aerial installations constitute the main activities of this company and their exhibit will show in model and in actual form some of the more interesting types they produce.

Sky-Masts, Beadon Garage, Beadon Road, London, W.6.

SOBELL (12)

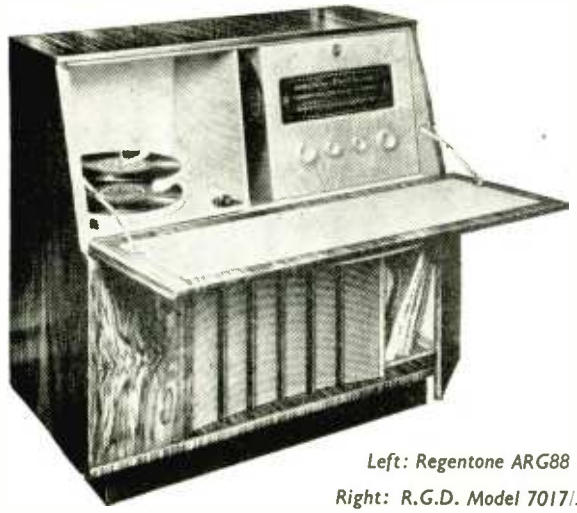
Sound-broadcast, television receivers and radio-gramophones will be displayed on this stand. Most of the last include automatic record changers and all have three-speed motors and employ crystal pickups. The sound receivers have provision for a pickup and an external loudspeaker.

Most television sets include turret tuners for Bands I and III; the 12-in model, which does not, has provision for a Band-III adaptor. A form of a.g.c. is included in the sets and flyback suppression is fitted. The models include 12-in, 14-in and 17-in types and all are for a.c./d.c. operation.

Sobell Industries Ltd., Langley Park, Slough, Bucks.

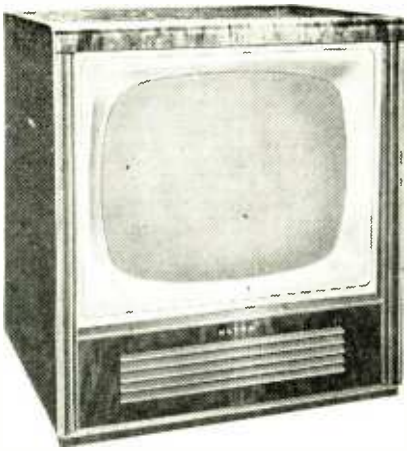
STELLA (55)

Four new table television receivers will be shown with provision for re-



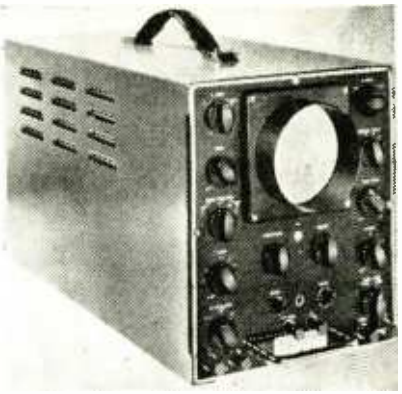
Left: Regentone ARG88 radio-gramophone.

Right: R.G.D. Model 7017/3C television receiver.



Ultra 17-in. table model, type V.9-17.

Vidor "Lady Margaret" handbag-size portable, but with 5-in. loud-speaker.



Telequipment oscilloscope Type 520 with 4-in. flat-faced tube.

Whiteley concentric Duplex loud-speaker.

Taylor Model 67A signal generator.

Waveforms type 405 television signal generator.

ception of Band-III programmes. The ST8314U 14-in model and ST8317U 17-in model are designed to incorporate a tuner when the programmes become available, while the 14-in model 6414U and 17-in model 6417U already include the tuners and have fine tuning and pre-set sensitivity controls for each channel.

An important feature of the model 102A sound receiver is bass compensation for low positions on the volume control. Also on view will be a portable record player with a pick-up needle pressure of less than one-third of an ounce.

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

T.C.C. (101)

Among the many capacitors shown by T.C.C. this year will be six new ceramic types for incorporating in Band III television converters and in multi-channel dual-band tuners. Some are known as "Hi-K" and some "Low-K," the former being fairly large-capacitance bypass types for soldering into punched holes in the chassis. They take the form of lead-through, bushing and stand-off types. The "Low-K" are mostly pre-set variables with very small capacitance sweep; 0.5 to 3 pF and 1 to 5 pF are typical.

Electrolytic capacitors with very high insulation resistance are now included in the T.C.C. range and these are suitable for inter-valve a.f. couplings. A feature this year of the T.C.C. exhibit will be a demonstration of power-factor correction.

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

TAYLOR (54)

Some entirely new models of test apparatus are being introduced on this occasion; one is a 100-kc/s to 240-Mc/s signal generator known as Model 67A. Internal modulation at 400 c/s is provided.

Another interesting test set is the Model 92A; this is a television sweep oscillator covering 0-250 Mc/s and with a frequency deviation, or sweep, variable from ± 1.5 to ± 15 Mc/s.

Other new items include a d.c. valve voltmeter covering 1 to 1,000 V with an input impedance of 25 MΩ and a 10-c/s to 100-kc/s RC oscillator.

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

TELEMAX (81)

Two models of front-projection television receiver are being shown by this firm. The 2352 gives a 4-ft by 3-ft picture and is self-contained; the new CT1 is in two units, camouflaged as normal articles of furniture.

There will be a direct-view receiver, with a 17-in tube and a 12-channel tuner, which is unusual in being combined with a record player.

The exhibit will include a Band-III converter and an insulation test set covering 150 V to 10 kV

Telemechanics Ltd., 3 Newman Yard, Newman Street, London, W.1.

TELEQUIPMENT (80)

Television test apparatus is the speciality of this firm, who this year will show a 625-line Monoscope equipment which provides a complete video signal and synchronizing pulses to C.C.I.R. standards. Models for 405 and 525 lines have been available for some time.

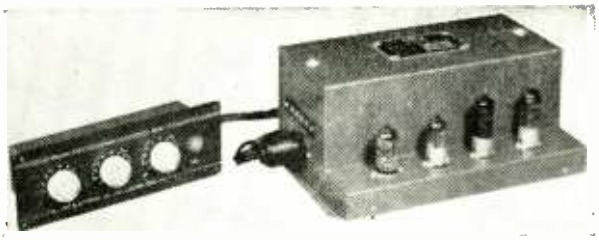
Specially designed for television work is the Type 520 oscilloscope embodying a 4-in flat-faced tube and a "Y" amplifier of exceptional performance. The "X" amplifier gives an expansion up to 5 screen diameters.

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

TELERECTION (5)

Considerable thought has been given by Telerection to the problems involved in the design of multi-band television aerials and while final designs cannot very well be produced before all the facts of Band-III television are known, they will be showing some examples of how the problems can be tackled for both the semi-local and fringe area viewers.

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



Left: Trix T41 domestic high-quality amplifier. Centre: Valradio tuner covering Bands I, II and III. Right: T.C.C. ceramic trimmer for use in TV tuners.

TELEVISION SOCIETY (205)

The equipment to be displayed has been chosen to illustrate the various aspects of television engineering covered by the papers read at the society's meetings. Reprints of some of the papers read during the past session will be available.

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

TRIX (65)

Amplifiers and auxiliary equipment for every class of sound reproduction from portable "crooner" outfits to rack-mounted large-scale p.a. installations are made by this firm. Designed for high-quality music reproduction in the home, the Model T41 amplifier, with a power output of 3-4 watts, is of special interest. A separate control unit is provided with independent bass and treble controls and there are two inputs for use with pickups of all types giving maximum output for 3 mV and 130 mV.

Trix Electrical Company Ltd., 1-5 Maple Place, Tottenham Court Road, London, W.1.

ULTRA (69)

Receivers embodying tubes of from 12-in to 17-in will be exhibited. Because of the particular mask shape adopted, a somewhat bigger picture than is usual for the tube size is claimed. The tuning system has a switch channel selector giving a choice of one Band-I and two Band-III stations, the Band-III tuner being a separate unit

In addition to a range of sound-broadcast receivers, a radio-gramophone will be on view. This is the ARG891 which includes space for record storage. A model for f.m. reception is available.

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

VALRADIO (29)

Reception of f.m. transmissions in Band II, as well as television transmissions in Bands I and III, is possible with the new multi-channel tuner to be shown by this firm. It uses a PCC84 cascode r.f. amplifier and a PCF80 frequency changer and covers 40-100 Mc/s in four steps and 170-225 Mc/s in two steps. Continuous tuning is provided over each step by ganged iron-dust cores and brass slugs in the coils.

Incorporating this tuner will be a new projection television set, giving a picture of 27in × 20¾in on a screen in the lid.

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

VIDOR (87)

No fewer than five different portable sets will be shown this year; one, the "Lady Margaret," is entirely new and although no larger than a lady's handbag (8 × 8 × 4 in) it incorporates a 4-valve receiver, takes a 90-V battery and boasts a 5-in loudspeaker; the weight is 6½ lb only.

Provision is made in the latest 14-in and 17-in television receivers for internally fitting a Band-III converter.

A special feature will be made of export type receivers, the batteries being protected against humidity and extremes of temperature.

Dry batteries of some 370 different types, ranging from those for torches to special models for nucleonic equipment, will be shown.

Vidor Ltd., West Street, Erith, Kent.

WAVEFORMS (75)

A new television signal generator will be on this stand. The Radar 405 provides an r.f. signal, tunable over Bands I and III, which is modulated by the correct sync pulses and a selection of test patterns. The sound and vision outputs are independently tunable and can be used together. The output is adjustable from 10 μV to 10 mV.

A more elaborate instrument, the type W90, will also be shown, together with a range of other test apparatus.

Waveforms Ltd., Radar Works, Truro Road, London, N.22.

WEARITE (74)

Principal interest on this stand centres on the Ferrograph magnetic tape recorder, which is available in many forms for scientific and industrial research as well as for domestic and professional sound recording.

A special version (2A/NH) of the Model 2A recorder will be shown, with tape speeds of 7½ and 15in/sec instead of 3¾ and 7½ in/sec. Another interesting version is the YDC with simultaneous dual-track recording for comparative analysis or stereophonic recording.

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

WESTINGHOUSE (2)

Tubular e.h.t. rectifiers will be prominent on this stand and the normal range will cover d.c. outputs of up to 15kV in single units with current outputs of between 100 μA and 8 mA. Copper-oxide instrument rectifiers, "Westectors" and germanium diodes will also be on view.

Westinghouse Brake & Signal Co. Ltd., 82 York Way, King's Cross, London, N.1.

WHITE-IBBOTSON (98)

Large-screen projection television receivers will be shown on this stand. The 4836 gives a picture 4ft × 3ft and is available in front- or back-projection forms. The 2418 and 2015 are rear-projection types and give pictures of 24in by 18in and 20in by 15in respectively.

Vision and waveform monitors will also be shown.

White-Ibbotson Ltd., Mortimer House, 37-41 Mortimer Street, London, W.1.

WHITELEY ELECTRICAL (105)

The cambric cone, introduced last year, has now been applied to the 12-in concentric Duplex and other loudspeakers in the high-quality range. A new dismountable "bass reflex" cabinet, which can be easily assembled, has been introduced for use with the 10-in and 12-in high-quality loudspeakers. Extension loudspeaker units with volume controls and optional push-button remote control will also be shown.

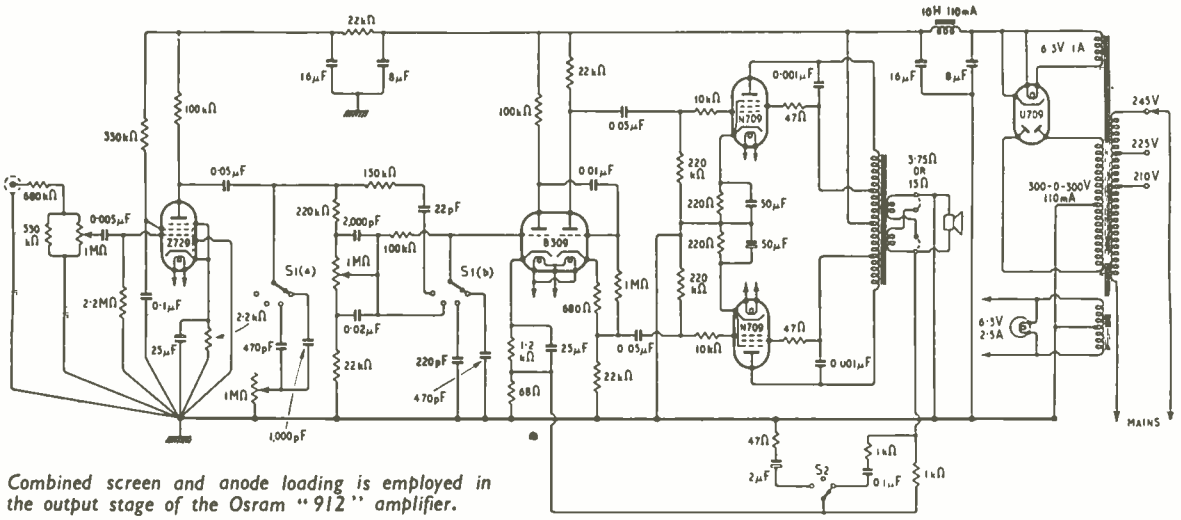
Sound reproduction is by no means the only activity of this firm, and the exhibit will also provide examples of a wide variety of components, including amplifiers, wavemeters, a.m. and f.m. transmitters.

Whiteley Electrical Radio Company Ltd., Mansfield, Notts.

WOLSEY (16)

To be shown this year will be a new "X" type television aerial with a "delta" matching section incorporated in one of the Vs formed by the crossed dipoles. Appropriately named the "Deltex" aerial it is said to give better matching between aerial and feeder. As neither dipole need be split and insulated at the centre it results in a far stronger construction. Like all other Wolsey aerials the "Deltex" is pre-assembled to simplify erection.

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



Combined screen and anode loading is employed in the output stage of the Osram "912" amplifier.

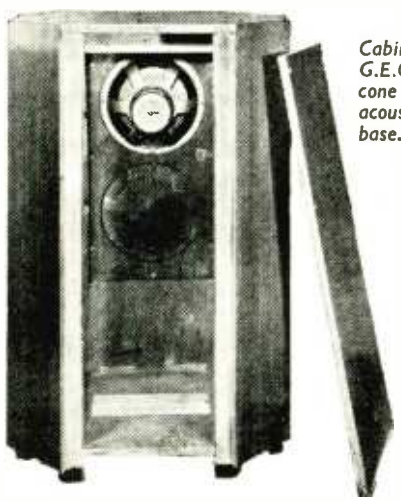
HIGH-QUALITY SOUND REPRODUCER

Osram "912" Amplifier and G.E.C. Metal-Cone Loudspeaker

NOW that the G.E.C. "F.R." metal-cone loudspeaker is in quantity production, the makers have decided to issue a design for an amplifier which will ensure that its full capabilities are realized. This design will be published as a booklet (price 3s 6d), which will also give details of a recommended cabinet for the loudspeaker.

The circuit type number "912" indicates that the frequency range is 9 octaves (30 c/s-16 kc/s) and that the power output is 12 watts. The first stage is a Z729 low-noise pentode, followed by a B309 double triode in which one triode acts as the second a.f. stage and the other as a phase splitter.

Two N709 pentodes in push-pull have the output load distributed between anodes and cathodes, thus giving a compromise between pentode and triode operation as far as efficiency and harmonic distortion are concerned.



Cabinet designed by G.E.C. for the metal-cone loudspeaker. The acoustic vent is in the base.

Feedback is applied over the last three stages and can be modified by a switched RC network in the feedback loop to give a flat response or one with an approximately 5 db level lift or drop from about 3,000 c/s upwards. This is described as a "presence" control and when "in" has the effect of transporting the listener to the front seats of the concert hall where the ratio of high to low frequencies is higher than, say, at the back of the hall, where the increased proportion of reverberation and high-frequency absorption tend to depress this ratio. The device is admittedly artificial but the effects are more realistic than those which would be obtained with normal sloping tone control characteristics. Normal tone control is, of course, provided (between the first and second stage) to cope with variations in recording and pickup characteristics.

The "F.R." metal-cone loudspeaker* in addition to its low non-linearity distortion is capable of a very uniform and extended frequency response when housed in a suitable enclosure. A very rigid cabinet of octagonal section has been developed in which unwanted panel resonances are suppressed, only the single Helmhotz resonance being applied at or near the fundamental cone resonance to control the impedance rise and extend the low-frequency response. The vent is situated in the centre of the cabinet, which is raised from the floor by four supports, the height of which tunes the acoustic resonance, since the air mass between the floor and base is in radial vibration. It is conceivable that, with this arrangement the resistive damping is increased. However this may be, the result is a remarkably smooth and full bass response down to 30 c/s which adds no trace of coloration to the reproduction of speech.

* See *Wireless World* Nov. and Dec. 1952.

Combination F.M./A.M. Receivers

Design Factors of Sets for the New B.B.C. Service

By G. H. RUSSELL,
Assoc.Brit.I.R.E.

FREQUENCY modulation broadcasting is to commence in this country in the near future. Special combination receivers will have to be provided for the reception of both the f.m. transmissions in the v.h.f. Band II, and the a.m. transmissions which will continue to be radiated in the medium and long broadcast bands.

The standards of f.m. transmission will be similar to those prevailing in America and Germany; 100 per cent modulation will correspond to 75 kc/s deviation, maximum modulation frequency will be 15 kc/s, and pre-emphasis corresponding to a time constant of 50 μ secs will be used. The nominal channel separation will be 200 kc/s, and judging from a preliminary list of stations it would appear that stations serving the same area will be separated by 2.2 Mc/s. Generally, the minimum field strength in towns may be expected to be in the region of 800 μV/metre, and in country districts about 250 μV/metre.

Translating this information into receiver requirements, we arrive at the following design data. The receiver should be tuneable over the whole of Band II; that is, 87.5 to 100 Mc/s, although initially only 88-95 Mc/s will be available for the f.m. service. Regardless of the modulation frequencies involved, the bandwidth will have to be made considerably greater than that theoretically required, to allow for oscillator drift; -3 db at ± 100 kc/s should be regarded as a minimum. In this respect, it is safer to err on the liberal side as the distortion produced on a f.m. receiver by mistuning is at least as great as that obtained on selective a.m. receivers. Taking into account the "capture effect" and the distribution of stations, a selectivity characteristic of -3 db at ± 150 kc/s would probably make a good compromise.

As the vast majority of these receivers will undoubtedly be used with the inevitable "piece of wire" acting as an aerial, a sensitivity of the order of 10 μV will almost certainly be required. Sensitivity in f.m. receivers means not only that the standard 50-mW output is obtained with a given r.f. input signal 30 per cent modulated, but also that the receiver limits satisfactorily with the same input. If satisfactory limiting requires a greater input than that required to produce standard output, it is this figure that expresses the true sensitivity of the receiver. Satisfactory limiting may be defined as that which produces an f.m. to a.m. ratio of not less than 30 db. For preference the figure should be in the region of 40 db. The f.m. to a.m. ratio expresses the difference in the output of a receiver produced by injecting consecutively (at the centre frequency) f.m. and a.m. signals both 30 per cent modulated. It is as well to point out here that the majority of f.m./a.m. signal generators available in this country to date show a distressing tendency to change frequency when the system of modulation is changed. As 100 per cent modulation corresponds to 75 kc/s deviation, it should be clear that 30 per cent modulation corresponds to 22.5 kc/s deviation.

General Considerations.—From the foregoing, the outline of the combination f.m./a.m. receiver becomes apparent. First, two tuners are required; one to tune the long- and medium-wave broadcast bands, and the other to tune the v.h.f. band. For obvious reasons these should be controlled by a single knob. Secondly, two separate intermediate frequency amplifier chains are required; one for the broadcast bands which will embody the usual selective amplifier operating at a frequency of about 470 kc/s, and the other a relatively wide-band amplifier operating at a considerably higher frequency. Thirdly, in all but a few cases, two detectors are required—one for a.m. and one for f.m. demodulation, the latter including, or being preceded by, some form of amplitude limiting. Fourthly, a method of switching both the wavebands and the systems must be devised.

In all but the most expensive receivers, the short waveband, which has been a feature of the majority of our receivers since the mid-thirties, may now be expected to disappear. In western Germany, where over 90 f.m. stations give almost complete coverage, even the long waveband has disappeared from what may be termed the standard receiver. This may eventually be expected to happen here when complete f.m. coverage is attained, but until then a long waveband will have to be provided in our receivers for the reception of Droitwich.

Due to the use of a higher value of intermediate frequency and the need for a considerably wider bandwidth, more stages of amplification are needed for f.m. than for broadcast reception. The usual method of obtaining this is to use the heptode section of the broadcast frequency changer as an extra i.f. amplifier, together with a second i.f. stage using a valve with a higher slope than is usual in broadcast receivers. A special series of valves has been made available for combination receivers. The Mullard range includes the ECH81 triode-heptode, the EF85 variable-mu pentode with a mutual conductance of 6 mA/V, and the EABC80 triple-diode triode. With the latter, two diodes are used for the f.m. demodulator and the third for detection and a.g.c. on the broadcast bands.

Delayed a.g.c. cannot be provided with this arrangement, but as a great deal more gain can be obtained from the i.f. amplifier than is usual in broadcast receivers, this should be of little consequence. Alternatively, a separate germanium diode could be fitted. A.G.C. is not generally used with f.m. receivers as minor variations in amplitude do not affect the receiver output, and the lack of a.g.c. provides extra limiting with large inputs. Both the ECH81 and EF85 are operated with relatively large screen resistors (22 kΩ and 56 kΩ respectively) which make it almost impossible to exceed the maximum permissible dissipation. With standard 470-kc/s i.f. transformers, the

EF85 stage gain will be far too high and instability will result unless this is reduced to manageable proportions. This can be achieved either by using i.f. transformers with a suitably low dynamic resistance or, possibly more simply, by switching in a supplementary cathode resistance. The conversion conductance of the ECH81 is 775 μA/V, and the mutual conductance of the heptode section is 2.4 mA/V when it is used as a straightforward amplifier.

V.H.F. Tuning Unit.—As the heptode section of the ECH81 is used as an i.f. amplifier for v.h.f. reception, it clearly cannot be used as a frequency changer at these frequencies. It is, furthermore, undesirable that it should be so used, as at v.h.f. it would give very poor gain in comparison with other methods. It would also require switching at v.h.f. which is something to be avoided as far as possible.

The v.h.f. mixer is therefore almost invariably a separate valve; triodes and pentodes being equally popular. Both types are usually employed as self-oscillating mixers; a circuit which gives a high conversion gain. In Germany, a triode self-oscillating mixer (EC92) is much favoured, but as the Germans tend to use this without a stage of r.f. amplification, oscillator radiation is a problem. To minimize this, the valve is used in a form of bridge circuit the function of which is to cancel out the oscillator voltages at the aerial. Its efficacy, however, seems somewhat limited, as one German receiver employing this circuit which the author tested showed 300 mV to be present across the correctly terminated aerial sockets. It is understood that this is by no means uncommon. As German receivers use an i.f. of 10.7 Mc/s and make use of the whole of Band II, it can be seen that the oscillator frequency actually falls within the band. It can only be assumed that this fact was taken into account when frequencies were allocated.

There can be no doubt that in this country such a practice would be frowned upon, and an r.f. stage should be regarded as a necessity. For the same reason, the use of a super-regenerative type of receiver is almost out of the question. Its high efficiency and apparent simplicity make it appear an attractive proposition, but as it makes use of a pulsed oscillator it could be placed under the heading of "small power transmitters." The power radiated by these oscillators is so high that it is doubtful whether an r.f. stage would provide adequate protection. To return to the r.f. stage, here again a choice between triodes and pentodes can be made; the triode being earthed-grid connected. As receiver noise is of little moment in f.m. receivers, the choice between triodes and pentodes for the mixer or r.f. amplifier is purely a matter of convenience. The choice is usually made by balancing amplification against cost.

Either permeability or capacitive tuning can be used; the latter being more convenient from a mechanical design standpoint. Tuning capacitors made specially for these receivers are now available. If permeability tuning is used, the r.f. stage can be pre-set tuned to the centre of the band to avoid alignment problems. Little is lost by so doing. One advantage of not having externally controlled signal frequency tuning is that the inter-valve circuit capacitance can be kept low, permitting a higher LC ratio to be obtained. A unit similar to that published in *Wireless World* recently[1], but designed for use on Band II, with an aerial step-up transformer and a 1:1 i.f. transformer, will give a gain from the aerial input to the secondary of the i.f. transformer considerably in excess of 100. One last word about the usefulness of the r.f. stage. Quite apart from the fact that it isolates the oscillator, it is well worth the extra cost because a well-designed stage will provide appreciable rejection of spurious responses as well as worthwhile gain.

I.F. Amplifier.—A typical i.f. amplifier for a combination a.m./f.m. receiver is shown in Fig. 1. As can be seen, system switching takes place at intermediate and audio frequency. Great care must be taken with the layout of the switch wiring, and particularly the relative positions of the grid and anode wires. German designers tend to use a slider switch which runs almost the whole length of the chassis in some cases. This enables the switching of each stage to be carried out as close to the valve as

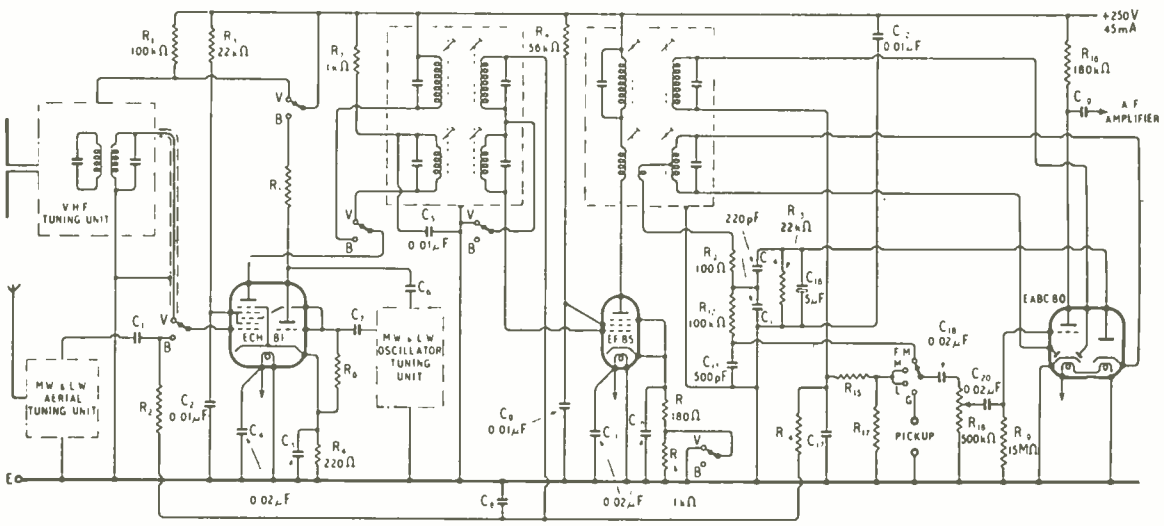


Fig. 1. Circut diagram of i.f. amplifier and detectors for combination a.m./f.m. receiver. "V" indicates switch position for f.m. reception and "B" that for medium- and long-wave reception.

possible. This type of switching is facilitated in German receivers by the fact that only a two-position switch is necessary. British receivers will be complicated by the necessity for incorporating a long waveband. Nevertheless, a similar arrangement will probably be necessary for switching the ECH81 anode and the EF85 grid and cathode. Care must also be taken with the output lead of the v.h.f. unit. It may not always be possible to place the output connections of the unit close to the switch, and if the connecting lead is more than an inch or two long it must be screened. Low-capacitance screened lead should be used and the i.f. transformer secondary tuning capacitance reduced accordingly.

The necessity for switching the ECH81 anode and the EF85 grid may not at first be clear. The reason for switching the ECH81 anode is that many frequencies are present at the anode of a mixer, and the presence of two circuits tuned to different frequencies in the output could cause undesirable effects. One obvious one is the possibility of unwanted signals passing through the wrong channel and reaching the audio section through leakage across the switch. The switch in the EF85 grid circuit is intended primarily to short-circuit the a.g.c. line when using the higher i.f. in order to prevent stray coupling between the i.f. stages. It incidentally performs the additional function of short-circuiting the secondary of the first 470-kc/s i.f. transformer which results in slightly improved v.h.f. sensitivity.

The reason for R_1 may also appear obscure. It is included in order to comply with the valve manufacturer's requirements which do not tolerate operating high-slope valves with their heaters on but with no high tension. Nevertheless, it is desirable to stop the v.h.f. unit operating when the receiver is being used for broadcast reception, and R_1 covers both requirements by reducing the h.t. to some 20 volts.

The f.m. discriminator is a ratio detector of the unbalanced variety; R_{13} is the load and C_{16} the stabilizing capacitor. R_{12} and C_{13} form the de-emphasis circuit. It will be noticed that grid current biasing is used with the EABC80 triode. This is preferable because it enables the cathode to be taken directly to chassis potential. As this cathode is common to one of the ratio detector diodes, this circuit reduces the possibility of unbalance in the detector. It incidentally shows a slight saving in cost over the cathode biasing arrangement. The distortion introduced by this stage is remarkably low and no fears need be felt on this score.

F.M. Detector.—There are many forms of f.m. detector, most of which are only of academic interest to domestic receiver designers as they are either very inefficient, or they require additional valves to act as limiters. Information on these can be obtained from the literature and it is proposed to confine this section to a discussion of two types only.

Until 1947, limiting in f.m. receivers was nearly always provided by two saturated amplifiers preceding the discriminator. That tended to make these receivers rather expensive. It would not be far from the truth to state that if a simpler solution to the limiting problem had not been found, f.m. broadcasting on a large scale would have been made impossible through the lack of listeners. Combination receivers are expensive enough without the additional cost of two extra stages! In fact, two solutions were found; the nonode valve and the ratio detector.

The nonode valve, designated EQ80 in this country,

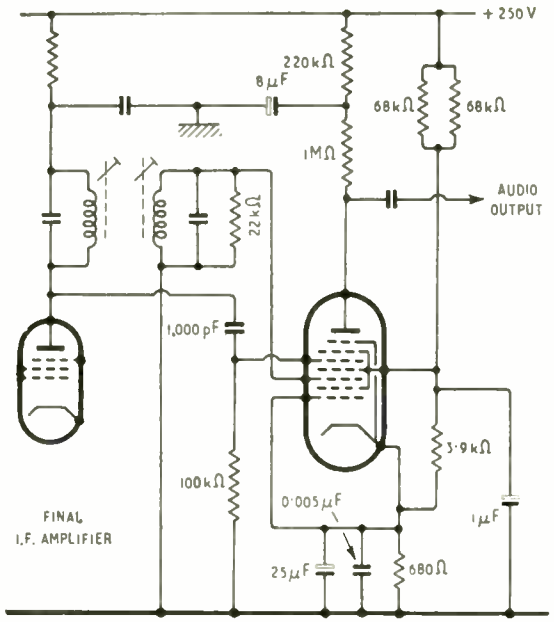


Fig. 2. Typical circuit of a nonode f.m. detector.

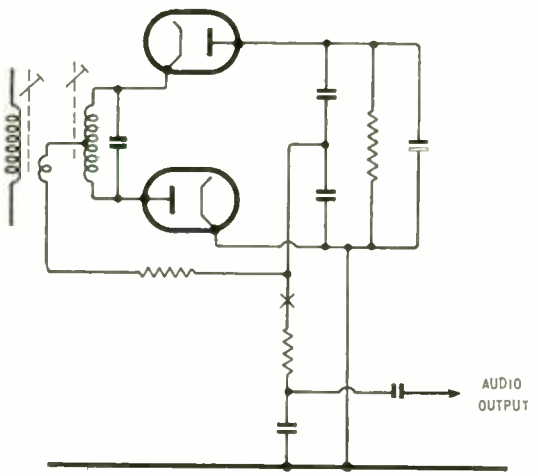


Fig. 3. Circuit diagram of ratio detector.

is a "gating" valve. Two voltages having a phase angle between them of 90 deg are applied to the third and fifth grids. The voltages at the first and second grids are held constant and anode current can only flow when both the third and fifth grids are positive. As in a pentode, if the first and second grid voltages are held constant, the electron current is likewise constant. Therefore, in the nonode valve any change in anode current will be solely a function of the phase difference of the voltages at the third and fifth grids. If this phase difference is made to vary in accordance with an f.m. signal, the valve will convert changes in frequency to changes in amplitude, and the valve will become an f.m. demodulator. As the electron current is constant, the valve will not respond to changes in amplitude of the input signal and limiting is therefore automatic. There is, however, one serious

drawback. For efficient limiting, over 11 volts peak is required at grids 3 and 5, and as the phase difference is usually obtained by means of a transformer, something of the order of 23 volts peak must be provided across the primary. Needless to say, at the intermediate frequencies generally used in f.m. receivers this is difficult to obtain, and the saving on the conventional phase detector with two limiters is probably one valve. Nevertheless, once limiting does take place, the results are excellent. A typical circuit is shown in Fig. 2.

It is not proposed to go into any detailed description of the operation of the ratio detector, as this has been dealt with elsewhere[2]. The circuit is shown in Fig. 3. As can be seen, it bears a resemblance to the conventional phase detector but with two major differences. The diodes here are connected in series and the resultant voltage developed across the load resistance is stabilized by means of a large capacitor. This capacitor holds the amplitude constant and limiting is therefore automatic. Satisfactory limiting can be obtained with about 6 volts input. As the loading is heavy, a form of matching is used between the primary and secondary of the discriminator transformer. Possibly the most important factor in the design of the ratio detector is what the designers have termed the S/P ratio; that is, the ratio of secondary to primary voltage. On this depends whether the detector will limit satisfactorily, if at all. After all other parameters have been fixed, the S/P ratio becomes a function of the coupling between the primary and the secondary, and therefore between the primary and the tertiary.

An easy method of adjusting the coupling is during alignment. A d.c. meter (low loading) is placed across the stabilizing capacitor and an unmodulated signal is injected into the receiver. All i.f. circuits except the secondary of the discriminator transformer are adjusted for maximum d.c. output. The meter is then transferred to the audio take-off point (point X in Fig. 3) and the secondary of the discriminator transformer is adjusted to give a d.c. voltage half of that which was obtained across the stabilizing capacitor. The primary may then require a slight re-adjustment after which the secondary setting should be checked. This process should be repeated until no further adjustment is necessary. The signal is then amplitude modulated and the point of maximum limiting should occur within about 10 kc/s of the alignment frequency. If it does not, the position of the tertiary winding should be adjusted with relation to the primary. The alignment process must then be repeated. The whole process must be repeated as often as is necessary until the point of minimum a.m. response does fall within about 10 kc/s of the alignment frequency. If it does not occur anywhere within the permissible range of adjustment of the tertiary winding (that is, between the top and bottom of the primary winding) the transformer has been incorrectly designed. It will be noted that it is not absolutely necessary to use an f.m. signal generator to align this detector. The need for such a generator will only arise if some obscure fault develops, or for more involved tests.

The ratio detector has enjoyed great popularity both in America and in Germany, and will no doubt become just as popular here. It is simple, reasonably sensitive, and f.m./a.m. ratios of 40 db and more can be obtained in practice with quite low inputs. It has another advantage in that the sideband responses are small and it tends to limit even on random noise. The result of this is extraordinarily low interstation noise. This is a great advantage in domestic receivers as it is doubtful whether most people would appreciate the colossal din, common with receivers using other types of detector, that occurs when tuning from one station to another.

Intermediate Frequency.—The choice of an intermediate frequency is, as usual, a difficult one. The designers of the ratio detector chose 10.7 Mc/s as being the highest frequency that would give a reasonably high gain per stage. Unfortunately, this frequency has the drawback of causing the fundamental oscillator frequency to fall in Band II, and the second harmonic to fall in the middle of Band III. In spite of this, 10.7 Mc/s has virtually become standard in both America and Germany.

The same considerations hold good for this country. Although initially an i.f. of 10.7 Mc/s may not cause the oscillator to interfere with broadcast reception in Band II, it will almost certainly affect the public services operating in Band II and to the commercial television services in Band III. It is highly debatable whether radiation in mass-production receivers can be kept within the limits laid down by B.R.E.M.A. The radiation problem is further complicated in f.m. receivers by the fact that the majority will not be used with a matched aerial. The piece of wire that will probably stand proxy for an aerial will almost certainly increase the nuisance value of the receiver. For this reason it is suggested that the oscillator voltage at the aerial socket should be measured without the usual terminating resistance.

Any frequency above 12.5 Mc/s will keep the oscillator out of Band II, but to keep its second harmonic out of Band III requires an i.f. above 20 Mc/s. For the same stability margin this frequency will only give half the gain per stage that can be obtained with 10.7 Mc/s. Even so, the sensitivity of the receiver should be adequate, and the higher frequency has advantages to offer. It will give increased protection from spurious responses; an important point when it is remembered that television stations in Band III could cause interference due to the oscillator second harmonic. Another advantage is that the farther removed the signal frequency is from the oscillator, the greater will be the protection against radiation given by the signal-tuned circuits. A minor advantage is that it makes the design of a receiver with a pre-set tuned r.f. stage easier by keeping the oscillator frequency well away from the centre of the band.

The Pseudo F.M. Receiver.—It will have become quite clear by now that combination f.m./a.m. receivers are going to be somewhat more expensive than the standard 4+1 domestic receiver we have been used to. In the circumstances, it was only to be expected that attempts would be made to produce something considerably cheaper—if only for use in high signal strength areas. It is well known that f.m. signals can be received on an a.m. receiver by the simple expedient of tuning down the slope of the selectivity characteristic[3]. This is often referred to as slope-detection. This form of detection has many drawbacks. It is very inefficient, it provides no limiting, and it gives two tuning points for each station. The use of it is only justified by its simplicity and cheapness.

A receiver using a slope-detector for f.m. reception has been produced in Germany; the circuit is shown in Fig. 4. It can be seen that the receiver consists of three valves plus rectifier. The first valve is a v.h.f. triode (EC92) used as a self-oscillating mixer

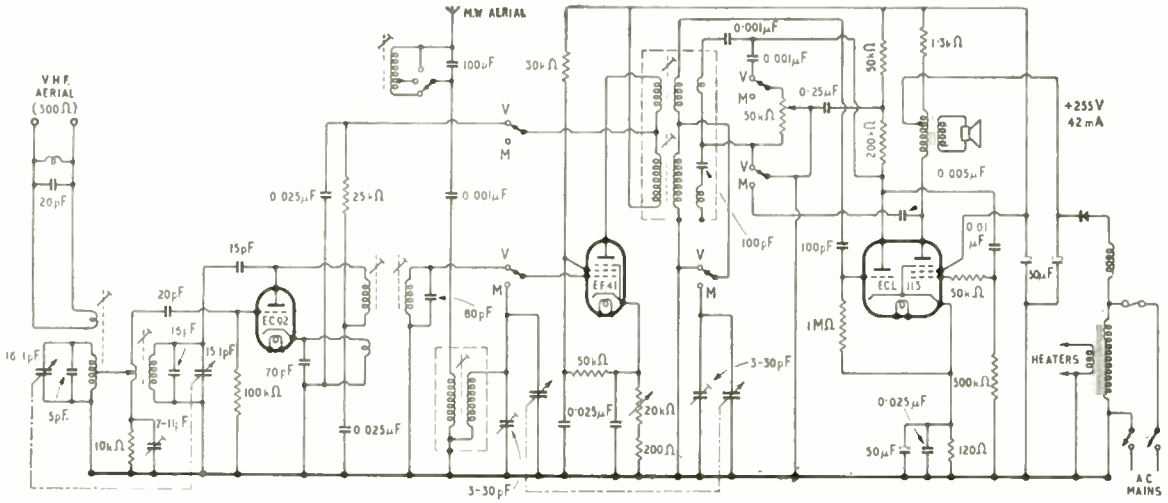


Fig. 4. Circuit diagram of German Grundig f.m. a.m. receiver, Model No. 810, showing use of slope-detector for f.m. demodulation. "V" indicates switch position for v.h.f. and "M" that for medium-wave reception.

on v.h.f. only. It incidentally illustrates the typical way in which this valve is used. The second valve (EF41) does service as an i.f. amplifier on v.h.f. and an r.f. amplifier on medium waves. The final valve (ECL113) is a triode-pentode, the triode section acting as a leaky-grid detector on both bands, the pentode being the audio output valve. Volume is controlled by a variable resistance in the cathode of the EF41, and a potentiometer in the anode circuit of the detector provides a reaction control on medium waves and a tone control on f.m. Whether for f.m. or a.m. reception, this receiver is only suitable for use in high field strength areas, and it is not known what success it has had.

This receiver has no r.f. stage, nor does it provide any form of limiting. As far as this country is concerned, such a circuit might conceivably fill a temporary need as a converter, but as a receiver it should surely be rejected. Quite apart from the ethics of the case, it is doubtful whether such a receiver would be capable of any better performance on f.m. than the standard broadcast receiver gives on medium and long waves.

Audio Amplifier.—The B.B.C. has stated that it is introducing v.h.f. broadcasting, "not as a complete substitute for long and medium wavelengths but as a powerful reinforcement of the sound services." We may therefore take it that fidelity will only be a secondary consideration. Taking into account the high-frequency attenuation of land-lines and the frequency response of studio equipment, it will only be on rare occasions that full advantage will be taken of the upper modulation frequency limit of 15 kc/s. This, however, need not make us downcast, as reception in many places will be considerably better than that which is obtainable on medium and long waves. It is suggested that in combination receivers the distortion level should not be higher than 2 per cent at the maximum rated output, and should preferably be of the order of 1 per cent. To attain these figures will require a substantial amount of negative feedback with a consequent reduction in amplification. The amount of feedback that has to be used may be so great as to reduce the sensitivity of the receiver to a level which is below that required. In this case, it may be thought

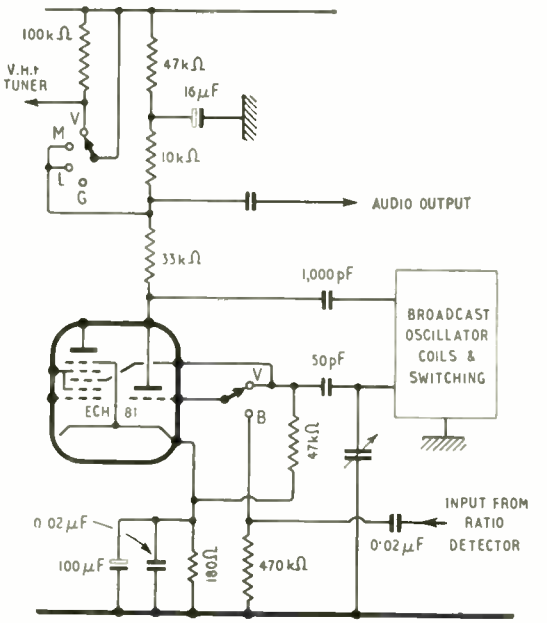


Fig. 5. Circuit diagram showing the method by which the triode section of the ECH81 can be used as an audio amplifier on v.h.f. without detriment to its function as an oscillator on medium and long waves.

worth while to use the otherwise idle triode in the ECH81 as an extra audio amplifier on v.h.f. The method by which this may be done is shown in Fig. 5. Hum is the greatest problem here, and extra smoothing must be used in the anode supply. Even then, full use of the valve cannot be made, and it will be noticed that only one-quarter of the anode load is used. This keeps the hum level low and enables the stage to give a useful power gain of over six times.

Results.—Three receivers comprising an EF80 preset tuned r.f. stage, EF80 self-oscillating mixer, ECH81 i.f. and a.f. amplifiers, EF85 i.f. amplifier, EABC80 ratio detector and a.f. amplifier, EL85 power

amplifier and EZ80 mains rectifier, used in a similar manner to that described in this article, had sensitivities of 3, 4 and 9 μV respectively, and f.m./a.m. ratios of between 36 and 40 db at these signal levels. The intermediate frequency was 19.5 Mc/s. Bass boost at 80 c/s was between 4 and 5 db with reference to 400 c/s, and the frequency response with pre-emphasis was level up to 8 kc/s. Overall distortion at 1.5 watts output was in the region of 2 per cent.

Conclusions.—It was mentioned in the "Second Report of the Television Advisory Committee, 1952," that the additional cost of incorporating v.h.f. in new receivers will be of the order of 30 per cent. It was also stated that the additional cost would be greater unless the receivers were mass-produced. Whether these receivers can be produced on anything like the scale of the 4 + 1 receiver will depend on two factors. The first is the speed with which the B.B.C. are able to erect the stations, and the second is whether the ordinary man-in-the-street is going to think it worth while to spend that extra 30 per cent on his receiver. If demand is great enough, we may be well on the way to building up a thriving industry in a.m./f.m. receivers. In this case, it may be possible to reduce the 30 per cent substantially, and that will justify all the arguments that have been made in favour of f.m. broadcasting.

References

[1] Russell, G. H., "Band III Convertor," *Wireless World*, Vol. 60, No. 5, May, 1954, p. 211.

[2] Seeley, S. W., Avins, J., "The Ratio Detector," *RCA Review*, June, 1947.

[3] Sturley, K. R., "Radio Receiver Design," Part II, Chapman and Hall, 1947, p. 335.

Colour Television Tests

By J. FRANKLIN

IF any television experimenters in London happened to have their sets running after programme hours during July they may have been lucky enough to see some strange things on the screen. The things in question, which I saw quite by chance on my receiver, were orderly patterns of white dots on a synchronized, but otherwise blank, raster. Sometimes the patterns had a bar or several bars across them and at other times they were quite plain.

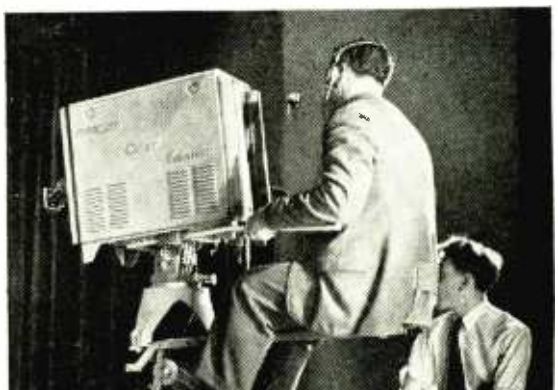
Having been following developments in colour television pretty closely, I realized immediately that the B.B.C. were transmitting a sub-carrier frequency on the main 45-Mc/s carrier wave from Alexandra Palace—a sub-carrier such as would be used for conveying colour information in a compatible colour television system of the N.T.S.C. type. As is generally known, this sub-carrier in the N.T.S.C. system enables the colour information to be transmitted within the same video band as the monochrome signal, and its frequency is chosen so that the colour sidebands are interleaved between the monochrome sidebands.

The great problem which British television people seem to be faced with at the moment is whether or not we can adapt the N.T.S.C. type of colour system to our existing 405-line standards. And this depends to some extent on whether the system is compatible enough. In short, is the presence of a sub-carrier and its resultant pattern on the screen going to cause too much deterioration of our pictures? I imagine that the B.B.C. were attempting to answer this question by arranging a series of test transmissions of a sub-carrier signal so that observations could be made on typical receivers. An interesting problem here is: what is the best frequency for the sub-carrier?

In the June issue of *Wireless World* a report was given of a British version of the N.T.S.C. colour television system developed by Marconi's, and in this the sub-carrier used was approximately 2.66 Mc/s. I therefore assumed that the B.B.C. were transmitting something comparable with this. Tests with an absorption wavemeter, however, showed the frequency to be more like 2.8 Mc/s, or perhaps slightly under. This higher frequency, of course, would give a finer and less visible dot pattern on the screen than in the Marconi system, and I personally found that I could not see the dots when I moved to a distance of about 4-5 feet from the screen.

On the other hand, the higher the sub-carrier frequency the more likely is the colour signal to interfere with the sound channel of the system. I presume that the bars I saw on the screen were a form of modulation on the sub-carrier to test for this effect (probably square-wave modulation). There was, in fact, a perceptible low-frequency noise in the loudspeaker when these bars appeared, but it did not strike me as being particularly obtrusive. No doubt the amount of this interference would vary with different receivers.

Presumably some organized observations were made on these test transmissions, apart from the clandestine ones such as my own, and it will be interesting to see the results when they are eventually published.



Colour television camera used with the Marconi system referred to in the article. It has only two pick-up tubes (one for high-definition monochrome information and the other for low-definition colour) and is notable for its small size.

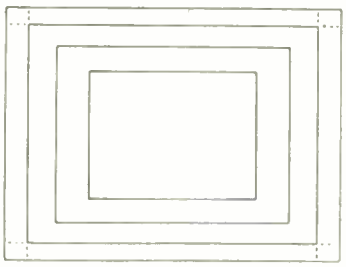
LETTERS TO THE EDITOR

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

"Why Lines?"

THE "Lissajous" scanning system proposed by F. P. Hughes (your August issue), if it earns full marks for originality surely merits none for practicability.

If one inscribes three similar and symmetrical rectangles within the screen so that the smallest is one quarter of the whole screen area, and the area between each rectangle and the next larger is also one quarter of screen area, it is clear that with B.B.C. standards the spot will be in each of the four equal areas for approximately 22 per cent of total transmission time, the remainder being lost to synchronizing pulses, etc. With "Lissajous" scanning the spot will be 11 per cent of transmission time in the central area, 14 per cent in the next area as one moves outward, 19 per cent in the next and 56 per cent in the outmost fringe. Moreover the spot will take as long in total to scan the four small rectangles in the corners (comprising together 1.8 per cent of screen area) as it does to scan the important centre area. In fact the transmission time wasted on the edges and corners of the picture will be very much greater than that "wasted" in sync. pulses in conventional systems and definition in the important central area will be equivalent to a 30 per cent cut in line number and 50 per cent in bandwidth as compared with the conventional.



Even more serious would be the consequences of the timebase waveform departing in the slightest degree from purity. As the screen is being scanned equally from left to right and from right to left any phase drift will shift half the picture elements one way and the other half in the opposite direction. At screen centre a drift of 0.001 c/s will cause the picture elements to separate by approximately 0.006 of the total picture width, giving a "defocus" effect equivalent to complete loss of the one-megacycle bands on the test card. Similar loss of definition, but varying in complex fashion from place to place on the screen, would result from 0.6 per cent of *total* harmonic distortion. As these results would be additive on some parts of the screen, it would probably be necessary to specify tolerances of not more than 0.0002 c/s max. phase drift and 0.1 per cent total harmonic distortion for the timebase oscillators. Such a specification is probably not unattainable, but the cost and complication would obviously be prohibitive.

Teddington, Middx. S. HOSKING TAYLER.

Why A.G.C.?

I SEE from p. 40 of the August issue that "Diallist" proposes to build a modified version of my midget sensitive t.r.f. receiver (described in the April issue) without a.g.c. A.G.C., he maintains, is unnecessary because the receiver is intended only for reception of local stations which, in his locality, are free of fading. Surely "Diallist" isn't under the impression that a.g.c. is used only to combat fading? It has another merit, equally important; namely, that it ensures equal volume from all signals. This fully justifies its inclusion in a local-station receiver. "Diallist" is indeed fortunate if all his local transmissions are of equal strength and, if they are not, he will need to reset the volume control after each tuning adjustment. The inclusion of a.g.c. avoids this, making operation easier and prolonging the life of the volume control potentiometer.

Although it may not apply in this particular case, a.g.c. is sometimes used to avoid the application of large signals to the detector. Such protection may be necessary if the detector overloads easily (as anode bend detectors do) or if the detector may be damaged by large signals (as some crystals are).

J. L. OSBOURNE.

Ionic or Iontic?

PEOPLE speaking languages of Anglo-Saxon or Latin origin employ, generally successfully, a great number of technical and scientific terms derived from the Greek. Occasionally, though, in the process of adaptation, there is a regrettable loss of clarity and precision.

An example of successful use is the word *ion*, which is the neuter present participle of a Greek verb meaning "to go." But non-Greek technologists, in coining derivatives and compounds of this useful word, have introduced error and confusion. *Ionic order* (architectural), *Ionic school* (philosophic), etc., refer to the ancient Greek land *Ionia*. *Ionic* is a synonym of *Ionian*; therefore, *ionic bombardment* might (and should, by the rules of language) refer, say, to a naval action off the Ionian Islands! The mythological Greek priestess Io ('Iω), sweetheart of Zeus, who gave her name to these islands, bore no relation whatever to the electrically charged atoms, molecules or radicals in which the radio engineer is interested. She also had nothing to do with the new radio-active isotope *ionium*.

To avoid confusion, derivatives of *ion* should be formed from the genitive *iontos* (ιοντος which gives us the root *iont-*, or sometimes, for the sake of euphony, *ionto-*.

The correct practice has already been adopted by the medical profession in the word *iontophoresis* (introduction of ions into human tissues). Radio technologists and physicists should, I suggest, follow suit by changing, for example, ionize into *iontize*, ionosphere into *iontosphere*, ionium into *iontium*, etc.

DIONYSIUS J. BATAIMIS.
Hellenic National Broadcasting Institute,
Athens.

Electronics and Automation

IN your report on a debate at the Brit. I.R.E. Convention ("Industrial Electronics," *Wireless World*, August, 1954, p. 358) you mention a discussion on the possibilities of flexible machines which could be programmed for different tasks as required: these would in fact be something like the original concept of a Robot; i.e., a mechanical substitute for a human being. One attempt to mechanize a production process in terms of "replacing human labour" has convinced me that this is a wrong approach. Human labour is very flexible and fairly cheap (especially if female) and a machine to carry out precisely an adjustment such as tuning a circuit to resonance, which at present is done by hand, is prohibitively complex. Not least of the difficulties is that of making the robot connect automatically with the appropriate part of different models of equipment.

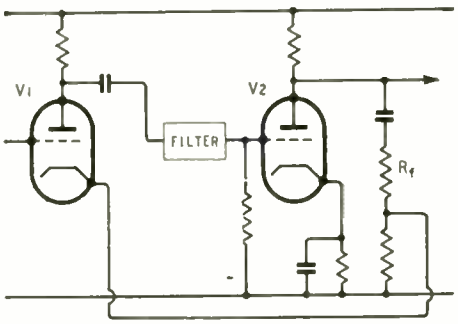
The future of "automation" (factory production with the minimum of labour) lies mainly in the development of appropriate manufacturing techniques, such as printed circuitry in radio and electronics, and the pressed-steel body in place of the coach-built body in the automobile

industry. The future of industrial electronics lies in doing things which the average human operator *cannot* do successfully. This applies particularly to fast-moving flow production; e.g., colour printing, textile manufacture, continuous steel strip mills, but it is also beginning to find application in precision machine tools. Whenever the quickness of the machine deceives the eye, or the potential accuracy of the machine is greater than that of human hand and eye, there may be an essential job for electronics.

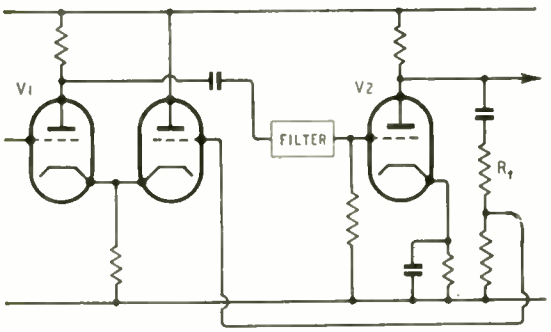
Birmingham. D. A. BELL.

Feedback Circuits

THE well-known feedback circuit (diagram (a)) is fully discussed in "Radio Designer's Handbook," p. 334. However, one soon finds out when trying to apply the circuit that either the anode load of V_2 becomes inordinately low or that the cathode load of V_1 becomes inordinately high with anything more than a small feed-



(a)



(b)

back ratio. These snags disappear when the feedback is applied to the grid of a cathode follower which is direct coupled to V_1 (diagram (b)). It is possible to vary the feedback between wide limits without upsetting the working characteristics of either V_1 or V_2.

I am using this circuit in a pre-amplifier with a parallel-T whistle filter between V_1 and V_2. Coupled to a Baxandall tone control (*Wireless World*, Oct. 1952) the whole arrangement works very well, is silent, stable and, judged by ear, of high fidelity.

It is possible that this circuit may be discussed somewhere in the literature and if one of your readers could enlighten me I would be grateful.

Burgess Hill, Sussex. A. V. SLATER.

Vector Diagram Conventions

IN his July article, "Cathode Ray" has advocated that certain conventions should be adopted to ensure that there should be only one correct voltage vector diagram to correspond to any given circuit diagram. The suggested conventions involve the addition and placing of vectors in an order uniquely determined by the circuit configuration. The conventions thus imply a slight restriction on the commutative law of addition of vectors, and also on the usual understanding of a graphical vector as having length and direction but no defined position.

In my view, although it is desirable in every problem to establish a defined relationship between the sign convention for the circuit diagram and the sign convention for the vector diagram, it is undesirable to extend this to "a perfect tie-up between circuit and vector diagrams" in the rigid one-to-one manner that has been advocated by "Cathode Ray."

"Cathode Ray" has invited his readers to point out any flaw in the system which might account for its lack of general acceptance since it was first proposed in 1951. It is possible that this may reside in the restriction to which the diagrams are subject when an attempt is made to develop them into vector loci. For example, with reference to Fig. 14 of the July article, and considering a constant current condition, diagram (a) would provide the most convenient basis for a locus to illustrate the variation of E and V with variation of ωL, R_1 and R_2 being constant. On the other hand, diagram (b) would be more convenient if R_2 were to be varied with R_1 and ωL held constant, while diagram (c) would be more convenient if R_1 were to be varied with R_2 and ωL held constant. To justify these alternative forms of vector diagram, "Cathode Ray" would have to redraw his circuit diagram to match each case, thus attributing undue importance to the cyclic order of the components in a circuit in which the only really significant fact is that the components are connected in series.

Bangor, N. Wales. DAVID MORRIS.

FURTHER EDUCATION

Radio Courses Available

IF the proposal put forward by the Parliamentary and Scientific Committee in a memorandum on higher technological education* is adopted, some twenty of the existing technical colleges will be granted charters and become Royal Chartered Colleges of Technology, with the right to award degrees in technology. They would provide for advanced full-time "sandwich" and part-time day and evening courses, post-graduate courses and full-time and part-time research.

These are, of course, purely recommendations. Facilities for further technological education do already exist even if some of them are inadequate. We have secured from the Ministry of Education a list of further education establishments providing classes in radio and allied subjects. The term "further education," by the way, is used for establishments providing classes for those whose whole-time formal education has ended.

On the opposite page is tabulated some 150 further education establishments in England† (grouped under counties) providing courses in telecommunications (col. A), radio theory, transmission and marine wireless (B), radio servicing (C), and television servicing (D). The letters used in these columns indicate full-time courses (F), part-time day courses (P) and evening courses (E).

* "Memorandum on Higher Technological Education," Parliamentary & Scientific Committee, 31, Palace Street, London, S.W.1, price 2s.

† It is hoped to give similar details for Scotland and Wales next month.

FURTHER EDUCATION . . . . . continued

	A	B	C	D
Bedfordshire				
Bedford, N. Beds. C.F.E.	P E			
Berkshire				
Maidenhead, E. Berks. C.F.E.	E		E	
Newbury, S. Berks. C.F.E.	E			
Reading T.C.	P E			
Buckinghamshire				
Bletchley E.I.	E			
High Wycombe C.F.E.	E			
Slough C.F.E.	E			
Wolverton T.I.	E			
Cambridgeshire				
Cambridge T.C.	E	P E	P E	
Cheshire				
Crewe T.C.			E	
Stockport C.F.E.	E		P E	
Cornwall				
Redruth, Cornwall T.C.	P E		P	
Cumberland				
Carlisle T.C.	E	E		
Derbyshire				
Derby T.C.	P E		P E	E
Devonshire				
Barnstaple, N. Devon T.C.	P E			
Exeter, Central T.C.	P E		E	E
Plymouth & Devonport Mun. T.C. ...	P E	E	P E	E
Tiverton Science & Tech. School...	E			
Torquay, S. Devon T.C.	P E	E		
Dorsetshire				
Weymouth, S. Dorset T.C.	E		E	
Durham				
Darlington T.C.	P E			
South Shields Marine & T.C.		F E	E	
Stockton-on-Tees T.I.		E		
West Hartlepool T.C.	P E		E	E
Essex				
Chelmsford, Mid-Essex T.C.		P E		
Colchester, Ardleigh House C.F.E. ...	P			
,, N.E. Essex T.C.	E	F		
Dagenham, S.E. Essex T.C.	P E	E	E	
Southend-on-Sea Mun. T.C	E	P	P E	E
Gloucestershire				
Bristol C.T.	E	F		
Cheltenham, N. Glos. T.C.	E	E	E	
Gloucester T.C.	E	E		
Stroud & Dist. T.C.	E			
Hampshire				
Aldershot E.I.	E			
Bournemouth Mun. C.T.	P E	E	E	
Farnborough T.C.	E			
Portsmouth Mun. Coll.	P E	E	P E	
Southampton University	P E	F P E	P E	P E
Herefordshire				
Hereford C.F.E.	P E		E	
Hertfordshire				
Hatfield T.C.	E		P E	
Letchworth, N. Herts. T.C.			E	
St. Albans C.F.E.	E			
Watford, S. Herts. C.F.E.	P			
Kent				
Beckenham T.I.	P			
Canterbury T.C.	P E		E	
Dartford T.C.	P E	E	E	
Dover T.C.	E			
Faversham E.I.		E		
Folkestone T.C.	E			
Gillingham, Medway T.C.	P E		P E	
Gravesend T.C.			E	
Ramsgate, Thanet T.C.	E			
Tunbridge Wells, W. Kent T.C.	P E			
Lancashire				
Blackburn Mun. T.C.	E	E	P E	E
Blackpool T.C.	P E		E	
Bolton Mun. T.C.	E		P E	
Bootle Mun. T.C.	P E			
Lancaster & Morecambe C.F.E.	E			
Liverpool C.T.	E	E		
,, Old Swan T.I.	E			
,, Riversdale T.C.	P		P E	E
,, Walton T.C.	P			
Manchester, Openshaw T.C.	P E		P E	E
Oldham, Mun. T.C.			P E	
Preston, Harris Inst.	E	E	E	
Salford, Royal T.C.	P E		E	E
Stretford, Metrovick School		P		
Wigan & Dist. Mining & T.C.	P E	E		
Leicestershire				
Leicester C.T.	P E	E	P E	P E
Malton Mowbray T.C.	E			
Lincolnshire				
Grantham T.C.	E			
Grimsby C.F.E.			P E	
Lincoln T.C.			E	E
London				
Acton T.C.	E	P E	E	
Battersea Polytechnic	E			
Deptford S.E. London T. C.	P E	E		E
Ealing T.C.	P			
East Ham T.C.	P E			
Finsbury, Northampton Polytechnic ...	P E	E		
Hammersmith Day College	P			
Hendon T.C.	P E	E		
Holborn, Kingsway Day College	P			
Holloway, Northern Polytechnic... ...	F E	P	P E	E
Kingsbury E.I.	E			
Norwood T.C.	F E		E	P E
Poplar T.C.			E	
St. Marylebone, The Polytechnic	E	E	E	E
Southgate T.I.	E			
Southwark, Borough Polytechnic... ...	P E	P E	P E	E
Walthamstow, S.W. Essex T.C.	E	E		
Wandsworth T.C.	P E	E		
West Ham C.T.	E	E		
Willesden T. C.	P E	E		
Wimbledon T.C.	P E	E	E	
Woolwich Day College	P			
,, Polytechnic	P E	E		
Middlesex				
Enfield T.C.	P E	E	E	
Isleworth, Spring Grove Polytechnic ...	P E	E		
Southall T.C.	E	E	P	E
Norfolk				
King's Lynn T.I.	E	E		
N. Walsham E.I.	E			
Norwich City College	P E			
Northamptonshire				
Kettering T.I.	E			
Wellingborough T.C.		E	E	
Northumberland				
Newcastle, Rutherford C.T.	P E	E	P E	E
Nottinghamshire				
Nottingham & Dist. T.C.	P E	E	P E	E
Oxfordshire				
Oxford C.T.	E	P		
Shropshire				
Bridgenorth E.I.	E			
Oswestry T.I.	P			
Shrewsbury T.C.	P E		E	
Somerset				
Bath T.C.	P		E	
Burnham T.I.	E			
Taunton T.C.	E		E	
Weston-Super-Mare, School of Science ...	E			
Staffordshire				
Burton-on-Trent T.C.	E	E	E	
Stafford, County T.C.	E	E		
Stoke-on-Trent, N. Staffs. T.C	P E		P	
Walsall T.C....		E	P	
Wolverhampton & Staffs. T.C.	P E		F P E	E
,, Wulfrun C.F.E.	P E		P E	
Suffolk				
Lowestoft T.I.	P E		E	
Surrey				
Croydon Polytechnic	P E	P E	P E	
Guildford, County T.C.	E			
Kingston T.C.		E		
Mitcham E.I.	E			
New Malden West E.I.	E			
Richmond T.I.			P E	
Weybridge, Brooklands T.C.			E	
Sussex				
Brighton Mun. T.C.	P E			
,, Preston T.I.	E	P E		
Crowborough E.I.	E			
Hastings T.I....	E	E		
Warwickshire				
Birmingham, Bournville Day College ...	P			
,, Bournville & Northfield T.I....				E
,, C.T.	P E	E	P E	E
Coventry T.C.	P	E		
Westmorland				
Kendal, Allen T.I.	E			
Wiltshire				
Chippenham, N.W. Wilts. C.F.E. ...	E	E	E	
Malmesbury F.E. Inst....	E			
Salisbury & S. Wilts. C.F.E.			E	
Worcestershire				
Bromsgrove Tech. School		E		
Worcester, Victoria Inst.	E			
Yorkshire				
Barnsley Mining & T.C.		E	E	
Bradford, Hanson T.I.	P			
,, T.C.	P E	E	E	E
Doncaster T.C.	E	E	P	
Huddersfield T.C.	P	E	P E	E
Kingston-upon-Hull Mun. T.C.	P E	F E		
Leeds C.T.	E		E	E
Middlesbrough, Constantine T.C. ...	P E	E		
Rotherham T.C.			P	
Scarborough T.I.	E			
Sheffield C.T.	P E	E		
,, University		E		
York T.C.	P E			

C.T. College of Technology; T.C. Technical College; T.I. Technical Institute; E.I. Evening Institute; C.F.E. College of Further Edutation

Ferrite Rod Aerials

Underlying Principles and Basic Design Formulæ

By W. A. EVERDEN,* G.I.Mech.E.

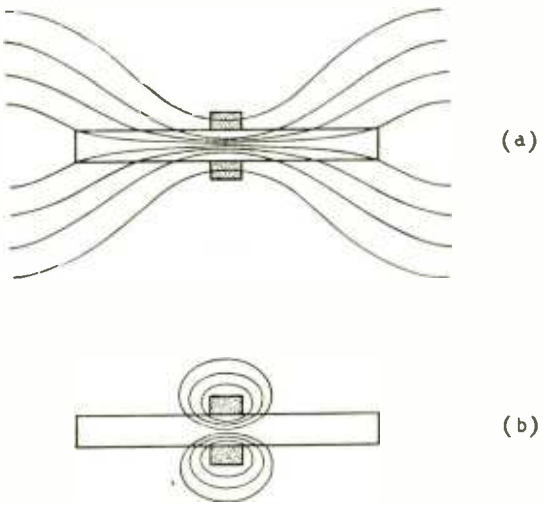


Fig. 1. The effective permeability μ of the rod to an external field (a), must be distinguished from the permeability μ_c relative to the coil (b).

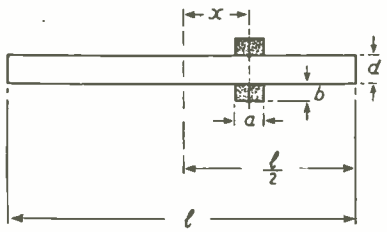


Fig. 2. Relevant physical dimensions of an aerial rod and coil.

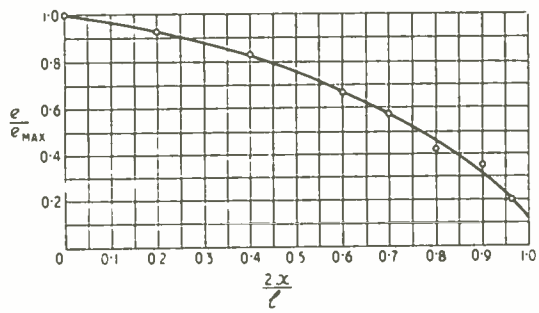


Fig. 3. Distribution of e.m.f. (e/e_{max}) induced in a coil as a function of its distance 2x/l from the midpoint of an aerial rod.

WITH the introduction of the nickel-zinc grades of Ferroxcube with their high material permeabilities and low losses many new fields of application have been opened up. Not the least important of these is the replacement of bulky frame aerials by relatively small rods and coils. All aerial rod designs in this article are based on Ferroxcube rods in grade B2, which has an initial permeability of approximately 200 and a resistivity of 10^5 ohm-cm. Its loss factor $\tan\delta/\mu$ at 0.5 Mc/s being 90×10^{-6}.

It should not be assumed that rod aerials, as they have come to be known, can only replace frames or indoor systems; with a rod of larger proportions than those discussed in this article, a signal voltage comparable with that of an outdoor aerial in combination with a normal input circuit can be approached. Interference which is now so prevalent all over the long and medium wavebands can often be reduced by the directional effect inherent in these assemblies.

Although the advantages of such a system are immediately evident, the design of a suitable assembly is rather complex, due mainly to the lack of practical design data on open-ended coils. An attempt will be made in this article to combine all necessary data on this form of aerial into workable formulæ, and to present examples of the manner in which ferrites can be used in practical aerial systems.

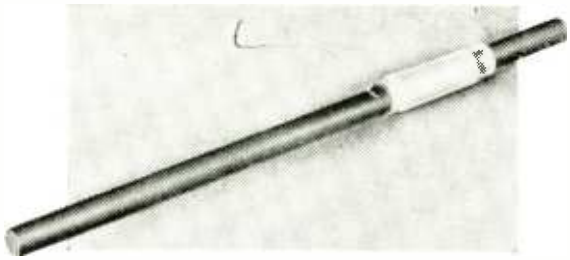
Before analysing the physical properties of rod aerials it may be worth while to discuss the relative merits of inductive and capacitive aerials, as the basis of comparison may not be immediately obvious.

Inductive and Capacitive Aerials

The efficiency of any type of aerial is usually judged from the voltage delivered to the grid of the first valve. With an average domestic aerial of dimensions under a half wavelength, used in conjunction with a matching transformer, the voltage is proportional to the product of the field intensity (vectorially) in volts per metre, the effective height (h) in metres and the transformer ratio (N).

With inductive aerials, including rod aerials, the voltage at the first grid is mainly determined by the product of the effective height (h) and the aerial circuit quality factor (Q). No direct comparison should be made between these two types of aerial. However, a comparison can be made between the products of effective height (h) and transformer ratio (N) of the capacitive aerial against the effective height and quality factor Q of the latter.

* Mullard. Ltd. (Components Division).



Experimental ferrite rod aerial for frequencies of the order of 1 Mc/s.

Basic Design Data

Frame Aerials.—At the input to any aerial the field concentration and frequency of the transmitter signal are usually known. A loop of n turns enclosing a part of the radiated field will then have induced in it an e.m.f. of

$$e_1 = \Phi \omega n.10^{-8} \quad .. \quad .. \quad .. \quad .. \quad (1)$$

$$= Ba\,\omega n.10^{-8} \text{ volts} \quad .. \quad .. \quad .. \quad (2)$$

where the cross-sectional area of the loop is a sq. cm., the flux $\Phi = Ba$ and the flux density B is in gauss.

If Q is the input circuit quality factor, then the voltage becomes e_1Q, denoted e_0, and is applied to the grid of the first valve. Therefore

$$e_0 = QBa\,\omega n.10^{-8} \text{ volts} \quad .. \quad .. \quad .. \quad (3)$$

Rod Aerials.—The main purpose of a high-permeability ferromagnetic core is to increase the flux density B within the closed loop. For satisfactory operation this should take the form of a rod so that the flux may be concentrated within the turns of the coil (Fig. 1(a)).

By redesigning the aerial coil and inserting a ferromagnetic core, the effective permeability of the enclosed medium to an external field is increased. This effective permeability μ' is much lower and should not be confused with the initial permeability μ_0 of the core material as measured in a closed magnetic circuit. The output voltage now becomes:

$$e_0 = \mu' QBa\,\omega n.10^{-8} \text{ volts} \quad .. \quad .. \quad .. \quad (4)$$

The calculations of μ' will not be dealt with here, as it is fully covered in the literature[1]; it is only necessary to say that μ' can never exceed μ_0, and depends mainly upon the physical dimensions of the core. This can be seen from Fig. (5).

It has often been argued that a flat plate of ferromagnetic material would be more suitable for this application than a small-diameter rod, but experiments leading to the computing of Fig. 5 have shown that the flux density inside a plate at right angles to the magnetizing field differs very little from that of the magnetizing field. This can be shown if we take a plate of Ferroxcube with an initial permeability of 200 and dimensions l = 114 mm, d = 6.3 mm. The l/d ratio then becomes 0.055 and from Fig. 5 we obtain an effective permeability μ', which is for practical purposes unity.

With the introduction of a ferromagnetic core, the aerial system becomes considerably modified. So far we have been considering it primarily in relation to the external field, but it is also part of a tuned circuit and must have a specific value of inductance L. From this it should be evident that the increased permeability necessarily involves a reduction in both a and n, and therefore equation (4) must be developed, to contain L as a parameter. It is thus obvious that the physical size of the coil may be reduced to one not very much larger than that of the core. With the introduction of any ferromagnetic core, the inductance L increases by a factor L_c/L_a, where L_c is the inductance with ferromagnetic core and L_a is the inductance with an air core. This is often termed the coil permeability μ_c and differs considerably from μ' (see Fig. 1).

At this stage all coils will be shown diagrammatically as being short pile-wound coils. The designing of the most efficient coil will be dealt with later. The inductance of an air-cored coil of the form shown in Fig. 2 is given by the following formulæ:

$$L = n^2 d\phi.10^{-8} \text{ henrys} \quad .. \quad .. \quad .. \quad (5)$$

where ϕ is a constant which depends on the dimensional ratios a/d and b/d of the coil.

The ratio of the external and internal reluctance paths of an air-cored coil mainly determines this value of inductance. It can be assumed that this ratio of reluctance within the coil to that outside the coil is 10 : 1. Thus approximately 1/11th of the circuit reluctance is outside the coil. For a coil where a ferromagnetic core is introduced the reluctance of the magnetic path inside the coil can be neglected compared with the external path.

If we now continue the assumption given above it is evident that the inductance ratio of a coil with a

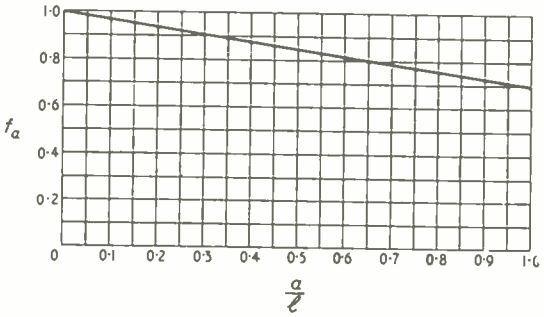
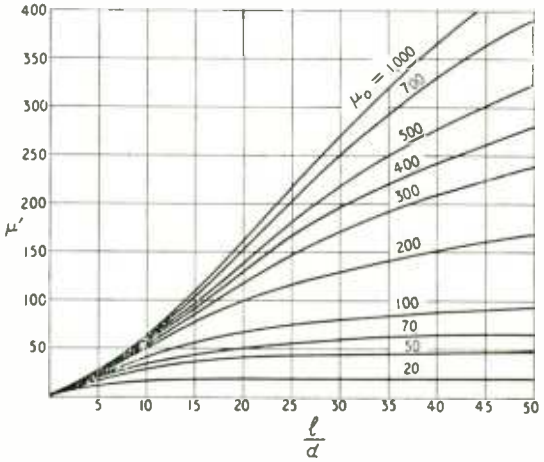


Fig. 4. Ratio of mean to maximum flux density (f_a) as a function of coil length relative to the length of the core.



Fiy. 5. Effective permeability of rod in an external field as a function of the ratio l d with initial permeability as a parameter.

[1] See for example "Demagnetizing Factors of Rods" by R. M. Bozorth and D. M. Chapin, *J. Appl. Phys.*, Vol. 13, p. 321, 1942.

ferromagnetic core to that of an air-cored coil will be approximately 11 : 1.

It can be shown that for a short-section coil of the type shown in Fig. 2 the effective coil permeability μ_c is usually between 5 and 15. With a ferromagnetic core the inductance will be:

$$L = n^2 d \phi \mu_c .10^{-8} \text{ henrys} \quad .. \quad .. \quad .. \quad (6)$$

By substituting in equations (4) and (6) we obtain:

$$e_0 = QBa\omega\mu' \sqrt{\left(\frac{L}{d\phi\mu_c'}\right)}.10^{-4} \text{ volts} \quad .. \quad (7)$$

Equation (7) thus shows that a high value of output volts e_0 can be obtained by the optimum choice of the effective values μ' and μ_c. These factors can be controlled during the design stage.

Control of Rod Permeability.—If a ferromagnetic rod is placed in a uniform magnetic field B, the field is distorted towards the centre of the rod. The maximum flux density is at the centre and decreases towards the two ends. The rod permeability μ' is of the ratio of *maximum* flux density with the rod in position, to that of the original field flux density B. For rods with large l/d ratios having reasonably high material permeabilities the flux distribution along the rod is almost parabolic. The curve of Fig. 3 shows this effect in terms of the ratio of induced e.m.f.'s for a grade B2 Ferroxcube rod 200 mm long and 8 mm diameter. From this curve it can be seen that equation (4) only holds when the coil is placed at the centre of the rod, where the flux density is maximum. The ratio of the mean to maximum flux density has been termed the averaging factor f_a and a curve, derived from Fig. 3 by integration, showing the dependence of f_a on the relative length of coil and rod for a symmetrical arrangement is given in Fig. 4. For a very short coil, $f_a = 1$ and for a coil surrounding the entire length of the rod it is 0.7.

Fig. 5 shows μ' plotted as a function of the initial permeability μ_0 and the ratio l/d. To obtain a high value of effective permeability μ' the ratio l/d and the initial permeability μ_0 must be high. As a first approximation, μ' may be assumed proportional to the ratio l/d, say

$$\mu' = \alpha \frac{l}{d} \quad .. \quad .. \quad .. \quad .. \quad .. \quad (8)$$

From equations (7) and (8), and substituting $a = \frac{\pi d^2}{4}$ we get

$$e_0 = QB\omega\alpha \frac{\pi l}{4} \sqrt{\frac{d}{\phi\mu_c}}.10^{-4} \text{ volts} \quad .. \quad .. \quad (9)$$

Circuit Quality Factor (Q).—The circuit quality factor Q is, of course, one of the main considerations. The reason for this is that an optimum Q value not only determines the output voltage e_0 but also the circuit selectivity. It would seem that as high a Q as possible would be an advantage, but tests have shown that if a Q value greatly in excess of 200 at 1 Mc s is used, severe sideband cutting is experienced.

Influence of Q on Signal/Noise Ratio.—When calculating the effective Q of the circuit the effect of valve input impedance must not be overlooked. To account for this, our quality factor will now be denoted as Q'. The circuit quality factor Q' also has an influence upon the signal/noise ratio e_0/V_n.

It can be proved that a given noise voltage (V_n) does not in any way depend on the value of Q' but is directly proportional to the frequency. By looking at either equation (3) or (4) it can be seen that e_0 is proportional to the frequency and quality factor, therefore e_0/V_n will not be subject to the frequency but will be proportional to the quality factor.

From this statement it can be seen that a high value of Q would be an advantage in respect of signal/noise ratio.

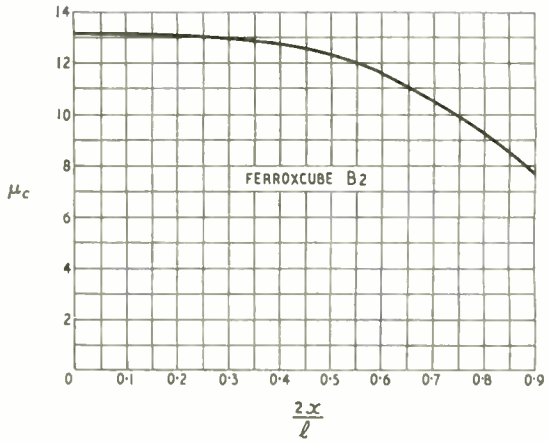


Fig. 6. Measured values of μ_c plotted as a function of distance 2x/l from centre of rod.

Temperature Coefficient.—The temperature coefficient of open-ended coils using Ferroxcube cores is a subject by itself and is extensively dealt with elsewhere.[2] It should suffice to say that at normal ambient temperature the permeability of Ferroxcube has a small positive temperature coefficient which, in this type of application, produces a positive temperature coefficient of inductance of approximately 0.4×10^{-4} (°C.). This variation of inductance can in turn influence the shape of the tracking curve.

Mechanical Mounting.—Wherever possible the rod should be mounted above or to one side of the chassis so that the additional losses introduced due to the proximity of any metal-cased components are reduced to a minimum. In order to ensure optimum performance it is also advantageous to keep the length of the rod almost the same as that of the chassis, otherwise the latter will have a screening effect, thus lowering the obtainable grid voltage.

A general method of mounting is to extend small plastic brackets from the end of the chassis and insert the rod between rubber grommets so that any vibration or torsion that may be set up during transportation is absorbed. Tag boards and soldering lugs should be mounted away from the actual coil, otherwise a reduction of Q of as much as 20% at 1 Mc/s (299.8 metres) may result. This loss and any other which may be set up due to metal objects, is proportional to the square of the frequency.

Adjustment of Inductance.—Two methods of adjustment are now in genera! use, the more popular being to slide the coil along the rod until the required value of inductance is obtained. This will be found to be most critical as the centre line of rod is approached. The second method is that of removing or spacing of end turns, and is used where the coil is wound directly on the core.

Material Tolerances.—Mechanical tolerances on

[2] *Electronic Application Bulletin*, Vol. 13, No. 6. Tolerances and temperature coefficient of coils with Ferroxcube slugs.

the dimensions of Ferroxcube B2 are ± 3% on diameter and ± 4% on length, and the value of initial permeability μ_0 is generally quoted on ring specimens as being > 200. The combined effect of these tolerances can cause a spread in μ_c of ± 5% when measured with a given coil in a fixed position, e.g., in the middle of the rod. For most rods and an average coil the required inductance should be designed at a point where $2x/l = 0.45$. Fig. 6 shows that for starting value $2x = 0.45$ a displacement of the coil to a position where $2x/l = 0.2$ or 0.6 will be sufficient to compensate for a spread in μ_c of ± 5%.

Effective Height.—The factor known as the effective height has already been discussed in so far as it affects the comparative merits of inductive and capacitive aerials. As already explained it is common to express the field intensity in volts/metre and the performance of an aerial as the effective height.

The effective height of a loop aerial is usually expressed as:

$$h = \frac{2\pi An}{\lambda} \cdot 10^{-4} \text{ (metres)} \quad .. \quad .. \quad .. \quad (10)$$

where A is the mean area of the loop in cm² and λ is the wavelength in metres. If a ferromagnetic rod is now introduced having a permeability μ' equation (10) becomes:

$$h = \frac{2\pi A \pi f_a \mu'}{\lambda} \cdot 10^{-4} \text{ (metres)} \quad .. \quad .. \quad (11)$$

where f_a is derived from Fig. 4, A is the mean area of the coil in cm² and λ is the wavelength in metres.

Coil Design.—First let us decide what is going to be the main design parameter, i.e., maximum output voltage or a high value of Q. If a high value of e_o is aimed at, the Q value will more often than not be poor, and if a high Q value is the main requirement then the grid voltage may well be below avarage. Because most radio engineers are continually striving to achieve better selectivity we will consider first a design with a predetermined Q value.

Most of the information which has so far been published on this subject has treated the problem on the basis of a fixed frequency of 1 Mc/s. Experiments have shown us that the value of Q increases with the rod diameter, but from an economic standpoint the optimum value occurs at about 200-210 on a 5/16in diameter rod 8in long in Ferroxcube grade B2.

If we take this value of Q as a general figure and design our coil around a rod 5/16in dia. × 8in long this will form a basis for all further designs. A coil whose length is relatively small has been chosen so

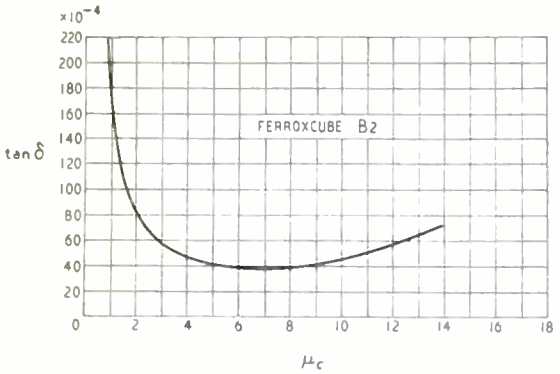


Fig. 7. Total losses plotted as a function of μ_c.

that the value of temperature coefficient can be kept within reasonable limits. It will be found that due to the manufacturing tolerances essential with most ferrite materials, the coil will have to be moved toward one end of the rod to obtain the required value of Q. Assuming an inductance of 197 μH for the medium-wave coil and a coil permeability of 13, the theoretical position of the coil from the centre line of the rod can be obtained from Fig. 6.

If we now take the reciprocal of our quality factor, i.e., $1/Q = \tan\delta = 50 \times 10^{-4}$ we see from Fig. 7 that this value of Q can be obtained with a coil permeability of 11. If this value of permeability is accepted the new position of the coil, with reference to the centre line of the rod can be found by referring to Fig. 6 to be $2x/l = 0.6$.

The decrease in coil permeability must now be compensated for by an increase in the number of turns, in this particular case by multiplying by the ratio of 1 : 1.1 where it will be found that the required number of turns will increase from 27 to 30.

Due to the displacement of the coil, the flux distribution will decrease as shown in Fig. 3, for $2x/l = 0.6$ the decrease of $e/e_{max} = 0.68$.

Converting physical dimensions into cm and taking $n = 30$, $f_a = 1$ and $\mu' = 117$, the effective height is

$$h = \frac{2\pi \times 0.5 \times 30 \times 1 \times 117 \times 0.68}{299.8} \cdot 10^{-4}$$

$$= 0.0025 \text{ metre}$$

The overall performance, $hQ = 0.0025 \times 200 = 0.5$.

If this value is compared with that of the second design it will be found that the increase of Q was obtained at the expense of overall performance.

From laboratory tests it has been determined that short thick rods should be employed where exceptionally high values of Q are required, i.e. say 9/16in × 4in long. A typical design for a medium- and long-wave aerial coil utilizing the core stated above would be 50 turns of 9/40 litz wound approximately ½in from one end, this forming the medium wave section with 120 turns of 9/40 litz wound on the opposite end and used in conjunction with the medium wave coil for the long wave reception. A multi-turn coupling coil is sometimes found to be necessary between the two windings, when coupling to an external aerial

With an assembly of these dimensions, and taking $n = 50$, $f_a = 1$, $\mu' = 40$ and $e/e_{max} = 0.75$, the effective height is

$$h = \frac{2\pi \times 1.54 \times 50 \times 1 \times 40 \times 0.75}{299.8} \cdot 10^{-4}$$

$$= 0.00484 \text{ metre}$$

and the overall performance $hQ = 0.00484 \times 250 = 1.21$ where a Q of 250 is applicable for this type of rod.

Let us now consider a design where the voltage applied to the grid of the first valve becomes a main consideration. This design is again based on the same Ferroxcube rod as the first example, i.e 5/16in dia. × 8in long.

The initial or toroidal permeability of Ferroxcube grade B2 is given as 200; knowing this and the l/d ratio we can find μ' from Fig. 5, i.e. 117. The coil effective permeability factor $\phi\mu_c$, on the other hand, can be determined from Fig. 8, which is a curve of measured values of $\phi\mu_c$ plotted as a function of a/l. The quality factor will be $Q = 10^4/62 = 161$.

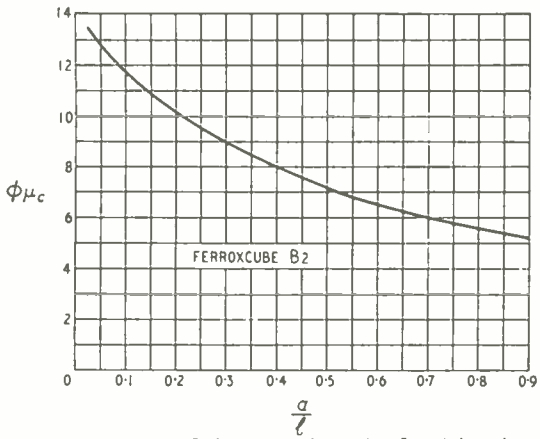


Fig. 8. Variation of $\phi\mu_c$ with the ratio of coil length to rod length.

With this information it is now possible to calculate the effective height, inductance, etc., of the aerial. As already explained, the value of f_a for the short type of coil used is practically unity.

Therefore the effective height is

$$h = \frac{2\pi \times 0.5}{299.8} \cdot \frac{27 \times 117}{} \cdot 10^{-4} = 0.0033 \text{ metre}$$

and the overall performance of the aerial system will be $hQ = 0.0033 \times 161 = 0.532$.

For proof that a higher overall performance can be obtained by increasing the value of the l/d ratio the above example has only to be re-calculated with an $l\,d$ ratio of say 40. The objection here being that the rod would be difficult to manufacture by normal processing and hence not an economical proposition.

From Fig. 8 the effect of increasing the length of the coil can be seen, the slope between unity and $a/l = 0.5$ is reasonably flat and between 0.5 and zero extremely sharp. Therefore there is little benefit to be gained in increasing the ratio of a/l above 0.5 as the price of a decrease of $\phi\mu_c$ would be considerable increase in both losses and temperature coefficient.

Variation in Coil Performance.—Recent tests on the size, shape and wire diameter of which medium wave coils are wound have proven rather interesting and will be summarized as follows. For reasons already explained, short-length single-layer coils have, up to now, been used, positioned towards one end of the ferrite rod. If we now spread-wind, or progressively wave-wind over approximately 2–3in of the rod length, keeping the ratio a/l less than 0.5, it will be found that the quality factor will drop by approximately 25%, i.e. from 200–210 to 150–160. The pick-up voltage will, however, increase. Therefore, before finally deciding upon the type of coil necessary for a particular circuit, the main parameter of selectivity or sensitivity should be decided upon. If a long loosely wound coil is used then the value of $\phi\mu_c$ will increase, which in turn will decrease the value of inductance, so that the number of turns must be increased to compensate for this loss.

The effects of temperature coefficient on the type of coil described influence the overall performance of the aerial by very little and can be more or less neglected.

Effect of Winding Wire.—For close wound coils the Q values vary greatly both with wire diameter and type. For instance, with solid wire 25 s.w.g. the Q value is approximately 100, whereas with the same coil wound from 9/40 litz the quality factor increases to 270. It is worth noting that the input voltage increases with a decreasing wire gauge and is a maximum with litz. On the other hand, with long spread windings the quality factor remains almost constant with the type and wire gauge, the circuit voltage following the same trend.

Up to now we have only considered the effects of various types of coil on the quality factor, but it is of importance to take into account the effects of variations in the coil upon the inductance.

1. The maximum variation of inductance as a function of frequency is $\pm 1\%$, and does not depend upon the coil dimensions.

2. As already pointed out, by increasing the length of the coil we also increase the value of μ_c and decrease the true value of inductance. Therefore for a constant inductance, the number of turns must be increased, but this in turn decreases the value of Q.

3. The type of wire used does not influence the value of inductance but can greatly effect the quality factor.

All coils so far described have a diameter which only exceeds the diameter of the rod by the thickness of the coil former which is usually of brown paper or very thin presspahn. To find what influence this increase in diameter has upon the circuit quality factor a series of measurements were taken with an increasing diameter of coil former and keeping the length of the coil and number of turns the same.

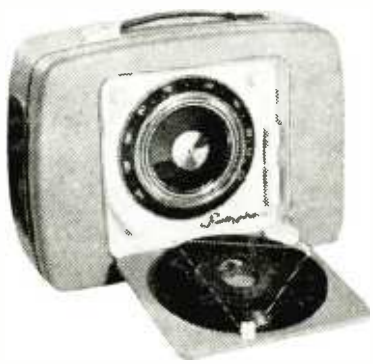
Coil Diameter (mm)	*Quality Factor* (Q)
8	203
9.5	227
12	233
14	224
20	216
28	205

All measurements were taken at 1 Mc/s.

Miniature Radio-Gramophone

WEIGHING only 10 lb, the "Babyphon" portable radio-gramophone is operated entirely from batteries—90-V h.t. and two 1.5-V cells being required for the valves and four 1.5-V cells for the special turntable motor. This is designed for 45 r.p.m. 7-in records and a speed control is provided to compensate for battery voltage variation. The miniature pickup is fitted with a sapphire stylus.

In the receiver, which covers medium waves only, four low-consumption (0.025-A) valves are used, in conjunction with a ferrite rod aerial. The circular tuning dial is concentric with the record turntable. Storage is provided for five records in the lid.



The price of this instrument, which is of German manufacture, is £32 9s 11d (including tax, but without batteries) and the distributors in the United Kingdom are G-A Distributors (Whitehall), Ltd., 29, Whitehall, London, S.W.1. A mains feeder unit is available and costs £4 4s.

Filters Without Fears

2.—*Tchebycheff : a Name to Conjure With*

By THOMAS RODDAM

LAST month I embarked on the task of persuading the reader that if he kept his nerve when confronted by a cumbersome algebraic expression there was no reason why he should not plunge into the exact theory of filter design without any fear of finding himself embroiled with the higher mathematics. As we shall see later, there are many problems where the classical theory is virtually useless. This is not because there is anything wrong with the classical theory itself, but is simply because the classical theory assumes that you have a lot of filter between the two ends, so that the end effects are relatively small correction terms. Where the filter is nearly all end, the direct approach is both easier and better. Moreover, the algebraic approach is balanced in regard to effort: a simple filter is easy to design, a complicated filter is extremely tedious.

The first stage of the process, which is always based on the low-pass filter, is to calculate the ratio of generator voltage to load assuming that we have a resistive generator, a resistive load, and n reactances in between. The n reactances, consisting of alternate shunt capacitances and serial inductances, form a low-pass filter of the nth order, and the standard way of calculating the currents and voltages is by means of Maxwell's circulating currents. Although I worked in terms of voltage, the whole treatment can be carried out in terms of current: often, indeed, it is desirable to work with current at one end and voltage at the other. For example, a pentode working into a valve grid suggests that we consider the input current/output voltage ratio; a triode working into a transistor emitter would best be treated by considering the input voltage/output current ratio: all we need to consider really is the ratio of input quantity/output quantity with and without the filter network. The ratio of those two ratios is the insertion loss.

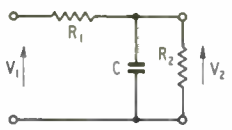
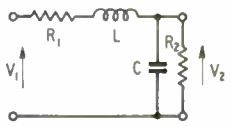
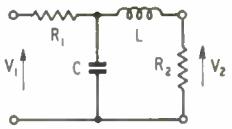
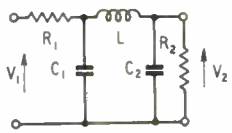
The first article expressed this ratio of ratios in the form $|N|^2$, where the insertion loss in decibels is 10 log $|N|^2$. We found that for the class of network we are considering, $|N|^2$ took the general form.

$$a_0 + a_1\,\omega^2 + a_2\,\omega^4 + \ldots\ a_n\omega^{2n}$$

where n is the order of the network. The coefficients a_0, a_1 .. a_n depend on the resistances, capacitances and inductances and some of the results are displayed in Table I. Since a low-pass filter has no insertion loss at zero frequency, the term a_0 is actually unity as you will see by looking at the table.

We then went on to the problem of choosing the element values. For a low-pass filter the insertion loss should be small if ω is less than some particular value ω_1, and large if ω is greater than some other value ω_2 ($\omega_2 > \omega_1$, of course). If ω is less than unity, ω^4 is smaller than ω^2, ω^6 smaller than ω^4, and so on. Near $\omega = 0$, therefore, the general form of

TABLE I

	NETWORK	N
1st ORDER		$1+j\omega C\frac{R_1R_2}{R_1+R_2}=1+j\omega CR$ $R=R_1R_2/(R_1+R_2)$
2nd ORDER		$1+j\omega(CR_p+\frac{L}{R_s})-\omega^2LCk$ $k=R_2/(R_1+R_2)$
		$1+j\omega(CR_p+\frac{L}{R_s})-\omega^2LCk'$ $k'=R_1/(R_1+R_2)$ $R_s=R_1+R_2 \qquad R_p=R_1R_2/(R_1+R_2)$
3rd ORDER		$1+j\omega\left[(C_1+C_2)R_p+\frac{L}{R_s}\right]-\omega^2\frac{L}{R_s}(C_1R_1+C_2R_2)-j\omega^3LC_1C_2R_p$ $R_s=R_1+R_2 \qquad R_p=R_1R_2/(R_1+R_2)$

Summary of insertion coefficients for basic low-loss filter structures

$|N|^2$ is very close to $a_0 + a_1\omega^2$, so that we can keep $|N|^2$ small by taking $a_1 = 0$. Then we transfer our attention to $a_0 + a_2\omega^4$, and by similar reasoning we can arrive at the Butterworth function $(a_0 + a_n\omega^{2n})$ which keeps very close to a_0 for small values of ω and then tips up sharply and smoothly. This gives us a maximal flatness, critically coupled, transitionally coupled response: there may even be some more names for it. Even more attractive, it gives a form which is fairly easy to work with.

The only problem is whether the Butterworth response is the most efficient one. There are three regions in a filter characteristic: the pass band, the transition region and the stop band. The transition region is that range of frequencies where there is too much attenuation for the signal to be useful, and too little attenuation to prevent it being a nuisance. Fig. 1, which shows the Butterworth function of the second order $(1 + x^4)$, indicates that if we regard the pass band as the region in which we can satisfy a $\pm \frac{1}{2}$ db condition, and the stop band as the region in which we have more than 20 db attenuation, the ratio of ω_2/ω_1 is about 4.7.

It is very tempting to see whether we cannot do something to improve this state of affairs. Tchebycheff, in St. Petersburg in 1875, published a paper discussing what are now known as the Tchebycheff polynomials, which are exactly what we need. There is, by the way, the usual difference of opinion about the correct way to spell this name, which in some post-war writing appears as Chebyshev, which conforms with the post-revolutionary alphabet. But the polynomials are always written as $T_n(x)$ and I see no reason for allowing foreign politics to confuse us.

I do not propose to delve into the mathematics of the Tchebycheff polynomials because we shall have all the mathematics we can stand before we reach the end. All we need to know is that these polynomials oscillate up and down within prescribed limits for values of x between -1 and $+1$, and then increase steadily. Curves showing this pass-band behaviour are given in Fig. 2, which shows the first five Tchebycheff polynomials. You will perhaps recognize the shape in the region $-1 \leqslant x \leqslant 1$ as that of the Lissajous figures of the same order and the appropriate phase conditions. It is not surprising, therefore, to find that the even polynomials, which are the only ones which concern us, are given by the equations:

$$\omega = \omega_c \sin \Phi$$
$$T_n = \cos n\Phi$$

These two equations are given by Darlington, but other writers prefer:

$$\omega = \omega_c \cos \Phi$$
$$T_n = \cos n\Phi$$

For our purposes there is yet a third form, which is much more convenient. The even polynomials are:

$$T_2(x) = 2x^2 - 1$$
$$T_4(x) = 8x^4 - 8x^2 + 1$$
$$T_6(x) = 32x^6 - 48x^4 + 18x^2 - 1$$
$$T_8(x) = 128x^8 - 256x^6 + 160x^4 - 32x^2 + 1$$

In the region we are considering as the pass band, $0 \leqslant x \leqslant 1$, these functions oscillate between a maximum value of $+1$ and a minimum value of -1. For $x \gg 1$ the highest order term takes control, and off they go, getting larger as x^n so that the asymptote has a slope of $10n$ db/decade or $33n$ db/octave. A third order filter, for example, which we shall see is associated with $T_6(x)$, cuts off at the rate of 18 db/octave.

How can we make use of these polynomials? We have an insertion loss function $|N| = a_0 + a_1x^2 + a_2x^4 + \ldots a_nx^{2n}$ where x, of course, is either ω or ω/ω_c, whatever ω_c might be. We want this function to be within the limits $1 \leqslant |N|^2 \leqslant 1 + t$ or $1 - t \leqslant |N|^2 \leqslant 1$ over a range of frequencies, the pass band. To fix our ideas, let us work with the second order filter. We have to consider the Tchebycheff polynomial $T_4(x) = 8x^4 - 8x^2 + 1$. At $x = 0$ $T_4(0) = 1$. At $x = 1$, $T_4(1) = 1$. At $x = 0.71$, $T_4(0.71) = -1$. For values of $x > 1$, $T_4(x)$ increases rapidly. We therefore take a function

$$1 - t + t\,T_4(x)$$

which lies between 1 and $1-2t$ for all positive values of x less than unity. The response is then $\pm \frac{1}{2}$ 10 log $(1-2t)$ decibels. Let us take as our permitted tolerance ± 0.625 db, for which we find $t = 0.125$. I have chosen this rather odd tolerance to make the arithmetic easier. Now we have the function

$$1 - 0.125 + 0.125\,(8x^4 - 8x^2 + 1) = 1 - x^2 + x^4$$

The response of the second order filter is,

$$|N|^2 = 1 + \omega^2\left[\left(CR_p + \frac{L}{R_s}\right)^2 - 2LCk\right] + \omega^4L^2C^2k^2$$

In this expression,

$$R_p = R_1R_2/(R_1 + R_2)$$
$$R_s = R_1 + R_2$$
$$k = R_2/(R_1 + R_2)$$

Last month I worked out in detail the conditions for a

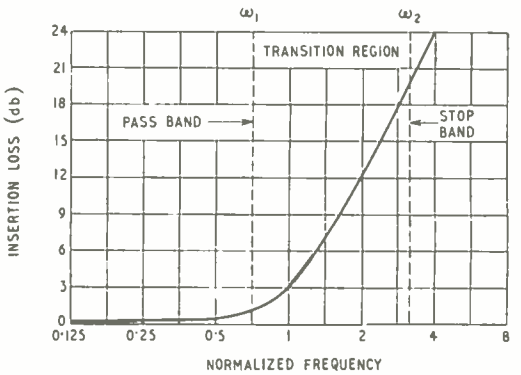


Fig. 1. Butterworth response of second order. The pass band is defined as the region in which the response is within ± 0.5 db, the stop band as the region in which the insertion loss exceeds 20 db.

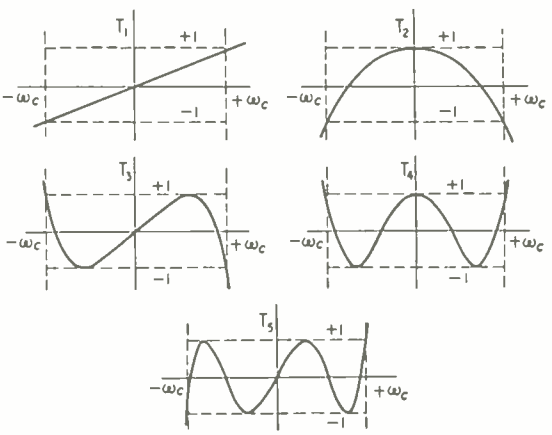


Fig. 2. Form of the first five Tchebycheff polynomials.

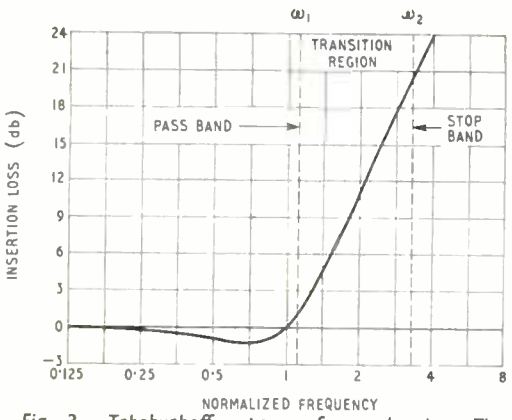


Fig. 3. Tchebycheff response of second order. The pass band is defined as the region in which the response is ± 0.625 db, and the stop band as the region in which the insertion loss exceeds 20 db.

Butterworth response with $k = \frac{1}{2}$, corresponding to $R_1 = R_2$. If you try to get a Tchebycheff response under these conditions, you find that you need a negative resistance somewhere in the circuit. We can, however, take $R_2 = \infty$, so that $k = 1$. Then

$$|N|^2 = 1 + \omega^2 [(CR_1)^2 - 2LC] + \omega^4 L^2 C^2$$

We now compare this with the form

$$1 - x^2 + x^4$$

For identity we must have

$$x^4 = \omega^4 L^2 C^2$$
$$x^2 = (2LC - C^2 R_1^2)\,\omega^2$$

It is not very hard to reach the equation

$$\omega^2 LC = (2LC - C^2 R_1^2)\,\omega^2$$

so that $C^2 R_1^2 = LC$

$$L = CR_1^2$$

which we must compare with the condition for a Butterworth response,

$$L = \tfrac{1}{2} CR_1^2$$

To see what we have gained by this change, let us look at Fig. 3 and compare it with Fig. 1. The small bump, less than $1\frac{1}{2}$ db, at a normalized frequency of 0.7, has reduced the ratio ω_2/ω_1, from about 4.7 to about 3.3. Another way of expressing this result is that for the same stop-band response the ± 0.6 db pass band is increased from 0.7 to 1.

Most important of all, we have made full use of one piece of information, the permitted tolerance in the pass band. There is nearly always some inefficiency in a circuit which can be designed without using one of the vital parameters.

We should, I suppose, complete our calculations for the example. At $\omega^2 LC = x^2 = 1$, the edge of the pass band is reached. This, of course, means that $\omega_0^2 LC = 1$. Then as $L = CR_1^2$

$$L = R_1/\omega_0$$
$$C = 1/\omega_0 R_1$$

The other case of $k = 1$, with $R_1 = 0$, leads us to $L = CR_2^2$ instead of $L_{(B)} = \frac{1}{2} CR_2^2$, with

$$L = R_2/\omega_0$$
$$C = 1/\omega_0 R_2$$

This particular example is, I must confess, deceptively simple. The reason is that the choice of $t = 0.125$ got rid of all the awkward numbers. If we had decided to adopt ± 0.5 db. as our design criterion we should have been working with the function

$$1 - 0.8x^2 + 0.8\,x^4$$

which, although theoretically no harder, leads us to

$$0.8\,x^4 = \omega^4 L^2 C^2$$
giving $0.894\,x^2 = \omega^2 LC$
and $0.8\,x^2 = (2LC - C^2 R_1^2)\,\omega^2$
or $1.12\,\omega^2 LC = (2LC - C^2 R_1^2)\,\omega^2$
$$C^2 R_1^2 = 0.88\,LC$$
$$L = 1.137\,CR_1^2$$

Of course there is no more mathematics, really, but the actual arithmetic is more tedious. It is interesting to notice here that the new value of ω_0 is $0.945\,(LC)^{\frac{1}{2}}$, so that by tightening the tolerance from ± 0.625 db to ± 0.5 db we have cut the pass band down by just over 5%. We may, perhaps, come back to this matter later.

The third order filter is related to the Tchebycheff polynomial of the sixth order, $T_6(x)$. For $x = 0$, $T_6(x) = -1$, so that we consider

$$1 + t + t \,.\, T_6(x)$$

which oscillates between 1 and $1 + 2t$. The expression we arrive at is therefore

$$1 + 18t\,x^2 - 48t\,x^4 + 32t\,x^6$$

Any value of t is going to make this look pretty alarming, and it is this sort of arithmetic which gives network design a bad name. A little investigation shows, however, that if we take $t = 1/16$, so that the response is to be within ± 0.25 db, and then take as our function $1 + x^2 - 3x^4 + 2x^6$, we shall not be too much in error. In the special case when $R_2 = \infty$, we can pick up the expression quoted in the previous article and simplify it to:

$$|N|^2 = 1 + \omega^2[(C_1 - C_2)R_1]^2 + \omega^4[-2LC_1C_2(C_1 + C_2)R_1] + \omega^6 L^2 C^2 C_2^2 R_1^2$$

and the conditions for this Tchebycheff response become

$$\omega^6 L^2 C_1^2 C_2^2 R_1^2 = 2\,x^6$$
$$2\omega^4 LC_1C_2\,(C_1 + C_2)R_1 = 3\,x^4$$
$$\omega^2\,(C_1 + C_2)^2\,R_1^2 = x^2$$

I am not going to solve these equations for L, C_1 and C_2, though they do not present insuperable difficulties. You will realize, however, that if we had not cheated in our writing of the polynomial, if we had taken t as, say, 0.1, and if we had chosen $R_2 = 3R_1$, the equations might have been rather grim.

Fortunately, there is a much more advanced approach to this problem, and this leads, as is not unusual, to a rather simpler arithmetical process. If you want to know the amount of £100 at 5% after 17 years, you do not write down a long table:

£100
£105
£110 5s and so on

You know that the answer is $100\,(1.05)^{16} = 100$ antilog (16 log 1.05). If you deal a lot with money you will not even do this: you will look the answer up in tables.

There are tables which give the values of the elements in second and third order Tchebycheff low-pass filter, for response tolerances up to ± 0.5 db. They are given in chapter 12 of "Filter Design Data," by J. H. Mole (E. & F.N. Spon, 1952). With the aid of these tables the use of the Tchebycheff response becomes a matter of no greater complexity than the use of the Butterworth response. The only trouble is that you must be satisfied, in the third order case, to work with either equal resistances at both ends, or with one end open-circuited.

Perhaps we should just look back. The ordinary processes of the application of Maxwell's circulating

currents have led us to an expression for the insertion loss of a network

$$20 \log \left[\left(\frac{\text{V or I in}}{\text{V or I out}} \right)_{\text{with network}} \Big/ \left(\frac{\text{V or I in}}{\text{V or I out}} \right)_{\text{without network}} \right] = 10 \log |N|^2$$

where

$$|N|^2 = 1 + a_1 \omega^2 + a_2 \omega^4 \ldots a_n \omega^{2n}$$

We have then sought a function of the same form which represents the frequency characteristic of a low-pass filter. Such a function, which we can call a filter function, is

$$F(x) = 1 + \alpha_1 \omega^2 + \alpha_2 \omega^4 + \ldots \alpha_n \omega^{2n}$$

If our network is to have this characteristic, obviously

$$\alpha_1 x^2 = a_1 \omega^2$$
$$\alpha_2 x^4 = a_2 \omega^4$$

and so on.

Two basic kinds of filter function, the Butterworth and the Tchebycheff, have been discussed, and we have seen how we can solve this set of simultaneous equations to find the reactances required. We have also seen that in the simple form we have used, the Tchebycheff equations become very cumbersome. It's a good thing we can dodge the hard work by looking up the answers in tables. We have not yet decided whether the Tchebycheff response is always worth while, or what price we must pay for a flatter response. These are matters of very great interest, but they will occupy more space than I can demand here.

The phase characteristics of filters are often of interest, and it must be noted that we have all the information for plotting these characteristics. From the results in part I we can see that the insertion phase shift is:

1st order $\theta = \arctan \omega CR$

2nd order

$$\theta = \arctan \frac{\omega(CR_p + L/R_s)}{1 - \omega^2 LCK}$$

3rd order

$$\theta = \arctan \frac{\omega \left\{ \left[(C_1 + C_2) R_p + \frac{L}{R_s} \right] - \omega^2 LC_1C_2 R_p \right\}}{1 - \omega^2 \frac{L}{R_s} \left(C_1R_1 + C_2 R_2 \right)}$$

Into these expressions we can now substitute the values we have found for the responses we consider. This may become one of the factors which settles our final choice of response.

Acknowledgment. Fig. 2 is adapted from Fig. 2 of "Network Synthesis Using Tchebycheff Polynomial Series" by S. Darlington, *B.S.T.J.* Vol. 31, p. 613 July 1952.

Correction: In the first part of this article it is regretted that the curves of Figs. 4 and 6 on pages 369 and 370 of the August issue became transposed.

Ultrasonic Developments

Techniques Revealed at Oxford and Manchester

PROBABLY the most familiar ultrasonic device to radio technical people is the ultrasonic flaw detector, which works on an echo-sounding principle and uses electronic circuitry somewhat akin to radar. While this idea has become well established it has not been allowed to stagnate, any more than has radar, and recently some interesting variants and developments of the original theme have come to light. One or two were described in papers read at the recent Brit. I.R.E. Convention on industrial electronics at Oxford, while others were on show as actual apparatus at the Ninth Annual Exhibition of Electronic Devices organized by the Institution of Electronics (North-West Branch) at the Manchester College of Technology.

A fairly straightforward application of the flaw-detector principle was an equipment for obtaining echo patterns from the living human brain, the idea being to detect abnormal structures such as cerebral tumours. This was shown at Manchester by the Department of Physics of the Royal Cancer Hospital (see Fig. 1). The ultrasonic waves are generated by a quartz crystal which is pulsed by a thyratron discharge at a repetition rate of 50 c/s and produces a series of damped wave trains at a frequency of 1.25 Mc/s. When the crystal transducer is applied to the patient's cranium a beam of ultrasonic energy about $\pm 4^\circ$ wide passes through the brain until it encounters an internal surface differing in elasticity or density, and then some of the energy is reflected back. The crystal also acts as a pick-up device, in between the times it is being pulsed by the thyratron, and it receives the burst of reflected energy and converts it back into an electrical signal. This is then amplified and applied to the Y plates of a cathode-ray oscillograph, which has a time-base locked to the 50-c/s thyratron pulse generator. The original transmitted pulse appears at the left-hand edge of the time-base sweep (since it is fed back into the receiver amplifier) while the returned pulse appears farther along to the right, the actual distance between them indicating the distance of the internal reflecting surface from the cranium.

The time-base of the oscillograph will show echoes from surfaces up to 20cm away, and it has been possible to calibrate it in centimetres by using a water tank and immersed reflecting surface in place of the patient's head, for the velocity of the ultrasonic waves in water is very little different from their velocity in brain tissue (a depressing thought!). Since the transmitted pulse is applied straight back to the receiving amplifier, however, this amplifier is paralysed for a short while and as a result echoes from less than 3-4cm away do not appear on the oscillograph.

With an amplifier gain of something like 100 db the equipment is extremely sensitive, and an echo with a

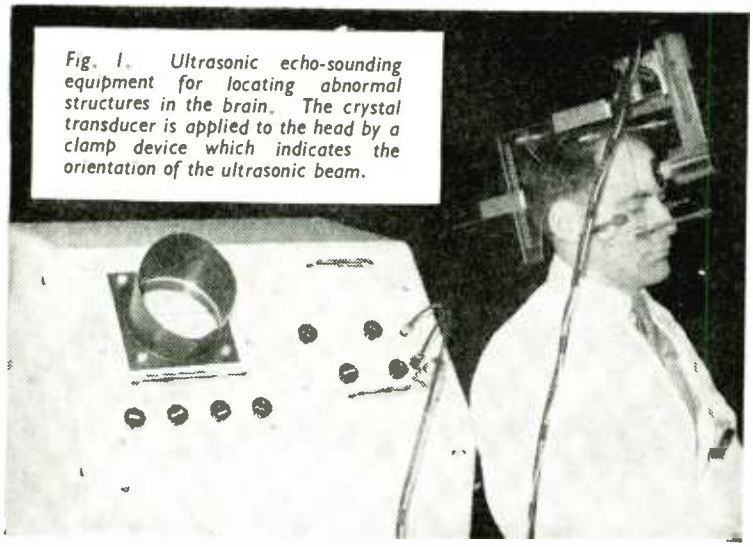


Fig. 1. Ultrasonic echo-sounding equipment for locating abnormal structures in the brain. The crystal transducer is applied to the head by a clamp device which indicates the orientation of the ultrasonic beam.

high signal-to-noise ratio can be obtained in a tank of water from a glass fibre of less than 0.001in in diameter. Particles and bubbles in the water, too small to be seen, can also be shown up clearly. As for the accuracy of location, a resolution of 20 microns is claimed for the equipment.

When the *Wireless World* reporter was invited to try the apparatus on his own head he was somewhat reluctant, having heard of the emulsifying and cavitation effects produced by ultrasonic waves. It appears, however, that there is no danger of the brain becoming addled, as the average power used is only about 10 microwatts.

One problem in ultrasonic flaw detection which is providing a great deal of food for thought is that of launching the ultrasonic wave into the material at an oblique angle—or more particularly at a variable angle so that the material may be scanned for flaws. Normally, of course, the beam simply travels in at right angles to the surface from the point where the transducer is applied. One approach to the problem has been the use of suitably shaped blocks of glass or Perspex between the transducer and the work. The lower surface of the block, in contact with the work, is made flat, while the upper surface is curved so that the transducer (also suitably curved to fit) may be slid round it in an arc. In this way a steerable beam is obtained, but the method is still rather slow and cumbersome.

A rather ingenious system of beam steering and scanning which the National Physical Laboratory has tried out was described by G. Bradfield at the Brit.I.R.E. Convention. This works on the principle of causing the ultrasonic wave to be launched from one side of the transducer slightly before or after it starts from the other side. The result is an inclined wave front (the actual inclination depending on the time lag) and the beam travels obliquely from the crystal instead of at right angles to its surface. A comparable situation in Nature is that of sea waves coming in at an oblique angle to a beach, so that they break at one end of the beach somewhat later than at the other end —though here, of course, the waves are arriving instead of departing.

To achieve this effect a barium titanate transducer is used and is divided into a number of sections by grooves (Fig. 2). Each section is then fed from a corresponding section of an LC delay line into which a short 2½-Mc/s electrical wave-train is injected. (Actually the barium titanate sections themselves form part of the capacitive elements of the line.) As a result the ultrasonic wave is launched from the "injection" end straight away and from the other end a fraction of a microsecond later. Using a 0.235-μsec delay line the wave-front is given an inclination of 4° from normal and with a 0.47-μsec line it has an inclination of 8°. This gives two beam angles in, say, an "easterly" direction, and by injecting the 2½-Mc/s signal into the other end of the line the same angles of inclination can be obtained in a "westerly" direction. Thus, with the normal propagation of the beam straight into the material, there are five beam angles available altogether.

A rotating switch enables any one of these five beam angles to be selected, but in practice it is arranged to sweep through them in rapid succession so that the returning echoes along the beams can be displayed almost simultaneously on a cathode-ray tube. In this way the material is scanned in a similar fashion to radar and the range and bearing of the echoes can be presented either in B-scope form (Cartesian co-ordinates) or as a p.p.i. display.

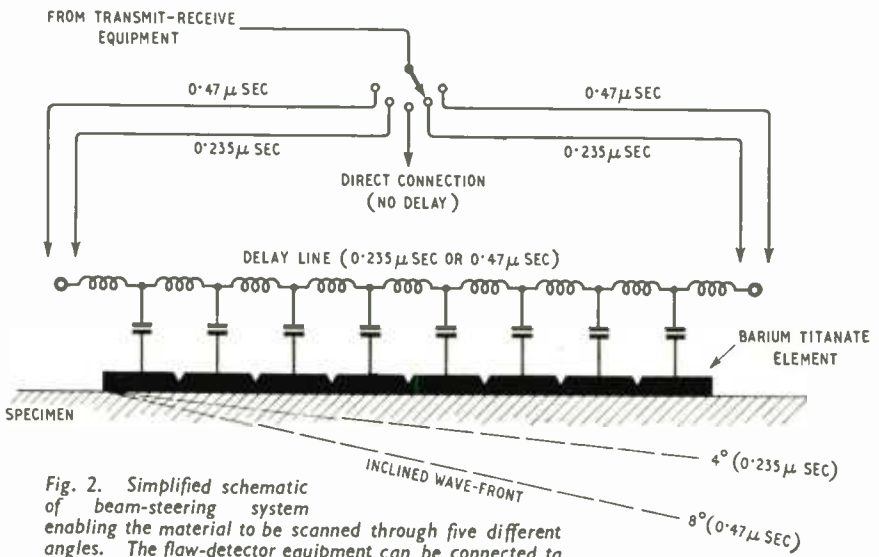


Fig. 2. Simplified schematic of beam-steering system enabling the material to be scanned through five different angles. The flaw-detector equipment can be connected to either end of the transducer delay line.

Fig. 3. Portable thickness gauge working on a mechanical resonance principle, with quartz crystal transducer in front.

Another ultrasonic examining device with cathode-ray tube presentation was mentioned by F. Gutman at Oxford. This is an ultrasonic microscope developed by the Russian scientist Sokolov for detecting and studying objects in opaque media. Here, a beam of ultrasonic waves is reflected from the object under examination and is focused and collected on a plate of piezoelectric material which is mounted in a cathode-ray tube. Secondary electrons are produced from the plate by the action of the electron beam and their path is modified by the piezoelectric charges caused by the ultrasonic waves. An image is then obtained by the usual television method. A magnification of several thousand is claimed for this instrument.

Thickness Measurement

Ultrasonic techniques are also being used a great deal nowadays for gauging the thickness of materials, and, as they generally utilize reflection of the waves, they are particularly valuable when only one surface of the material is accessible. The reflection, however, is not used in the same direct way as in the flaw detector. An ultrasonic generator is applied to one surface of the material and the reflected waves returning from the far side intersect with the outgoing beam to produce standing waves. At a certain frequency (determined by the thickness of the material and the velocity of the waves in it) a resonance condition occurs, and from this frequency the thickness can be calculated. The mechanical resonance also occurs at harmonics of this fundamental frequency.

To put the principle into practice it is therefore necessary to be able to vary the frequency of the ultrasonic generator and to obtain an indication of the mechanical resonance. The first is easily done with a variable frequency oscillator, while the resonance indication is obtained from the fact that the internal damping of the material at resonance puts a load on the oscillator; this can be detected by an increase of anode current in the oscillator valve.

Unfortunately, this increase of anode current is not always enough to give a good indication. One way of overcoming the trouble was described by F. M. Savage at Oxford, and the improved technique has been used in a commercial instrument which was exhibited at Manchester (see Fig. 3). The oscillator is frequency-modulated over a small deviation range by a motor-driven capacitor. Then, when the oscillator is tuned (by a permeability control) to the mechanical resonance frequency of the material, pulses of anode current are produced as the oscillator frequency is swung back and forth through this point. These pulses are at an audio frequency rate (determined by the motor-driven capacitor) and they are amplified, rectified and applied to a meter and to a pair of headphones. Resonance is then indicated by an increase in the meter reading or by an audible note.

Padding capacitors are placed in series with the motor-driven capacitor so that modulated bands of various widths can be chosen. Narrow bands provide maximum selectivity and accuracy while the wider bands are used when the material has a rough surface or is of variable thickness. The oscillator covers a range of 0.75 Mc/s to 2 Mc/s and this enables the same crystal transducer to be used for all frequencies with very little loss of sensitivity. If only the fundamental resonance indications were used the thickness measurement range would be of the same order as the frequency range (just over 2 to 1), but by using harmonic resonance indications as well this range can be extended to about 1,000 to 1.

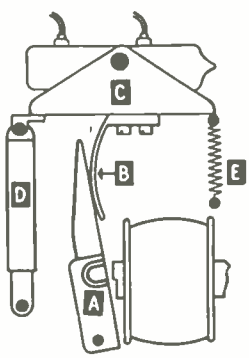
MERCURY SWITCHES

THE Tiltray mercury switch is operated by a built-in relay, but the design is a little unusual in that the mercury elements are carried by a tilting tray pivoted in such a way that it ensures a smooth surgeless flow of mercury from one contact to the other. In certain operating sequences this could be important.

How this is achieved is shown in the schematic diagram reproduced here. The armature A moves the tilting tray C carrying the mercury capsules by what is called a variable ratio one-tooth gearing, consisting of an extension of the armature A and a curved finger B. This slows down the movement of the tray as the armature accelerates towards the coil. Acceleration of the tray is further retarded by the action of the pneumatic damper D and the return spring E.

Mercury switches find many applications in circuits where heavy currents flow, and they are especially useful where inductive loads are involved as quite high inductive surges can be handled safely since the energy is released in a mercury-vapour arc and there is no high-voltage build up.

Tiltray mercury switches are made by Besson and Robinson, Ltd., 6, Government Buildings, Kidbrook Park Road, London, S.E.3, and can be arranged for switching three circuits of up to 60 A each in a single compact unit; the operating power is ½ to 2 W d.c. or 5-15 VA a.c.



Schematic diagram of the Besson and Robinson Tiltray mercury switch.

Measuring Small Voltage Changes

Simplified Method Using Polystyrene Film Capacitors and Electrometer Valves

By J. P. SALTER, A.M.I.E.E.*

A PROBLEM that arises quite frequently in development work is the accurate measurement of small changes in the d.c. level of relatively high voltages. The change of level may be produced deliberately by an adjustment made elsewhere in the circuit, or it may develop over a matter of minutes as a result of slow changes in circuit constants.

A change of, say, 0.1 V at a 300-V level would be imperceptible on a voltmeter; the rate of change would be too slow for normal a.c. techniques to be employed; and the application of manually adjusted backing-off voltages is fraught with danger to the meter on which the change is to be read.

The development of the polystyrene film capacitor and the low grid conductance of modern electrometer valves enables this problem to be solved very simply. Fig 1 shows the basic circuit where C_1 and V_1 are the capacitor and the electrometer valve respectively, and S_1 is a polystyrene-insulated switch. So long as the switch is closed the valve and the difference meter are protected from any changes of d.c. level at the input. When a measurement is required the switch is opened and, as the capacitor is already charged to the correct backing-off voltage, only difference voltages are transferred to the metering system. The potential across the capacitor can change only as a result of internal leakage, of leakage across the switch, of leakage or grid current in the valve, or of electrification effects in the dielectric.

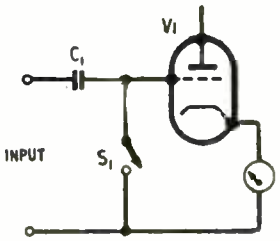


Fig. 1. Basic circuit used for measuring very small voltage changes.

The insulation resistance of good types of polystyrene film capacitor is so high that their time constants are measurable in terms of years, and in this application both internal leakage and electrification effects can be ignored entirely. On most types of relay the supporting insulant of one of the contacts can be replaced by polystyrene without difficulty. The grid conductance of the valve can be kept acceptably small by choice of valve and operating potentials.

The system has many advantages. Backing off is automatic, is independent of polarity, and is independent of input level within the operating range of the capacitor. Since leakage in the capacitor can be ignored, a direct calibration check against any voltage standard of suitable range can be carried out at zero-voltage level, and drift in the instrument itself over any desired period can be checked simply by shorting the input and opening the switch.

Polystyrene film capacitors are now generally available in values up to 0.2 μF with quite a modest ratio of volume to capitance. A single 0.2-μF capacitor is sufficient for most applications, but there are occasions when, in order to be able to use a more familiar type of valve such as the EF37A or the ME1400, it may be worth while using a number in parallel to provide, say, 1 μF. Various voltage ratings are available, and capacitors rated at 350 V working at 65°C (1,000-V d.c. test) have operated very satisfactorily at a 500- to 600-V level when mounted in such a position that they remain substantially at room temperature.

Practical Circuit

In considering the layout of the instrument, there is only one lead whose insulation is vital; that connecting the grid, the capacitor, and one contact of the switch. The use of a length of polythene-insulated coaxial cable for this lead and the adoption of a simple "guard" system[1] will reduce leakage to negligible proportions. For the guard system, the mounting clip for the capacitor, the outer conductor of the cable, the framework of the switch (preferably relay-operated), and the metalizing of the electrometer valve, should all be connected to the earthy input lead.

The characteristics of electrometer valves and of general purpose valves which can be pressed into use in this role have been the subject of a number of articles of recent years[2], and little need be added here. The electrode potentials are so chosen that normal grid current is almost completely suppressed, and the "reverse" grid current which flows is predominantly the result of ionisation of free gas molecules by the electrons flowing to the other electrodes. The gas pressure varies somewhat from one type of valve to another, and from valve to valve within any one type, but there is little the user can do about it other than to avoid any careless maltreatment which might result in the release of further gas from the electrodes.

The choice of a valve for this application depends mainly on the range of difference voltages to be measured, on the time interval over which the measurement is to extend, and on the accuracy demanded. By reducing the anode voltage to some 5-10 V, and by adjusting one's methods to deal with

* Ministry of Supply.

[1] Scroggie, M. G. "Measuring High Resistance," *Wireless World*, June 1952.

[2] Scroggie, M. G. "A Valve Megohmmeter," *Wireless World*, November 1953.

values of g_m and μ as low as 15 μA/V and unity respectively, grid currents of 10^{-13}A and below can be achieved without much difficulty, but the range of input and output voltage tends to become somewhat limited. It is advisable, therefore, to be content to achieve a grid current no lower than is really necessary for the particular application in mind. The arithmetic is quite simple; one assumes a constant charging rate for the capacitor and employs $VC=Q=it$ (volts, farads, amps and seconds) to calculate the grid current that would result in the development of an acceptably small error voltage across the chosen capacitor during the time needed to complete the measurement.

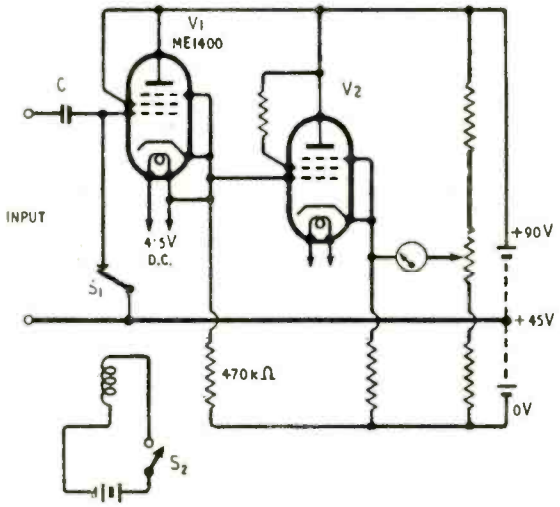


Fig. 2. Simple form of measuring set using battery operation.

As an example of what can be achieved using quite conventional circuitry, we can take the case of the ME1400. Strapped as a triode, the electrode potentials recommended by the makers are 4.5 V on the heater, 45 V on the anode, and -2 V bias on the grid. Under these conditions the valve has a μ of 20 and a g_m of 300 μA/V, whilst the anode current is about 100 μA and the grid current is around 6 $\mu\mu$A. The grid can be swung about half a volt each side of the recommended operating point without approaching too close to anode current cut-off on the one hand or the commencement of normal grid current on the other. The grid current is reduced by a factor of three, or thereabouts, at the peak of the negative swing, and is increased by a similar factor at the peak of the positive swing.

With such a limited grid base there are obvious advantages in adopting the cathode follower technique. The required conditions will be met by the use of 90 V h.t. and a 470-kΩ cathode load. Using such a value of cathode load, the gain of the system will approximate to $\mu/(\mu+1)$ and only $1/\mu$ of the input voltage will appear between grid and cathode. A change of level at the input not exceeding 10 V, of either polarity, could therefore be handled satisfactorily.

If we use a 1-μF capacitor and take 6 $\mu\mu$A as being a representative value of grid current for small excursions, we obtain a leakage rate ($V/t=i/C$) of 6 μV per second or 22 mV per hour. If the error due to this leakage is not to exceed say 1 per cent, we should have about three minutes in which to complete a difference measurement of 0.1 V, or about half an hour for one of 1 V. For a 10-volt measurement

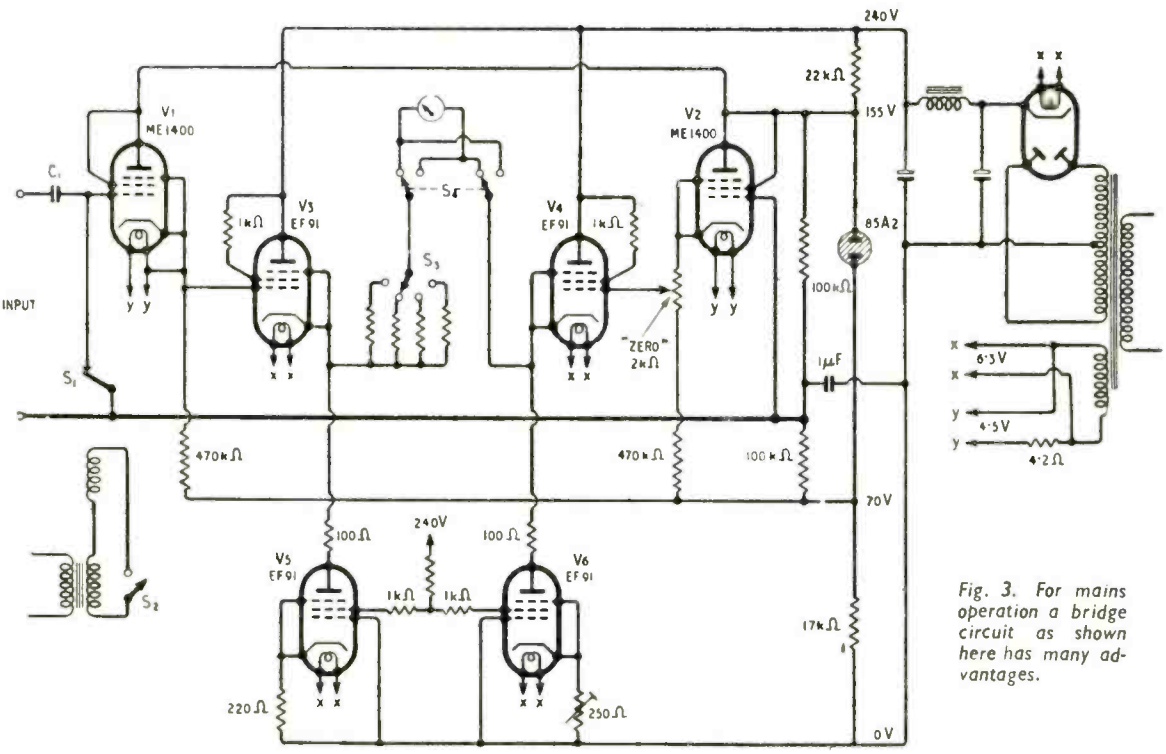


Fig. 3. For mains operation a bridge circuit as shown here has many advantages.

(taking the positive-going input as being the worst case) the leakage rate would increase to about 70 mV per hour, giving us an hour and a half for the same percentage error.

Periods such as these are quite long enough for the completion of most tests in which the change to be measured is the result of a change in the effective value of a component (e.g., a thermal change), and it is only in the more specialized applications that it is worth employing one of the more esoteric types of electrometer valve. In fact, for applications where the change of voltage level develops more or less concurrently with the making of some adjustment elsewhere in the circuit, as, for example, when one is examining the response of a stabilized power pack to changes of load or of input voltage, we could safely use a single 0.2-μF capacitor and still have a large margin in hand for stray leakages. In the same way, there are occasions when it would be in the nature of an extravagance to employ an electrometer valve at all and when the average EF37A would do the job quite satisfactorily if used in the circuit described.

The design of the metering portion of the instrument is largely a matter of personal choice. Although the valve is operating as a cathode follower in the arrangement described, the output impedance is not particularly low and it is not really satisfactory to feed even a 25-μA meter movement direct from the cathode. The simplest form of practical circuit is probably that shown in Fig. 2, in which V_2 is any convenient valve of reasonable slope. An unbalanced circuit such as this is very vulnerable to both l.t. and h.t. variations, and is best suited to battery operation, particularly as the current requirements are small.

Mains Operation

For mains operation, the use of a Bridge circuit such as that shown in Fig. 3 makes the provision of stabilized h.t. and l.t. unnecessary for most applications. Pentode loading of the cathode followers V_3 and V_4 provides them with high impedance cathode loads through which they can be fed with 8 or 9 mA apiece at the expense of a very modest voltage drop. This keeps up their g_m and permits the use of a robust meter. With correct adjustment of the preset variable resistor which provides the bias for V_6 the bridge will remain balanced over quite a wide variation of mains voltage.

Since the change to be measured may be of either polarity, a centre-zero meter or a change-over switch for the meter should be provided, and voltage ranges of 0.25, 1.0, 2.5, and 10 volts f.s.d. can be provided by the use of a range switch and series resistors suitable to the meter employed. The use of a relay-operated switch for S_1 simplifies the control of surface leakages and permits the linking of other events to the opening of the switch. Where the power supplies are unstabilized and the relay is a.c.-operated, it is advisable to feed the relay coil from a separate transformer. For general use it is desirable to include in the instrument a suitable resistor in series with the input terminal; this will limit the charging current when the instrument is first attached to a high voltage point.

Hay G. A. "Receiving Valves Suitable for Electrometer Use." *Electronic Engineering*, July 1951

Yarwood, J. and Le Croisette, D. H. "D.C Amplifiers," *Electronic Engineering*, January 1954.

Infra-red Analysis

Mervyn-NPL infra-red spectrometer for chemical analysis and process control.

THE selective absorption of electromagnetic waves by organic and other liquids and gases is becoming increasingly important as a rapid method of analysis in the petroleum, chemical and many other industries. Wavelengths of the order of 3μ (3×10^{-3}mm) in the infra-red region of the spectrum are generally used, and a curve is plotted showing how the absorption varies with wavelength. From this and a knowledge of the absorption characteristics of pure substances, an analysis of mixtures can be made.

The first essential is the production of a "monochromatic" source of radiation of variable frequency, and in the past this was provided by a refracting prism and an expensive auxiliary optical system. Recently the National Physical Laboratory have developed an efficient method of making diffraction gratings, based on a method originated by Sir Thomas Merton, which produces comparable resolution at a fraction of the cost.

Mervyn Instruments, Copse Road, St. John's, Woking, Surrey, have undertaken the commercial production of an infra-red spectrometer using the Merton-NPL grating. The source of radiation is a Nernst filament lamp and the beam is interrupted 800 times per second. After absorption in the specimen under test, the beam passes to a lead selenide photocell, the output of which is amplified and recorded on a chart.

To achieve accuracy comparable with a balanced double-beam null method of measurement, a high degree of overall stability is required. In the Mervyn instrument this is achieved by continuously monitoring the source of radiation and the sensitivity of the detector and applying any variations to the amplifier in the form of gain control. Compensation for the wavelength-dependent characteristics of the source, the grating filter and the detector is effected continuously, as the spectrum is transversed, by an adjustable shaped cam.

Magnetic Tape Spools

DIMENSIONS of spools for nominal tape lengths of 300, 600, 1,200 and 1,750ft are given (with tolerances) in a new specification (B.S.2478:1954) obtainable from the British Standards Institution, 2, Park Street, London, W.1, price 2s. These spools are for domestic and commercial recording, as distinct from those used in broadcasting studios.

Other matters touched on by this specification include the width of safety lane and the direction of recording in dual track tapes. It is recommended that if the tape moves from left to right with the active side away from the observer, the upper track should be in use.

TRANSFORMERS for Low and High Frequencies

By "CATHODE RAY"

Demonstrating Their Differences by "General" Vector Diagrams

NOW that we have spent two issues studying vector diagrams—and I hope the time has not been wasted—we should be better equipped to tackle problems like the one an Australian reader put to me some while ago. He asked for an explanation of the fact that in critically-coupled r.f. transformers, such as those often used in i.f. amplifiers and f.m. discriminators, the voltage across the secondary is 90° out of phase with the voltage across the primary. He says that the textbooks (and "Cathode Ray"!) gloss over this part of the story.

Well, I can't easily forget that when dealing with the discriminator stage in f.m. receivers a few years ago I tripped up over this very thing, so it is some comfort to be told that it is a difficult point. One catch, perhaps, is that in ordinary low frequency transformers the secondary voltage is in phase with the primary voltage, or very nearly so, and it is easy to assume the same thing holds for transformers in general.

A clue can be given quickly by saying that the r.f. transformer is very loose-coupled and normally works in the condition of resonance, whereas the ordinary power transformer is very close-coupled and non-resonant. To get a complete picture, however, there is nothing for it but to pull out our small but trusty kit of basic principles and get to work.

Probably the best approach is to start with a theoretically perfect 100% coupled transformer and see what happens as the coupling is loosened. If you like we can start with something simpler still—a single winding on an iron core, as in Fig. 1. When this is connected to an a.c. generator, as in Fig. 2(a), the alternating current that flows through the coil produces an alternating magnetic flux in the core. Because the current is the direct cause of the flux, the flux is in phase with the current.

The alternations of flux generate an e.m.f. ("the e.m.f. of self-induction") in the coil, proportional to the rate of flux variation, and always tending to oppose its cause—the variation of current. Accerding to the current notation explained last month, I_{JK} means the current whose positive direction in Fig. 2(a) is clockwise around the circuit. At the start of the current cycle, as shown in Fig. 2(b), the current is increasing at its greatest rate, so this induces the maximum e.m.f. tending to oppose the increase of current, and therefore anticlockwise at this moment. To keep the current increasing, notwithstanding this opposition, it is necessary for the generator to be exerting an equal e.m.f. clockwise (we are neglecting the resistance of the coil). Whether one looks at it from the point of view of the coil or the generator, *b* must be maximum positive with respect to *a*. So V_{ab} (which, using the "potential-rise" convention, means the voltage change on moving from *a* to *b*) is peak positive, as shown. In the familiar words of the text-books, the current lags the applied e.m.f. by 90°. The information given in Fig. 2(b) is much more conveniently portrayed in Fig. 2(c), which is the general vector diagram for Fig. 2(a). (The whole point of going over this very elementary stuff is really to remind ourselves of the conventions explained in detail in the last two issues.)

It would make no difference in principle if the wire we used for this coil happened to be composed of two strands. Nor would it make any appre-ciable difference whether the strands were insulated

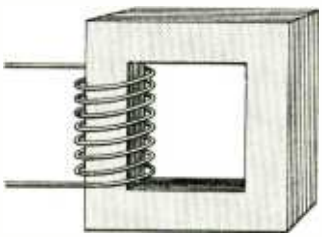


Fig. 1. The starting point—a single iron-cored coil.

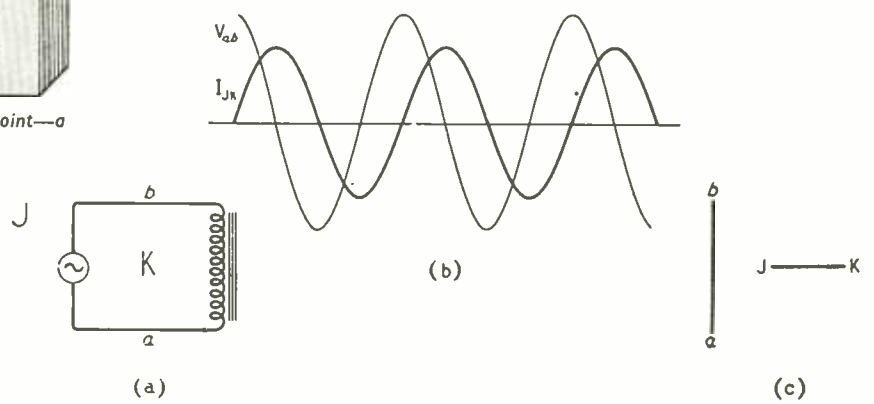


Fig. 2. (a) s the lettered circuit diagram for the coil connected to an a.c. generator; (b) is the wave-form diagram; and (c) the general vector diagram—ab for voltage and JK for current.

or not. The flux causing the e.m.f. would link both strands practically equally, and if one strand happened to become disconnected from the generator, the same voltage, in the same phase, would exist between the ends of the disconnected strand as between the ends of the connected strand. Fig. 3 shows an enlarged view of the separated strands, with the disconnected one dotted to distinguish it. What we have now is a virtually 100%-coupled transformer, and there can be no doubt that the secondary e.m.f. V_{cd} (Fig. 4) is in phase with the primary e.m.f. V_{ab}.

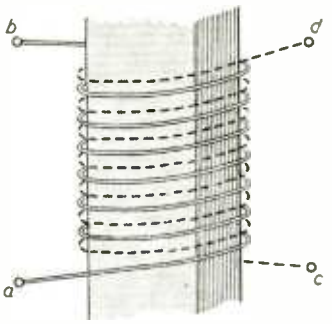


Fig. 3. The result of separating the two strands of the wire with which the coil in Fig. 1 is wound.

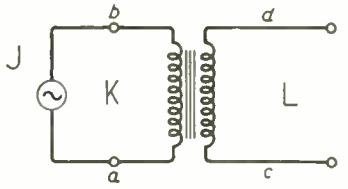


Fig. 4. Circuit diagram of the close-coupled 1 : 1 transformer formed by separation of strands as in Fig. 3.

Now consider what happens when a resistance load is connected across the secondary. Being a resistance, it passes current (I_{JL}) in phase with V_{cd}. This current of course has to flow through the secondary winding, and in doing so it creates an alternating magnetic flux —a quite unchangeable result, like the law of the Medes and Persians, only more so. Yet it can't be allowed! The generator is still applying the same e.m.f. as before (we assume) and this must be exactly balanced by the e.m.f. generated in the primary by the alternating magnetic flux. That flux was just right before I_{JL} started to flow, so it can't still be right when another lot of flux is being caused. There is only one way out of this deadlock; the way of the Persian monarch Ahasuerus when his wife convinced him that a law he had made under the influence of a sinister courtier was wrong. He couldn't rescind it, but he could issue another that would neutralize it. Nothing can be done to prevent I_{JL} exerting its magnetizing influence, but this influence can be exactly neutralized and the *status quo* restored if the generator supplies a primary current that creates an equal and opposite flux. This current is of course in addition to the original magnetizing current needed to induce the back e.m.f.

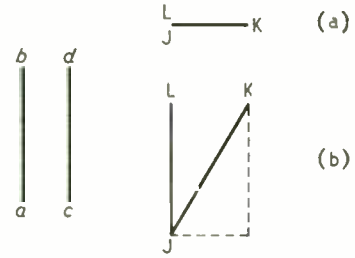


Fig. 5. Voltage diagram for Fig. 4; and current diagrams, (a) unloaded, (b) with resistance load.

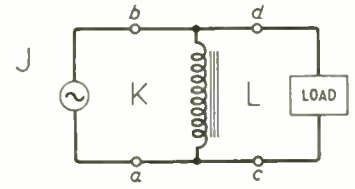


Fig. 6. For analysis the double-wound transformer as in Fig. 4 can be replaced by the original single wound coil.

100% Coupling

It is time we brought our vector diagram up to date. Because it is induced by the same flux as the primary e.m.f., the secondary e.m.f. is represented in Fig. 5 by *cd*, an exact duplicate of *ab*. The current diagram at (a) applies before the secondary was loaded; the fact that I_{JL} was then zero is shown by the distance J to L being zero. After connecting the resistance load the current I_{JL} is represented at (b) by JL in phase with *cd*. The current effective for causing magnetic flux is the total current crossed on moving from L to K ($I_{LK} = I_{LJ} + I_{JK}$), and this can only be kept the same as in (a) by raising K to the new position shown at (b); that is to say, by adding the vertical dotted portion (equal to JL) to the original horizontal portion.

The fact that there is no actual connection between meshes K and L is appropriately represented by leaving K and L without a direct connecting line in Fig. 5(b), but the distance from K to L does nevertheless correctly represent the total current in the two windings lying between meshes K and L. This logical interpretation of vector diagrams constructed on this plan is particularly helpful in transformers, for it shows the net magnetizing current, irrespective of the individual currents flowing through the windings.

The sign of the currents is automatically taken care of, provided that the circuit diagram is drawn so that the coils are wound in the same direction—see Fig. 4—and have equal numbers of turns. (This is covered by the normal practice with transformer vector diagrams, of working in volts per turn and ampere-turns, rather than total volts and amps, so as to avoid vectors of absurdly different lengths.) It is easy enough to take separate account of unequal turns, by multiplying or dividing by the turns ratio as required.

In Fig. 5(b) the primary current I_{JK} lags the applied e.m.f. V_{ab} much less than the original 90 . Power transformers are usually designed so as to make the magnetizing current (I_{LK} here) small compared with the other part of the primary current needed on account of full load. That other part has the same phase relative to the e.m.f. applied to the primary as the secondary current has to the e.m.f. given by the secondary. For instance, if the secondary is loaded by a capacitor, a leading current is added to the magnetizing current in the primary.

On the equal-turns-ratio assumption, if *a* in Fig. 4 is joined to *c*, *d* is at the same potential as *b* and can be joined to it without making any difference. We have, in effect, reverted to our single-winding two-strand coil, and the load current can be regarded as going straight from generator to load, only the magnetizing current flowing via the coil, which is no more than an inductive shunt (Fig. 6). This " distinction without a difference " would be represented in Fig. 5 by making *cd* coincide with *ab*, and joining L directly to K.

The next step is to take account of the resistances of the windings. These can be shown separately from

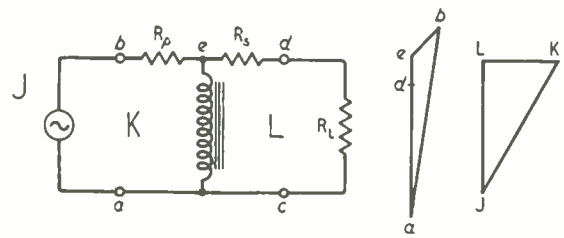


Fig. 7. Circuit of 1 : 1 transformer with resistive load, and corresponding vector diagram; account being taken of the primary and secondary coil resistances.

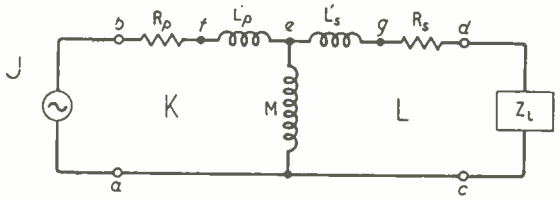


Fig. 8. Elaboration of the transformer equivalent circuit to take account of incomplete magnetic coupling.

the coils, as if they were resistors in series with the primary and secondary coils. In the Fig. 6 representation they are also in series with one another, so if the magnetizing current were small enough to neglect they could be lumped together as one resistance; but as we don't know whether we shall always be justified in neglecting the magnetizing current we shall keep them separate. Fig. 7 shows the modified diagrams. Since R_s and R_L form a simple potential divider, the potential of *d* is part of the way down from *e* to *a*, and on the assumption that R_s is small compared with R_L it is shown only a little way below *e* in the voltage diagram. The voltage V_{eb} across R_p must be in phase with the current flowing through it, however, so *eb* must be drawn parallel to JK. The result is that the phase angle between primary current and generator voltage is slightly reduced. But the more important practical effect of these resistances is to make the secondary terminal voltage V_{ad} less than the primary terminal voltage V_{ab}.

Leakage Inductance

And now we come to the point of this enquiry: to see what happens when the coupling between the two windings is not 100%. It never quite is, of course, in any actual transformer. If the windings are separate they cannot coincide, so at least a small amount of the flux caused by the primary current fails to link with the secondary winding. One of the objects of using a closed iron core is to make the magnetic path around both coils so easy that very little flux will take short cuts. With care, the leakage flux (as it is called) can be reduced to less than 1% of the whole, so a very good approximation can be made to the theoretical fully-coupled transformer—at least at low frequencies. At high frequencies it is much more difficult, for several reasons: the iron core loses much of its permeability, and very close coupling of the windings tends to cause excessive stray capacitance and loss. Fortunately, very close coupling is seldom wanted in r.f. transformers.

The effect of the magnetic leakage in a transformer is the same as if the inductance of each winding were divided into two parts: one part common to both windings as in Fig. 7, to represent the flux that links both; and the other completely uncoupled, to represent the leakage flux. Putting two and two together we get—*three*, as in Fig. 8 (since one inductance in each winding is common to both).

Let us remember that inductance is the name given to the flux-making ability of any part of the circuit. This ability is reckoned as the number of volts the flux would generate if the current in that part of the circuit were made to change at the rate of 1 amp. per sec. When an alternating current of 1 amp. (r.m.s. value) is made to flow, the r.m.s. value of its rate of change is $2\pi f$ amps per sec, so the back voltage generated by an inductance L is $2\pi fL$. To drive the 1 amp against the back voltage, an equal e.m.f. must be applied. The number of volts needed to drive 1 amp. through a resistance equals the resistance in ohms; by analogy, $2\pi fL$ is the reactance in ohms of the inductance L.

So the effect of leakage flux L'_p in the primary winding is similar to that of the resistance R_p, except for the usual 90° difference in phase. And the same for L'_s. The inductance common to both windings is the mutual inductance, M. And the coefficient of coupling, usually denoted by *k*, is equal to $M \sqrt{(L_p L_s)}$, where L_p and L_s are the *total* primary and secondary inductances. This formula applies whatever the ratio of the transformer, but if the ratio is 1 : 1, so that $L_p = L_s$, then $k = M/L_p = M/L_s$, and $L_p = L'_p + M$ and $L_s = L'_s + M$. When $L_p = M$, then $L'_p = 0$ and $k = 1$, which means that the coupling is 100%.

Before we go on to loose-coupled transformers, shall we just draw the general vector diagram for a loaded power transformer with appreciable leakage, on the basis of Fig. 8. Although this case is a "must" in every book and course on electrical engineering, so that one would have thought that by now a standard technique would have been arrived at, there is still the utmost chaos. Some teachers draw an upward arrow alongside the generator and another upward arrow alongside the primary (to represent the back e.m.f. opposing it); some show the primary arrow pointing downward, in the same circuital direction: some show both arrows pointing both ways; some draw two primary voltage vectors pointing in opposite directions; some in the same direction; and so on. No wonder that when a certain teacher tested a class by asking what, in Fig. 3, would be the polarity of the voltage from *c* to *d* relative to that from *a* to *b*, 11 said the same and 12 said the opposite ! *

It is usually easiest to work backward from the load to the generator. So the first vector to draw in Fig. 9 is *ad*, representing the output terminal voltage V_{ad}. The nature of the load Z_L is unspecified, but a mixed power load is generally somewhat inductive, so we draw the load current vector JL slightly lagging on *ad*. (If we take the e.m.f. applied to Z_L in the direction *ad*, that is to say clockwise, the corresponding direction of current is downwards, that is to say in the direction JL.) Now that we have the phase of I_{JL} we can draw *dg* in phase with it to represent the drop in the secondary resistance, and *ge* leading 90°, for the drop in the secondary leakage inductance. That gives us *ae*, representing the e.m.f. induced in the

* J. E. Parton, *Bulletin of Electrical Engineering Education*, No. 7 (Nov. 1951). page 22.

transformer. The current needed to create the flux to induce it is I_{LK}, which (since it passes wholly through inductance, M) lags V_{ae} by 90°, and LK is therefore drawn accordingly. (To be quite correct it should be slightly less than 90°, to allow for core losses.) If we like we may mark this vector "Φ," to show that it also represents Φ_{LK}. I_{JK}, the primary current, is of course $I_{JL} + I_{LK}$, so we join J straight to K to represent it. This shows its phase, enabling us to draw *ef* and *fb*, and so finally to arrive at V_{ab}, the generator voltage needed to maintain the assumed load conditions.

If you have a book on electrical engineering handy, look up its vector diagram for the equivalent transformer circuit, Fig. 8, and compare it with Fig. 9 for clarity and ease of construction.

Just to exercise this new simplicity you might care to redraw Fig. 9 for a highly capacitive load, making JL turn well to anticlockwise of *ad*. Then you will demonstrate the untruth of the axiom that the part cannot be greater than the whole. But, of course, being radio men, familiar with the workings of tuned circuits, we see nothing new or surprising in this. It is quite normal for the current in one branch of a parallel tuned circuit to be very much greater than the whole current fed in.

Tuned Transformers

This thought makes a convenient bridge to the loose-coupled tuned r.f. transformer. Its equivalent circuit, Fig. 10, is almost the same as Fig. 8, except for the capacitance in series with the primary, and the explicitly capacitive load. But the proportions of L and M are vastly different. In the power transformer, nearly all the inductance is mutual, L'_p and L'_s being just minor leakage. In the r.f. transformer, nearly all the inductance is L′, M being relatively tiny. The condition for "critical" coupling—the coupling between two resonant circuits giving the greatest secondary voltage—is that the reactance of M ($= 2\pi fM$) = R. (So that we don't become involved in complications right at the start, we are assuming that the two tuned circuits are identical.) Now since the reactance of the whole primary or secondary, $2\pi f(L' + M)$, is Q times R, M is 1 Q of the whole inductance of either coil—and a typical value for Q is 100. It may seem queer that the biggest output voltage is obtained with something like 1% coupling; it might be expected that it would be with 100%. But close coupling throws the two circuits out of tune and largely destroys their magnification. Any closer than critical coupling makes the single resonant peak divide into two, and it is the deepening hollow between them that makes the output at the original resonant frequency drop.

Just before drawing the complete vector diagram for Fig. 10 it may be a good thing to take note of the characteristic shape of the diagram for a single tuned circuit, as shown in Fig. 11(a). The current in a series tuned circuit is a maximum at resonance, so we make JL fairly long. But R in a good tuned circuit is relatively small, so notwithstanding the maximum current we draw a short line *dg* in phase with JL. The voltages across C and L are Q times as great however; V_{ge} leading and V_{ad} lagging the current by 90°. (Even if we had made *dg* quite small, a Q of 100 or more would put *a* and *e* well off the paper—and probably off the desk as well !—so a somewhat lower Q will have to do.) The result is a long thin rectangle, with *a* and *e* so placed as to show that V_{ae}, the injected e.m.f., is equal to and in phase with V_{dg}. This picture fits all that one knows about series resonant circuits—I needn't go into all the details. The only point to note is that if R and L in the circuit changed places the voltage diagram would be as in Fig. 11(c). Seeing that in reality R and L are mixed up together, it is purely a matter of choice which order we show them in the equivalent circuit; personally I think (b) is a clearer and more recognizable picture than (c).

We already have a good start towards the vector diagram for the coupled circuits, of which Fig. 10 is the equivalent circuit. As you see, I cunningly lettered Fig. 11 so that it corresponds with the secondary, the "generator" being M, which induces the necessary e.m.f. There is one other important difference however: the reactance of L′ is not exactly equal and opposite to that of C, for L′ is L less M. Now we have made the reactance of M equal to R, so the amount by which *eg* must be shortened is equal to *dg*, representing the drop across R (Fig. 12). The vector *ae* is now the diagonal of a square instead of one of its sides, so is $\sqrt{2}$ times as long as before;

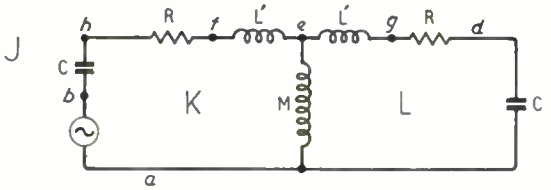


Fig. 10. Modification of Fig. 8 equivalent to a loose-coupled tuned r.f. transformer with identical primary and secondary coils.

Fig. 11. (a) is a single tuned circuit; (b) the corresponding vector diagram; and (c) the modified form of the voltage diagram if L and R in (a) changed places.

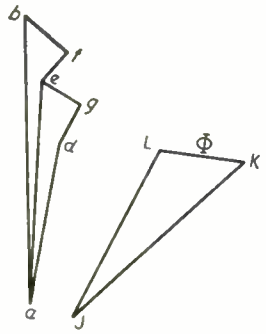


Fig. 9. Vector diagram corresponding to Fig. 8, for a transformer having comparatively little magnetic leakage.

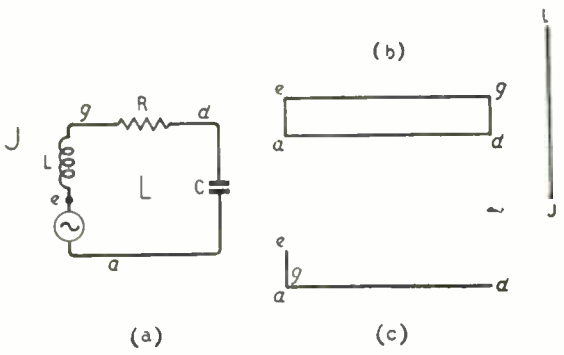


Fig. 12. Vector diagram for secondary circuit only of Fig. 10 at resonance.

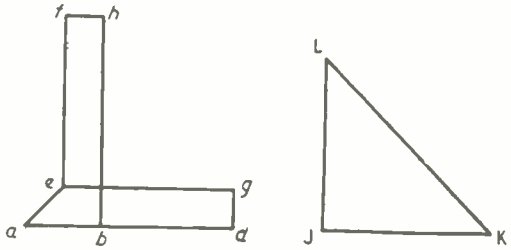


Fig. 13. Complete vector diagram for Fig. 10, at the resonant frequency.

and its phase is 45° behind. The current through M is therefore $\sqrt{2}$ times I_{JL} (it includes I_{JK} as well), and of course 90° behind V_{ea}. So we know the length and direction of KL, which we draw accordingly, Fig. 13. This gives us I_{JK}, the primary current, and we can now proceed to complete the diagram by drawing first *ef*, 90° ahead of JK, and equal to *eg* (for JK = JL); then *fh* in phase; then finally *hb* 90° behind JK, and equal to *ad*.

This complete picture has been arrived at without any deep thought, just by following exactly the same rules as for previous examples—the three fundamental phase relationships (for R, L and C) and the two prescribed rotations for voltage and current. Apart from following these rules correctly, there has been no need to worry about which way arrows should point, or whether we have the vectors in the right directions. And the diagram is simplicity itself to interpret. We see at once the two slim rectangles representing the two tuned circuits, and that they are at right angles to one another, showing that the voltages across them are 90° out of phase—which was what we set out to do. We see that the primary current is in phase with the injected e.m.f., which therefore sees a resistance load (as of course it should, at resonance). Since *fh* and *dg* are only half as long as *ab*, we see that the primary and secondary currents and the voltages across the circuits are half what the same input e.m.f. would produce across a single tuned circuit with the same characteristics. (If you are not quite sure about this, take away the secondary L, R and C from Fig. 10 and draw the voltage diagram for what is left. It should be a rectangle standing on *ab*, twice as tall as *bh*).

If you have become intrigued by all this you probably won't be kept from going on with it, drawing diagrams for less and more coupling than critical, and in doing so will learn (or confirm) quite a lot about coupled circuits. So far, I haven't come across a conventional vector diagram for critically-coupled tuned circuits. Perhaps it is such an unintelligible mess that no one dared publish it!

BOOKS RECEIVED

Microwave Theory and Techniques, by H. J. Reich, P. F. Ordnung, H. L. Krauss and J. G. Skalnik. Textbook for advanced students covering basic field and electron motion theory and its application in the design and operation of practical microwave generators, amplifiers, waveguides and radiators Pp. 901+XIII; Figs. 602. Price 75s. Macmillan and Company, St. Martin's Street, London, W.C.2.

Grundlage der Verstärkertechnik, by Hans Bartels. Revised and enlarged fourth edition of a monograph on the design of feedback amplifiers and their auxiliary stages, with an extensive bibliography. Pp. 279+XII; Figs. 181. Price DM20. S. Hirzel Verlag, Stuttgart, Germany.

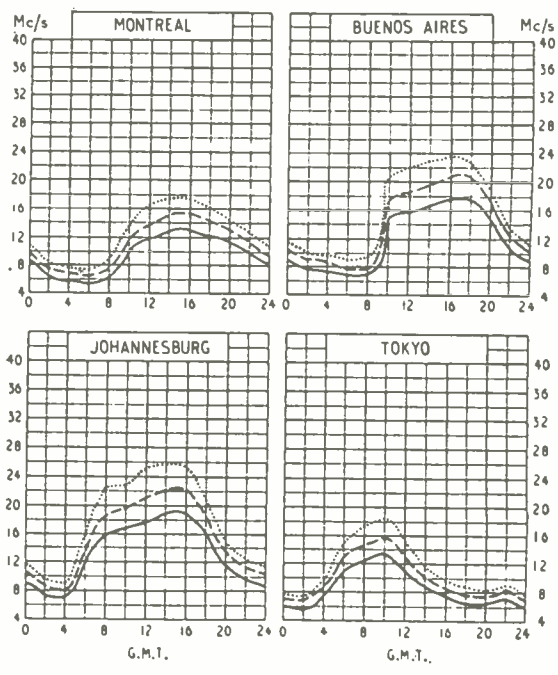
Electrical Measuring Instrument Practice by E. H. W. Banner, M.S.E., M.I.E.E., F.Inst.P. Survey of the types and designs of pointer instruments and recorders and their uses, including applications to the measurement of non-electrical quantities. Pp. 130; Figs. 50. Price 15s. United Trade Press, 9 Gough Square, London, E.C.4.

Short-wave Conditions

Predictions for September

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

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.



Neon Timers

Simple Circuits Based on CR Time Constants

By B. T. GILLING

IN radio work neon tubes are used mainly as voltage stabilizers and occasionally as saw-tooth generators, but they also have a very useful field of application as interval timers. Two different types of timers have recently been built by the writer and they are described below as examples of what can be done and also as exercises in simple relay switching. A very good article on relays by T. Dawson appeared in the January, 1953, issue of *Wireless World* and this should be consulted.

The basic neon timer circuit is shown in Fig. 1(a). A large capacitor is charged slowly from a high voltage through a high-value resistor. The voltage across the capacitor will rise until it reaches the striking voltage of the neon, which will fire and discharge the capacitor until the extinguishing voltage of the neon is reached. The relay in series with the neon will operate and close its contacts and this will complete the discharge of the capacitor. The relay will then drop off, opening its contacts, and the whole operation will recommence. This cycle of events will continue as long as the high voltage is applied. A small resistor of a hundred ohms or so is connected in series with the contacts to prevent a too rapid discharge of the capacitor with consequent sparking.

A disadvantage of this circuit is that only the small portion of the charge of the capacitor between the striking and extinguishing voltages of the neon flows through the relay coil, the rest being dissipated in the series resistor. The circuit can be rearranged as Fig. 1(b) to overcome this. When the neon strikes the relay operates and its contacts short-circuit the neon; the capacitor then discharges through the relay and a more positive action is achieved. This latter method in a slightly modified form is used in both of the instruments to be described.

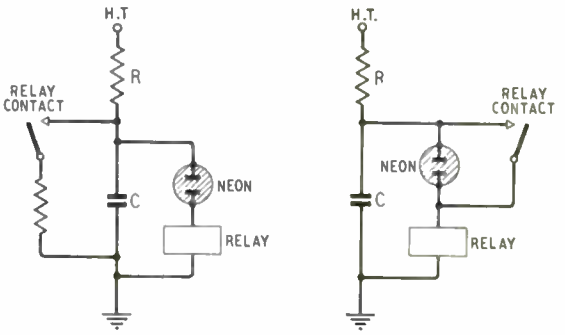


Fig. 1 Above. Basic neon timer circuit (a), with improved arrangement (b) giving a more positive action.

The first one is an interval indicator, shown in Fig. 2. The object of this instrument is to give an audible indication at the end of any half minute from one to two-and-a-half minutes. It was developed to time the operations of a cleaning machine used by watch repairers in which the parts to be cleaned are immersed in different fluids for set times. It is push-button operated for simplicity of working and uses one relay. This relay has windings of 50 and 1,500 ohms and three sets of contacts, two being change-overs and the third a single make which is arranged to close at low spring pressure before the others start to move. The operation is as follows. Assume that push-button 1 is pressed. C_1 will charge through R_3. When the neon strikes

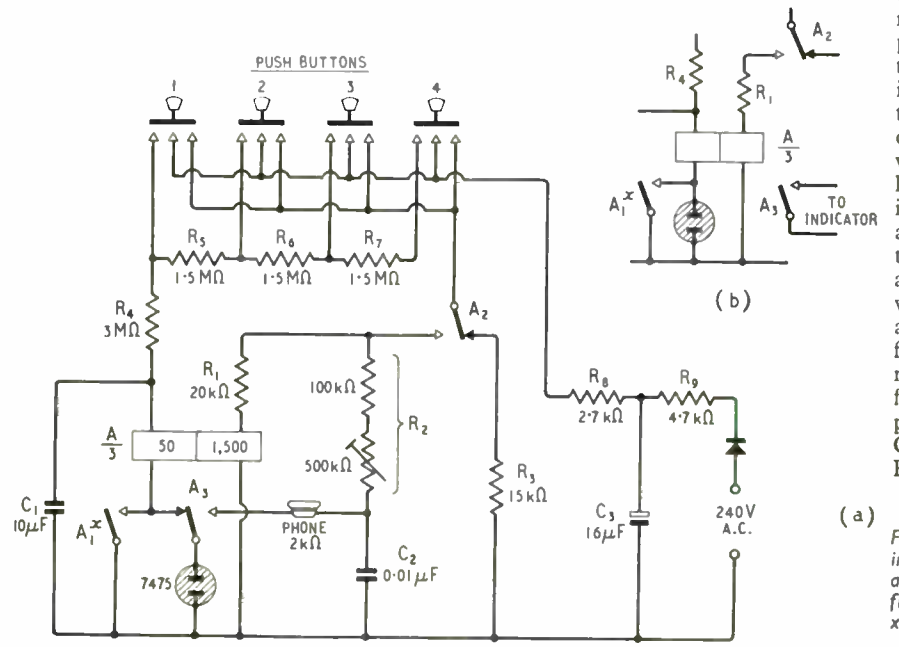


Fig. 2 (Left). Circuit of interval indicator giving an audible note at the end of any half minute from one to two-and-a-half. x indicates early operation.

the current through the 50-ohm coil will cause the relay to start to operate and A_1 will close, short-circuiting the neon. The entire remaining charge in the capacitor will then flow through the coil, causing the relay to operate completely. A_2 will change over, locking up the relay through its 1,500-ohm coil and R_1. A_3 will change over, transferring the neon to the oscillator circuit R_2C_2 and a note will be heard in the telephone earpiece. This note is adjusted by the variable portion of R_2 and will continue until any one of the projecting buttons is pressed, releasing the operated button. The supply voltage is thus removed, the relay drops off and the instrument is ready to be operated again.

The values of the resistors in the high voltage circuit, R_7, R_8, R_9, are chosen to give an operating value of 150 volts at the push buttons, R_7 being chosen to pass the same current as the holding and tone generating circuits combined. In this instrument, close accuracy of timing was not essential and so no attempt was made to stabilize the high voltage. The values of the capacitor and resistors in the charging circuit give times of 1, 1½, 2 and 2½ minutes. This depends on the value of the high voltage and it may be necessary to alter the value of R_8 to obtain exact timing on an individual instrument.

A Post Office type 3000 relay is used and the values of the windings are not critical. The first coil will work at any value up to 1,000 ohms, and provided appropriate alterations are made to R_1 any high resistance value will suit the second coil. A point to bear in mind is that the second coil has only to hold the armature after it has been operated, therefore a very much lower value of current is called for than would be needed had the relay to be operated by this winding.

The method of generating the indicating signal is a simple one calling for the minimum of additional components but the circuit can be rearranged as shown in Fig. 2(b) to switch in an external indicator, either sound or light.

The second instrument (Fig. 3) was designed to switch on the lamp of a photographic enlarger for any predetermined time with close accuracy. It is operated by a telephone key-switch having a central off, one locking and one non-locking position. Two relays are used, one having a 50-ohm coil and a change-over contact. The other has a 2,000-ohm coil and three contact sets, two make contacts and a change-over. It is a two-step relay, the first step being controlled by B_1 which closes at light spring pressure before the other two sets move.

The operation is as follows. The key-switch is pressed in its non-locking position, closing its contacts K_1 K_2, the contacts K_2 being adjusted to close a fraction before K_1. Relay B will operate, but as K_2 has put R_4 in shunt with its coil there is only sufficient power to close B_1. This state of affairs will continue until the key-switch is released. The shunt is then removed and full current passed through the relay over B_1, operating the relay fully. B_3 closes, connecting the enlarger lamp across the mains. B_2 changes over, connecting the resistor R_1 to the capacitor, which starts to charge. When the neon strikes relay A operates. A_1 changes over, disconnecting relay B which drops off and the enlarger lamp is extinguished. B_2 changes over, disconnecting the charging circuit and completely discharging the capacitor through R_2, and the apparatus is ready to be used again.

The locking position of the key-switch is to enable the enlarger lamp to be switched on permanently for setting-up and focusing operations. The high voltage supply is stabilized by a tube, type VR150/30, and an accuracy better than 5 per cent is obtained from one exposure to another. R_1, which is the time control, can be a variable resistor of 2 MΩ calibrated in seconds, but a preferable method is to use a Yaxley type switch with fixed resistors so chosen that each step increases the time by one half of the previous one. Resistor values for this are given in Table I.

A Post Office type 3000 relay is used for B and since differences in spring pressure and armature clearance will alter its characteristics the values of R_3 and R_1 may need modification. The method of setting up is as follows. With R_1 disconnected a value for R_3 is found which will give a good positive action to the relay when the key-switch is depressed. This

TABLE I

The resistance values are selected to give an increase of approximately one half per step in a ratio series familiar to photographers as f numbers.

Seconds	1	1.4	2	2.8	4	5.6	8	11	16	22	32	45
Kilohms	62.5	25	37.5	50	75	100	150	190	310	400	600	800

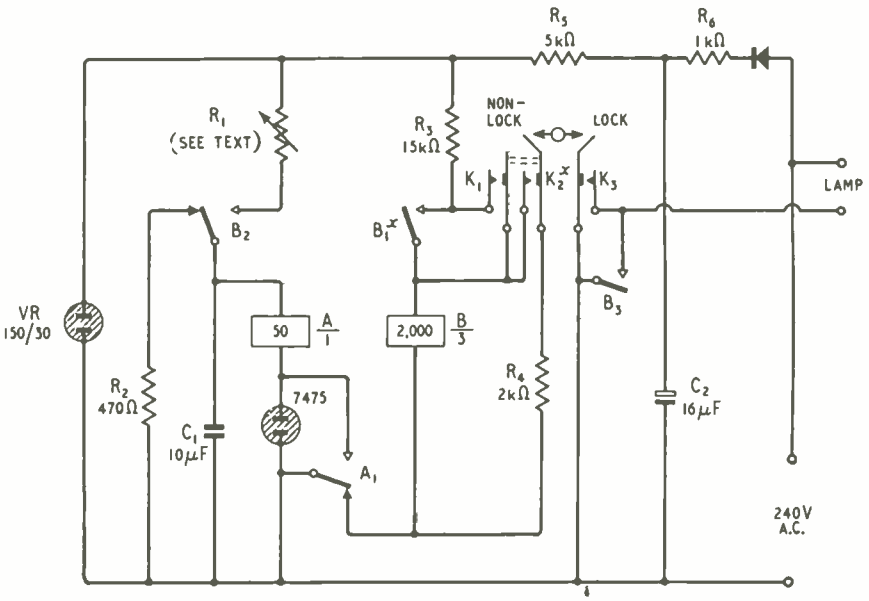


Fig. 3. Timer for switching on a mains circuit for any predetermined time with close accuracy.

value is wired in circuit and a variable resistor connected in place of R_4. A value for this is found which will allow the relay to operate only to close B_1 when the key-switch is operated. Finding the value of these resistors in this way also permits the use of relay coils having a resistance other than 2,000 ohms. Relay A is a Post Office type 600 and its resistance is not critical; values of up to 1,000 ohms can be made to work.

In the examples shown the high voltage supply is obtained directly from the mains. This is a simple and efficient method but it must be very strongly emphasized that either the instrument must be in a case made entirely of insulating materials with no metallic controls exposed, or, if a metal case is used, no wiring must be allowed to come into contact with it and it must be securely earthed. Rectification is by a small 24-section selenium unit and smoothing is of the simplest, consisting of resistor and a single 16-μF capacitor in each case. The maximum current drawn in either is less than 20mA.

A point of importance to be observed in all timers is that the charging capacitor must be of high-grade paper construction with very low leakage and, in fact, all parts associated with the charging part of the circuit must be of the highest insulation.

Training in Television Servicing

By G. N. PATCHETT,*
Ph.D., B.Sc., A.M.I.E.E., M.Brit.I.R.E.

Special Apparatus for Practical Demonstrations

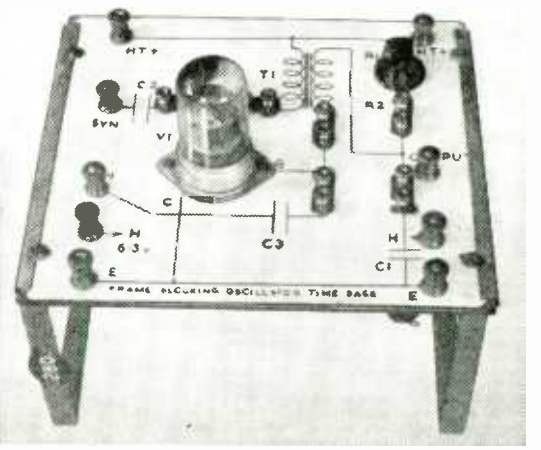


Fig. 1. Experiment board of frame blocking oscillator.

IN the training of television service technicians there are a number of problems which do not occur in most other subjects. The course is essentially a craft type and the people normally attending such courses have a limited academic background, so that the subject must be dealt with in as simple and as practical a manner as possible. Unfortunately, a modern television set is a complicated piece of equipment and is tending to become more so with the introduction of efficiency diodes, Band III, etc. It is extremely difficult to explain the operation of many television circuits without going into mathematics and complicated circuit theory. Although a television servicing technician is only required to repair sets and not design them, the author finds it difficult to understand how a satisfactory repair can be made without at least an elementary knowledge of how the circuit operates and, what is equally important, what will happen under various fault conditions. It is, of course, possible to cure many faults by a trial and error method, but this may be very time-consuming and expensive. Experience of typical faults on particular models is, of course, most valuable but is something which cannot be easily taught.

In view of the difficulties of explaining many circuits the author considers that practical demonstrations are the ideal way and essential to the teaching of this subject. This idea is used to a great extent at Bradford Technical College, where the course consists of two nights per week for a period of two years. One night is devoted to lectures and demonstrations and the other night to practical work by the students themselves. Turning to the practical work, this is divided into two types, (a) experiments on simple circuits, (b) actual fault finding on commercial television receivers. The work done during the first year of the course consists of type (a). For this purpose a number of experiment boards have been constructed, each board consisting of a simple circuit of a section of a television receiver, e.g., a time base or a synchronizing separator. These boards are designed so that they may be used for three purposes:—

1. Experiments on the general operation of the circuit. Voltages, waveforms, etc.
2. The effect of faults on the general operation of the circuit and on the voltage readings and waveforms.
3. The actual location of faults on these circuits.

A typical board is shown in Fig. 1. The "board" consists of hardboard covered with drawing paper on one side. The circuit is drawn on this paper which is then covered with celluloid or, rather better but more expensive, Perspex. More recently a transparent plastic covering has been used which can be secured to the paper by heat. The components of the circuit are fastened to the back of the board and are con-

* Bradford Technical College.

nected to small terminals which are located in the correct positions on the circuit diagram. In series with most components are connected two terminals which are normally joined together by a link. By removing the link the component is effectively open circuited. The board is most useful to show the operation of the circuit, and voltage readings and oscillograph waveforms may be taken at various points. Since these are taken at points on an actual circuit diagram it is easy to see just what voltage is being measured. By removing the links, one at a time, the effect of open-circuited components can be seen on both voltage readings and oscillograph waveforms. The effect of short circuits may be seen by connecting appropriate terminals together.

Fault Finding Scheme

In order that the same board may be used for actual fault finding the links are of special construction. They are made of a sandwich of Leatheroid and copper foil (cemented with Bostik) and are used with the Leatheroid upwards. For fault finding, a number of dummy links are available which are constructed in a similar manner but a slot is cut in the copper foil so that, although the circuit is not completed, the link appears the same as normal. Short circuits may be placed on the circuit by shorting links fitted with crocodile clips on the underside of the board, the students being instructed not to turn the board over. From the point of view of fault finding these boards have the advantage that they can be used repeatedly, whereas when soldered connections are broken and remade to place faults on circuits the apparatus soon becomes useless, owing to damage to components, soldering tags, etc.

In order to operate these boards a coaxial cable is fed to each position in the room. Each position may be supplied with any of the following:—

1. B.B.C. signal from aerial.
2. R.F., modulated with test pattern.
3. Video signal of test pattern.
4. Composite synchronizing pulses.
5. Line pulses.
6. Frame pulses.

The last four are fed through an amplifier and cathode follower unit on each position so that the output may be varied in amplitude and either polarity may be obtained by means of a switch. These supplies and boards have been found invaluable for demonstrations and save much time in connecting up circuits when wishing to give demonstrations. If much connecting up is required in order to give a demonstration the general result is that the demonstration does not get shown.

At present 33 such boards are available and it is hoped to make more in the near future. For the second part of the practical work a number of commercial television receivers are available and also two sets constructed at the college. One is a normal circuit (largely *Wireless World* design) arranged with separate chassis for the various sections while the other is a projection set. Faults of various types are placed on these sets and the students get experience in locating them.

Apart from the normal equipment of cathode-ray oscillographs, valve voltmeters, signal generators, etc., a number of special pieces of equipment are available which are most useful. The first is a commercial oscillograph with d.c. amplifiers and an X trace which can be expanded to approximately five times the screen diameter. This is invaluable for showing the operation of d.c. restorers and of circuits where the d.c. component is important.

The second is a television waveform display apparatus which was constructed at the College and is described in more detail elsewhere.[1] The apparatus is essentially a special cathode ray oscillograph arranged so that the waveform of 2 to 250 lines of a television picture may be shown. The lines can be varied so that any selected ones may be shown and a pulse is available for brightening the corresponding lines on a picture on a normal receiver. This is particularly useful for showing the operation of synchronizing separators, which are almost impossible to demonstrate on a normal cathode-ray oscillograph. Fig. 2(a) shows the frame synchronizing period on even frames taken on the signal from the pattern generator, while (b) shows the effect of integration of the frame pulses. In this the build-up of voltage can easily be seen but it is quite impossible to show anything of this nature on an ordinary oscillograph since the frame synchronizing pulses occupy only a small fraction of the total frame time. The apparatus can, of course, be used with advantage for fault finding.

Camera Equipment

Recently a complete television camera has been constructed to help in clarifying some of the mysteries of the camera side of television, which cannot normally be seen by students outside the London area. The camera itself consists of a Pye Staticon miniature pick-up tube with a two-valve pre-amplifier, a cathode follower and a pulse amplifier. It also contains an electronic view-finder with corresponding time bases and video amplifier. The camera is fed from a control unit which is mounted on two racks. These contain the power supplies, video amplifiers, time bases, pulse generator and monitor tube. The signal from the pre-amplifier is fed by coaxial cable to the video amplifier on this control unit. After amplification and frequency-response correction, the signal is fed to a clamp circuit to set the black level, and then to a blanking amplifier which suppresses the signal for the required periods. The synchronizing signal is then added to give a complete video waveform. The control unit also contains a small r.f. oscillator and amplifier which is modulated

[1] Patchett, G. N. "A Television Waveform Display Apparatus," *Electronic Engineering*, May and June, 1953.

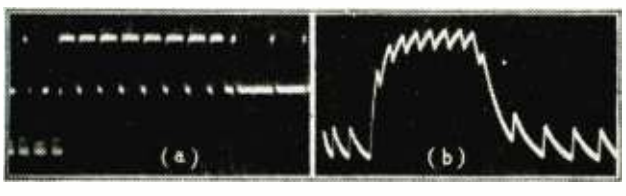


Fig. 2. (a) Video signal of pattern generator during even frame synchronizing period. Negative picture signal. (b) The effect of integrating the synchronizing pulses during the frame synchronizing period. Positive pulses.

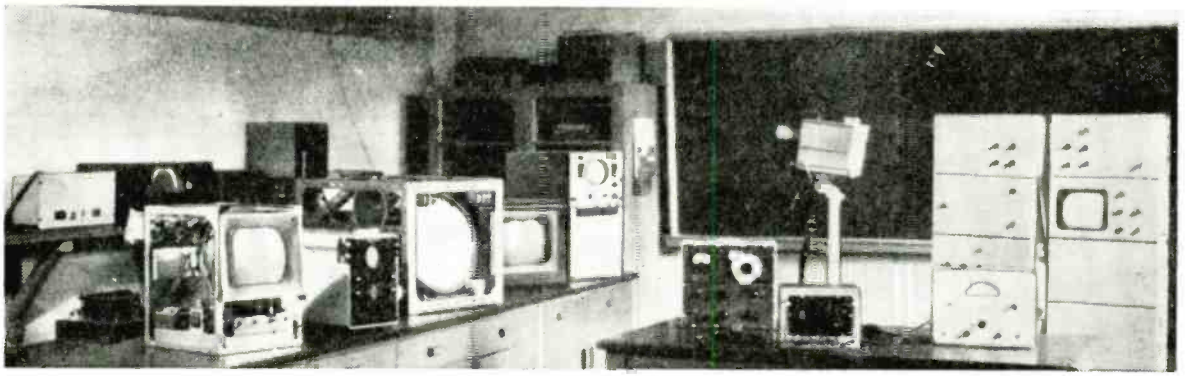


Fig. 3. A corner of the television servicing laboratory at Bradford Technical College, showing camera and control unit.

with this video signal so that the camera may be used to operate a normal commercial set.

The camera is most useful for showing effects of d.c. component, definition, etc., which are difficult to show on a normal pattern-generator signal. It is designed to give a correct B.B.C. synchronizing signal and will resolve at least the 2-Mc/s bars on Test Card C. Built into the same control unit is a monoscope which enables a Test Card C pattern to be produced when required. Some further work is required on this section to give complete satisfaction but it will be a most useful addition as this signal is not available (apart from a few minutes) during normal class time. Fig. 3 is a general view of part of the laboratory with the television camera control unit and other apparatus.

Although much time and effort have been devoted to this work it is felt that it is well worth while if it enables students to obtain a better understanding of the working of a television receiver. With the introduction of more channels and, at some later date, colour, the complexity of the television receiver will increase and it will be even more difficult to give satisfactory training. The servicing trade is already short of technicians and it will become more important to have highly skilled people available as more sets are installed and as their complexity increases.

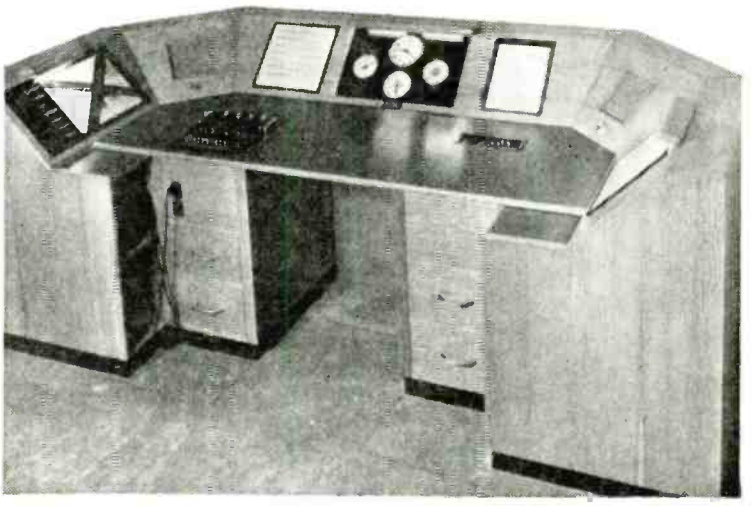
MODERN AIRFIELD RADIO

A NEW civil airport near Dungeness, known as Ferryfield, opened recently by Silver City Airways, is said to be the first airfield in the world planned especially to deal with the transport of vehicles, as distinct from passengers or freight. It will eventually replace the cross-channel car ferry now operating from Lympne.

Its interest from our standpoint is that, being a new airport, it has no legacy of existing radio facilities that must be integrated with new services and the whole radio and radar installation has been planned from the ground up, so to speak.

First and foremost is the air-to-ground communication; this is carried out primarily on two v.h.f. channels in the 118- to 132-Mc/s aircraft band by means of modified T1131 crystal-controlled transmitters of 50 watts telephony rating and four Marconi HR82 receivers. Two transmitters and receivers are in service and two on stand-by. There are also two h.f. transmitters (one operational and one stand-by) for single spot-frequency operation in the 2- to 25-Mc/s band. They are rated at 250 watts telephony and 350 watts c.w. telegraphy and have been installed to handle long-distance communications in connection with charter work. There are two h.f. receivers of Racal design.

Two aids to navigation are provided; one is a v.h.f. direction finder operating on the null-signal aural



The flying controller's desk at Ferryfield is typical of the type now installed at civil airports. Facing the controller is a panel of instruments giving wind velocity, time and barometric pressure information. On the left is a recessed loudspeaker to which all receivers are connected, and on the extreme left is the runway's lighting control. Convenient to the controller's left hand is a panel carrying switches and indicator lights for remote control of all radio services. A hand telephone set is in a recess below.

principle and employing a pair of rotatable dipoles with switched reflectors to give "sense." Bearings are taken on the normal R/T transmissions from the aircraft. The other navaid is a Decca 424 radar with the scanner and radio-frequency head located about 400 to 500 yds from the control tower. The i.f. signal is "piped" to the tower where, in a room fitted with tinted glass windows, are two c.r. tube display units, with separate i.f. receivers to allow for independent operation. Thus one can cover the distant approaches out to 25 miles or so, while the other can give an expanded picture of aircraft movement within a mile or two of the airfield.

Radio-telephone facilities are provided in this room to enable aircraft to be "talked down" to within visual distance of the runways under conditions of poor visibility. Here is located also the v.h.f. direction finder so that all the radio navigational aids are conveniently to hand.

Not yet installed, but planned, is a v.h.f. radio-telephone system for keeping in touch with all airport vehicles. It, and all the other radio services, will be operated from the controller's console as is now customary practice at all airfields, large and small.

The radio and other airport equipment at Ferryfield was planned and installed by Racal, Ltd., and, of course, is approved by the Ministry of Transport and Civil Aviation.

International Technical Questions

PROFESSOR BALTH. VAN DER POL, director of the International Radio Consultative Committee (C.C.I.R.), has sent us a copy of Volume I of the Proceedings of the VIIth Plenary Assembly of the Committee which was held in London last September. Engineers and technicians interested in the international aspects of technical radio questions will find the book (which is available in English and French) of considerable interest.

Volume I contains the full text of 90 recommendations, reports and resolutions adopted by the assembly. It also gives full details of the study programmes and questions which will be investigated during the three years before the next assembly, to be held in Warsaw in 1956. These investigations are carried out by the study groups of each of the member countries of the International Telecommunication Union of which the C.C.I.R. is a permanent organ. It is as a result of the papers submitted by these national study groups that the recommendations and further study programmes are arranged.

As the book also contains the texts of those reports, etc., adopted at the previous two plenary assemblies which are still valid, it forms a complete collection of the current C.C.I.R. documents.

Some idea of the diversity of subjects covered in this 406-page book may be gained from the following summary of some of the entries in the 20-page index:—

Propagation: Ionospheric, tropospheric and ground-wave.

Receivers: Noise and sensitivity; selectivity; frequency stability; choice of i.f.

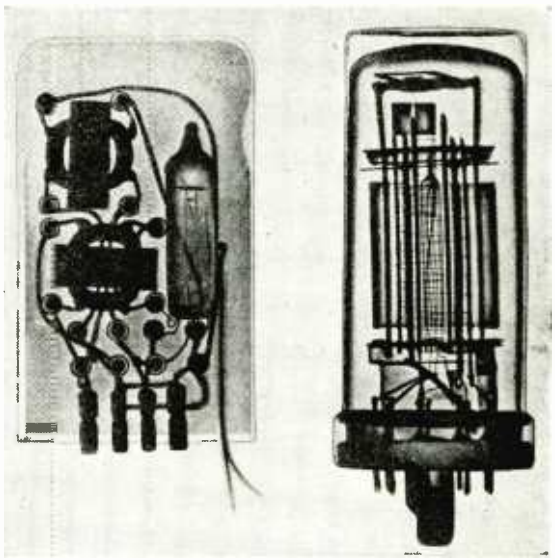
Recording: Standards for sound on discs, film and tape.

Television: Recording, polarization, standards conversion, picture and sound modulation, combining monochrome and colour.

Two further volumes covering the reports of the study group chairmen and the director (Vol. II), and the minutes of the plenary assembly (Vol. III) will be published later.

Volume I is obtainable from the Publications Department, International Telecommunication Union, Palais Wilson, Geneva, Switzerland, price 23.10 Swiss francs.

ELECTROSTATIC RADIOGRAPHY



THIS picture shows an x-ray image of a valve and a potted circuit obtained by a new process called xeroradiography which dispenses with ordinary photographic techniques. The method is cheap because the plates can be used over and over again and is very quick—the radiograph being ready in less than a minute from the time of exposure.

In place of the ordinary photographic plate a thin film of selenium on a conductive backing plate is used, and this is charged electrostatically. On exposure to the x-rays the charge is modified according to the pattern of the object being radiographed, so that an electrostatic image is obtained. This image is then made visible by spraying on to the plate a very thin film of charged powder, which adheres in accordance with the charge distribution. For re-use it is only necessary to wipe the plate clean and recharge.

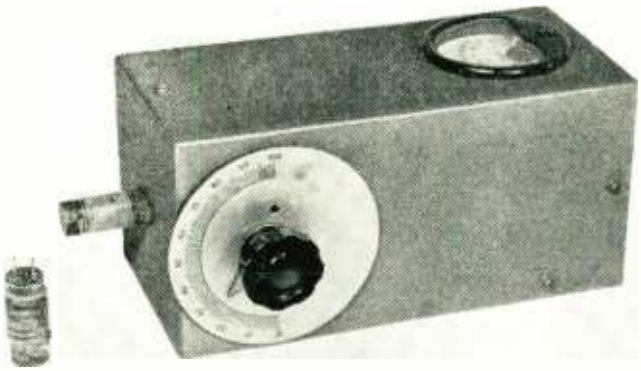
The method has been developed by Ferranti, who say that it is possible to obtain pictures with an even finer grain than in conventional x-ray photographs.

Problem Picture

What is it? Clue: the external form is strictly functional. No, it is not a r.f.-heated pressure cooker, but the latest transmitter-receiver for ships' lifeboats, made by Marconi Marine.

The "Salvita" set, as it is called, is waterproof—indeed, submersible—and is powered by a hand-driven generator. It complies with the latest Government specification, and operates on 500 kc/s and 8.364 Mc/s.

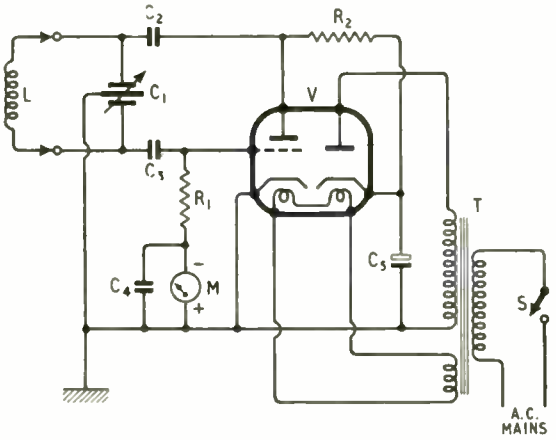
COMPACT GRID-DIP OSCILLATOR



By G. P. ANDERSON
(Amateur Radio Station G2QY)

A Useful Method of Finding the Resonance Frequency of Coils and Circuits

DURING recent years the increasing appreciation of the value of the grid-dip oscillator as an item of test gear has been reflected in the number of articles published describing different varieties of the species. The only excuse the present writer has for offering yet another contribution on the subject lies in the use of a triode-diode v.h.f. mixer valve as an oscillator and mains h.t. rectifier.



Circuit diagram of the grid-dip oscillator described in the text.

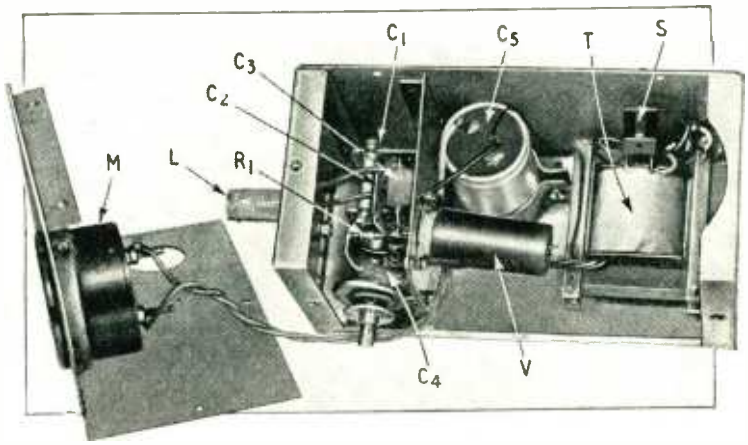
Basically the GDO comprises an oscillating valve tunable over the desired frequency range, and including a meter to show the rectified current flowing in the grid circuit. The oscillator coil is usually placed on the outside of the unit in order to permit it to be brought near to the circuit under test. When the test circuit and the GDO are tuned to the same frequency, power is absorbed from the oscillator causing the grid current to fall; hence its name.

An examination of the makers' characteristics for the diode part of the Mullard EAC91 shows that it is designed with limiting values of 50 volts between heater and cathode, and a cathode current of 5 mA. Using the triode section as an oscillator with approximately 50 volts h.t., the current taken is well within this limit, and the valve may be made to oscillate easily up to frequencies of the order of 220 Mc s, using components suitable for operation at lower frequencies as well. The particular model shown in the photographs is designed to cover the range from 5 to 160 Mc s with seven coils, which are arranged to plug in to the end of the unit.

The mains transformer may be quite small as it supplies about 2 watts only, and the smoothing shown in the circuit diagram, comprising C_5 (32μF) and R_2 (10 kΩ), is adequate for the purpose. The

LIST OF COMPONENTS

C_1	20 + 20 pF variable
$C_{2, 3, 4}$	100 pF silvered mica
C_5	32 μF 50 V wkg.
R_1	22 kΩ $\frac{1}{2}$ W
R_2	10 kΩ $\frac{1}{2}$ W
V	EAC91 (Mullard)
A	250 μA meter
L	See table
T	Mains transformer; secondaries 50 V at 5 mA, 6.3 V at 0.3 A.



On the right the layout of the parts inside the box is shown with the top and one side removed.

signal produced, if listened to in a receiver, is modulated very deeply with 50 c/s, but this is no disadvantage in using the instrument; it is in fact very useful for identifying the signal when accurate frequency checking is desired.

The model shown is built into a box measuring $7 \times 3\frac{1}{4} \times 3\frac{1}{4}$in, which is a convenient size for holding in the hand. It could be made smaller, but was originally built as a companion to a self-contained battery model, which used one triode of a 3A5 in a similar oscillator circuit, driven by hearing aid batteries. The only external difference was in the replacement of the mains toggle switch by a spring-loaded push button, conveniently placed for thumb operation. This switch was fitted in the heater circuit in order to prevent the batteries being run down unnecessarily.

Details of the coils, and the approximate ranges covered, are shown in the table. If use at the upper end of the range only is contemplated a smaller capacitor at C_1 permitting a different layout to secure shorter leads in the oscillator circuit would probably enable the GDO to be used at even higher frequencies. In passing it may be mentioned that tests have been carried out with 120 volts applied to the rectifier without any signs of distress; with the heater left unearthed, this voltage does not appear across the heater and cathode, but only between the two cathodes, and, of course, the cathode and anode of the diode.

For completeness, a few notes on the use of the GDO may be added. Each range should be calibrated, conveniently by comparison with a suitable receiver, but it should be kept in mind that such calibration is only approximate, since coupling to a tuned circuit tends to "pull" the oscillator. In use the coil of the GDO should be brought near to the circuit under test, and the tuning condenser varied until a decrease in grid current is indicated. The coupling should then be reduced, by moving the GDO away, until the smallest observable "dip" is obtained; in this way, the "pulling" of the oscillator frequency is reduced to a minimum. If more accurate knowledge of the frequency than is given by the GDO calibration is required, the oscillator frequency may be checked on a receiver, maintaining meanwhile the coupling to the circuit under test.

Apart from the obvious uses in adjusting tuned circuits in receivers, transmitters and such like, the GDO may also be used to find the resonant frequencies of aerials, guy-wires, etc.

COIL TABLE

Coil	Approx. Freq. Range	Turns	Winding Length	Wire
A	5–9 Mc s	$68\frac{1}{2}$	$\frac{3}{4}$in	36 s.w.g. enamel
B	9–15 ,,	$39\frac{1}{2}$	,,	28 ,,
C	14–24 ,,	$24\frac{1}{2}$	,,	24 ,,
D	23–40 ,,	$15\frac{1}{2}$	,,	22 ,,
E	37–63 ,,	$8\frac{1}{2}$	,,	20 ,,
F	60–110 ,,	$5\frac{1}{2}$	$\frac{1}{2}$in	20 ,,
G	100–160 ,,	$1\frac{1}{2}$	$\frac{1}{4}$in	20 ,,

The coils are each wound on 1-in lengths of $\frac{1}{2}$-in diameter Paxolin rod, and are terminated on two 20 s.w.g. tinned copper wires inserted in the ends, spaced to suit the socket on the grid-dip oscillator. In the original model, the socket is a diode valveholder (Base Type B3G).

FITTING CAR RADIO

IN order to encourage radio dealers not having facilities for handling motor cars to take a more lively interest in car radio, Pye Telecommunications are organizing fitting depôts throughout the country to which dealers can send their customers for skilled and prompt fitting of the latest Pye car radio receiver. At the time of writing depôts are functioning in Birmingham, Cambridge and Manchester.

To facilitate speedy installation in the widest possible range of cars the new set is made in three separate parts; radio tuner, combined output and power unit and loudspeaker respectively. The first and last only need be in the body of the car and space can generally be found somewhere under the bonnet for the power unit, where, incidentally, it will be within easy reach of the battery in most cases.

The tuner is a complete three-valve, two-waveband superhet less output stage, and is designed to have a reasonably small frontal area so that it can be accommodated conveniently in the space provided on the dash board, or immediately below without obstructing either the driver or passenger.

Tuning and the combined volume/on-off controls are fitted with normal type knobs and disposed on either side of a rectangular dial, while the tone control and wavechange switch have disc-shaped "dollies" for finger or thumb operation and are let into the lower part of the dial. There are separate scales for medium and long waves with illumination for night-time operation. The price of the new set, including aerial, purchase tax and fitting fee is £28.

Right: To facilitate installation the new Pye car radio receiver is broken down into the three units shown here.

Manufacturers' Products

NEW EQUIPMENT AND ACCESSORIES FOR RADIO AND ELECTRONICS

Strip Connectors

THE plug and socket connector illustrated is one of a new range introduced by Bulgin for the electrical interconnection of individual items of a larger equipment. A typical application would be where several chassis are mounted in a rack or a cabinet and slide in and out on guide rails for maintenance and servicing. The socket part can be fixed to the back of the chassis and the plug part (or vice versa) on the back of the rack or cabinet. When the chassis are pushed fully home the two parts mate together and the electrical interconnections are automatically made. To ensure correct alignment of the pins and sockets, individual sockets are

Bulgin 3-way plug and socket strip connector.

allowed a free lateral movement of ±5 deg.

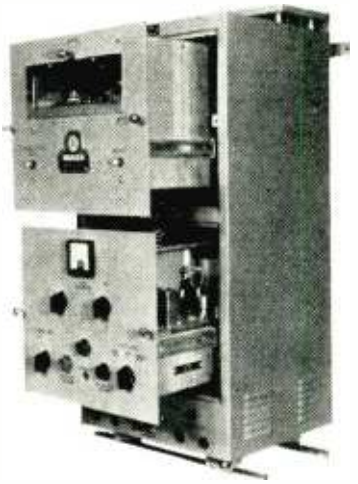
Plugs and sockets are mounted on strips of good-quality bakelized material, the pin spacing being $\frac{7}{16}$ in. Pins are hollow and the leads are secured by tip soldering as in the older-type valve pins. Sockets are fabricated from resilient metal strips, bent to shape, and have integral soldering tags.

These new connectors are available in 3- to 6-, 8-, 10- and 12-way types and prices range from 1s $1\frac{1}{2}$d for a 3-way plug and socket to 3s 6d for a 12-way.

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

Auto-alarm Receiver

THE "Seaguard" auto-alarm receiver is intended to take the place of the ship's radio officer when he goes off duty. It maintains a constant watch on the marine distress frequency of 500 kc/s, and, in the event of a distress signal conforming to the international standard of 12 four-second dashes at one-second intervals being received, operates an alarm. In order to allow for slight mis-tuning of the caller's transmitter the Seaguard receiver is pre-tuned



Marconi Marine Seaguard auto-alarm equipment with chassis withdrawn for inspection.

for reception over the band 490 to 510 kc/s.

A receiver of high sensitivity is employed and elaborate precautions are taken to ensure that only a genuine distress signal of the agreed form will actuate the alarm mechanism, which comes into operation after the fourth dash of correct duration and spacing.

The Seaguard consists of two main units, receiver and power supply, both housed in a single cabinet with draw-out chassis for servicing. A built-in meter provides means for checking all valve feed currents and failure of either unit is indicated by one of two lamps lighting up; also the alarm bells ring.

The equipment is supplied by the Marconi International Marine Communication Co., Ltd., Marconi House, Chelmsford, Essex.

NON-FERROUS METALS

ELECTRICAL, physical and mechanical properties of non-ferrous metals and alloys are given in the 472-page "Metal Industry Handbook and Directory, 1954," which also includes summaries of relevant British Standard specifications, compositions and melting points of solders and a classified directory of products. The volume, which is in its 43rd year of publication, is published by the Louis Cassier Company, Ltd., Dorset House, Stamford Street, London. S.E.1, price 21s.

RANDOM RADIATIONS

By "DIALLIST"

Sporadic E

YOU'VE probably had your whack of television interference by sporadic E reflections at one time or another in the course of the present summer (*sic*). "Clouds" of intense ionization, forming sporadically in the E-layer and capable of propagating long-distance interference with our TV services were forecast as most likely to occur in the daytime between May and August by T. W. Bennington,* whose work is well known to *Wireless World* readers. His forecast has been amply borne out by what happened this year. At one time or another from early May onwards severe modulated r.f. interference during daylight has been reported from many parts of the country. Unless there's some interesting event, sporting or otherwise, on tap, I don't often use my receiver during the afternoon. Hence it wasn't until early in July that I saw sporadic E interference in full swing. It began more or less mildly with the appearance of a number of faint whitish lines on the screen. They were not stationary, but jittered about, sloping now from left to right and now from right to left between the top and bottom of the screen. The lines grew rapidly more obvious and "greys" appeared between the "whites.' Meantime, they became steadier and less inclined this way or that. Watching them was very trying to the eyes, but I was too fascinated to switch off. So far as I remember, the next development was sudden: the lines became alternate black and white vertical bars of equal width, covering the entire screen. They were at one time so steady that I could count them: 24 black bars, with jagged edges indicating modulation.

Long-Range TV

TELEVISION is full of surprises. If you were asked what were the chances of obtaining consistently good pictures at a seaside town, 70 odd miles from the nearest transmitter and with huge hilly areas inland, you'd probably reply without hesitation that they were not very bright. That's certainly what I should have said about Torquay—if I hadn't just returned from a visit to friends who live there and seen for myself the quite excellent pictures that they regularly have on their screen. Good reception is rare in the more low-lying parts of the town; but, given an efficient receiver and a high 3- or 4-element Yagi array, pictures in the higher parts are very nearly up to the standard of those obtainable in a normal service area. When you think of Torquay you are apt to picture it as lying under the shadow of Dartmoor. You might even feel that the direct path from Wenvoe must pass over Exmoor as well. Take a look at the map and you'll see that a straight line between the two places doesn't cross either: there are, in fact, few natural obstacles in the way of a metre-wave transmission.

A.G.C.

Almost the only fly in the ointment in this part of South Devon is slow, and sometimes not so slow, fading. My host had done a good deal towards minimizing the effects of this by rigging up a remote-control arrangement for the contrast. With this he could keep the picture-level more or less steady; but I couldn't help feeling that this job of work should have been done in the receiver itself by means of effective a.g.c. It is not only in places far from a transmitter that receivers have to cope with signal variations big enough to be a nuisance to the viewer. I am glad to see that an increasing number of manufacturers are including a form of a.g.c. in their sets. What a boon it will be if it is really effective against aeroplane flutter; for this form of interference is becoming more and more frequent with the increasing number of planes in the air.

The F.M. Scheme

THOUGH the first stage of the B.B.C.'s plan for v.h.f. broadcasting provides for only nine stations, it will cover a good 75 per cent of the homes of this country. The idea is to turn every TV station eventually into a combined television and sound broadcaster This means that the provision of interference-free sound broadcasting will go forward hand in hand with steadily improving television coverage. Since it should be possible to share much of the building, maintenance and running costs

* *B.B.C. Quarterly*, Autumn 1953.

between the two services this should make for a considerable saving in expense. A saving in manpower, too; for the number of engineers and technicians needed to run a "combined" transmitting station should be quite a bit smaller than that called for by two completely separate outfits. Although we may not be the first country to have a nation-wide high-fidelity sound service we shall, I believe, be the first to demonstrate the economies of combined sound broadcasting and television stations.

AWARDS TO AUTHORS

AUTHORS of a dozen or more papers on radio and allied subjects read before the Institution of Electrical Engineers last session, or accepted for publication during the session, are to be awarded premiums by the Institution.

The Duddell Premium (£20) goes to G. W. Barnes (R.A.E., Farnborough), for his paper "A Single-Sideband Controlled-Carrier System for Aircraft Communication," the Blumlein-Browne-Willans Premium (£20) to G. Dawson, K. G. Hodgson and R. A. Meers (all of S.T.C.), and L. L. Hall and J. H. H. Merriman (P.O.), for "The Manchester-Kirk o'Shotts Television Radio Relay System," the Ambrose Fleming Premium (£10) to Dr. M. M. Z. Kharadly (Imperial College), and Dr. Willis Jackson, F.R.S. (Metrovick), for "The Properties of Artificial Dielectrics Comprising Arrays of Conducting Elements," the Fahie Premium (£10) to T. Hayton, C. J. Hughes and R. L. Saunders (all of C. & W.), for "Telegraph Codes and Code Convertors" and the Heaviside Premium (£10) to J. F. Coales (Cambridge University), for "The Application of Information Theory to Data-Transmission Systems and the Possible Use of Binary Coding to Increase Channel Capacity." A £10 Premium will also be awarded to Dr. A. L. Cullen (University College, London), for "The Excitation of Plane Surface Waves."

Premiums valued at £5 will be given to the following authors for the papers quoted: E. D. Daniel and Dr. P. E. Axon (B.B.C.), for "The Influence of Some Head and Tape Constants on the Signal Recorded on a Magnetic Tape" and "The Reproduction of Signals Recorded on Magnetic Tape"; Dr. E. A. O'Donnell Roberts (Mullard), for "A Study of Some of the Properties of Materials Affecting Valve Reliability"; Dr. J. A. Saxton and B. N. Harden (Radio Research Station, Slough), for "Basic Ground-Wave Propagation Characteristics in the 50-800 Mc/s Band" and "Ground-Wave Field Strength Surveys at 100 and 600 Mc/s"; J. Brown (Imperial College), for "Artificial Dielectrics Having Refractive Indices less than Unity"; Dr. A. Talbot (Imperial College), for "A New Method of Synthesis of Reactance Networks"; and E. Green (Marconi's), for "Synthesis of Ladder Networks to give Butterworth or Chebyshev Response in the Pass Band."

UNBIASED

By FREE GRID

Teleoptics

I HAVE been reading with very great interest an article in the June issue of the French journal *Télévision* in which the author, Gaston Muller, puts forward some very original ideas. He is, like myself, afflicted with a divine discontent, as, indeed, is F. P. Hughes, who wrote "Why Lines?" in last month's *Wireless World*.

Muller criticizes the use of scanning in television; the picture is transmitted piecemeal and not in one complete whole as in the long-range TV system employed by the moon and other heavenly bodies.

Although the viewer thinks he sees a complete picture it is in reality a mere illusion—like marriage, where one gets to know the real personality of ones partner bit by bit instead of all at once. As things are at present the marriage between electronics and optics, which produces as its offspring the television picture on our screens, is rather an unsatisfactory one from Muller's point of view. The offspring, by means of the scanning process, grows up gradually into a fully fledged adult over a period of time in the same way as an infant in the biological world. M. Muller wants the offspring to arrive in the world like Venus as a ready-made adult with none of this time-wasting growing business.

He describes his proposed remedy for this unsatisfactory state of affairs at considerable length, but admits that practical details are likely to prove very formidable. It is these tiresome practical details that are holding up a teleoptical scheme of my own as I want to provide every room in my house with television, using one set only.

As you cannot just couple up an extension c.r.t. as you can a loudspeaker I propose to mount my set on the roof next to my masthead pre-amplifier and to distribute the picture optically. I intend to use a small projector-type c.r.t. in the set and by an elaboration of the optical arrangement used in a binocular microscope, coupled with the necessary number of periscopes, I shall be able to beam the picture down each chimney of my house. It doesn't look as if we are going to get any coal next winter and I don't like to think of the chimneys as being entirely useless.

In the empty grate of each room, there will be a prism or inclined mirror to throw the image forward on to the back of a translucent screen standing in the position occupied by the normal fire screen. In this way television will be available in each room and the occupants will be able to gather in a half-circle round the fireplace as has been the habit of families for generations past.

Optical television distribution.

The Etch and the Itch

ONE sometimes comes up against the problem of replacing a defunct valve, on which the etched type number is indecipherable, in a receiver about which no technical information is available.

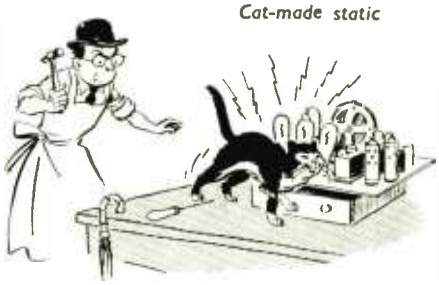
In a recent issue of the American journal *Radio-Electronics* a gallant attempt is made to solve this problem by suggesting various things which may be done to enable the faint and elusive type number to be read. All depend on the fact that the etching process causes a slight roughening of the glass over the actual etched area. Among other things suggested is that the valve be rubbed on your hair; the rough etched area of the glass collects more of the natural scalp oil than the rest and so shows up. But those of us who have dry scalps need not despair. All we need do is to stick the valve in the refrigerator and when it is really cool take it out and breathe on it; and we shall find that the resultant condensation has collected more readily on the rough etch than elsewhere.

These suggested remedies are all very well in their way, but I am surprised at a technical journal like *Radio-Electronics* having any truck with such non-electronic methods. I must confess, however, that I only discovered the correct method myself by chance.

One day I had on my laboratory table the chassis of a set which I had picked up cheaply in the Petticoat Lane of radio. I was having trouble in deciphering the valve numbers and had left the room for a few moments in search of a valve data book and when I returned I noticed the cat rubbing itself against the valves and other components of the up-ended chassis.

There was nothing abnormal about all this, of course, but when I reached the chassis I noticed that the etching stood out boldly amid the dust which had gathered on the rest of each valve. The explanation is simple. When glass is rubbed with a piece of catskin it becomes electrified and readily attracts particles of dust. But there had been a much greater degree of friction between the itching skin of the cat and the rough area of the etching, and, therefore, a greater electrical charge with the result that the dust had been attracted there to a much greater extent than elsewhere on the glass envelope of each valve.

Cat-made static

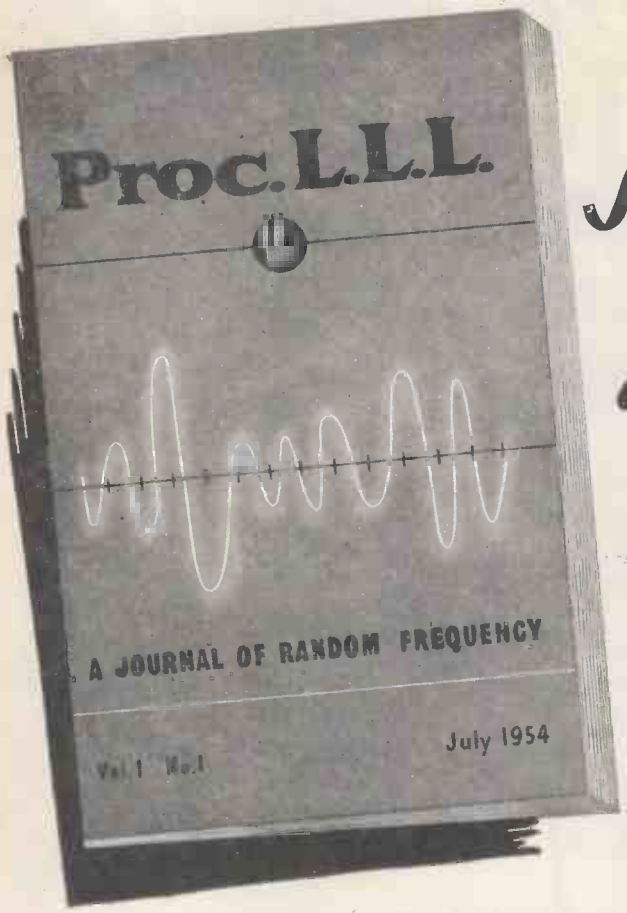


Mobile Phone Boxes

EACH YEAR there is an outcry from punters at the shortage of 'phone boxes at Newmarket, Epsom and other racing centres, to give people a chance of getting on to their London bookmakers for the later events in the programme after they have lost all their hard cash to the ready-money course bookmakers in the earlier races.

The usual excuse of the G.P.O. is that the capital outlay in building dozens of telephone kiosks which would be used for only a few days in the year would not be justified. Have they never heard of such things as radio waves, or are the officials in charge of the telephone department totally lacking in imagination?

I see no reason at all why temporary 'phone boxes made of wood and canvas should not be dumped down where needed, each containing a battery-powered radio unit for linking with a similar installation on the roof of the local telephone exchange. Such temporary boxes, with their complete freedom from connecting cables, could be readily moved by a suitably equipped pantechnicon from course to course as required.



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Valve requirements of extremely diverse equipments, from servo amplifiers to video modulators, are ideally met by the new Mullard beam tetrode, QV06-20.

This compact and rugged valve with an anode dissipation of 20 watts will function equally well as driver, frequency multiplier, power oscillator or output valve at all frequencies up to 60 Mc/s. With ratings reduced the frequency of operation may be increased to 175 Mc/s.

One QV06-20 as a class "C" amplifier will deliver 52 watts at 60 Mc/s, and two in a class "AB1" push-pull amplifier will provide 82 watts of audio power. The mutual conductance is 7 mA/V, and even with relatively low anode voltages a large output can be obtained with small driving power.

The anode connection of the QV06-20 is brought out to a top cap, and this feature, together with a short metal base screen which is connected to a base pin, ensures excellent separation between input and output.

The QV06-20 is directly equivalent to the popular American 6146. Further details of the QV06-20 and other valves in the comprehensive Mullard range are readily obtainable from the address below.

QV06-20

TETRODE

Heater:		
V_h	6.3	V
I_h	1.25	A
Limiting Values:		
V_a max.	600	V
p_a max.	20	W
V_{g2} max.	250	V
V_{g1} max.	—150	V
f max.	175	Mc/s
Base	Octal.	

Typical Applications	V_a (V)	Pout (W)	f (Mc/s)
R.F. Power Amplifier			
Class "C" Telegraphy and F.M. Telephony	600 320	52 25	60 175
Class "C" Anode and Screen-grid Modulated	400	32	60
A.F. Power Amplifier or Modulator (Two valves.)			
Class "AB1"	600	82	A.F.
Class "AB2"	600	90	A.F.

Mullard

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

MVT160

Ferrograph 2A

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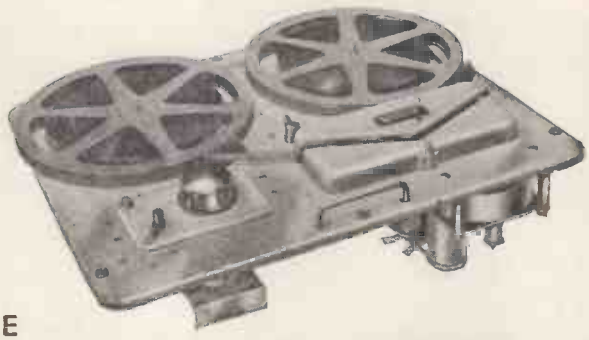

THE WEARITE TAPEDECK

The reputation of the 'Tapedeck' is so well-known and so firmly established as to call for no extravagance in describing its many virtues. Indeed, it forms the basis of the recorder instruments in common use in the Defence Services of the United Kingdom and many other countries, as well as being the choice of broadcasting Authorities throughout the World.

FERROGRAPH 2A A reasonably inexpensive instrument approaching professional standards with a specification commending it to those engaged in educational and cultural pursuits.

FERRROGRAPH MODEL YD A triple-speed instrument designed mainly for use in the scientific and industrial fields. Principally intended for operation from and into 600 ohm lines, a high gain stage has been provided, however, to allow for recording direct from normal microphones.

EQUIPMENT YDC A simultaneous dual-channel Recorder-Reproducer offering special facilities for analytical research into medical, aeronautical and scientific problems. Any two activities capable of translation into electrical phenomena within the frequency and phase shift limitations can be recorded and relayed simultaneously.

Demonstrations of Ferrograph Recorders will be given in Demonstration Room D.20.

Originators of Tapedecks

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RCA is first choice for television equipments

RCA TELEVISION in the Philippines and Thailand has quickly followed the first TV installation in Asia in 1953. The first transmitter in Japan has now expanded to three . . . all completely RCA-equipped.

So the tremendous educational and cultural capacities of television are being introduced 'round the world . . . the most powerful means ever conceived for public enlightenment and international understanding.

Abroad, as in the U.S.A., RCA provides everything for television . . . from camera to antenna, from mobile remote units such as pictured here to complete studio and transmitter equipments. RCA also makes available the services of distributors and companies long versed in the electronic needs of their countries.

You can look with confidence to RCA for this complete co-ordinated service . . . manufacturing, installation facilities, instruction, servicing . . . *everything* that goes to make RCA TV such a dependable instrument of education and enjoyment throughout the world.

Your RCA distributor or company will gladly tell you about RCA TV; or write to RCA International Division.

RCA produces complete TV studio equipments, from microphones to monitoring consoles. This scene shows a broadcast from the RCA-equipped station DZAQ-TV, Manila.

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First in Television

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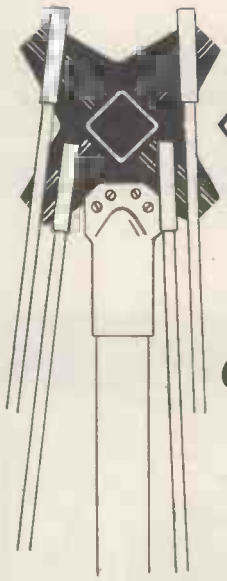
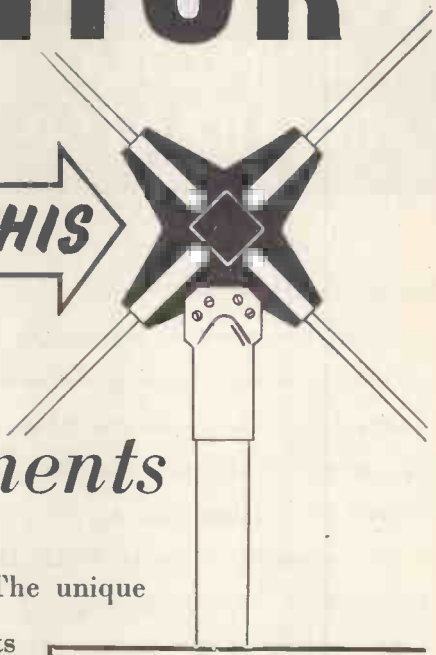
Before you can say

"SNAPACITOR"



THIS BECOMES **THIS**



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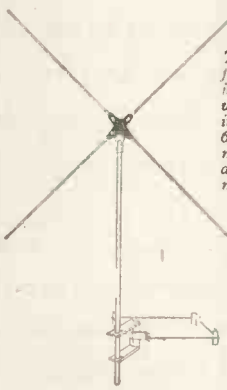
There's another vital point about Antiference capacitor couplings; there are no metal-to-metal connections. This eliminates inter-metal corrosion and guarantees life-long 100% electrical efficiency. There are no servicing headaches with Antiference.



The Antex aerial for vertical mounting. Model X4L with chimney lashing. Complete with 6ft. x 1in. dia. aluminium alloy mast and lashing equipment.

List Price 75/-

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10 to 300 Mc/s DIRECTLY CALIBRATED

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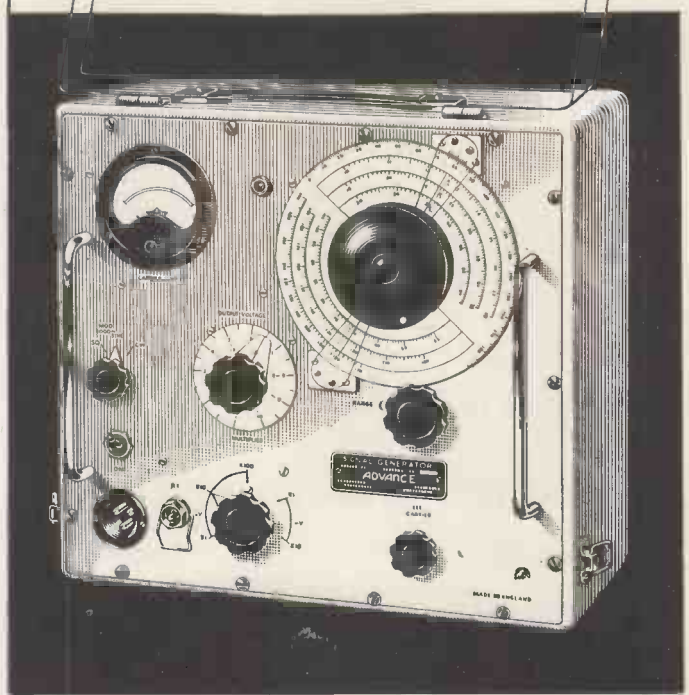
V.H.F. SIGNAL GENERATOR



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The Advance D1 Signal Generator has long been recognised as supreme in its sphere for accuracy, ease of operation and reliability. Now comes the D1/D—an up-to-the-minute successor—possessing all those proven qualities, but plus *the advantage of being DIRECTLY CALIBRATED. Whilst the range of the D1/D (10 to 300 Mc/s) is only slightly less than the original D1, its characteristics, given below, prove the " D " series to be the finest V.H.F. instruments available in their price class.*

- *Frequency range 10 to 300 Mc/s*
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- *Max. attenuation error at 300 Mc/s plus/minus 4 db*
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- *Light weight, only 34 lbs.*

Full technical details available in Leaflet W26

Net Price in U.K. **£97**

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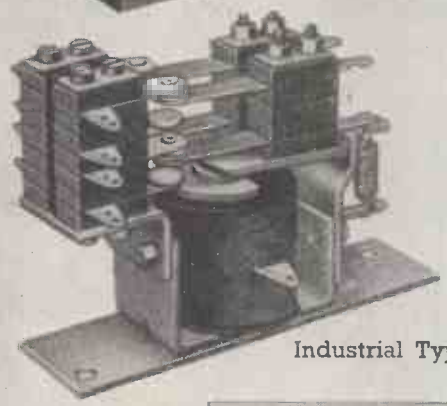
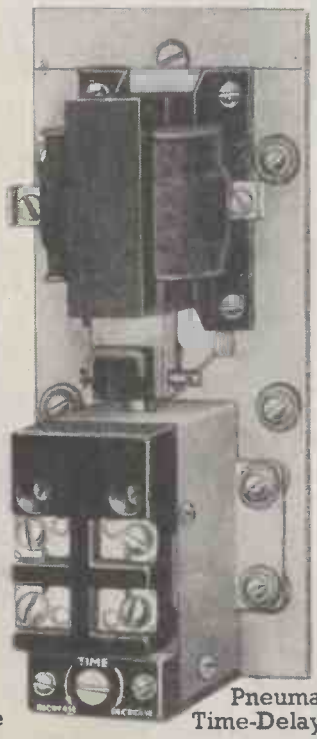
Instrument Type



Industrial Type

Miniature
Moving-Coil Type



Pneumatic
Time-Delay Type

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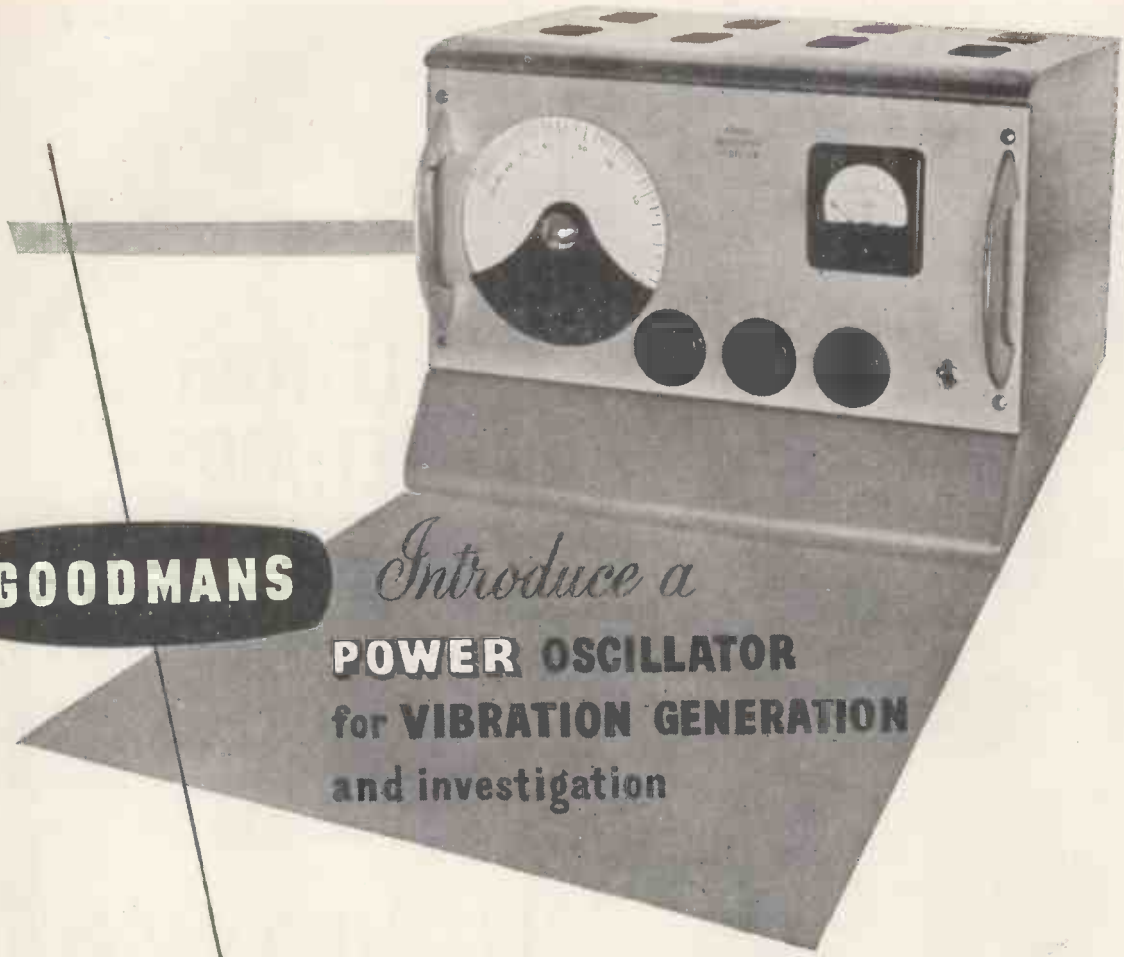


GOODMANS *Introduce a*

POWER OSCILLATOR for VIBRATION GENERATION and investigation

—provides a stabilised 10-10,000 c/s supply

A vibration generator depends for its accuracy largely upon the suitability of its driving equipment. Goodmans—who pioneered vibration generators in this country—have now produced a self-contained drive unit consisting of oscillator, amplifier and power pack. Although primarily intended for use with Goodmans Model V.47 Generator, it will also find wide application in the laboratory and in industrial processes where a high quality source of audio frequency is required. A brief specification of this latest Goodmans product is given below, and full circuitry details are available on request to " Vibration Dept. W".

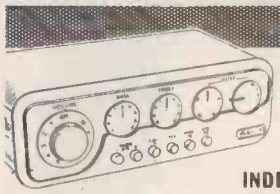
FOR USE WITH THE GOODMANS VIBRATION GENERATOR MODEL V.47
or where small scale vibration testing is involved.

Brief Specification

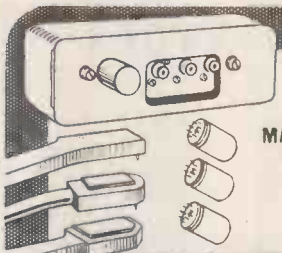
Frequency range—10-10,000 c/s. in 3 ranges.
Power output—5 watts into 3 ohms.
Output Level Stability—±0.05 db 10-10,000 c/s.
Distortion—less than 0.2%.
Hum level—72 db down on 5 watts.
Power supply—100/115 v, 200/225 v, 225/250 v 50-60 c/s. 75 watts.
Weight—45 lb.
Dimensions—16½in. × 13in. × 11in.

GOODMANS INDUSTRIES LTD., AXIOM WORKS, WEMBLEY, MIDDX. *Telephone: WEMbley 1200 (8 lines)*
GD

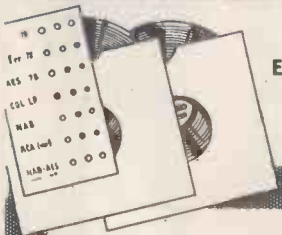
The best which present techniques can devise . . .



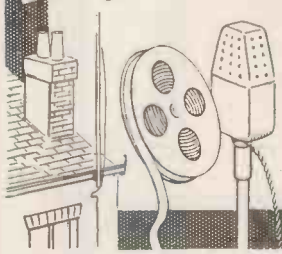
UNIQUE FILTERING SYSTEM INDEPENDENT OF MUSICAL BALANCE



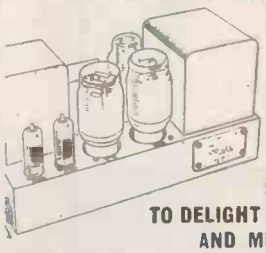
CORRECT MATCHING FOR ANY PICK-UP BY PLUG-IN UNITS



CORRECT EQUALISATION FOR EVERY RECORDING



INPUTS FOR RADIOS TAPE MIC. ETC. VIRTUALLY MADE TO MEASURE



A POWER AMPLIFIER WITH PERFORMANCE STABILITY SPECIFICATION TO DELIGHT THE ENGINEER AND MUSICIAN ALIKE

Like its predecessor, the QUAD II embodies outstanding features anticipating trends in both amplifier and associated equipment design. The importance of these features will be apparent to all who have followed the growth of high quality reproduction in recent years.

The criterion, as always, is that the reproduced sound shall be the closest approach to the original—that the enjoyment and appreciation of music may be unimpeded. This is reflected throughout the electrical and mechanical design. It is reflected, too, in the straightforward and logical system of control, achieved without the sacrifice of a single refinement or adjustment capable of contributing to the final objective.

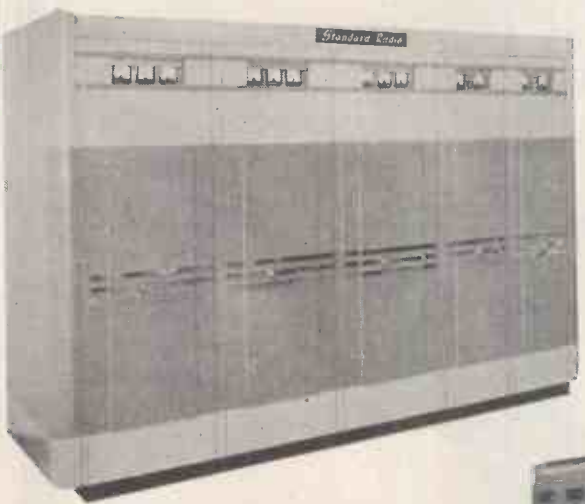
The QUAD II for convenience of installation, is constructed in two units—the main amplifier and the control unit. Each is complementary to the other, offering in complete form the best which present techniques can devise.

ACOUSTICAL MANUFACTURING CO LTD

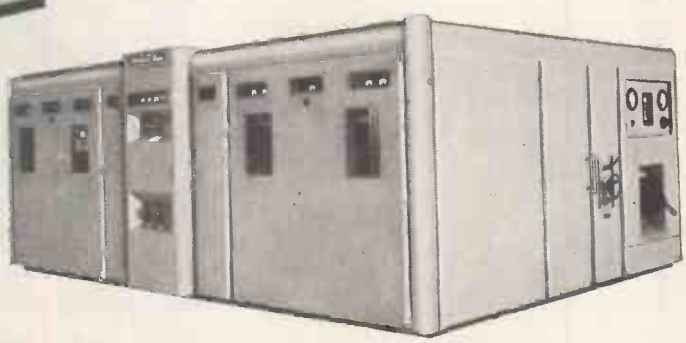
ACOUSTICAL MANUFACTURING CO. LTD., HUNTINGDON, ENGLAND

Standard in 6 Continents

The D.S. RADIO POINT-TO-POINT TRANSMITTER



Powerful 40 kilowatt D.S.13's were used to transmit Her Majesty the Queen's Speech direct from Auckland, New Zealand, to the United Kingdom on Christmas Day, 1953.



More than 180 of these transmitters are in use throughout the World

✻ **Available for early delivery**

D.S. series of transmitters

D.S.10	**3/5 kW**	*Double Sideband*
D.S.12	**4 kW**	*Independent or Single Sideband*
D.S.13	**40 kW**	*Independent or Single Sideband*

Write for Radio leaflets :

Type **D.S.10** No. 179/25
Type **D.S.12** No. 129/25
Type **D.S.13** No. 130/25

Standard Radio

Standard Telephones and Cables Limited

Registered Office ; Connaught House, 63 Aldwych, London, W.C.2.

RADIO DIVISION · OAKLEIGH ROAD · NEW SOUTHGATE . LONDON, N.11

ADVANCE COMPONENTS LTD., MARLOWE ROAD, WALTHAMSTOW, LONDON, E.17. Telephone: LARkswood 4366/7/8

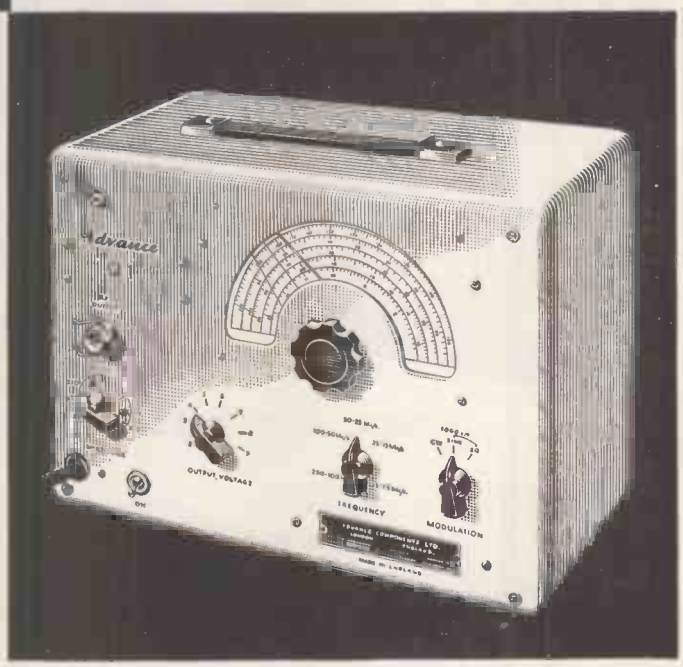
7·5 to 250 Mc/s
ON FUNDAMENTALS
IN FIVE RANGES
SINE AND SQUARE WAVE MODULATION
R.F. OUTPUT 1 μV to 100 mV

Advance

MODEL Q1

V.H.F. SIGNAL GENERATOR

£45
(List price in U.K.)



Again Advance lead the way—this time with a V.H.F. Signal Generator covering 7.5 to 250 Mc/s, a range that embraces Bands 1 and 2 *and also the impending Very High Frequency Television Transmissions on Band 3.* Moreover, this instrument is available at a price well within the reach of every service man. In the traditional Advance manner, this instrument is designed for simple operation and with a versatility that not only fulfils present needs, but anticipates the even more exacting requirements to deal with the television test problems of tomorrow.

Below are some outstanding features:-

- WIDE RANGE—7.5 to 250 Mc/s
- SINE AND SQUARE WAVE MODULATION
- RELIABLE ATTENUATION
- LOW LEAKAGE—*less than 3 microvolts*
- TRULY PORTABLE—*weighs only 17lbs*
- COMPETITIVE PRICE

The Q1 provides the ideal complement to the Model E2. These together give complete coverage from 100 kc/s to 250 Mc/s.

Full technical details available in Folder W23 on request.

ADVANCE COMPONENTS LTD. MARLOWE ROAD, WALTHAMSTOW, LONDON, E.17 Telephone: LARkswood 4366/7/8
GD

IT'S A QUESTION OF

SOME SUGGESTED EQUIPMENT COMBINATIONS

	£	s.	d.
Lowther Amplifier A.10F.	35	0	0
Lowther Master control unit	20	0	0
Lowther F.M. unit	22	0	0
Lowther DT.4 radio unit	37	6	3
Connoisseur motor	23	8	11
Lowther pick-ups with diamond styli	43	19	8
Pick-up transformer	1	17	6
Extra power pack	5	10	0
	£189	2	4

	£	s.	d.
Rogers Baby-de-Luxe amplifier and control unit	23	0	0
Rogers Radio Feeder unit 3 waveband	24	16	0
Garrard T/B unit with 2 Decca pick-ups	14	0	11
	£61	16	11

Goodsell amplifier and pre-amp. type M.A.5 can be substituted for the above if desired.

	£	s.	d.
Goodsell Williamson amplifier	33	10	0
Goodsell pre-amplifier	18	18	0
Goodsell F.M. unit	15	0	0
Connoisseur 3-speed motor	23	8	11
2 Leak pick-ups with diamond styli and transformer	21	19	9
	£112	16	8

	£	s.	d.
Leak T.L.10 and Leak Point One pre-amp.	28	7	0
Leak pick-up with 2 diamond styli and transformer	21	19	9
Collaro transcription motor	13	9	0
Goodsell F.M. unit	15	0	0
	£78	15	9

Loudspeakers and Cabinets to choice. Standard Radio Feeder units available, and special Export units with extra short wavebands if required.

CLASSIC

THE

STANDARDS . . .

It seems paradoxical to refer to variable standards. Yet even amongst Hi-Fi enthusiasts—whose critical perceptions none could question—there is no yardstick of performance. A "Standard" is that which wholly satisfies an individual requirement. And requirements are as diversified as the means to their attainment. To misquote—"Perfection lies in the ears of the listener."

We are well aware of this at Classic, and we devote our service to matching individual requirements, backing it with specialised advice.

When you come* to Classic you can be sure of getting the precise combination of equipment you need. Any combination of equipment can be supplied to specification and will be specially packed for export orders. **All equipment and cabinets are available on hire purchase or credit sale terms in Great Britain and Northern Ireland.**

* *and you get the same specialised attention if you write—wherever you may be. We can ship any equipment anywhere in the world.*

LOUDSPEAKERS HI-FI

	Cash Price	Credit Sale 9 equal P'mts of	Hire Purchase Deposit	Hire Purchase 12 P'mts of
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Vitavox Klipschorn	145 0 0	17 11 6	50 0 0	9 11 8
Lowther Type PM3	96 0 0	11 14 7	32 0 0	6 2 8
Acoustical Corner Ribbon ..	95 0 0	11 12 3	32 0 0	6 0 0
Wharfedale "Triune" ..	96 0 0	11 14 7	32 0 0	6 2 8
Wharfedale Corner 3 Unit ..	72 0 0	8 16 0	24 0 0	4 12 0
Tannoy 15in. dual concentric	33 10 0	4 2 0	11 10 0	2 19 0
Tannoy 12in. dual concentric	27 10 0	3 6 0	9 10 0	1 14 6
Lowther PW1 (walnut) ..	78 10 0	9 12 0	26 10 0	5 0 0
Goodmans Axiom 22 (in recommended reflex cabinet)	37 14 0	4 12 3	12 14 0	2 7 0
Goodmans 150 in Corner Baffle	22 17 0	2 16 0	7 17 0	1 8 9
Wharfedale Super 12/CS/AL in Classic Reflex cabinet ..	38 10 0	4 14 3	12 10 0	2 10 0
Wharfedale W/10 CSB Corner Baff. Assembly	24 16 0	3 4 0	8 16 0	1 10 8

COMPLETE WHARFEDALE AND GOODMANS AND W.B. RANGE NORMALLY STOCKED.

Bass reflex cabinet of contemporary design and heavy construction finished in straight grained or burr walnut veneer, or oak veneer, lined with Cellotex and fitted with a Wharfedale W12/CS/AL Loudspeaker. Dimensions 20in. × 21in. × 42in. high. .. £37 10 0

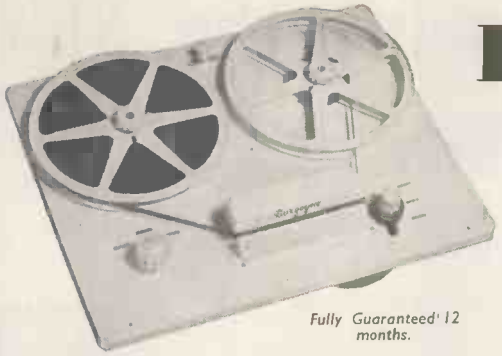
Radiogram Cabinet to match. Dimensions 20in. × 21in. × 36in. high £36 0 0

Equipment Cabinet to match for Tape Recorder or Record storage. Dimensions 20in. × 21in. × 36in. high. £27 0 0

ELECTRICAL CO LTD

'HI-FI' SPECIALISTS

352-364 LOWER ADDISCOMBE ROAD · CROYDON · SURREY TEL. ADDISCOMBE 6061-2



Fully Guaranteed 12 months.

Burgoyne

TWO SPEED TAPE DECK

3¾in./sec. and 7½in./sec.

£13·19·6

Carr. & Packing 7/6.

Here is the heart of your Tape Recorder! If you are building or modernising your own equipment—you MUST have the latest BURGOYNE Tape Deck giving 2 speeds, designed for building into complete recorders. Greatest value ever offered.

TECHNICAL DATA

- 2 HOURS' PLAYING TIME
- 2 SPEEDS: 3¾in. and 7½in./sec.
- Fully automatic mechanical speed change (no tinkering with pulleys and belts).
- Instantaneous and positive braking.
- Precision engineered giving minimum wow and flutter.
- Frequency range 50/10,000 c/s. at 7½in./sec. with suitable amplifier.
- Overall size 11¼in. × 14¼in.
- For use on A.C. Mains 200/250 v.
- Powered by 3 high grade motors.
- Fast forward run and high speed rewind *without unlacing tape.*
- Automatic high frequency erasure.
- Twin track high impedance heads totally enclosed in cover affording complete protection from stray magnetic and electrostatic fiesdl. No matching transformers required.
- Deck will take all standard plastic and paper tapes up to 1,200ft. capacity.
- Washable top panel of very durable finish.

ACCESSORIES

1200 ft. Spool Burgoyne Tape (high coercivity) 35/-
600 ft. Spool Burgoyne Tape (high coercivity) 21/-
Take-up Spool 4/3

M.O.S. PERSONAL CREDIT PLAN
SEND ONLY 10% DEPOSIT
with balance spread over any period up to 24 months.

Made exclusively for MAIL ORDER SUPPLY and unobtainable elsewhere

This is the EASY way to BUY!

SEND ONLY £1 TO SECURE ANY EQUIPMENT

The M.O.S. PERSONAL CREDIT PLAN gives you a variety of methods of purchase. Here is a further selection of equipment:—

ITEM	CASH PRICE	CREDIT SALE £1 dep. 8 inst.	HIRE PURCHASE Deposit	12 inst.	18 inst. (Instalments are monthly)
AMPLIFIERS AND TUNERS					
Goodsell	£ s. d.	£ s. d.	£ s. d.	s. d.	s. d.
GW18 Williamson	£33 5 0	90/-	£11 1 8	42/5	28/6
GW12 Williamson	£27 10 0	74/-	£9 3 4	35/-	24/-
MA5	£13 10 0	36/-	£4 10 0	18/4	12/6
F/TC Tone Control	£10 10 0	28/6	£3 10 0	15/-	10/4
F/U/TC Tone Control	£14 14 0	38/6	£4 18 0	20/-	13/8
PFA Tone Control	£18 18 0	50/-	£6 6 0	24/6	16/8
Lowther AM/FM Tuner	£22 0 0	58/6	£7 6 8	28/-	18/11
Leak					
TL10 Amp. & Pre-amp.	£28 7 0	76/-	£9 9 0	36/2	24/6
Tuner Unit	£35 0 0	94/-	£11 13 4	46/6	31/6
Quad Mk. II Amplifier	£42 0 0	114/-	£14 0 0	53/4	36/-
Rogers					
Senior Main Amplifier	£28 0 0	75/-	£9 6 8	35/-	23/7
Senior Control Unit	£15 0 0	39/6	£5 0 0	20/-	13/6
Mark II Baby de Luxe Amp.	£14 0 0	37/6	£4 13 4	19/-	12/10
Mark II Junior Pre-Amp.	£9 0 0	25/-	£3 0 0	13/4	9/-
Mark II Minor Amplifier	£12 17 6	34/6	£4 5 10	17/7	12/-
RD Minor Baffle	£3 15 0	24/6	£2 18 4	13/-	8/9
RD Junior Corner Horn	£18 17 6	50/-	£6 6 0	24/6	16/8
Junior Tuner Unit	£25 6 1	66/6	£8 9 0	31/6	21/6
Burkoyne					
RG1 8-valve Superhet	£23 2 0	63/9	£7 14 0	29/-	19/6
RF1 TRF Tuner	£3 12 6	11/3	£1 4 2	6/4	4/6
LOUDSPEAKERS					
Goodmans					
Axiom 150	£10 5 6	28/3	£3 8 6	14/9	10/-
Axiom 102	£9 18 2	27/-	£3 6 0	14/4	9/9
Axiom 101	£6 12 1	18/9	£2 4 0	10/7	7/6
Axiom 22	£14 14 0	38/6	£4 18 0	20/-	13/8
Tannoy					
15in. Dual Concentric	£33 10 0	90/-	£11 3 4	42/5	28/6
12in. Dual Concentric	£27 10 0	73/6	£9 3 4	36/-	25/-
Wharfedale					
W12C8	£9 15 0	26/9	£3 5 0	14/2	9/8
W10C8B	£12 6 6	33/6	£4 2 6	16/11	12/-
Super 8 C8AL	£6 13 3	18/9	£2 4 5	10/9	7/9
Golden 10	£7 13 3	21/6	£2 11 1	11/10	8/3
Bronze 10	£4 12 8	14/-	£1 10 11	8/2	5/9
W.B.					
HF 610	£2 10 6	8/6	16 10	6/-	4/2
HF 810	£3 0 6	9/8	£1 0 2	6/6	4/6
HF 912	£3 7 0	10/8	£1 2 4	6/11	4/10
HF 1012	£3 13 6	11/6	£1 4 6	7/3	5/2
Lowther PM2	£35 0 0	94/-	£11 13 4	46/6	31/6

ITEM	CASH PRICE	CREDIT SALE £1 dep. 8 inst.	HIRE PURCHASE Deposit	12 inst.	18 inst. (Instalments are monthly)
PICK-UPS	£ s. d.	s. d.	£ s. d.	s. d.	s. d.
Connoisseur, with 2 Heads	£9 5 6	25/6	£3 1 10	13/4	9/3
Decca XMS, with 2 Heads	£6 9 3	18/-	£2 3 1	10/-	7/-
Cosmocord HOP39/GP20 Arm	£3 8 4	—	£1 2 9	7/-	4/11
Leak Ruby 78 r.p.m. or LP	£11 11	31/-	£3 17 0	15/10	11/-
Ronette Miniweight, with 2 Heads	£3 9 6	—	£1 3 2	7/-	4/11
Ronette Superweight, with 2 Heads	£3 16 3	—	£1 5 5	7/4	5/3
PLAYERS					
Regentone RP2 3-speed	£9 19 6	27/-	£3 6 6	14/6	10/-
Regentone HG2 3-speed Amplifier	£15 15 0	41/6	£5 5 0	20/10	14/3
Regentone AHG2 3-speed Auto Amp.	£21 0 0	55/-	£7 0 0	26/8	18/2
Plus-A-Gram Junior	£9 9 0	26/-	£3 3 0	14/-	9/6
Trixette A.375 3-speed Auto Amp.	£37 16 0	101/-	£12 12 0	48/4	32/8
E.A.R. Auto 3-speed Amplifier	£24 17 6	66/-	£8 5 10	31/6	21/6
E.A.R. Non-Auto 3-speed Amp.	£19 15 0	52/-	£6 11 8	25/4	17/4
Volmar L425 3-speed Auto Amp.	£24 13 6	65/6	£8 4 6	31/6	21/5
TEST EQUIPMENT					
Advance					
P1 Generator	£19 19 0	52/6	£6 13 0	25/6	17/9
J1 Generator	£35 12 0	95/-	£11 17 4	45/6	31/6
E2 Generator	£28 0 0	75/3	£9 6 8	36/6	24/3
H1 Generator	£25 0 0	66/3	£8 6 8	32/-	23/-
Avo					
Model 9 Meter	£23 10 0	64/9	£7 16 8	30/4	21/3
Model 7 Meter	£19 10 0	51/6	£6 10 0	26/-	18/4
Universal Avominor	£10 10 0	29/-	£3 10 0	14/6	10/6
Electronic Test Meter	£40 0 0	107/6	£13 6 8	51/-	35/-
Signal Generator	£30 0 0	80/6	£10 0 0	39/-	27/-
D.C. Avominor	£5 5 0	15/-	£1 15 0	9/2	6/6
Universal Bridge	£34 0 0	91/-	£11 6 8	43/-	29/6
Amplion Test Meter	£5 19 6	17/-	£2 0 0	9/3	6/8
Cossor					
Oscilloscope 1039	£29 10 0	79/6	£9 16 8	37/3	25/9
Oscilloscope 1052	£104 0 0	283/-	£34 13 4	132/10	90/-
Voltage Calibrator 1433	£18 5 0	49/-	£6 1 8	24/-	16/4
Denco Modulated Test Oscillator	£3 15 0	—	£1 5 0	7/6	5/3
Pullin Series 100 Test Meter	£11 11 0	31/-	£2 0 0	19/6	13/6
Taylor					
44A Meter	£2 10 0	—	16 8	5/-	3/9
77A Universal Meter	£15 0 0	39/6	£5 0 0	20/-	13/9
88A Universal Meter	£22 0 0	57/9	£7 6 8	28/-	19/3
110C Bridge	£14 10 0	38/-	£4 16 8	19/5	13/4
150A Output Meter	£33 10 0	90/-	£11 3 4	42/4	29/-

If you do not see your requirements here, write to us. If it is available on the market—we can supply. Add sufficient for carriage and packing to your initial deposit since the above prices are ex-warehouse.

M·O·S SUPPLY COMPANY

33 Tottenham Court Rd., London, W.1 *Telephone : MUSeum 6667*

Prov. Patent 10037/53

the famous range of

Stentorian

HI-FI

CAMBRIC CONE UNITS

now includes nine models

MODEL HF510. 5″ unit, incorporating 10,000 gauss magnet. Handling capacity, 2 watts. Frequency response, 100-7,000 c.p.s. Bass resonance, 160 c.p.s. Steel chassis **£1.17.6**
Die cast chassis **£1.19.6** *(Tax Paid)*

MODEL HF610. 6″ unit, incorporating 10,000 gauss magnet. Handling capacity, 3 watts. Frequency response, 60-12,000 c.p.s. Bass resonance, 70 c.p.s. Steel chassis **£2.10.6**
Die cast chassis **£2.12.6** *(Tax Paid)*

MODEL HF810. 8″ unit, incorporating 10,000 gauss magnet. Handling capacity, 5 watts. Frequency response, 50-12,000 c.p.s. Bass resonance, 65 c.p.s. Steel chassis **£3.0.6**
(Tax Paid)

MODEL HF812. Die cast chassis (12,000 Gauss) **£3.5.6**
(Tax Paid)

MODEL HF912. 9″ unit, incorporating 12,000 gauss magnet. Handling capacity, 7 watts. Frequency response, 40-13,000 c.p.s. Bass resonance, 45 c.p.s. Die cast chassis **£3.9.6**
(Tax Paid)

MODEL HF1012. 10″ unit, incorporating 12,000 gauss magnet. Handling capacity, 10 watts. Frequency response, 30-14,000 c.p.s. Bass resonance, 35 c.p.s. Die cast chassis **£3.17.6**
(Tax Paid)

MODEL HF1214. 12″ unit, incorporating 14,000 gauss magnet. Handling capacity, 15 watts. Frequency response, 25-14,000 c.p.s. Bass resonance, 39 c.p.s. Die cast chassis **£9.15.6**
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3 or 15 ohms impedance
Transformer available if required.

OUR High Fidelity units — incorporating the patented Cambric Cone—created a world-wide demand in a matter of months. This phenomenal success has caused us to reorganise our manufacturing programme for this remarkable range, and we can now offer a choice of nine models, up to 12 inches in diameter, each providing outstanding performance in relation to price.

We would draw special attention to the new 12-inch model, which sets a new high standard in faithfulness of reproduction, comparable to many far more expensive units.

Write for details of the new ready-to-assemble Bass Reflex Console Cabinet, or dimensional drawings of recommended cabinet, and leaflets giving full technical details of High Fidelity Units, or ask your dealer to demonstrate. Alternatively, these speakers may be heard at our London Office, 109 Kingsway, W.C.2, any Saturday between 9 and 12 noon.

SEE AND HEAR THEM AT STAND 105
RADIO SHOW

WHITELEY ELECTRICAL RADIO CO. LTD
MANSFIELD · NOTTS

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	¼ watt	¼ watt	250	10 ohms to 10 megohms	⅜" x 1/32"
R	½ watt	1 watt	500		¼" 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

Built by Craftsmen . . . . . Assembly of Scalamp Galvanometers Cat. Nos. W.W. 7901/S-4/S

The

SCALAMP

Range

You are invited to write for details of the instruments illustrated here.

The *Galvanometers* and *Electrostatic Voltmeters* are available in a range of sensitivities—the *Fluxmeter* has a very high performance and a unique return-to-zero device. Outstanding SCALAMP attributes include a truly functional dustproof case, mains or battery operation, and an easy-to-read hairline spot.

Fluxmeter Cat. No. W.W. 8834

Electrostatic Voltmeter
Cat. Nos. W.W. 11308-11310

STANDARD EQUIPMENT IN MANY LEADING LABORATORIES

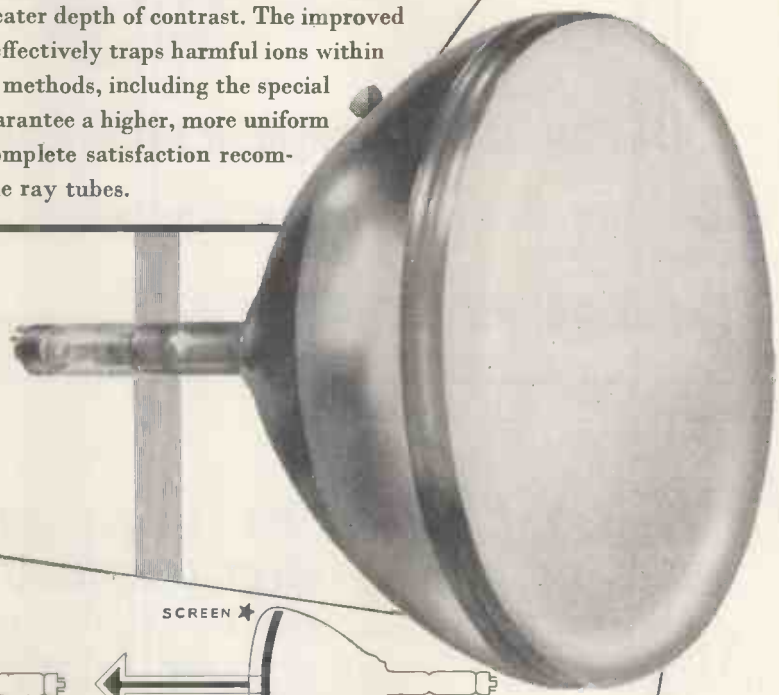
SCIENTIFIC PYE INSTRUMENTS

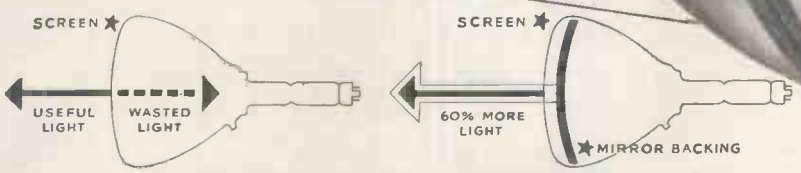
W. G. PYE & CO. LTD. GRANTA WORKS · CAMBRIDGE · ENGLAND

WG.54

Clearly—you get better pictures with this ALUMINIZED cathode ray tube

You cannot beat the new Ediswan Mazda Aluminized Cathode Ray Tubes for picture quality or length of life. Ediswan Aluminizing gives 60% brighter pictures with greater depth of contrast. The improved ion trap tetrode electron gun effectively traps harmful ions within the tube. Ediswan production methods, including the special in-line exhausting process, guarantee a higher, more uniform standard of efficiency. For complete satisfaction recommend Ediswan Mazda cathode ray tubes.





Without Aluminizing

Without Aluminizing, tubes waste half their light by backward reflection. To counteract this the brilliance must be increased which shortens tube life.

With Ediswan Aluminizing

Ediswan aluminized tubes have a mirror backing to the screen. All the light is thus thrown forward giving brighter, clearer pictures, and extra life.

Quicker Service

Ediswan are the only company to have 6 fully equipped cathode ray tube service Depots throughout Great Britain, thus providing better, quicker tube testing should the need arise. Also, 18 Ediswan District Offices carry stocks of tubes.

EDISWAN

MAZDA ALUMINIZED CATHODE RAY TUBES

THE EDISON SWAN ELECTRIC COMPANY LIMITED

155 Charing Cross Road, London, W.C.2, and branches

Member of the A.E.I. Group of Companies

OSMOR radio products ltd.

(Dept. W.57) 418 BRIGHTON RD, SOUTH CROYDON, SURREY. *Telephone Croydon 5148/9*

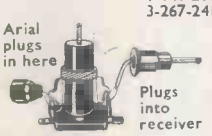
These really powerful units in compact form give quality and performance right out of proportion to their midget size and modest cost. Osmor' 'Q" Coilpacks have everything that only the highest degree of technical skill can ensure—**extra selectivity, super sensitivity, adaptability.** Size only 1⅞ x 3½ x 2¼ with variable iron-dust cores and Polystyrene formers. Built-in trimmers. Tropicalised. **Prealigned.** Receiver-tested and guaranteed. Only 5 connections to make. All types for Mains and Battery superhets. and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver, TR.1196, Type 18, Wartime Utility and others. Send to-day for particulars!

SEPARATE COILS 4/-

A full range is available for all popular wavebands and purposes. Fully descriptive leaflets and connection data available. (Optional) new simple fixing 2d. extra. Just note these "5 Star" Features. * Only 1in. high. * Packed in damp-proof containers. * Variable iron-dust cores. * Fitted tags for easy connection. * Low loss Polystyrene formers. L. or M.W. T.R.F. REACTION COIL TYPE QR 11-12 4/9.
A range of coils for F.M. Receivers shortly available.
A special design of coils now available for reflex circuits.

OSMOR STATION SEPARATOR

The Separator may easily be tuned to eliminate any one station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.



TYPE	METRES
1-141-250	
3-267-241	
2-218-283	
4-319-405	
5-395-492	
6-455-567	
7-1450-1550	
8-410-550	k/c.

7'6 COMPLETE

CHASSIS CUTTER

Type	Hole Sizes
	1in. x 1¼in.
2	⅞in. x 1⅛in.
3	⅞in. x 1⅛in.
4	1⅜in. x 2in.

Illust., price list on request.

I.F.s. 465 k/c. Permeability-tuned with flying leads. Standard size 1⅜in. x 1⅜in. x 3½in. For use with OSMOR coilpacks and others, 14/6 pair. Midget I.F.s. 465 k/c. ⅞in. x ⅞in. x 2⅜in., 21/- pair. PREALIGNED, 1/6 extra, both types.

FREE! Send 5d. (stamps) for fully descriptive literature including "The really efficient 5-valve Superhet Circuit and practical Drawings," 6-valve ditto, 3-valve (plus rectifier) T.R.F. circuit, Battery portable superhet circuit, Coil and Coilpack leaflets, Chassis Cutter leaflet, and full radio and component lists, and interesting miniature circuits, etc.

DIALS—VARIOUS DIALS CALIBRATED TO COILS
Metal dials, overall size 5¾in. square. Cream background, 3-colour Type M1, L.M.S. waves. M2, L. & M. waves. M3, M. and 2 S. waves. Price 3/6 each.
Pointer 1/6; Drum, Drive, Spring and Cord, 3/2.
Type A glass dial assembly, measuring 7in. x 7in. (9½ x 9½ overall). Mounts in any position. Choice of two 3-colour scales, 24/6. P. & P. 1/6.

OUR TECHNICAL DEPT. WILL BE PLEASED TO ANSWER (BY LETTER ONLY) ANY ENQUIRY RELATING TO CIRCUITS IN WHICH OSMOR COILS OR COIL PACKS ARE USED OR ARE INTENDED TO BE USED.

WE ENDEAVOUR TO KEEP ABREAST OF THE TIMES BY BUILDING THE VARIOUS CIRCUITS PUBLISHED IN "WIRELESS WORLD," "PRACTICAL WIRELESS," "RADIO CONSTRUCTOR" ETC. WE KEEP STOCKS OF THE COMPONENTS SPECIFIED.

"PRACTICAL WIRELESS"

Coronet Four; Beginners' Superhet; Modern High Power Amplifier 2; Attache Case Portable; R1155 Converter; A.C. Band-Pass 3; Modern 1-Valver; 3-speed Autogram, modern reflex, etc.

"WIRELESS WORLD"

"No Compromise" TRF Tuner. "Midget Mains Receiver." Sensitive 2-valve Receiver. Television Converter (special coils in cans available), Midget sensitive T.R.F., etc.

"RADIO CONSTRUCTOR"

Converting the TR1196 receiver to a general purpose s'het receiver simple crystal diode set. Radio feeder units. Economy 8 W.P.P. Amplifier. Circuit and details available for adding push-pull to the 5/6 valve Osmor superhet.

A LIST OF FIXED CAPACITIES AS REQUIRED FOR SWITCH TUNING AVAILABLE ON APPLICATION.

Single variable condensers	9/-
2 Gang variable condensers	12/6
3 Gang variable condensers	17/6
Reaction variable condensers	3/10

Smoothing choke 7 om A	6/6
Output Trans. for 6v6/25A6	7/6
Fil. trans., 6.3 v. 5 v. output	8/6 & 15/6

Mains Trans. 250-0-250	29/6
350-0-350	35/-
Push-pull Trans. heavy duty	40/-
Chassis for various circuits from	5/-

Potentiometers less swit.	4/-
Potentiometers with swit.	6/6
Switches 4 P. 3 way	3/6
Switches 4 P. 2 way	3/6
Trimmers	
Single bank	10d.
Two bank	2/4
Three bank	3/6

Capacitors to .1 mFd., 10d. 25uF x 25 v., 3/6, 50 x 25, 3/6, 50uF x 50 v., 3/6, 500/12 v., 3/6, 8 x 16 mfd., 5/-. 32/32, 5/3.

ALL ¼w RESISTORS 6d. each (On marked cards)

SPECIAL REDUCTION in sets for **PUBLISHED CIRCUITS**

SPECIAL COILS for SPECIAL CIRCUITS

(Such as Midget Sensitive T.R.F. W.W.) A modern reflex receiver P.W.

DESIGNERS ARE ASSURED OF FULL CO-OPERATION

PLEASE LET US KNOW YOUR REQUIREMENTS

NEWCOMERS TO RADIO. WE HAVE A NEW DEPARTMENT READY AND WILLING TO HELP

SEND US YOUR PROBLEMS

SOONER OR LATER YOU WILL GO F.M. — WHY NOT NOW?

LOWTHER F.M. TUNER UNIT. Variable tuning from 85-100 Mc/s. Complete with Magic Eye tuning indicator for F.M. or A.M. reception. Consumption: 35 mA. 250-450 v.; 6.3 v 2 a. PRICE: £22.

SOUND SALES F.M. TUNER UNIT Variable tuning from 86-100 Mc/s for F.M. or A.M. reception. Consumption: 30-40 mA. 200-250 v; 6.3 v. 1.5 a. PRICE (complete with experimental aerial), £15/10/-.

AMOS AND JOHNSTONE F.M. FEEDER UNITS All parts in stock, together with 10.7 Mc/s I.F. and Discriminator Transformers.

The NEW LEAK DYNAMIC PICK-UP with plug-in heads fitted with Diamond Stylii Impedance 6 ohms at 1 Kc/s Input with transformer approx. 40 mV at 1 Kc. Tracking weights 2-3 gr. for L.P.; 5-6 gr. for 78. Response —40 c/s.-20 Kc/s. ± 1 db. with L.P. heads incl. transformer. L.F. resonance 20 c/s. ± 5 c/s H.F. resonance 21 Kc/s. ± 2 Kc/s. on L.P. above 27 Kc/s. on standard. PRICE: Head and arm (L.P. or Standard), £11.9/6. Head only. £7/15/3. Transformer, 35/-.

The NEW ACOS MIC 36 CRYSTAL MICROPHONE. Response substantially flat from 30-7,000 c/s PRICE (with table stand or floor stand adaptor without switch). £3/3/- (Switch 5/- extra.)

GRAMOPHONE UNITS

"COLLARO" 3-sp. Studio TRANSCRIPTION DESK. Heavy duty non-ferrous balanced turntable. 100% dynamically balanced rotor assembly Off position between each speed change Rumble, wow and flutter free PRICE, less pick-up and arm, £13/19/6. (With Studio Pick-up £4/15/3 extra.)

COLLARO.
3/544 3-sp. with Studio Pick-up, £10/6/1
3/RC/531, do., auto., £15/3/10.

GARRARD.
TA/AC or TB 3-sp. (less heads), £8/10/11.
TA/AC T/O Crys. head. £2/5/1. T/O Mag. head, £2/8/-.
HGP 35/1 Std. or L.P. (for TA/AC) each. £2/2/11.
DECCA XMS (for TB), £2/14/8.

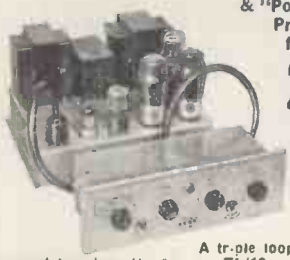
CONNOISSEUR.
3-sp. Transcription Desk, £23/8/11.
Pick-up with one head (extra heads 66/3). £5/19/3.

THE NEW "LEAK"

TL/10 Amplifier & "Point-One" Pre-Amplifier AT

27 gns.

Complete or 9 gns. down and 12 monthly payments of 34/8.



A triple loop feedback circuit based on the famous 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 watt output
- **Feedback magnitude:** 26 db main loop
- **Damping factor:** 25.
- **Hum:** —80 db referred to 10 watts.
- **Variable Treble and Bass Tone controls**

The pre-amplifier will operate from any pick-up generally available in the world.

The NEW GRUNDIG TK819 2-SPEED TAPE RECORDER. Response: 50 c/s-14 Kc/s. at 7½" per sec.; 50 c/s-9 Kc/s. at 3¾" per sec. Playing time: 2 x 30 mins at 7½" per sec.; 2 x 60 mins. at 3¾" per sec. Track changeover in less than 1 sec. at 3¾" and less than 3 sec at 7½" per sec. Automatic stop at end of spool. Built-in precision clock place indicator PRICE: 95 Gns. Ribbon Microphone, GRMI, 12 Gns. M.C. Microphone, GDM5, 6 Gns.
ALSO **GRUNDIG TK9 TAPE RECORDER.** As above but 3¾" per second only and playing time 2 x 45 minutes. PRICE: 65 Gns. Microphones: GDM5 Movg. coil, 6 Gns.: or GXM1 Crystal, 4½ Gns.
Accessories for both instruments:
Remote foot control (for back spacing), 7 Gns.
Stethoscope headphones, 3 Gns.
Telephone attachment, 3 Gns.

"POLYMAX" UNBREAKABLE INSULATORS

Stand offs: ½", 6d.; 1", 9d.; 1½", 1/-.
Beehives, 2/-.
Feed-throughs, 1/3

THE "WILLIAMSON" AMPLIFIER

This is a world-wide known HIGH QUALITY AMPLIFIER, **BUT** high quality can **ONLY** be obtained if precision quality products as specified by the designer, are used.
WE can supply ALL COMPONENTS, including precision condensers and resistors, potted transformers and chokes. EXACTLY AS SPECIFIED, not substitutes.

"Q-MAX" CHASSIS CUTTERS

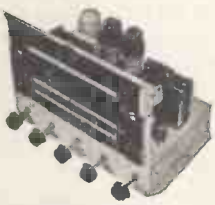
STILL the easiest and quickest way of cutting holes in **SHEET METAL.**

	each
⅜" or ½"	11/6
⅝"	12/6
1", 1⅛" or 1¼"	14/9
1⅜" or 1½"	16/6
1¾"	18/6
2⅛"	30/-
2½"	35/-
1" square	23/-

Keys, small 10d.; medium 1/3; large, 1/9

Patent No. 619178

8-VALVE ARMSTRONG SUPERHET



8 watts push-pull output. Negative feedback, Bass and Treble controls Short, medium and long wavebands

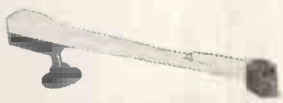
£23/13/-.

Or £8 down and 12 monthly payments of 28/9.

Also 10 valve Superhet Chassis (Model RF41) **£31 19 8**
EXP 119 10 v. 6 bandspread, plus M and 2 S..... **£55 19 4**

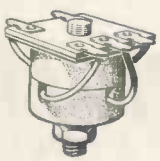
"Q-MAX" MODEL G.D.O.I.A GRID DIP OSCILLATOR

is an ideal instrument for the determination of tuned circuit resonant frequency, tuning transmitters without application of power, for the determination of coil mutual and stray inductances and both fixed and stray capacitances. Covers 1.5 to 300 Mc/s in eight ranges. PRICE: 12 Gns. Complete. Or 4 Gns. Dep. and 12 monthly payments of 15/5.



"ACOS" HIG PICK-UP.
Interchangeable clip-on heads for Std. or L.P. Response flat from 40 to 13,000 cps
GP20/HiG. Arm only, **26/5.**
HGP39/1 Std. or L.P. head, 42/-.
HGP35/1. 3-pin plug-in head, 42/11

"LINCOLN" OSCILLATOR COIL



Completely enclosed in "Neosid" former ensuring minimum external field. Unusually good waveform with maximum amplitude at 45 Kc/s. Lettered tag panel connections and one-hole fixing.

Overall size, 1¼in. x 1¼in. x 1in. PRICE 12/6. (Post 6d.)
Complete Oscillator unit with valve, 50/-.

W.B. STENTORIAN HIGH FIDELITY UNITS

Developed to provide reproduction of high fidelity recordings—speech coil impedance 3 or 15 ohms.

H.F.1012—10in. die cast unit; 12,000 gauss magnet; 10 watts; 30-14,000 cps., **73/6.**

H.F.810—8in. steel unit; 10,000 gauss; 5 watts; 50-12,000 cps., **60/6.**

H.F.610—6in. steel unit; 10,000 gauss; 3 watts; 60-12,000 cps., **50/6.**

Illustrated Catalogue 6d. post free.

H.P TERMS AVAILABLE ON PURCHASES OVER £10.

BERRY'S (SHORT WAVE) LTD.

25 HIGH HOLBORN, LONDON, W.C.1

TEL HOLBORN 6231

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 auxillary 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

PRICE REDUCTION

12E1 BEAM TETRODE

NOW £2 *LIST*

Increased demand for the Ediswan Mazda 12E1 Beam Tetrode has enabled us to step up production and thereby offer a reduced list price.

The 12E1 has the unusually high maximum cathode current rating of 300mA with a screen voltage of 150V. Mutual conductance is 14mA/Volt. It is, therefore, very suitable as a series or shunt valve in stabilised power packs. It also finds application in electronic control and other circuits.

RATING		
Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	1.6
Maximum Anode Voltage (volts)	$V_{a(max)}$	800
Maximum Screen Voltage (volts)	$V_{g2(max)}$	300
Maximum Control Grid Voltage	$V_{g1\ (max)}$	100
Maximum Voltage between g1 and g2 (volts)	V_{g1-g2}	400
Mutual Conductance (mA/V)	S_m *	14
Inner μ	$\mu_{g1,g2}$ *	5.3
Maximum Anode Dissipation (watts)	P_a	35
Maximum Screen Dissipation (watts)	P_{g2}	5.0
Maximum Cathode Current (mA)	$I_{k(max)}$	300
Maximum Potential Heater/Cathode (volts DC)	$V_{h-k(max)}$ †	300

* Taken at Va = Vg2 = 150v Ia = 200 mA.

† Provided the cathode is positive

All maximum ratings are Absolute values not Design Centres.

Reduced prices also for

19H4 to **£5 . 0 . 0**

19H5 to **£8 . 0 . 0**

Full technical information available on request

EDISWAN

MAZDA

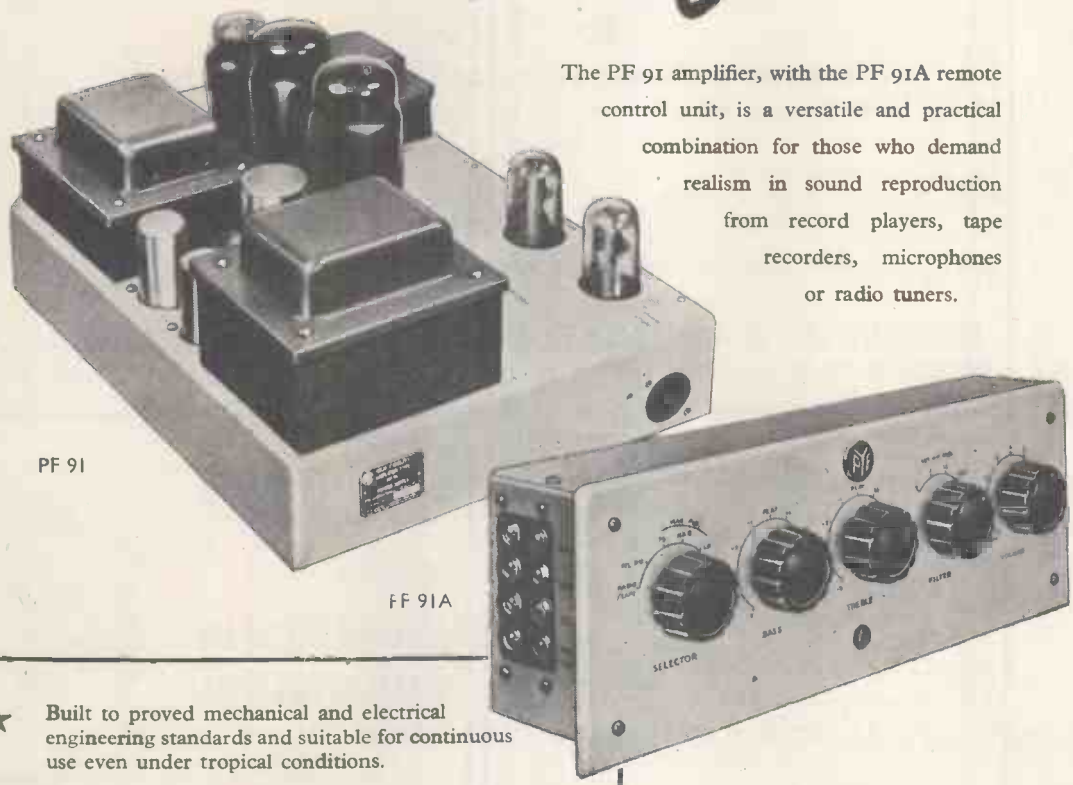
RADIO DIVISION · THE EDISON SWAN ELECTRIC COMPANY LIMITED

155 Charing Cross Road, London, W.C.2. *Telephone:* Gerrard 8660. *Telegrams:* Ediswan, Westcent, London

Member of the A.E.I. Group of Companies

SV2

Hi Fi
HIGH FIDELITY
amplifier



The PF 91 amplifier, with the PF 91A remote control unit, is a versatile and practical combination for those who demand realism in sound reproduction from record players, tape recorders, microphones or radio tuners.

- ★ Built to proved mechanical and electrical engineering standards and suitable for continuous use even under tropical conditions.
- ★ Frequency range substantially flat over entire audible range of 20-20,000 cycles per second, up to 12 watts output.
- ★ Excellent oscillatory transient response because of balanced response characteristic from 2 cycles per second to 160,000 cycles per second.
- ★ Low noise level.
- ★ High damping factor.
- ★ Very low harmonic and intermodulation distortion.

MODEL PF91
28 GNS
MODEL PF91A
12 GNS

4ft. extension cable available free of charge

PYE LIMITED OF CAMBRIDGE

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. **£3/19/6.** Plus 5/- pkg., carr., ins.

ALL BRAND NEW

★ QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 26/-
Plus 1/6 Pkg. and Carr.

CABINETS—PORTABLE

Model PC/1
Brown Rexine covered 22/6
Overall dimensions 15in. × 13½in. × 5 in.
Clearance under lid when closed 2½in.

Model PC/2
Grey Lizard Rexine covered 45/-
Overall dimensions 15in. × 13in. × 6in.
Clearance under lid when closed 2½in.

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.

PREMIER MAINS TRANSFORMERS

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened.

SP175B, 175-0-175, 50 mA., 4 v. @ 1 a., 4 v. @ 2-3 a. 15/-
SP350A, 250-0-250, 100 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a. 21/-
SP352, 350-0-350, 150 mA., 5 v. 2-3 a., 6.3 v. 2-3 a., 6.3 v. 2-3 a. 30/-
SP501, 500-0-500, 150 mA., 4 v. @ 2-3 a., 4 v. @ 2-3 a., 4 v. @ 2-2 a., 4 v. @ 3-5 a. 37/-
SP501A, 500-0-500, 150 mA., 5 v. @ 2-3 a., 6.3 v. @ 2-3 a., 6.3 v. @ 2-3 a. 40/-
SP425A, 425-0-425, 200 mA., 6.3 v. @ 2-3 a., 6.3 v. @ 3-5 a., 5 v. @ 2-5 a. 52/6
250-0-250, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a. 19/6
350-0-350, 80 mA., 6.3 v. @ 4 a., 5 v. @ 2 a. 19/6
200-230-250 output 3 v.-30 v. @ 2 a. 17/6

RECTIFIERS

	E.H.T. Pencil Type S.T.C.		
Type K3/25	650 v.	1 mA.	4/7
,, K3/40	3.2 kV.	1mA.	6/-
,, K3/45	3.6 kV.	1 mA.	8/2
,, K3/50	4 kV.	1 mA.	8/8
,, N3/160	12 kV.	1 mA.	21/6
	H.T. Type S.T.C.		
Type RM1	125 v.	60 mA.	4/-
,, RM2	125 v.	100 mA.	4/6
,, 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, 3¾in. wide, 3¼in. high. Guaranteed 12 mths. The above unit is manufactured by PREMIER and does not contain Ex-Govt. components. Plus 2/6 post and pkg. **39/6**

BATTERY CHARGER KITS

All incorporate metal rectifiers. Transformers are suitable for 200/250 v. A.C. cycle mains.
Cat. No.
2002 Charges 6 volt accumulator at 1 amp. Resistance, supplied to charge 2 v. accumulator 19/6
2004 Charges 2, 6 and 12 v. accumulators at 1 amp. 22/6

ALUMINIUM CHASSIS 18 s.w.g.

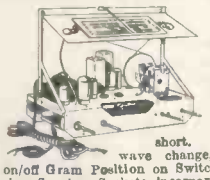
Substantially made from Bright Aluminium, with four sides:

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

LIMITED SUPPLIES OF 5-VALVE SUPERHET RADIO RECEIVER CHASSIS



Built to high standards ensuring quality reception. Specifications:—VALVE LINE-UP: 7S7, 7B7, 7C6, 7C5, 7Y4, 3 WAVEBANDS, Long, medium and, short. CONTROLS: Tuning, wave change, volume tone control on/off Gram Position on Switch. Pick-up and Extension Speaker Sockets incorporated. For use on 200/250 v. A.C. mains. DIMENSIONS: Length 14½in., height 11½in., width 6½in. Distance between controls, left to right from edge of chassis: 1in. 3in., 6½in., 3in. Plus 5/- pkg., carr., ins. **£7.19.6**

STOP PRESS

The above Chassis with 6½in. Speaker, Output Transformer and Walnut Cabinet, **£10.19.6** Plus pack. ing and carriage 7/6.

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 wave bands. 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, ¾in. × ¼in. brass screw, 4AB × ¾in. 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.

The New
"PREMIER PORTABLE"
TAPE RECORDER

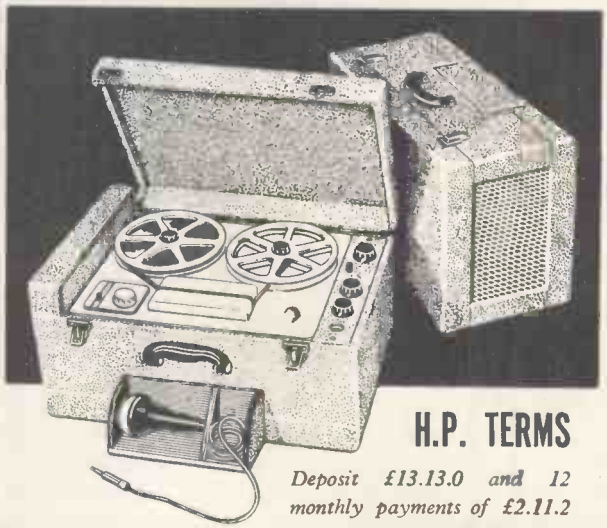
USING THE NEW LANE 2 SPEED TAPE UNIT MARK 6

COMPLETE 39 GNS CASH

Packing & Carriage 1 gn.

(Including Reel of Scotch Boy Tape and Microphone)

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 £13.13.0 and 12 monthly payments of £2.11.2

SPECIFICATION

★ TWO SPEEDS 7½ in. AND 3¾ in. PER SECOND
★ THREE SPECIALLY DESIGNED RECORDING MOTORS
★ 1,200ft. TAPE REELS PROVIDING PLAYING TIMES OF 1 HR. AND 2HRS.
★ 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 £4/18/4 and 12 monthly payments of £1/4/7.
Amplifier Kit (including speaker,) £11/-/-, plus packing and carriage 5/-.
New Lane 2 speed Tape Unit Mark 6, £18/10/-, plus packing and carriage 7/6.
Hire purchase terms, Deposit £6/3/4 and 12 monthly payments of £1/10/10.
Portable Cabinet (Rexine covered), £4/19/6, plus postage and carriage 5/-.
Microphone, £2/19/6, plus postage and carriage 1/-.
Reel Scoth Boy Tape MC2-111 (1,200ft.), £1/15/-, plus packing and carriage 1/-.
Instruction Booklet, 2/6. Post free.

Wireless World

RADIO, TELEVISION AND ELECTRONICS

44th YEAR OF PUBLICATION

Managing Editor: HUGH S. POCOCK, M.I.E.E.
Editor: H. F. SMITH

SEPTEMBER 1954

In This Issue

PUBLISHED MONTHLY (last Monday 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.

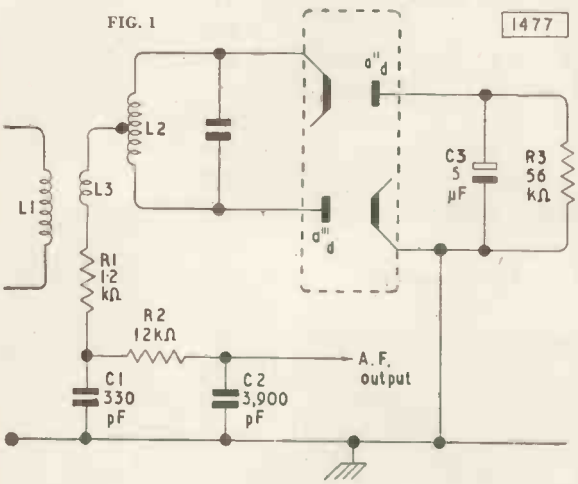
VALVES, TUBES & CIRCUITS

21. DETECTION IN F.M./A.M. RECEIVERS

For the detection of frequency modulated signals it is necessary to convert frequency changes into amplitude changes and to recover the intelligence contained in the original signals from the amplitude modulated carrier. The method most widely used for this purpose employs a form of phase discriminator known as the ratio detector. The particular advantage of the ratio detector is its excellent suppression of any amplitude modulation which may be present on the F.M. carrier as a result of noise or variations of gain in the earlier stages of the receiver. This type of circuit has good sensitivity and eliminates the expense of providing additional limiting stages.

A typical form of ratio detector circuit is shown in Fig. 1, and it will be noted that two diodes with independent cathode connections are necessary. The Mullard EABC80 is recommended for use in this type of circuit. This valve is a combined triple diode and voltage amplifying triode, with a heater rating of 6.3V, 0.45A, and it is mounted on the B9A (noval) base. One diod (a″d) is provided with a separate cathode (pin 3), the other two diodes and the triode sharing a second cathode (pin 7). The ratio detector circuit employs two of the diodes (a''_d and a'''_d) which have low impedances (about 200Ω) whose ratio never exceeds 1.5. The other diode (a'_d) is suitable for use in A.M. reception as a conventional detector and generator of A.G.C. voltage. The triode section is designed to be used as an audio amplifier following the detector during both F.M. and A.M. reception. Its electrical characteristics are similar to the triode section of the Mullard EBC41.

FIG. 1



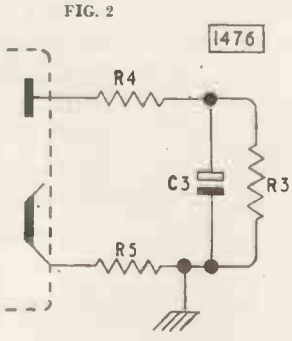
In the circuit illustrated, the primary winding L1 of the ratio filter is in the anode circuit of the final I.F. valve. The secondary coil, L2, is tuned to the intermediate frequency (10.7 Mc/s). The voltages in the two halves of L2 have a 180° phase difference, and their magnitudes depend upon the sweep frequency of the F.M. signal. The tertiary winding, L3, consisting of a few turns wound over the anode end of the primary, matches the anode circuit of the preceding I.F. stage into the diode circuit.

The ratio detector can take the form of a balanced circuit in which two equal capacitors are placed across the load resistor, R3, and their common connection taken to earth. In Fig. 1 the unbalanced type of circuit is given. Here only one capacitor, C1, has been retained, from which the audio output is taken. The 5μF electrolytic capacitor, C3, is then necessary to stabilise the voltage across R3.

The value of load resistance (56kΩ) is a compromise between that required for optimum gain and the necessary A.M. suppression. Good A.M. suppression is also achieved by using a relatively high resistance, 1.2kΩ, in series with the tertiary coil. Further increase in the value of load resistance (say, to 68kΩ), whilst resulting in larger ouput voltage, requires more satisfactory balancing in the preceding circuit in order to keep the rejection of A.M. to an acceptable value. Thus a trimmer capacitor could be connected from the centre-tap on the secondary to earth, and a small series resistance included in the lead from the centre-tap to the tertiary coil L3. These modifications will lead to a considerable improvement in suppression and some increase in sensitivity, but the preliminary adjustments to the trimmer are much more involved.

As a further refinement, some suppression can be sacrificed by connecting the stabilising capacitor across only a part of the total diode load (Fig. 2). With suitable values for R4 and R5 the suppression will depend to a much smaller extent on spreads in the forward resistance of the diodes and on variations in the amplitude.

FIG. 2

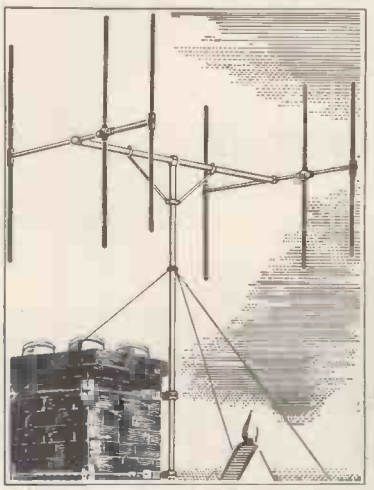


"BELLING-LEE" NOTES

A New Multi-Element Array

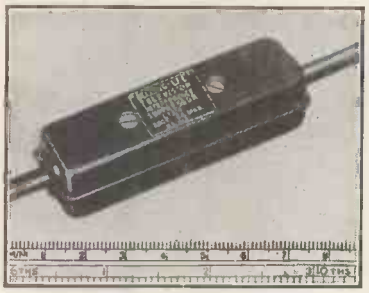
On the "Belling-Lee" stand at Earls Court there will be seen for the first time, the broadside array illustrated below.

Recently we were asked to provide a good picture in a location surrounded by the hills of South Wales. There was a poor signal and several ghosts. We arranged for the erection of a double 3-element array, comprised of two "Junior Multirods" spaced a half-wave length apart. With this arrangement you can expect a theoretical gain of 3 dB over a



single "Junior Multirod" or in micro-volts, about half as many again. As the erection was something of a problem the aerial was tried out on the ground, and right away the ghosts had gone. When properly installed, the customer wrote to say that they now enjoyed a marvellous picture, black and white instead of grey. It is well worth pointing out that we could have obtained the same gain with quarter-wave spacing and consequently a smaller and more manageable array, but the half-wave spacing gives a truly remarkable front-to-back ratio, which in turn greatly reduces unwanted signals.

The installation of this rather difficult aerial was in the capable hands of Mr. G. R. Silverthorne, Radio House, Abergavenny, who is to be congratulated on a really fine job.



"Telefilter"

This is the name given to a miniature flex lead suppressor designed to be fitted in the lead of a small domestic appliance for the abatement of interference to television. As it contains chokes, its application is limited to appliances taking not more than 2 amps. It does not suppress at broadcast frequencies unless used with a plug suppressor such as L.1308.

The "Telefilter" is also available moulded into a lead with which an appliance could be wired.

Aircraft Fuselink

This new fuselink L.1330 has been specially developed for use on 30 V circuits and is being manufactured in ratings from 35 amp. to 275 amp. It is very light

in weight and is intended for direct bus-bar mounting, thus obviating the use of a holder with its cost and weight. It is expected to be explosion proof, and tests in this respect are still being carried out.

This type of fuse-link is already in service on considerable numbers of American aircraft and is expected to go into service very shortly on the Vicker's Viscount and other British-made aircraft. A.R.B. and Ministry of Supply approval is being sought. It is interchangeable with the American types and is, as far as we know, the only one of its kind manufactured on this side of the Atlantic, and therefore should be a dollar saver.

Typical of the Ekcovision range is this 14″ aluminised-tube table model incorporating Ekcovision Turret Tuning, Full Automatic Picture and Sound Control and Optical Filter. Handsome cabinet in walnut veneers. AC/DC mains.

MODEL T221
66 GNS.
Tax Paid.

GOOD LOOKING *See* for yourself the clear brilliant pictures on Ekcovision. And notice the many picture-improving refinements of this fine range of 14″, 15″ and 17″ receivers. Choose for the future, too! Ekcovision 13-channel Turret Tuning is already incorporated in some models, and can be fitted at any time in others for easy, efficient reception of the Alternative Programmes as and when they become available in your locality.

GOOD LISTENING *Hear* and enjoy the wonderful fidelity and depth of sound of Ekco radio. You will find there are models of every size and price for your listening pleasure.

GOOD VALUE Every receiver, Vision and Radio, is backed by outstanding Ekco quality-engineering and utmost reliability. Distinctive in design and performance, these receivers offer you exceptional *value-for-money!* Your Registered Ekco Dealer can offer you expert Ekco 'Sales and Service' and will see that you get full and lasting satisfaction from the receiver you choose.

EKCO

vision and radio

NATIONAL RADIO SHOW STAND 92

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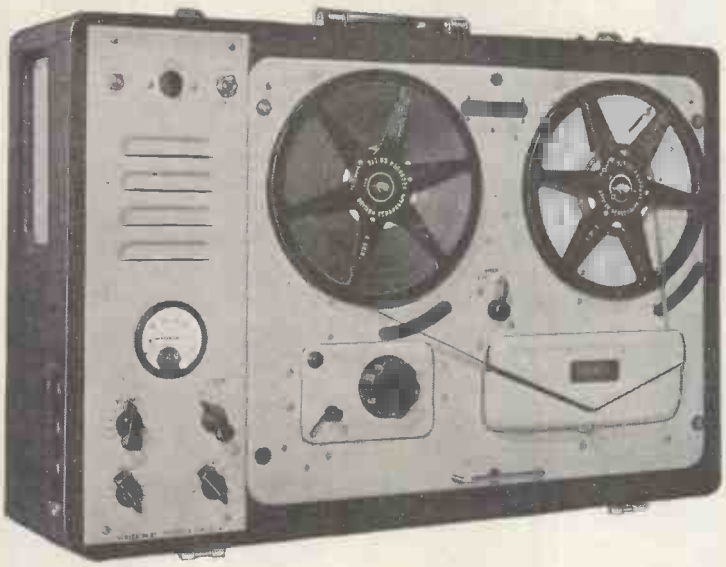
good . . .

MODEL ARG233
5-valve all-wave, floor standing auto-radiogram. Plays up to eight 12″ or ten 10″ or 7″ records at three speeds. 5-position tonecontrol. Mahogany veneered cabinet. For A.C. mains.
66 gns. Tax Paid.

MODEL A160
All-wave superhet in handsome walnut veneer cabinet. 8″ speaker. Floodlit tuning scale. Sockets for gramophone pick-up and for tape recording. For A.C. mains.
£26. Tax Paid.

MODEL A222
The Ekco 'New Radiotime' combines a 4-station switch-tuned radio and a Smiths mains-operated clock. It tells the time, acts as an alarm and switches itself 'on' and 'off'. Inbuilt aerials and sockets for extension speakers. For A.C. mains.
20 gns. Tax Paid.

VORTEXION TAPE RECORDER



The amplifier, speaker and case, with detachable lid, measures 8¼in. x 22½in. x 15¾in. and weighs 30 lb.

PRICE, complete with WEARITE TAPE DECK £84 0 0

★ The noise level is extremely low and audibly the hum level and Johnson noise of the amplifier and deck are approximately equal. Only 25% of this small amount of hum is given by the amplifier alone.

★ Extremely low distortion and background noise, with a frequency response of 50 c/s.—10 Kc/s., plus or minus 1.5 db. A meter is fitted for the measurement of signal level and bias level.

★ Sufficient power is available for recording on disc, either direct or from the tape, without additional amplifiers.

★ 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.

★ The .5 megohm input is fully loaded by 18 millivolts and is suitable for crystal P.U.s, microphone or radio inputs.

★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.

★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.

★ Facilities are provided for using the amplifier alone and using power output or headphones while recording or to drive additional amplifiers.

★ The unit may be left running on record or play back even with 1,750 ft. 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.**

FOUR CHANNEL ELECTRONIC MIXER

is almost essential for the professional or semi-professional where a number of different items have to be mixed on one tape recording.
It is recommended by a number of tape recorder manufacturers for this purpose.
Any normal input impedance can be supplied to order, balanced or unbalanced, the standard being 15-30 ohms balanced.
The normal output is 0.5 volt on 20,000 ohms or less, but 600 ohms is available as an alternative.
The steel stove enamelled case is polished and fitted with an engraved white panel suitable for making temporary pencil notes.
An internal screened power pack and selenium rectifier feed the five low noise non-microphonic valves.
Used in many hundreds of large public address installations and recording studios throughout the world.

PRICE £36 15 0.

Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London."

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!

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: ± 1db 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* ★

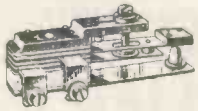
H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

'Phone : SHEpherds Bush 1173/4 *Telegrams : Sinusoidal, Ealux, London* *Cables : Sinusoidal, London*

22/6 FLUORESCENT LIGHTING

Complete kit comprises 40 watt control unit, starter lamp, lamp holders, clips and wiring diagram. Price, less tube, 22/6, plus 1/6 post. With tube, 30/-, plus 3/6 carr.

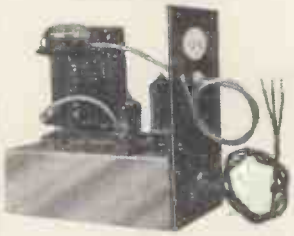
NEW 5 AMP. THERMOSTAT (MINIATURE)



2½" × 1" × 1½" high

Useful for the control of appliances such as convectors, gluepots, vulcanisers, hot plates, etc. This thermostat is adjustable to operate over the temperature range 50-550 deg. F., fitted with heavy (5 amp. A.C.) silver contacts size 1½in. long × ¼in. wide, price 8/6, post 6d.; 1 amp. type, 3/6, 2 amp. type, 5/6.

THE ELPREQ E.H.T. GENERATOR



This is a made up unit working on the blocking oscillator/overwound amplifying stage principle. It is of moderate power consumption (6.3 volt .8 amp. filament and approx. 59 mA. H.T.) and contains three of the latest BVA all glass valves. Output obtainable ranges from 6 kv. to 9 kv. with normal H.T. rail input but somewhat higher outputs can be obtained with higher H.T. supply.
Price 69/6. P. & P., etc., 5/-.

BEDROOM-NURSERY MAINS MIDGET RADIO

All the parts, cabinet, valves, knobs, back—in fact everything will cost you only £3/15/- (plus 2/6 postage). The set is economical to run, too, for it uses only three valves in a special reflex T.R.F. circuit which gives ample power combined with good tone. Incidentally if you wish to give the sets to young children why not decorate the cabinet with a few suitable transfers? These can usually be obtained from local handicraft shops. Circuiting and construction data free with the parts or available separately at 1/6.

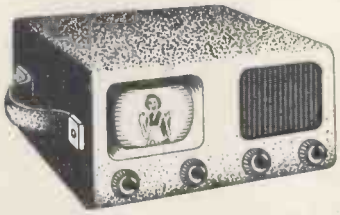
BE PREPARED

For a cold winter by making our low-cost Electric Blanket. 27 yards of special heater wire and blueprint, 20/-. Blueprint only 1/6. Alternatively make a Bed-Warmer. Constructional data 1/6.

EMPRESS CONSOLE

This cabinet is undoubtedly a beautiful piece of furniture. It is elegantly veneered externally in figured walnut, internally in white sycamore. The radio section is raised to convenient level but is not drilled or cut. The lower deck acts as the motor-board, again is uncut, it measures 16 × 14 and has a clearance of 5in. from the lid. There is a compartment for the storage of recordings. Overall dimensions of this essentially modern cabinet are 3ft. wide, 2ft. 8in. high, and 1ft. 4½in. deep.
Price £15/15/- or £5 deposit.
Many other cabinets in stock—table models from 10/- upwards—Consoles from £8.

MINIATURE PORTABLE T.V.



The Elpreq Miniature Televisor uses standard conventional circuitry, employing a total of 13 valves and 2 crystal diodes. The cathode ray tube used is a 2½in. Service type V.C.R. 139A, which has a standard equivalent and will therefore always be obtainable. The layout is extremely clean, straightforward, and professional. The wiring, whilst naturally being a little more intricate due to miniaturisation, is nevertheless completely accessible, and very good results have been obtained.

The total cost, if you have to buy every part, would come to £16-£17, but you may have many of the components already in stock as only standard conventional components are used. A carrying case, similar to the artist's illustration above, will be available shortly. Its size will be approximately 9½in. × 8in. × 6in. (internally).
Full construction data, layouts, diagrams templates, etc., running into some 50 sheets, is available, price 5/-, post free.

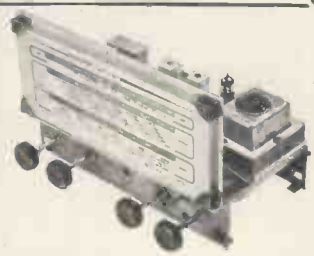
THE WOLSEY 54

A really fine ready built modern Superhet at the remarkable price of £8/19/6 or £3 deposit, balance over twelve months.
The Wolsey 54 is an A.C. mains superhet employing latest circuitry covering long and mediumwave bands in an ultra modern case with illuminated dial—overall size approximately 11½ × 7 × 8—complete ready to work—twelve months' guarantee.

CONSTRUCTORS PARCEL

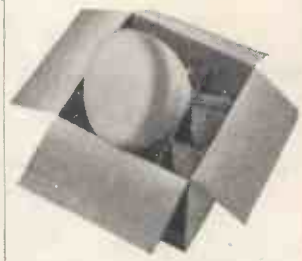
Contains cabinet as Wolsey 54, drilled metal chassis—dial—pointer, etc., 29/6. All other components available total cost £6/10/- data 1/6 (free with components).

THE CLEVELAND "ORGANTONE"



The Cleveland "ORGANTONE" is a 5-valve, 3-wave band superhet covering long wave (1,020-1,875 metres) medium wave (187.5 545.5 metres) and short wave (16-50 metres). Built to a very stringent specification, it attains a high level of performance both with regard to sensitivity and fidelity.
Osram all-glass miniature valves are employed throughout and low loss iron cored coils in both aerial and oscillator sections together with permeability tuned I.F.'s 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 on the wave change switch 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. It is an instrument which could fairly be described as a custom-built chassis.
Price £11/10/- or £3/16/8 deposit—carriage, etc., 7/6.
A circuit diagram and photograph available price 2/- post free.

LAST FEW



15in. MAGNETIC TELEVISION TUBE

By famous maker. Specification Blue/White screen 9 Kv. ion trap triode, heater 6.3 v. at .55 amp., 50° deflection. New, with written guarantee, offered at approximately half price, £13/10/- each, plus 10/- carriage and insurance. H.P. terms, £4/10/- deposit and 12 monthly payments of 18/3. Limited quantity, so order immediately.

SLIDER RESISTORS

Heavy Duty Type.
Size 7in. × 1½in. 11 ohms 4.5 amp., 22/-; Size 9in. × 1½in. 1.2 ohms. 15 amp. 15/-.Size 13½in. × 1½in. 3 ohms 10 amp., 15/-.

LAST FEW £3/19/6

The Lectross warms room as it dries clothes, bathing costumes, towels, etc. Size 3ft. wide, 3ft. high and 5in. deep. It has four stove enamelled rails and works off A.C. or D.C. mains, consuming 650 watts. Fully guaranteed. Price £3/19/6. plus 7/6 carriage.

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 £7/10/- Radiogram cabinet and our 37/6 table cabinet below.

THE WINDSOR STANDARD

This takes our Windsor 5 chassis and 6½in. speaker. It is a very nice job, walnut veneered and pleasantly polished. Size approximately 16in. × 16in. × 7in. Offered at the particularly low price of 39/6, plus 3/6 post.

ALL THESE AND MANY MORE BARGAINS AT →

OVER 1000 OF THESE NOW FAMOUS TELEVISORS IN DAILY USE ALL OVER BRITAIN

THE ELPREQ 1955 CORNER CONSOLE

A Combined Radio, Radiogram and 15in. Television valued at a shop price of £300–£400, can be yours for about £75 if you adopt our plan.

OUR PLAN

You first build the " Superior 15 " Televisor, which will give you T.V. (sound and vision) right away. Next you should purchase the 1955 Corner Console cabinet, to hold and protect the T.V. chassis. After this build the radio chassis; (the data for this is being prepared and should be ready by the Autumn). Finally, if you want recordings, then under the lid you can fit a tape recorder or an auto-changer. The cabinet, auto-changer and the tape deck would, of course, be supplied as ready-made units.

PRICE SCHEDULE

		Carriage & Packing
All components, including 15in. Cossor Tube, and 20 valves for the Superior 15in. T.V	£37 10 0	£1 0 0
All components for the radio chassis	£8 10 0	5 0
1955 Corner Console Cabinet	£18 0 0	£1 0 0

H.P. terms available, if required. Send 1/3rd of the cash price, plus carriage. Balance (plus charges) can then be spread over twelve months.

COUPON

To E.P.E. Ltd., 46, Windmill Hill, Ruislip, Middx.

Please send me your " Superior 15 " Data. I enclose 7/6 but understand that if I return the Data within seven days, you will refund me 7/-.

Name .....

Address .....

DEMONSTRATED AT 1953 RADIO SHOW

ELECTRONIC PRECISION EQUIPMENT LTD.

249, Kilburn High Road, Kilburn.

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.

from all this

to just this

The EVER READY development that revolutionised the DRY BATTERY

The "Batrymax" dry battery is an Ever Ready development that made possible the miniature self-contained hearing aid and the smaller, lighter electronic equipment of today. In addition, Ever Ready "Batrymax" layer-cell construction gives you more efficient, more economical radio batteries. For example, the latest B136 "Batrymax" battery, used with new Ever Ready low consumption valves, has a balanced service life of over 350 hours. At the present time, you cannot better a "Batrymax"; but Ever Ready research goes on, seeking new developments to increase, still further, the efficiency of the dry battery.

EVER READY
REGD. TRADE MARK
MADE IN BRITAIN

Batrymax

"Batrymax" is a Trade Mark of The Ever Ready Co. (Gt. Britain) Ltd.

YOU'RE SURE TO GET IT AT STERN'S

Constructors everywhere are amazed!

AT THE EXCELLENCE OF

The "TELE-VIEWER"

5 CHANNEL TELEVISOR

DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER

PERFECT PICTURE QUALITY — SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY

PERFECT FRINGE AREA RECEPTION — BETTER RECEPTION AT HALF COMMERCIAL COST

Here are some of the features which combine to make this such a fine receiver.

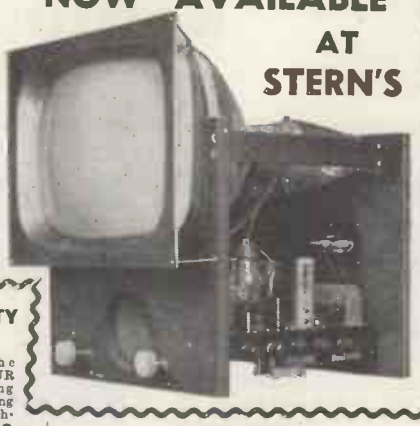
- The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON COLDFIELD, HOLME MOSS, WENVOE and KIRK-O-SHOTTS. (The extreme ease of tuning is accomplished by the provision of pre-aligned I.F.T.s.)
- A lifelike, almost stereoscopic, picture quality made possible by the following factors :
  a. Excellent band width of I.F. circuits.
  b. A really efficient video amplifier.
  c. C.R.T. Grid modulated from low impedance source.
  d. High E.H.T. voltage (approx. 10 kV.).
  The picture brilliance is also much above the average and enables comfortable viewing with normal room lighting or daylight.
- FIRM picture "HOLD" circuits (Frame-Line) ensure a steady picture, free from bounce or flicker even under the most adverse conditions met with in "fringe" areas and excellent "interlace" ensures the absence of "liney effect."
- Negative feedback is used in the audio frequency circuits which provide 2/3 watts of High Quality Sound.
- Entire receiver built on two chassis units each measuring 14½in. x 6½in. x 3½in.
- Rigid C.R.T. mounting enables entire receiver to be safely handled with tube in position.

● All pre-set controls are mounted on side of chassis, enabling all adjustments to be carried out whilst facing the C.R. Tube.

This complete TELE-VISOR, including all Valves, can be built for only (*Plus cost of C.R.T.*) **£28/16/4**

As no hire purchase terms are available the receiver can be bought in five separate stages (practical diagrams and circuits are provided for each stage) thus enabling hire purchase interest rates to be avoided. The complete set of ASSEMBLY INSTRUCTIONS is available, price 5/-. The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST. ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.

NOW AVAILABLE AT STERN'S



The "WIDE ANGLE" TELE-VIEWER

- A design that retains all the distinctive features of the 12in. Televisor but with increased Time Base efficiency, producing 15 to 16 kV. E.H.T., with ample scanning power for C.R. Tubes up to 17in.
- It can be completely built including supply of all valves for **£33** (plus cost of C.R.T.) and is as simple to construct as the 12in. model.
- This is the most efficient "WIDE ANGLE" large screen design yet offered to constructors, and yet it can be built for almost half the cost of similar designs.
- Complete assembly instructions, diagram, etc., available for 5/-.

A COMPLETE KIT OF PARTS TO BUILD A 3-4 WATT HIGH GAIN AMPLIFIER

for operation on A.C. or D.C. Mains, 200-250 volts.

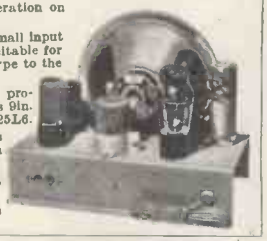
This amplifier will give 3 watts output for the small input voltage of only 75 millivolts, and is therefore suitable for use with any type of pick-up from the crystal type to the miniature H/F Magnetic type.

A tone control is incorporated and the quality produced is excellent. The overall size of chassis is 9in. × 5in. × 7in. and valve line-up 25Y5-6sH7-25L6.

Price of complete kit, including drilled chassis and valves, £4/2/9, plus 6½in. P.M. (which fits on chassis, 16/-, or 8in. P.M., 18/9.

Price of fully assembled chassis ready for use, £5/5/- (plus cost of speaker).

Copy of assembly instructions and components price list available for 1/3.



HIGH FIDELITY PICK-UP

Incorporating the famous CONNOISSEUR Lightweight Moving Iron Head and including the Connoisseur matching Transformer. (1/- carr. & ins.) **39/6**

The "REGENT" CRYSTAL HAND MICROPHONE 25/6

Plus 1/- carr. & ins. Complete with screened lead. List price £2/2/-.

The DENCO M.T.O.I. Modulated Test Oscillator £3/15/-

(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.

SELENIUM RECTIFIERS

6 or 12 volt 1 amp. rating..	7/6	6 or 12 volt 4 amp. rating..	17/6
6 or 12 volt 2½ amp. rating	12/6	6 or 12 volt 6 amp. rating..	£1/2/9

THE NEW DENCO ULTRA MIDGET SUPERHET COIL PACKS

MODEL CP4/L. A 4-station "Pre-set" unit providing any 3 stations on medium waveband and one station on long wave, price £1/13/4.

MODEL CP4/M. A 4-station "Pre-set" unit which provides any 4 stations on medium waveband. Price £1/13/4. The above are supplied fully wired leaving only four connections to be made.

MODEL CP3/370PF and CP3/500PF. Completely wired 3 waveband Coil Packs for use with either 350PF or 500PF condensers. Coverages 190-550 metres, 800-2000 and 16-50 metres. Price £2/2/8.

An attractive Dial and Drive Assembly is available for 25/-. Overall size of each unit 3½in. × 2½in. × 1in. deep.

FILAMENT TRANSFORMER

6.3 v. 1½ a.	5/9
4 v. 1½ a.	5/9

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.

WE CAN SUPPLY EX-STOCK

(a) The Editor Tape Recorder complete..	£47/5/0
(b) The Truvox Tape Deck.....	£23/2/0
(c) The Grundig Model TK9 Tape Recorder, complete	£68/5/0
(d) The Grundig Model 700L Tape Recorder, complete	£84/0/0

Each is available on Hire Purchase and descriptive leaflets are available—send S.A.E.

NEW C.R.T.s.

Unused 12in. C.R.T.s by one of the leading manufacturers. 6.3 volt heater, 7-9 kV standard size. Supplied in maker's sealed cartons. (Plus 15/- Carr. & Ins.) **£12/19/6**

BRAND NEW C.R.T. MASKS

Latest aspect ratio for 12in. "Round" tubes, finished Ivory (plus 1/- postage) **12/6**

SPEAKER BARGAINS

PLESSEY, 10in. 3 ohm V/coil	£1/5/0
TRUVOX 12in. 3 ohm V/coil	£2/9/6
ROLA, 12in. 3 ohm V/coil	£3/19/6
BAKERS, 12in. 15 ohm V/coil	£4/15/0
GOODMANS, 12in. 15 ohm V/coil	£5/5/0

(Carriage and Ins. 1/6 extra.)

THE NEW W.B. "STENTORIAN" HI FI SPEAKERS ARE IN STOCK

Model H.F. 6-inch	£2/10/6
Model H.F. 9-inch	£3/7/0
Model H.F. 8-inch	£3/0/6
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.

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 8in. × 4in. × 2¾in. 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.

BATTERY PORTABLE

THE "MINI TWO-THREE"

An "Alldry" Battery Portable of midget size, 6¾in. × 4¼in. × 3¼in. 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 1T4—1T4—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 which enable the most inexperienced constructor to successfully build either set. All components are available for separate sale, a price list being supplied with assembly instructions.

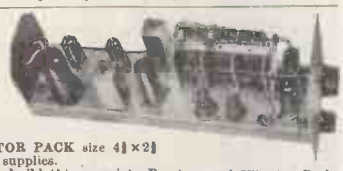
"PERSONAL SET" BATTERY ELIMINATOR

A complete Kit of parts to build a 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 4¾in. × 1¾in. × 3¾in. 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. × 2¼in. × 1¼in. Price 47/6.

A COMPLETE "CAR RADIO" FOR THE HOME CONSTRUCTOR



11½in. × 4¾in. × 3¼in.

A design of a complete 5-VALVE SUPERHET RECEIVER employing an R.F. Stage, and incorporating a separate VIBRATOR PACK size 4¼ × 2¼ × 6¼in. 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 £12/19/6. (Carr. and Ins. 5/6 extra.) Or the Receiver Components for £9/19/6 and the Vibrator Components for £3.

This is NOT an EX-GOVT. Receiver, it is 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.

!!!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**

If the Receiver is first built to cover the Medium Waveband, Long Waves can be added at any time, separate diagrams are provided for this purpose.

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.

FOR HOME CONSTRUCTORS

A 5 VALVE 3 WAVEBAND SUPERHET RECEIVER for £10'10'-

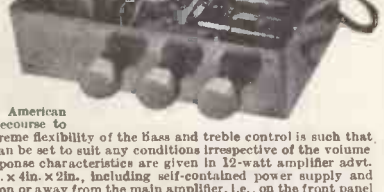
For use on A.C. Mains 200 to 250 volts.

The following are outstanding features:

- A superhet circuit designed for high efficiency on all three wavebands.
- A 3½in. P.M. speaker accurately matched for good quality reproduction.
- The latest range of new 6-volt B.V.A. miniature valves.
- Built-in frame aerial with provision for external aerial for distant stations.
- A white plastic cabinet of very attractive appearance, overall size 7½in. × 5½in. × 5¾in.

Send 2/6 for the fully descriptive stage by stage assembly and wiring diagrams with which complete price details are given.

DUAL-CHANNEL PRE-AMPLIFIER and TONE CONTROL UNIT



This comprehensive PRE-AMPLIFIER and TONE CONTROL UNIT provides a full control of base and treble in conjunction with a main Volume/Mixer 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-up and all natures of recordings, i.e., English, American and long-playing, without recourse to pick-up correction. The extreme flexibility of the bass and treble control is such that the level of bass and treble can be set to suit any conditions irrespective of the volume output of the amplifier. Response characteristics are given in 12-watt amplifier advt. The unit measures only 7in. × 4in. × 2in., 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 (68N7 and 6J5), £3/16/9. Complete assembly data are available separately for 1/-. Completely assembled and ready for use, £5/5/-.

"MINI-TWIN" 1-VALVE BATTERY SET

A design of a simple 1-valve 2-stage Battery Receiver, giving excellent results on medium and long wavebands and having exceptionally low battery consumption. Drilled chassis and practical diagrams make it the ideal set for the beginner to build.

The complete chassis, including valve, can be built for 37/6, plus 8/11 P/Tax, the attractive plastic case is 9/6, and suitable headphones, 14/9.

The complete assembly instructions, layouts and a component price list are available for 1/6.

This Receiver also performs excellently, without modification, as a tuning unit, and, in addition, with simple modifications for which a complete diagram is provided, makes a first-class pre-amplifier for pick-up or microphone.

AN AMAZING OFFER!

A COMPLETELY ASSEMBLED 4 VALVE T.R.F. CHASSIS

Including a 5in. P.M. SPEAKER and VALVES FOR ONLY **£6'9'6** (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 BVA miniature valves The line up being 12 BA6—12AT6—12A6—35W4. It incorporates Permeability Tuned Coils, thus ensuring excellent selectivity and sensitivity. The overall size of the complete chassis including speaker is 10¼in. × 4¼in. × 6¼in. An attractive Bakelite Ivory-finished Cabinet size 11¼in. × 5¼in. × 6¼in. is available for 16/6 (plus 2/6 carriage and insurance).

109 and 115 FLEET ST. LONDON, E.C.4

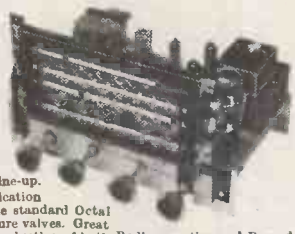
Phone: CENTRAL 5812-3-4

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)

We will supply it assembled and READY FOR USE for **£13/13/0** (Plus 7/6 Carr. & Ins.)
H.P. Terms £3.10.6. deposit and 12 months at 19/-.
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:

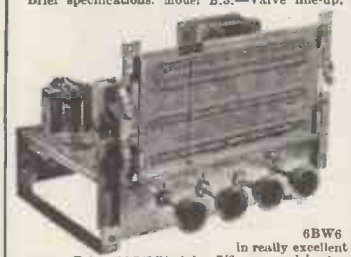
- Covers 3 wavebands 18-50 metres, 190-550, and 800-2,000 metres.
- Employs 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all wavebands and pre-selective feedback.
- A 4 position Tone Control operates on both Radio and Gram.
- Has independent mains supply socket for 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.

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 are 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 (3-position switch operative on gram. and radio), Negative feedback is employed over the entire audio stages. Chassis size: 11 × 7⅞ × 8¼in. high. Dial size 8¼ × 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 17/6.

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 as 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.

!!AN OUTSTANDING OFFER!!
A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER

For only **£12/19/6** (Carr. and Ins. 7/6 extra). H.P. Terms £3/4/6 Dep. 12 months at 18/4.

These receivers Model AW3-7 are made by a well-known set manufacturer 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.
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 × 7⅞in. × 6¼in. high, dial aperture 8¼in. × 4¼in. (Dial Escutcheon available for 4/9).

THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

109 and 115 FLEET ST., London, E.C.4. 'Phone: CENtral 5812/3/4

This AUTOCHANGE UNIT by a famous Manufacturer
is offered for £11/10/0 (Plus 7/6 Carr. and Ins.)

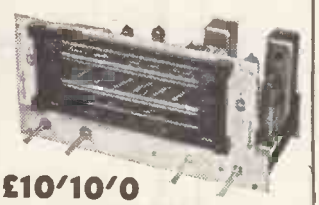
Hire Purchase Terms £2/17/6 Dep. and 12 Months at 16/4.
(Normal price is £16/10/-).

- These units will autochange on all three speeds, 7in., 10in. and 12in.
- They play MIXED 7in., 10in. and 12in. records.
- They have separate sapphires for L.P. and 78 r.p.m., which are moved into position by a simple switch.
- Minimum baseboard size required 14in. × 12½in., with height above 5½in. and height below baseboard 2½in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

The COLLARO 3RC/521 3-SPEED AUTO CHANGE UNIT
£9/19/6 (Plus 7/6 Carr. and Ins.) H.P. Terms £2/10/0 Deposit and 11 months at 15/9.
Normal price £18/10/-.

- Complete which High Fidelity Crystal "Turnover" Head which incorporates separate stylus for L.P. and 78 r.p.m. Records.
- Will autochange on 7in., 10in. and 12in. records not intermixed.
- Minimum Baseplate size 15in. × 12½in., with height above 4½in. and below baseplate 3in.
- Brand new in Maker's Cartons, complete with Mounting instructions.

A Replacement RADIO-RADIOGRAM CHASSIS



- MODEL AW3-5. A 5-Valve Superhet Receiver covering the standard 3 wavebands, 16-50, 190-550, 900-2,000 metres. PRICE COMPLETELY ASSEMBLED AND READY FOR USE **£10/10/0** (plus 7/6 carr. and ins.)

H.P. Terms £2/12/6 Deposit and 12 Months at 15/-. This receiver is for operation on A.C. Mains 200-250 volts. It contains the latest MULLARD VALVE LINE-UP, being ECH42 (Freq. Ch.), EF41 (I.F.), EBC41 (Det. 1st Audio), EL41 (Output) and EZ41 (Rect.). It incorporates Negative Feedback and delayed A.V.C., the four controls being (1) Tuning. (2) Wavechange and Gram. Switch. (3) TONE. (4) VOLUME-OFF. It provides really good reproduction on both Gram. and Radio and gives an exceptionally good range of station selection. Overall size 13½in. × 7in. high × 6in. deep. Dial aperture 10in. × 4¼in.

SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY

Select a RECORD PLAYER and CHASSIS and we will supply it TOGETHER WITH AN 8-inch or 10-inch P.M. SPEAKER as follows :—

THE £11.10.0 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) " " Super six (assem. chassis only)	£28 0 0	£7 0 0	12 of £1 19 5
(e) " " AW3-5	£22 15 0	£5 10 0	12 of £1 12 4
(f) " " AW3-7	£25 5 0	£6 7 0	12 of £1 15 5

THE COLLARO AUTOCHANGER MODEL 3RC/521 WITH A SPEAKER AND:—

(a) With Model B3 chassis	£23 6 0	£5 16 0	12 of £1 12 10
(b) " " B3PP	£26 9 0	£6 11 0	12 of £1 17 4
(c) " " B3PP/RF	£29 12 0	£7 9 0	12 of £2 1 6
(d) " " Super six (assemb. chassis only)	£26 9 0	£6 11 0	12 of £1 17 4
(e) " " AW3-5	£21 4 0	£5 6 0	12 of £1 9 10
(f) " " AW3-7	£23 14 0	£6 0 0	12 of £1 13 2

An additional charge of 10/- is made in each case to cover Carriage and Insurance.

Prices slashed at Clydesdale

PLEASE NOTE. Carriage and Postal charges refer to the U.K. only. Overseas freight, etc., extra.

INDICATOR UNIT "A.S.B." SERIES (U.S.A.)

Contains: 5 BPI C.R.T. with mu-metal screen, 3/6H6s, 2/6SH7s, 6AG7, 6AC7, plus H.V conds., etc. Metal case 18¼in. x 8¾in. x 8in. All controls brought to front panel beside viewing screen.

ASK FOR X/E776 — **£3.19.6** each — CARRIAGE PAID

INDICATOR UNIT TYPE 62

With VCR-97 tube, and valves, 16-VR65-CV118 (SP61), 2-VR54 (EB34), 2-VR92 (EA50), etc. Dim.: 18in. x 18¼in. x 11¼in. Wgt. 42 lb. In original wood case.

ASK FOR X/H526 — **£3.19.6** each — CARRIAGE PAID

INDICATOR UNIT TYPE 62

as above, but in used, good condition, loose stored.

ASK FOR X/E774 — **£2.9.6** each — CARRIAGE PAID

INDICATOR UNIT TYPE 305

Ref. 10QB/6504. Brand New.

With tubes, VCR/524A, VCR525, and valves 7/VR91 (EF50), 2/VR54 (EB34), 6/VR92 (EA50). Dim.: 12in. x 7in. x 18in.

ASK FOR X/H493. — **£3.19.6** each — CARRIAGE PAID

POWER UNIT TYPE 285

Ready made for T.V.

A.C. mains, input 230 v. 50 cps. Outputs E.H.T. 2kV. 5 mA. H.T. 250 v. 150 mA. L.T. 6.3 v. 10 a. and 6.3 v. 5 a. Fully smoothed and rectified with valves VU120, 5U4G, VR91 (EF50), plus cond. resistors, etc.

ASK FOR X/H947 — **£4.19.6** each — CARRIAGE PAID

INDICATOR UNIT TYPE 6

With VCR97 Tube and valves 4/VR91 (EF50). VR54 (EB34), 3/VR92 (EA50), VR78 (D1), etc. Dim.: 18in. x 8¼in. x 7¼in. Wgt. 21 lb. In original wood case.

ASK FOR X/H524 — **£2.19.6** each — CARRIAGE 5/- extra.

REPRINTS FROM "PRACTICAL TELEVISION"

Components Price List Free on Request.	
The "Beginner's Receiver," modifying the R3170A	1 6
The "Beginner's Timebase," modifying Ind. Unit 6H	1 6
The "Economy Televisor" modifying the Ind. Unit 62	1 6
Argus Televisor, data and blueprint	2 6

BEGINNER'S T.V.

Mains Transformer .....each	£1 12 6
Output Transformer .....each	9 9
Crystal Diodes .....each	5 3

THE BEGINNER'S TIMEBASE

Mains Transformer .....each	£1 0 0
E.H.T. Transformer each £2/10/- and	£2 5 0

INDICATOR UNIT TYPE 6H

With VCR97 Tube and valves 4/VR91 (EF50). 3/VR54 (EB34). Dim.: 18in. x 8¼in. x 7¼in. Wgt. 22 lb. In original wood case.

ASK FOR X/E777 — **£4.9.6** each — CARRIAGE PAID

ION TRAP MAGNET ASSEMBLY

Mfg. Surplus.

Type IT/6 by Elac for 35 mm. tube neck.

ASK FOR X/H919 — **2/6** each — POST 3d. EXTRA

IF/AF AMPLIFIER UNIT R1355

With Valves 8/VR65 (SP61), 5U4G, VU120A (5U150A), I.F 7 mc/s., etc. Dim.: 18in. x 8¼in. x 7¼in. Wgt. 31 lb. Used, good condition. In transit case.

ASK FOR X/E770A — **£1.12.6** each — CARRIAGE PAID

R.F. UNIT TYPE 24. In original carton.

With valves 3/VR65 (SP61), etc. Range 20-30 mc/s. switched tuning. Dim.: 9½in. x 7¼in. x 4¼in. Wgt. 7 lb.

ASK FOR X/H850 — **15/-** each — POST 1/6 EXTRA

R.F. UNIT TYPE 25. In original carton.

Range 40-50 mc/s., otherwise as R.F.24.

ASK FOR X/H847 — **19/6** each — POST 1/6 EXTRA

R.F. UNIT TYPE 27. With broken dial.

Range 65-85 mc/s. valves 2/VR135 (EF54), VR137 (EC52), etc. Dim.: and Wgt. as R.F.24.

ASK FOR X/E771 — **29/6** each — POST 1/6 EXTRA

RECEIVER UNIT R3601. Ref.: 10DB/6037

With valves 2/VR136 (EF54), VR137 (EC52), 5/VR65 (SP61), 4/VR92 (EA50), VR91 (EF50), 6V6G, VU39A (R3), etc. I.F. 13 mc/s. Dim.: 18in. x 9in. x 8in. Wgt. 38 lb.

ASK FOR XEH493 — **£1.19.6** each — CARRIAGE PAID

EX U.S.N. TEST OSCILLATORS TS-24/ARR2

Low/high frequency, battery powered for TBX alignment, H.F. signal 245 mc/s. I.F. signal tunable 540 to 830 kc/s. with valves 2/955 acorn triodes and clockwork time switch with calibrated dial 0/30 minutes. Unit Dim.: 9½in. x 7½in. x 7in. Finish black.

ASK FOR X/H364 — **27/6** each — CARRIAGE 3/- EXTRA

DINGHY TELESCOPIC MAST

Aluminium, telescopes from 14½in. to 7½ft. Seven sections, base dia. ¾in. Wgt. 4 oz.

ASK FOR X/H489 — **4/6** each — CARRIAGE PAID

AERIAL ROD

15in. lengths, copper plated steel tube, ferruled to interlock an aerial of desired length. ⅞in. dia. Ask for X/H709. ½in. dia. Ask for X/H710.

EITHER UNIT — **4/6** doz. lengths. — POST 6d. EXTRA

RADAR REFLECTOR AERIAL MX/137/A

Spider web mesh aerial in original moisture-proof carton, with assembly instructions.

ASK FOR X/E175 — **4/11** each — POST 9d. EXTRA

AERIAL SYSTEM TYPE 62

U.H.F. Antenna on streamlined moulding with VR92 (EA50), untuned detector stage. Overall dim.. 13in. x 4¾in. x 2¾in. Antenna 22.5 cm.

ASK FOR X/H496 — **3/6** each — POST 9d. EXTRA

Circuit 1/3 each.

CERAMIC AERIAL SPREADER

Individually boxed. Length overall 11in., between centres 9¼in.

ASK FOR X/H718 — **1/-** per pair — POST 3d. EXTRA

GLASS DOMED INSULATORS

With threaded terminal top and metal lead-through rod. Dome dim.: 2½in. x 1¾in. high, lead-through projects 6½in. Overall length 9¾in.

ASK FOR X/H54 — **2/-** each — POST 3d. EXTRA

MICROPHONE, Ref. 10A/14381

(Flying Helmet type)

Electro Magnetic 500 ohms. with switch, lead and 2 way sockets.

ASK FOR X/E16 — **3/11** each — POST 6d. EXTRA

WALNUT-FINISH WOOD RADIO CABINET

Dim.: Internal H. 8½in. x L. 15⅝in. x D. 7⅞in. approx. External, H. 9½in., x L. 17in., x D. 8in. approx.

ASK FOR X/H394 — **12/6** each — POST PAID

VOLUME CONTROLS

Potentiometers, Carbon Track. ½ meg. (500,000 ohms), long spindle, fitted DP/ST switch and mtg. plate.

ASK FOR X/E189 — **3/11** each — POST 3d. EXTRA

W.W. POTENTIOMETERS

2 watt by Clarostat, U.S.A. 10,000 ohms. Ref.: CMC-63532 Preset.

ASK FOR X/H957 — **2/6** each — POST 3d. EXTRA

MORSE PRACTICE BOARD ONLY

Comprises key, buzzer and 'phone terminals on board 6½in. x 6½in. x ½in with battery clamps.

ASK FOR X/E1X — **5/6** each — POST 9d. EXTRA

HALF MILE REELS (880 YARDS)

23 s.w.g. P.V.C. covered signal corps wire.

ASK FOR X/H855 — **25/-** per reel — CARRIAGE PAID

METAL (MINE) DETECTOR NO. 5A

Amplifier Unit with Search Coil Assembly ZA.22158.

An A.F. Amplifier, employing 3/ARP12s (VP23) valve mounted, with battery space in metal case 11in. x 11in. x 4½in., plus small metal box fitted with controls, which can be fitted to search coil, with slight modification (details supplied), and used for finding buried metal. Power requirements are 6 "S" type 1½ volt cells, and a 60/90 volts H.T. battery (not supplied).

ASK FOR X/E768 — **39/6** each — CARRIAGE PAID

SUITABLE AS UNIVERSAL ELECTRIC MOTORS

For 200/250 v. A.C. or D.C. mains. By simple external wiring, full data supplied. New method gives better than 1/6th H.P. with MG.29, or approx. ¼ H.P. with MG.30.

MOTOR GENERATOR TYPE 29

as Generator. Input 24 v. 16 a. Output 1,200 v. 200 mA. Dim.: 11in. x 5¼in. x 5¼in.

ASK FOR X/E880 — **17/6** each — CARRIAGE PAID

MOTOR GENERATOR TYPE 30

Ref. 10K/21. Input 9.3 v. 23 a. Output 7.2 v. 13 a. 255 v. 110 mA. Size: 12in. x 5¼in. x 5in.

ASK FOR X/H488 — **15/-** each — CARRIAGE PAID

COOLANT PUMP, by Packard, U.S.A.

A turbine type pump, directly driven from semi-ball joint splined socket (by motor NOT SUPPLIED) clockwise rotation. Dim.: overall 11¼in. x 7¼in. x 13in.

ASK FOR X/H407 — **39/6** each — CARRIAGE PAID

HAND OPERATED WOBBLE PUMP, R98, BC-1444

Reciprocating action provides a suction and exhaust action to each stroke. Designed to pump hydraulic oil to a maximum reservoir pressure of 750 lb. per square inch. This pump is capable of drawing water from approximately 5 feet below its own level, and exhausting same to a height of 4 feet above its own level, at a rate of 60 strokes per quart. Inlet and outlet threaded nozzles fitted at one end of the unit. Suspension arms and rams fitted at the other end.

Length of Pumping Handle 27¼in. Length of pump overall 8in. Height of pump overall 4in.

ASK FOR X/H568 — **12/6** each — POST PAID

FUEL PUMP (STANDARD) TYPE 36R/82450

Part No. FB66881.

A Rotary unit with two pump chambers each having 4 blades, complete (less motor) with inlet and outlet valves, gear wheel, drive with ⅜in. spindle. Diecast aluminium body, 6 hole mtg. at gear end. Overall dim.: 6¾in. x 4¼in. x 4¼in. Wgt. 4½ lb.

ASK FOR X/H922 — **16/6** each — POST PAID

ROTARY PUMP, 24 v D.C. 2.5 AMPS. Ref. 5U/2492.

¾in. bore inlet, ¾in. bore outlet. 4¼in. flange for connecting to tank. Ideal for pumping oil, petrol, water, etc. Diecast constructions with brass rotor blades. Dim.: 4½in. x 7in. x 7½in. Wgt. 5 lb.

ASK FOR X/H944 — **£1.15.0** each — POST PAID

DIRECT CURRENT GENERATOR TYPE 3D3G. Ref. 42U/506

Output 14/32 v. 9 amps. 2,500 r.p.m. ¾in. dia. splined spindle 1in. projection. Size 11in. x 7in. x 6in., Wgt. 31 lb. Can be used as a battery charger or low voltage lighting generator, when driven by a motor or petrol engine.

ASK FOR X/H937 — **£2.19.6** each — CARRIAGE PAID

ENGINE DRIVEN GENERATOR TYPE KX. Ref. 5U/190. In Manufacturer's Carton.

24 volts, 1,500 watts (rotation clockwise). splined spindle: Dia. ¾in., projects ¾in., overall size 14in. x 8¼in. Wgt. 27 lb. 4 hole fixing. Speed: 3,500-5,000 r.p.m.

ASK FOR X/H880 — **£3.15.0** each — CARRIAGE PAID

Order direct from:— *Phone : South 2706/9.*

CLYDESDALE SUPPLY CO. LTD. **2, BRIDGE STREET, GLASGOW · C.5**

R.1155 RECEIVERS

BRAND NEW AERIAL TESTED BEFORE DESPATCH

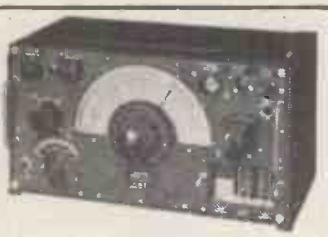
These well-known ex-Air Ministry Receivers need no further introduction. Supplied complete with 10 valves and full circuit data.

LASKY'S PRICE. BRAND NEW £11/19/6

Secondhand. Grade 1 **£9/19/6**

Secondhand. Grade 2 **£7/19/6**

Carriage 17/6 per receiver extra. including 10/- returnable on case.



ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER

For use on 200-250 v. A.C. mains. Complete with 2 valves. In metal case size: 12 × 7 × 5½ins. **LASKY'S PRICE,** 79/6. Carr. 5/- extra. **Power Pack** as above. Fitted with 6½in. p.m. speaker. **LASKY'S PRICE,** £5/5/-. Carriage 5/- extra.

SUPERHET COIL PACKS
With Circuit.

No. 1. L.M.S.G. Size: 4¾ × 5 × 2½in. With ¼in. spindle. 19/6.

No. 2. M.S.S. Size: 4 × 4 × 3in. With ¼in. spindle. 16/-.

Both for use with 465 Kc/s. I.F.

TABLE TELEVISION CABINETS

For 12 and 14 inch C.R. tubes. Beautifully finished in polished medium walnut veneer. Complete with mask, glass, speaker - fret. Internal dimensions:— 15in. wide. 16in. deep, 14in. high.

LASKY'S PRICE 39/11 Carriage 7/6 extra.

Also available in unpolished veneer.

LASKY'S PRICE 19/11 Carriage 7/6 extra.

SOLON SOLDERING IRONS
220-250 volts

Latest model instrument iron.. 19/8

Standard model 19/–

1-lb. REELS OF RESIN CORED SOLDER. LASKY'S PRICE 7/6.

HEARING AIDS

By well-known Manufacturer. In metal case, size: 2½in. × 4½in. × 1in. Complete with batteries and 3 sub-miniature valves. Only two controls: volume and on/off. Fitted with internal crystal microphone.

Used condition.

LASKY'S PRICE 39/6. Postage 2/6 extra.

Earpiece and cord for use with hearing aid. **LASKY'S PRICE** 17/6.

GANGED TUNING CONDENSERS
.0005 MFD.

Standard 2-gang. Size: 2¾ × 1¾ × 2½in. ¼in. Spindle. 5/-.

Standard 3-gang. Size: 2¾ × 1¾ × 3½in. ¼in. spindle. 7/6.

Midget 2-gang with trimmers. Size: 1¾ × 1¾ × 2½in. ¼in. Spindle. 7/6.

Midget 3-gang with trimmers and perspex cover. Size: 1¾ × 1¾ × 2¾in. ¼in. Spindle. 12/6.

Special Clearance Lines. Callers Only.

TAPE RECORD AMPLIFIERS. Fully wired but untested. With 6 valves: 2-6J7, 2-6V6, 1 each 5Z4 and 6J5. **PRICE £4/19/6.**

DINGHY AERIALS. WIRE MESH. 3/11.

MICROPHONE FLOOR STANDS. 2 Section Chrome. Heavy Base. 35/-.

TABLE MICROPHONE STANDS. 2 Section Chrome. Heavy base. 12/6.

J/RA/3 AMPLIFIERS. As previously advertised, complete with all valves, but less output transformer. **LASKY'S PRICE £7/10/-.**

MAGNETIC RECORDING TAPE. SPECIAL OFFER

Plastic. 600 feet reels. 6/11.
Paper Base. 1,200 feet reels. 17/3. Postage 1/6. per reel extra.

TANNOY PRESSURE UNITS

10 watts. 7.5 ohms impedance. Last few only.
PRICE 59/6

AERIAL ROD SECTIONS

Steel, heavily copper plated. 12in. long, ¼in. diameter. Any number may be fitted together. **PRICE** 2/6 per doz. POST FREE.

300 PF. FEED THROUGH CONDENSERS

Ceramic. 6d. each. 4/6 per dozen.

20 PF. AIR SPACED TRIMMERS

9d. each. 7/6 per dozen.

RADIO CABINETS

Size: 12in. wide, 6½in deep, 8in. high. Finished in medium walnut veneer, with high polish. Complete with back, chassis, and dial, calibrated L. M. and S. **LASKY'S PRICE 16/11.** Carriage 2/6 extra.

L. AND M. DUAL WAVE SUPERHET COILS

Aerial and Oscillator. 5/11 pair.

L. AND M. WAVE T.R.F. COILS
With circuit 4/6 pair.

INTERCOM. UNITS

4-station operation. For use on A.C./D.C. mains 200-250 volts. Complete, with 3 valves. Fitted in attractive plastic cabinet. **MASTER UNIT £5/19/6.** Carr. 5/- extra. **Extension Units.** Price 21/- each complete. Carriage 2/- each extra.

CAR RADIO AERIALS

2 section, chrm., 75 inches. Side fitting. 15/-. Post 3/6.

THE UNIVERSAL A.C./D.C. TELEVISOR AND RADIOGRAM

A 30-page booklet giving full instructions for building a large 17 inch screen T.V. receiver, and a 3-speed auto-change gram. as an extra.

* A.C./D.C. Mains.
* Table T.V.
* P.M. Focusing
* Mullard valves and C.R.T.
* 5 Channel Superhet
* Gram and T.V. entirely separate.

PRICE 3d. POST FREE.

"THE HARROW" Baffle Radio Cabinet

Build a second set to be proud of. Pleasing design cabinet, with drilled chassis, dial, drive and back. Finished in satin mahogany veneer. Outside dims.: 17½in. wide, 11½in. high, 5in. deep.

LASKY'S PRICE 36/6

Carriage 2/-.

Receiver design uses 2-6K7, 6V6 and 5Z4. Total cost to build is less than £5/10/-.

Circuit for receiver 1/6.

P.M. LOUDSPEAKERS

All with 3 ohm speech coil.

2½in., 15/-. 5in., 14/6. 8in., 19/11. 3in., 14/6. 6½in., 15/-. 10in., 19/6. 4in., 12/6.

I.F. TRANSFORMERS 445-520 Kc/s.

Miniature ¾ x ¾ x 2½in. 9/6 pair
Midget, 1 x 1 x 2½in. 8/6 pair
Wearite 500 and 550 8/6 pair

ENERGISED SPEAKERS

8in. with O/T 600 ohm field 15/6
8in. less O/T 600 ohm field 12/6
8in. less O/T 1,200 ohm field 12/6
6½in. with O/T 600 ohm field 14/-

SPECIAL OFFER. BY FAMOUS MANUFACTURER. FRUSTRATED EXPORT ORDER

6 VOLT D.C. RADIO RECEIVER

Uses 4 valves, vibrator and metal rectifier. Valve line up: ECH35, EF39, EBC33, EL32. 8in. P.M. Speaker fitted. In attractive polished walnut veneer cabinet. Size 19 × 8 × 15in. Full vision dial, battery economy switch, p-u. sockets, tone control. Superhet. Wavebands: 200-500 metres; 50-120 metres; 20-50 metres; 10-20 metres.

BRAND NEW AND UNUSED. COMPLETE WITH VALVES.

LASKY'S PRICE £9/19/6. Carriage and packing 10/6 extra.

BAKER'S SELHURST SPEAKERS

"Stalwart." 12in. 15 ohms impedance. Frequency response 30-13,500 c.p.s. Power handling capacity 15 watts, peak A/C. **PRICE £5/10/-.**

"Standard." 12in., 15 ohms impedance. Frequency response 30-14,500 c.p.s. Power handling capacity 20 watts, peak A/C. **PRICE £6/10/-.**

"De-Luxe." 12in., 15 ohms impedance. Re-entry cone. Frequency response 18-17,000 c.p.s. Power handling capacity 15 watts, peak A/C. **PRICE £8/10/-.** CARRIAGE 3/6 per speaker extra.

CAR RADIO SPECIAL—PARTLY ASSEMBLED CAR RADIOS

Small size case, 12 × 4 × 6in. Will fit most cars. For either 6 or 12 volts, depending on vibrator. Chassis supplied with 5 octal valve holders, medium wave aerial and oscillator coils output transformers, volume control, sundry resistances and condensers, dial and knobs. Case finished in brown crackle. Dial calibrated 150-550 metres, 5 valves to suit. One each, either GT or metal: 6SA7, 6R7, 6V6, 6K7, OZ4.

LASKY'S PRICE £5/5/-. Carriage 5/- extra. Or less valves, 69/6. Carriage 5/- extra. Other chassis in various conditions of completion are available for personal callers only. CIRCUIT for 5 valve car radio, using above chassis. PRICE 1/6.

TELESCOPIC PORTABLE AERIAL MASTS

Lightweight but extremely strong alloy. Extends to 15 feet. Guyed at at top and centre complete with all guys.

LASKY'S PRICE 32/6. Carriage 2/6 extra.

A LASKY'S RADIO ADVERTISEMENT. SEE OVER.

THE TELE KING

5 CHANNEL 16 or 17 INCH SUPERHET RECEIVER

WIDE ANGLE — LARGE SCREEN

This famous and well tried home constructor set can now be built for £29/10/- including valves. Only tube and cabinet extra.

EVERY COMPONENT CAN BE SUPPLIED SEPARATELY.

Full constructional data, wiring diagrams and circuits. **Price 6/-** POST FREE.

WRITE NOW FOR OUR NEW TELE KING PRICE LIST. WE CAN SAVE YOU MONEY.

LASKY'S RADIO

A MULTI CHANNEL TUNER FOR THE TELE KING WILL BE AVAILABLE SHORTLY.

Co-axial Cable. 75-80 ohms impedance. Single Core. 8d. per yard. Twin Core, 1/- per yard. Twin Balanced Feeder, 6d. per yard.

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/-

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.**

HIGH VOLTAGE E.H.T. CONDENSERS

.1 + .1 mfd. 3.5 Kv.	5/11
.1 mfd. 7 Kv.	15/-
.001 mfd. 12.5 Kv.	7/6
.001 mfd. 15 Kv.	10/-
.0005 mfd. 10 Kv.	3/6
.0005 mfd. 15 Kv.	6/6
.04 mfd. 12.5 Kv.	5/-

SPECIAL T.V. CONDENSERS

64 mfd. 450 v.w.	3/11
100 mfd. 450 v.w.	4/11
32 + 100 mfd. 450 v.w. ..	7/6
100 + 200 mfd. 350 v.w...	5/11

CYLDON 5 CHANNEL T.V. TUNERS

Uses two valves, EF80 (6BW7) as R.F. amp. and ECC81 (12AT7) as frequency changer. Instant and positive selection of any channel by switching incremental inductances. Power gain 24dB, I.F. frequency output 9.5-14 Mc/s or 15.5-22 Mc/s. With full details and circuit diagram. Supplied less valves. Size:—4½ × 2¾ × 2½in. The Tuner with Valves. **LASKY'S PRICE 37/6.** Post 2/6 extra.

12/6
LESS VALVES
POST FREE

MANUFACTURERS SURPLUS T.V. COMPONENT BARGAINS

WIDE ANGLE 38 mm.

Line E.H.T. trans., ferroxcube core. 9-16 Kv.	25/-
Scanning Coils, low imp. line and frame	25/-
Frame Output Transformer	10/6
Scanning Coils low imp. line and frame	17/6
Frame blocking osc. transformer	7/6
Line blocking osc. transformer, caslam cored	6/6
Focus Magnets Ferroxdure ..	25/-
P.M. Focus Magnets. Iron Cored	19/6
Duomag Focalisers	29/6
300 m/a. Smoothing chokes	15/-
Electro magnetic focus coil, with combined scan coils ...	25/-

STANDARD 35mm.

Line Output Transformers. No E.H.T.	12/6
Line Output Transformers. 7-9 Kv. E.H.T. and 6.3 v. winding	19/6
Scanning coils. Low imp. line and frame	12/6
Scanning Coils. Low imp. line and frame, by Igranic	14/6
Line blocking oscillator transformer	4/6
Frame blocking oscillator transformer	4/6
Frame output transformer ..	7/6
Focus Magnets. Without Vernier	12/6
With Vernier	17/6
Focus Coils. Electromagnetic	12/6
200 m/a. Smoothing chokes	10/6

PERSPEX IMPLOSION GUARDS, incorporating escutcheon and filter plate.

12in.	12/6
12in. de Luxe	15/-
16in. de Luxe	17/6

MAINS TRANSFORMERS
All 200-250 v. 50 c.p.s. primary Finest quality, fully guaranteed.
MBA/3. 350-0-350 v. 80 mA. 6.3 v. 4 a., 5 v. 2 a. Both filaments tapped at 4 volts. An ideal replacement trans. Price 18/-.
MBA/6. 325-0-325 v. 100 mA. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. Price, 22/6.
MBA/7. 250-0-250 v. 80 mA. 6.3 v. 3 a., 5 v. 2 a. Both filaments tapped at 4 volts Price, 18/-.
MBA/8. SPECIAL OFFER Drop through type. 235-0-235 v. 60 mA. 6.3 v. 3 a. 12/6.
MBA/9. 400-0-400 v. 60 mA. 6.3 v. 1 a., 4 v. 2.5 a. Price, 12/6.
AT/3. Auto transformer. 0-10-120, 200-230-240 volts 100 watts. Price 17/6.

C.R.T. MASKS. Brand New LATEST ASPECT RATIO

9in.	7/-
10in.	7/6
12in.	15/-
12in. Flat Face	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/-

ARMOUR PLATE GLASS

16in. Actual size 17⅛ × 15⅛ × ⅛in.	7/11
15in. Actual size 16⅛in. × 13in. × ⅛in.	6/11
12in. actual size 13in. × 10⅛in. × ⅛in.	4/-
9in. actual size 9in. × 8in. × ⅛in.	3/-

TRIPLEX DARK SCREEN FILTERS

14 × 12⅛ × 3/16in.	7/6
15⅛ × 13¼ × 3/16in.	9/6

Postage and packing 5/- per piece extra. (This charge is necessary owing to extra packing required).

C.R.T. Neck Protectors 2/6.

FAMOUS MANUFACTURERS TAPE RECORDER AMPLIFIERS

Complete with 5 valves. For 200-250 volts A.C. mains. Finest quality components throughout. Twin Inputs. Volume control, and record level control. Speaker on/off switch. On steel chassis, black crackle finish. Size 11½ × 2½ × 9in. Valve line-up: 2 6V6, 2 6SN7, 1 5Z4. Full circuit supplied. Complete with 8in. speaker and all valves.

LASKY'S PRICE COMPLETE £9/19/6. Less Cover, £8/15/-. Less cover and head lift transformer £7/15/-. Carriage 5/- per unit extra.

SPECIAL OFFER. 12 INCH CATHODE RAY TUBES. Standard types, suitable for T.V. LIMITED QUANTITY. **LASKY'S PRICE £12/19/6.** Carriage and insurance 15/- extra.

ION TRAPS. All types 3/-.

S.T.C. SENTERCEL RECTIFIERS
R.M.1 3/10; R.M.2. 4/3; R.M.3., 5/-; R.M.4 16/-. K3/40, 3.2 kV., 6/-; K3/45, 3.6 kV. 8/2; K3/50, 4.0 kV. 8/8; K3/100, 8.0 kV. 14/8; K3/160 12.8 kV. 21/6. K3/200 16 Kv., 26/-.

FILAMENT TRANSFORMERS
200-250 v. primary 50 c.p.s. 6.3 v. 1.75 a., 6/6. 6.3 v. 3 a., 9/6.

FOR CALLERS ONLY
Secondhand cathode ray tubes. With heater-cathode short and/or ion burns. 9in. 35/-. 12in. 55/-.

LASKY'S RADIO

LASKY'S (Harrow Road) Ltd.,

370 HARROW RD., PADDINGTON, LONDON, W.9

(Opposite Paddington Hospital)

Telephone, all departments: CUNningham 1979/7214.

Please Add a Reasonable Amount For Postage.

SELENIUM RECTIFIERS

L.T. Types		H.T. Types H.W.	
2/6 v. ½ a.h.w....	1/9	90 v. 20 mA....	3/6
6/12 v. ½ a.h.w.	2/9	120 v. 40 mA.	3/11
		250 v. 50 mA.	5/9
F.W. Bridge Types		250 v. 80 mA.	7/9
6/12 v. 1 a.	5/9	RM2 125 v. 100 mA	3/11
6/12 v. 2 a.	9/9	RM3 125 v. 120 mA	4/11
6/12 v. 4 a.	14/9	RM4 250 v. 250 mA	11/9
6/12 v. 6 a.	19/9	300 v. 275 mA.	12/11
6/12 v. 10 a. ...	29/9		

CO-AXIAL CABLE. 75 ohms ¼in., 7d. yard. Or in 20yd. lengths, 6d. yd. Twin screened feeder, 9d. yd.

RHEOSTATS (VARIABLE RESISTORS) 2 ohms 5 amps, 6/9; 7.5 ohms 5 amps. 8/9; 0.4 ohm 25 a., 8/9; 10 ohm 3 amps, 8/9; 150 ohms 1.5 amps, 14/9. All complete with control knob.

SILVER MICA CONDENSERS. 5, 10, 15, 20, 25, 30, 35, 50, 100, 120, 150, 180, 200, 230, 300, 330, 400, 470, 500, 1,000 pfd. (.001μF), .002 mfd. (2,000 pfd.). All at 5d. each, 3/9 dozen one type.

DIAL BULBS, M.E.S., 8 v. 0.15 a., 6/9 doz.; 6.5 v. 0.15 a., 6/9 doz.

ELECTROLYTICS (Current production) NOT ex-Govt.

Tubular Types		Can Types	
8μF 450 v. ...	1/11	16μF 450 v. ...	2/9
16μF 350 v. ...	2/3	24μF 350 v. ...	2/11
16μF 450 v. ...	2/9	32μF 350 v. ...	2/11
16μF 500 v. ...	3/9	32 mfd. 450 v.	4/9
24μF 350 v. ...	3/3	64 mfd. 450 v.	4/9
32μF 350 v. ...	3/9	8-8μF 350 v....	3/9
32 mfd. 500 v.	5/9	8-8μF 450 v....	3/11
8-16μF 500 v.	4/11	8-8 mfd. 500 v.	4/9
25μF 25 v. ...	1/3	8-16μF 450 v.	2/11
50μF 12 v. ...	1/3	16-16μF 450 v.	4/11
50μF 50 v. ...	2/3	16-32μF 350 v.	4/9
Can Types		16-32 mfd. 450 v.	4/9
8mfd. 350 v.	1/3	32-32μF 350 v.	4/9
8mfd. 450 v.	2/3	32-32μF 450 v.	5/11
8mfd. 500 v.	2/9	60-100 mfd. 450 v.	7/9
16mfd. 350 v.	1/11		

AMPLIFIER OR CHARGER CASES. Size 14¾ × 5⅜ × 7¼ins. high. Strongly made in perforated steel. Grey enamel finish. Only 9/6.

R.S.C. TRANSFORMERS

FULLY GUARANTEED, INTERLEAVED AND IMPREGNATE

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
300-0-300 v. 60 mA., 12 v. 1.5 a., c.t.....	18/11
250-0-250 v. 100 mA., 6.3 v.-4 v. 4 a., c.t., 0-4-5 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 v. 4 a. c.t., 0-4-5 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.	22/9
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
350-0-350 v. 250 mA., 6.3 v. 6 a., 4 v. 8 a., 0-2-6 v. 2 a., 4 v. 3 a., for Electronic Eng. Televisor	69/6
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
425-0-425 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
275-0-275 v. 80 mA., 6.3 v. 3 a., 4 v. 2.5 a	14/11
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 or ACR2X 36/6
5,000 v. 5 mA., 2 v. 2 a..... 39/6

FILAMENT TRANSFORMERS
Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a. ...	5/9	6.3 v. 2 a.....	7
6.3 v. 3 a.	9/6	0-4-6.3 v. 2 a....	1
12 v. 1 a.	7/11	6.3 v. 6 a.	1
0-2-4-5-6.3 v. 4 a.	16/9	12 v. 3 a. or 24 v. 1.5 a.	1

CHARGER TRANSFORMERS
All with 200-230-250 v. 50 c/s Primaries: 0-9-15 1.5 a., 12/9; 0-9-15 v. 3 a., 16/9; 0-9-15 v. 6 22/9; 0-4-9-15-24 v. 3 a., 22/9; 0-9-15-30 v. 3 23/9.

ELIMINATOR TRANSFORMERS
Primaries 200-250 v. 50 c/s. 120 v. 40 mA. 7/
120 v. 40 mA. 5-0-5 v. 1 a. 14/

OUTPUT TRANSFORMERS

Midget Battery Pentode 66: 1 for 3S4, etc.	3/
Small Pentode, 5,000Ω to 3Ω	3/
Standard Pentode 5,000Ω to 3Ω	4/
Standard Pentode, 8,000Ω to 3Ω	4/
Standard Pentode, 10,000 ohms to 3 ohms	4/
Multi-ratio 40 mA. 30:1, 45:1, 60:1, 90:1, Class B Push-Pull	5/
Push-Pull 8 Watts 6V6 to 3 ohms	8/
Push-Pull 10-12 Watts 6V6 to 3Ω or 15Ω...	15/
Push-Pull 10-12 Watts to match 6V6 to 3-5-8 or 15Ω	16/
Push-Pull 15 Watt 6L6s, KT66s, etc. to 3 or 15 ohms.....	19/
Push-Pull 20 Watts high-quality sectionally wound 6L6, KT66, etc., to 3 or 15Ω.....	47/
Williamson type, exact to author's spec.	85/

SMOOTHING CHOKES

250 mA., 3 H. 50 ohms	11/
150 mA. 7-10 H. 250 ohms	11/
100 mA., 10 H. 200 ohms	8/
80 mA., 10 H. 350 ohms.....	5/
60 mA., 10 H. 400 ohms.....	4/
50 mA., 40 H. 1,000 ohms Potted	10/
20 mA., 30 H. 1,000 ohms	4/

MICROPHONE TRANSFORMERS
100:1 ..... 5/

VOLUME CONTROLS with long spindles, all values less switch, 2/9; with S.P. switch, 3/9.

WIRE WOUND POTS: 20 ohms, 500 ohms, 1,000 ohms, 5K, 20K, 50K (medium length spindles), 2/9. 220 ohms, 2K, 10K, 20K, 50K Preset type, 1/9 ea.

AMMETERS. Moving coil. G.E.C. 0—5 amps, 2in. scale, 11/9.

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 any 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 £4/16/- including cabinet.

EX. GOVT. MAINS TRANSFORMER
All 230 v. 50 c/s input.

250-0-250 v. 40 mA., 6.3 v. 2 a., 5. v 2 a.	9/
8.8 v. 4 a.	9/
48 v. 1 a.	9/
175 v. 200 mA.	9/
0-11-22 v. 15 a.	35/
0-11-22 v. 30 a.	72/
10/20 v. 35 a.....	79/
7.7 v. C.T. 7 amps 4 times	25/
460 v. 200 mA., 6.3 v. 5 a.	27/
300-0-300 v. 150 mA., 610-0-610 v. 150 mA., 1,220 v. 350 mA.	29/

EX-GOVT. SMOOTHING CHOKES

250 mA., 10 H. 50 ohms.....	14/
250 mA. 10 H. 100 ohms.	14/
250 mA. 3 H. 50 ohms. Potted	8/
150 mA. 10 H. 50 ohms	10/
100 mA. 10 H. 100 ohms, Tropicalised ...	6/
100 mA. 5 H. 100 ohms. Tropicalised	3/
50 mA. 50 H. 1,000 ohms. Tropicalised ...	3/
90/100 mA. 10 H. 100 ohms. Potted	8/
50 mA. 5-10 H.	2/
L.T. type 1 amp.	2/

EX-GOVT. T.V. TYPE TRANSFORMERS. Al
230 v. 50 c/s input.

2800 v. 30 mA.....	22/9
400 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. TRANSMITTER-RECEIVER TYPE TR9D, complete with all valves, only 47/9, plu carr. 5/-.

EX-GOVT. E.H.T. SMOOTHING CONDENSERS

.02 mfd. 8,000 v. Cans	1/11
.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. or 3 in wood carrying case 9 × 7 × 5in., 14/9, plus 3/6 Carr.

EX-GOVT. BLOCK PAPER CONDENSERS

2 mfd. 800 v....	1/9	4 mfd. 2000 v....	6/9
4 mfd. 500 v....	2/9	6-6 mfd. 500 v.	5/9
4 mfd. 750 v....	3/9	8 mfd. 500 v....	5/9
4 mfd. 1500 v....	4/9	11-7 mfd. 500 v.	8/9
		15 mfd. 500 v....	7/9

4 mfd. 400 v. plus 2 mfd. 250 v. 1/11

EX-GOVT. AUTO TRANSFORMERS 50 c/s.

Double Wound 10-0-220-200-240 v. to 10-0-270-290-310 v. 200 watts	25/9
15-10-5-0-195-215-235 v. 200 watts	25/9
0-110-190-230 v. 400 watts	49/6
Double Wound 220/240 v. input. Output 55 v. to 230 v. 21 amps in steps of 11 v....	£6/15
Double Wound 10-0-200-220-240 v. to 10-0-275-295-315 v. 500 watts	69/6

M.E. SPEAKERS. All 2-3 ohms, 6½in. Rola-field 700 ohms, 11/9. 10in. R.A. field 600 ohms, 23/9. 10in. R.A. field, 1,500 ohms 23/9. 10in. R.A. field 1,000 ohms, 23/9.

P.M. SPEAKERS. All 2-3 ohms. 2½in. Celestion, 14/9. 3½in. Goodmans (Ex New Units), 10/9. 4in. Goodmans, 14/11. 5in. Goodmans, 15/6. 6½in. Goodmans, 16/9, 8in. Plessey, 15/9, 10in. Rola, 27/9. 10in. Plessey, 18/6. 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.

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, 37/6.

CHASSIS

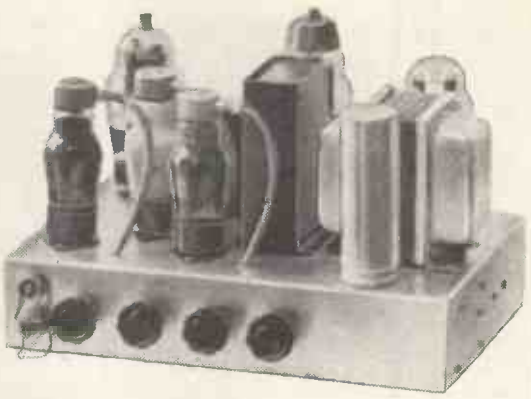
18 s.w.g. undrilled aluminium amplifier type (4-sided).	16 s.w.g. aluminium, receiver type.
12in. × 9in. × 2½in.... 6/11	12in. × 8in. × 2½in.... 5/3
14in. × 9in. × 2½in.... 6/11	16in. × 8in. × 2½in.... 7/6
14in. × 10in. × 3in.... 7/11	20in. × 8in. × 2½in.... 8/11
10in. × 10in. × 3in.... 8/3	
18 s.w.g. aluminium receiver type.	16 s.w.g. aluminium, amplifier type, 4-sided.
6in. × 3½in. × 1½in.... 1/11	12in. × 8in. × 2½in.... 7/11
7½in. × 4½in. × 2½in.... 2/9	16in. × 8in. × 2½in. 10/11
10in. × 5½in. × 2in.... 3/3	20in. × 8in. × 2½in. 13/6
11in. × 6in. × 2½in.... 3/11	14in. × 10in. × 3in. 13/6

R.S.C. 25 WATT "PUSH-PULL" AMPLIFIER

Now firmly established and proving extremely popular, our A11 Quality Amplifier we consider to be the best value in amplifiers offered to-day. The volume of its high fidelity reproduction is completely controllable, from the sound of a quiet intimate conversation to the full glorious volume of a great orchestra. Its sensitivity is so high that in areas of fair signal strength it can be operated straight from a crystal receiver. Entirely suitable for standard or long-playing records in small homes or in large auditoriums. For electronic organ or guitar or for garden parties or dance bands.

The kit is complete to the last detail, and includes easy to follow point-to-point wiring diagrams.

Twin volume controls with twin input sockets allow SIMULTANEOUS INPUTS for BOTH MICROPHONE and GRAM, or TAPE and RADIO. SEPARATE BASS and TREBLE CONTROLS giving both LIFT and CUT. FOUR NEGATIVE FEEDBACK LOOPS with 15 db in the main loop from output transformer to voltage amplifier. Frequency response ± 3 db 50-20,000 c.p.s. Hum and distortion LESS THAN 0.5 per cent. measured at 10 watts. This is comparable with some of the highest priced amplifiers. Six B.V.A. valves, Marconi-Osram KT series output valves. A.C. only, 200-230-250 v. 50 c/s. input. 420 v. H.T. LINE. Paper reservoir condenser. Compact chassis. Matched components. OVERALL SIZE 12 × 10 × 9in. approx. Output impedances for 3 and 15 ohms speakers.



Available in kit form at the amazingly low price of **9 gns.** Plus carriage 5/- Or ready for use 50/- 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.**

CONNOISSEUR HIGH FIDELITY LIGHTWEIGHT MAGNETIC PICK-UP COMPLETE WITH MATCHING TRANSFORMER. A fortunate purchase enables us to offer limited supplies. Brand New, Boxed and Perfect at a fraction of normal price. Buy Now at only **26/6.**

COLLARO 3-SPEED AUTOMATIC RECORD CHANGERS (brand new), type 3RC/521, complete with 2 plug-in Crystal P.U. heads for long playing or standard records 7, 10 or 12in. Not intermixed. Mains input 200-250 v. Limited number available at only **£9/19/6,** plus carr. 5/-.

COLLARO 3-SPEED MIXER AUTOCHANGER, Type 3RC/522 with 2 plug-in Crystal P.U. Heads with Sapphire Stylus for long playing or standard records. Plays 7, 10 and 12in. records intermixed. Limited number, Brand New, Cartoned. **£10/19/6** (approx. half price). Carr. 5/- extra.

COLLARO TAPE DESK MOTORS. Shaded pole type. Clockwise or anti-clockwise. Mains input 110-200-250 v., **31/6.**

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).

A PUSH-PULL 3-4 WATT HIGH-GAIN AMPLIFIER FOR £3/12/6

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, **7d.**

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 also 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 **30/-** each. Full descriptive leaflet 10d.

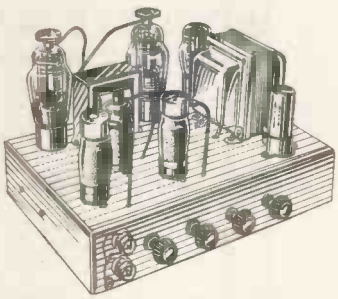
The Master Unit can be supplied assembled and tested for **30/-** extra.

PERSONAL SET BATTERY SUPERSEDER KIT.

All parts for an "All Dry" Battery Eliminator. Complete with case. Supplies 90 v. 10 mA. and 1.4 v. 250 mA. fully smoothed, from normal. 200-250 v. 50 c/s mains. For 4-valve superhet receivers. Price with circuit, **35/9.** Or ready for use, **42/6.** Size of unit 5½-4-1½in

BATTERY SET CONVERTER KITS. All parts for converting any type of battery receiver to all mains. A.C. 200-250 v. 50 c/s. Kit will supply fully smoothed H.T. of 120 v. 90 v. or 60 v. at up to 40 mA., and fully smoothed L.T. of 2 v. at 0.4 a. to 1 a. Price complete with circuit and instructions only **48/9.** Supplied ready for use for **8/9** extra.

R.S.C. 10-watt "Push-Pull" HIGH-FIDELITY AMPLIFIER A3



Complete with integral pre-amp. Tone control stage (as A11 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. **Six Negative Feedback Loops.** Completely negligible hum and distortion. Frequency response ± 3 db. 30-20,000 c.p.s. Two independently controlled inputs. Six B.V.A. valves. A.C. mains 200-230-250 v. input only. Outputs for 3 or 15 ohm speakers. Kit of parts complete in every detail, **£7/19/6,** plus 5/- carriage, or ready for use, **45/-** extra. Descriptive leaflet **1/-.**

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 11-6-7⅓in. 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.

R.S.C. TONE CONTROL-PRE-AMP. UNIT. A complete set of parts for the construction of a very efficient but simple pre-amplifier and tone control unit. For use with any amplifier and pick-up. Fil. supply self-contained. Size 7½-5-5½in. approx. Descriptive leaflet 9d. Price, inc. wiring diagrams, **37/6.** Ready for use, **15/-** extra.

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.

(3) 1 min. Piccadilly Tube Station.

G.W. SMITH & CO. (RADIO) LIMITED

3-34 Lisle Street, London, W.C.2

Telephone: Gerrard 8204/9155

(34) 1 min. Leicester Square Tube Station

FOR ALL RADIO BARGAINS

DESK TYPE METERS. Fitted with 0/1milliamp. first grade moving coil meter, with 2½in. scale, resistance 100 ohms. Brand new, 25/-.

CRYSTALS. R.C.A. 100 kc/s frequency, 3 pin plug in type. 15/- each.

CRYSTAL DIODES. Wire Ended G.E.C., 1/6 each.

METER RECTIFIERS. Full Bridge 2 mA. S.T.C. Brand new, 5/6 each.

MIDGET 18 WAY PLUGS AND SOCKETS non reversible, size 2in. x ⅜in., 3/6 pair.

MICRO SWITCHES. Universal Change-over Type, size 2in. x ⅜in., 2/6 each, many other types available.

AMERICAN CONDENSERS. Wire ended, .1 mfd., .01 mfd., .02 mfd., .05 mfd., .005 mfd., all at 9d. each.

NITROGOL CONDENSERS, 4 mfd. 4,000 volt working, size 9in. x 5in. x 3½in., brand new, 22/6 each. Mansbridge Paper Condensers, 4 mfd. 2,000 volt working, size 5in. x 5in. x 2¾in., 7/6 each.

MULTI WAY TOGGLE SWITCH BOXES. Fitted with 16 Toggle type switches, brand new and boxed, 9/6 each.

AMERICAN ROTARY TRANSFORMERS. 12-volt D.C. input, output 255 volt 65 mA. size 4½in. x 2½in. Suitable for car radios or electric shavers. 22/6.

MUIRHEAD PRECISION BUILT KEY SWITCHES with Heavy Contacts. 8 pole 2-way. Brand new, 4/6 each, cost £2/15/- to make. Wonderful bargain.

CERAMIC TRANSMITTER SWITCHES. Extra heavy duty silver contacts, 3in. dia., 1 pole 6 way, 3 bank, 9/6. 1 pole 6 way 2 bank, 6/6 each. 1 pole 4 way 1 bank, 5/6 each.

H.R.O. 6-VOLT VIBRATOR POWER SUPPLY UNITS. Output 165 volt 80 mA. 6.3 volt @ 3 amps., 6X5 Rectifier, Choke and Condenser smoothed, cabinet size, 7in. x 7in. x 6in. supplied with clips and leads, brand new, 29/6 each.

CHOKES ALL EX-W.D.
20 Henry 120 mA. size 4in. x 3in. x 2½in., 10/6 each.
15 Henry 275 mA. size 4½in. x 4in. x 3in., 125 ohm. 10/6 each.
Swinging chokes, 150 mA 4/20 Henry, size 3½in. x 3in. x 3in., 7/6 each.
20 Henry 300 mA. 2,000 v. Insulation. Will pass 500 mA. 13/6 each.

TELEPHONE HANDSETS, Ex-American, Standard P.O. type, wonderful instruments, 12/6 each.

R.1155 2-SPEED SLOW MOTION CONDENSER DRIVES "A" type with double knobs, 3/6 each.

MICROAMP METERS. 0/100. 2½in. flush panel mounting, scaled 0/1500 yards, first-grade Instruments, brand new and boxed, 42/6 each.

ROTARY CONVERTORS. 12 volt D.C. input or 24 volt D.C. Input, output 230 volt A.C., 50 cycle at Ministry rating of 100 watts, 92/6 each.

UNISELECTOR SWITCHES. 4 Bank Double Wipers, coil resistance 25 ohm., 25 position, 32/6 each. Brand new.

HEADPHONES. Brand new, Canadian, "Northern Electric," finest ever produced, 50 ohm coils, complete with P.O. Jack Plug, 10/6 pair.

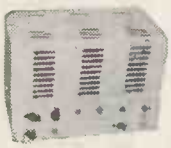
MAINS TRANSFORMERS. ALL EX-W.D. 500 x 500 volt 170 mA. 4 volt 4 amp. C.T. Insulation test 3,000 volts with ample room for additional windings if required, 22/6 each.
670 x 670 volt 200 mA. 6.3 volt 4 amp., 5 volt 3 amp., 49/6 each.

WELDING TRANSFORMER, output 11/13 volts at 70/100 amps., 72/6 each.

FILAMENT TRANSFORMERS, 6.3 volt 1½ amp., 230 primary, 5/9 each.

FILAMENT TRANSFORMERS, 6.3 volt 3 amp., 230 primary, 9/6 each.

WANTED. Good class Communication Receivers and test gear, send yours stating reasonable price, cash by return.



PUSH PULL AMPLIFIERS, 6V6 output, standard mains 200/50 A.C. input, variable tone control, matched output 3 or 15 ohm, £6/10/- complete.

METERS. All Brand New and Boxed. Milliamps. 0-1 mA., 2in. round, F/M M/coil, 12/6; 0-1 mA. 2½in. round, F/M M/coil, 22/6; 0-1 mA. 3½in. round, F/M M/coil, open scale, 39/6; 0-5 mA. 2in. square, F/M M/coil, 7/6. 0-10 mA. 2½in. round, F/M M/coil, 10/-; 0-100 mA., 2½in. round, F/M M/coil, 9/6; 0-150 mA. 2in. square, F/M M/coil, 7/6; 0-200 mA. 2in. square, F/M M/coil, 7/6; 0-200 mA. 2½in. round, F/M M/coil, 10/-.

AMPMETERS. 0-1 amp. 2½in. projecting, R.F., 7/6; 0-5 amp. 2½in. round, F/M, R.F. 7/6; 0-10 amp. 2in. square, F/M, M/coil, 8/6; 20/20 amp. 2in. round, F/M, centre zero, 6/6; 0-30 amp. 2in. square F/M M/coil, 7/6.

VOLTMETERS. 0/20 volt 2in. square, F/M, M/coil, 7/6; 0/40 volt 2in. square, F/M, M/coil, 7/6.

A.C. VOLTMETERS 50 CYCLE. 0-15 volt 2½in. round, F/M, M/I, 10/-; 0-20 volt 2½in. round, F/M, M/I, 10/-; 0-300 volt, 2½in. round, F/M, M/I, 25/-; 0-300 volt 5in. projection, M/I, 50/-.

TRADE ENQUIRIES INVITED.

SPEAKER TRANSFORMERS. 6V6 Push Pull to 15 ohm output, 7/6 each. Single ended 6V6 to 3 ohm, 3/6 each. Midget Speaker Transformers 1¼in. x 1in. x 1in., 3/6 each.

CERAMIC SWITCHES. 4 pole 3 way 3 bank, boxed, new, 6/6 each.

CERAMIC SWITCHES. 3 pole 4 way 4 bank, boxed, new, 10/6 each.

METER SWITCHES. Standard Yaxley type, 8 bank, single pole, 9, 11 or 12 way, size 2½in. diameter, switch length 5¼in. plus spindle 2½in., 7/6 each.

PYE 45 MEG I.F. STRIPS. Complete Television Strip with 6 EF50 valves and 1 EA50 valve. Size 14in. x 3¾in. x 3¾in. Finest strip ever produced, 69/6 each complete. Brand new.

PYE 45 MEG 2 VALVE PRE AMPLIFIER, as above, with 2 EF50 valves, size 6in. x 3¾in. x 3¾in. 15/6 each. Brand new.

TEST SETS TYPE 109. Brand new and boxed, fitted with 2in. 0/5 mA. M/C meter also 0-40 volt 2in. M/C meter, with mains plugs and leads and many other useful parts, size 6in. x 6in. x 3in., 12/6 each.

PLEASE PRINT YOUR NAME AND ADDRESS CLEARLY, ALSO INCLUDE POSTAGE OR CARRIAGE ON ALL ITEMS.

EX A. M. SWITCH BOXES fitted with 3 independent 5 amp. switches, size 3½in. x 2in. x 2in. Ideal for cars, boats and caravans, 1/9 each.
Ditto, 5 way, 3/6 each.

RELAYS. 50 volt A.C. with 2 pole change-over heavy duty silver contacts, size 4in x 3in. x 2½in., 10/6 each. Polarised Relays Twin, 600 ohm coils, 6/6 each.
We stock all types of relays, 600 and 3,000 types heavy and light contacts including platinum. Send us your enquiries, we ar the cheapest in the Trade.

P.O. MAGNETIC COUNTERS. Supplied with 3 ohm or 2,300 ohm coils, 5/6 each.

P.O. KEY SWITCHES, 2 pole change over, 2/9 each.

TYPE 4 WAVE METERS. Cavity Tuned Absorption wavemeter covering 200-220 Megacycles. Brand New and Boxed, supplied with V.U.39, S.P.61, E.A.50, and C.V.51 M/Eye Tuner 39/6 each.

AUTO TRANSFORMER. Heayberd 200/250 A.C. — 110 A.C. @ 750 watts, Ex W. D, brand new in strong metal carrying case. Size 9"x 8" x 6". £4.10.6 each.

SANGAMO WESTON GEARED 200/250 VOLT 50 CYCLE ELECTRIC MOTOR UNITS, self starting. 9/6 each.

VALVES. VU.111, VR65a, 6H6, 7193, CV6, VR.78, all at 2/3 each.

HOURS OF BUSINESS: 9 a.m.-6 p.m., Thursday 1 p.m. Open all day Saturday.

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., 6v. 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' 280-0-280, 200 mA., 6 v. 5 amp., 5 v. 3 amp., 27/6.

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.

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., 9 v., 3.5 amp., 12/6.

Pri. 200/250. Secondary 9 v. 3.5 amp., 6.3 v. 3 amp., 12/6.

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.

350-0-350 70 mA. 4 v. 4 a., 4 v. 2.5 a. C.T., 18/6.

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 contrasting walnut veneers, size 16½in. long, 11½in. high, by 12½in. wide. Complete with two pieces expanded aluminium in gold, 12×9in. and 5in. speaker baffle, 15/-. post paid.

P.M. SPEAKERS	with trans.	less trans.
2½in.	—	15/6
3½in.	—	13/6
5in.	16/6	12/6
6½in.	16/6	12/6
8in.	18/6	15/-
10in.	—	19/6

6½in. M.E. Speaker, 1,000 ohm field, 15/-.

R. & A. T.V. Energised 6½in. Speaker, field coil 175 ohms. Requires a minimum 150 mA. to energise, maximum current 250 mA., 9/6. P. & P. 2/6.

Extension Speaker Cabinet, in contrasting walnut veneer, size 15×10½in. Will take 6½ or 8in. speaker, 17/6.

Completely built All-dry Mains Unit by famous manufacturer, 200/250 v. Metal case size 8×5×3in., incorporating Westinghouse metal rectifiers, 3 500 mfd., 16×24 mfd., mains trans., 3 smoothing chokes, output 90 v. 10 mA., 1.4 v., 0.25 amp., 39/6. P. & P. 2/6.

Volume Controls. Long spindle 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.

Line Cord, 2-way 0.3 amp., 60 ohms per foot, 1/3 per yard.

Twin-Gang .0005, with feet, size 3¼ 3×1½in., 6/6.

3-gang .0005, with feet, size 4¾×3×1½in., 7/6.

T.V. Coils, moulded former, iron-cored, wound for rewinding purposes only. All-can 1½×1½in., 1/- each, 2 iron-cores all-can 2½×½in., 1/6 each.

Used Metal Rectifier, 250 v. 150 mA., 6/6.

Metal Rectifier. 250 v. 250 mA., 12/6.

Metal Rectifier. 230 v, 45 mA., 6/-.

Metal Rectifier. RM2, 125 v., 100 mA., 3/6.

D. COHEN

RADIO AND TELEVISION COMPONENTS

Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packing charge is not stated please add 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries, S.A.E., lists 5d. each.

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE.

23 HIGH STREET (Uxbridge Road) ACTON, W.3. Telephone: ACOrn 5901.

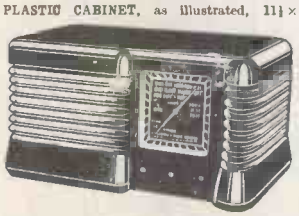
Hours of Business:

Saturday 9—5 p.m. Wednesday 9—1 p.m. Other days 9—4.30 p.m.

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.

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, 11½×6½×5½in., in Walnut, Cream and Green. also in polished Walnut complete with T.R.F. chassis, 2 wave-band 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.

AS ABOVE, complete with new 5in. speaker to fit, and O.P. trans, 35/-. P. & P. 3/6. With superhet chassis, 36/-. 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/-; 32×32 mfd., 4/-; bias condenser, 1/-; resistor kit, 2/-; condenser kit, 4/-; M. & L. Superhet Coils with circuits, 6/6; iron-cored 465 I.F.s, 7/6; min. gang, 5/6; volume control with switch 4/-; wave-change switch, 2/6; heater trans., 7/6; 4 v/h, 1/6; 4 obsolete ex-Govt. valves, metal rectifier and Xtal diode with circuit, 14/6; 25×25 mfd., 1/-; 16×16 mfd., 3/3; condenser kit (17), 7/6; resistor kit (14), 3/6.

Clydon 5 channel T.V. Tuner, uses 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 13×6½×2¼in., size of scale 7½×3½in. valve line-up 10C1, 10F9, 10LD11, U4C4 and 10P14. Twin mains filter input, 2 dial lights and 8in. P.M. £8/17/6. P. & P. 5/-.

CONSTRUCTOR'S PARCEL No. 1, comprising chassis 12½×8×2½in., cad. plated 18 gauge, v/h., I.F. and trans., cut-outs, backplate, 2 supporting brackets, 3 waveband scales, new wavelength station names. Size of scale 11½×4½in., drive spindle drum, 2 pulleys, pointer, 2 bulb holders, 5 paxolin international octal valve holders, 4 knobs and pair of 465 I.F.s, 16/6. P. & P. 3/-.

AS ABOVE, but complete with 16×16 mfd. 350 wkg. and semi-shrouded drop thro' 250-0-250 60 mA., 6 v. 3 amp. Pri. 200-250, and twin-gang, 31/6. P. & P. 3/-.

CONSTRUCTOR'S PARCEL. As No. 1 plus 16×16 mfd. 350 wkg., semi-shrouded drop thro' 250-0-250 60 mA., 6.3 v. 3 a., 5 v. 2 a., twin gang, and 6 L., M., S. superhet coils complete with trimmers and tracking condensers with circuit. £2/5/-. P. & P. 3/6.

COMPLETELY BUILT SIGNAL GENERATOR

Coverage; 120 Kc/s.-320 Kc/s., 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8.5 Mc/s.-25 Mc/s., 71 Mc/s.-50 Mc/s., 25.5 Mc/s.-75 Mc/s. Metal case 10×6¾×4¼in. Size of scale 6½in. x 3½in., 2 valves and rectifier. A.C. mains 230/250 v. Internal modulation 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated. R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel, £4/19/6. Or 34/- deposit and 3 monthly payments of 25/-. P. & P. 4/- extra.

PATTERN GENERATOR, 40-70 Mc/s direct calibration, checks frame and line time base frequency and linearity, vision channel alignment, sound channel and sound rejection circuits, and vision channel band width. Silver plated coils, black crackle finished case, 10 x 6¾ x 4¼in. and white front panel. A.C. mains 200/250 volts. This instrument will align any T.V. receiver. Cash price £3/19/6 or 29/- deposit and 3 monthly payments of £1. P. & P. 4/- extra.

Similar in appearance to the above Sig. Generator.

OUTPUT TRANSFORMERS. Standard type 5,000 ohms imp., 4/9; 42-1 with extra feed-back windings, 4/3. Miniature 42-1, 3/3. Multi-ratio 3,500, 7,000 and 14,000, 5/6. 10-watt push-pull, 6V6 matching, 7/-. 90-1 3 ohm speech coil, 6/6.

PUSH-BACK CONNECTING WIRE. Doz. yds., 1/6, post paid.

STANDARD WAVE-CHANGE SWITCHES 4-pole 3-way, 1/9; 5-pole 3-way, 1/9; 3-pole 3-way, 1/9; 9-pole 3-way, 3/6; Miniature type, long spindle 3-pole 4-way, 4-pole 3-way and 4-pole 2-way, 2/6 each. P. & P. 3d.

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.

CR100 I.F.s, 465 Kc/s., types 3, 4 and 5, 7/6 each. CR100 B.F.O., 7/6. 465 Kc/s. Xtal., 12/6.

Crystal Set, medium and long wave in plastic cabinet, 15/-.

Head-phones, 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 4½×1½in. EY51 rec. winding, 27/6.

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/-.

Scan Coils, low line, low impedance frame, complete with frame transformer, to match above, 27/6. P. & P. 2/-.

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 with screening can, 1/6 each.

32 mfd., 350 wkg.	2/-
16×24, 350 wkg.	4/-
4 mfd., 200 wkg.	1/3
40 mfd., 450 wkg.	3/6
16×8 mfd., 500 wkg.	4/6
16×16 mfd., 500 wkg.	5/9
16×16 mfd., 450 wkg.	3/9
32×32 mfd., 350 wkg.	4/-
32×32 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+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, ea.	7d.

T.V. Filter in lightly tinted Perspex, size 13½×11×3/16in., 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 9½×4½in. 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., with vernier adjustment, 17/6.

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.

465 Kc. I.F.s, size 2½×1½in. Q.110 removed from American equipment, 5/- per pair. Standard 465 Kc. iron-cored I.F.s, 4×1½×1½in. per pr. 7/6. Wearite standard iron-cored 465 Kc. I.F.s 3½×1⅛×1⅛in. 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, ⅞in. deep by very famous manufacturer. Pre-aligned adjustable iron-dust cores, per pair 12/6.

Mains Droppers. 0.3 amp., 460 ohms, tapped 280 and 410, 1/6; 0.2 amp., 717 ohms, tapped at 100 ohms, vitreous, 1/6; 0.3 amps, 950 ohms, tapped 700 and 825, 2/6; 0.2 amp., 1,000 ohms, vitreous, tapped, 2/6; Vitreous, 0.3 amp., 700, tapped 680, 640, 600. 3/6 P. & P. on each 3d.

T.V. Width Controls, 3/6.

Best Buy at Britain's

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 volt (50 cycle) 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/-; 150 milli-amp. 2in. sq. pnl. mtg., 7/6; 5 milli-amp. moving coil 2in. sq. pnl. mtg., 7/6; 20 amp. moving coil 2½in. dia., 7/6; 1 milli-amp. 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/-.

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METAL RECTIFIERS. Heavy duty Selenium 10½in. long with 3½in. square plates. Two are required for a full wave bridge giving 48 volts at 10 amps. Brand new and ridiculously cheap at only 57/6 per pair plus 2/6 post. R.M.4 250 volts 250 mA. Only 12/6. R.M.2., 3/4 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 R.C.A. 3 pin ex-Loran indicator unit, 15/- each.

6 VOLT H.R.O. VIBRATOR PACK. Gives 165 volts at 80 mA. smoothed D.C. Uses Mallory Vibrator, 6 x 5 heavy duty smoothing choke, etc. In black crackle cabinet size 7in. x 7in. x 6in. Brand new, only 29/6.

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. 5 cps. 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. x 13½in. x 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.

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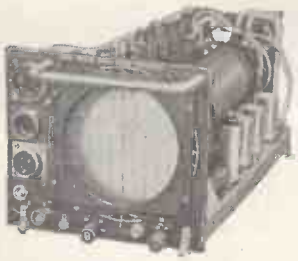

INDICATOR TYPE 182A

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.

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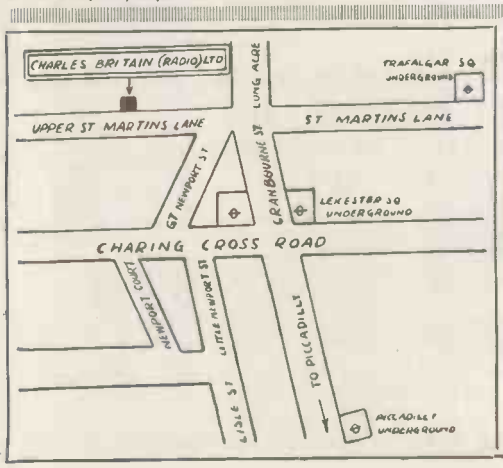

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2 volts ½ amp.	4/6	5 volts 2 amps.	10/-
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8×16 mfd. 450 v.	4/-
8×24 mfd. 350 v.	3/-
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12×4 mfd. 450 v.	2/-
16 mfd. 450 v.	3/-
16×8 mfd. 350 v.	4/-
16×16 mfd. 350 v.	3/3
20×20 mfd. 500 v.	4/9
24 mfd. 450 v.	2/9
25×16 mfd. 350 v.	3/6
32×8 mfd. 350 v.	3/6
32×16 mfd. 350 v.	4/6
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32×32×8 mA. 350 v.	5/6
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8×8 mfd. 450 v.	4/-
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16×8 mfd. 450 v.	4/-
16×16 mfd. 450 v.	4/6
16×24 mfd. 350 v.	4/9
24 mfd. 350 v.	2/9
32 mfd. 350 v.	1/9
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100 mfd. 12 v.	1/9
100 mfd. 25 v.	1/9

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50 mfd. 12 v.	1/9
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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.

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R.F. Units, types 26 @ 37/6, 25 @ 17/6, 24 @ 12/6, brand new in original cartons.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [2877

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R.C.A. receivers, type AR.88D, immediately available in quantity, fully reconditioned. McELROY-ADAMS MANUFACTURING GROUP, Ltd., 46, Greyhound Rd., London, W.6. [0194

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

QUAD. amplifier Mk. I, almost new, £20; Goodmans 12in speaker 15ohm with temp. reflex cabinet, £6; Wharfedale Golden 10 unit, almost new, £4/10; Lowther, whistle filter, 30/-.—115, London Rd., Chelmsford, Essex. [3270

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AMPLIFIERS, 4-channel 20w, 5w each channel frequency response flat 40 cycles to 12kc/s input and output 600ohms; 4 amplifiers in one case, gain control and monitoring input and output chokes price without valves £5/10/6 carr. extra; as new cost £40 ea.—Leslie Dixon & Co., 214, Queenstown Rd., Battersea, S.W.8 [3265

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53 transmitter, 500watts, output 1.2/17.5mc/s 'phone/CW with some spares; can be seen S.W. London.—Box 6910. [3268

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TAYLOR-WINDSOR model 260A television wobbulator, 5 to 140 mc/s, A.C. mains, as new; £24, or nearest offer.—Lyne, 81, Lincoln Rd., Peterborough. [3167

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1000 new meters, 2in upwards, milli, volts, amps, £275; 30 sig generators, No. 103, soiled outside, perfect internally; offers; AR88D, mint condition, offers.—P. Merrick, New Whittington, Chesterfield. [3227

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ALSO, rotary transformers, alternators, D.C. generators, etc.
WARD, 75, South St., Bishop's Stortford, Herts. Tel. Bishop's Stortford 1694. [0039

BATTERY chargers, 4 models, 2-6-12v, 1-2-4 amp D.C. any mains voltage; also larger types special transformers, chokes, test gear, interior car heaters, etc.—The Banner Electric Co., Ltd., Hoddesdon, Herts. [0112

NEW GRAMOPHONE AND SOUND EQUIPMENT

FERROGRAPH magnetic tape recorder, 76gns.
WEARITE tape decks and component parts.
DISC recording machines and blank discs.
LEAK amplifiers, 10w £17/17; preamp £10/10.
GOODSELL, 5w £13/10, preamp £10/10.
RESLO ribbon microphones and stands.
EVERYTHING for the professional recording studio and quality dealers.
SOUND DISCS (SUPPLIES), Ltd., 178, Bispham Rd., Southport, Lancs. Tel. 88153. [3169

BUYING a new amplifier or rebuilding the present one? See Bernard J. Brown's adverts under New Receivers and Amplifiers, also Repairs and Service. [0029

ALTERNATORS, 230/1/50, 400VA, self-energised 3,000rpm, ball bearing, £24/5; also special television model same price; voltage regulator £1 extra.
J.A.P. No. 2A, 1.2hp petrol engine, air-cooled, 4-stroke, starting rope, tools; £17/10 delivered for above alternators.
SPECIAL rotary converters, guaranteed interference free, fitted radio and television filters, wt. 60lb, d.c. input 12v 200va, out. 24v, 50v, 110v. d.c. to 230v, out, 250va, £28/10 del.; also converters for general use, inputs, outputs, prices as 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 9½amps, picture and sound were perfect and completely free of interference or flutter.
THE above are the latest products of British manufacture, and are guaranteed; fullest details of 400VA alt. or rotary converters, by return post; state which required; terms c.w.o., pro forma invoice c.o.d (post goods only).
T. W. PEARCE, 66, Great Percy St., W.C.1 (near Angel). [0013

FOR SALE AND WANTED ADVERTISEMENT FORM

TURN TO PAGE NO. 147

NEW GRAMOPHONE AND SOUND EQUIPMENT

TRUVOX Decks.—Amplifier, to suit, 8min. Valves, 10w P.P., Latest design. Sep. Power Unit; Treble lift choke; Var. Bias, Mic. and Radio inputs, Mixer control. M. Eye indicator. 30-10Kc/s response; 19gns.
PRE-AMP/Rec. Units (Meter ind.) from £16.
AMPS. for Wearite Decks; 21gns.
HARDING ELECTRONICS, 120a, Mora Rd., London, N.W.2. [0029

TAPE decks.—Due to cancelled South American export order we have been able to purchase, on very favourable terms, a limited quantity of a very well-known tape deck in kit form which we are offering at a knock-out price of £6/19/6; full details by return of post from
HOTAX PRODUCTS, Ltd., 59, Gray's Inn Rd., London, W.C.1. [3163

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

AS new, Lowther T.P.I. corner reproducer; £75.—Trueman, 52, Brookfields Rd., Langley, Oldbury, B'ham [3288

IMPRESSARIO tape recorder, unused, complete with mic and tape, guarantee card not completed; £36, carriage paid.—Hay, 3, Primley Gdns., Moortown, Leeds. [3287

CONNOISSEUR Super-L.W., P.U., Sapphire 78 head, little used, £4; Decca P.U., XMS, C. & D. heads, Styli new, 65s; 2 more XMS heads, 50/-.—M. Williams, 9, King Edward's Rd., Ruislip, Middx. [3234

FOR sale, Vortexion gramophone reproducer, complete with Hartley-Turner speaker model 215, true-bass boffle, A.C. mains, Garrard record player RC70A, R/F. unit Denco CT3, enclosed in suitable cabinet; offers.—Bardsley, Upwell, Wisbech, Cambs. [3194

NEW E.M.I./H.M.V. battery tape recorder, ideal for dictating letters whilst travelling, makes on-the-spot recordings, without mains electricity; complete with carrying case, lapel microphone, earphones, loudspeaker, spare batteries and 36 reels of tape; original total cost £120, will accept £70 o.n.o.—Tel. Boxmoor 3636, or write Multicore Solders, Ltd., Hemel Hempstead. [3225

PRESTO disc recorder, 78 or 33, complete, £55; 2 Tannoy amplifiers, V/L/UP, EF39, 6J5, FJC, PX.25, push pull, £10 each.; recording motor and play back, ditto on 1 deck, £10; 6ft rack, £3/10; 2 H/DUTY amplifier, KT66, 2, £9 ea.; 4ft 6in racks, 50/- ea.; S/S/Sales cutting head and Traugrle gear, £10; K.B. head, 50/-; Garrard h/duty motor and t/table, £3/10; Master contactor, £5; wanted, cheap mains sets and recording blanks.—Crowe, 33-35, London Rd., Newbury, 830. [3184

TRANSMITTING EQUIPMENT

SCR522, ET4332B T.U.s for BC375, T1131, TR1430, TR1143A offered.—E.W.S. Co., 69, Church Rd., Moseley, Birmingham. [3115

WILCOX-GAY V.F.O. and crystal multiplier units; small quantities.
McELROY-ADAMS MANUFACTURING GROUP, Ltd., 46, Greyhound Rd., London, W.6. Cables: Hallicraft, London. Tel. Fulham 1138-9. [0201

TRANSMITTING EQUIPMENT—SURPLUS & SECONDHAND

COMPLETE Pye 80 Mcs. radiotelephone, master station, 3 mobiles with P.A. equipment, guaranteed; £280.
McELROY-ADAMS MANUFACTURING GROUP, Ltd., 46, Greyhound Rd., London, W.6. Cables: Hallicraft, London. Tel. Fulham 1138-9. [0197

R.C.A. transmitters, type ET.4332 and ET.4336, fully reconditioned to maker's spec., complete with V.F.O. crystal multiplier, etc.
McELROY-ADAMS MANUFACTURING GROUP, Ltd., 46, Greyhound Rd., London, W.6. Cables: Hallicraft, London. Tel. Fulham 1138-9. [0196

COMPONENTS—RADAR

1.—723AB Klystrons; available in quantity.
2.—Magnetrons type CV.292, complete with cavities.
3.—Large quantity long length 3cm wave guides, junctions, cavities, projectors, radiators, spinners, etc.; immediately available.
ALSO 3cm echo boxes and oscilloscopes.
McELROY-ADAMS MANUFACTURING GROUP, Ltd., 46, Greyhound Rd., London, W.6. Cables: Hallicraft, London. Tel. Fulham 1138-9.

NEW COMPONENTS

CRYSTAL microphone inserts (Cosmocord Mic-6), guaranteed brand new; 15/6, post free.—Radio-Aids, Ltd. (Retail Dept.), 29, Market St., Watford. [0036

NEW COMPONENTS

NEW, rugged, stable transistors, less destructible than a battery valve; a speaker set can be demonstrated: send an s.a.e for technical sheet.—Bel, Marlborough Yard, Archway, N.19. [0186

FLUORESCENT 80w chokes 16/6, glow starter lamps 2/-; transformers, 10,000v 25mA 230v a.c., 32/6; metal rectifiers, 6/12v 2amp 8/6, 4amp 12/6, 6amp 18/6; battery chargers, 6/12v 1amp, 39/6; complete 5ft 80w fluorescent fittings, 75/-; heavy duty battery chargers, 24v 50amp, £16; car batteries, 6v £3, 12v £5/10, 2 years' guarantee.—Malden Transformer Supplies, 2a, Cambridge Rd., & 134, London Rd., Kingston-on-Thames. Kingston 7534. [0038

COMPONENTS—SURPLUS AND SECONDHAND

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. ELECTROLYTICS, capacity, voltage, size, type of mounting, price post paid: 400, 6v, 1×2in, lug, 1/9; 250+250, 6v, 1×2in, lug, 2/-; 40+40, 150v, 1⅛×2, clip, 2/9; 40, 150v, 1×2, clip, 2/6; 20+20, 275v, 1×2, lug, 3/3, 16+32, 275v, 1×2, lug, 3/3; 16+16, 275v, 1×2, clip, 3/3; 60+100, 275v 1⅜×3, lug, 4/6; 100, 275, 350v, 1¼×3, clip, 3/6; 32+12, 350v, 1⅜×2, clip, 4/-; 16+16+16, 350v, 1⅜×2, clip, 1⅛×2, 4/9; 16, 350v, ¾×2, lug, 1/9; 40+40, 300v, 1×3, lug, 3/6; 10, 450v, ¾×2, lug, 1/6; 16, 450v, ⅞×2, tag, 2/9; 20, 450v, 1×2, 2/3; 32, 450/525v, 1⅜×2, clip, 3/9; 30+30, 450v+20mi 25v, 1⅜×3, lug, 5/-; 15+15, 450v+20mf 25v, 1⅛×3, lug, 4/6; 200, 6v, ¾×1¾, clip, 1/6; 100, 12v, ¾×1¾, clip, 1/9; 8, 450v, 1×2, clip, 2/-; 50, 12v, ¾×1⅝, tag, 1/6; 150, 25v, ¾×1¾, clip, 2/-; 250, 12v, ¾×1¾, wire 2/3; 16+16, 450v, 1¼×2, clip, 4/-; 40+40, 275v, 1⅜×2, clip, 3/3; 24+24+16, 350/425v, 1⅜×2, clip, 4/9; 60+200, 275/350v, 1¾×4¼, clip, 6/6; 4, 150v, ¾×1¾, clip, 1/1; 500, 12v, 1⅜×2¾, clip, 2/-; 8, 350v, ¾×2, clip, 1/9; 32+32, 350/425v, 1⅜×2, clip 5/-; 8+16, 450/525v, 1×2, clip, 4/-; 2, 450/525v, ¾×1¾, tag, 1/6; 2, 350v, ¾×1¾, tag, 1/3; 8, 450v, ¾×2, clip 1/9; 32+32, 450/525v, 1½in×3in, wire ended, 5/6; all all cans, some with sleeves, all voltages, WKG, surge where marked new stock, guaranteed.

TELEVISION! Set of 3 components, comprising line output trans., with E.H.T. winding to give 7kV using EY51 (heater winding for EY51 also included), and fitted with width control scanning coils, low impedance line and frame, focus coil (res. 10,000Ω, current approx. 20 mA): the set of 3 for 42/-, plus 2/- post, diagram of line trans. supplied.

PERSONAL receivers, 3 valve T.R.F. using 1T4s, contained in handsome bakelite case with lift-up lid, size 7×6½×5in with lid closed, plastic carrying handle fram, AE in lid, these receivers cover the medium waveband and operate from self-contained, dry batts., standard types, W1435 and U2, output to a pair of lightweight 'phones (H.R.), controls, SM tuning and reaction, opening lid switches on, supplied brand new, with valves, batteries, 'phones, an ideal set for invalids, hos. patients, etc., these receivers are not Govt. surplus and are offered ready to play; carr. paid £4/10.

UNIVERSAL amplifiers, 8-valve 20watt A.C./D.C., black crackle chassis, and black and chrome cover, overall size 15½in×7½in×7in. First-class components (Partridge O.P.T., and driver, Gardner choke, A.E.E. Mu-Metal input trans. for mike) Valves, 2×EF37, 4×CL33, 2×UR3C. Switched input for high or low imp., top cut and bass cut switches, V.C., mains switch, mains plug and socket, 220-250v, isolated chassis, 15Ω output. Wired and tested, ready for use, with valves, brand new, £10/19/6, carr paid

5mA meters, moving coil, bakelite case, 2in square, flush mounting, new, boxed; 7/- post paid.

MAINS trans., 250-0-250v, 80ma, 6.3v, 2.5A, 6.3v, 0.6A, Pri. 0-210-230-250v 12/- post paid.

MAINS trans., Pri. 200/250v, sec., 305-0-305v, 80mA, 800v 5mA, 6.3v 4.2A 6.9v 0.4A, 2v 2A, 4v 1.1A, 5v 2.3A; these trans. have been taken from ex-Govt. equip.; some may have tag panels broken, but guaranteed O.K.; 13/- post paid; ideal for scopes.

RADIO CLEARANCE, Ltd., 27, Tottenham Court Rd., London, W.1. Tel. Museum 9188. [0015

BRAND new surplus volume controls, 1,000 ohms, long spindle, 6/6 dozen; lists free.—Bardwell & Co., Sellers St., Sheffield. [2927

SUPREME RADIO, 746b, Romford Rd., Manor Park, London, E.12. Tel. Ilf. 1260. Est. 19 yrs.

"SUPREME" for summer radio and television bargains at the right price:—

ELLIPTICAL P.M. speakers, 2 to 3 ohm V/coil, 7in×4in, our price 15/11 ea.; another smashing bargain! 5in P.M., 2 to 3 ohm V/coil, with trans. platform, 12/6 ea.

TAPPED filament trans. Primary 0-210v-230v-250v, sec., 0-2v 4v-6.3v at 1.5a, really a bargain at 6/6 each.

FILAMENT trans. Primary 0-250v, secondary, 6.3v at 1.5 amp, 5/9 ea., or 3 amp type, 8/9 ea.

VOL/controls: Small type, with S/P switch, and L/spindle, 1 meg., ½ meg. or ¼ megohm, bargain price 2/6 ea.

POPULAR value, ¼ and ½w resistors, 3d ea. or 2/6 per doz. or ass. doz.

STEEL chassis in grey finish, ready punched, for sup/het layout, 14in×6in×3in, our price 2/6 ea.

STILL the best value money can buy!! Crystal sets in brown bakelite case, 3¼in×2¾in×1¾in, wired ready for use, with crystal diode as detector, cannot repeat, 7/6 ea.

TERMS c.w.o., no c.o.d.

SEND 9d extra for postage orders under £5. 2½d s.a.e. all enquiries and list. [0021

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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.

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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 0.2 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 "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 set 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." 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.

3-SPEED GRAM UNIT MODEL "T" with new type turnover pick-up head, **£10/12/8,** post 2/6.

MODEL TA as above, but with plug-in turnover head, **£10/16/-,** or with two separate high fidelity Acos HGP35 heads, **£12/15/6.** Unit less heads, **£8/11/-,** post 2/6. Heads, 42/3 each, post 1/-.

MODEL TB as above but with long pick-up arm. Less heads, **£8/11/-,** post 2/6.

Heads to fit this unit: Decca XMS, 55/-, Decca Crystal, 35/-, Garrard Standard Magnetic, 25/-, miniature magnetic low impedance, 25/-, miniature magnetic high impedance, 35/-. Post on heads 1/-. Unit can be supplied with any combination of above heads and is carefully adjusted for stylus pressure on despatch.

RC110 NEW MODEL AUTO-CHANGER with new type turnover head, **£13/19/6,** carriage 5/-.

MODEL RC75A, less heads, **£15/4/6,** with new turnover head, **£17/9/6,** with two separate Acos HGP35 heads, **£19/9/-,** carriage 5/-.

RC80, less heads, **£17/1/7,** with new turnover head, **£19/6/7,** with two XMS heads, **£22/11/6** with Garrard head for miniature fibres for Standard, and Decca crystal for LP. **£20/12/-,** carriage 5/-.

COLLARO latest model AC3/544 3-SPEED GRAM UNIT, with new "STUDIO" Pick-up type "O" or "P," **£10/6/1,** post 2/6.

COLLARO latest model 3RC531 AUTO-CHANGER. We are pleased to say that after most careful and rigorous trial, we can highly recommend these latest improved Auto-Changers by Collaro. The standard of engineering is of the highest and in addition to being very easy and quick and fool-proof in operation, they are fitted with the revolutionary high-fidelity pick-up "STUDIO" Pick-up heads of which the Type "O" is matched to radio sets and medium-gain amplifiers and the Type "P" is designed for high-gain amplifiers. The Type "P" is exactly matched to our new model Studio Symphony Amplifiers. The price complete with either type pick-up head is **£15/3/-.** The **3RC532** as above, but mixes 10-inch and 12-inch records, costs **£17/10/-,** carriage 5/-. Delivery from stock. Illustrated leaflet 2½d.

COLLARO "STUDIO" PICK-UP (Arm and Head) type "O" or "P," **74/8,** post 2/-.

ACOS GP20 Hi-g PICK-UPS. Arm with one HGP39 head (Standard or L.P.), **£3/8/9,** or with both heads, **£5/11/-.** Post 1/6. Heads separately, 42/3 each. Immediate delivery.

TRANSCRIPTION MOTORS IN STOCK.

COLLARO MODEL 2000, less pick-up, **£13/9/6.**

COLLARO 2010 with pick-up complete on unit plate, **£18/4/9.**

CONNOISSEUR, £21/17/3.

GOODMANS CORNER CABINETS for the AXIOM 150 Mark 2 manufactured by us to Messrs. Goodmans' measurements. Height, 44in. Price: complete kit in plain board with felt, 8 gns. Price ready built, 10 gns. Finished in figured walnut, 16 gns. Other veneers to order. Carriage extra according to area.

"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.

"SYMPHONY" BASS REFLEX CABINETS, as above but 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, 33in. high, lift-up lid with piano hinge, take Gram Unit or Auto-changer, Amplifier, Pre-amplifier, and Radio Feeder Unit, finished medium walnut veneer to match our veneered Bass Reflex Cabinets De Luxe version, 10 gns., carriage according to area. Other veneers 10/- extra.

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Buses: 2, 13, 31, 113, 187.

COMPONENTS—SURPLUS AND SECONDHAND

800 items in amateur's sale; s.a.e. list.—506, Loughborough Rd., Birstall, Leicester. [3259

TWO American tubes, radio, 26B5, INU56.—Mrs. B. Day, Fernlea, Ormesby St., Michael, nr. Gt. Yarmouth. [3261

GERMANIUM diodes, 1/- each; large quantities cheaper.—B. D. C., 591, Green Lanes, London, N.8. [2930

SOUTHERN RADIO SUPPLY, Ltd., 11, Little Newport Street London W.C.2. See our displayed advertisement, page 169. [0016

TRANSFORMERS, 500-0-500v, 500ma, 5v 6a, £2/10 ea; primary, 200-230v, choke, 10 henries, 500ma, £1/10 ea; manufactured by Haines Radio, new and guaranteed tropicalised.—Chancery Precision Instruments, Ltd., 64, George St., W.1. Welbeck 2535. [3255

3-SPEED mixer autochanger, by a famous manufacturer, brown, £9/10 (5/- carr.), or cream, £10/5 (5/- carr.); rectifiers, WX6 at 1/6, and 230v 40ma selenium, 5/-; bargain 20/- parcel, 30 new components, resistors, condensors switches, etc., retail price over £4; mica condenser, moulded case, .1mf 1,500v d.c. wkg., 4/-; 50 different condensers and resistors, 10/-; potentiometers, 8 different, 100 ohm to 2m, for 12/-; selection 25 yds. insulating sleeving, 1mm to 8mm, in 4 sizes 4/-; Allen mains transformer, std. input, 250-0-250 at 80ma, 6.3v 3a, and 6.3v 0.6a, 22/6; high gain 4W 200-250v a.c. audio amplifier for mike and gram with tone control and suitable speaker, chassis 8in×6in, price £6, complete with valves and working; oak 5 position tone control switch with s.p. on-off (2in spindle), 2/6; B.T.H. diode CG5M, 2/- (18/- doz.); dial and pointer, 2/- (6¾in×2¾in), 19, 25, 31 MSW and MW; plastic dial with pointer (5in×1¾in), MW and LW, 1/6; unused 1m 3KV type 9l condenser, 10/-; unused, .5mf 6KV d.c. wkg., 20/-; all goods guaranteed and unused.—Gladstone Radio, Gladstone Place, Newton Abbot, Devon. [3233

WANTED, EXCHANGE, ETC

VHF test equipment.

TS47AP, TS174, TS175/U, TS148 or TSX-4SE; analysers; BC221 freq meters, TS69, and any U.S.A. test gear; Klystrons type 723/AB, 2K33 2K39 2K41; receiver, APR4 and units TN16 17-18-19; RCA AR88D, S27 and SX28s and S27CA; microwave equipment; highest offers given by return.—Ger. 8410. Universal Electronics, 27, Lisle St., Leicester Square, London, W.C.2. [0229

ALL cables and flexes bought.—B.D.C., 591, Green Lanes, London, N.8. [5152

ANY goods for sale second-hand?—Write: Arcade Recording Circuit, Arcadian Gdns., Wood Green, London. [3189

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

WANTED, set manufacturers' or ex-Government radio equipment, large or small quantities of valves, electrolytics, speakers, meters, also components. LOWE BROS., 5, Fitzroy St., London, W.1. Tel. Museum 4389. [2703

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.—BC610 Hallicrafters, ET4336 transmitters, AR88s receivers, and spare parts for above; best prices.—P.C.A. Radio, Beavor Lane, Hammersmith, W.6. [0079

WANTED.—RCA speech amplifiers type MI-11220 J or K, and ariel tuning units BC939a.—Offers, stating quantity and price, to P.C.A. Dadio, Beavor Lane, Hammersmith, W.6. [0080

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Tel. Gerrard 2504. [2950

WANTED, good quality communication rxs., domestic radios, test equipment, etc.; top prices paid, established since 1937.—Miller's Radio, 38a, Newport Court, 1 min. from Leicester Sq. Tube. Tel. Ger. 4638. Call, write or send. Hours of business 10-6 p.m. Open all day Saturday. [0199

WANTED, signal generators types 30, 31, 51, 53, 54, 56 and 101; also any American test equipment with prefix TS or BC; American receivers types AR88, APR4 or similar.—Send price and details to Hatfield Instruments, Ltd., 175, Uxbridge Rd., Hanwell, W.7. Tel. Ealing 0779/9857. [0037

VALVES WANTED

50/- paid for 723A/Bs 45/- 813s, also required types 808, 70/B, 832, etc., any quantity.—Write/tel. Pype Hayes Radio, 606, Kingsbury Rd., Birmingham, 24. Erdington 4942. [2456

VALVES WANTED

ALL types of valves required for cash; state quantity and condition.—Radio Facilities, Ltd., 38, Chalcot Rd., N.W.1. Primrose 9090. [3260

BATTERIES

AMAZING battery offer! Very large purchase of all-dry H.T./L.T. batteries enables us to make this special offer: 2 batteries 72v H.T., plus 1½v L.T., for 5/-, post and packing 1/8; all of recent manufacture and are tested by us for full voltage before despatch; note: these batteries are layer built and will last for several years if properly stored; apply now.—Walton's Wireless Stores, 48, Stafford St., Wolverhampton. [0061

CABINETS

LEWIS RADIO have the best selection and finest finish.—See page 158. [0224

CABINETS made to order. Send details for quotations.
BASS Reflex cabinets, finished in period or contemporary styles.—See display advertisement. Page No. 162.
CABINETS for Goodmans and other loudspeakers. (We submitted to Goodmans a Bass Reflex cabinet of their design for testing, and this has been approved by them as suitable for the speaker for which it was made.) You can see your cabinet being made in our cabinet making shop. Open till 5.30 Saturdays.
A. DAVIES & Co. (Cabinet Makers), 3, Parkhill Place, off Parkhill Rd., Hampstead, N.W.3. Gulliver 5775. [3221

WALNUT radiogram cabinets; details.—Cabinetware, 1a, Heyes St., Blackburn [0091

WALNUT radiogram and television cabinets, soundly constructed; stamp for details.—R. Shaw, 69, Fairlop Rd., Leytonstone, E.11. [3193

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. [3192

SERVICE sheets for hire or sale, over 2,000 models, radio and television; s.a.e. enquiries.—W. Gilbert, 24, Frithville Gardens, London, W.12. [2874

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

MAINS transformers, E.H.T. line outputs, chokes and field coils, etc., promptly and efficiently rewound or manufactured to any specification; 12 months' guarantee.
LADBROKE REWIND SERVICE, Ltd., 820a, Harrow Rd., Kensal Rise, N.W.10. Lad. 0914. [0022

ELECTRICAL test instruments repaired and standardized, all types British or American, ammeters, voltmeters, ohmmeters DC/AC multi-range meters, etc.: meters converted to specification.
THE ELECTRICAL INSTRUMENT REPAIR SERVICE, 329, Kilburn Lane, London, W.9. Tel. Lad 4168. [2821

AUDIO Equipment repaired/rebuilt or modified, disk or tape recorders/amplifiers/sound projectors, quotations without obligation, extended payments available above £15.—Bernard J. Brown, 33, Goldhawk Rd., London, W.12. [0025

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

AS professional sound recordists and members of the Association of Professional Recording Studios, we are particularly well qualified to give advice and service on all aspects of sound recording and reproduction. Design of tape equipment a speciality. Circuits designed, repairs and modifications carried out quickly. Advice freely given. See also below:—
COMPREHENSIVE service to trade and amateur; design, manufacture and repair of electronic equipment carried out by specialists; equal attention given to small or large orders. See also below:—Autochangers, 48-hour service, cleaning and adjusting at fixed price of 45/-, plus carriage; also all repairs carried out; trade enquiries invited; callers by appointment only please.—Ariel Sound, 57, Lancaster Mews, London, W.2. Tel. Paddington 5092 (2 lines). [0026

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 specialise 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

MACHINERY FOR SALE

UNUSED and as new, 5kW G.E.C. high frequency induction heating and melting set, complete with various accessories, owner selling due to reorganisation at one-third cost; can be inspected working at—Davidsons Eng. (M/cr.). Ltd., Garratt St., Manchester, 10. Tel. Collyhurst 1610. Price £350. [3223

BUSINESS AND PROPERTY

RADIO electrical business, Worthing; modern shop and home, trade £4,300 p.a., long lease vauable agencies; price £2,750 S.A.V.—Charles & Co., 221, Tarring Rd., W. Worthing. [3222

BUSINESS OPPORTUNITIES

OLD-ESTABLISHED firm of exporters in the electronic field, invite manufacturerr seeking overseas sales to communicate Box 0239. [0252

RADIO Consultant (part-time), use of furnished office and facilities and retainer for nominal services, Croydon area.—Box 6676. [3217

WORK WANTED

ASSEMBLY, wiring of all types of electronic eqpt., control panels, switchboards, etc.—R.A.E., 377, High Rd., London, N.2. [0219

SMALL versatile firm has electronic, winding and engineering capacity; comprehensive measurement facilities; A.I.D approved.—Bel, Marlborough Yard, Archway, N.19. Arc. 5078. [0183

MISCELLANEOUS

COIL winding machines; from £15.—Hawkins, 170, Witton Rd., Birmingham, 6. [2879

LAMPSHADE makers! Old legal handwritten parchments, 1/- per sq ft; piece with seals 1/- extra.—BDC(ww), 591, Green Lanes, London, N.8. [3134

STEEL lattice and guyed radio masts, 100ft high, for sale, delivery from stock, excellent condition.—Bellmans, Terminal House, S.W.1. [3072

METALWORK, all types cabinets, chassis, racks, etc., to your own specifications; capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd. (G4B1), Chapman St., Loughborough. [0208

HS-30 headset complete with plug PL-55 and transfo C-410, new original Signal Corps packing, stocked free warehouse zone Holland—T. Majewski, 6 Rue Vandermeyer, Brussels, Belgium. [3274

PLYWOOD—Hardboards. Send s.a.e. for free price lists and samples, including 3/16in mahogany ply 10d sq ft, sheets 72in×36in; hardboard all sizes, from 6d sq ft; free delivery (100 miles).—N. Gerver, 2-10, Mare St., London, E.8. Amherst 5806. [0027

S.P.s, L.P.s, and now extended play discs from your tapes! (9min. 8in side, 33⅓); Ferrograph recorders, microphones, tape, blank discs, Grundig accessories; prompt postal service.—"Eroica" Recording Services, Peel St., Eccles, Manchester. Tel. Eccles 1624. Director, Thurlow Smith, A.R.M.C.M. [0121

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

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

PATENTS

THE proprietor of British Patent No. 653484, entitled "Two-coordinate radar system," offers same for licence or otherwise to ensure practical working in Great Britain.—Inquiries to Singer, Stern & Carlberg, 14, E. Jackson Blvd., Chicago 4, Illinois, U.S.A. [3095

AGENCIES WANTED

ELECTRONICS rep. with good connections aircraft, marine, motor and general trades, contemplates own agency and would be interested to hear from good class companies desiring representation instruments, communications (land and marine), electronic sub-contracts and sheet metal work; operating from London area to line Liverpool/Hull, and would consider sole agency in Essex, Kent and Hants,—Further details to Box 6946. [3282

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.

TV improver drivers wanted; commencing salary £7/10.—Box 6762. [3229

SITUATIONS VACANT

JERSEY Civil Service.

THE Civil Service Board of the States of Jersey invites applications for a post of Radio Technician in the States' Telecommunications Department.
CANDIDATES must have sound technical knowledge, and good practical experience in the installation and maintenance of electronic aids to navigation, wireless transmitters and receivers; City and Guilds Certificate in Telecommunications Engineering, or a pass in the Ministry of Transport and Civil Aviation's qualifying test for Radio Technicians an advantage.
SALARY £420 rising to £530 with prospects of establishment in the Jersey Civil Service after a qualifying period.
APPLY in writing to the Greffier of the States, States' Greffe, Jersey, stating date of birth and full details of education, technical training, qualifications and experience, enclosing copies of two recent testimonials and giving names and addresses of two referees. Closing date September 11th, 1954. [3251

TECHNICAL supervisor required by NIGERIA for one tour of 15-24 months with option of appointment either (a) on agreement with prospect of permanent and pensionable employment in salary scale (including expatriation pay) £1,210 rising to £1,315 a year, or (b) on contract in a temporary capacity with salary (including expatriation pay) £1,307 rising to £1,453 a year. Gratuity at the rate of £150 a year. Outfit allowance of up to £60. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates must hold C. and G. Intermediate Certificate in Tele-communications Engineering and have passed the final paper in (1) Line Transmission II, or (2) Telegraphy II, or (3) Radio IV and should have had considerable experience in the maintenance of V.H.F. multi-channel equipment and associated carrier and V.F. telegraph equipment at major V.H.F. terminals.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30626/WF. Candidates at present employed by the G.P.O. should submit their applications through their Establishment Division. [3252

SENIOR Radio Engineer required by VIDOR-BURNDEPT, Ltd., for their laboratory engaged on portable and other domestic receiver design; applications invited from candidates having previous experience on similar work, outlining their qualifications, age, salary expectations, etc., to—Personnel Manager, Vidor-Burndept, Ltd., West St., Erith. [3248

NORTHERN Polytechnic, Holloway, London, N.7.
THE Governing Body invite immediate applications for appointment as full-time Lecturer in Telecommunications Engineering for the three-year full-time course in preparation for the Full Technological Certificate of the City & Guilds of London Institute in Telecommunications Engineering. A knowledge of radar and television engineering is desirable. Salary scale —£940×£25—£1,040 plus London Allowance. Form of application, together with full particulars, will be forwarded on receipt of a stamped, addressed foolscap envelope.
R. H. CURRELL, A.S.A.A.
Clerk. [3284

ST. CRISPIN HOSPITAL, Duston, Northampton.
ELECTRO-Encephalography Recordist, Grade 1, required at the above hospital for Mental and nervous disorders, for a new E.E.G. department to be opened in the near future. The hospital has 1,250 beds and is situated three miles from Northampton. Whitley Council Scales and conditions. Excellent social amenities.
APPLICATIONS giving full details and names of two referees to the Physician Superintendent within fourteen days of the appearance of this advertisement. [3238

FERGUSON RADIO CORPN., Ltd., have vacancies for:
SENIOR Engineers with initiative and sound sound technical background for work on a wide range of projects in the field of electronics including television, radio communications and test equipment; permanent posts for men able to carry responsibility in rapidly expanding department offering exceptional promotion and long term prospects.
JUNIOR engineers of ability for work on development projects offering a wide experience in the fields of television, radio communications and test equipment with excellent prospects for advancement; vacancies exist in laboratories situated at both Enfield and Spennymoor Co. Durham; these laboratories are well equipped and working conditions excellent; successful applicants eligible for Company's pension and life assurance scheme; applications specifying the post for which application is made and giving full particulars as to age, qualifications and experience, etc., to.—Personnel Manager, Ferguson Radio Corp., Ltd., Gt. Cambridge Rd., Enfield. [3271

ONE qualified electronic engineer or physicist required, with experience of electronic development work.—Apply, R. Y. Pickering & Co., Ltd., Wishaw. [3197

SITUATIONS VACANT

ATOMIC Energy Research Establishment, Harwell.

OPPORTUNITIES exist on a wide variety of mechanical, electrical, electro-mechanical, electronic and chemical plant work, including checking duties on electronic and electro-mechanical work. Vacancies exist in the draughtsman, leading draughtsman and senior draughtsman grades, with salary maxima £640, £742 and £910 respectively.

FURTHER details (including information on starting pay) and application forms available on request from Establishment Officer, A.E.R.E., Harwell, Berkshire. (Quote 2/103/98.)

INSTRUMENT Mechanics required to serve as Research and Experimental Mechanics at DEPARTMENT of Atomic Energy, Industrial Group, Windscale Works, Sellafield, Cumberland. All applicants must have served a recognized relevant apprenticeship.

INSTRUMENT Mechanics (Electronic) must have sound theoretical knowledge of electronics (Ordinary National Certificate standard desirable) with practical knowledge of pulse amplifiers, D.C. amplifiers, electronic scalers, discriminators, or general trigger circuits, and in wiring and assembly of electronic apparatus. Experience of test gear and general instrument calibration an advantage.

INSTRUMENT Mechanics (Physical) must have experience of industrial instruments used in measurements and control of temperature, specific gravity pH and flow. Knowledge of vacuum techniques and measurements of gaseous properties an advantage.

INSTRUMENT Mechanics (General) must have experience of relay circuits and automatic telephone exchange maintenance. Knowledge of X-ray or electrical measuring apparatus an advantage.

RATES of pay for 44hr 5-day week: 155/10 on entry with early assessment for merit pay. Opportunities for advancement to 181/10 with a ceiling, for a specialised few, of 197/10. Married applicants will be given consideration for housing within a reasonable period of recruitment.—Apply, giving details of apprenticeship, training (including Forces training), qualifications and experience, to Senior Labour Manager, Windscale Works, Sellafield, Calderbridge, Cumberland. [3083

WIRELESS Station Superintendents required by the NIGERIA Posts and Telegraphs Department for one tour of 18 to 24 months in the first instance. Option of appointment (a) on temporary terms with salary scale (including Expatriation pay) £864 rising to £1,392 a year. Gratuity at the rate of £100/£150 a year, or (b) with prospect of pensionable employment with salary scale (including Expatriation pay) £750 rising to £1,175 a year. Outfit allowance £60. Free passages for officer and wife. Assistance towards cost of children's passages or grant up to £150 annually for maintenance in U.K. Liberal leave on full salary. Candidates must have had wide practical experience of modern radio techniques and equipment, in particular V.H.F. equipment, and preferably also V.H.F. multi-channel equipment.

WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/30086/WF. [3214

APPLICATIONS are invited for the following vacancies:—

(1) SENIOR Development Engineer for Paper Dielectric Capacitors.
APPLICANTS should have had at least five years' experience in the capacitor or cable industries. Minimum age 30 years.

(2) JUNIOR Development Engineer for Paper Dielectric Capacitors.
APPLICANTS should have had at least two years' experience in the Capacitor or Cable industries and possess H.N.C. Minimum age 21 years.

(3) SALES Engineers.
APPLICANTS should preferably have some background in electronic circuitry. Minimum age 30 years.

ATTRACTIVE salaries will be offered to suitable candidates. Housing assistance can be given in approved cases for Post No. (1). Applicants for Post. No. (3) would normally reside in the London area.

APPLICATIONS in the first instance should be made to The Personnel Manager, The Plessey Company, Limited, Kembrey St., Swindon, Wilts, quoting OG.1. [3254

TV field engineers wanted: clean driving licence; commencing salary £9, rising to £11.—Box 6763. [3230

A CANADIAN Telecommunications Manufacturer has vacancies for qualified Engineers with at least five years' design experience in one or more of the following fields:

COMMUNICATIONS Measuring equipment.
TELEVISION Test equipment.
PRECISION Waveguide Components and Measurements.
MODULATION Techniques (including FM).
WIDEBAND I.F. and other V.H.F. techniques.
MICROWAVE Antennæ design.
TELECOMMUNICATIONS System design.

THESE appointments are in connection with long term development of equipment primarily for commercial applications.

SALARIES $6 000 upwards according to experience and qualifications. Transportation for family to Canada will also be provided.

APPLICATIONS, giving full details of age, experience and qualifications, should be addressed to Dept C., Dept. of Labour of the Government of Canada, 61, Green St., London, W.1. [3220

SITUATIONS VACANT

A. T. & E. (BRIDGNORTH), Ltd., have vacancies for Senior and Junior Electronic Engineers for
(a) PRODUCTION Testing and
(b) DEVELOPMENT of Production Test Gear.
THE work, which is in the field of radio telecommunications, is varied and interesting. Five-day week, good conditions. Apply in writing, giving details of training and experience, to Personnel Officer at Bridgnorth. [3256

ELECTRONIC test equipment engineers required by large, reputable electronic and radar manufacturing company to operate a new factory in the South.
VACANCIES exist for—
A. EXPERIENCED circuit checker and routiner designers.
B. RADAR production test gear designers.
C. Microwave component test gear designers.
APPLICANTS must have had previous experience in a similar position.
SUPERANNUATION and housing facilities will be available. Salary commensurate with ability.
STATE full experience and age to Box 6761. [3228

RADIO and/or television engineer required for bench and outside repairs; driver; references.—Field's Radio, Ltd., 52, Hall Gate, Doncaster. [3242

ENGINEERS, radio/TV, for appointments within the salary range £400-£750.—Apply, Broadmead Wireless Co. Ltd., 123, The Broadway, Wimbledon [3203

EXPERIENCED TV servicemen wanted, drivers preferred, congenial permanent situation in expanding organization.—Supreme Radio, Ltd. Edm. 3891. [3249

CINEMA Sound Installation and Service Engineers required, good prospects, pension plan.—Write, Western Electric Co., Ltd., Liberty House, Regent St., W.1. [3093

ONE graduate electrical engineer or physicist required; previous experience of electronic development work not necessary.—Apply R. Y. Pickering & Co., Ltd., Wishaw [3198

RADIO and TV service eng.neers required for old-established retailers: must be experienced and able to drive; good pay and prospects.—Aneloy Radio, 15, Up.and Rd., S.E.22. [3240

ELECTRONIC Development Engineer required for design of scientific instruments involving use of amplifiers, oscillators and pulse generators; H.N.C. or equivalent; salary £650 p.a.—Apply Box 6511. [3183

BENTALLS of Kingston-on-Thames require radio and television engineer for large and busy workshop; permanent position; excellent staff amenities; discount on store purchases.—Apply Personnel Controller. [3285

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

PROJECT engineers, aged 25/33, required for work detailed below, with Graduate I.E.E. or recognized equivalent, qualifications; the positions are permanent and pensionable and the advertisers are of good standing.
1. ELECTRONIC component development, experience of electronic or light electrical engineering work required, but design experience not essential.
2. TELEVISION and radio aerial development, experience of stress calculations and the handling of light alloy extrusions and castings required.
APPLICATIONS (which will be treated in confidence), to give full details of education and experience, and state salary envisaged. Box 6660. [3216

SHORT BROTHERS & HARLAND LIMITED have vacancies in their Research Department for the following additional staff to work on guided missiles and other interesting military and commercial projects:—
MECHANICAL Section.—Senior engineers, engineers and technical assistants to develop hydraulic and pneumatic servos, precision mechanical devices, etc.
ELECTRONICS Section.—Senior engineers, engineers and technical assistants to work on computing, navigationa, and servo systems.
ELECTRO-Mechanical Section.—Engineers and technical assistants to develop small electromagnetic devices, navigational instruments, etc.
QUALIFICATIONS.—Senior engineers, Honours Degree plus at least five years' good engineering development experience; engineers, University Degree or equiva.ent, with several years' experience of development work; technical assistants N.N.C. or equivalent, with good practical experience in appropriate field.
THESE are permanent positions in an expanding development experience; engineers Univerfor men with initiative; pension scheme, assistance with housing.—Send full particulars of age, qualifications and experience, with salary required, to Short Brothers & Harland Limited, Castlereagh Factory, Belfast quoting Ref. No. E9. [3267

BERRY'S (SHORT WAVE), Ltd., have vacancies for experienced senior and junior sales staff; applications in writing should give full particulars of experience, age and salary required to 25, High Holborn, London, W.C.1. [3224

ELECTRONIC Engineer required by capacitor manufacturers (East London) for development work on test instruments and electrical research; opportunity for young engineer with some years' experience.—Write Box 6685. [3219

SITUATIONS VACANT

EDISON SWAN ELECTRIC Co., Ltd., have a vacancy for an engineer experienced in mechanical and electronic design to take charge of their Special Products Development Laboratory.
EDISON SWAN also require engineers with experience in the fields of electro-medical and industrial electronic design.
PLEASE write to 155 Charing Cross Road. W.C.2. stating experience and salary required; the envelope should be marked "S.P. Lab." [3272

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
REDIFON, Ltd., Kelvin Way, Crawley, Sussex. [3207

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

PYE, Ltd., Radio Works Cambridge, invite applications for the appointment of Electrical Draughtsman capable of producing intelligent circuit and layout diagrams of radio equipment.—Applications in writing to Personnel Manager. [3044

BUSH RADIO, Ltd., have a number of vacancies in their expanding laboratories at London and Plymouth, applicants for posts (a) and (b) should preferably hold a B.Sc. or equivalent qualification in physics or engineering.
(a) RESEARCH and Development Engineers and Junior Development Engineers for work in new television and circuit fields, applicants should have interests and preferably experience in: Telecommunication, television, network analysis, feedback, pulse techniques, optics.
(b) JUNIOR Development Engineers for interesting work on Government contracts, experience in any of the following fields would be an advantage: Video amplifiers, feedback, pulse techniques, microwave techniques.
(c) DEVELOPMENT Engineers to initiate design and engineering layout of domestic radio receivers, experience of design of domestic radio receivers, and familiarity with working drawing office and production departments, are required.
GOOD prospects, pension scheme, interviews in London or Plymouth.—Write giving full details and salary required, to the Chief Engineer, Bush Radio, Ltd., Power Rd., Chiswick, W.4. [3051

PYE, Ltd. require experienced development engineers for radio receiver development in Cambridge; salaries in the range of £400 to £800 according to qualifications.—Apply Personnel Department, Pye, Ltd., St. Andrew's Rd., Cambridge. [2997

DRAUGHTSMAN, senior, design; good salary and prospects for first-class man; apply in confidence stating experience, age, salary required, or Tel. Wembley 1200 for appointment. —Goodmans Industries, Ltd., Axiom Works, Wembley. [3276

FOREMAN required for electronics production; small quantities of varied instruments; must be good leader, able to maintain high level of output; full support given; good salary offered with excellent prospects for promotion in expending company.—Box 6638. [3211

PYE, Ltd., Radio Works, Cambridge, invite applications for appointment of Technical Author to compile maintenance handbooks on individual radio equipments; command of English and technical background essential.—Applications in writing to Personnel Manager. [3043

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 Redifon Ltd., Kelvin Way, Crawley, Sussex. [3187

TECHNICAL sales engineers required for export department of well-known manufacturer of communications equipment; essential all applicants young men with good general knowledge modern radio communications techniques and keen to sell.—Reply to Box 6945. [3280

THE British Electrical & Allied Industries Research Association have vacancies for student apprentices; also for laboratory assistants for building and operation of electronic recording equipment, for use in researches on electrical discharges in gases, circuit-breakers, etc.
WRITE to Laboratory Manager, E.R.A. Laboratories, 5, Wadsworth Rd., Greenford, Middlesex. [3206

DRAUGHTSMEN, experienced in the radio field on electrical/mechanical assemblies required for interesting work on aircraft.—Write, giving full particulars, including age and salary required, to Personnel Department, Vickers-Armstrongs, Ltd., Hursley Park, nr. Winchester. [3069

TELEVISION engineer required, must be experienced with leading makes and quick fault finder, able to drive, permanent progressive position to right applicant; wages £600 per annum, single or married; flat supplied if necessary.—Apply, giving full particulars, to Box 6637. [3210

SITUATIONS VACANT

TECHNICAL development engineers required, senior, intermediate and junior, for interesting work in electronics, including defence contracts; excellent salaries for suitable applicants.—Apply to Technical Director, All-Power Transformers, Ltd., Chertsey Rd., Byfleet, Surrey. [3266

ELECTRONIC Digital Computors, electronics engineers with an interest in mathematics are required by English Electric to work on fault diagnosis and maintenance of advanced digital computors, in the London area.—Please reply to Dept. C.P.S., 336-7, Strand, W.C.2, quoting Ref. 1353. [3257

ELECTRICAL engineers, junior technical engineers required for development application and pre-production of thermionic valves: minimum desirable qualification, O.N.C., Inter B.Sc. or equivalent.—Write to Personnel Department, The M.O. Valve Co., Ltd., Brook Green, Hammersmith, W.6. [3232

SENIOR and Junior Engineers required for research and development work on magnetic amplifiers, transistors and electronics, with particular reference to aircraft and guided weapon applications.—Full particulars of qualifications, experience and salary required, to Box 6942. [3275

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, Aliesley, Coventry. [0260

LOUDSPEAKER development engineer to work in extremely well-equipped laboratory: good prospects for man with creative ability; state experience, age, salary required, or Tel. Wembley 1200 for appointment; replies treated confidentially.—Goodmans Industries, Ltd., Axiom Works, Wembley. [3277

RADIO mechanic preferably with experience of car radio service and installation, is required by S. Smith & Sons, Ltd., at their Great Portland Street showrooms and Depot; applicants should write in the first instance, giving age and experience to—SMA/PLI, Cricklewood Works, London, N.W.2. [3195

GODFREY ALVIST, Ltd., representing U.S.A. leading manufacturers of highly specialised electronic instruments and test and control equipment, require technical representatives for U.K. and Continent; write giving full details and experience to—Godfrey Alvist, Ltd., 29, Whitehall, London, S.W.1. [3174

MICROPHONE development engineer to work in extremely well-equipped laboratory: salary according to experience; good prospects for man with creative ability; write in confidence stating age, salary required, experience, or Tel. Wembley 1200 for appointment.—Goodmans Industries, Ltd., Axiom Works, Wembley. [3278

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 Redifon, Ltd., Kelvin Way, Crawley, Sussex. [3186

ASSISTANT Chief Engineer required for design and development of radio and electronic components; technical qualifications plus executive ability essential; commencing salary dependent on qualifications and experience; a pension scheme is in operation.—Apply in writing to Carr Fastener Co., Ltd., Stapleford, Nottingham. [3239

RADIO testers required, some V.H.F. experience desirable together with some servicing knowledge on domestic or service equipment. —Applications, giving full details of previous experience and qualifications, should be submitted in writing to the Personnel Manager, Pye Telecommunications, Ltd., Newmarket Rd., Cambridge [2965

LABORATORY technician (Radio) at South-East London Technical College, Lewisham Way, S.E.4. Rate 73/6 a week at 16 to 102/- at 19; £286/17/6 a year at 20 x £19/2/6 to £401/12/6 with certain quals. to £439/17/6. (Max. comm. sal. £363/7/6).—Further partics. and appl. forms returnable within 14 days from secretary. (942.) [3213

STANDARD TELEPHONES & CABLES, Ltd., have vacancy for engineer; work involves design, enginering and testing of a wide variety of special amplifier and sound re-inforcement systems; applicants should have H.N.C. (Electrical) or near equivalent.—Apply, Personnel Manager, North Woolwich, London, E.16. [3173

PROGRESSIVE position of great interest to Electronic Engineers; large Midland engineering plant requires qualified and experienced electronic engineers both senior and junior for rapidly expanding laboratory engaged upon measurement and control problems.—State age, qualification and experience fully in confidence to Box 5857. [3045

CRAFTSMEN for radio and television service required, applicants should be fully experienced in the repair and maintenance of all types of radio and television receivers; rate of pay at present 3/9 per hour; N.J.I.C. conditions; apply in writing to—District Manager, Midlands Electricity Board, 45, High St., Shrewsbury. [3204

SITUATIONS VACANT

RADIO and television field service and bench service engineers required, with first-class experience; excellent oportunities in new service factory with good working conditions and good salary.—Write or telephone, Leytonia Radio, Ltd., Service Department, 784-786, High Rd., Leyton E.10. Tel. Leytonstone 3003. [3172

SOUND equipment manufacturers require experienced testers for production of amplifiers and electric gramophones; also technical assistant/draughtsman for work on special equipments and prototypes; write with details of age and experience.—Trix Eletcrical Co., Ltd., Maple Place, Tott. Court Rd., London, W.1. [3283

TELEVISION: High-Definition Films, Ltd., require Maintenance Engineers for television camera equipment: appointments to permanent staff with excellent prospects of promotion: Starting salary £700/£800 per annum.—Apply, giving details of experience and qualifications, to Personnel Manager, Highbury Studios, 99, Highbury New Park, N.5. [3236

KELVIN & HUGHES, Ltd., Barkingside, Essex, have vacancies for Research Engineers for experimental work relating to underwater sound apparatus. Applicants should be of Degree standard and should have a sound knowledge of communications, in particular electronics.—Applications stating salary required should be addressed to the Personnel Manager. [3150

TELEVISION engineers required by old-established company holding every one of the well-known agencies; applicants must be fully experienced and preferably able to drive; top rates and permanent progressive positions to the right men.—Apply to A. S. White & Sons, Ltd., 130/2. High Rd., S. Tottenham, London, N.15. Sta. 7861-2. [3178

AN opportunity occurs in progressive manufacturing concern in London area for engineer aged 25-35 with electrical or physicist degree, on development and research work on high-frequency telecommunication cable and associated testing equipment. Salary will be commensurate with qualifications and experience.—Apply, giving full particulars to Box 6310. [3135

AIRMEC, Ltd., require development engineers and technical assistants in their laboratories at High Wycombe; applicants would be required to work on the development of commercial and service electronic equipments, and should be capable of carrying a project through on their own initiative; salary according to qualifications and experience; staff pension scheme.—Apply Personnel Officer. [3264

ENGINEER or Physicist with degree or similar qualification and some post-graduate experience of specialised audio frequency circuit design involving feedback amplifiers, filters, pulse techniques or allied subjects, required for interesting development work. Applicants should write, giving full details of previous experience, etc., to Personnel Dept., (ED/121), E.M.I. Eng. Dev., Ltd., Hayes, Middx. [3190

RADIO technician with wired-wireless experience required by International Aeradio, Ltd., in East Africa; single men preferred; salary £1,026 per annum inclusive; free fares and medical facilities; pension fund; qualified candidates to whom replies only will be sent please write full particulars quoting WWT to—Personnel Officer, 40, Park St., W.1. [3175

JUNIOR draughtsmen required, excellent opportunity for suitable men with at least Ordinary National Certificate, to broaden experience and develop progressive career with prominent, well established organisation; near City centre and all amenities, easy reach London, well served transport routes; holidays fixed can be held.—Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd. St. Albans. [3062

RADIO mechanics required for work on high quality electronic equipment; preference will be given to men accustomed to working on their own initiative, who are familiar with circuit diagrams and modern components; some skill with machine tools would be an asset.—Write to The Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey. [3201

SERVO-MECHANISM designers (Ref. W.W./8) to join a laboratory section engaged on design and development of guided missile control systems; Degree and some experience of this work essential; good salary and bonus; pension scheme.—Apply with full details quoting above reference to the Assistant Manager, The Fairey Aviation Company Ltd., Weapon Division, Heston Aerodrome, Hounslow, Middx. 3176

ELECTRONIC Digital Computors, mathematicians with first- or second-class Honours Degrees are invited to apply for vacancies in the "English Electric" team at present working in collaboration with the National Physical Laboratories at Teddington in the design and operation of Advanced and Electronic Computors.—Please reply to Dept. C.P.S., 336-7, Strand, W.C.2, quoting Ref. 1352. [3258

ELECTRONIC technical assistant required for the construction of specialized apparatus and instruments for vibration laboratory; must be capable of working from circuit diagrams and should have had some service or civilian experience in similar fields; please write, stating age and giving full details of previous experience, to—The Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [3231

SITUATIONS VACANT

SALES engineer required for London Office of the Equipment Division of Mullard, Ltd., candidates should have previous sales experience preferably of H.F. and V.H.F. communication equipment, permanent and pensionable appointment; write giving age and full details of education training, previous experience and salary required to—The Personnel Officer, Mullard, Ltd., Century House, Shaftesbury Ave., London, W.C.2. [3250

LEADING manufacturers of television aerials, components and accessories require additional technical representatives in London, Home Counties, West, North and Wales; qualifications to H.N.C. in electrical engineering with radio or telecommunications, or an equivalent one essential; must own car; salary, commission and car allowance, contributory pension scheme; age limits 30 to 40.—Applications (in confidence) to Box 6659. [3215

DRAUGHTSMEN, senior and junior, are required for development work on electronic equipment; the work is interesting and offers considerable scope for men of ability; salaries in excess of A.E.S.D. rates will be offered to suitable applicants; the positions are permanent and pensionable; write giving full details of past experience to—The Wayne Kerr Laboratories, Ltd., Sycamore Grove, New Malden, Surrey [3202

TELEVISION and radio engineers required for retail radio shops in all parts of London and provinces, excellent wages and weekly commission, holidays with pay; applicants should be able to drive and vehicles are supplied; these are permanent, pensionable positions for experienced men.—Tel. or write: Staff Manager, J. & F. Stone Lighting & Radio, Edgware Rd., The Hyde, Hendon, N.W.9. (Corner of Colindale Avenue.) Colindale 7061. [3253

ROYAL Free Hospital School of Medicine, Hunter St., W.C.1 Technician reqd. Oct. for work on construction of electronic apparatus for medical research; technical training in electronics essential, and preferably experience in medical electronics; work non-routine, offering scope for enthusiasm and ability in assisting with design of recording and testing equipment; Whitley Council scales.—Apply Secretary. [3191

SENIOR and junior design draughtsmen reqd. for interesting work in connection with electronic equipment, commercial radio and television and/or light electro-mechanical engineering; London area; the positions vacant offer ample scope and opportunity for future advancement to men of good ability; a high salary will be paid to the selected candidates; all recognized staff privileges available.—Please reply, giving full details of experience, to Box 6896. [3263

THE English Electric Valve Co., Ltd., Chelmsford, have vacancies for young engineers to work on radio valve design and development; applicants should be of degree standard; whilst experience of this type of work is desirable, it is not essential and otherwise suitable candidates will be considered.—Write giving full details quoting Ref. 497F to Central Personnel Services, The English Electric Co., Ltd., 336-7, Strand, London, W.C.2. [3286

THE GENERAL ELECTRIC Co., Ltd., Brown's Lane, Coventry, requires senior and junior electronic development engineers for work on guided weapons and like projects, particularly in the field of microwave and pulse applications; mechanical development engineers, designer draughtsmen and draughtsmen, preferably with experience of radar-type equipments, also required for the above projects; salary according to age, qualifications and experience —Apply by letter, stating age and experience, to the Personnel Manager (ref. R.G.). [0259

DRAUGHTSMEN.—Openings will arise in the immediate future for a number of senior design draughtsmen, draughtsmen and detailers who desire to progress in electronic engineering, as applied in the rapidly expanding field of VHF and UHF radio communications equipment; pension scheme, good salaries and excellent conditions at newly developed works and laboratories in the South West Middlesex area. Own staff informed; please write giving full particulars of experience, qualifications, and when available to—Box 6345. [3142

McMICHAEL RADIO, Ltd., require senior and junior engineers in their equipment division laboratory at Slough; training and experience in the field of applied electronics (including communications) and experience of working with Government Departments are the chief qualifications required.—Write, stating age and full details of training, qualifications and experience, to the Chief Engineer, Equipment Division, McMichael Radio, Ltd., Slough, Bucks. [0198

OLD-ESTABLISHED British Company in Far East requires the services of a technical sales assistant. Candidates should preferably be between the ages of 23-27, of good education and have a general knowledge of some of the following: (a) Broadcast and telecommunications equipment; (b) television; (c) cinema equipment; (d) light electrical engineering. Sales experience an advantage.—Write in confidence to Box JN/159, c/o 95, Bishopsgate, E.C.2. [3136

The Mullard Radio Valve Co. Ltd. has staff vacancies in its Valve Measurement and Applications Laboratory. This department is concerned with the uses of thermionic devices of all kinds rather than with their manufacture. It provides information to the valve user, the development departments and to the manufacturing departments. For these purposes it carries out dynamic measurements and conducts circuit investigations connected with new applications. It also undertakes the design of some of the more specialised test equipment required for these investigations.

Due to expansion in this department, applications are invited from Electronic Engineers and Physicists for posts concerned with the following fields of specialised work.

Ref.: W.11 (1) Gas or mercury vapour thyratrons and rectifiers.

Ref.: W.12 (2) Ultra high frequence valves such as magnetrons, klystrons and travelling wave tubes.

Ref.: W.13 (3) Transmitting valves for communications and general industrial uses.

Ref.: W.14 (4) Pulse techniques associated with U.H.F. devices and thyratrons.

Ref.: W.15 (5) Receiving valves used for frequencies between 100 and 1,000 m/cs.

Ref.: W.16 (6) Valves and semi-conductors used in computing and switching apparatus.

Applicants for any of the above posts should possess a university degree or equivalent qualification and previous experience in similar work, although not essential, is considered an advantage.

In addition to the above posts, there are a number of less senior posts available for applicants who possess advanced level G.C.E. in science subjects or equivalent qualifications or who are at present pursuing courses leading to H.N.C. or external degrees. Such applicants should quote Ref. W.17.

The vacancies outlined are at or near the Company's Mitcham factory. Salaries will be according to individual age, experience and qualifications and can be considered as progressive. Company policy regarding the employment of scientific staff provides adequate prospects for advancement and breadth of outlook is assured by opportunities of transfer to other fields of work within the Company's activities. There are facilities for further training and a Company Pension scheme.

Applications in writing, which will be treated with the strictest confidence, should be addressed to the Personnel Officer, The Mullard Radio Valve Co. Ltd., New Road, Mitcham Junction, Surrey, quoting the appropriate reference number.

SITUATIONS VACANT

MICROWAVE inspection; engineer required to take charge of microwave inspection department; must have both electrical and mechanical knowledge of testing aerials, waveguide sections, attenuators, wave-meters, oscillators, mixers, etc.; opportunity for advancement with progressive company in S.W. London area.—Application in writing, stating experience and salary required, to Box 5879, 15, Hill St., London, W.1. [3262

ELECTRICAL engineer, qualified, required by cable manufacturers to work on the design of cable fittings; the work involves the development of fittings for polythene insulated high voltage cables; practical experience of cable accessories desirable; this post is pensionable and carries a salary of £550-£600 upwards according to qualifications and experience.—Write details, quoting reference RG/2, to Staff Officer, The Telegraph Construction & Maintenance Co., Ltd., Telcon Works, Greenwich, S.E.10. [3200

KELVIN & HUGHES, Ltd., Barkingside, Essex, have vacancies for Technical Assistants for development of electro-mechanical and electronic instruments (Marine). Work involves initial experiments, sea-going trials, pre-production models and factory liaison. Occasional visits overseas are arranged. Qualifications—Practical: 5 years' workshop or drawing office experience. Academic: City and Guilds Telecommunications Final Group Certificate, or equivalent.—Applications stating salary required should be addressed to the Personnel Manager. [3151

THE Ministry of Supply requires craftsmen with practical experience in the servicing and maintenance of ground and airborne radar equipments, to serve as Research and Experimental Mechanics (Special) at Boscombe Down, Wilts. Applicants should have served an apprenticeship or have had equivalent experience. They should have a sound knowledge of basic radar techniques and an ability to remain conversant with advancing development in the radar field. Experience with H.M. Forces on similar work would be an advantage. RATE of pay for a 44-hour 5-day week 139/4 plus 26/- merit lead on entry with prospects of re-assessment for merit lead in 1-3 months. Limited hostel accommodation may be available. APPLY, giving particulars of apprenticeship, training (including Forces' training), qualifications and experience, to Air Commodore Commanding, Aeroplane and Armament Experimental Establishment, Boscombe Down, Amesbury, Wilts. [3196

TWO physicists or electrical engineers are required to develop electronics for infra-red apparatus of advanced design, a flair for devising electronic circuits is required, with a special interest in high-stability L.F. amplifiers, servo-mechanisms and circuits for improving signal to noise ratio, B.Sc. standard or equivalent is expected and applicants should be under 30.—Apply, in writing, stating age, education, industrial experience and salary required, to Sir Howard Grubb, Parsons & Co., Optical Works, Walkergate, Newcastle-upon-Tyne, 6. [3035

APPLICATIONS are invited for component design engineer with education to H.N.C. or equivalent standard; a knowledge of modern quantity production methods and the use of new insulation materials is desirable, but not essential; the post concerned is in the Engineering Department of the Company's Rectifier Division at Chippenham, Wiltshire; applications should be addressed in the first instance to—The Assistant Divisional Manager, Rectifiers, Westinghouse Brake & Signal Co., Ltd., 82, York Way King's Cross, London, N.1. [3199

ELECTRONIC Engineers are invited to apply for two senior posts of exceptional interest and opportunity with Decca Radar, Ltd., to work in their laboratories on an extensive and expanding programme of radar display and receiver development; applicants must have had responsible development experience in the electronic field; posts are permanent and pensionable; good starting salaries and considerable prospects of advancement; British Nationality essential; write, quoting ref. RLA/49, to—Decca Radar, Ltd., 2, Tolworth Rise, Tolworth, Surbiton, Surrey. [3247

JOSEPH LUCAS (Gas Turbine Equipment), Ltd., invites applications for electronic engineers; some knowledge of Servo mechanisms would be advantage; should have University degree; these appointments are pensionable and offer god prospects to individuals with initiative and technical ability; salary will be in accordance with experience and qualifications—Details of experience and qualifications should be sent to Personnel Manager, Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green Birmingham. [3170

MITCHAM WORKS, Ltd., have vacancies for technical assistants able to carry out without close supervision, measurements on radio and/or television receivers and associated components; these posts offer excellent opportunities for young men to enter the factory laboratory of a leading receiver manufacturer COMMENCING salaries in accordance with age, experience and qualifications.—Candidates, who should have academic qualifications in radio to the standard of H.N.C., should apply in writing to the Personnel Officer, Mitcham Works, Ltd., New Rd., Mitcham Junction, Surrey, quoting reference G.1. [3281

The Mullard Radio Valve Co. Ltd. has Staff vacancies in its Central Testing and Quality Department. This department deals with the control of the quality of all the vacuum tube and semi-conductor products of the Company, using both direct and statistical methods and is responsible for the investigation and further development of these methods.

Assistants are required for the following vacancies:—

REF: W.6 The design and construction of apparatus and equipment for testing radio valves and other vacuum devices. A knowledge of Pulse techniques is involved.

REF: W.7 The testing by Quality Control methods of Cathode Ray Tubes of all types. Liaison work with other departments will be required.

REF: W.8 The supervision of a small section carrying out quality control testing and special measurements of receiving valves. Liaison work with other departments will be required.

REF: W.9 The testing of klystrons and similar U.H.F. devices and the development of testing techniques for this purpose.

REF: W.10 Testing and experimental work on semi-conducting devices of the crystal diode and transistor type.

Applicants for the above posts, which are permanent, should be Physicists or Electrical Engineers and should possess a university degree or equivalent qualification.

In addition to the above posts there are a number of less senior posts available for work in similar fields, for applicants who possess Advanced Level G.C.E. in science subjects or equivalent qualifications or who are pursuing courses leading to H.N.C. or external degrees. Such applicants should quote reference W.17.

For both grades previous experience is desirable but not essential.

The vacancies outlined above are at or near the Company's Mitcham factory and are due to the expansion of its activities in these fields. Salaries will be according to individual age, experience and qualifications and can be considered as progressive. Company policy regarding the employment of scientific staff provides adequate prospects for advancement and breadth of outlook is assured by opportunities of transfer to other fields of work within the Company's activities. There are facilities for further training and a Company Pension Scheme.

Applications in writing, which will be treated in the strictest confidence, should be addressed to the Personnel Officer, The Mullard Radio Valve Co. Ltd., New Road, Mitcham Junction, Surrey, quoting the appropriate reference number.

The Mullard Radio Valve Co. Ltd. has senior and junior staff vacancies in several of its **Development Departments** situated in or near Mitcham, Surrey. The field in which applicants would be required to work are listed below:—

Receiving Valve Development Department

REF. W.1. (a) The general engineering development of receiving valves.
(b) Glass techniques, including the control of existing and experimental work on new methods.
(c) The investigation of manufacturing processes with a view to attaining closer control and further development.

Gas Filled Valve Development Department.

REF: W.2. (a) The technological development of hot cathode gas filled rectifiers and thyratrons of all sizes and classes.
(b) The general development of cold cathode gas filled valves including stabilisers and reference tubes and also multi-electrode types.
(c) Investigational work on gas discharge phenomena in relation to the tube classes mentioned under (a) and (b) above.

U.H.F. and Transmitting Valve Development Department

REF: W.3. (a) The technological development of magnetrons, klystrons, travelling wave tubes and kindred devices. This work includes metal-glass sealing, ceramic and metal brazing techniques.
(b) General development work on the more conventional glass, metal-glass and disc seal valves usually for the V.H.F. range.
(c) Investigational work on the effects of variation of mechanical structure and of changes in materials used for (a) and (b) above.

Cathode Ray Tube Department

REF: W.4. (a) The glass, mechanical and chemical technology of all types of cathode ray and kindred tubes including colour television tubes.
(b) Process development of methods used for the manufacture of new types of cathode ray tubes.
(c) Improvements in gun design including electron optical work.

Semi-conductor Development Department

REF: W.5. (a) The technological development of all types of semi-conducting devices including transistors and rectifiers.
(b) The investigation of semi-conducting materials to establish their possible application to practical devices.
(c) The development of processes and production methods for semi-conducting devices.

Applicants for the senior posts should be physicists, electrical engineers or, where appropriate, physical chemists and should possess a university degree or equivalent qualifications.

For the more junior posts candidates should possess Advanced Level G.C.E. in science subjects or equivalent qualifications, or should be pursuing courses leading to H.N.C. or external degrees.

For both grades past experience in similar work is desirable but not essential.

The vacancies outlined above are caused by the expansion of the Company's activities in these fields. Salaries will be according to individual age and experience and qualifications and can be considered as progressive. Company policy regarding the employment of scientific staff provides adequate prospects for advancement and breadth of outlook is assured by opportunities of transfer to other fields of work within the Company's activities. There are facilities for further study and a Company Pension Scheme.

Applications in writing, which will be treated with the strictest confidence, should be addressed to the Personnel Officer, The Mullard Radio Valve Co. Ltd., New Road, Mitcham Junction, Surrey, quoting the appropriate reference number.

SITUATIONS VACANT

DRAUGHTSMEN are required for permanent posts in the field of radar engineering; excellent opportunities for advancement; Salaries beyond A.E.S.D. rates to suitable applicants; staff pension scheme and canteen facilities; 5-day week; British Nationality essential. Posts to be filled in the following grades: Senior section leader; checker draughtsman and senior design draughtsman; intermediate draughtsman; circuit draughtsman; installation draughtsman.—Apply, quoting Ref. RLA/21, Chief Draughtsman Decca Radar, Ltd., Research Laboratory, 2, Tolworth Rise, Surbiton, Surrey. [3131

A SENIOR electrical development engineer is required by a large manufacturing company of repute specialising in low voltage equipment; the successful applicant, who should possess 10/15 years experience with a wide background in electrical engineering, will be required to lead a team of engineers engaged on the design and development of rotating machines and electro mechanical devices; this is a pensionable senior staff appointment and the starting salary will be commensurate with the position and the responsibility involved.—Applications should be made in confidence, quoting reference G.L.E., to Box 6451. [3177

A SENIOR appointment will shortly be filled in the London laboratory of a firm holding contracts in guided weapon and kindred fields. Engineers who wish to be considered for this vacancy should be graduates and should have had some experience in industrial engineering laboratories. Some production engineering experience in addition to microwave electronic and/or servo experience would be an advantage. Starting salary will range according to age and experience and will be on a generous scale and will be subject to good increases, according to merit. Pension and life assurance schemes are in operation.—Write, giving full details, in confidence, to Box 6807. [3241

AN electronic or electrical engineer, between the age 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 Personnel Manager, Standard Telephones & Cables, Ltd., Crystal Factory, Industrial Estate East, Harlow, Essex. [3185

ENGINEERS who wish to broaden or commence career as electronic engineers in a field of great interest and variety and involving latest techniques can avoid restrictive specialization by joining Marconi Instruments, who produce light current communications, measuring and test apparatus for a wide range of requirements; we have positions for men of degree standard and experience, also City and Guilds Telecommunications Certificate standard, or compensating experience and natural aptitude for electronic engineering; holiday arrangements if fixed can be held; Saturday interview if required; applications in strictest confidence. —Apply Marconi Instruments, Ltd., Longacres, Hatfield Rd., St. Albans. [3063

JUNIOR development engineers are urgently required to ass t in the development of precision electronic laboratory instruments. Successful applicants will be engaged on interesting long-term projects concerned with the development of a wide range of equipment. The appointments are permanent and carry considerable technical responsibility. Applicants should have had previous development experience, preferably in the instrument field. Academic qualifications ranging from O.N.C. to degree standard are acceptable. Salaries are dependent upon age, qualifications and experience.—Apply, stating full details, to the Chief Engineer, Messrs. Furzehill Laboratories, Ltd., Shenley Rd. Boreham Wood, Herts. [0030

ASSISTANT technical supervisors required by the Nigerian Broadcasting Service for two tours of 15 to 18 months each in the first instance; salary scale (including expatriation pay) £807 rising to £1,115 a year, gratuity at the rate of £100/£150 a year; outfit allowance £60; free passages for officers and wives; assistance towards cost of children's passages or grant up to £150 a year for their maintenance in U.K.; liberal leave on full salary; candidates should have some administrative ability and have had wide theoretical and practical experience of low-frequency amplifiers and radio equipment.—Write to the Crown Agents, 4 Millbank, London, S.W.1; state age, name in block letters, full qualifications and experience and quote M2C/30482/WF. [3171

TECHNICAL Sale/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 months' tours, pension scheme.—Apply in own handwriting stating age (preferably between 21 and 30), whether married or single, full details education, qualifications, national service and business experience. Original references should not be sent.—Apply T.S.D., Box 6486. [3180

GUIDED WEAPONS

The Guided Weapons Department of Vickers-Armstrongs Limited, Weybridge, has vacancies for the following Staff—

GRADUATE ENGINEERS, with degrees in Engineering, Physics or Mathematics, and 3 to 5 years' experience in one of the following categories:—

E.1. Design and development of high pressure hydraulic or pneumatic systems and components.
E.2. Development of techniques for vibration and/or climatic testing as applied to electronic equipment and design of associated test gear.
E.3. Development work on reinforced plastics.
E.4. Design of missile autopilots, simulators and computers.
E.5. Design of U.H.F. and Micro-wave Transmitters and Receivers.
E.6. Design of Transformers and magnetic amplifiers, with good general knowledge of electrical properties of materials.
E.7. Design of electronic circuits and servo mechanisms.
E.8. Engineering development of missile electronic equipments.

TECHNICAL ASSISTANTS, with degree, Higher National Certificate or equivalent, and experience in one of the following categories :—

T.1. Development and test of high pressure hydraulic or pneumatic systems and components.
T.2. Environmental testing of missile components.
T.3 Manufacture of prototype missile electronic equipments to M.O.S. specifications.
T.4. Manufacture of reinforced plastic components and potting of electronics.
T.5. Development and test of instrumentation for missile trials.
T.6. Development of missile autopilots and analogue computers.

LABORATORY ASSISTANTS, preferably with O.N.C. or equivalent.

L.1. Assembly, test, and maintenance of hydraulic and pneumatic systems and components.
L.2. Drawing and constructing test rigs used for mechanical and environmental testing.
L.3 Manufacture of prototype electronic equipment and electro-mechanical devices. Layout and wiring from circuit diagrams and sketches, chassis work and simple machining.

DRAUGHTSMEN, with 2 years' experience or more as follows:—

D.1. Design of ground, airborne or missile types of radar equipment.
D.2. Design of small mechanisms such as missile autopilots, and electro-mechanical computers embodying gyroscopes, accelerometers, small motors, gearboxes, etc.

Apply to Employment Manager, Vickers-Armstrongs Limited (Aircraft Division), Weybridge, Surrey, giving full particulars and quoting reference EO/G.W./reference number above.

Weybridge station is 30 minutes from London on the main Waterloo/Portsmouth line.

Additional buses operate to and from the Works at starting and finishing times.

Canteen facilities.

SITUATIONS VACANT

TECHNICAL writer with command of good English to create publicity material and deal with technical correspondence; apply in confidence, stating age, salary required, experience, or Tel. Wembley 1200 for appointment.—Goodmans Industries, Ltd., Axiom Works, Wembley. [3279

AN opportunity for advancement, governed only by ability, exists in a newly opened Division of a world-wide organization in N.W. Lancashire; a University or comparable degree in electrical engineering is essential and experience in the use of radiation equipment and general instrumentation for process control would be of value; although initially the servicing of installed instrumentation will be the primary responsibility, refinement of these controls, their adaptation to new equipment, and the development of entirely new processes will be the final goal. Superannuation, bonus and health schemes are all excellent but if these are of primary interest to you your application is not of interest to us. Faith that your own ability will determine your future is essential. If you have this we will be pleased to arrange an interview.—Box 6485. [3179

THE War Office requires for No. 35 Base Workshop, R.E.M.E., Old Dalby, Leicestershire: One Mechanical Engineering Officer (Main Grade) to control workshop repairing radar and associated equipment. Knowledge and experience of modern electronic and allied engineering progress and process methods and technique of management essential, also ability to organise large repair programmes and production. Inclusive salary range £960-£1,240 (Provincial). Applicants must be British of British parentage and Corporate Members of the Institution of Electrical Engineers or have passed or be exempt from Sections A & B of their membership examination. Starting salary fixed according to age, qualification and experience on range quoted. Annual increments subject to satisfactory service. Post temporary but long-term possibilities.—Application forms from M.L.N.S., Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D.258/54.A. [3237

MINISTRY of Supply requires Senior Examiners at various places including Birmingham, Bristol, Glasgow, London, Manchester and Sheffield to inspect and supervise firms' inspection in one of following fields: (a) Aircraft and Aero Engines; (b) Radio and Radar; (c) Instruments and Electrical Equipment; (d) Materials (metallic and non-metallic). Qualifications: Recognised engineering apprenticeship or equivalent training in radio industry or (for materials posts) suitable training in chemistry, physics or metallurgy. O.N.C., City & Guilds or equivalent qualn. desirable. Salary: Within £635 (age 30)—£780, according to age and location. Not established but opportunities to compete for establishment may arise. State preference for duties and location when applying, but appointees required to serve anywhere in U.K. and to move when necessary.—Application forms from London Appointments Office, 1-6, Tavistock Square, London, W.C.1, quoting AA462. [3182

WAR OFFICE require temporary assistant engineers for No. 2 War Office Signal Regiment, Droitwich, Worcester and Bampton, Oxon. Salary payable on range £375—£765 (provincial); starting salary according to age, qualifications and experience; must be British of British parentage and possess either City and Guilds of London Institute Certificate in Telecommunications principles (First Class in Grade I or Second Class in Grade II) and first class certificates in one of following: Telephone Exchange systems, Telegraphy, Radio or Line Transmission/or City and Guilds Intermediate Certificate in Telecommunications Engineering/or first class certificate in Telecommunication Principles Grade I or above and TWO other certificates in different Telecommunication subjects which should be first class in Grade I or II or first or second class in Grade III or above; Higher National Certificate in Electrical Engineering or Inter. B.Sc. will be accepted; write, giving date of birth, education, full details of qualifications and experience of posts held (including dates) to—E.A.394 Appointments Officer, Ministry of Labour and National Service, 1-6, Tavistock Sq., W.C.1, by 20 September, 1954; no original testimonials should be sent; only candidates selected for interview will be advised. [3273

SITUATIONS WANTED

LECTURER, telecommunications, TV, A.M.I.E.E., wide experience, requires evening lectures, London or Surrey.—Box 6835. [3243

RADIO engineer desires overseas position, 20 years' experience British/American broadcasting and communications.—Box 6526. [3188

RADIO officer, M.N., aged 35, first-class certificate, radar maintenance certificate, teacher's training certificate, general science, desires interesting work home or European countries; available September 1st.—Box 6447. [3168

BRITISHER. Assoc. Brit. I.R.E., age 31, wide experience radio/radar techniques, present resident abroad, requires admin. and/or tech. rep. post, home or overseas (intimate knowledge Mid. East, Pakistan, Bharat, Ceylon, but would go anywhere); available interview U.K. Sept.-Oct.; present salary equiv. £2,500 p.a.—Box 6356. [3155

TECHNICAL TRAINING

CITY & 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

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

WIRELESS operating; attendance and postal courses.—Stamp for reply to Manager, The Wireless School, Manor Gdns., London, N.7. [0104

CITY OF LIVERPOOL.
EDUCATION Committee.
RIVERSDALE Technical College.
MARINE Radio Officers' Course.
A full-time course leading to the Postmaster-General's Certificate in Radiotelegraphy and Radiotelephony will commence in September, 1954.
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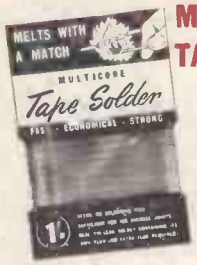

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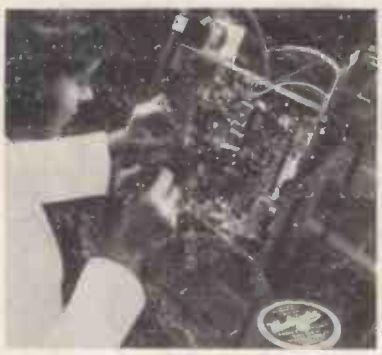

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