MAY 1959 TWO SHILLINGS

Wireless World

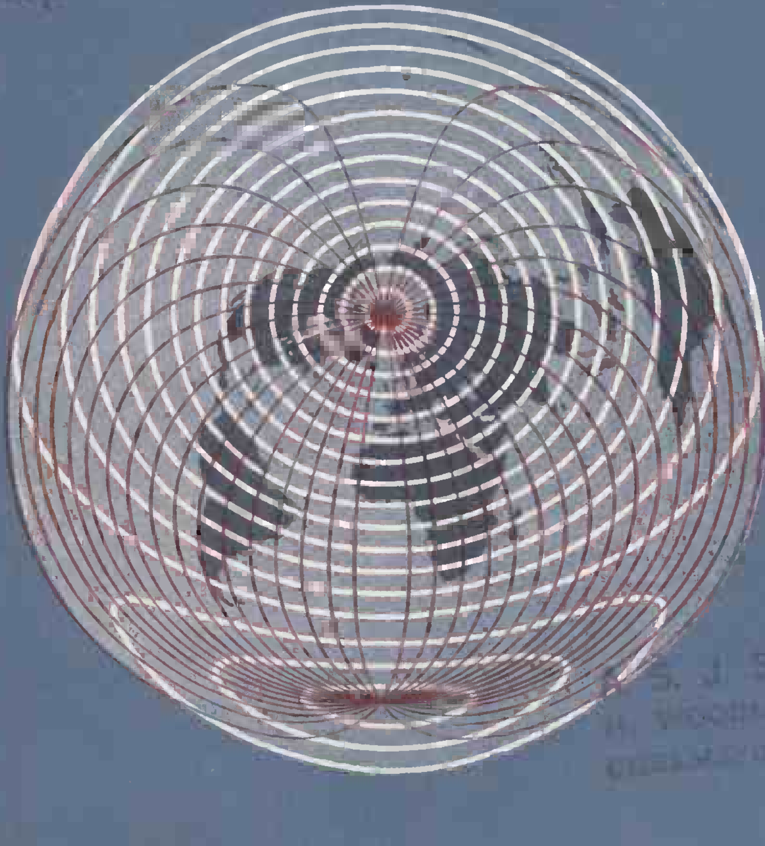
PAGE 217 TRANSISTORS. SILICON & GERMANIUM

ELECTRONICS

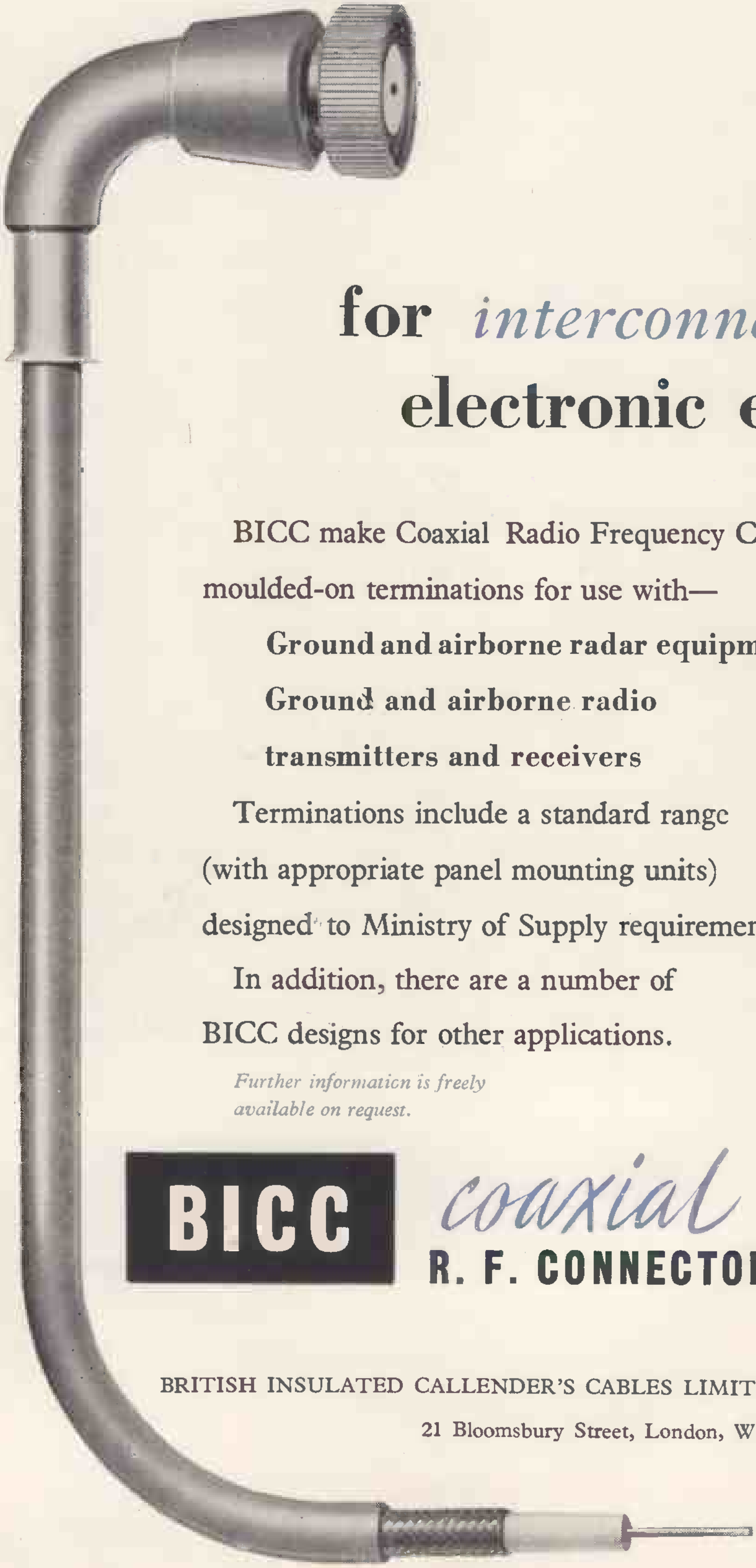
Radio · Television

PAGE 350 TRANSISTOR EXHIBITION

PAGE 219-224 MAGNETIC AMPLIFIER



FORTY-NINTH YEAR OF PUBLICATION



Wireless World

ELECTRONICS, RADIO, TELEVISION

MAY 1959

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

Editor:
F. L. DEVEREUX, B.Sc.

Assistant Editors:
H. W. BARNARD
T. E. IVALL

VOLUME 65 No. 5

PRICE: TWO SHILLINGS

FORTY-NINTH YEAR OF PUBLICATION

Offices: Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager, or Publisher, as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* "Iliffepres, Sedist, London." *Annual Subscriptions: Home and Overseas,* £1 15s. 0d. *Canada and U.S.A.,* $5.00. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 26B, Renfield Street, C.2. *Telephone:* Central 1265. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

Transistor Transmitter for 500kc/s

The recently introduced Mullard OC24 power transistor is suitable for high-frequency applications and it can dissipate several watts at the collector. The combination of these qualities has made possible the design of a 500kc/s push-pull amplifier capable of delivering an output of 4 watts into a resistive load. This amplifier can be used as the output stage of a transmitter such as that shown in the accompanying circuit.

The transmitter was designed for operation in the International Marine Frequency Band. It is particularly useful for lifeboats and life rafts, but it can be adapted, using an automatic-keying system, for life-jackets, air-sea rescue equipment, helicopters and radio beacons for coastal stations. The long life and reliability of the transistors make them particularly suitable for the type of apparatus suggested above, in which standby conditions of long duration are experienced. The low-consumption, light weight and compactness add to these advantages. A 4 ampere-hour accumulator will power the transmitter for some 60 hours. For emergency applications a self priming battery, which requires no attention (other than charging and sealing) until it is needed for use, is suitable.

The transmitter comprises an oscillator, a modulator, a driver and a power amplifier stage. The oscillator is crystal controlled and uses an OC45 transistor. The resonant circuit in the collector line is tuned to the series-resonant frequency of the crystal. The crystal is connected in series with the feedback winding to control the frequency of oscillation.

The modulator is a silicon transistor (OC201) also recently announced. The output from the modulator is applied to a driver amplifier and then to a push-pull power amplifier which feeds an aerial. The modulator, driver and power-amplifier stages are all operated under Class B conditions.

The design of the Class B push-pull amplifier follows the same basic technique as that for an audio amplifier except that, as the collector circuit is tuned, no bias is required to eliminate cross-over distortion. The use of a shared emitter resistor reduces the effect of variations in base-emitter voltage V_{be}, and reduces the lengthening, caused by hole storage, of the collector-current pulse. This reduction of the hole-storage current gives a marked improvement in the efficiency of the amplifier. The winding details for the output transformer are shown on the circuit.

The design procedure for the driver and modulator stages is similar to that for the output stage. A 6V supply is used for the modulator because of the voltage limitations of the oscillator transistor. This supply is also used because it is convenient for the modulator, and because of the keying system adopted.

A crystal-controlled oscillator with a tuned collector is used. Feedback is obtained by a transformer coupling from the parallel-tuned circuit in the collector circuit, to the base. The crystal is connected in series with this feedback winding. The collector circuit is tuned to the series-resonant frequency of the crystal. The series resistance of the crystal is low enough for the feedback current to start oscillation. The oscillator operates under Class A conditions, the base bias is provided by a potentiometer (R1R2). The emitter resistor is bypassed to r.f. signals.

It is hoped to publish details of the modulation arrangements and the automatic keying system (transmitting SOS signals) at a later date.

The tuning procedure adopted is the usual one of rough tuning at reduced power, followed by adjustment at full power. A resistor of 27Ω is connected in the emitter lead of the modulator amplifier Tr2, the 12V supply is then connected to the transmitter, and the oscillator tuned-circuit is adjusted to the series-resonant frequency of the crystal. The modulator amplifier is tuned next. The driver and power-amplifier stages should then be tuned for a maximum power output (about 2 watts) across the 68Ω load.

The emitter resistor of Tr2 should then be short-circuited. The complete transmitter, from the oscillator to the power amplifier, should be progressively readjusted. Careful tuning of the power amplifier is necessary, because excessive collector current flows if the stage is off tune. The full output of 4 watts should now be obtained.

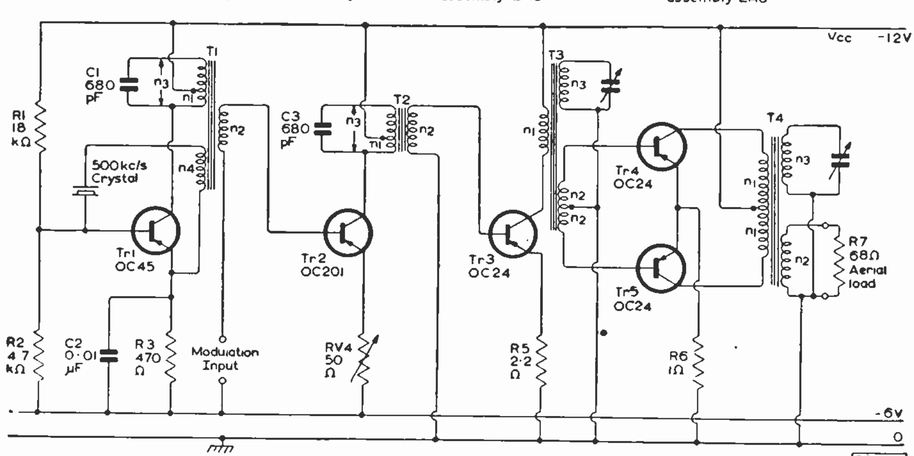
An experimental transmitter was built and the performance tested over a temperature range from 0 to 60°C. The output falls gradually at temperatures above 25°C, although quite reasonable output is still available at 60°C. Field tests were carried out under licence using a 520kc/s crystal, the transmitter being retuned to this frequency. A transmitting aerial 30ft high and a receiving aerial of about 30ft of wire were used. Strong signals were received within 12 miles across land. This is not the maximum range over land, and a range of at least 50 miles can be expected at sea.

Oscillator Transformer T1
n_1 18 turns, n_2 7 turns, n_3 52 turns, n_4 6 turns — 9/0024 bunched conductors
Ferroxcube adjustable pot-core assembly LA35

Modulator Transformer T2
n_1 6 turns, n_2 4 turns, n_3 52 turns — 9/0024 bunched conductors
Ferroxcube adjustable pot-core assembly LA35

Driver Transformer T3
n_1 4 turns, n_2 3+3 turns, n_3 30 turns — 19/0028 bunched conductors (n_1, n_2) 3 strands
Ferroxcube pot-core assembly LA3

Output Transformer T4
n_1 2+2 turns, n_2 4 turns — 21 s.w.g enamelled copper; n_3 33 turns — 19/0028 bunched conductors
Ferroxcube pot-core assembly LA6



Complete Circuit of the Transmitter

MAY 1959
Vol. 65 No. 5

Wireless World

Making and Selling Valves

IT has been rightly said that valves and cathode ray tubes are at the heart of our affairs, and although in this journal we are concerned primarily with the technical aspects of their use, we cannot always stand aloof from the manner of their supply and marketing. Commercial considerations will always be an important factor in setting the pace of development in an industry where capital costs are high.

British valve manufacturers and their Association, the BVA, have never lacked critics of their marketing methods, and these critics have not concealed their satisfaction in the abandonment by the BVA of price-fixing agreements in 1956 just prior to the publication of the "Report on the Supply of Electronic Valves and Cathode Ray Tubes of the Monopolies and Restrictive Practices Commission,"* and again last month in the decision of the BVA not to offer evidence at the Restrictive Practices Court hearing in support of a continuation of agreements on "exclusivity" and maximum discounts or of the practice of limiting the number of wholesalers handling BVA valves.

The Restrictive Trade Practices Act, 1956, which requires registration of certain types of agreements and restrictions, is in many ways a new form of legislation—at least in this country. It has established a Court and a Registrar who may bring before the Court any association whose agreements are deemed to be contrary to public interest. The onus then rests on that association of proving to the satisfaction of the Court that the practices in question are, in fact, in the public interest.

What is "the public interest"? In wartime it was the restriction of the supply of valves to the public to a mere trickle. To the man in the street today it could mean the reduction of prices to the absolute minimum—if necessary by cut-throat competition, which would divert the whole of the manufacturer's resources to the cheaper production of existing types. To others it might mean an increase in prices so that more money could be applied to the discovery of entirely new valve techniques to keep this country in the lead and to improve the balance of trade. The Act enunciates no fewer than seven criteria by which the public interest is to be assessed. These are of a highly complex nature and must involve lengthy stage-by-stage legal argument before it can be decided whether an agreement may stand—or must be abandoned.

* Her Majesty's Stationery Office, price 7s.

In the case of the BVA many of its trading agreements have their origin in the early days of broadcasting when the dumping of foreign valves was a serious menace to an industry which had not yet built up adequate capital resources. Today they are in a much stronger position. Set manufacturers and servicemen in general prefer to use BVA valves; in 1955, according to the Report mentioned earlier, imported valves not sold through BVA channels were estimated to amount to 5% of the total supply. Faced with the alternatives of fighting for the maintenance of the old-established collective agreements or standing on their own feet, the member firms of the BVA have, we think wisely, decided to take the latter course. The decision is unlikely to influence the prices of valves and tubes which have for a long time been determined by far more fundamental factors than trade agreements. The industry has already declared its profits and opened its books for analysis by the Monopolies and Restrictive Practices Commission and the results are set out in great detail in their 1956 Report. It should be compulsory reading for all would-be critics—in particular those who complain that set makers get valves for 2s 6d each which cost the best part of £1 to buy in the shops. This comparison overlooks the fact that the cheaper valves will be subject, as part of a set, to distributive costs which are of the same order as those which apply to a maintenance valve. It is true that valve manufacturers charge *on an average* 10% more to a wholesaler than they do to a set maker, but this is accounted for by the smaller bulk of supplies, the cost of special packaging and by the fact that short production runs of replacement valves for maintenance are often very expensive. Again on average, the valve manufacturer's profit on cost to the set maker in 1954 was about 18% and to the wholesaler 28%. If this difference were levelled, television sets might cost anything up to £10 more to the customer. It is clearly in the consumer's interest that the sixteen odd valves he *must* buy in the set cost him less per valve than the two maintenance valves that, on a statistical, basis, he *may* have to buy during the life of the set. (The ratio of "first-equipment" to maintenance valves sold is about 8:1.)

In spite of the fact that the valve makers have had difficulty in finding proof of specific and substantial public benefit from some of their past trading restrictions, we think that valve users, both professional and domestic, are well served by what is undoubtedly an efficient and well-managed industry.

Fifth International Instrument Show

EXHIBITS BY FIFTY-SIX FIRMS OF TEN NATIONALITIES

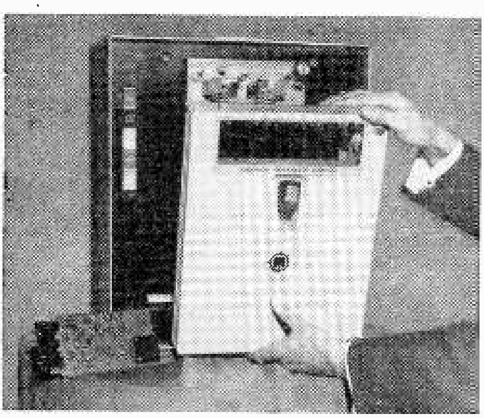
HELD for the first time at the International Instrumentation Centre, London, this year's international instrument exhibition was a little smaller than last year's, and many of the exhibits had been seen before, in at least prototype form. Nevertheless, since most of the larger instrument shows are restricted to British exhibitors, this one offers a welcome opportunity for comparing foreign developments, and there are always some interesting novelties.

Data Recorders

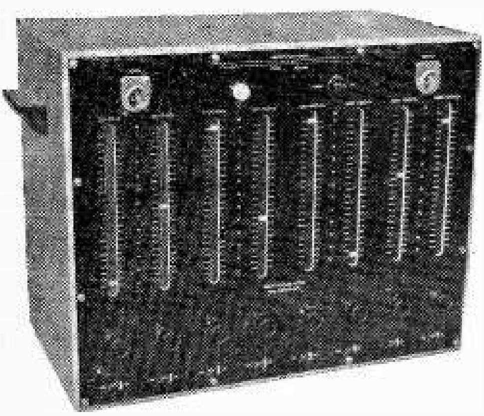
One of these is the PS.200 tape data recorder by Precision Instrument Co. (U.S.A.). This uses 1-in magnetic tape, carrying 14 tracks. Two pairs of 2:1 tape speeds, selected from the range of $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$, 15, 30, and 60 in/sec, are available by motor-pole switching and drive-belt change. Four varieties of recording are available: direct; f.m. (using a kc/s carrier-frequency equal to nine-tenths tape speed in in/sec); pulse-width modulation; digital. One of the most interesting features is that tapes are mounted in rectangular magazines which can be changed in a few seconds by a plug-in arrangement whereby the tape is self-threading. The whole of the gate is visible all the time through a window. Another feature is that the weight of the equipment has been reduced from nearly half a ton to 65 lbs by the use of transistors and printed circuits, making the equipment fully portable for field use. It will, incidentally, run off 24-volt d.c. as well as the usual a.c. Control is by push tabs, which are back-lighted to show clearly the state of operation.

An altogether different type of data recorder is one that was shown by Elema-Schonander (Sweden), in which a jet of ink is squirted at a moving paper strip from the centre of a galvanometer movement which deflects the jet. Instead of the mess which this procedure might be expected to create, beautifully fine traces are produced, thanks to the extreme fineness of the jet; and when several channels are in use the traces can cross and recross without mutual interference. It is remarkable, too, for an ink-and-paper instrument, that frequencies can be recorded up to 1,000 c/s, with sensitivity as high as 0.2 mm/mV.

Yet another interesting recording technique appears in the Hughes Aircraft (U.S.A.) "Memotron" c.r. tube —a 5-in tube in which traces applied in the conventional manner are not only displayed but retained on the screen until erased. This result is achieved by means of a

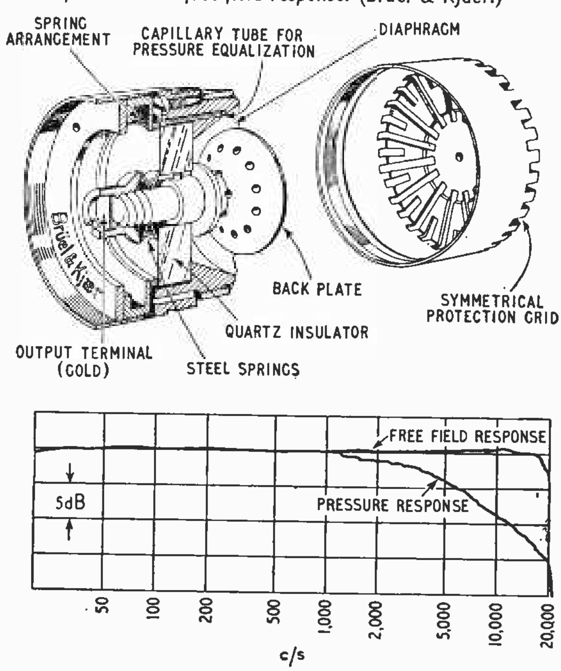


Type PS200 tape data recorder, showing tape magazine being changed and (left) one of the printed circuit panels. (Precision Instrument Co.)



Type TF823 variable multi-octave-band filter (Peekel)

Construction of the Type 4131 capacitive microphone and its pressure and free-field response. (Brüel & Kjær.)

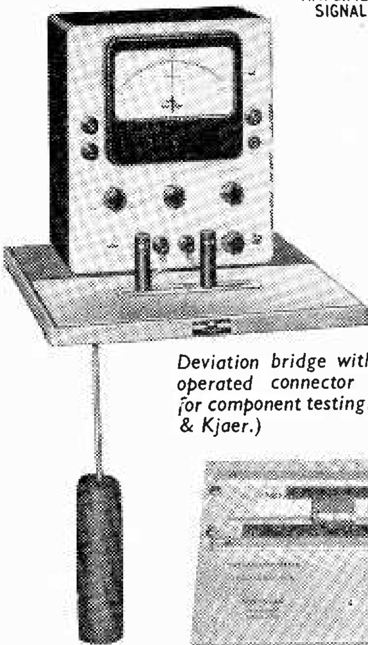


dielectric storage mesh and two electron guns: a writing gun and a flood gun. This type of tube is incorporated in a complete c.r.o.—the "Memoscope."

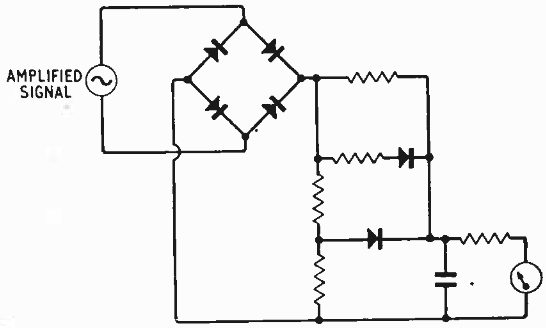
For audio workers, the Peekel (Holland) TF.823 variable multi-octave band filter is a particularly interesting and useful instrument. It consists of a low-pass filter, a high pass filter, and six intervening octave filters, covering between them roughly 30 c/s to 16 kc/s. Each filter can be individually adjusted by a vertical sliding linear attenuator with a dB scale, so that an infinite variety of frequency characteristics can be set up, for such purposes as equalization, intelligibility and distortion studies, and bridge measurements. The attenuator scales being arranged across the front panel, their settings trace a visual frequency curve. With all the attenuators at zero, the insertion loss is nil. Input and output impedances, 200 Ω.

The portable sound spectrum meter by the same firm, mentioned last year, now appears in improved form.

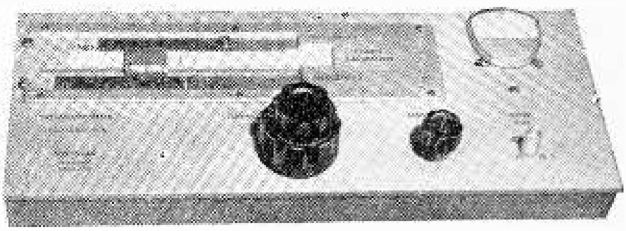
Much of the very extensive Brüel & Kjaer (Denmark) range of instruments is for a.f. work, and a notable newcomer is their Type 4131 capacitive microphone. It is a precision instrument for sound measurements as well as for high-quality studio use. The free-field response is practically flat from 20 c/s to 18 kc/s, and the sensitivity is 5 mV/microbar. Combined with it is a cathode follower, and a full range of accessory equipment is available.



Deviation bridge with knee-operated connector release for component testing. (Brüel & Kjaer.)



Square-law (parabolic) network for r.m.s. measurements used in the new B & K valve voltmeter Type 2409.



Type SL7626 microwave search frequency meter (Sivers).

The most interesting feature of the new B & K valve voltmeter—which is of the high-sensitivity amplifier type, covering 2 c/s to 200 kc/s and 1 mV to 1,000 V—is the arrangement for enabling peak, average, and true r.m.s. values to be measured. The r.m.s. facility is provided by a network as shown in the circuit diagram, approximating closely to a parabolic character*.

The same firm showed a series of deviation bridges for production-line use in component manufacture. A special knee-operated test connector release speeds operation, and the scales are marked in percentage deviation from standard in impedance and phase-angle. Bridges are available for test frequencies of 100 c/s, 1 kc/s, 10 kc/s, and 1,000 kc/s.

pH Meters

Except in so far as they exemplify extra-high-input-impedance voltmeter techniques, pH meters hardly come within the scope of *Wireless World*, but the Seibold (Austria) Model GV-52 is a striking illustration of how what used to be a delicate and non-portable assemblage of laboratory apparatus requiring skilled handling can now be obtained as a single smooth functional unit which is operated simply by dipping one end in the liquid to be tested, pressing a button and reading the meter at the other end.

A notable feature of the exhibition as a whole was the increasing use of transistors and other semiconductor devices. Its advantage in the "Precision" tape recorder has already been noted. H. Struers (Denmark), whose unusual types of regulated power supply units were mentioned two years ago, have taken advantage of the high current ratings of transistors to design a unit ("Transistavolt") supplying 0-6 A at a voltage adjustable from 5·6 to 6·3 V. The internal resistance is less than 5 mΩ, the ripply voltage 1 mV, and mains fluctuations from −15% to +10% affect the output voltage less than 0·02%.

Several transistorized power units are supplied by Valor Instruments (U.S.A.), who have also a transistor checker which must be invaluable wherever many transistors are used. It locates burnt-out transistors, identifies type (p-n-p or n-p-n), measures leakage current, checks voltage breakdown, identifies terminals, and checks characteristics and electrodes shorts and open-circuits.

Microwave equipment figured largely, and Polarad Electronics (U.S.A.) have again upheld their reputation for spectrum analysis equipment. Model SA.84 covers the remarkable frequency range 10 to 44,000 Mc/s in eight bands. There is only a single tuning control, with direct-reading linear dial. The frequency deviation is adjustable from 0·5 to 5 Mc/s.

Sivers (Sweden) again showed a very wide range of microwave cavity wavemeters, waveguide joints and switches, etc., to which they have now added Type SL.7626 search frequency meter—a compact and handy instrument for measuring oscillator frequencies over the wide band 1 to 10 kMc/s. Two signals can be separately measured on linear vernier scales, and inaccuracy as low as 0·2 to 0·5% is claimed.

* "A True r.m.s. Instrument," by C. G. Wahrman. *B. & K. Technical Review*, No. 3, 1958, pp. 9-21.

WORLD OF WIRELESS

Budget Changes

THE exemption of cathode-ray tubes (both new and rebuilt) from purchase tax, previously standing at 60%, is welcomed as it removes an anomaly and is a first step in bringing the radio industry into line with others where there is no P.T. on spares. In announcing this concession the Chancellor of the Exchequer stated "this tax has been represented to me as being unduly burdensome, and technical developments in the reconditioning of tubes have made it difficult to administer the tax with equity".

To ensure that this concession "does not give an opportunity for tax avoidance on sets themselves", the Treasury has made an order stating that "television receiving sets of the domestic, portable, or road vehicle types and apparatus of the domestic type designed for receiving television programmes re-transmitted by wire, except kits of parts . . . (whether or not in a cabinet) which are complete or substantially complete *except that they lack a cathode-ray tube* . . . are to be treated for tax purposes as if a cathode-ray tube formed part of the receiver, and the value of a new tube of appropriate size and character is to be included in the full value of the receiver, upon which tax is charged."

With the general reduction of purchase tax by a sixth (except in the 5% rate), the tax on television sets, sound receivers, radio-gramophones, record players and reproducers, record changers, turntables, pickups, valves, r.f. tuners, gramophone records, etc., is reduced to 50%.

Radio in Space Research

AT the first meeting of the newly-formed National Committee on Space Research a report on the U.K. observations of artificial earth satellites by radio and optical methods was presented by the I.G.Y. Artificial Satellite Sub-committee. The report was an outline of work in progress, covering the types of observations and giving details of the twelve U.K. radio observing stations (and other organizations) and their facilities. Several prominent people well known in the radio world are members of the National Committee on Space Research, including Dr. R. C. Cockburn, Professor A. C. B. Lovell, Dr. J. S. McPetrie, J. A. Ratcliffe and Dr. R. L. Smith-Rose.

Mobile Radio

THE Third Report of the Mobile Radio Committee* to the Postmaster General proposes the introduction of 25-kc/s carrier separation, instead of 50-kc/s, in the land-mobile "low" band (71.5 to 88Mc/s). It will be recalled that its Second Report covered the reduction of channel spacing in the "high" band (165 to 173Mc/s) from 100 to 50-kc/s. This recommendation is in the process of being implemented.

The present report has been adopted by the P.M.G. and the new channel spacing comes into force on June 1st. Five years is being allowed for the change-over to 25-kc/s equipment by present users. After June 1st all new land-mobile schemes in the low band will have to use equipment meeting the 25-kc/s specification. The report includes a revised allocation of channels amongst the various categories of users.

R.E.C.M.F.—At the annual general meeting of the Radio and Electronic Component Manufacturers' Federation in March, Major L. H. Peter (Westinghouse) handed over the presidency to E. M. Lee (Belling & Lee). The new vice-presidents are K. G. Smith (N.S.F.) and A. F. Bulgin (Bulgin & Co.). The new council consists of the representatives of the following member firms: Bakelite (G. J. Taylor); Belling & Lee (N. Dundas Bryce); Garrard (H. V. Slade); A. H. Hunt (S. H. Brewell); Multicore (Richard Arbib); Painton (C. M. Benham); Plessey (P. D. Canning); Reliance Cords and Cables (C. H. Davis); Salter & Co. (C. Ottewell); S.T.C. (L. T. Hinton); T.C.M. Co. (Dr. G. A. V. Sowter) and Texas Instruments (Dudley Hayward). This year's chairman and vice-chairman are Hector V. Slade and Dr. G. A. V. Sowter, respectively.

B.R.E.M.A. Audio Group.—At the first general meeting of the recently formed Audio Manufacturers' Group of the British Radio Equipment Manufacturers' Association, Major J. F. E. Clarke, chairman and managing director of Clarke & Smith Manufacturing Co., was elected chairman of the Group. The companies elected to the management body were: B.T.H. Sound Equipment; Clarke & Smith Manufacturing Co.; E. K. Cole; Dynatron Radio; Electric Audio Reproducers; E.M.I. Sales & Service; Grampian Reproducers; Jason Motor & Electronic Co.; Lowther Manufacturing Co.; and Trix Electrical Co.

VHF/UHF Convention.—The fifth international amateur v.h.f./u.h.f. convention organized by the R.S.G.B. and the London U.H.F. Group will be held at the Prince of Wales Hotel, De Vere Gardens, London, W.8, on May 30th. The morning session will be devoted to informal discussions and the afternoon to lectures. Tickets for the convention and dinner, costing 22s 6d, are obtainable from F. G. Lambeth, 21 Bridge Way, Whitton, Twickenham, Middx.

Ghana is to have a television station operating in time for the visit of H.M. The Queen in November. The station, which will be in Accra, the capital, and will operate on the 625-line 7-Mc/s standard, is being provided jointly by Marconi's and Pye. A large number of television receivers is to be installed in community centres, hospitals and public places.

* H.M.S.O. 1s 3d.

Careers.—A number of organizations in the field of radio and electronics are participating in the careers section of the forthcoming National Education and Careers Exhibition. Organized by the National Union of Teachers, it will be held at Olympia from May 26th to June 5th.

Hospital Equipment.—Radio and electronics manufacturers are among the 150 exhibitors at the International Hospital Equipment and Medical Services Exhibition, which is being held at Olympia from May 25th to 30th. The exhibition, which is sponsored by the Institute of Hospital Administrators, is open to the public from 1.0 to 6.30. Admission costs 2s 6d.

A.P.A.E. News.—Although the Association of Public Address Engineers has not held an exhibition for several years, the committee has met regularly to further the interests of its manufacturer and user members. This year's annual meeting and luncheon at the King's Head Hotel, Harrow, was well attended and a small private exhibition was arranged for members. The president for 1958/59 is S. V. Williams, of Pamphonic Reproducers, who was invested with the badge of office, a recent gift to the Association by A. E. Buchan, of Aberdeen, who was president in 1953/54. The honorary secretary is Alex. J. Walker, 394 Northolt Road, South Harrow, Middx.

Full House.—As far back as March 16th all tickets for G. A. Briggs' concert-demonstration at the Royal Festival Hall, London, on May 9th had been sold.

University of London.—Two lectures are being given in London at the end of April by Professor B. D. H. Tellegen, of Philips Research Laboratories, Eindhoven, and the University of Delft, under the scheme for the interchange of British and Dutch lecturers. The first lecture, entitled "The Gyrator as a Network Element," will be given at King's College on the 29th, and the second, entitled "The Search for a Complete Set of Ideal Non-linear Network Elements," at Imperial College on the 30th. Admission to both lectures, which start at 5.30, is free; tickets are not required.

Sound Reproduction.—A series of six lectures on high-fidelity and stereophonic sound reproduction is being given by J. Moir at Norwood Technical College on successive Tuesday evenings, from May 19th. Full details of the course, for which the fee is 10s, are obtainable from the College, Knight's Hill, London, S.E.27.

Broadcast Receiving Licences.—Combined TV/Sound licences in the U.K. increased during February by 108,549, bringing the total to 9,152,927. Domestic sound-only licences decreased during the month by 109,440, reducing the total to 5,189,399. Car radio licences rose by 3,603 to 372,297. The overall total of receiving licences was 14,714,623.

Radio Control.—The Post Office issued the three thousandth licence for the radio control of models, such as aircraft, boats and cars, etc., in March. These licences, which cost £1 and remain in force for five years, were introduced on June 1st, 1954.

Personalities

E. M. LEE

E. W. HAYES

A. G. Touch, M.A., D.Phil., since 1954 Director of Electronics Research and Development (Ground) in the Ministry of Supply, has been appointed senior superintendent of the Radio Department at R.A.E., Farnborough, in succession to **Dr. J. S. McPetrie** (see *W.W.*, November 1958, p. 526). After graduating at Oxford, Dr. Touch joined Watson-Watt's radar team at Bawdsey research station in 1936. For his contributions to the development of meter-wave AI and ASV he received a substantial award on the recommendation of the Royal Commission on Awards to Inventors. From 1941 to 1947 he was liaison officer with the British Joint Services Mission in Washington. On his return to this country he became superintendent of the Blind Landing Experimental Unit at Martlesham Heath, Suffolk, and from 1952 to 1954 was Deputy Director of Electronics Research and Development (Air) in the M.o.S.

D. W. Fry, M.Sc., M.I.E.E., having been appointed director of the Atomic Energy Establishment, Winfrith, his place as deputy director of the Atomic Energy Research Establishment, Harwell, is to be taken by **F. A. Vick,** O.B.E., Ph.D., since 1950 Professor of Physics in the University College of North Staffordshire. Mr. Fry was at T.R.E. throughout the war working on problems of centimetre-wave techniques. Dr. Vick was assistant director of scientific research in the Ministry of Supply from 1939 to 1944.

E. M. Lee, B.Sc., M.I.E.E., M.Brit.I.R.E., successor to **Major L. H. Peter** as president of the Radio and Electronic Component Manufacturers' Federation, has been managing director of Belling & Lee since its formation in 1922. He is also a director of Insulators Limited (Plastics). During the war he was chairman of the Joint Industries and Services Technical Components Committee. Mr. Lee is keenly interested in the educational side of the industry and is chairman of the Radio Trades Examinations Board.

E. W. Hayes, M.I.E.E., becomes head of the B.B.C.'s Planning and Installation Department on the retirement of **A. N. Thomas.** Mr. Hayes joined the Corporation in 1933 and was appointed assistant to the Superintendent Engineer Transmitters in 1946. For three years from 1948 he was resident engineer in the British Far Eastern Broadcasting Service, Singapore, and since 1951 has been head of the Transmitter Equipment Section of the Planning and Installation Department. Mr. Thomas, who joined the B.B.C. in 1926, served at a number of transmitting stations before transferring in 1929 to the Research Department where he assisted in the establishment of synchronized transmitter networks.

D. B. Weigall, B.A., A.M.I.E.E., who succeeds Mr. Hayes as head of the Transmitter Equipment Section of the Planning and Installation Dept., has been with the Corporation since 1933. He was seconded for two years in 1940 as chief engineer to the Malayan Broadcasting Corporation and in 1943 was seconded to the Ministry of Information as technical adviser on broadcasting.

L. Essen, O.B.E., D.Sc., Ph.D., A.M.I.E.E., has received the Wolfe Award of £500, which is the first of ten annual awards to be made under the terms of a will to the research worker who is considered by the Department of Scientific and Industrial Research to have made an outstanding contribution to the research work of the Department during the previous 12 months. Dr. Essen, a senior principal scientific officer at the National Physical Laboratory, receives the award for his work on the establishment of the cæsium atomic frequency standard as a basis for the future standard of time. Dr. Essen joined the N.P.L. in 1929.

J. W. Godfrey is retiring from the position of Editor, Technical Instructions, in the B.B.C.'s Engineering Training Department. He joined the B.B.C. maintenance staff in the London control room in 1929 and in 1935 transferred to the Technical Recording Section. He became an instruction writer in 1942 and four years later was appointed to his present position in which he has been largely responsible for building up this section of the Corporation's Engineering Training Dept. Mr. Godfrey, who is editor of the B.S.R.A. journal *Sound Recording and Reproduction*, is joint author with G. Parr of "The Technical Writer." He is being retained by the B.B.C. in a part-time consultant capacity.

S. W. Amos, B.Sc.(Hons.), A.M.I.E.E., a frequent contributor to *Wireless World,* succeeds Mr. Godfrey as editor in the Technical Instruction Section of the B.B.C. on May 1st. He has been with the B.B.C. since 1941. He spent three years as an instructor in the B.B.C. Engineering Training School before joining the Section in 1946. He has been assistant editor in the section since 1957. He is joint author with D. C. Birkinshaw of the four-volume B.B.C. engineering text book "Television Engineering," issued by our publishers, and author of "Principles of Transistor Circuits."

S. W. AMOS.

HECTOR V. SLADE.

Hector V. Slade, M.B.E., this year's chairman of the Radio and Electronic Component Manufacturers' Federation, became managing director of the Garrard Engineering and Manufacturing Co. in 1957 on the retirement of his father. He joined the company as an apprentice in 1935. On returning from military service in 1947 he became assistant managing director and in 1952 joint managing director.

J. W. Soulsby, chief radio officer in the British India Steam Navigation Company's *Uganda*, has been elected chairman of the Radio Officers' Union, for the fifth successive year. He has been on the staff of the Marconi Marine Company since 1918. The vice-chairman of the Union is **W. S. Armstrong,** elected for the third year in succession. He was for some years on Marconi's sea-going staff but since 1947 has been a member of the company's technical shore staff and is now an inspector.

A. R. Williams has retired from the managing directorship of Grampian Reproducers, which he founded in 1932. At the recent annual meeting of the Association of Public Address Engineers he was made an honorary life member in recognition of his services to the public address industry. For 21 years prior to forming Grampian he had been with Marconi's, where he was for some time commercial manager.

E. D. Hart, M.A., A.Inst.P., A.M.I.E.E., for the past five years general secretary of the Scientific Instrument Manufacturers' Association, has joined the board of Industrial Exhibitions Limited. He was with Marconi Instruments for twelve years before joining, in 1952, the Equipment Division of Mullards as head of the technical department.

T. C. Owen, advertisement manager of *Wireless World*, has retired after 47 years' association with the journal. In 1912 he joined Marconi's, who issued *The Marconigraph*, which in 1913 became *Wireless World.* In December, 1917, after being invalided out of the Army, Tom Owen transferred to Wireless Press Ltd., and he was appointed advertisement manager when *Wireless World* was acquired by Iliffe & Sons Ltd. in 1925. He is succeeded as *W.W.* advertisement manager by **G. Benton Rowell,** who had been assisting him since 1950.

C. C. Whitehead, author of the article on variable-gain magnetic amplifiers, was for 12 years in the Royal Corps of Signals and six years with the B.B.C. before starting his industrial career in 1938 when he joined the Telephone Manufacturing Co. He was with them for a two-year contract in charge of the radio section to fulfil a foreign order for v.h.f. communications equipment. He then joined Marconi's, where for ten years he was on development and research work. From 1950 to 1953 he was chief development engineer with Bailey Meters & Controls, and since 1954 has been senior engineer (research and development) with the Sperry Gyroscope Co.

OBITUARY

Professor J. T. MacGregor-Morris, D.Sc.(Eng.), M.I.E.E., Emeritus Professor of Electrical Engineering, University of London, died on March 18th, aged 87. He received his scientific education at University College (London), where he was a student under Professor (later Sir) Ambrose Fleming, and afterwards spent some years as his assistant. He was, therefore, well qualified to write in 1954 a biography of Sir Ambrose Fleming entitled "The Inventor of the Valve." In 1898, at the age of 26, MacGregor-Morris started organizing classes in electrical engineering at what subsequently became Queen Mary College, London. When the college was affiliated to London University he was appointed Professor of Electrical Engineering and occupied the chair until his retirement in 1938.

Alexander James Muir, M.B.E., who died as a result of a road accident at Malvern on February 28th, was well known in the field of radar. He joined D.S.I.R. in January, 1927, and worked as an assistant at Ditton Park. In 1935 he was one of Watson-Watt's original team of six to build the first radar station at Orfordness. He moved to the research establishment at Bawdsey with the inception of the programme for CH stations, and later to R.R.E., Malvern, where he was still actively engaged on radar development at the time of his death. Sir Robert Watson-Watt pays tribute to Muir's work in his book "Three Steps to Victory."

H. Howitt, secretary and later director of the British Radio Valve Manufacturers' Association from its formation in 1926 until his retirement in 1936, died on April 5th at the age of 85.

Radio Components Show

NEW DEVELOPMENTS SEEN AT THE R.E.C.M.F. EXHIBITION

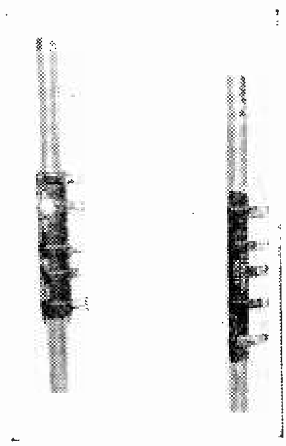
ONCE again the annual show of the Radio and Electronic Component Manufacturers' Federation was held in Grosvenor House and Park Lane House, London, W.1 (6th-9th April). The number of firms exhibiting was the largest ever and the stands were crowded with visitors from abroad and with British engineers and technicians from industrial firms and Government establishments.

Our technical staff found a great many new techniques in component design as well as the less spectacular, but none the less important, steady improvements in established products. The following review is a selection of those exhibits which seemed to us to hold the greatest originality and technical interest.

Resistors:—The main trend indicated by development over the last year is not a new one—both fixed and variable resistors are getting smaller; but at this year's exhibition the effects of miniaturization were very marked indeed. Possibly the most far-reaching example of this was the introduction by S.T.C., Painton and Dubilier of ranges of miniature high-stability carbon resistors. The Dubilier Type S27 resistor, rated at $\frac{1}{10}$W, is the smallest of a new range in sizes rated up to 2W and 800V, using turned-brass silver-dipped end-caps. The finish applied is three coats of a silicone varnish and the new series identified by the serial letter "S," corresponds (with the exception of the $\frac{1}{10}$-W size) to the existing "R" series. The new S.T.C. resistor is also rated at $\frac{1}{10}$W; but Painton's Type 70, though of roughly the same physical size (about 0.35in long and 0.1in in diameter) is rated at $\frac{1}{8}$ watt —this increase is due to the use of their Sintox base material, which has a heat conductivity similar to that of steel. An improved ceramic with low-alkali content is used by Welwyn as the base in ranges of oxide-film resistors both for high-power-dissipation and high-stability applications. This, and improved overall-coating and film-depositing processes, allow the use of these resistors at temperatures of at least 150°C.

A new power resistor from Dubilier —the PW series—is of all-insulated construction. The wire element is wound on a glass-fibre core, silicone impregnated and placed in a ceramic "coffin" which is sealed with a ceramic cement. Ratings are 5, 7 and 10 watts in ±10% and ±5% tolerances.

The difficulty of removing heat from high-temperature components such as power resistors is not a new one; but as units become more compact the difficulty increases. One solution to this problem for mains droppers is the provision of a "chimney" in the form of an aluminium tube through the resistor itself. This technique was employed by Pye in their 110° television receiver* and the logical development is to dispense with a separate former and use the metal tube itself. This has been done by several manufacturers—Labgear were showing examples of both types, called "Convectalite" The insulation employed is a silicone-impregnated asbestos paper and a 5:2 reduction in weight is achieved by the elimination of the ceramic former. Also using silicone-impregnated asbestos paper were Welwyn; but Erie favoured a mica compound.

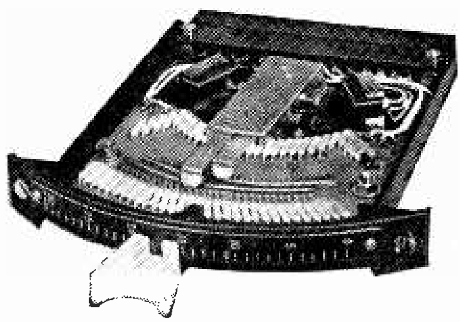


"Convectalite" mains-dropper resistors by Labgear. Resistor on right is wound on insulated aluminium tube.

Another approach to resistor cooling problems was shown on the Ministry of Supply stand. This took the form of a finned light-alloy shield enclosing the resistor, which was packed in silicone rubber; but the main cooling effect was achieved by conduction into the chassis. A resistor, which, to outward appearances, was a 5-W type, was stated to be capable of dissipating 20 to 50W: this method would seem to be ideally suited to a cooled-chassis technique.†

For more normal applications Morganite have introduced a new range of non-insulating $\frac{1}{10}$-W carbon resistors in standard values between 10Ω and 10MΩ. These are available in 5, 10 and 20% tolerances and are known as "Type X."

Painton's new $\frac{1}{8}$-W high-stability resistor is no doubt partly responsible for the small size of a new professional vision or sound attenuator of the quadrant type. This, too new to have a type number yet, is only half the thickness of the normal type, yet



"Half-thickness" fader by Painton.

it is provided with plug-in connections and microswitches for operating internal scale and warning lamps. Electronic Components, too, have introduced a new small fader unit; but this consists of two "half-thickness" attenuators mounted together so that the double unit plugs into the same space as the existing single type. Again, internal switches for scale and warning lamps are incorporated, and there is also a companion unit of reduced height (4½in) with a smaller number of studs. Another new Painton product is the Bournes Trimpot. This is superficially not unlike the "Flatpot" shown last year—it is a small rectangular pre-set; but it is available in a wide diversity of mounting styles and values and can be operated at up to 175°C. It is

* *Wireless World*, January, 1959, p. 23.

† "Cooling Airborne Electronic Equipment," by L. A. Williamson, *Wireless World*, February, 1959, p. 87.

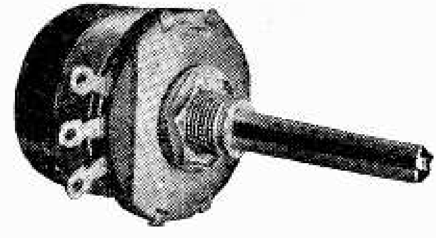
fully sealed and the element can be either of wirewound or carbon construction.

Among the many printed-wiring adaptations of ordinary potentiometers were noted several of the mount-through type in which the ordinary spindle-bush nut clamps the unit to the board, the tags being extended forward to locate on the printed wiring (Egen 315 series, Reliance 2W wire-wound, etc.). One pre-set unit designed expressly for printed-wiring use was shown on the Colvern stand. Rated at ½W this is available in values up to 50kΩ.

Perhaps the most interesting trend in controls for domestic equipment is that manufacturers are tending, more and more, to buy complete control sub-assemblies rather than separate units. Some of these are mounted on the cabinet; but some pre-set groups are designed for printed-wiring mounting with very little mechanical support other than tags. Several manufacturers expressed the hope that there would be an increase in the use of flexible links between the knobs exposed to the rigours of everyday domestic life and the delicate printed-wiring board.

Single controls are, of course, still being produced in vast numbers and several new developments feature increased safety or a better product at a lowest cost. As an example of the first trend, Morganite were showing volume controls with a hard p.v.c. spindle. This is splined on to a short steel stub which takes the place of the spindle on an otherwise normal unit. Originally produced for the Scandinavian market, this control obviously presents no danger of electric shock should the control knob be broken or pulled off.

A large number of potentiometer failures in domestic equipment are due to the sprayed track being damaged by the wiper. Several years ago Plessey produced their moulded-track units to overcome this; but as they are rather more expensive than the sprayed-track type their use has been confined to better-class apparatus. However, they have now produced a moulded-track potentiometer to sell at a price only slightly higher than a sprayed-track type by using a far less costly assembly than is usual. The main feature of the Type Y is a triangular-section spindle formed from sheet brass: at the inside end this is splayed to make the switch operating cam, brush carrier and stop, whilst the slight springiness enables a simple, moulded push-on knob without a retaining spring to be used. Another new



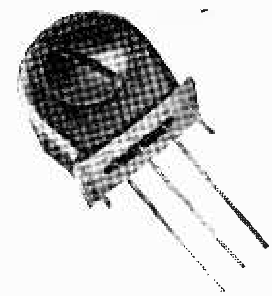
Triangular-spindle potentiometer with moulded track (Plessey).

Plessey product is a range of moulded-track sub-miniature preset potentiometers rated at ¼W and designed for panel grouping for television receivers.

A cam-corrected precision potentiometer usually requires a higher driving torque than the uncorrected type. In an effort to reduce the additional drag Colvern have developed a cam-corrected potentiometer with a very light action. In this the cam acts as the "slip-ring" contact and a very light cranked wire bears on it. This twists against light spring pressure, rotating a fork carrying the brush, so moving the brush and achieving correction. The Reliance SPP25 is a precision potentiometer with an accuracy of 0.1% which is achieved, not by a correcting mechanism, but by careful manufacture. The other new products from the Reliance Manufacturing Company are a sine/cosine resolver potentiometer (Model CO3) with 2% accuracy and a miniature (Type J12) helical potentiometer 1-in long and of ½-in diameter. Siemens Edison Swan offer a 10-turn helical type only 0.3in by 0.6in and Ferranti have produced a 3-gang precision potentiometer only ¾-in in diameter which weighs only ½oz and has a linearity tolerance of 0.1%. Ferranti state that its production has been made possible only by the design of a new winding machine capable of handling wires of diameter down to 5×10^{-4}in.

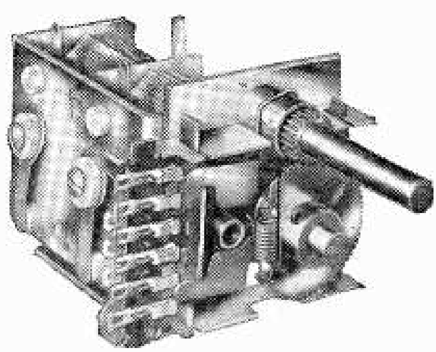
Manufacturers*: A.B. Metal (W, V); Ardente (V); Armand-Taylor (W); British Electric Resistance (W, V); Bulgin (W); Colvern (V); Dubilier (C, HS, W, V); Egen (V); Electronic Components (W, V); Electrothermal (HS, W); Erie (C, HS, W); Fortiphone (V); Jobling (HS); Labgear (W); McMurdo (W); Morganite (C, V); N.S.F. (V); Painton (HS, W, V); Plessey (W, V); Reliance Mfg. (V); S.T.C. (HS); T.M.C. (W), Welwyn (HS, W); Zenith (W).
***Abbreviations:** C, composition; HS, high stability; W, wirewound; V, variable (wirewound or composition).

Variable Capacitors:—A major trend at once evident in tuning capacitors for radio receivers was that the double, spring-loaded anti-backlash gear is becoming popular for at least one stage of the reduction drive. Among the numerous samples seen a 50:50 distribution between cut gears and the stamped-from-sheet type was noted. Cost, of course, is the deciding factor; but the superiority of the cut gear is evident at once from handling the drive. A cut gear is used on the Wingrove and Rodgers two-gang C86/302, which is a double type of maximum capacitance 500pF and 10pF. Designed for a.m./f.m. receiver manufacturers, this capacitor has an exceptionally rigid frame and the reduction-drive provided is 3:1. Another product shown by this company was a miniature 3-gang capacitor (Type C78/23), only 2¼×1½×1½in approximately, with a maximum capacitance of 196pF per section. The small size is realized by the use of a gap of only 12 "thou" between fixed and moving vanes. Jackson, too, were showing a two-gang a.m./f.m. capacitor—in this case pressed gears are used and the vane shape is modified slightly to give a good frequency distribution over the scale (Type LFM2). Very rigid f.m. sections are a feature of this model, and a new version of Jackson's "OO" two-gang capacitor for transistor applications is fitted with a concentric slow-motion drive and "spikes" for printed-wiring-board mounting.



Colvern wire-wound pre-set potentiometer printed-wiring boards.

Plessey tuning capacitor with anti-backlash reduction gear and integral wave-change switch.



Plessey have extended the scope of wavechange switches ganged to the tuning capacitor with several new models: the Type S has a fork mechanism which actuates at each end of travel of the capacitor a double-pole changeover switch. This is not unlike one "wafer" of a push-button switch and is completely insulated from the frame of the capacitor. The Type V capacitor is a two-gang a.m./f.m. type fitted with a cut-gear reduction drive which is notable for a very smooth action.

Fixed Capacitors:—Electrolytic capacitor developments during the last year have been confined mainly to reductions in overall size. One point made by Daly was that the use of etched foil for the cathode, as well as for its more customary use as the anode, can allow a reduction in size to be effected. An improvement in technique is responsible for the increase in maximum operating temperatures announced by T.C.C. for their tantalum-anode capacitors. The range covers capacities and working voltages from 200μF (6V) to 16μF (150V) in polarized types (non-polarized versions exhibit half the capacity of the polarized types) and the operating temperature range is now -55°C to $+125$°C.

Possibly the most interesting development in ceramic capacitors was a 0.1μF type, shown by Hunt, which measured about ½-in square by 1mm thick. Some of the gilt is taken off the gingerbread by the maximum voltage rating (30), but this capacitor should be ideal for transistor applications where space is very limited. Made by a new process of rolling-out the dielectric material, a permittivity of 6,000 is realized.

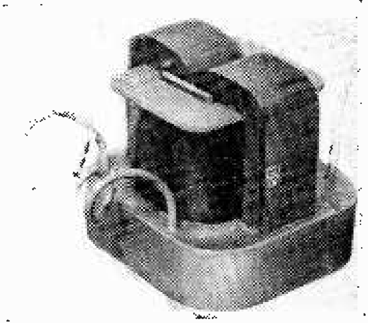
B.S.415 seems to have been responsible for a considerable divergence of opinion over the amount of external insulation needed on isolating capacitors for use in live-chassis apparatus; several manufacturers produce isolating units with only a light, external insulating coating, whilst others produce capacitors in a moulding of a material capable of withstanding the test potentials. Erie produce both types in tubular and disc shapes, and they were showing also two new high-voltage ceramic-capacitor series, designed specifically for line timebase applications. The type numbers are 2163B (15 to 25pF, 2kV) and 2163C (18 to 56pF, 3 to 4 kV). A modification of Erie's PAC component assembly (the Mk. III) features individually replaceable components from their "Pluggable" ranges with tags at 0.25-in centres.

Polycarbonates are thermoplastic compounds containing aromatic rings linked by the carbonate group electrically not unlike polystyrene; but with a higher softening point. Suflex capacitors utilizing polycarbonate dielectrics exhibit much the same characteristics as polystyrene types; but they can be used at temperatures up to 140°C. Stantelac capacitors (S.T.C.) also use a synthetic film dielectric; but the films are so thin that they cannot be handled; they are coated onto aluminium foil which is itself only 8μ thick! Working voltages are 50 and 100, and the capacity range is 0.01μF to 2.2μF.

The Dubilier Type 560 is a high-grade paper dielectric capacitor encapsulated in mineral-loaded resin. It is claimed to be resistant to mechanical shock and moisture: it exhibits an insulation resistance better than 2×10^{4}MΩ at 30°C and life expectancy for a 1 in 10 failure rate is better than 10,000 hours at 70°C and 50% d.v. overload. Hunt's popular "Moldseal" range is now produced with a new coating material which is more resistant to mechanical shock than the original substance and the end-mounting printed-wiring adaptations of this range feature a new moulded end cap. This holds the lead-out wires rigidly in position and provides a three-point support for the capacitor.

Manufacturers*: Ardente (V); B.I.C.C. (P); Bird (T); Bulgin (M); C.C.L. (E); Daly (E); Dubilier (C, E, F, M. P); Erie (C. M, T, V); Hunt (C, E, F, M, P); Jackson (T, V) L.E.M. (C, F, M. T); Mullard (T, V); Mycalex and T.I.M. (M); Plessey (C, E, F, P, T, V); Salford (F); Stability (C, F); Stratton (V); S.T.C. (C, E, F, M, P); Suflex (F); T.C.C. (C, E, F, M, P, T); T.M.C. (F, M, P); Walter (T); Wego (F, M, P); Wingrove and Rodgers (T, V).
***Abbreviations:** C, ceramic or glass; E, electrolytic; F, plastics film; M, mica; P, paper; T, trimmer; V, variable (tuning, etc.).

Transformers and Inductors: Wound-strip transformer cores are usually regarded as too expensive for use in domestic-equipment because of high costs, due mainly to the "banding" process of holding the C-shaped sections of the core together. However it has been shown, by "re-thinking" the C-core process, that it is a realistic form of core for low-cost transformers. An example of a new low-cost assembly process was shown on the Telcon-Magnetic Cores stand. The wound core is cut, not across the middle of the long sides; but as near to one end as is practicable. The bobbin carrying the windings is then placed on the smaller sections; the larger sections are placed in position and a d.c. of sufficient magnitude to attract firmly together the core sections is then passed through a winding. A resin potting compound is poured round the assembly to a sufficient depth to cover the join between the core sections. In this way the cores automatically align themselves and the whole transformer is held rigidly.



C-core transformer assembled by new method (Telcon-Magnetic Cores).

Also on show on the Telcon-Magnetic stand were some examples of their Y-cores. These are wound-strip cores for 3-phase transformers; but instead of being formed in the usual E-shape they resemble a "star" (as opposed to "delta"). This is claimed to give a superior phase balance and to ease winding problems.

Partridge Transformers have produced a new range of microphone transformers—the MC5, MC6 and MC7. All three use Mumetal cores and are fitted into $\frac{1}{16}$-in thick Mumetal round cans with a single-hole mounting so that they can be rotated for minimum hum pick-up. The MC6 is provided with two 150-Ω primaries for use with a 600-Ω balanced line and the MC7 matches

Partridge Type MC7 microphone transformer.

a 30-Ω line into the grid circuit, both have a response within 1dB from 30c/s to 20kc/s. The MC5 is a smaller and cheaper unit with a more limited response providing a 50:1 ratio from 20-Ω line.

To provide a "tropicalized" transformer of high reliability at low cost Hinchley Transformers have "potted" vacuum impregnated units into drawn aluminium cans, using pitch as the sealing material. This is claimed to be more satisfactory in reducing electrolysis of the insulants than the usual pitch-dipped type of construction. Also featured were mains-isolating transformers for service-bench and domestic use.

Weymouth were showing samples of their popular Type "H" coils wound on a new former moulded from high-impact polystyrene. This reduces losses and improves performance. Also shown by Weymouth was a high-precision delay line. It is possible to "repeat" inductors to fairly close limits on production (Weymouth quoted 1%) but the lumped effect of small errors could cause a precision delay line to be useless. In view of this the inductors are wound with adjustable iron-dust cores and each line is set up for optimum performance.

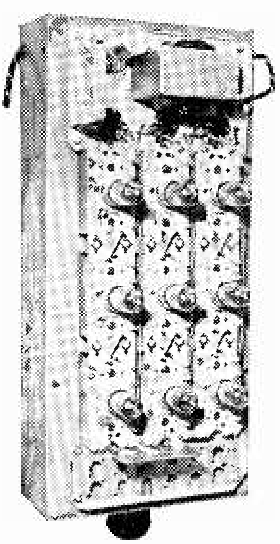
Both Plessey and Weymouth are now producing double-tuned i.f. transformers for transistor receivers: whilst slightly more costly than the single-tuned versions they do offer improved performance, particularly on selectivity. One very neat solution to "Q-boosting" problems was noted on the Plessey stand in their range of miniature i.f. transformers for transistor circuits. This range is identical in performance with the established sub-miniature range employing pot-cores; but by the use of bigger ($\frac{13}{16}$-in square) cans losses can be cut down to the point where the pot core is no longer necessary except for the final transformer. The use of a pot core here is avoided by fitting a U-shaped ferrite section round part of the coil only. The increase in permeability enables a small enough quantity of wire to be used to realize a Q of 160. In the double-tuned range of transformers the detector diode and filter have been fitted inside the screening can to reduce 2nd harmonic radiation.

Another example of the accuracy possible with modern coil-winding techniques was shown by Plessey. This was a permeability-tuned coil for the 20 to 40Mc/s range for use in their 1750-channel communications equipment. A 0.4% tolerance on inductance between a set of six inductors at any insertion of the cores is allowed, and to realize this an accuracy of turn spacing of 2×10^{-3}in is required.

Manufacturers*: Ardente (LA, LR, TA); Belling and Lee (LR, TR), Bulgin (LR); Dubilier (LA); Electro Acoustic (TA, TR); English Electric (LA, TA TR); Erie (LR); Fortiphone (LA, LR, TA, TR); Goodmans (LA, TA); Gresham (LA, TA, TR); Haddon (LA, TA, TR); Hinchley (LA, TR); Henry and Thomas (LR); Lion (LA, LR, TR); Mullard (LA, LR); Painton (LR); Parmeko (LA, TA, TR); Partridge (LA, TA, TR); Plessey (LA, LR, TA, TR); Reproducers and Amplifiers (LA, TA); Richard Allan (TA); Rola Celestion (TA); S.T.C. (LA, LR, TA); Stratton (LR, TR); Teledictor (LA, TA); T.M.C. (LA, TA); Wayne Kerr (TA); Welwyn (LR); Weymouth (LA, LR, TA, TR); Whiteley (LA, LR, TA, TR); Wireless Telephone (LA, LR, TR); Woden (LA, TA); Wright and Weaire (TA); Zenith (LA, TA).

***Abbreviations:** LA, a.f inductors; LR, r.f. inductors; TA, a.f. transformers; TR, r.f. and pulse transformers.

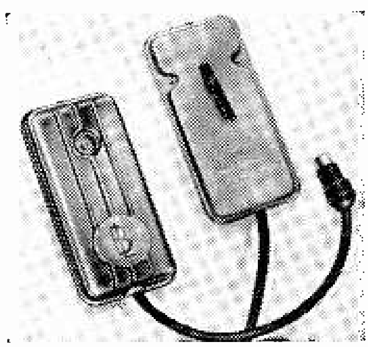
Aerials and Accessories:—A new loft aerial provided an interesting example of economy in design. Produced by Kimber-Allen, it consists of a ground-plane Band-I aerial with a telescopic vertical element which gives a variation in gain of about 20dB as well as enabling resonance to be achieved on any channel in Band I. The horizontal ground-plane element is shortened and carries the Band-III directors and reflector; proximity coupling is used so that a common feeder can be used and a Band-II "twig" is available (only one is used). The feeder connection is simplicity itself—a saddle connector for the coaxial-cable outer conductor is effective and quick and the inner conductor is clamped under the head of the bolt retaining the Band-I vertical element. A universal clamp and a key-hole mounting complete what should be a popular and effective design. Labgear were showing a new dual-band aerial—Band-I dipole and director with five directors for Band III The Band I dipole carries two "twigs" which are claimed to cause the whole dipole to behave as a co-linear array, so boosting signal pick-up.



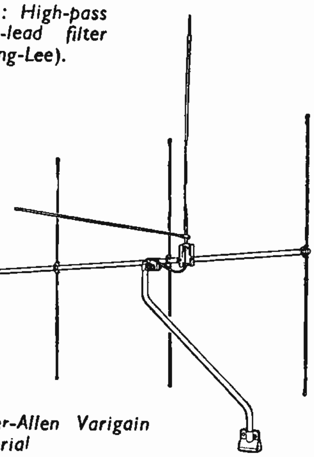
Wolsey A3/3/3 high-gain distribution amplifier for Bands I, II and III.

Wolsey Electronics were showing a new range of equipment for communal-aerial installations including padded and terminated outlet boxes with attenuations between 38 and 20dB, and splitter networks. Designed to fit conduit or for surface mounting the outlet boxes are fitted with isolating capacitors to BS415 (so protecting other users of the installation should one receiver become faulty) and they provide two outlets, if desired, one for f.m., one for TV. The A3/3/3 amplifier consists of three of Wolsey's high-gain amplifier strips and a power supply and it can be provided with a conduit type outlet. Providing a 50dB gain on one channel each in Band I and Band III and over the v.h.f./f.m. band, it is designed for feeding large blocks of flats, small estates, etc.

A new triplexer by Antiference (Type Y4) is designed for mast-head or gutter mounting. It uses a plastics moulding to carry conventional



Above: High-pass aerial-lead filter (Belling-Lee).



Kimber-Allen Varigain loft aerial

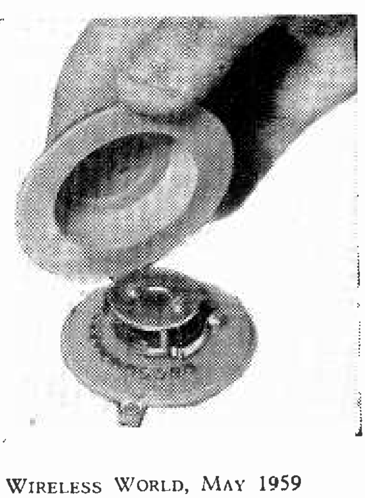
components and it is claimed that it can be used as a diplexer between f.m. and television aerials also. The out-of-band losses are 20dB and pass-band attenuation is 2dB.

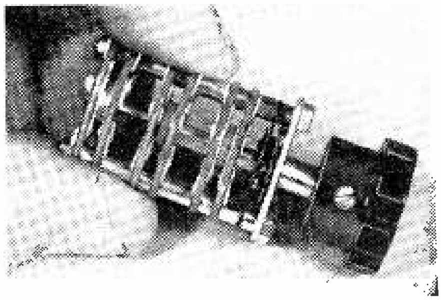
Two new products from Belling and Lee should prove popular—one mainly for export, the other for the home market. The L1418 is a 300Ω twin-feeder outlet box moulded in high-density polythene. Solderless connections are made by crimping, in both the box and its associated plug. The L1425 is a high-pass multi-section filter with a characteristic impedance of 80Ω. It has an insertion loss in the region of 2dB at frequencies down to 40Mc/s, 55dB at about 38.5Mc/s and 90dB at about 33Mc/s. The trim flat case carries a plastics clip to hold the unit on the receiver back and it is supplied complete with a standard coaxial plug. Belling and Lee were also showing some examples of multi-section telescopic rods for on-the-receiver aerials.

Manufacturers*: Antiference (AS, DA); Belling and Lee (AS, DA, D); J-Beam (AS, CA, DA); Kimber-Allen (DA); K.L.G. (DA); Labgear (AS, DA, D); Wolsey (AS, DA, D).
***Abbreviations:** AS, accessories; CA, communications aerials; DA, domestic aerials; D, distribution amplifiers and equipment.

Switches:—Miniaturization is still the main trend in switch development. One of the smallest rotary switches on show was a wafer type by Ardente, measuring about ½ inch in diameter. An interesting feature of the design is that each switch bank consists of a pair of wafers with fixed contacts, between which a shorting contact is moved round by the drive shaft. An example with three banks was shown, but more can be used. The switch has 6 ways and up to 3 poles and is continuously rotating.

Electronic Components front-of-panel stud switch.





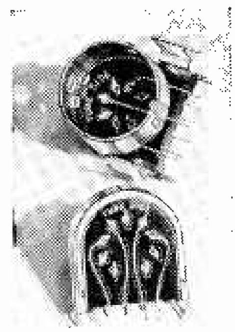
Ardente miniature rotary wafer switch.

Miniature OAK type rotary wafer switches (about 1 inch in diameter) were shown by N.S.F., who also had a miniature version of their Ledex rotary solenoid, which drives 4-6 wafers in 12 steps with an input power of about 7 watts. The OAK switches, in common with several other rotary switches seen on other stands, had wafers made of a glass fibre material instead of the usual resin bonded paper. This is a new trend, giving better insulation resistance and greater mechanical strength.

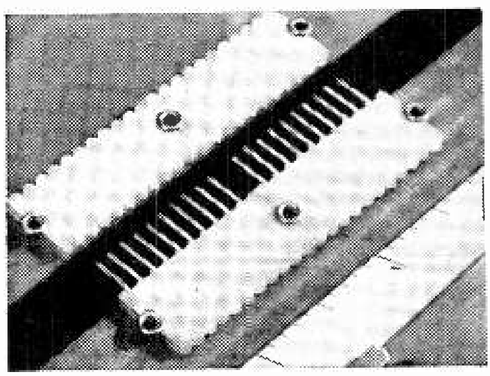
Probably the ultimate in miniaturization has been accomplished by Electronic Components in a new rotary stud switch, which is made to disappear altogether—at least from its usual place behind the control panel. In fact, the mechanism is designed to fit on the *front* side of the panel, underneath its control knob. A particular advantage of this scheme, apart from space saving, is that the studs are freely accessible for cleaning or lubricating when the control knob is removed.

Manufacturers*: A. B. Metal Products (K, T, P, R, SL); Ardente (P, R, SL); B.E.R.C.O. (R, ST); Bulgin (K, T, M, P, R, SL, ST, TH); Diamond H (T, R); Egen (P, R); Fortiphone (T, R); Henry and Thomas (K, T); Kimber-Allen (T), Magnetic Devices (P), N.S.F (K, T, P, R, SL); Painton (T, P, R, ST); Plessey (K, T, P, R, SL); S.T.C (TH); T.M.C. (K, T); Walter (T, P, R, SL, ST); Welwyn (T, P); Whiteley (K, P, R, SL, ST).
***Abbreviations:** K, key, T, lever or toggle; M, micro, P, push-button, R, rotary; SL, slide, ST, stud; TH, thermal delay.

Chassis Fittings: — Right-angle valveholders have been introduced by Painton to permit horizontal mounting of valves on printed circuits, thereby making possible more compact circuit assemblies and simplifying heat sink arrangements. A new nylon printed-circuit valveholder shown by Cinch is available with a detachable half-circle clip which provides a simple means of anchoring valve retainers. The clip can be rotated to the desired position and is located by small slots in the nylon holder. This firm also had metal clip transistor holders. Other types on show were cylinders of p.v.c. to give a push fit (Hellermann) and T-shaped flat pieces of Neoprene designed to fold over and enclose the transistor (Electrothermal).



Painton right-angle valve holders.

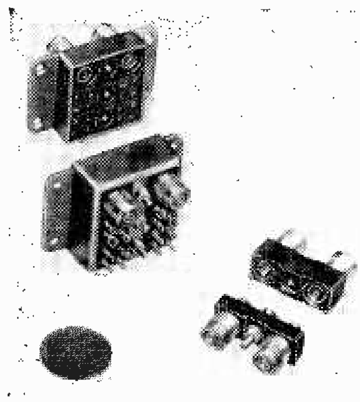


Siemens Edison Swan printed-circuit connectors.

Different types of multi-way connectors for printed circuits are still being developed. The latest, from Siemens Edison Swan, is a simple and compact system of round pins and sockets inserted into flat pieces of nylon, each unit being 1-inch long and containing ten pins or sockets. An inexpensive connector for multi-way cables shown by Plessey has the pins and sockets shrouded in single-piece polythene mouldings, which eliminate the need for gaskets and provide the necessary anchorage. The pins or sockets are crimped or soldered to the cable away from the mouldings then inserted into keyed holes in the polythene.

New terminal arrangements included a terminal block with spring-

Electronic Components coaxial connector system.



Belling-Lee coaxial Unitors.

loaded wire grips instead of screw clamps (Hellermann). Spring loading is also used for quick release in some large insulated pillar terminals (Mycalex) for providing mains supplies on benches or counters. The insulated pillar is deflected by the fingers, allowing the ends of the flex wire to be inserted in a serrated brass grip.

A new design of coaxial cable connector by Electronic Components simplifies considerably the task of preparing the cable ends and assembling the connector parts. It is unnecessary to bare the braid sleeve. A knife-edged metal collar is inserted between the inner insulator and the braid, which is clamped on to the collar by means of a threaded bush which grips on to the outer covering of the cable. Belling-Lee have extended their "Domino" miniature Unitors to include coaxial connectors. The plugs and sockets are mounted in pairs with earth pins on small insulating blocks, and these blocks are assembled in groups in metal shrouds to form the Unitors. Ordinary single-pole connector blocks can be assembled with the coaxial ones if necessary. For jointing coaxial cables Hellermann were showing cable crimps consisting of copper cylinders with nylon bushes inside and small concentric metal bushes to take the cable inners. Crimping is done by a special tool.

Widney Dorlec have increased the versatility of their "prefabricated" cabinet system by providing for movable tapped holes in the main frame members to take the fixing screws of equipment panels. This avoids the need for having the main members already drilled and tapped at regular intervals. A pre-drilled metal strip is bolted behind the main frame members and the holes in this are used as a location for drilling into the main frame. Small tapped blocks are then inserted behind the clearance holes in the main frame to take the panel fixing screws.

Manufacturers*: Antiference (CPS); Bakelite (P); Belling and Lee (CPS, T, F, J, V); B.E.R.C.O. (DL, K); Brayhead (EFC); Bulgin (V, EFC, CPS, DL, ES, T, F, J, K); Carr Fastener (EFC, CPS, T, F, V); H. Clarke (T); Colvern (RPS); Cosmocord (K); Creators (EFC, G, T); Egen (CPS); Electro Methods (CPS, T); Electronic Components (CPS, DL); Electrothermal (CPS, EFC); Fortiphone (CPS); Goodmans (CR); Hallam, Sleigh and Cheston (CR); Harwin (EFC, CPS, T); Hasset and Harper (CR, EFC, ES); Hellermann (EFC, G, T, K); Imhof (CR); Insulating Components (DL, P, T, V); Jackson (DL, DR); K.L.G. (T); Long and Hambly (G); Lustraphone (EFC); McMurdo (V, CPS); Mica and Micanite (EFC, T, V); Morganite (CPS); Mullard (CR); N.S.F. (CPS); Painton (CPS, DL, T, K); Permanoid (CPS); Plessey (CR, CPS, DR, T, P, F, K, V); Salter (EFC); Siemens Edison Swan (CPS, T, V); Simmonds (EFC); Spear (EFC, CPS); Standard Insulator (EFC, G); Stocko (EFC, T); Stratton (CR, CPS, DL, DR, K); Suflex (ES); T.C.C. (P); Telcon (CPS); Thermo-Plastics (CR, DL, ES, T); Thorn (P); T.M.C. (J); Tucker ((EFC, G); Tufnol (T); Walter (P); Weymouth (DL, T, K); Whiteley (CR, CPS, T, K, V); Wimbledon (CR, EFC, DL, ES); Wingrove and Rogers (DR, T); Wolsey (CPS).

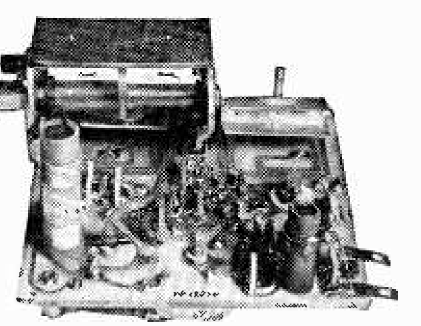
***Abbreviations:** CPS, connectors, plugs and sockets; CR, cabinets, racks and chassis; DL, dials; DR, drives; EFC, eyelets, fasteners and clips; ES, escutcheons; F, fuseholders; G, grommets; J, jacks; K, knobs, P, printed circuits; T, terminals and tagboards; V, valveholders.

Sub-Assemblies: — Manufacturers of television tuners are now producing them in alternative versions to cope with varying requirements. The Plessey-Brayhead tuner, for example, which has so far been in production with a 10-position turret, is now available with 14-position and 18-position turrets. The 14-position tuner provides for all 13 television channels and the 18-position one for 13 television channels and four f.m. sound channels—both models looking far enough ahead to include the extra position for possible u.h.f. broadcasting in Band V. Provision is made also for dual-frequency i.f. strips—34/38Mc/s for television and 10.7Mc/s for f.m. sound. Other versions of the tuner are available for 625-line television sets and f.m. sound-only receivers.

An interesting f.m. tuner introduced by Cyldon is based on a printed circuit which includes the coils, and these are tuned by an eddy-current system. Rotation of the control shaft operates a cam which causes small metal plates to approach, or move away from, the printed coils —the cam being designed to give a linear tuning scale. A single ECC85 double triode is used, one half acting as an r.f. amplifier and the other as an oscillator/mixer. The gain is 60dB at 87Mc/s or 57dB at 101Mc/s. The printed circuit is made from glass fibre and the oscillator drift is 35kc/s for a 15°C temperature rise.

Band-pass crystal filters of small size and high selectivity for the i.f. sections of communications receivers were shown by Cathodeon Crystals. Three types, intended for channel spacings of 50kc/s, 25kc/s and possibly 12.5kc/s, have centre frequencies of 10.7Mc/s and bandwidths (at −6dB) of 25, 12.5 and 6kc/s respectively. The crystals and other components are mounted on printed circuits and hermetically sealed in compact metal cans (2in × 2in × 1¼in) with two terminals.

Encapsulated circuits for many different functions were noted. As an example, Wayne Kerr had a resin-



Eddy-current tuning system of Cyldon printed circuit f.m. tuner.

Cathodeon crystal filter.

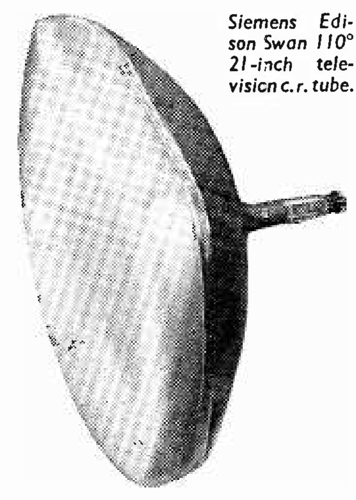
cast voltage stabilizer consisting of a chain of small neon tubes with a series/parallel striking network. Versions with stabilizing voltages from 370V to 5kV are available. The structure can be made slighrly radio-active to ensure an adequate level of residual ionization after periods of storage.

Manufacturers*: A.B. Metal Products (T); Belling-Lee (F, IS); B.I.C.C. (DN); Bray-head (T, AD); Bulgin (IS); Cathodeon (F); Cyldon (T); Dubilier (DN, IS); Erie (PC); Goodmans (F); Hunt (IS); Labgear (F, IS); Lion (DN); Morganite (IS); Mullard (DN, F); Plessey (AD, F, IS, T); Salford (F); S.T.C. (IS, F); Stratton (IS); T.C.C. (DN, IS); T.M.C. (F, IS); Wayne Kerr (F, IS); Wego (DN); Weymouth (DN, F); Whiteley (AD, IS).

***Abbreviations:** AD, r.f. adaptors; DN delay networks; F, filters; IS, interference suppressors; PC, pre-assembled components; T, tuners.

Valves and Tubes:—For use in the cascode r.f. amplifier stages of television tuners, Mullard have introduced a new variable-mu double-triode, the PCC89, of considerably improved performance. It has a frame grid, by means of which the grid-cathode spacing is reduced, and as a result the slope is as high as 12.5mA/V—which is twice that of the conventional PCC84 now commonly used. The noise factor is 5.5dB at 200Mc/s.

Another new double triode for this application is the Ediswan Mazda 30L15 (with conventional grid) which has a slope of 9mA/V, while its companion triode-pentode frequency changer is the 30C15. Brimar also have a new triode pentode, the 6BR8. The two sections have separate cathodes and the valve is mainly intended for a.f applications in which the two stages are connected in cascade. An r.f. beam tetrode from the same firm, the 6688, is intended for wide-band amplifiers and has the high slope of 16.5mA/V.



Siemens Edison Swan 110° 21-inch television c.r. tube.

The Nodistron numerical indicator tube of S.T.C. has been improved in a new model, G10/201E. This glow-discharge device has larger numerals, is now capable of working from both d.c. and a.c. and has no wire mesh anode in a visible position to obscure the view of the numerals.

Television cathode-ray tubes with 110° deflection angles are now well-established on the market A new addition to the types already available (from Mullard and Siemens Edison Swan) is the 17 inch C17AA from Brimar. It has electrostatic focusing and operates with a final anode voltage of 16kV.

As ion trap magnets are not used in these tubes other means have to be provided to adjust the alignment of the beam emerging from the electron gun. This is provided for by wire-ring magnets produced by Eclipse (James Neill), which are magnetized across a diameter and fitted round the tube neck. Known as "steering magnets," strengths of the order of 10 to 30 oersteds are used.

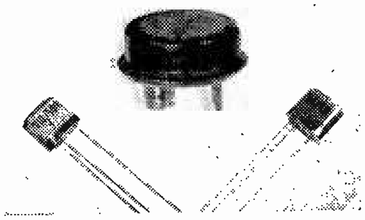
Manufacturers*: Ferranti (CC, IT, M, R, T); M-O (CC, IT, M, PC, R, T); Mullard (CC, IT, M, PC, R, T); Siemens Edison Swan (CC, IT, PC, R, T); S.T.C. (CC, IT, M, R, T).

***Abbreviations:** CC, cold-cathode; IT, industrial and transmitting; M, microwave; PC, photocells; R, receiving; T, cathode-ray tubes.

Semiconductors:—The v.h.f. transistor is now very much a reality. As an example, some of the micro alloy diffused types available from Semiconductors will give useful gains at frequencies up to 200Mc/s. Mullard have introduced a new series of r.f. transistors made by the alloy diffusion technique, and the first of these, the OC170, has an average cut-off frequency of 70Mc/s and a current gain of 80. The maximum collector dissipation is 60mW. Newmarket Transistors have developed an alloy-junction drift transistor, the V15/20R, with a maximum cut-off frequency of 75Mc/s.

The above are all germanium transistors. Silicon types, with their ability to work at temperatures up to about 150°C, are now being produced in appreciable quantities, mainly for switching applications. Texas Instruments showed an extensive range of grown-junction n-p-n types, including an h.f. tetrode, 3S004, capable of giving a power gain of 20dB at 70Mc/s. Silicon alloy-junction transistors for switching applications have been introduced by both Semiconductors and S.T.C. As an example of performance, the rise time obtainable with the SA496 made by Semiconductors is 80 milli-microseconds A range of p-n-p junction silicon transistors was shown by the Brush Crystal Company. These types, OC430 to OC470, have total power dissipations of 330mW and are intended for use in d.c. amplifiers, class-B output stages and switching circuits.

An interesting experiment in tackling the problem of variations in characteristics between transistors of the same type number has been started by Mullard. They are introducing packages of specially selected and tested transistors which give guaranteed minimum overall gain figures when used in suitable circuits.



Newmarket power transistor and r.f. transistors.

An a.f. package contains a matched pair of OC78 output transistors and an OC78D driver. This is to give an audio output of 500-600mW with a maximum input requirement of 30µA. An r.f. package contains three OC44/OC45 transistors (for oscillator/mixer, 1st and 2nd i.fs), guaranteeing a minimum overall gain of 74dB. In general, better gain figures are said to be achieved than the averages obtained with randomly chosen transistors.

Power handling capacities of transistors continue to be developed. A notable example on show was the Texas Instruments power transistor 2N458, which has maximum collector ratings of 80 volts and 5 amps. Newmarket have introduced a range of power types (in experimental production) with a junction geometry of a special kind which gives higher emitter efficiency and current gain than is normally obtainable at high currents (here up to 6 amps). A new Mullard type, OC27, intended for the output stages of car radios, will give an output of 4W in class-A output stages operating from 7- or 14-volt supplies.

In the rectifier field, S.T.C. were showing a new range of selenium h.t. rectifiers which correspond with their well-known RM series but have somewhat smaller radial dimensions. Texas Instruments have extended the range of their Zener voltage reference diodes to cover Zener voltages up to 91 volts. The maximum power dissipation of these types is 8 watts.

Manufacturers*: Brush (D, TR): Ferranti (D, TR); M-O (D, TR); Mullard (D, TR, TH); Newmarket (TR); Salford (D, MR); Semiconductors (TR); Siemens Edison Swan (D, TR); S.T.C. (D, MR, TR, TH); Texas (D, TR); Westinghouse (D, MR).
***Abbreviations:** D, diodes; MR, metal rectifiers; TH, thermistors; TR, transistors.

Materials:—A modification of the transfer moulding process is used by Insulating Components and Materials and Anglo-American Vulcanized Fibre to produce transformer bobbins for high-temperature operation. The material used is an epoxy-resin and glass-fibre mixture and bobbin walls as thin as 0.015in can be achieved.

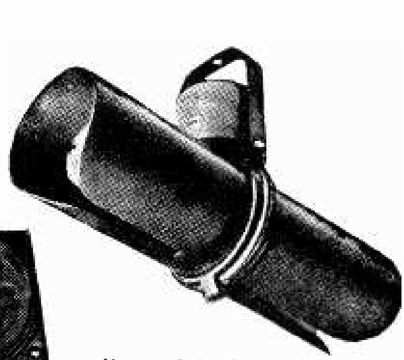
Swift Levick had on show a high-saturation magnetically soft material for use as pole-pieces where very concentrated fields are required. Called Vaco-Iron, it is a mixture of cobalt, iron and a small quantity of vanadium; but, in spite of the vanadium content, it can be machined easily and with high accuracy. The saturation flux is about 25% higher than ordinary mild magnet steel.

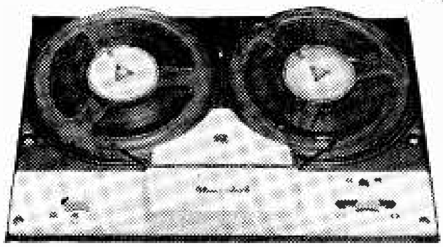
Strictly speaking, Magloy (Plessey) is not a new magnetic material, but the result of a process. Normally when a magnet of, say, Alnico, is required it is cut into sections such that they conform to the shape of a leakage field about the poles of another magnet. The sections are then allowed to cool through the Curie point in the leakage field; then they are joined to make a magnet of complex shape. In the Magloy process a shaped field, produced by an arrangement of conductors, is used instead of a leakage field, so far more complex shapes can be produced in one piece. Also, Magloy magnets can be covered with aluminium jackets which serve two purposes—they prevent the approach of other magnetic assemblies to the point where the Magloy magnets sustain damage, and they provide a convenient mounting arrangement.

Manufacturers: — *Insulating Materials:* Anglo-American Vulcanized Fibre, Bakelite, Geo. Bray, CIBA, H. Clarke, Creators, Enanlon, Formica, Hellerman. Henry and Thomas, I.C.I., Insulating Components and Materials, Jobling, K.L.G., Langley London, Long and Hambly, Mansol. Mica and Micanite, Micanite and Insulators, Minnesota, Mycalex T.I.M.. Plessey, Siemens Edison Swan, Standard Insulator, Steatite, Symons, Telegraph Construction, T.C.C., Thermoplastics, Tufnol, Wandleside, Wayne Kerr.

Magnetic Material: Darwins, Marrison, Mullard, Murex, James Neill, Plessey, Salford, Swift Levick, Whiteley.

Audio Equipment:—The automatic trip mechanism in a record player can often be damaged if the pickup arm is moved too far away from the record. The possibility of such damage is, however, prevented by using a cam action for this trip in a new range of E.M.I. 4-speed record players. A finger-tip speed-change control is provided by using a larger knob than usual and placing its edge vertical and partially protruding through the base plate, instead of, as is more usual, horizontally above the base plate.





Above: Rola Celestion twin re-entrant loudspeaker.

Left: B.S.R. T.D.1 tape deck.

New tape decks were shown by Collaro and B.S.R., this being the first tape deck, as distinct from other audio equipment, that B.S.R. have made. The B.S.R. Monardeck T.D 1. is a single-speed ($3\frac{3}{4}$in/sec) device powered by a single motor. The record/replay head gap length is 2×10^{-4}in. The new Collaro deck uses a single pair of heads (unlike their other model). Three speeds are provided ($1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$in/sec) and three motors are used.

In a new twin loudspeaker for relatively low-level public address purposes introduced by Rola Celestion two re-entrant horns placed back-to-back each load a corresponding loudspeaker cone. The two voice coils are placed at opposite sides of the same magnetic gap so that only a single magnet is needed. A slot along the bottom of each horn gives some downward sound radiation in addition to that to two sides from the horn mouths. The frequency response is from 375 to 8000c/s and the power-handling capacity 3 watts.

The problems of inhibiting cone break up and relieving stresses at the corners in rectangular "slot" speakers have been tackled by Rola Celestion in their 8 by $2\frac{1}{4}$in C28 model by means of two long strengthening protruberances in the cone covering most of the cone length on either side of the voice coil, and by making the rolls in the surround larger at the corners and across the breadth than along the length.

Several items shown also at the London Audio Fair are discussed in our review of that exhibition.

Manufacturers: — *Loudspeakers:* — Richard Allan; Electro-Acoustic Industries; E.M.I.; Goodmans; Plessey. Reproducers and Amplifiers; Rola Celestion; Truvox; Whiteley Electrical

Magnetic Tape:—E.M.I.; Minnesota Mining and Manufacturing.

Pickups and Microphones:—Ardente; B.S.R.; Collaro; Cosmocord; Electronic Reproducers (Components); Fortiphone; Garrard; Goldring; Lustraphone, S.T.C.; Technical Ceramics; Vitavox; Walter; Whiteley Electrical

Tape Recorders:—B.S.R.; Collaro; E.M.I.; Multimusic; Truvox; Walter; Wright and Weaire.

Turntables:—B.S.R.; Collaro; E.M.I.; Garrard; Goldring; Staar.

Test and Measuring Equipment:—In the Wayne-Kerr LT100 the resistance of a thermistor in a glass probe is measured using a Wheatstone bridge powered by a U2 battery. The thermistor resistance varies non-linearly with temperature. This normally results in a non-linear scale, but this is avoided in the Wayne-Kerr LT100 with the aid of compensating non-linear resistances in the form of Zener diodes. Temperatures from 0 to 100°C can be measured and leads to the probe up to 1000 ft long are available.

Two new multi-range meters were shown by Taylor. In the pocket-size 127A the maximum sensitivity is 20,000Ω/V on the d.c. ranges, and resistances up to 20MΩ can be measured (up to 200kΩ centre scale). A centre-pole meter with a f.s.d. of 40μA is used. In the Taylor 100A an 8μA f.s.d. centre-pole movement gives a maximum sensitivity on the d.c. ranges of 100,000Ω/V. All the d.c. and a.c. range scales are coincident except for the most sensitive a.c. range (10V f.s.d.). Another useful facility on this meter is a push-button for reversing the polarity.

A new a.m. signal generator covering frequencies from 2Mc/s to 225 Mc/s was shown by Avo (Type 378). The spurious f.m. is claimed to be particularly low on this instrument. This is achieved by means of a circuit in which non-linear crystal diodes are used to ensure that the a.m. occurs at a constant impedance.

Manufacturers:—Avo; British Physical Laboratories; Dawe; Labgear; Lion Electronic Developments; Measuring Instruments (Pullin); Siemens Edison Swan; Taylor; Wayne Kerr.

"Variable-μ" Magnetic Amplifier

System of Controlling Gain Giving a Versatile Circuit

By C. C. WHITEHEAD

MAGNETIC amplifiers at the present time are undergoing developments comparable with those of semiconductor amplifiers and the valve amplifiers of two or three decades ago. Each type of amplifier (valve, semiconductor or magnetic) has its advocates, who press for its application over as wide a field as possible. In truth these alternative forms of amplifier are, in various fields of application, both competitive and complementary.

Broadly speaking the magnetic amplifier scores over its rivals when the following conditions have to be met:—

1. Mechanical robustness. It is relatively free from maintenance troubles.
2. The ability to deal with large power in relatively small space.
3. The ability (given suitable design) to work under very unfavourable environmental conditions, e.g., wide variations of ambient temperature and pressure, dust, dirt, moisture, etc.
4. High overload capacity. In comparison with valve or semiconductor amplifiers of similar rating it has relatively enormous overload capacity.
5. It is capable of developing full gain with very low input impedance—especially useful in d.c. amplifier applications.

The magnetic amplifier is not, however, the most desirable choice when: (a) an extremely high input impedance is needed; (b) an extremely fast response (rise-time on a step-function input) is required.

The simplest form of magnetic amplifier is shown in Fig. 1, where L_S is an iron-cored choke in which air-gaps have been reduced to the absolute minimum and the core material has a closed circuit, of, as far as possible, uniform cross-section throughout normal to the magnetic flux. These features ensure that the core is relatively easily and fully saturated. The special oblique line symbol indicates this type of core. An additional winding is for convenience provided to carry the control current (d.c.) to saturate the core. Specially developed magnetic alloys (such as HCR, Deltamax, Orthonol, in which the optimum combination of permeability and saturation flux density have been achieved) enhance the performance.

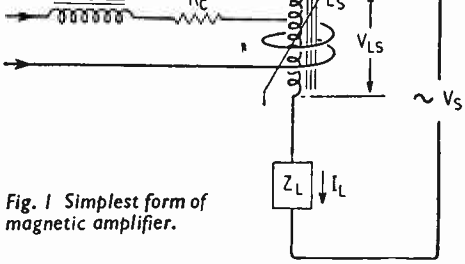


Fig. 1 Simplest form of magnetic amplifier.

The degree of saturation of the choke is dependent upon both the a.c. supply voltage and the d.c. control current. If the supply voltage (V_S) is constant, and the impedance of L_S is decreased due to saturation by the control current (I_C) ampere-turns, the voltage across the choke (V_{LS}) decreases owing to the voltage drop in the load impedance (Z_L). So consequently does the degree of saturation of the core, necessitating a larger value of control current to obtain a given degree of saturation.

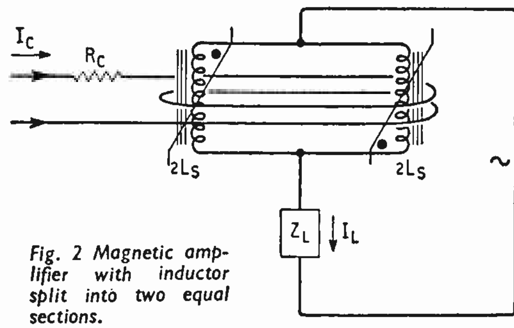


Fig. 2 Magnetic amplifier with inductor split into two equal sections.

The current-gain of this amplifier (see Appendix) is defined as

$$\frac{\text{Change of load current}}{\text{Change of control current}} = \frac{dI_L}{dI_C}$$

The self-limiting action just described is quite analogous to that of the valve cathode follower. There is a high degree of inherent negative current feedback, with the result that control ampere-turns (N_CI_C, see Appendix) and load ampere-turns (N_LI_L, see Appendix) are always equal, a univeral characteristic of basic non-feedback magnetic amplifiers. The power-gain of the amplifier (see Appendix) is easily seen to be $\frac{dI_L{}^2R_L}{dI_C{}^2R_C}$ where R_L and R_C are the load and control circuit resistances respectively. Modest power gains of the order of 10 to 20 (20 to 26 dB) are commonly attained. That is to say, the current gain is usually in the region of $\sqrt{10}$ to $\sqrt{20}$.

This simple amplifier has other disadvantages besides that of relatively low gain. A considerable voltage at the supply frequency is induced in the control winding. If we make $N_C > N_L$ in order to enhance the current gain (which, as in the case of a transformer, is simply N_C/N_L) the induced voltage into the control winding may be very high indeed, and especially so since, owing to saturation, the load-current waveform is non-sinusoidal. The power fed back into the control circuit is abstracted from that delivered to the load, and if the source of control

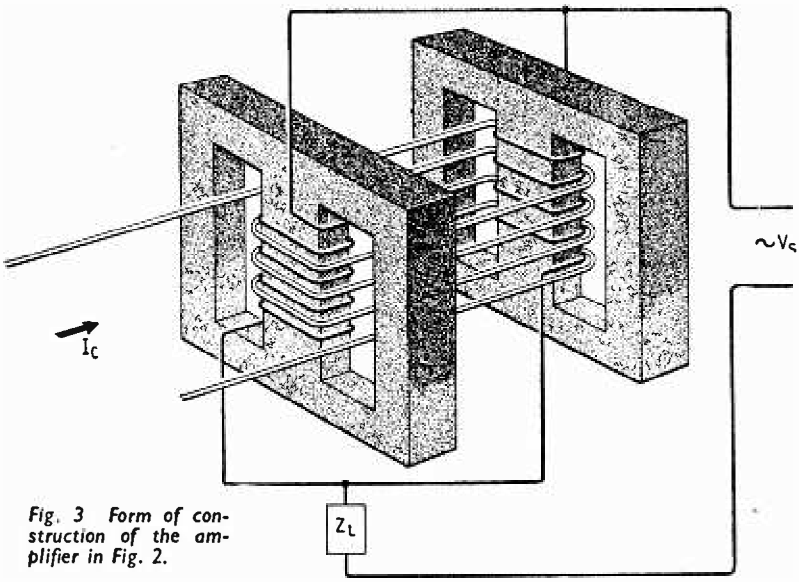


Fig. 3 Form of construction of the amplifier in Fig. 2.

current has a low impedance, the control winding acts as a short circuited turn, rendering the device inoperative. Consequently in cases where this form of amplifier is used, a choke (L_C) is included in the control circuit to block the induced current. This makes the device practicable, but the resistance of L_C in the control circuit further reduces the available power gain.

Consequently the next step in development was to split the choke into two equal sections, each carrying also half of the control winding. The sense of the windings (conventionally indicated by a dot showing the start of a winding, all windings being assumed to be wound in the same direction) is so arranged that the induced voltages in each half of the control winding are in opposition. Our amplifier can then take the form of Fig. 2. This is usually constructed as shown in Fig. 3, with a single control winding embracing both cores, the direction of the fundamental supply frequency flux in the two cores being in opposition in relation to the control winding. The Output (I_L)/Control (I_C) characteristic of this device (usually termed a transductor, see Appendix) takes the form of Fig. 4.

This arrangement allows us to do a trick in the way of providing *positive* feedback to offset the inherent negative feedback discussed above. If we instal a pair of rectifiers, as shown in Fig. 5(a), we get the characteristic as shown in Fig. 5(b). A transformer or transductor requires a certain value of current drawn from the supply to maintain the flux, and this results in a minimum value of load current, shown in Figs. 4 and 5(b) as I_0. This is usually (in a good design) less than 5% of the average load current.

In the amplifier without feedback this value of load current (I_0) flows when the control current (I_0) is zero, and the two branches of the characteristic are symmetrical about $I_C=0$.

Fig. 5(b) presents a very different picture. Here I_L at $I_C=0$ has risen to a high value, and I_0 has been displaced to the region of negative (reversed) I_C. What has happened is that I_0 (a.c.), flowing through each rectifier on alternate half-cycles of the supply, has produced a pulsating d.c. current (I_{fb}, see Appendix) flowing in the closed loop around the load windings as shown, tending to saturate the cores, and so producing a high value of I_L at $I_C=0$. This feedback current is seen to be strictly proportional to the load current, so that over the region of the right-hand branch of the characteristic, where the control and feedback currents are acting in the same sense in the individual cores in the appropriate half-cycles, the slope of the I_L/I_C characteristic (and therefore the current gain) is greatly increased. Over the region of the left-hand branch, where I_C and I_{fb} are acting in opposition, the slope of the characteristic is correspondingly reduced.

In order to make use of this increased gain, another winding (the so-called bias winding) is for convenience provided, in order to set the working point, where $I_C=0$, at a convenient part of the characteristic.

In passing, the curious resemblance between the characteristic of Fig. 5(b) and that of the I_a/V curve of a triode valve will be noted, and, in fact, with a high degree of feedback such as is usually attained in an amplifier of this type, it is possible to operate the amplifier in modes analogous with the Class A, Class B or Class C of the valve amplifier. In Fig. 5(a) the analogue of Class A operation is shown, where $I_{L\,mean}=\frac{1}{2}I_{L\,max}$.

Consider now Fig. 6. If $N_L=N_C$ we have at all times that $I_L=I_C$, $dI_L/dI_C=1$ and the slope of the characteristic is $45°=\theta_0$ *when there is no feedback* (i.e. when the rectifiers are omitted or are inoperative). *With feedback* (i.e. the rectifiers are operative) the right-hand branch of the characteristic subtends an angle θ_1 and the left-hand branch subtends an

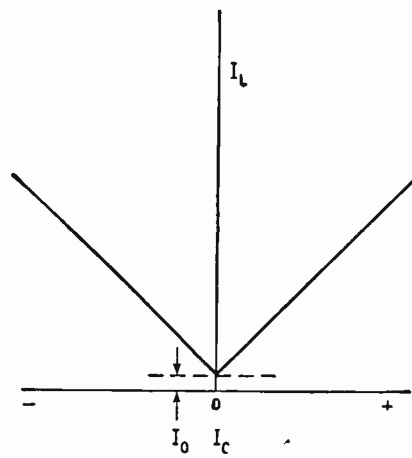


Fig. 4 The output-current/control-current characteristics of the amplifier in Figs. 2 and 3.

angle θ_2 with the abscissa. If we assume a "feedback factor" due to the rectifiers, which factor we will call β, we find that

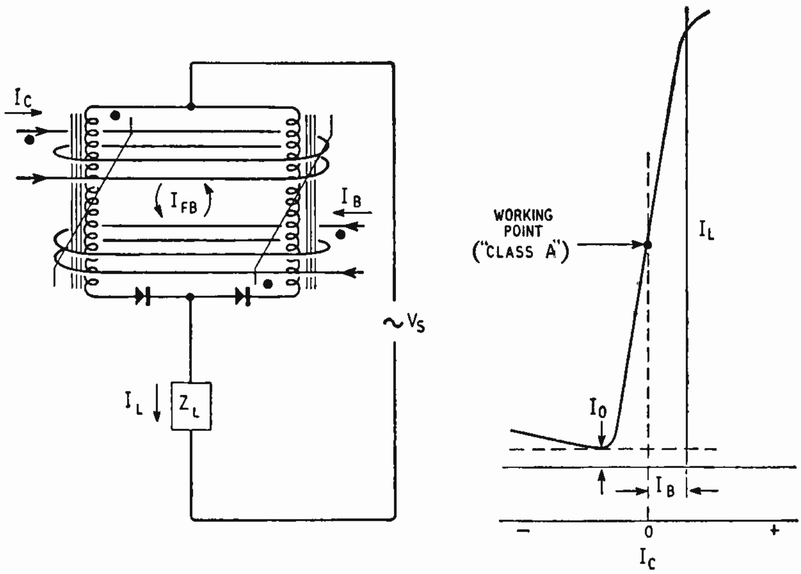
$$\theta_1 = \tan^{-1} \frac{1}{1-\beta}$$

$$\text{and } \theta_2 = \tan^{-1} \frac{1}{1+\beta}$$

which define the increase and reduction of slope respectively. Bearing in mind that normally we use only the right-hand branch of the characteristic, the relationship between the current gain of the amplifier without feedback (A_0) and with feedback (A') is simply

$$A' \frac{A_0}{1-\beta}$$

and the change in current gain due to the action of the rectifiers is $1/(1-\beta)$. In accordance with convention this change in gain may be expressed in "decibel" terms as $10 \log_{10} A'/A_0$ or $10 \log_{10} 1/(1-\beta)$. It generally happens that in usual designs β seldom lies outside the limits 0.94 and 0.99. Therefore we can tabulate the change in gain due to the use of the rectifiers as follows:—



(a) (b)

Fig. 5 (a) Magnetic amplifier with rectifiers to give positive feedback, and (b) the characteristic obtained.

β	A'/A_0	dB
0.94	16.7	12.25
0.95	20.0	13.0
0.96	25.0	14.0
0.97	33.3	15.25
0.98	50.0	17.0
0.99	100.0	20.0

As a simple numerical example, let us assume a transductor assembly with a normal power gain (without rectifiers) of 20. This means a current gain of $\sqrt{20}$ or 4.45. If we now install rectifiers giving a feedback factor of say 95% (0.95), we cause two things to happen:—

1. We cause I_0 (which we have neglected in the immediate discussion above) at $I_C = 0$ to increase to 20 I_0.

2. We cause the current gain to change from 4.45 (6.5 dB) to 89 (19.5 dB), a change of 13 dB.

If we can arrange to control, continuously, the effectiveness of the rectifiers, we have a means of controlling the inherent gain of the amplifier from A_0 to A', which range of control is dependent basically upon the value of β, as tabulated above. This can conveniently be done as indicated in Fig. 7, where Z'_C is a variable impedance (or resistance) shunting the rectifiers. Owing to the fact that it is not usually convenient to make Z_C' large in comparison with the reverse resistance of the rectifiers, the full range of control of gain indicated in the table is not attained, but something pretty close to it (generally within 1 dB) can be realized.

The writer has succumbed to the temptation to call this device a "variable-μ" amplifier for the following reasons. The "variable-μ" valve is made by using a grid structure of variable pitch. As the static bias on this grid is increased in the negative sense, the fine-pitch (high-μ) portion of the grid, by shutting off the anode current *from the underlying portion of the cathode,* becomes ineffective, whilst the coarse-pitch (low-μ) portion of the grid remains effective. Notice that two things are happening here:—

1. There is a change in μ, defined as dV_a/dV_g (I_a constant), due to the change from a grid of high μ to one of low μ.

2. There is a change in the mutual conductance (g_m), defined as dI_a/dV_g (V_a constant), due to the reduction in effective cathode area.

Which of these two effects is the more important

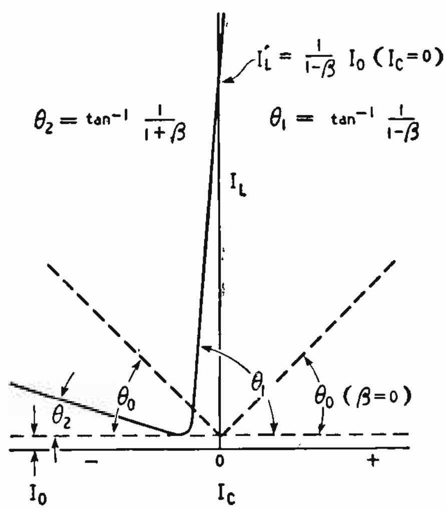


Fig. 6 Comparison of amplifier characteristics with feedback (full line) and without feedback (broken line).

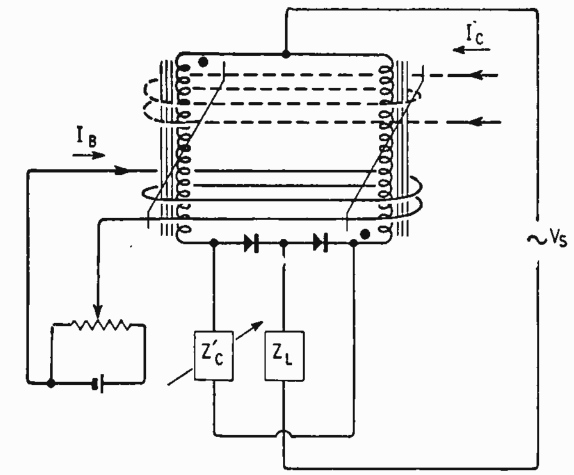


Fig. 7 Method of controlling the effectiveness of the rectifiers to get variable gain.

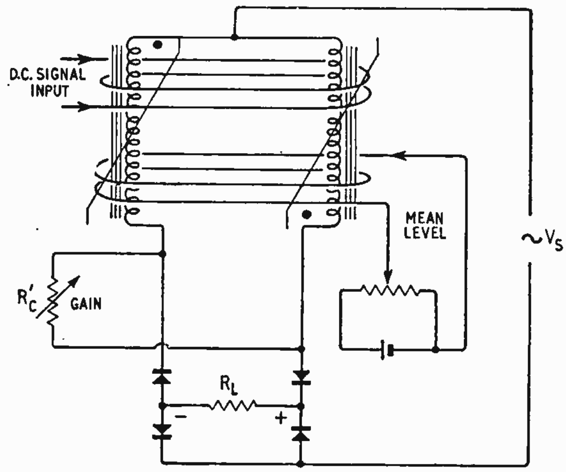


Fig. 8 A d.c. amplifier, with control of gain and mean level of output.

depends upon whether, corresponding with 1 and 2 above,

1. Z_L (the load impedance) is much higher in value than the valve internal resistance (R_a) and the valve is operating as a constant-voltage generator.
2. Z_L is much lower in value than R_a, and the valve is operating as a constant-current generator.

Since practically all variable-μ valves are tetrodes or pentodes, operating under condition 2, the change in mutual conductance is the more important effect by far. The term "variable μ" is therefore (as other writers have pointed out) a misnomer, but sticks by reason of custom and convenience. "Variable-mutual-conductance," "variable-g_m" or "variable-perveance" (American) do not trip off the tongue so easily. "Variable μ" valves have the following characteristics—

$$dI_a/dV = k.V_g \text{ if } Z_L << R_a$$

In the magnetic amplifier under discussion,

$$dI_L/dZ_C = k.Z_C \text{ if } Z_L << Z_i$$

where Z_i is the internal impedance of the amplifier. This establishes an analogy. The validity of the term "variable μ" *as generally understood* falls

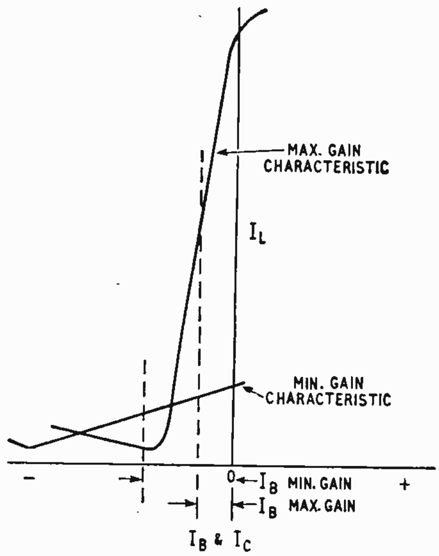


Fig. 9 Biasing point can be fixed for both high- and low-gain characteristics or varied to obtain greater signal handling capacity at low gain.

down in both cases if $Z_L >> R_a$ or Z_i, and is only truly applicable *in the classical sense* in the case of the valve amplifier if $Z_L >> R_a$, a condition which rarely obtains in practice.

The amplifier of Fig. 7 has another interesting attribute. It may be controlled by means of Z'_C alone. As Fig. 6 shows, if bias and control windings are omitted, variation of Z'_C causes I_L to vary between the limits I_0 and $(1/1\text{-}\beta)I_0$. No source of control current is needed. The amplifier in effect provides its own control current. This is sometimes very convenient. In the conditions of either maximum or minimum output (or gain, when Z'_C is used as a gain control) the amount of power dissipated in Z'_C is negligible, and is never greater than the amount of power dissipated in a control winding having the same resistance and number of turns as the control windings in series, for any given level of output power. The writer, for want of a better name, has dubbed this an "impedance-controlled amplifier." He will be grateful if any reader can think of a better term.

Fig. 7 also indicates an amplifier with a normal control winding and a bias winding, Z'_C then being used to control the gain, in "variable-μ" fashion. This can be done over a number of stages by the use of ganged variable resistances for the Z'_C's.

Fig. 8 shows an amplifier—a "d.c." amplifier in which the mean output level is set by means of the current in a bias winding, whilst the gain is controlled in the way already described. "Complementary" rectifiers are used to obtain a d.c. output.

There is one interesting difference between the magnetic amplifier and its valve counterpart, a difference in favour of the former. In the variable-μ valve amplifier the "undistorted" signal-handling capacity of the amplifier is reduced at low values of controlled gain. This is often inconvenient, since low values of gain are often required with large signals, and vice versa. In the case of the "variable μ" magnetic amplifier the signal-handling capacity is restricted with increase of gain and vice versa. In the case of the valve amplifier, nothing can be done about this restriction in signal-handling capacity, since both the signal and the bias are operating upon the same electrode. In the magnetic amplifier separate "electrodes" (windings) are used, and it is possible, as Fig. 9 shows, either to work with a constant bias current, giving the same signal-handling capacity at both high and low gain, or to vary the bias in accordance with the input signal, by means of a circuit such as that shown in Fig. 10, in order to obtain greater signal-handling capacity at low gain setting. In this figure, an auxiliary bias winding is supplied with current derived from the load voltage, and acting in opposition to the normal bias current, reducing the effective bias as the gain is increased. This could of course also be done by means of the manually-controlled scheme of Fig. 11, which will usually be preferred.

One very useful feature of the d.c.-controlled magnetic amplifier is that any number of control windings of similar or differing current-gain values may be used, up to the limit that it is physically possible to install, and that there is no interaction between them. They may of course be connected to signal sources at widely different mean potentials, floating or earthed. Consequently such an amplifier is a useful computer component for algebraic addition, since

$$I_L = I_0 + (k_1 I_1 + k_2 I_2 + k_3 I_3 \ldots \text{etc.})$$

where k_1, k_2 etc. are the current-gain factors of the control windings, and I_1 I_2 etc. the corresponding control currents. If in addition we have the "variable-μ" feature we have

$$I_L = K(I_0 + k_1 I_1 + k_2 I_2 + k_3 I_3 \ldots \text{etc.})$$

where K is the controlled "variable-μ" gain, multiplying a number of algebraically added quantities by a common factor. "Circuitwise," as the Americans say, I_0 can be eliminated in the output, one obvious method being by using a push-pull stage. This use of the amplifier is indicated in Fig. 12.

Finally, in Fig. 13, the results of an experiment upon a stage in which no attempt had been made to optimise the performance in any way, are shown. The various quantities are in linear units. Several interesting things appear. The current gain and power gain are roughly linear over the full range of R'_C. The voltage-gain behaves in a peculiar manner, being linear over the first 5% of R'_C and constant over the upper 50%. The load resistance was of the optimum value, which for optimum efficiency is, as in the case of a triode valve, equal to $V_S/I_{L max}$. There is, it will be noted in this case, a *classical* "variable-μ" action over a small portion of the characteristic, but this is not of much practical importance since it amounts only to some 6 dB in range, whilst the whole of the variable-gain region amounts to roughly 14 dB.

The range of variable current gain obtainable with this type of amplifier per stage (about 20 dB as a maximum) does not seem impressive when compared with the 25-30 dB change obtainable with the variable-μ valve amplifier, but it is fully adequate for the great majority of applications. Most amplifiers

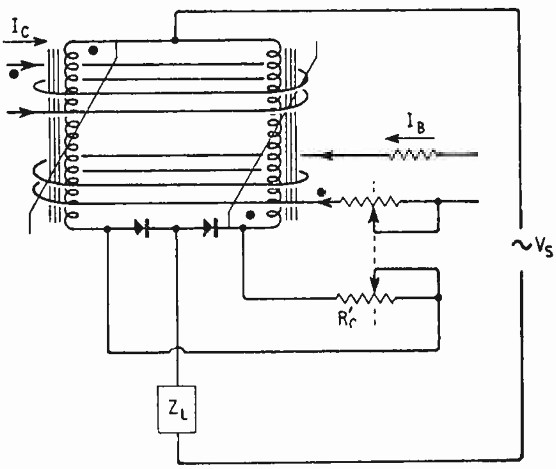


Fig. 11 Ganged manual control of bias and gain.

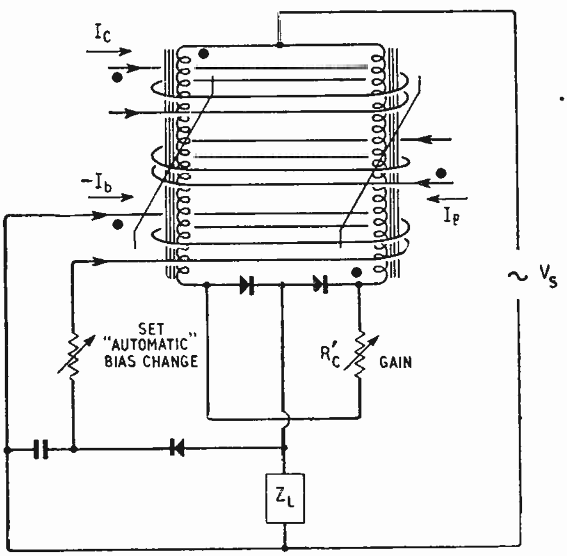


Fig. 10 Amplifier with auxiliary bias winding to give automatic bias setting with varying gain.

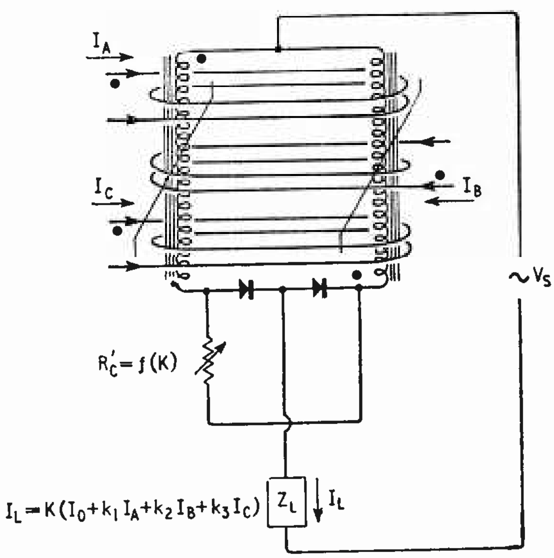


Fig. 12 Magnetic amplifier used as a multiplier or an adder.

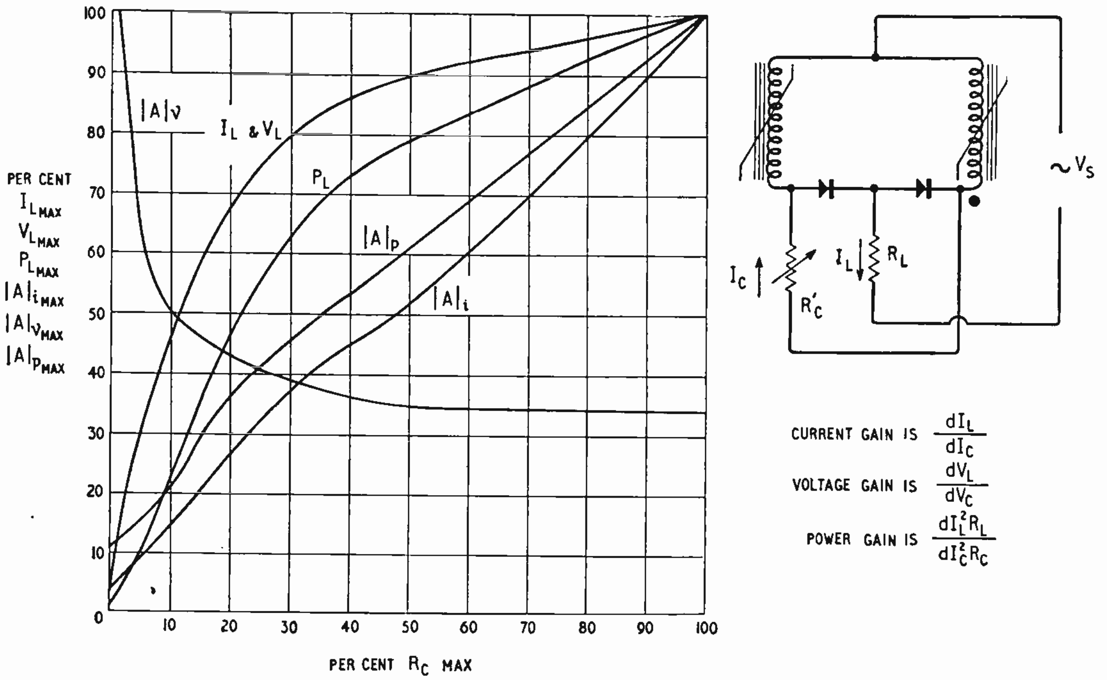


Fig. 13 Characteristics of the amplifier on the right with different settings of the gain control R'_C. I_L = load current, V_L = load voltage, P_L = load power, $|A|_i$ = current gain, $|A|_v$ = voltage gain, $|A|_p$ = power gain.

of this type, if properly designed, will be working with a β of about 96%, which after allowing for the limitation in range of Z'_C, will give a variable-gain (current) range of about 13-14 dB per stage. The numerical example given earlier corresponds closely with the results obtained with an experimental amplifier built by the writer.

To conclude, the writer would like to acknowledge his indebtedness to his colleagues for technical assistance and constructive criticism.

APPENDIX

Nomenclature, explanations and definitions

N_L: number of turns in series in the load circuit winding(s).

N_C: number of turns in series in the control circuit winding(s).

I_L: current (average a.c., or if rectified, d.c.) flowing in the load circuit.

I_C: current (d.c.) flowing in the control circuit.

I_b: current (d.c.) flowing in the bias winding. (N_b, the number of turns in series in the bias winding, is not mentioned in the text, as it is not necessary for purposes of explanation.)

R_L, Z_L: resistance, impedance in the load circuit, exclusive of the resistance or impedance of the load windings of the transductor.

R_C: resistance in the control circuit, exclusive of the resistance of the control windings of the transductor.

R'_C, Z'_C: value of the gain-control resistance or impedance.

L_S: effective series inductance of the transductor in the load circuit.

L_C: choke inductance used in control circuit of single-core magnetic amplifier stage.

β: the "feedback factor" due to the use of rectifiers. (In practice, generally lies within the limits 94-99%.)

I_{fb}: mean value of (pulsating d.c.) current flowing in series with the load windings and "feedback" rectifiers.

Current-gain: by definition, dI_L/dI_C, and by analogy with customary (though incorrect) practice in the case of the valve amplifier, where the voltage gain is defined as (in dB terms) $10 \log_{10} V_{out}/V_{in}$, we define the current-gain as $10 \log_{10} I_L/I_C$. This also gives ½ the power gain, if R_C and R_L are equal.

Power-gain: by definition $\frac{\text{change of power in load}}{\text{change of power in control current source resistance.}}$

$= dI_L^2 R_L / dI_C^2 R_C$.

Voltage-gain: by definition $dV_L/dV_C = dI_L R_L / dI_C R_C$ and is not used in the text, because the magnetic amplifier is normally used as a current amplifier.

A_0: the basic current-gain of the amplifier, as above defined, when $\beta = 0$.

A': the enhanced current-gain of the amplifier, when rectifiers are used, $A' = A_0/(1 - \beta)$

V_S: the supply voltage (a.c.).

V_{LS}: the voltage drop in the load circuit across the choke or transductor due to the load current.

V_L: voltage across the load, average a.c. or (rectified) d.c.

I_0: the magnetizing current (a.c.) of the transductor or choke. Defines the minimum load current, unless special arrangements are made.

Transductor: term used to connote the core-and-windings assembly used in magnetic amplifiers. If of single-core type (as Fig. 1 in the text) it would be referred to as a "saturable reactor."

All gains are given in terms of current gain. Rough indications of power gains are obtained by squaring the linear values, or doubling the dB values. The purist will object (and rightly) that this is only correct if we assume that input and output impedances are equal, but for changes in gain the objection does not apply.

London Audio Fair

NEW EQUIPMENT FOR SOUND REPRODUCTION

UNFORTUNATELY space does not permit a description of all the new products shown at this year's Fair but a selection of those thought to be of more than usual interest is given in this review. While the main emphasis was on stereo, considering audio equipment generally, the most obvious changes were in a field partly outside stereo, that of tape recording.

Tape Recording and Reproduction.—The many new tape recorders shown included two by Trix, a company whose products have previously been in other fields of audio. The "Everest" is a two-speed (3¾ and 7½ in/sec) model with a specified frequency range of 30-12,000c/s ±3dB at 7½ in/sec and a signal/noise ratio of 60dB. The "Companion" is a single speed (3¾ in/sec) portable, weighing only 21lb which incorporates the recently introduced B.S.R. "Monardeck" tape mechanism.

In the Tandberg Model 5 shown by the Harting-Tandberg group the track width has been reduced sufficiently to accommodate four instead of the usual two tracks on normal width tape. This model can reproduce tapes in which the four tracks are divided into two staggered stereophonic pairs; alternatively, erasure, recording and replay of the tracks one at a time is possible.

A considerably lower crosstalk figure is required for satisfactory recording and reproduction of independent rather than stereo signals, since the difference between the levels of the wanted and unwanted signals is likely to be greater with independent signals, and the unwanted signal tends to be more noticeable when it is quite different from the wanted signal. A sufficiently low crosstalk figure in the region of −50dB or better is claimed for the Tandberg stereo Model 5 for four tracks, and for two-track stereo models shown by Reflectograph (Model 570) and Grundig (TK55).

The reproducing head magnetic gap length is now very frequently made as short as about 10^{-4}in so as to reduce the speed required to give a high-frequency response up to the region of the highest audible frequencies from 7½ to 3¾ in/sec. Unless care is taken in the design of the tape transport mechanism, wow and flutter are now likely to be the factors limiting quality when halving the speed from 7½ to 3¾in/sec. However, several of the new recorders claim acceptable total wow and flutter figures of about 0.25% at 3¾in/sec.

A speed as slow at 15/16in/sec is provided on the new Stuzzi "Tricorder". At 1⅞in/sec, the next higher of the three speeds available, the response is stated to be 3dB down only at 8kc/s and the wow and flutter only 0.3% r.m.s. Up to 5¾-in diameter reels can be handled and space for an extra head and amplifier is provided. For office use, stethoscope type headphones for taking dictation from the recorder and an adaptor for recording telephone conversations are available. Remote control facilities are also provided.

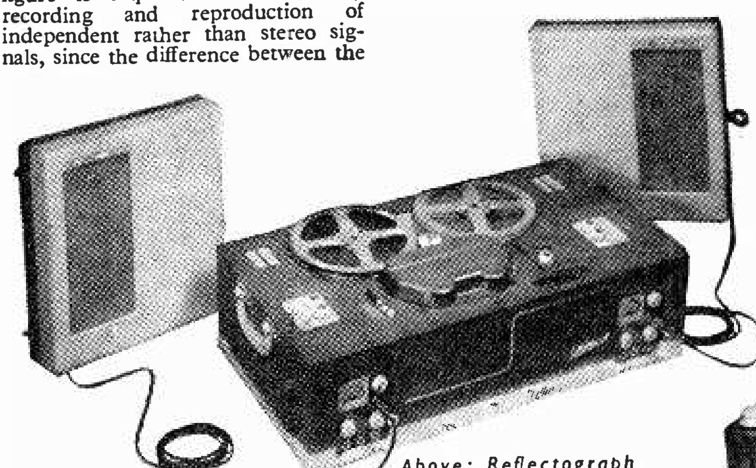
Independent level adjustment and mixing facilities for two or more channels are now fairly often incorporated into tape recorders. The use of d.c. to heat the filaments of valves amplifying low-level signals, so as to reduce the hum level, was also noted in several cases. No pressure pads are used in a number of the newer models (notably throughout the Telefunken range) and one possible source of head wear is thus avoided.

Tape tension is made more constant in the Telefunken M85 series by using a spring-loaded finger on which the tape bears. As the angle formed by the tape at the finger alters with the amount of tape on the reel, the component along the tape of the force due to the spring alters so as to reduce changes in the tape tension.

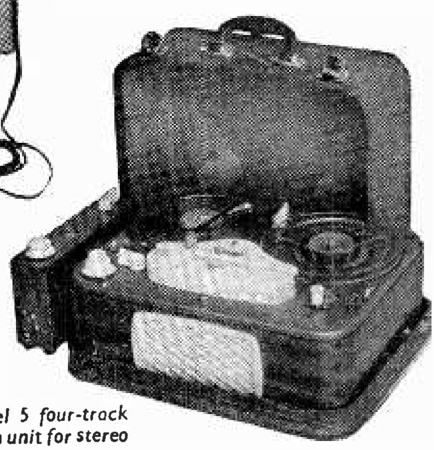
American Ampex professional tape recorders, including their tape duplicator series S-3200C for copying 3¾in/sec or 7½in/sec master tapes at a speed of 30 or 60in/sec, are now available in this country from Rank Cintel.

Special features of a small studio recorder shown by Telefunken (M23) include 4-channel mixing facilities, a recording level meter calibrated in dB, and alternative type of plug-in head assembly which can be located accurately enough to avoid the need for additional azimuth adjustment. A smooth fade-in on pre-existing recordings is automatically obtained by bringing the tape gradually into contact with the erase and recording heads.

Reflectograph were brave enough to demonstrate stereo recording as well as subsequent reproduction. Two ribbon microphones, spaced about three feet apart and angled slightly outwards and downwards, were placed about a foot above an accordionist who moved about in



Above: Reflectograph stereo recorder with the two halves of the lid containing the monitor loudspeakers detached.



Right: Tandberg Model 5 four-track reproducer with add-on unit for stereo recording on the left.

front of the microphones while playing. The size of the room was only about 10ft by 12ft, but the experiment was completely successful.

Two transistorized recorders were seen. One of these, the Stuzzi Magnette, has already been described in *Wireless World* (June 1958, p. 276). The other is the Fi-Cord whose size is only 9⅝in × 5in × 2⅝in and which weighs only 4¼lb. This recorder is unusual in that the ratio of the two available speeds of 7½ and 1⅞in/sec is four rather than the almost universal two to one. Four special miniature 2-V accumulators are used, and a charger is supplied. A high-frequency transistor oscillator supplies the erase and bias voltages and also the h.t. for the valve level indicator.

Tape of half the standard thickness giving double the playing time of standard tape for the same reel size or 33⅓% more playing time than long-playing tape of two thirds of the standard thickness, was introduced by E.M.I., B.A.S.F., M.S.S. and M.M.M. (Scotch Boy). A p.v.c. base chemically similar to that generally used for standard thickness tape was used by B.A.S.F., whereas M.S.S. and M.M.M. (Scotch Boy) used a polyester base.

Pickups.—An unusual mechanical arrangement seen in the Goldring 700 variable-reluctance stereo pickup uses a cantilever pivoted about its middle rather than one end. This enables the two sets of magnetic gaps to be placed one at each end of the cantilever rather than both at one end. By thus separating the gaps crosstalk problems are reduced. The lateral and vertical compliances are both 4×10^{-6}cm/dyne and the effective mass at the stylus tip is 8mgm.

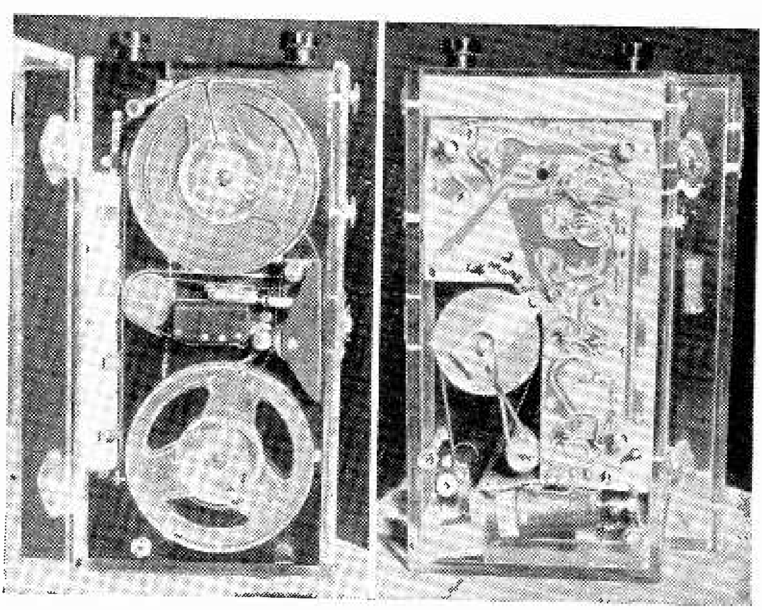
In the Connoisseur crystal stereo pickup, by using two very small (0.25in × 0.06in × 0.025in) ceramic crystals and partially de-coupling the crystal assembly from the stylus in the usual way by means of a rigid cantilever, the effective stylus tip mass has been reduced sufficiently to raise the resonance between this mass and the record groove wall compliance up to about 18kc/s.

An effective stylus tip mass of only 0.6mgm has been achieved in a new Cosmocord mono crystal cartridge. An unusual feature of this cartridge is that the compliance of 12×10^{-6} cm/dyne is provided in the cantilever itself which is not rigid. This cartridge was mounted in a specially balanced arm whose static side thrust and vertical frictional forces are equivalent to only 0.02 and 0.05gm respectively. The arm is little affected by external vibrations. The design of the pickup has already been described in *Wireless World* (April issue, p. 182) and the design of the arm will be described in a forthcoming issue.

A modification of Cecil Watts' "Dust Bug" which can be clipped on to most pickup arms and which is recommended for use with record changers was shown by Cosmocord. A downward-bearing spring counteracts the weight of the "Dust Bug", whose tracking angle can be adjusted. The decrease in stylus and record wear resulting from the removal of dirt in the grooves more than compensates for any harmful effects due to an increase in the side thrust caused by friction between the "Dust Bug" and the record.

Radio Tuners.—An impressive specification is quoted for the Avantic combined v.h.f./f.m. and medium wave a.m. tuner type BM612. For f.m. reception two i.f. stages and two limiters precede the Foster-Seeley discriminator to give a sensitivity of 2μV for an a.m./f.m. rejection ratio of 50dB. A.f.c. is provided, and the extent of this can be varied to avoid the "capture" by strong stations of neighbouring weak stations whose reception may be desired. Inter-station noise suppression to a variable extent is available with both a.m. and f.m. reception. The a.m. selectivity is ±4.5kc/s for a 6dB loss in output.

Top (left) and bottom (right) views of the Fi-Cord transistorized tape recorder in a special transparent cover.



Pre-amplifiers and Amplifiers.—A stereo balance control range of up to about ±4dB is now frequently provided. Such a control can be simply obtained by connecting the fixed ends of a single potentiometer at similar points in each of the two amplifiers. The connections must be made where the movable contact on the potentiometer will be earthed (so that crosstalk is eliminated) and also, of course, where the resistances in the potentiometer can influence the gain. As the balance control potentiometer is altered, the gain of one channel is increased while that of the other is reduced. If the average gain is arranged to remain the same, readjustment of the level control will probably be unnecessary.

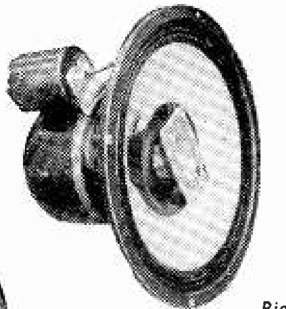
Ganged pairs of switched precision resistors were used instead of ganged potentiometers for the level control in the Rogers HG88 and Jason J4-4 amplifiers so as to reduce variations in the balance as the level is altered.

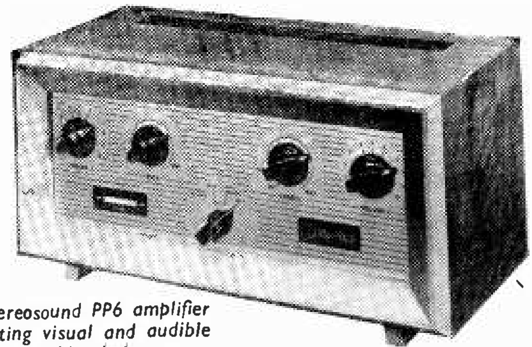
Very comprehensive facilities for checking balance are provided in the Stereosound PP6 amplifier. The balance between the two amplifiers and pre-amplifiers can be checked by feeding 100c/s ripple from the h.t. before smoothing to both inputs in parallel. The outputs from the two amplifiers are sampled at special tertiary windings on the output transformer, backed off against each other, and fed to a valve tuning indicator. Maximum separation of the illuminated portions of the indicator shows zero input, and thus correct balance of the amplifier. The balance of the whole system, including loudspeakers, can be aurally checked using an internally generated approximately sawtooth oscillation. This oscillation also is fed equally to both inputs in parallel, and the balance control adjusted until the metronome-like sound appears to come from mid-way between the two loudspeakers.

Two types of channel switching are frequently offered: the two signals can be interchanged between the two reproducing systems and the phase of one of the two signals can be reversed.

Although Lowther have shown low-level transistor amplifying stages for some time as separate units, such

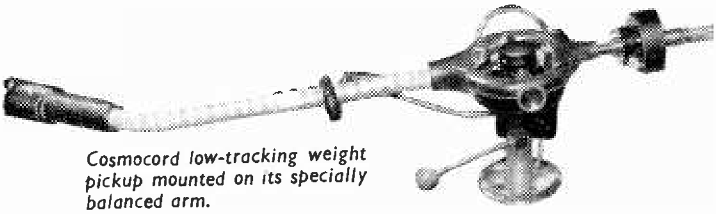
Right: Goodmans Triaxiom 12/20 loudspeaker with crossover unit mounted on the magnet.





Right: Stereosound PP6 amplifier incorporating visual and audible methods of checking balance.

Wharfedale Coaxial 12 loudspeaker with tweeter level control.



Cosmocord low-tracking weight pickup mounted on its specially balanced arm.

stages are only now being incorporated into complete pre-amplifiers. Examples were shown by Lowther and Sound Sales (A-Z). Steep-cut low-pass filters in which the cut-off point can be continuously varied were noticed in the Lowther control units and Rogers HG88 amplifier.

Mixing units using valves are already available from several manufacturers, and a simple high-impedance resistive unit can now be supplied by T.S.L.

Those who like to "roll their own" will be pleased by the appearance of several stereo amplifier kits such as those shown in the Audio Fair by Altobass and Jason, for example. For amplifying the signals from pickups on musical instruments such as the guitar, the 10-watt Valencia made by Grampian combines amplifier and loudspeaker in a single baffle/cabinet with readily accessible tone controls.

Loudspeakers and Cabinets.—An interesting system of mounting was shown by Rogers in their 1284 3-speaker system. The 8-in and 12-in low-frequency speakers are connected in parallel and mounted at the top and bottom respectively of a column shaped cabinet 37in × 15in × 14in. The 12-in speaker faces a normal circular opening (equal to the effective cone size) in the bottom of the cabinet. The 12-in speaker is, however, spaced 1$\frac{1}{2}$in from its opening so that this space forms a reflex port for the radiation from the rear of the speakers. The opening in the bottom of the cabinet is filled with a layer of foam plastic $\frac{3}{4}$in thick so as to add resistive loadings to both the front of the 12-in speaker and the port. The foam plastic also prevents all frequencies above about 200c/s from being radiated from the bottom of the cabinet, thus producing a crossover effect between the two bass speakers. The foam plastic layer furthermore tends to act as a secondary diaphragm. This arrangement is claimed to result in damping of both the normal resonances of a reflex cabinet, and also lowering of their frequency by a factor of about 1.4 down to about 75c/s and 35c/s.

The analogue computer for investigating the effect of various parameters (including resistive loading in various places) on both the steady and transient response from reflex loudspeaker cabinets which was described in our April issue (p. 162) was shown by Ekco.

Two methods of avoiding cabinet wall resonances used by Wharfedale in their new speaker systems are the inclusion of $\frac{3}{4}$in polystyrene panels mechanically strengthened on both sides by a thin skin of plywood in their PST/8, and the gluing and battening of ceramic tiles in critical positions in their W3 and W4 cabinets.

In small cabinets, for an inward cone excursion the temporary increase in the air pressure inside the cabinet may be considerable over an appreciable range of frequencies. If this causes the surround to balloon outwards, not only is the tension exerted by the surround on the cone increased and more non-linear distortion thereby produced, but furthermore, the sound from the surround will be out of phase with that from the rest of the cone and some cancellation will occur. For this reason a more rigid than normal surround must be used for speakers in small cabinets. A single half-wave corrugation of rubber-treated resin-impregnated fabric forms the surround for the Wharfedale WLS/12 which has been specially developed for sole use in their relatively small W2, W3 and W4 reflex systems.

New coaxial speakers were shown by Goodmans and Wharfedale. Two concentric magnetic gaps with completely separate cones are used in the Wharfedale Coaxial 12. The angle of the 2-in diameter inner tweeter is only about 80 degrees. This tweeter is fitted with an inner aluminium dome and the total weight of its moving parts is only 1gm. The Goodmans Triaxiom 12/20 actually has three cones. The outer two are mechanically connected in the usual way so that at higher frequencies where the radiation from the large outer cone falls off because of its weight the lighter inner cone takes over and tends to move by itself to prevent any overall loss in output. The innermost tweeter magnet and cone are completely separate. The cone is loaded by a horn of elliptical cross-section so that dispersion is wider in a plane parallel to the breadth of this ellipse than in a plane parallel to the length.

A number of modifications have been made to the well-known Tannoy dual concentric coaxial loudspeaker. The useful flux in the gap for the low-frequency outer cone has been increased by about 20% by reducing the overall magnetic reluctance by partially shunting the gap for the high-frequency inner diaphragm at the rear of the magnet. This shunt is made so thin that it becomes magnetically saturated. The field in the high-frequency gap, which is limited by magnetic saturation at the pole pieces, thus remains unchanged. The rear of the high-frequency diaphragm is now damped by a small cavity with a hole in it which is filled with acoustically resistive material.

LETTERS TO THE EDITOR

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

Evaluating Aerial Performance

MR. C. F. WHITBREAD'S letter in the April issue raises two points which could usefully be further discussed. These are (a) the extent of the validity of my approximations, and (b) the practice of feeding a receiving aerial into a matched load although considerations of noise-factor dictate a mismatch. Matching is, I believe, standard commercial practice and mainly justified by the fact that the bandwidth of many commercial aerials would not be adequate without it.

Bandwidth as defined in my article is a property of the aerial only and takes no account of what is done between the aerial terminals and the grid of the first valve in the receiver. Use of a matched load should tend to double the bandwidths given by my formula.

Generally speaking I would say that if the bandwidth given by the formula is less than the required system-bandwidth one or other of a number of undesirable consequences tend to follow, such as the necessity of a matched load, or the various effects listed in my discussion of standing wave ratio in the second part of the article. I have not yet had a chance to check up on the references, but referring to p. 864 of Terman ("Radio Engineers' Handbook") Fig. 101 (which is after Schelkunoff) confirms my formula over a bandwidth of at least 25% to within the accuracy to which the curves can be read. The resistance variation, to which your correspondent refers, introduces some asymmetry in the impedance characteristic but is not significant in relation to the context.

The average characteristic impedance of an aerial (Terman, *loc. cit.*) is given by $276 \log_{10} \dfrac{\text{length}}{\text{radius}} - 120$ and comes to about 550 ohms for a Channel 1 dipole made from 1-in tubing, so that from my formula, $B = \dfrac{4}{\pi} \times \dfrac{73}{550} \times 44 = 7{\cdot}4$ Mc/s. Doubling this on the assumption of a matched load gives 14·8 Mc/s which is not far short of your correspondent's figure of 17·25 Mc/s. The impedance plot shows a change of only ±15% in the resistive term over the bandwidth used in my example.

L. A. MOXON.

Long Distance V.H.F. Reception

I WAS extremely interested in Mr. H. V. Griffith's article in your April issue, as I have myself been making fairly regular observations on sporadic-E propagated signals in Band I since 1955.

In general my observations have only served to corroborate previous evidence concerning the prevalence and behaviour of sporadic-E propagation, but in view of Mr. Griffith's article I would like to make the following comments, which may be of interest.

Over the path from Europe to Tangier, at distances of 1,000 to 1,500 miles, sporadic-E propagation is considerably more prevalent than over the paths observed at Tatsfield. Observations made during 1955/1958 gave the following results, in terms of days on which signals were observed:—

1955—July 1st to August 31st	32
1956—June 10th to September 14th	50
1957—May 8th to August 14th	64
September 8th to October 8th	5
1958—April 22nd to June 30th	41
July 22nd to October 8th	24

Over the months May/August signals were observable on more than 50% of the days. By far the most prevalent, and the strongest, signals came from the various B.B.C. television transmitters. On some occasions these signals provided pictures of entertainment quality for a whole evening. Signals were also observed from Belgium, Czechoslovakia, France, Germany, Holland, Italy, and Switzerland. I believe that it has been stated, I think by Mr. Bennington, that paths of the order of 1,000 to 1,200 miles are the best from the point of view of sporadic-E propagation. This may account for the prevalence of such signals in Tangier, which lies at an ideal distance from the source of many television transmissions in Band I.

During 1956 and 1957 I was also in a position to observe some channels in Band II. These observations showed that during some periods of sporadic-E activity, signals of up to nearly 100 Mc/s were being propagated. Between June 30th and July 14th, 1956, a B.B.C. transmission on 89.1 Mc/s was heard on three occasions, and an Italian transmission on 89.9 Mc/s once. During 1957, between May 18th and August 11th, the B.B.C. on 89.1 Mc/s was heard on 19 occasions, a German station on the same frequency on four occasions, and an Italian station on 89.9 Mc/s also on four occasions. In addition, at a station some 100 miles south of Tangier, a German f.m. broadcast station caused severe interference on 93 Mc/s, on July 31st and August 1st.

J. E. le B. TERRY,
Tangier, Morocco. RCA Communications, Inc.

Alternatives to the Wien Bridge

WITH regard to Mr. J. F. Young's comments in your April issue, I should like to point out that the reference in *General Radio Experimenter*, Vol. 6, November, 1931, describes the use of a Wien Bridge for the measurement of audio frequency by balancing the bridge network and not for a resistance-capacitance tuned oscillator.

Resistance-capacitance oscillators appear to date from 1921 when a U.S. Patent 1,442,781 was filed by Nichols describing a single-stage amplifier giving 180° phase shift together with a 4-section resistance-capacitance ladder network. However, the earliest references to the Wien Bridge and similar circuits as the tuning element of an oscillator which I was able to locate after an extensive search made some years ago are those given in my letter published in your April issue.

W. V. RICHINGS,
London, W.5. Dawe Instruments, Ltd.

Printed Circuits

IT is interesting to follow the correspondence with regard to the disadvantages of printed circuits to the servicing engineer.

As specialists in the development and manufacture of printed circuits, we appreciate the need, not only for the development of new types of processes and applications for printed circuits but to ensure their advantages and popularity with manufacturers, users, and that most important last link in the chain, the man who has to maintain the apparatus in efficient working order.

For this reason we have introduced as a new development (patent pending) the printing on the top (component) side of printed panels a mirror image of the circuit in colour. This means that when the components are mounted the panel, the main cause of criticism that, to quote Mr. Kisch in the March issue, "a disjointed array of resistors and capacitors fixed apparently at random and one is unable to see the interconnections," no longer applies and the engineer sees a complete traceable circuit. Of course, as most components, valve holders, etc., normally have bare metal or wire ends on the top side of the panel, it is possible to fault-find with the normal test equipment on the component side of the panel.

D. L. PHILLIPS,

Coventry. Mills & Rockleys (Production), Limited.

I HAVE followed the letters re printed circuits with great interest. I would like to add my views on this important subject. I agree with Mr. Flack only on the point that printed circuits should not really be so difficult to service as claimed. We have surmounted many obstacles in the past, we remember amongst others the chassis without an inspection flap at the bottom of the cabinet which was separate to the tube, and could not be tested outside its cabinet without either extending the leads or having a special lead adaptor from the makers, and the multi-chassis monstrosity which defied any attempt to service it until it was completely dismantled from its cabinet and precariously assembled all in separate pieces on the bench.

Let us cut out the humbug and realize that printed circuits are here to stay on one count only, cheapness. We are all well aware that wiring failures have never been even a factor in television or radio breakdowns compared to other causes. The odd dry joint has arisen, but the printed circuit is equally prone to this. Without insulting anyone's intelligence, it is obvious that the conventional chassis with its greater flexibility of wiring can withstand vibrations better.

Regarding the points raised about tracing faults in printed circuits, I regard these as red herrings, correct interpretation of meter readings must invariably reveal the fault and in the old-type chassis makers often bound their wires in tight bundles in any case, making tracing just as hard. Mr. Flack appears to have taken a peculiar stand in a technical journal, for if he wants greater reliability why not start much higher up the scale with say, valves, controls, line output transformer, etc.? What about designing sets well within the valve maker's ratings? Will he now tell us that the present-day sets using only 14 valves are more reliable because they have fewer valves to give trouble?

Let me hasten to say, however, that I believe we are forced to accept printed circuits, etc., because the trade must keep competitive to maintain a high level of employment. I only want to be completely honest (at least in this journal) and face up to the undeniable fact that the printed circuit, those banks of shoddy, preset controls, the 14-valve chassis are retrograde steps in quality, but forced upon us by the iniquitous purchase tax.

I cannot but admire the ingenuity displayed by the manufacturers in producing cheaper, bigger screens, glossier cabinets, brighter pictures, in spite of rising costs, and how they manage to prune substantial amounts of solidity with every succeeding model and still get the performance they do. Happily, the customer rarely looks inside, and we, the servicing fraternity, have never counted anyway. Even though the compromise between design and production has invariably worked out to the detriment of the service engineer the public are getting cheaper and cheaper sets, and even they can't have it both ways.

London, S.W.18. J. L. WILDGOOSE.

MAY I, on behalf of all service engineers, thank Mr. Flack for descending from the Olympus of the golfing weekend, to discuss the problems of the poor souls, towards whom the passing buck inexorably gravitates.

In the matter of printed circuits, his company is not among the most hated. There are, however, among the silent observers, those to whom the criticisms justly apply, including one ingenious designer, save the mark, who, having backed his printed panel by a stout metal plate and anchored it firmly in position by short connecting leads, proceeds to fit valves through the plate!

There has also been introduced a new, diabolical method of securing control knobs which has I am sure, caused consternation in the courts of heaven.

In conclusion I firmly believe, in company with all other service engineers, that the incredible mistakes that are made, including the urgent circular commanding modifications to be carried out to protect customers from electrocution, are not the work of idiots but are part of an international plot, designed to ensure that most technicians will be in mental homes in the event of their services being needed in a national emergency!

Leigh-on-Sea. L. W. TURNER.

Rigidity of L.S. Diaphragms

FURTHER to Mr. H. A. Hartley's letter in your March issue, on the effect of damp on foam plastic, I have soaked a piece of expanded polystyrene in water for five weeks, and its modulus in bending, measured while still wet and before drying out is almost unchanged, i.e., the material has *not* become limp. In practice, when foil or other materials are used to form sandwiches, not only will the foil reduce water absorption, as Mr. Hartley suggests, but even if water absorption does occur, the bending stiffness will be unaltered, as it depends almost entirely on the skins (see article p. 564, Dec. 1958 issue), the core being merely a lightweight device to keep the skins apart and to prevent them from buckling. If Mr. Hartley's material gives trouble, I can only conclude that it is not the same type as mine and that with correct choice of plastic water absorption is not a problem.

Banbury. D. A. BARLOW.

Plymouth Effect

I WAS very surprised to read in your December 1958 issue that the flutter effect which Mr. Grant has labelled "The Plymouth Effect" is still being puzzled over, so I would like to put forward my observations, the conclusions I came to and "the way around the problem" I found quite satisfactory before I left Plymouth in early 1957

The sharpish ridge known as Maker Heights over which the signals have to pass is around 450ft in height and causes considerable upcurrents of air or turbulence, similar to convectional currents, and somehow the warm rising air meeting the colder upper air presents alternative paths to the signals, reflecting and refracting them. I reached this conclusion after 'scoping and noticing the amplitude variations in Cawsand and making use of a highly directional radar device from approximately the same route as the signals would meet the ridge, which gave not only the expected solid response signals from the ridge but gave, when moved up approximately 150ft above the ridge, a group of continually varying signals at the same range above the ridge in space. Thus, the transmission having to pass varying paths, the signals received in Cawsand arrived in and out of phase with each other, varying in amplitude considerably. Lines were pulled when overall delays occurred, and there were overall brilliance variations also.

I found the best way round the problem was to screen "H" aerial from direct transmissions and to swing it 70° out to sea, and thus receive the re-radiated transmissions from Staddon Height aerials lattice masts (¼in horizontally to the right on your December maps) and use the 40% of the "direct" signal—thus making use of the main ghost noticed on direct reception without any ghosting whatsoever.

Just before I left I did contact Mr. Cooms of the B.B.C. to suggest the possibility of improving the reflecting surface of the Staddon Height masts to give us a better "ping off".

Hoping the above may help to lay the TV ghost of our village before my return in May 1960.

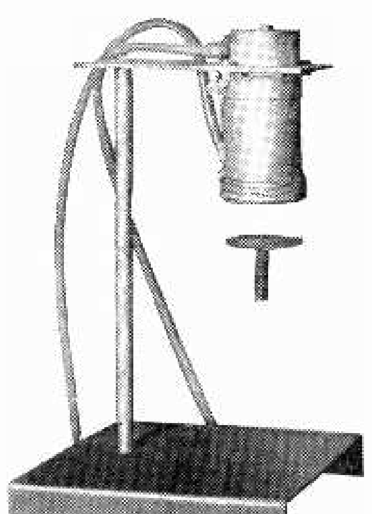
Singapore. A. MAYHEW.

Technical Notebook

Self-Monitoring Colour Tube to give automatically the correct chrominance balance in a colour television receiver is suggested as a possibility by J. J. Belasco and J. J. Chantrill in B.B.C. Engineering Monograph No. 23 (February, 1959). The proposed tube is a single-beam type working on the beam-indexing principle—the red, green and blue colour signals being gated to modulate the beam according to its position as it scans red, green and blue vertical phosphor strips. In this respect the tube is similar to the well-known Philco "Apple" c.r.t. (January, 1957, issue, p. 2) but instead of the beam-position information being obtained by a secondary emission process a photoelectric system is used. This involves vertical strips of photoconductive or photoemissive material laid on the viewing side of the fluorescent screen to correspond with the colour phosphor strips. All the red photo-sensitive strips are connected together and similarly with the green and blue strips, and the resultant three connections provide signals for gating purposes. The chrominance balancing system makes use of a small group of photosensitive strips at the edge of the picture, masked from view and not connected to the others. These are activated by a white bar produced by injecting a pulse into the video amplifier during the line suppression period. They consequently monitor the red, green and blue components which are combining to form the white bar. The voltage outputs from the monitoring strips are compared with reference voltages which have the correct relative proportions to form white when combined. The colour error signals so produced are then used to adjust the gain of each colour channel for the following line period.

Compatible Stereo "left" and "right" signals from widely-spaced (about 6ft or more) microphones are possible according to Bell Telephone Laboratories. The Bell modification to the ordinary left and right signals to make them compatible depends on the psycho-acoustic phenomenon known as the "precedence" or Haas effect. This effect arises if two identical or similar sound waveforms are reproduced at different places at nearly equal intensity levels with a delay of between 5 and 35 msec between them, when the apparent loudness of the delayed or echo sound is reduced by about 10dB below its actual intensity. The Bell modification combines each stereo signal with the other signal delayed by about 10msec and with its level reduced by about 1dB. When both the left and right modified channels are reproduced then, because of the Haas effect, the delayed signals are each masked by the corresponding undelayed signals on the other channel, so that apparently only the left and right signals are reproduced, as required. When only one channel is reproduced the combination of one signal with the other one delayed and at a slightly reduced level is said to provide a compatible signal. This modification has been developed primarily for use with stereo broadcasts in which a separate transmission is used for each channel, but in which an unmodified receiver tuned to only one of the two transmissions is required to give a compatible signal.

Levitation, though normally associated with the occult, can be achieved on strictly physical principles with an apparatus recently demonstrated by G.E.C. Research Laboratories. In this a small bar permanent magnet is made to hang in mid-air a



few inches below an energized electromagnet. Normally, of course, the bar magnet would either drop to the ground or fly up to the electromagnet. The secret of the trick is therefore to adjust continuously the field of the electromagnet so that its pull just balances the pull of gravity on the bar magnet. This is done by a servo system. The energizing current in the electromagnet is made to depend on phase variations in a tuned circuit which are produced by a disc of metal on top of the bar magnet altering the inductance of a coil mounted on the electromagnet. A 2.6-Mc/s oscillator supplies two signals to a phase detector, one direct and one through the sensing tuned circuit containing the coil. Phase changes in the tuned circuit due to movements of the bar magnet are thereby detected, and they produce a signal which is used to control the electromagnet current in a corrective sense. Positive feedback has to be applied in the control system to achieve stability.

Solid Circuits is the name given to small blocks of semiconductor material in which transistor, diode, resistance and capacitance elements are formed into complete circuits by special manufacturing techniques of diffusion, etching, masking, deposition, etc. (see Nov. 1957 issue, p. 516). They have now reached the stage of commercial development and are expected to be available for certain applications in the U.S.A. some time during the year. Texas Instruments recently exhibited two examples, each measuring less than $\frac{1}{4}$in × $\frac{1}{8}$in × $\frac{1}{32}$in. One was a multivibrator circuit, containing as integral parts of the semiconductor material the equivalent of twelve normal electronic components—two diffused-base transistors, two capacitors and eight resistors. The other was an oscillator containing the equivalent of nine components—one transistor, five resistors and three capacitors. The whole object of solid circuits is, of course, to reduce drastically the size and weight of electronic apparatus in such things as satellites, airborne equipment and computers. The criterion here is "component density" (though "volumetric efficiency" is sometimes quoted), and with solid circuits it is possible to achieve densities of up to 34 million components per cubic foot. This compares with several thousand per cubic foot for conventional circuitry.

High-Temperature Diode, made of the semiconductor material gallium arsenide, is another recent introduction by Texas Instruments in America. It is said to be capable of operating in the extremely wide temperature range of −65°C to +325°C.

Elements of Electronic Circuits

2.—CLAMPING OR D.C. RESTORATION

By J. M. PETERS, B.Sc. (Eng.), A.M.I.E.E., A.M. Brit. I.R.E.

IT is sometimes necessary for the potential at a point in a circuit to be restricted to variations within fixed limits. The use of a clamping diode makes this possible. The name is chosen because the valve appears to fix or "clamp" the point to the desired potential.

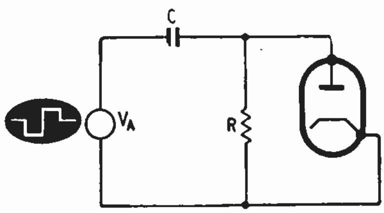


Fig. 1.

A common arrangement using a diode and CR circuit is shown in Fig. 1. For the purpose of explaining the action of this circuit we will assume that the peak voltage of the applied square wave V_A in Fig. 2 is 20 volts.

(i) The application of 20 volts to R (AB in Fig. 2) causes the diode to conduct.

(ii) When the diode conducts R is short circuited, hence the time constant is very small. C quickly charges to 20 volts, causing V_R to decay to zero (BC).

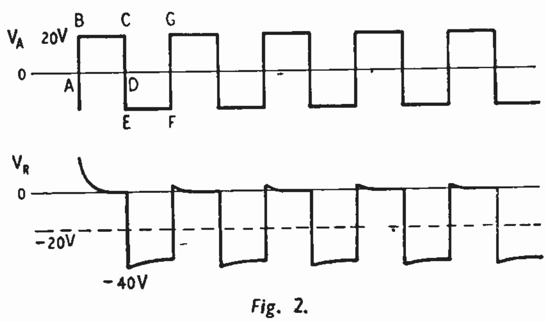


Fig. 2.

(iii) V_A now falls from C to E, i.e., from +20 volts to −20 volts. So −20 volts is applied to the circuit. V_C is, however, also at −20 volts, thus making the voltage across the resistance V_R = −40 volts.

(iv) Since the anode of the diode is now negative with respect to the cathode the valve does not conduct. Consequently as the time constant CR is now long, C only discharges very slightly (EF).

(v) When V_A goes from F to G the applied voltage again becomes +20 volts. V_C is, however still only about −19 volts, making V_R = + 1 volt.

(vi) C quickly charges, V_R quickly falls to zero again and the cycle is repeated. Except, therefore, for a very small positive excursion at the commencement of the positive-going applied pulse, the maximum positive value of V_A is "clamped" to zero volts.

It can also be shown that if the diode connections are reversed as in Fig. 3, V_R is made all positive and the maximum negative value of V_A is "clamped" to zero. In each case a direct voltage component is introduced into the original applied waveform, −20 volts in the circuit of Fig. 1 and +20 volts in the circuit of Fig. 3. It is often said that d.c. (voltage) restoration takes place under these conditions.

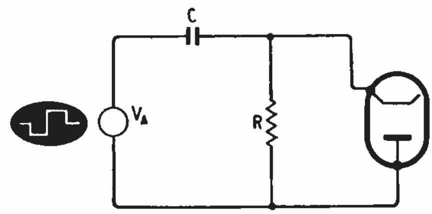


Fig. 3.

We will now consider what happens when a biasing voltage is applied to the diode. With the diode biased, the "clamping" voltage may be made as required. In the example in Fig. 4 an input square wave of 30 volts peak (Fig. 5) is applied to .

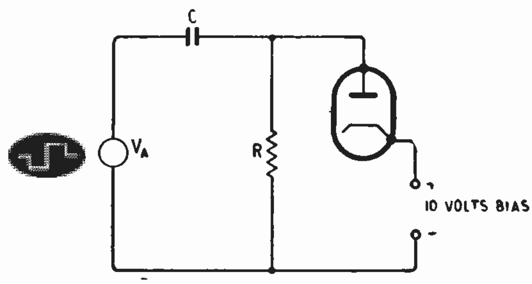


Fig. 4.

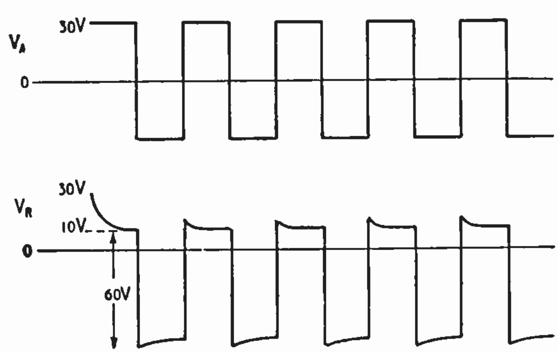


Fig. 5.

diode whose cathode is biased at $+10V$. The result is as shown in the lower part of Fig. 5, where the maximum positive excursion of V_A is clamped to $+10$ volts. Similarly, if the bias is reversed the maximum negative excursion of V_A is clamped to -10 volts.

Now let us consider the use of a triode valve for clamping. Here, as shown in Fig. 6, the grid and

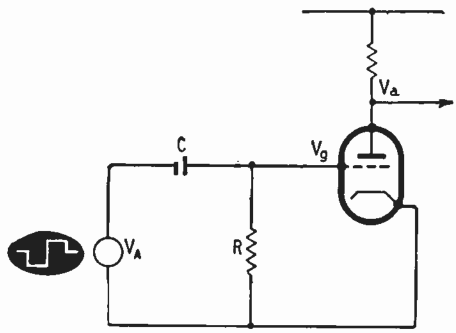


Fig. 6.

cathode act as a diode to the applied square wave V_A, which, for the purposes of the description, is assumed to be 10 volts peak (Fig. 7). V_g, the grid voltage, is therefore clamped to zero. The negative excursion of the input wave will now exceed the cut-off bias of the triode, with the result that the anode voltage waveform V_a is clamped to h.t.

It is important to note that, as illustrated in Fig. 7, a peak input voltage of 10V can cut off a valve which has a cut-off bias of 15V. This is due to the intro-

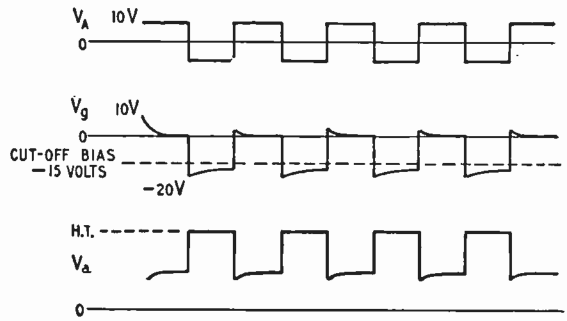


Fig. 7.

duction of a $-10V$ d.c. component which makes the maximum negative excursion of the applied voltage $(V_g) = -20V$.

Before leaving this section it may be of interest to note that applying a similar treatment to the diode detector in conventional radio circuitry may offer a more satisfactory explanation of its operation than that sometimes given in textbooks.

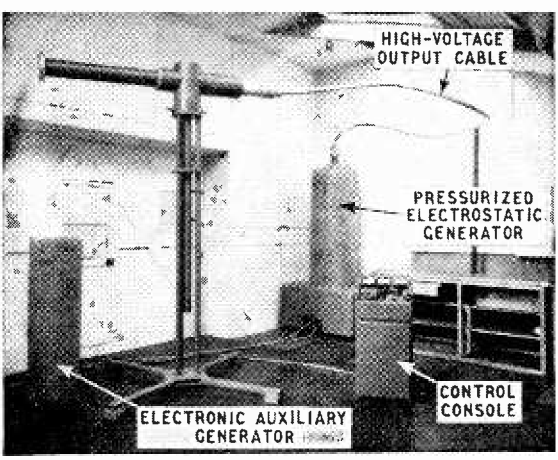
CORRECTION

In the first paragraph of last month's article (p. 156) the sentence beginning "If the input voltage is maintained at steady value . . ." should continue to read as follows: ". . . the voltage across the resistor will drop as the capacitor C charges through R. This rate of charge through the resistor depends on the values of C and R; the greater the values of C and R the longer will this time be." Also, the next paragraph should begin: "On discharge, it can be shown from theory . . ."

High-Voltage Generator

EQUIPMENT for generating voltages up to about one megavolt is finding increasing application in industry for such purposes as testing high-voltage cables, insulators and switchgear, as well as for use in electron microscopes, X-ray apparatus and various kinds of particle accelerators.

Miles Hivolt, Ltd., who in this country market the high-voltage generators made by the Société Anonyme de Machines Electrostatiques of Grenobles, recently demonstrated one of the S.A.M.Es. 600-kV generators at their works at Shoreham Airport.



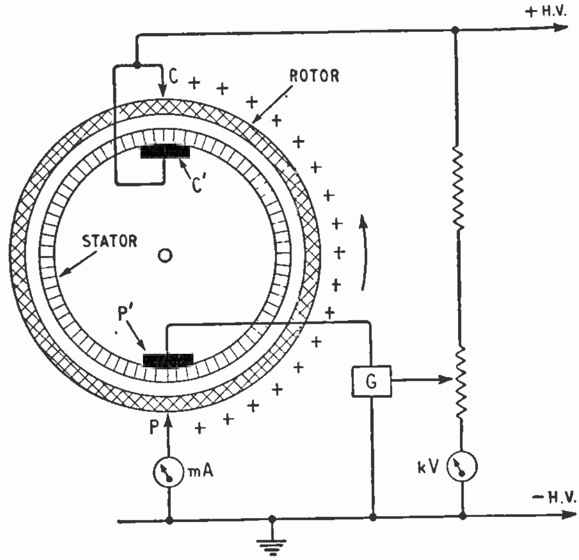
The three units of the Model CD600/4 high-voltage generator with oil-filled output cable on supporting stand.

The Model CD600/4, as this 600-kV generator is known, will give 4mA output, which, while not impressive by this figure alone, actually represents 2.4kW at 600kV. This equipment is relatively small in size, being easily assembled in a single vehicle if necessary and, complete, weighs a little over 2,000lb.

These are electrostatic generators (once called "influence machines") and closely resemble the Van de Graaff generator in principle, though not in form.

Basically the S.A.M.Es. generator consists of a stationary glass cylinder (the stator in the diagram) with another cylinder of insulating material (the rotor) revolving around it at relatively high speed. A positive charge is "sprayed" on to the revolving cylinder from electrodes P and P', the priming charge being provided by an auxiliary generator G. The charge is carried round to the collector electrodes C and C' where the voltage builds up to the working value. Prototype generators of this kind were shown at the Physical Society's exhibition in 1951 and 1954.

The CD600/4 generator consists of three main units, a pressurized electrostatic convertor unit, auxiliary electronic generator and remote-control console; these three are shown in the photograph. The pressurized unit contains the glass stator, rotor and its driving motor and the high-voltage resistance network and stands 8ft 10in high. It is filled with hydrogen at a pressure of about 25 atmospheres, and is water cooled. The rotor



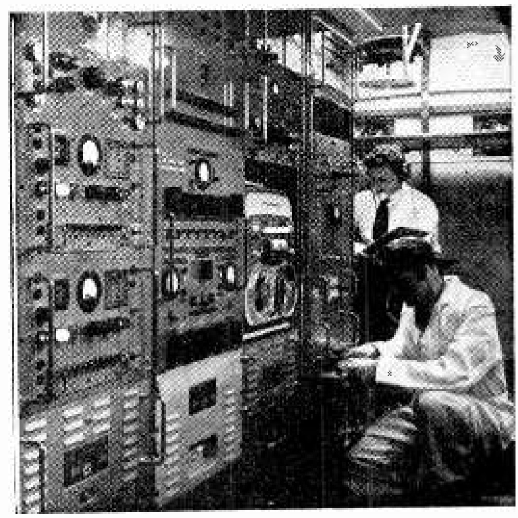
Schematic arrangement of the S.A.M.E. electrostatic high-voltage generator.

driving motor is a three-phase machine running at about 2,800 r.p.m. Cooling water circulates in the pressurized unit at between 1 and 2 gallons a minute.

The auxiliary, or priming generator, consists of a r.f. oscillator, high-voltage unit and a small electrostatic generator and provides priming voltages of from 10 to 50kV according to the output required. It is built into a floor-standing cabinet 4ft 4in high and includes voltage-regulating and stabilizing circuits and the various safety devices essential in high-voltage generators. Voltage stabilization is $\pm 1\%$ of the selected output in the Model CD600/4 and it can be as close as 1 part in 10^5 in some of the high-stability versions of these generators, such as, for example, the 50-kV model "Samtron 50."

The remote control console is a cabinet 3ft 3in high and houses equipment for selecting and measuring the priming and output voltages and current.

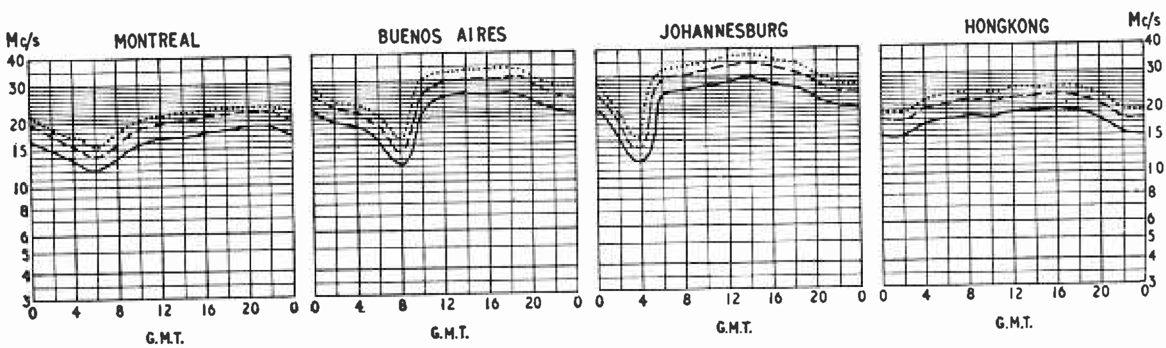
Comprehensive safety and protecting devices are incorporated in the equipment and it would seem impossible to damage any apparatus used with the generators by accidental flash-over, internally or externally. If sparking occurs the electromagnetic waves radiated are picked up by a telescopic aerial on the auxiliary generator unit and this "signal" is used to suppress the priming voltage and the output falls to zero. After a brief interval of time it slowly builds up again to the exact pre-selected value. Voltage or current overloads also "trip" the generator. The total consumption of the CD600/4 is about 3.5kW.



RADIO CONTROL FOR THE CANBERRA U Mk. 10:—Short Brothers and Harland Limited have produced a remote control system for this aircraft which is used as an unpiloted "target" for guided missile tests. The Canberra is controlled from the ground via a v.h.f.-radio link, the commands being in the form of pairs of tones. Twenty-four of these pairs are available and a transponder is installed in the aircraft to improve its radar "visibility." The photograph shows part of the interior of the control station.

SHORT-WAVE CONDITIONS

Prediction for May



•••••••••• FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE FOR 25% OF THE TOTAL TIME

— — — PREDICTED AVERAGE MAXIMUM USABLE FREQUENCY

——— FREQUENCY BELOW WHICH COMMUNICATION SHOULD BE POSSIBLE ON ALL UNDISTURBED DAYS

THE full-line curves 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 May.

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

Long-Distance Propagation

DETAILS OF FORTHCOMING TESTS BETWEEN ASCENSION ISLAND AND SLOUGH

THE Department of Scientific and Industrial Research with the co-operation of Cable and Wireless, Ltd., will in June set up an experimental radio station at Ascension Island, from which two of their staff will conduct test transmissions to their Radio Research Station at Slough, Bucks, for a year. The object of the tests will be to investigate propagation over long distances.

The D.S.I.R. officer in charge of the project at Slough is A. F. Wilkins, who was closely associated with Sir Robert Watson Watt in the early development of radar. The two officers going to Ascension are L. A. Brackstone and R. Aria. On the Cable and Wireless side, arrangements have been made by R. J. Hitchcock, head of the section dealing with radio propagation, who is also a member of the Ionospheric Communications Committee of the Radio Research Board.

Explaining the objects of the tests, Mr. Hitchcock writes:

"Over certain parts of the earth's surface we now know a great deal about the characteristics of the ionized layers of the upper atmosphere by means of which high-frequency radio communication is established. But we do not know much about the exact path followed by radio waves in the course of their journey from transmitter to receiver, and this, in spite of the fact that commercial high-frequency circuits have been in operation for the past 30 years or more. The actual paths taken by radio waves are called the 'modes of propagation,' and it is to investigate the nature of these modes that the tests at Ascension Island have been planned.

"It may well be asked why such investigations are necessary, for if we point a directional transmitting aerial in Nairobi towards, say, London, and use the right order of frequency for the route, the signal will in all probability be receivable in London. The answer lies in the fact that, in common with all forms of engineering, it is becoming increasingly important to do the job efficiently. In Cable and Wireless, Ltd.'s particular case, the necessity providing the spur is an ever-increasing congestion of the radio spectrum, an increasing demand for reliability and, possibly the most important factor of all, an ever-increasing demand for additional channels on existing and planned circuits.

"Considered academically, high-frequency systems are exceedingly wasteful, for although signals are required only at the few acres where the receiving aerials are located, they fall over great areas of the earth's surface to no useful purpose. Furthermore, we have no assurance at present that we are in fact putting down the maximum possible energy at the point where it is required. These are the sort of problems we must tackle if we are to improve the efficiency of our radio systems and remain competitive in the rapidly progressing communications world.

"Preliminary investigations into modes of propagation have been going on for some years, and many will recall the transmissions already made from the Ascension Island relay station for the D.S.I.R. Useful though these transmissions have proved, they were only a start, and we now go deeper into the matter with more complex and specialized apparatus.

"A receiver and transmitter have been developed at Slough which, even if separated by great distances, may yet remain accurately in tune with one another while the radio frequency is automatically changed.

"This particular equipment is capable of sending and receiving signals on nearly 2,000 different frequencies between 5.5 Mc/s and 50 Mc/s in the space of about 15 minutes.* Only the transmitter will go to Ascension. The receiver will remain at Slough, where the signals will be observed and analysed.

"Possibly, from the Cable and Wireless point of view, the most important group of experiments will be those associated with aerial effects. Aerial design is largely dictated by propagation considerations, and an interesting series of tests is planned to see the effects of shooting into the ionosphere at different angles. We have always wanted to know the best angle to the horizon at which we should transmit radio energy on long radio routes, and all the indications at present are that this angle should be very low. In this experiment three dipoles at different heights above ground are to be erected on a 150ft mast. By placing this mast as near as possible to the water's edge and transmitting from each dipole in turn, it is possible to alter the shape of the vertical polar diagram of transmitted energy and to see what effect this has on the received signal at Slough. It is believed that this is the first time a controlled experiment of this nature has been made. In addition, our own rhombic aerials at Ascension Island will be used to test the effects of good and poor sites as represented by having sea in front of one aerial and rock in front of the other.

"Although we shall not be making any direct observations in connection with the new 'forward scatter' techniques now being used for communications, we shall be using a very important new technique based on the radar principle, and developed by A. F. Wilkins and his colleagues, to measure 'back scatter.' This is the small fraction of energy scattered back to the transmitter from the ground reflection areas along the radio path. The technique shows not only the location of these areas, but also indicates the relative strengths of the signals in these areas. A change of frequency and/or aerial can substantially change the 'back scatter' pattern, and its value to the transmitting engineer, in ensuring that he is covering the reception point with the strongest possible signal, can be appreciated.

"We should not overlook the effect this project is having in expanding our good relations with the D.S.I.R. In recent months A. R. Harrison, Manager at Ascension Island, S. G. Crow, the previous engineer at Ascension, and J. Berry, his relief, have all visited Slough to inspect the equipment and discuss details of the project.

"We know the D.S.I.R. would very much like to carry out the next series of large-scale experiments from Singapore, to which place one piece of research equipment is already on its way. With our extensive traffic commitments between there and the U.K., we must look forward with particular interest to the results of investigations into the complexities of this route."

* Dr. Smith-Rose in his presidential address to the R.S.G.B. disclosed that in similar tests to Malta the frequency was changed every 0.4 sec by steps of 20 kc/s, the two sets of equipment being kept in synchronism by very stable crystal clocks.—Ed.

A Second Band-III Programme? —The Aerial Problem

Requirements for Wide-Band Coverage With Useful Gain

By F. R. W. STRAFFORD,* M.I.E.E.

(Concluded from page 174 of the April issue)

THE previous article dealt with the conventional Yagi array and showed that such aerials were less efficient than simple dipoles when operated three channels from the optimum design frequency. Since Yagi aerials represent by far the largest proportion of Band-III installations, and are particularly concentrated in the fringe areas, it will be seen that quite a serious problem must be overcome before the fateful day.

The lazy way of approach is the add-on technique which, in this instance, would mean duplication of the existing aerial optimized for the additional channel and somehow erected over the already overcrowded chimney and connected through yet another diplexing filter to the input feeder. Remembering that the greatest problem will exist in the genuine fringe area where double-stacked six-element Yagis mounted on 12ft poles are commonplace, the prospects are quite alarming.

Obviously, the sensible long-term approach is to replace the existing Band-III aerial with one which will receive both stations with equal efficiency. In order to rationalize production the aerial should cover the whole frequency band, namely, 174-216Mc/s. The two extremities of this band are already occupied by other services but the P.M.G. has pledged to release them for the television service in due course.

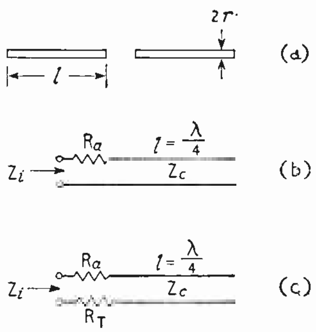


Fig. 1. Basic half-wave dipole (a), the equivalent series circuit for deriving intrinsic bandwidth (b) and equivalent series circuit for deriving loaded bandwidth (c).

It is the object of this article to study the requirements for the design of a wide-band aerial capable of providing a directive gain of the order of 9dB, and to suggest the lines upon which development might proceed.

Bandwidth of a Half-wave Dipole.—Whether a single dipole with reflector, or a combination of suitably connected dipoles are used, the bandwidth must be 42Mc/s when operated into a 75-ohm feeder and load resistance. In this instance the loss should not exceed 1.0dB at the extremities. The 3-dB bandwidth has been studied, empirically, by various workers including the author[1] and it would appear that a bandwidth of about 84Mc/s, that is, twice the desired coverage, based upon 3-dB points will result in a 42-Mc/s bandwidth for the 1-dB loss which is the target in this instance.

The intrinsic 3-dB bandwidth of a half-wave dipole, fed at the centre, may be derived empirically by replacing the dipole by a loss-less quarter-wave transmission line in series with a resistance equal to the radiation resistance of the dipole referred to the centre, Figs. 1(a) and (b). For a cylindrical dipole Schelkunoff[2] calculates an *average* characteristic impedance Z_c given by the formula:—

$$Z_c = 120(\log_e 2l/r - 1) \quad \ldots \quad \ldots \quad 1.0$$

The input impedance of the equivalent dipole circuit of Fig. 1(b) is:—

$$Z_i = R_a + Z_c \coth\frac{j\pi l}{\lambda}$$

$$= R_a + Z_c \coth\frac{j\pi}{2}\left(1 \pm \frac{\delta\lambda}{\lambda_o}\right)$$

$$= R_a + iZ_c \tan\frac{\pi\delta f}{2f_o}$$

where f_o is the resonant frequency. The 3-dB half-power points occur when the resistive and reactive components are of equal magnitude, i.e. when

$$R_a = Z_c \tan\frac{\pi\delta f}{2f_o}$$

Equating and solving for δf we obtain:—

$$\delta f = \frac{2f_o}{\pi}\tan^{-1}\frac{R_a}{Z_c}$$

The total bandwidth is given by:—

$$\Delta f = 2\delta f$$

So that:—

$$\Delta f = \frac{4f_o}{\pi}\tan^{-1}\frac{R_a}{Z_c} \quad \ldots \quad \ldots \quad \ldots \quad 1.1$$

Since the ratio R_a/Z_c is always much less than unity, equation 1.1 may be further simplified as tan x equals x for small values. Hence we may now write the general empirical formula for the total 3-dB bandwidth of a centre-fed halfwave dipole as:—

$$\Delta f \doteqdot \frac{4f_oR_a}{\pi Z_c} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad 1.2$$

This result was also derived by Smith[3] by an alternative approach.

Equation 1.2 is very useful for preliminary design

* Radio and Electronics Consultant.

work and has been experimentally confirmed[1]. These results for the calculated and measured bandwidth for a very thin dipole checked remarkably well, but there was some discrepancy for the thicker dipole. This was due to overlooking the fact that the radiation resistance for the thick dipole was lower than that for the thin one so that equal values for R_a were used in both calculations. Had a lower value of R_a been inserted in the thick dipole calculation much closer overall agreement would have been reached.

The interesting point about equation 1.2 is that it gives the intrinsic bandwidth for the 3-dB points. In the presence of a load resistance equal to the radiation resistance, and this is the practical arrangement, Fig. 1(c), the bandwidth now becomes:—

$$\Delta f = \frac{4f_o(R_a + R_T)}{\pi Z_c}$$

$$= \frac{8f_oR_a}{\pi Z_c} \quad .. \quad (R_a = R_T) \quad .. \quad 1.3$$

Hence, the working bandwidth is twice the intrinsic bandwidth, so that by working on the basis of 3-dB intrinsic bandwidth one automatically obtains the 1-db working bandwidth as previously explained.

As a starting point for preliminary calculations, let the dipole radius be 0.25in. The mid-band frequency is 195 Mc/s and l, which is about 90% of a physical quarter-wavelength, works out to 13.75in. The radiation resistance of such a dipole, erected at least one wavelength from the ground and clear of surrounding conductors, is of the order of 50 ohms. Combining this data in equations 1.0 and 1.2 the required 1-dB loaded bandwidth works out to 34.5 Mc/s, so that the 0.5-in diameter dipole does not make the grade since the bandwidth is less than the required 42 Mc/s. In order to meet the requirement it will be found that the elements must be increased to 2in in diameter, but this is accompanied by a drop in radiation resistance to about 40 ohms. The mis-match loss to a 75-ohm load through a 75-ohm feeder will be slightly less than 0.4 dB, but this must be added to the 1dB loss at the margins of the band, and one must not forget the inherent feeder losses—they all add up!

The dipole need not have cylindrical elements. It is an advantage to employ a shape which provides a low value of average characteristic impedance but maintains the radiation resistance nearer to the 70 ohms of the thin dipole. The bi-conical dipole of Schelkunoff[2] achieves this objective. The basic

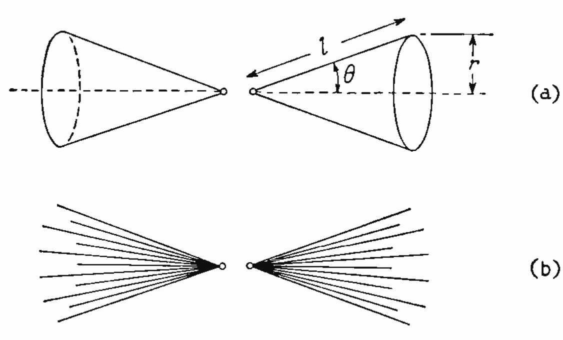


Fig. 2. Basic bi-conical dipole (Schelkunoff) shown at (a) with a skeletonized equivalent using thin flared rods.

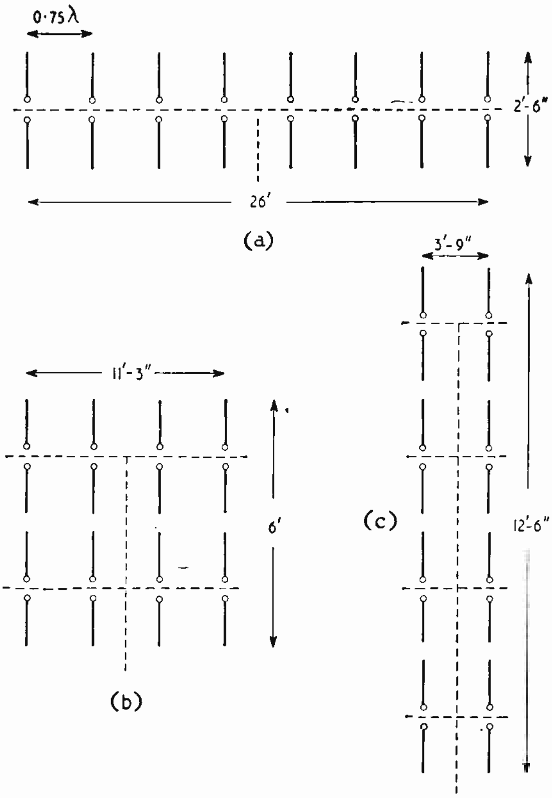


Fig. 3. Three methods of arranging eight half-wave dipoles to produce a gain of 9dB. (a) has an area of 65 sq ft, (b) an area of 67.5 sq ft and (c) an area of 47 sq ft. Dotted lines represent booms and masts.

arrangement is shown in Fig. 2(a) but the cones may be skeletonized by the use of a bundle of flared rods, Fig. 2 (b), with little effect on its properties.

The bi-conical dipole possesses the rather amazing properties of having *constant* values of distributed inductance and capacitance per unit length so that the *exact* characteristic impedance may be calculated. This is given as:—

$$Z_o = 120 \log_e (\cot \theta/2) \quad .. \quad .. \quad 1.4$$

Note that when θ is very small:—

$$Z_o \doteqdot 120 \log_e 2l/r \quad .. \quad .. \quad .. \quad 1.5$$

This latter expression is used to derive the average characteristic impedance of a thin cylinder by integrating equation 1.5 between the limits $l = 0$ and $l = l$ from which equation 1.0 is obtained.

A bi-conical dipole constructed of six 14-in. rods 0.25in in diameter and flared so that $\theta = 20°$ has a characteristic impedance of 260 ohms and a radiation resistance of 70 ohms. Substituting these values in equation 1.2 the loaded 1-dB bandwidth is 66 Mc/s and is more than adequate for full Band-III coverage. By reducing θ to 5° the 1-dB bandwidth is just 42 Mc/s. In these circumstances, however, it is a more practical proposition to use simple cylindrical rods or tubes of about 1.0in diameter to obtain the same result at the expense of somewhat lower radiation resistance.

Gain and Directivity.—Having shown that a fat dipole, suitably shortened to maintain mid-band resonance, will provide adequate wide-band response it remains to consider how one or more of these may be arranged to provide a power gain of, say, 9dB as a fairly modest target.

The power gain of N dipoles, spaced at least 0.75 wavelength to reduce mutual interaction, and connected so that all values of instantaneous induced currents are in phase at the feeder input, is given by:—

$$G = 10 \log_{10} N \text{ (dB)} \quad \ldots \quad 1.5$$

To obtain 9dB gain N must equal 8 and this number of dipoles must be stacked in some convenient manner of which Figs. 3(a), (b) and (c) are examples. All these arrangements present quite formidable mechanical problems in terms of mounting them on chimney stacks and providing adequate strength for 80 m.p.h. wind gusts. A further problem is that of connecting all dipoles in the appropriate phase. Series connection of dipoles does not work when unbalanced coaxial feeder is used—in fact, it does not seem to work at all well when balanced open-wire feeders are used. Parallel connections must therefore be made to the main feeder and the net impedance must be suitably transformed to match its characteristic impedance, which is usually of the order of 75 ohms. If N elements are connected in parallel, each having a radiation resistance of 50 ohms, the resultant resistance presented to the main feeder will be 50/N ohms so that eight elements will amount to 6.25 ohms. If no transformation is introduced the mis-match loss into a 75-ohm feeder will exceed 5.0dB, which would be intolerable. The mis-match may be removed by the use of the transforming properties of feeders whose electrical length is made any odd integral multiple of one quarter-wavelength. Such a feeder terminated by a resistance R_a has an input resistance given by $R_i = Z_o^2/R_a$ so that $Z_o = \sqrt{R_i R_a}$. It is desired to connect eight 50-ohm dipoles to a main feeder of 75 ohms characteristic impedance so that each interconnecting feeder must present an impedance of 600 ohms. Hence, the characteristic impedance of each inter-connecting feeder will be given by $Z_o = \sqrt{50 \times 600} = 175$ ohms. Lines having this characteristic impedance are readily constructed from 0.25-in diameter rods spaced about 2.25in between centres. According to the mode of connection the array may be given omni-directional, bi-directional, or uni-directional characteristics. To maintain a high signal-to-noise ratio and minimise the effects of multi-path reflections a uni-directional array must be chosen, in which case the arrangement of Fig. 3(b) would have to be used and fed in such a manner that the currents in the left (or right) set of dipoles were lagging in phase by 90° with respect to the other set. Unfortunately the quarter-wave transformer is frequency selective—it must obviously be so—and the use of inductive and/or capacitative parallel stubs must be included and laborious adjustments made to give the desired overall bandwidth. These adjustments are invariably made by using apparatus for the measurement of the standing-wave ratio of the reflections set up in the main feeder and an overall figure of less than two-to-one must be achieved before the performance can be regarded as satisfactory for the stringent requirements that have been set.

From the viewpoint of stacked dipoles the arrangement of Fig. 3(c) is desirable since the major support comprises the mast which need not be more than, say, 15ft in length. By introducing the 90° phase shift in one set of elements the uni-directional characteristics will be obtained and the gain will rise by a further 2.5dB, the theoretical limit being 3dB

Corner-reflector Aerial.—An alternative, and very simple, aerial giving a forward gain of the order of 9dB with good directivity, and which uses only one dipole, is the corner reflector which has been very thoroughly investigated by Moullin[4]. The reflector need not be constructed from sheet material, an open-mesh netting, or a row of rods, may be substituted provided that their spacing does not exceed 0.1 wavelength A manageable, although not altogether attractive sample, was made by the author for operation on Channel 9 prior to making a further mode on a reduced scale for operation at the B.B.C. experimental frequency of 654.25Mc/s. This latter aerial was described by the author in a previous article[5] The original model was designed for Channel 9 because measurements were more readily available in terms of existing measuring apparatus.

Fig. 4 shows a plan of the corner-reflector aerial in which the fat dipole is placed at a distance d from the apex. When the included angle is 90° Moullin obtains the two curves relating power gain and radiation resistance to d in terms of wavelength These curves are based upon the assumption that the reflector is of infinite length and breadth. Moullin goes on to show that the reflectors may not only be made finite in size, but may be reduced to practical proportions without serious change in

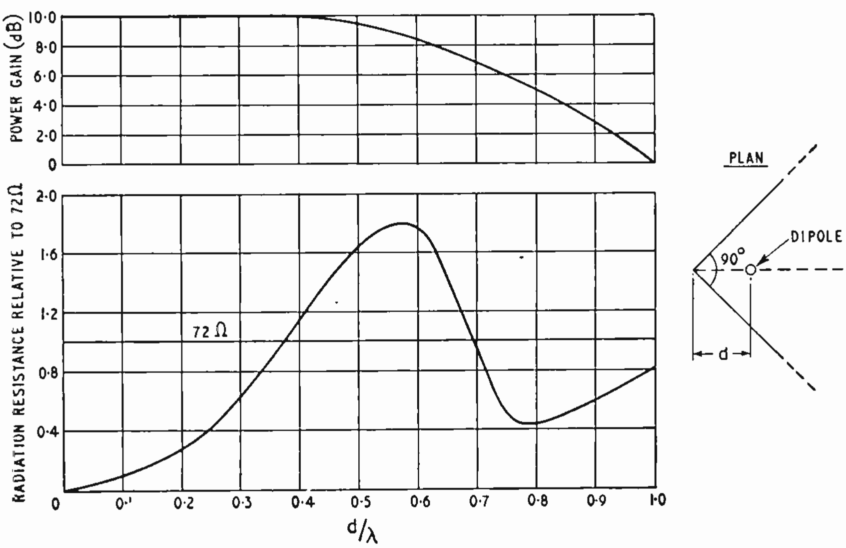


Fig. 4. Variation with spacing (d) of radiation resistance and gain for a corner-reflector aerial.

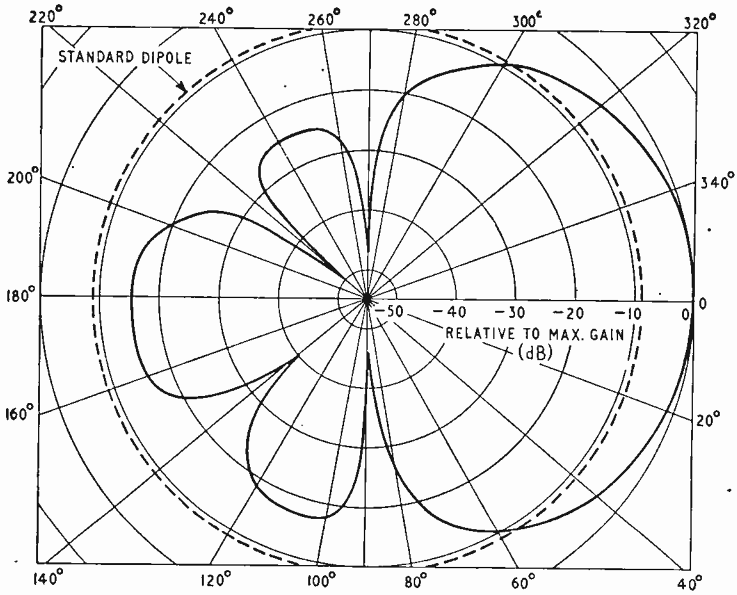


Fig. 5. Polar diagram of the corner-reflector aerial.

characteristics. It will be observed that, up to $d = \lambda/2$ the radiation resistance rises from zero, through 72 ohms up to 120 ohms while the power gain remains flat at 10dB. From $d = \lambda/4$ to $\lambda/2$ the mis-match loss to a 75-ohm feeder will not exceed 1.6/1.0 so that less than 0.3dB will be lost. If, therefore, the dipole is located at a distance $d = 3\lambda/8$ from the apex a deviation of $\pm 33\%$ about the design frequency can be allowed. Since only $\pm 10\%$ is required for complete coverage of Band III the attractiveness of this simple aerial will be obvious. The author constructed an experimental corner reflector for Channel 9 (194.75Mc/s). The overall dimensions of each leg were 5ft long and 3ft wide and consisted of 0.25-in diameter rods spaced 6.0in apart. The dipole consisted of two 1.75-in diameter tubes 12in long and tapered to 0.25in diameter over the last two inches from the centre to which the coaxial feeder connections were made. A forward gain of a little over 9dB was obtained with a front-to-back ratio of 14dB and a beam width between half-power (3-dB) points of 65 degrees.

Four sharp minima, very useful for de-ghosting, in excess of 40dB were observed towards the rear. The directional response is shown in Fig. 5. This is plotted in dB which does not make it appear in such a flattering light as the conventional voltage-ratio scale, which the author does not support since it does not link up with all the other parameters of a complete TV system from transmitter to receiver, where everything else is expressed in dB.

The projected area of this aerial on the axis of the beam is about 21 sq ft which is considerably less than anything obtained by stacking sufficient dipoles to give the same gain. There is no reason why the rods comprising the reflector should not be replaced by wire netting of 6-in mesh suitably reinforced at the corners to give self-support. Such an aerial should give comparable results and a fairly low windage might be achieved by the use of the latter form of construction.

Summarising, there does not appear to be any simple way of providing the unique properties of the Yagi array over a wide frequency range without recourse to a much larger structure with its attendant mechanical problems. This contention would appear to be supported by a study of the theoretical and experimental work carried out to date, and particularly, by examination of specifications for wide-band aerials designed for television transmitters and general v.h.f. and u.h.f. telecommunications equipment.

REFERENCES

[1] F. R. W. Strafford, *Proc. I.E.E.*, Vol. 99, Part IIIA, No. 19, 1952.

[2] S A. Schelkunoff and H. T. Friis. "Antenna Theory and Practice," Chapman and Hall, 1952.

[3] R. A. Smith. "Aerials for Metre and Decimetre Wavelengths." Cambridge University Press, 1949.

[4] E. B. Moullin. "Radio Aerials." Clarendon Press, Oxford. 1949.

[5] F. R. W. Strafford. "Television Receiving Aerials for Bands IV and V." *Ibid.* January, 1958.

Principles of Transistor Circuits

ANYONE who is about to embark on the design of transistorized equipment, and has had no previous experience of transistors, is faced with a wealth (or shall we say a welter?) of literature on the subject, ranging from advanced physical treatises through complex network analyses to the most superficial of popular treatments. There is a great need for a concise introduction to the design of transistor amplifiers, receivers and other circuits, which will give the student, engineer or amateur constructor only the sort of information that is really essential to his purpose.

Such a book has just been issued by our publishers—"Principles of Transistor Circuits" by S. W. Amos, B.Sc. (Hons), A.M.I.E.E. Assuming no previous knowledge of the subject, it starts off with two chapters on the physical principles and electrical characteristics of transistors. But the main emphasis is on the application of these principles to the practical problems of design, and the bulk of the book is concerned with the determination of such quantities as input resistance, stage gain, optimum load, power output, values of coupling capacitors and transformer winding inductances.

The mathematics is confined to simple algebraic manipulation and is illustrated by a large number of numerical examples, which show the order of practical magnitude of the various quantities. Some details are included of photo-sensitive devices, transistor relaxation oscillators, and the newer types of high frequency transistors.

The book, which contains 167 pages and 105 diagrams, is available from booksellers, price 21s, or direct from our publishers at 21s 11d including postage.

Convention on Stereophony

INTERESTING PAPERS AND LIVELY DISCUSSION AT THE I.E.E.

ALMOST every conceivable aspect of stereophony was discussed at the excellent two-day convention held recently at the Institution of Electrical Engineers in London, but only the more recent developments or lesser-known aspects of the subject which were discussed are reported here. The full papers and discussion will be published in the Proceedings of the Institution.

Theory of Hearing.—F. H. Brittain described some of the results on stereophonic listening which have been obtained by Dr. B. Sayers and Dr. D. M. Leakey working under Professor C. Cherry at the Imperial College of Science and Technology. These results indicate that in hearing the position of a sound source is obtained from the difference between the times of arrival at the two ears of the sound, as distinct from the intensity difference at the two ears of the sound as has sometimes been thought. The variations of this time difference produced by head movements as small as one tenth of an inch are used to remove the ambiguity as to whether the sound source is in front or behind (both positions would produce the same sounds at the ears).

When listening to two loudspeakers in a stereophonic system each ear hears both loudspeakers, but the sounds at each ear from the two loudspeakers apparently combine to form a single sound provided that the time difference between the sounds from the two loudspeakers is less than about 0.5msec. For longer time differences up to about 3msec, such as might be produced by off-centre listening or a spaced-microphone recording technique, partial apparent combination at each ear of the sounds from the two loudspeakers can still occur.

The apparent arrival time of each combined sound relative to the arrival times of each of its two constituent sounds from the two loudspeakers depends on the relative intensities of these two constituent sounds, and also, for delays between the two constituent sounds of more than about 0.5msec, increasingly on the arrival time of the earlier of the two sounds. This latter phenomenon is known as the Haas or precedence effect.

The difference between the apparent arrival times of the combined sounds formed at each ear gives the apparent single source position. Thus intensity differences between the two loudspeakers are converted in hearing into apparent time differences between the two ears. This somewhat surprising asymmetry between sounds from the loudspeakers and the corresponding sounds at the ears can (in case any readers are sceptical about it) be derived trigonometrically (see for example the paper by H. A. M. Clark, Dr. G. F. Dutton and P. B. Vanderlyn in *Proc.I.E.E. Part B*, Vol. 104, Sept. 1957, p. 422). This asymmetry arises because each ear hears both loudspeakers—an elementary fact of loudspeaker as distinct from headphone stereophonic reproduction that is sometimes forgotten.

Reproducing Conditions—Rooms.—In stereophonic reproduction interfering reflections from the walls of the listening room should be avoided by absorbing material in suitable positions according to T. Somerville of the B.B.C. In the excellent B.B.C. demonstrations, given at the I.E.E. during the convention, reflections were avoided by hanging curtains so as to form a sort of room within a room.

The deliberate use of reflections from the room walls using directional loudspeakers has been suggested as a means of producing apparent loudspeaker sources farther apart than the actual loudspeakers and thus as a means of increasing the apparent size of the overall sound field beyond the region between the two loudspeakers. However, this increase will not occur for the reverberant sound which consists mainly of low frequencies at which loudspeakers are not directional.

Reproducing Conditions—Loudspeakers.—A discrepancy between the apparent size of the reverberant and direct sound fields also arises in the sometimes used system in which signals at frequencies below about 300c/s in the two channels are added together and reproduced by a single loudspeaker. This economical system is generally advocated on the grounds that stereo information is mainly confined to the upper frequencies and that sound source positions can be located less and less accurately as the frequency decreases. This latter point was challenged by H. A. M. Clark and by F. H. Brittain who stated that he had been able to locate mortars fired on Salisbury Plain at great distances to an accuracy of one degree although their sound on arrival did not contain any energy above 50c/s and had a maximum energy at 20c/s.

Compatibility.—A combination of the two stereophonic signals to form a single signal which can be reproduced by ordinary unmodified single-channel equipment so as to sound as good as or only slightly inferior to the corresponding non-stereophonic signal is said to be compatible.

The sum of the left and right stereophonic signals is often stated to be compatible, but a number of criticisms of this view were put forward in two papers by T. Somerville and D. E. L. Shorter of the B.B.C. This sum signal is least compatible when a multi-microphone recording technique has been used. Such a technique may be necessary to correct for poor acoustics and is often used in "pop" music or drama to correct the relative intensities of the various parts of the sound source. When the alternative of a single pair of coincident (or nearly so) microphones is used its optimum position may not be the same as that for a single microphone for a single-channel recording. Also when a coincident microphone recording technique is used, this sum signal may be equivalent to that from a microphone of unsuitable polar response, though according to Dr. W. S. Percival this response can be improved by altering the phase of one of the stereophonic signals by ninety degrees before addition. Incidentally, use is often made of the fact that signals obtained with microphones with one kind of characteristic can be combined to produce signals which would have been produced by microphones with different polar responses. When a pair of spaced microphones is used the difference between the times of arrival of the same sound at the two microphones may produce some cancellation at various frequencies in the sum signal. A revealing ear-opener was provided in the B.B.C. demonstration when, with a soprano, choir and orchestra, the emphasis on the soloist was very much greater when the sum of the left and right signals rather than the stereophonic recording was played.

Broadcasting.—Two new systems were mentioned by T. Somerville and D. E. L. Shorter. These use primarily amplitude modulation, and this can be at frequencies in the ordinary medium waveband as distinct from the more usual frequency-modulation multiplex systems at v.h.f. In the R.C.A. system the left- and right-hand signals are carried one on the upper and the other on the lower sideband, so that this might be described as a double single-sideband system. An ordinary detector will give an output proportional to the sum of the left- and right-hand channels. In the Philco system the sum of the left- and right-hand signals is used to amplitude-modulate the carrier in the usual way and provide a compatible output from an ordinary unmodified receiver, while the difference between the left- and right-hand signals is used to phase-modulate the carrier. The difference modulation is confined to frequencies above 300c/s to avoid certain complications in the receiver circuit. In both these systems distortion is possible in the detector when one modulation is much deeper than the other.

In an interesting paper by J. J. Geluk of the Netherlands Broadcasting Union (some of the results from which have also been given by the same author jointly with H. J. van der Heide in *E.B.U. Review, Part A (Technical)* for Feb. 1959, p. 15) a comparison was made between a number of versions of the v.h.f./f.m. multiplex system in which the sum of the left- and right-hand signals is used to frequency-modulate the main carrier and provide a compatible signal for an unmodified receiver, while the difference between the left- and right-hand channels is used to frequency-modulate a sub-carrier of the main frequency. In all the cases considered the total maximum deviation was kept at 75kc/s while being sub-divided in various ratios between the two modulations. Three factors of importance in comparing various systems are the loss in the power transmitted from the main compatible carrier caused by the power which must be diverted to maintaining and modulating the sub-carrier; the differing amounts of filtering between the carrier and sub-carrier necessary to secure a sufficiently low cross-talk and finally, the various amounts of spurious radiation which could cause adjacent-channel interference. A possible detector for the difference signal was described using four double-triodes in which the difference signal is used to synchronize a multivibrator. By limiting the output from the multivibrator rather than limiting the difference signal itself very efficient limiting is obtained. With efficient receiver limiting, the sub-carrier deviation can be decreased so that the power loss on the main channel is only 2.7dB and also cross-talk between the two signals and spurious radiation are reduced.

Systems in which the sub-carrier is amplitude rather than frequency modulated were also considered by Geluk. The detector can be simpler than with an f.m. sub-carrier, but the r.f. stages are more difficult to design, since a flat amplitude response over the channel bandwidth is required to avoid distortion rather than the more easily obtained flat phase response required for an f.m. sub-carrier. The cross-talk tends to be higher using an a.m. sub-carrier so that, unlike the case with an f.m. sub-carrier, it is unlikely that two independent signals could be satisfactorily transmitted. As was pointed out by D. E. L. Shorter, a time-division multiplex system would be equivalent to using a sub-carrier spaced by the switching frequency and a.m. by the difference signal.

In considering the optimum division of available power between the sum and difference signals, it is often assumed that the peak level in the sum is considerably greater than that in the difference. In fact, the usual difference between these levels is only about 4dB, according to Shorter, and can be less even than this value.

Considerable interest was aroused by the discussion of the Percival system, of which some details have already been given in *Wireless World* (Vol. 64, Nov. 1958, p. 521) and in which the directional information is separated from the signals themselves and processed so as to occupy a bandwidth of only about 100c/s. The processing is primarily based on the Haas or precedence effect which can be stated in the form that in hearing the apparent direction of a sound is determined primarily from the first few milliseconds of it. Thus the directions of a number of nearly simultaneous sounds can be apparently given by stereophonically reproducing only their beginnings provided that these beginnings are not simultaneous to within a few milliseconds. Even when the whole orchestra is supposed to start together the attacks of the individual instruments seldom coincide exactly and the system usually remains unbeaten. The processing of the directional information thus mainly consists in heavily weighting the initial transients of signals.

One advantage of separating the directional from the main signal is that the latter signal can be obtained from one or more microphones independently of the directional signal, and so can be made more compatible.

Some attention was given to the possibilities of stereophonic sound in television. This is surprising since in this case the widest possible sound source corresponds to the widest possible picture so that little benefit would seem to be obtainable from stereo in home viewing even considering large projection models. The difficulty of changing the apparent sound field to correspond with every change in the field of view is also obvious.

Pickup Design.—Two lesser-known but still very important sources of distortion which apply equally well to monophonic or stereophonic pickups were discussed in a paper by D. G. Jaquess relating to the Decca stereo pickup. These sources of distortion are, first, impacts between the stylus and groove when vertical groove motions are not satisfactorily traced (which cause most of the wear on the record), and secondly, longitudinal stylus movement in the direction of the unmodulated groove.

The reasons for using two balanced pairs of magnetic gaps in the design of variable-reluctance stereophonic pickups were discussed in a paper by S. Kelly. If each magnetic gap between the moving armature and a fixed pole piece is not balanced by a corresponding gap on the other side of the armature, then, as the side thrust varies across the record due to changing tracking error and frictional force in the modulated groove, the lengths of the unpaired gaps will alter so as to alter the relative sensitivities of the two channels. The sensitivity of at least one of the channels will for a similar reason vary with the playing weight, though for gap lengths parallel to the two modulation directions this will not affect the relative sensitivities of the two channels. Another

(*Continued on page* 241)

disadvantage of an unbalanced gap system is that induced hum cannot be cancelled by suitably winding two separate coils for each channel.

An interesting sidelight on the hazards of pickup manufacture mentioned by P. Wilson in the discussion is that the rejection rate is about 75% for the coils of two American pickups using 54 and 56 gauge wire.

Four-track Tapes and Cartridges.—Two important disadvantages of tape relative to disc—its higher price per reproducing time (particularly for stereophonic tapes) and the inconvenience of threading it on to the tape deck—have both been tackled recently in America. Some of the results were described in papers by A. D. Burt and D. R. Andrews and also by Dr. G. F. Dutton. The price per time of tape has been reduced both by using four instead of two tracks across the ¼in width and also by halving the speed to 3¾in/sec. To secure the same response at high frequencies at 3¾in/sec as at 7½in/sec the effective gap length of the reproducing head must be halved down to about 10^{-4}in, but this can be achieved.

To keep losses caused by spacing of the tape from the replay head due to the tape roughness to an acceptable value the tape must be made smoother. Smoother tape (and also greater freedom from dropouts) are also necessary to allow the halved wavelengths at the slower speed to be recorded satisfactorily. The allowable angular azimuth error of the gap length direction is proportional to the recorded wavelength divided by the linear error along the tape between the two sides of the gap, i.e., this error is proportional to the tape speed divided by the track width, and thus remains unchanged. In stereophonic reproduction crosstalk problems are reduced by staggering the four tracks so that no two stereo tracks are adjacent to each other. The signal-to-noise ratio tends to deteriorate when four rather than two tracks are used since the signal is proportional to the number of magnetic particles, i.e., the tape width, and the noise is more nearly proportional to the square root of the number of magnetic particles. An increased recording emphasis at frequencies near the region of maximum hearing sensitivity has been suggested as a method of reducing the apparent signal-to-noise ratio. According to Dr. G. F. Dutton however, results on orchestral output spectra show that peak signal levels in this region can only be increased by about 4dB or less before overloading occurs.

The slower speed also increases the difficulty of making the transport mechanism sufficiently free of wow and also (particularly) of flutter. For example, a slipping clutch providing take-up tension tends to be jerky and produce longitudinal oscillations of the tape. The flutter produced by such oscillations will be more serious at the shorter wavelengths recorded at the slower speed. The inertia of a given capstan which tends to smooth out irregularities in the tape motion will be quartered at the slower speed. The wow and flutter for the R.C.A. 3¾in/sec tape cartridge on its deck was quoted as about 0.3%.

Easier handling of the tape has been achieved in a number of ways. For example, half loops at the ends of the tape are automatically caught and pulled through the transport mechanism in a development of the Armour Research Foundation of America. The paper by A. D. Burt and D. R. Andrews described the R.C.A. cartridge. In this the tape is enclosed in a plastic container which can be readily slotted into its correct playing position on the tape deck. Thus the cartridge can be removed even when the tape is only partially played through, and a particular tape cannot be "lost" by being transferred on to another reel by mistake. The two hubs carrying the tape before and after playing do not have any flanges on them at the side of the tape so that the whole space between the hubs can be filled with tape throughout the playing time. Windows in the cartridge allow the amount of tape which has been played to be seen. The tape is secured by a loop at each end which slips over a peg on each hub. At the end of each reel the change in the position of the end of the tape as the peg completes its last revolution can be used to actuate a trip mechanism to stop the tape or reverse it and replay on another track. Interlocks (which can be removed) between the transport mechanism and cartridges carrying pre-recorded tapes prevent such tapes from being accidentally erased.

Is Stereo Worth While—Dr. W. S. Percival was brave enough to give an opinion on this question. With both stereo and mono reproducers their value increases proportionately to their price at low price levels but tends to flatten out to a constant value at high price levels. At first the value for money increases more rapidly with single-channel than with stereo reproducers. The maximum attainable value is, however, greater with stereo so that at some point the value-for-money curves cross for the two types of reproducer. Dr. Percival would not, however, commit himself as to what price this occurred at!

New Range of Kits

ITEMS from the American Heathkit range are becoming available in this country from Daystrom, Ltd., of Gloucester. Kits already obtainable from the audio range include two stereo combined amplifiers and pre-amplifiers, a loudspeaker system and two transistor receivers, and from the test and measuring gear range an oscilloscope and valve voltmeter. A kit for an amateur 40-W transmitter covering the 80, 40, 20, 15 and 10 metre bands is also available. Forthcoming kits will include an R-C bridge, audio oscillator, wattmeter, sensitive a.c. valve voltmeter and low-level stereo pickup and tape head amplifier.

The S-88 stereo combined amplifier and pre-amplifier incorporates two 8-watt ultra-linear push-pull output stages using ECL82 triode pentodes. A low-pass filter cutting off at a rate of about 18dB per octave above 4, 8 or 12kc/s can be switched in. A balance control with a range of ± 4dB is incorporated, and the two stereo signals can be interchanged. Similar facilities are provided in the S-33 amplifier kit, except that there is no low-pass filter, and the output uses two EL84s in single-ended ultra-linear stages to give 3 watts per channel.

The UXR-1 transistor receiver kit covers the medium and long-wave bands and uses six transistors. A push-pull output stage feeds a 7-in × 4-in loudspeaker. The UJR-1 kit is intended for beginners and also covers the medium and long-wave bands. It uses a single transistor (with reaction) to feed headphones with an impedance between 2 000 and 4,000 ohms.

The 0-12U 5-in oscilloscope kit has a maximum Y-amplifier sensitivity of 14mV/cm and a frequency response flat within 1dB from 8c/s to 2.5Mc/s. An X-amplifier with a maximum sensitivity of 170mV/cm and a response flat within 1dB from 1c/s to 200kc/s is provided, or, alternatively, a time base with a repetition frequency variable from 10c/s to 500kc/s is available.

The V-7A valve voltmeter can measure alternating or direct voltages (1.5V to 1,500V f.s.d.), resistances (0.1Ω to 1,000MΩ) and power ratios. The input impedance is 11MΩ on the d.c. ranges, and the frequency response on the a.c. ranges within 1dB from 40c/s to 7Mc/s.

MAVARS

By "CATHODE RAY"

ANOTHER KIND OF QUIET MICROWAVE AMPLIFIER

YES, I know they are usually called parametric amplifiers, but that is an octosyllabic mouthful, liable moreover to be confused by the quick reader with paramagnetic amplifiers, which could be parametric or on the other hand could be the crystal maser described last month or in fact something altogether else. So I prefer the title given in America* MAVAR, meaning " Mixer Amplification by Variable Reactance." Except that as I abhor the term " mixer" for a modulator or frequency changer I make the " m " stand for " microwave," as in " maser," even though in theory the mavar could be used for other waves.

If you are thinking that " maser " and " mavar " sound like twins, that is all to the good, because it quite rightly suggests some likeness between the devices so named. They both amplify, and both yield a much better signal/noise ratio than conventional amplifiers, enabling weaker signals to be effectively received. This is most valuable at the very high frequencies called microwaves—wavelengths of a few centimetres or millimetres. Both kinds of amplifier tend to be sharply tuned, unlike travelling-wave tubes, which cover a wide frequency band.

Amplification in Masers

In the maser, the amplification comes from the release of energy when atoms or molecules drop back from an " excited " or energized state to their normal state, in response to stimulation by the weak signal. The frequency at which it amplifies is determined by the energy difference utilized; in the ammonia maser this is fixed by Nature, making it a very precise and reliable frequency standard; but in the more practical cold-crystal or solid-state maser it can be varied by a magnetic field. The basic principle of the mavar is completely different. and while its chief application is in the microwave band and one variety makes use (like one variety of maser) of electronic spin in paramagnetic atoms, these resemblances are coincidental rather than essential.

The solid-state maser, as we saw, is almost unbelievably simple for the highly sophisticated apparatus it is—just a special kind of crystal stuck in a metal box at the end of a waveguide, tuned by a magnet and cooled by liquid helium or oxygen. The difficulty lies in understanding exactly what goes on in the crystal, because it involves rather advanced knowledge of atomic structure and behaviour. The general idea of energy lifts and drops in an atom is not too hard to grasp, however.

The general idea of the mavar is also simple, but its working is not at all easy to visualize clearly. I have been finding it a severe test of my doctrine that anything which can be dealt with mathematically can be explained to the non-mathematical by analogy, diagram or model. And yet it involves no recondite concept such as ψ waves; only straightforward basic circuit theory.

Briefly, a mavar is like the frequency changer in a superhet, except that (a) the local oscillator varies a reactance instead of a resistance, and (b) amplification takes place without change of frequency.

Fig. 1 is a circuit diagram of a simple frequency-changer stage as used in many receivers, especially for radar. Currents of two different frequencies, due to incoming signal and local oscillation, are mixed by coupling them into the same circuit. If everything in that circuit were linear, no signal at any other frequency would appear. Merely mixing is not enough. Hence my dislike of the name " mixer " for an arrangement in which the key component is the crystal, Cr, which is essentially a non-linear resistor—i.e., one whose current/voltage graph is not a straight line, so that its resistance varies with the current through it or voltage across it, contrary to Ohm's law.

Ohm's law or not, the current through a resistor is equal to the applied voltage divided by the resistance (at that voltage). Alternatively—and in what follows we shall find it simpler—the current is equal to the voltage multiplied by the conductance. Either way, if the resistor is linear the resistance and conductance are constants, so the current has exactly the same waveform and mathematical form as the voltage. If the voltage has two frequencies, the current has two and only two.

Let us call the voltage at any instant v, and suppose it consists of two frequencies (oscillator and signal) f_o and f_s, with peak amplitudes V_o and V_s. For brevity we use the usual symbol ω for $2\pi f$, and have

$$v = V_o \sin \omega_o t + V_s \sin \omega_s t \quad .. \quad .. \quad (1)$$

If we multiply this by a constant conductance G,

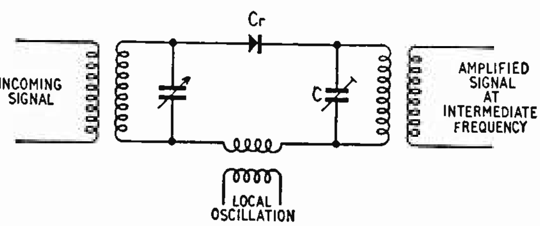


Fig. 1. Simple frequency changer circuit, in which the crystal diode, Cr, is essentially a non-linear resistor. If a non-linear reactor is used instead, the system is nearly a mavar.

then the result (the current, i) obviously has the same form.

But now let us suppose that the conductance depends on the voltage. In a diode, for example, the conductance is less than the average during the negative half-cycles and more during the positive half-cycles. A simple case would be one in which the conductance was equivalent to a fixed amount, G_o, plus

* "The Mavar: A Low-Noise Microwave Amplifier," by Samuel Weber, *Electronics*, 26th Sept. 1958, pp. 65-71.

an amount varying in proportion to the voltage, vG. The whole conductance is usually denoted by a small letter to show it is variable:

$$g = G_0 + vG$$

And, since $i = vg$,

$$i = v(G_0 + vG) \quad .. \quad .. \quad (2)$$

We have already written out v in full (1), so we can fill it into (2) to obtain

$$i = (V_0 \sin \omega_0 t + V_s \sin \omega_s t) [G_0 + (V_0 \sin \omega_0 t + V \sin \omega_s t)G] \quad .. \quad .. \quad .. \quad .. \quad (3)$$

If you are one of those who can only tolerate trigonometry in very small doses there is no cause for alarm, for all you are being asked to do is take note of the fact that this expression inevitably involves $\sin \omega_0 t \times \sin \omega_s t$. And if you look up any list of trigonometrical formulæ you will find that this (usually in the form sin A sin B) is equal to a half of $[\cos (\omega_0 - \omega_s) t - \cos (\omega_0 + \omega_s) t]$. (The appearance of cos instead of sin, and a minus sign between them instead of a plus, signifies no more than the phase relationship; they are still, with reference to a suitable starting point, sine waves.) So we have two new frequencies, equal to the difference and sum of those put in, and can take our pick of them for the i.f. signal, by tuning to it by means of C in Fig. 1.

Incidentally, anyone who might feel like working out (3) in detail but who doesn't want unnecessary work can take advantage of the fact that V_s is usually so small compared with V_0 that its effect on g is negligible, and so the second occurrence of $V_s \sin \omega_s t$ in (3) can be omitted without much error. The sum and difference frequencies still come.

Those who are completely allergic to any sin-and-cos at all can convince themselves of at least the production of the difference frequency by a diagram such as Fig. 2, which is a typical current/voltage characteristic of a diode. The input voltage waveform is drawn on end, below, with the signal frequency exaggerated in amplitude to show it up clearly. Being different in frequency from the oscillation, it alternately strengthens and weakens it, giving the phenomenon known as beating. The beat frequency is equal to the difference between the two input frequencies, but there is no voltage at the beat frequency. All the positive half-cycles in one whole beat are nullified by negative half-cycles. Nor, if this voltage were applied to an ordinary resistor, represented by a straight-line graph, would there be any beat-frequency current to use as an i.f. signal. But when applied to a diode the negative half-cycles are suppressed as shown, and the current averages to give a beat-frequency component, shown dotted. There is also a sum-frequency current, but it is masked from sight by the currents at the original frequencies.

Let me emphasize again that the reason for the production of sum and difference frequencies is that the conductance of the diode depends on the applied voltage, as shown one way in Fig. 2 and another way by $g = G_0 + vG$. Actually the conductance in Fig. 2 would not follow such a simple formula, but the principle is the same.

I have recapitulated the elementary principles of frequency changers at length, well known though they must be to all radio students, because the likenesses and differences of the mavar will be clearer if this basis for comparison is fresh in the mind. The mathematical treatment is bulkier but no more difficult in principle than what we have just gone through.

The difficulties begin when we try to visualize what is happening. Directly we substitute a reactance for the diode we rule out the Fig. 2 kind of diagram, which only works when current and voltage are in phase. If it were an ordinary constant reactance, then vector diagrams would come to our aid. But if you can make a vector diagram work satisfactorily for a circuit in which the reactance is a function of the voltage you are a better man than I.

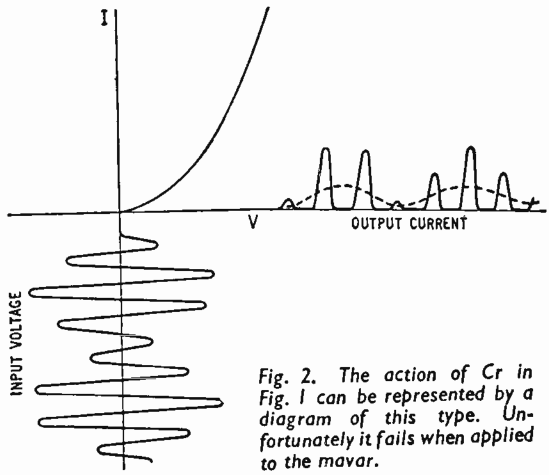


Fig. 2. The action of Cr in Fig. 1 can be represented by a diagram of this type. Unfortunately it fails when applied to the mavar.

The reason for wanting some sort of visual aid perhaps more than usual is that the story told by the mathematics is something we should probably never have expected. And if you are one of the types who regard all mathematical results with suspicion until supported by clearer evidence you may even have some difficulty in believing it.

Negative Resistance

The mathematical result in this case is that if the usual non-linear resistance of the simple additive frequency changer is replaced by a reactance, it looks to the signal like a negative resistance. In other words, power finds its way from the local oscillator into the signal, *at the frequency of the signal*, and in proportion to the *signal* voltage. In still other words, the signal is amplified, without change of frequency, and the power for doing this comes from the local oscillator, working at a different frequency. As we shall see, this result is not absolutely inevitable—certain conditions have to be fulfilled—but that it should happen at all is surely interesting enough to stimulate investigation.

Either inductive or capacitive reactance can be used, but I think capacitive is better for a first study, because the simplifying assumption that it is free from resistance is very nearly true of familiar capacitors. It also offers better possibilities for mechanical models, real or imaginary. What may take a little more getting used to is capacitance that varies according to the voltage across it. (Inductance that varies with the current through it is only too familiar.)

The basic fact about capacitance is that it is a measure of the amount of electric charge a given voltage can store. Just like, in fact, the size of a tyre

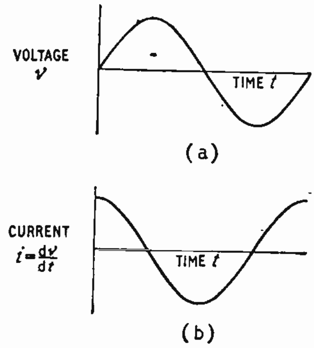


Fig. 3. Showing how the current through a capacitive reactance can be derived graphically from the voltage.

or balloon, where the charge is air and the voltage is pressure. In symbols:

$$Q = CV \quad .. \quad .. \quad (4)$$

This says that the charge is directly proportional to both voltage and capacitance. We are quite used to applying varying voltages to capacitors, but usually their capacitances are constant. So the effects of variable capacitance are less familiar, except perhaps to specialists such as engineers of the Compton Organ Co., who do exactly the reverse of most of us—vary C sinusoidally while keeping V constant. The result is the same, however.

It is unfamiliarity with this, presumably, that gives rise to the question with which successive generations of students try to baffle their teachers: If a capacitor is charged and then dismantled, what happens to the charge (and its energy)? It is assumed that the insulation of the plates is maintained. The charge, Q, therefore remains; and, in so far as C is reduced by the dismantling, V rises. For proof, see (4). This is the basis for the "Cathode Ray" voltage raiser, proposed in the May 1950 issue. (No doubt lots of other people proposed it centuries ago, so don't write in to tell me.)

Current Flow

Now of course a charge in motion is a current, so if one varies either V or C (but not both at once in opposite directions so that V × C is constant) a current must flow in and out. Expressed more precisely, and using small letters to indicate variables:

$$i = \frac{dq}{dt}^{*}$$

If C is constant, then q (= Cv) varies at C times the rate that v is varied. So we have

$$i = C\frac{dv}{dt}$$

Supposing v is our usual sine wave, V sin ωt:

$$i = C\frac{d\,(V \sin \omega t)}{dt}$$

Fig. 3(a) shows a single cycle of v, and underneath at (b) is drawn a curve showing the rate at which v is varying. It is easily derived from (a); for example, v increases fastest at the start, making dv/dt a positive maximum; it isn't varying at all at the peaks, so then dv/dt is zero; and so on. It is, in fact, a cosine wave. The well-known calculus result is d(V sin ωt)/dt = ω V cos ωt. And the capacitive current is proportional to this, as we have just seen, so

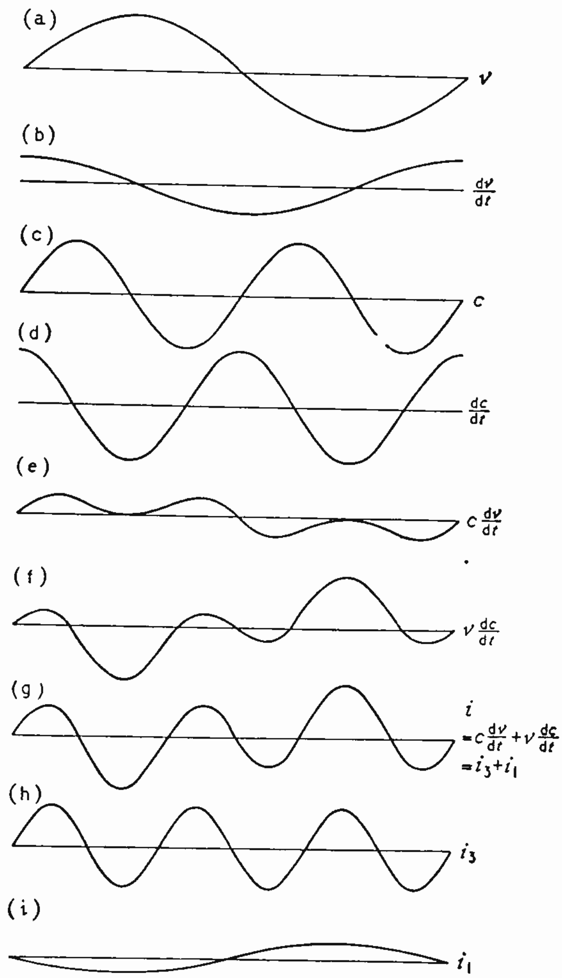
$$i = \omega CV \cos \omega t \quad .. \quad .. \quad (5)$$

which is the same waveform as v but advanced quarter of a cycle in phase. That is the familiar fact of a.c. theory, commonly expressed by showing a current vector leading a voltage vector by 90°. We are familiar, too, with the fact that when you multiply i by v to find the power you get a positive product during the first and third quarters of the cycle, when v is charging C, and an exactly equal negative product during the second and fourth quarters, when C is discharging back into the source. The net power either way is therefore nil.

Again, we have gone through all this old stuff

*If, most regrettably, you are unfamiliar with the differential calculus, there is no need to be dismayed by the appearance of $\frac{dq}{dt}$, which is simply a short way of saying "the rate of change of charge with respect to time" or "the slope of a charge/time graph."

Fig. 4. These waveforms represent: (a) the applied signal voltage v; (b) the slope of (a), which could represent the current driven v through a constant capacitance; (c) the variation of the capacitance due to the pump oscillator, working at twice the frequency of v; (d) the slope of (c); (e) current due to v applied to the variable capacitance (c), found by multiplying (b) by (c); (f) current due to variation of (c) with v applied, found by multiplying (a) by (d); (g) total current, equal to (e) plus (f); (h) triple frequency part of (g); (i) the part of (g) at same frequency as (a), and in opposite phase, signifying negative resistance.



for the sake of comparison with the less familiar case of capacitance varying and voltage constant. If we make c vary in the same way as v did ($c = C \sin \omega t$) then obviously the result is the same except for interchange of V and C, which as (5) shows makes no difference at all.

It is quite interesting to realize that precisely the same current-making result can be obtained by varying capacitance exposed to a constant voltage as by varying voltage across a constant capacitance. Note in particular that there is no net transfer of power.

But in a mavar both vary at once, just as both voltage and conductance vary at once in a frequency changer. What makes the mavar a little more complicated is that what we are interested in is not just the product of two varying quantities (as in $i = vg$ for the frequency changer, or $q = cv$) but their slope or rate of change. We have found that, when v alone is varying the current is $c\, dv/dt$, and when c alone is varying it is $v\, dc/dt$, so when both are varying:

$$i = c\frac{dv}{dt} + v\frac{dc}{dt} \quad \ldots \quad \ldots \quad (6)$$

As before, let us make our signal voltage

$$v = V \sin \omega_s t$$

We know that

$$\frac{dv}{dt} = \omega_s V \sin \omega_s t$$

And, as we did with g, we can make c consist of a constant part, C_o, and a part varying at the frequency of the local oscillation:

$$c = C_o + C \sin (\omega_o t + \theta)$$

The θ denotes the phase difference, if any, between the two voltage waves. The rate at which C_o varies being obviously nil,

$$\frac{dc}{dt} = \omega_o C \cos (\omega_o t + \theta)$$

Filling these into (6) and working out how much current there is at each frequency we have

$$\begin{aligned} i = {} & \omega_s C_o V \cos \omega_s t + \omega\, CV \sin (\omega_o t + \theta) \cos \omega_s t \\ & + \omega_o CV \sin \omega_s t \cos (\omega_o t + \theta) \\ = {} & \omega_s C_o V \cos \omega_s t + \frac{\omega_s CV}{2} [\sin (\omega_o t + \theta + \omega_s t) \\ & + \sin (\omega_o t + \theta - \omega_s t)] \\ & + \frac{\omega_o CV}{2} [\sin (\omega_s t + \omega_o t + \theta) \\ & + \sin (\omega_s t - \omega_o t - \theta)] \\ = {} & \omega_s C_o V \cos \omega_s t + \frac{CV}{2} [(\omega_s + \omega_o) \sin (\omega_o t + \theta \\ & + \omega_s t) + (\omega_s - \omega_o) \sin \\ & (\omega_o t + \theta - \omega_s t)] \quad \ldots \quad (7) \end{aligned}$$

The first term of the final result is of course the current that v would cause if the capacitance consisted only of C_o. The "cos" indicates that it is 90° out of phase, dissipating no power.

The first of the two terms in the square bracket represents the "sum" frequency current, and the second the "difference" frequency. If we assume $\theta = 0$, then (remembering that $\sin - x = -\sin x$) whatever frequencies are chosen the first term must be positive and the second negative. This means

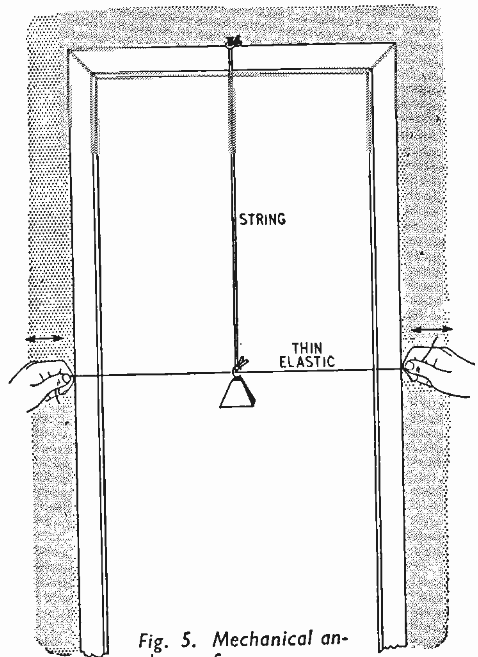


Fig. 5. Mechanical analogue of mavar.

that the sum-frequency current is a positive sine wave and would draw power from a sine voltage at that frequency, but the difference frequency is a negative sine wave so would deliver power to a sine voltage at that frequency. If we choose our frequencies so that $\omega_o - \omega_s = \omega_s$ (i.e., $\omega_o = 2\omega_s$) then the second term simplifies to $-\omega \sin \omega_s t$, indicating power flowing into the signal. Which, as Euclid said, *erat faciendum*, meaning it's just the job.

That is why in mavars the local oscillator, colloquially termed the pump, usually works at twice the signal frequency. The closer scrutiny we shall later give (7) will show that this is not the only possible useful frequency, but it will do to be going on with.

Graphical Illustration

Meanwhile we must do our best for those who find purely mathematical treatment obscure or unconvincing. We can, with a bit of an effort, accomplish the same thing less precisely but more graphically by drawing waveforms. In Fig. 4 (a) is one cycle of the applied voltage v—a sine wave. Next, at (b), is a graph of the slope of (a), dv/dt—a cosine wave. (c) represents the variable part of c—a double sine wave, because the pump frequency is twice the signal frequency. Next, at (d), comes dc/dt—a double cosine wave. The part of the current due to variation of v—$c\,dv/dt$—is got by multiplying (b) by (c), and is shown at (e). And the part due to variation of c, which is (a) multiplied by (d), appears at (f). Finally, the complete current is obtained by adding (e) to (f), as at (g).

This appears pretty clearly as a mixture of a sine wave of three times the frequency of (a), starting in phase with it, and a sine wave of the same frequency as (a), but opposite in phase. They are shown separately at (h) and (i). Because (h) is different in frequency from the voltage (a), it conveys no net power—its single half-cycle of current in opposition to the voltage half-cycle exactly balances its two half-cycles in the other direction because it comes near the voltage peak. But (i) is always *into* the voltage source, feeding it with power.

Any to whom even this procedure smacks too much of maths and who are more mechanically minded may like to try the following. Take a weight, say 1 lb, and suspend it by about 4 ft of string from the centre of the lintel of an open doorway, preferably one not in frequent use (Fig. 5). Attach the middle of a piece of thin elastic (or the ends of two pieces) to the weight. Standing on the side away from the door, hold one of the free ends in each hand. Now set the weight swinging towards and away from you and then rest your hands on the door posts. The swinging will gradually die out like the pendulum of an unwound clock. But if you alternately increase and decrease the stretch of the elastic by moving your hands away from and towards the weight, at twice the frequency of the weight's swing and in phase with it, you should with a little practice be able to keep the weight swinging indefinitely (which means until you get tired). You must not cheat by moving your hands other than strictly at right angles to the direction of swing. If the elastic is kept in contact with the

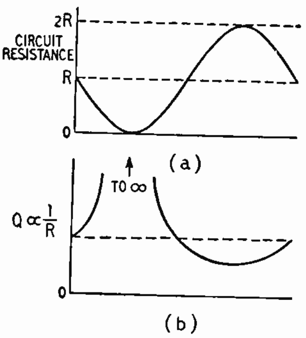


Fig. 6. If the r.f. resistance of a circuit, R by itself, is periodically varied by a mavar from 0 to 2R as shown at (a), the Q of the circuit is affected as shown at (b), which results in net amplification.

door posts, even the most sceptical should be convinced that power is being fed in by periodical variation of mechanical capacitance (which is the compliance of the elastic). The constant and greater part of this capacitance is due to gravitational pull on the weight. The velocity of the weight represents i, and the pull on the weight due to gravity and elastic represents v.

This helps to explain how in both electrical and mechanical systems having reactance which depends on voltage or stress there sometimes occur subharmonic oscillations (frequencies *lower* than one would expect). Loudspeakers, for example. This is quite a big subject in itself, so the brief hint must suffice, while the attention of the trigonometrists is directed back to equation (7).

If $\theta = \frac{\pi}{2}$ (which is 90_o) then, since $\sin\left(x + \frac{\pi}{2}\right) = \cos x$, the whole current becomes "wattless." When θ is increased to π, the difference-frequency term represents power taken instead of given. If the pump is not synchronized with the signal, so that θ continuously drifts on, the signal circuit gets on the average as much positive resistance as negative, which (it might seem) would do the signal no good. Fortunately this is not so, for the signal amplitude is proportional to Q or 1/R; consequently a given amount of negative resistance builds up the signal more than the same amount of positive resistance damps it down. Suppose the resistance of the signal circuit without benefit of mavar was R ohms, and that owing to lack of synchronism the resistance contributed by the mavar alternated slowly between +R and −R. The +R could do no worse than halve the signal amplitude, but the −R would eliminate all circuit resistance and start the signal building up towards infinity, as shown in Fig. 6. The signal would of course be amplitude-modulated at the frequency by which the pump oscillator was straying from exact synchronism with twice the signal frequency.

Other Pump Frequencies

For microwaves, this need for the local oscillator to be twice the signal frequency is likely to be a nuisance. Although the simplified way in which we have looked into the mavar principle doesn't directly show it, the fact remains that other frequencies—including lower ones than the signal—are possible. Equation (7) does show that there is an opposite-phase current at the difference frequency, no matter what ω_o may be in relation to ω_s. So far, we have considered only the special case in which $\omega_o = 2\omega_s$, so that $\omega_o - \omega_s = \omega_s$. When $\omega_o - \omega_s$ is something different, say ω_i, a resistive so-called idling circuit must be provided for this current to flow in. Its flow there sets up a voltage at the same frequency across the reactance, and that, in combination with the pump voltage, results in a current into the signal circuit.

In some experiments by Chang and Bloom, their choice of frequencies (in Mc/s) was $f_s = 380$, $f_o = 300$, and $f_i = 220$. Twice f_o (produced as a harmonic by the non-linearity of the reactance) minus 220 yields f_s. In their work they used a germanium diode as the varying capacitance. (Its use for a.f.c. has already been described in *Wireless World*—by G. G. Johnstone, August 1956, p. 354.)

The original mavar made use of electronic spin in paramagnetic crystals to vary inductance, in a rather similar way to the 3-level maser described last month. But it needs such an enormous amount of pump power (20 kW has been mentioned!) that the whole thing is in danger of going up in smoke. The diode scheme, which needs only milliwatts, looks much more practical, though there may well be doubts about the higher frequencies. Still another, and again remarkably different, method of putting the mavar principle into action is by means of varying space charges in a tube. This arrangement, the precise functioning of which does not exactly leap to the mind's eye, has been developed by the Zenith Radio Corporation of America and was described on the Technical Notebook page in the November 1958 issue.

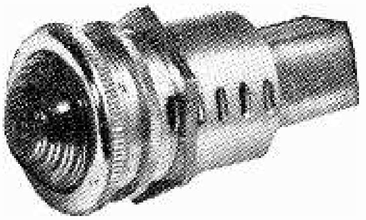
Although a noise figure of 1 dB is claimed for this tube, the tendency is for mavars to be nearer the 3-4 dB mark—not so quiet as masers with their liquid helium, but markedly better than conventional amplifiers. Besides avoiding extreme refrigeration, mavars also handle much more power than masers. So we are likely to hear quite a lot more about them. Why (you are asking) are they so quiet, in spite of working at room temperature? Because the business part of the device is a reactance, which being non-resistive doesn't generate thermal noise.

Manufacture 's' Products

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Versatile Signal Lamp Fitting

A NEW signal lamp fitting possessing a number of novel features is the new Bulgin model D788. It fits panels up to 0.5in thick, can be supplied to take a wide variety



Versatile Signal and Indicator Lamp (Bulgin).

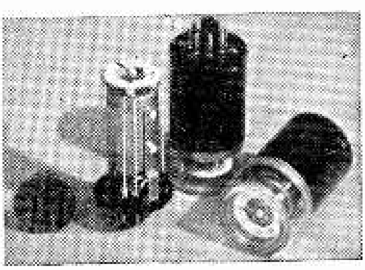
of British or American indicator and signal lamps, filament or neon in bayonet or screw types; the lamp socket is adjustable for depth within the body and the lamp can be renewed from either the front or the rear. The front bezel can be either plastic or metal. It fits into a $1\frac{1}{32}$-in diameter panel hole.

The front lens, which is nearly 1in in diameter, can be either plastic or glass, in the former material it can be either transparent or translucent but in glass only transparent lenses are available. In either material there is the choice of five colours.

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

Measuring Relays

FRENCH Leland Leroux "Sensitact" relays are now available in England. Each relay consists of a screened moving-coil galvanometer with pointer and contact attached, and two separate contacts adjustable over the full range of the scale provided. Sixteen models are available with full-scale deflections ranging from 10mA down to 0.02mA. For the most sensitive model the minimum change of control power necessary to make or

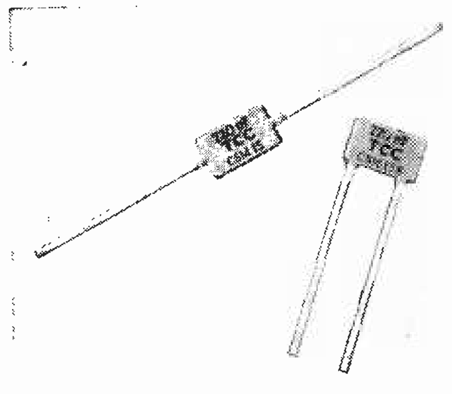


Leland Leroux "Sensitact" measuring relays.

break contact is about 0.05μW; the maximum power which can be handled by the contacts in all models is 200mW. The response time is from 0.1 to 0.2 seconds, depending on the positions of the adjustable contacts. The cost of these relays ranges from £13 10s to £15, and they are available in this country from Leland Instruments, Ltd.. 22-23, Millbank, London, S.W.1.

Miniature Silvered Mica Capacitors

THE new range of protected miniature silvered mica capacitors recently introduced by the Telegraph Condenser Co. Ltd., North Acton, London, W.3, measure



New miniature T.C.C. silvered mica capacitors Types CSM15 (end connections) and CSM15s (side connections).

only $\frac{7}{16} \times \frac{1}{4} \times \frac{3}{32}$in, yet the rated working voltage is 350 d.c. and the test voltage 1,000 d.c. The range covers capacitances of 10pF to 220pF with tolerances of from 1% to 20% as required. These capacitors have a power factor of less than 20×10^{-4} at 1Mc/s and a temperature coefficient of +5 to +50 parts per 10^6 per degree C over the temperature range $-70°$C to $+100°$C and the insulation resistance is better than 10^5MΩ.

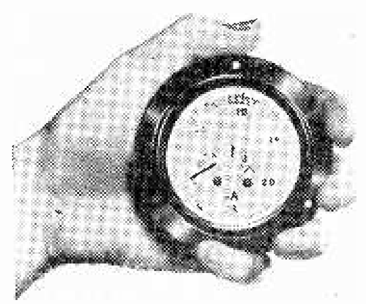
The new capacitor is available in two styles, one, the CSM15, with flat end-connecting strips and the other, CSM15s, with side-entry connections.

Miniature Long-scale Meters

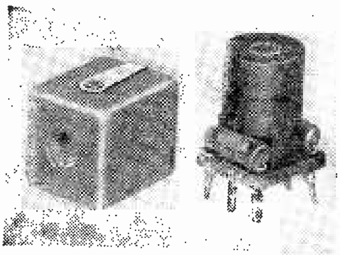
A RANGE of small, flush-mounting, moving-coil measuring instruments, based on the design of the well-tried Crompton Parkinson industrial switchboard meters, has been introduced for use in electronics, telecommunications equipment and test gear. These have pointer rotations of 240° and are available with 2-in or $2\frac{1}{2}$-in diameter dials and assembled in either moulded-plastic or die-cast metal cases, the latter being a sealed type conforming with the requirements of British Draft Defence Specification 62.

The $2\frac{1}{2}$-in models provide a scale $4\frac{1}{4}$in long, while that of the smaller meter is $3\frac{1}{8}$in. The range includes d.c. microammeters, milliammeters, ammeters and voltmeters, also a.c. milliammeters and voltmeters, the resistance of voltmeters being 1000Ω/V.

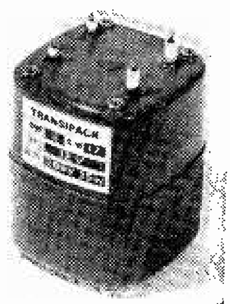
In a flush-mounting moulded case a 0-200 d.c. micro-



Crompton Parkinson 240°-scale moving-coil milliammeter in moulded case.



Left: Neosid miniature pot-type coil, shown with screening can removed.



Hermetically sealed "Transipack" d.c. convertor using semiconductors.

Above: Fane Acoustics bass loudspeaker.

ammeter costs £4 5s for 2in or 2½in size, and in sealed metal case £5 18s and £6 3s respectively. A 0-400 volt d.c. meter (moulded case) costs £5 3s 6d in 2½in size. In 2-in size the highest range is 0-200V. A.C. meters cost about 12s more.

The makers are Crompton Parkinson Ltd., Crompton House, Aldwych, London, W.C.2.

Miniature Toroidal and Pot-Type Coils

COILS wound on miniature dust-iron toroids down to 2mm in outside diameter can now be supplied by Neosid to special order. They are primarily intended for computor equipment and these tiny coils can be machine-wound with up to 150 turns of No 47 s.w.g wire and even more by hand winding. A screwed slug in the toroidal core provides about 10% variation in inductance.

Some very small pot-type coils in ½-in square screening cans for transistor and printed circuit applications are also new.

As shown in the illustration two tiny fixed capacitors can also be included in the assembly. Qs of 200 are readily obtained with coils or transformers for use up to 4Mc/s and with inductance values of up to 11mH, while a Q of 100 is realizable at 20Mc/s. A limited variation in inductances is provided by a slug in the centre of the pot core.

Further details can be obtained from Neosid Ltd., Stonehills House, Howardsgate. Welwyn Garden City,

"Transipack" Convertors

THESE are semiconductor h.t. supply units intended primarily for operating portable and mobile electronic and communications equipment from low-voltage batteries, such as 6 to 28 volts. They are available as hermetically sealed units, as illustrated, or housed in orthodox screening cases, and the range includes a miniature model of about 2 watts rating as well as one of the order of one kilowatt.

A typical sealed unit for 12-volt operation giving 300 volts d.c. output at 30 watts costs about £20. It measures approximately 2½in × 2⅜in × 3in and weighs about 11¼lb.

An unsealed unit, the Model 707, provides a d.c. output variable in 50-volt steps from 50 to 550 volts and with a rating of 30 watts. This model has a tapped toroidal transformer and is claimed to have an efficiency of 85%. It measures 4 7/16in × 2 7/16in × 1in, weighs 11lb 15oz and costs £12 3s.

The makers are Transipack, 29 Burnt Ash Hill, London, S.E.12.

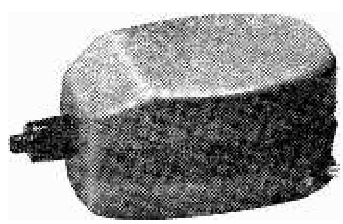
Bass Loudspeaker

ALTHOUGH developed primarily as a replacement for the bass loudspeaker originally used in their "Quartet" 4-speaker system (see Dec. 1958 issue, p. 607), the Fane Acoustics 12-in H.D. unit is also available separately.

It has a smooth response from 30 to 4,500c/s with a gradual roll-off beyond, and a maximum input power rating of 20W (continuous). The total flux is 160,000 lines; the flux density being 12,000 gauss and the voice-coil diameter 2in. The cone is curved-sided and is reinforced by a double roll at its junction with the foam plastic surround to inhibit bell-like vibrations. The cost of this speaker is £9 (not liable to purchase tax), and it is manufactured by Fane Acoustics, Ltd., Batley, Yorkshire.

Tape Bulk Eraser

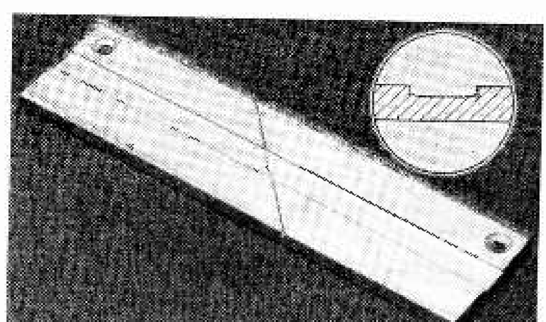
AN a.c. mains energized coil is wound on the centre limb of an E-shaped core to provide the magnetic field for the "Instant" eraser. The push-button switch is depressed and the dimpled side of the eraser passed over the entire area of both sides of the tape reel. The eraser is then removed some way from the reel (to allow the erasing field to decrease gradually) and the push-button allowed to spring back. Erasure of the tape is then complete. Reels should not be erased *in situ* on recorders with magnetic chassis as so much flux may be diverted through the chassis as to give incomplete erasure. This eraser costs 27s 6d and is available from Osmabet, Ltd., 14, Hillside Road, London, N.15.



"Instant" tape bulk eraser.

Magnetic Tape Splicer

IN the "Editape" splicing block, the tape holds itself in position in the shallow slot because of the special cross-sectional shape of this slot (see inset on photograph). The narrow slit crossing at 45° is for guiding the tape cutting blade—which should preferably be non-magnetic The splicing block costs 7s 6d (including postage) and is available from Sound Developments, 9, Osborne Road, Kingston-upon-Thames.



"Editape" splicing block with inset showing special cross-sectional shape of shallow slot for retaining the tape

News from the Industry

Philips-Cossor Link.—Philips Electrical Ltd. have acquired control of Cossor Radio and Television Ltd., a subsidiary of A. C. Cossor Ltd., together with the right to use the Cossor trade mark in the fields of domestic sound radio, television and sound reproduction in all countries except Canada and Pakistan. The new directors of Cossor Radio and Television Ltd. are A. L. Sutherland, director of Philips since 1956, E. W. Brades, director and sales manager of Philips' associate company Stella Radio and Television, and J. S. Clark, joint managing director of A. C. Cossor Ltd. and a director of a number of companies within the Cossor group. D. I. Turner, former sales promotion manager of Cossor, is appointed sales manager. For the time being correspondence should continue to be addressed to Highbury Grove, London, N.5.

Pilot Radio has become a wholly owned subsidiary of Ultra Electric Ltd., who have also acquired from the Pilot Radio Corporation, of America, "Pilot" trade marks in 17 European countries. Pilot Radio, whose works are at Park Royal, Middlesex, was formed in 1935.

E.M.I.-S.T.D. Link.—An agreement has been entered into between E.M.I. Sales & Service Ltd. and Scientific & Technical Developments Ltd. (S.T.D.), of Wallington, Surrey, whereby E.M.I. will undertake world distribution outside the U.K. of the "Orthotone" range of high-fidelity units. Equipment will carry both "Emisonic" and "Orthotone" trade marks. Distribution to the Trade in the U.K. will continue to be the direct concern of S.T.D. The identity and management of S.T.D. remains unchanged and the manufacture of all "Orthotone" products will continue at the Wallington factories.

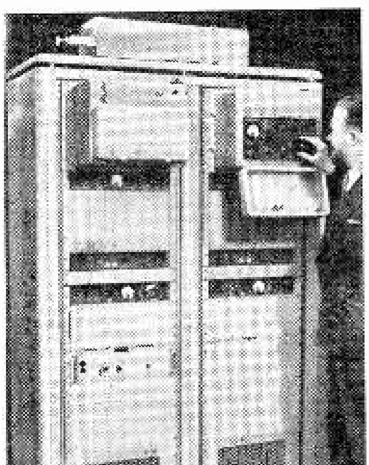
Miniature Relays.—One of the subsidiaries of the Elliott-Automation Group, C. P. Clare, Ltd., which was formed towards the end of last year to manufacture and sell under licence the products of C. P. Clare & Co., of Chicago, received £12,000 worth of orders for its miniature relays in its first full month of operation.

The "Gramdeck" turntable-driven tape transport and transistor record/replay mechanism mentioned in "Technical Notebook" in our July 1958 issue (p. 330) is now marketed by Andrew Merryfield Ltd., 29-31, Wright's Lane, London, W.8. It costs £13 12s.

Marconi's and A. T. & E. have been jointly awarded a contract by the United States government for the supply of a mobile microwave telephone and telegraph communication system linking many of the U.S. Air Force bases in this country. The radio equipment, which is capable of carrying 240 telephone channels and operates in the 4000-Mc/s band, will be supplied by Marconi's and the telephone carrier equipment, which operates in the 60-552kc/s band, by A. T. & E., who, in association with Telephone Manufacturing Co., will also supply the telegraph channelling equipment. The overall value of the order is about $3.5M.

Educational Technical Developments Ltd., of Market Place, Reading, Berks., has been formed by R. Clyne, well known in the industry as a supplier of kits and parts, etc. (who is chairman), and P. T. V. Page, until recently manager and director of instruction at E.M.I. Institutes (who is principal). The company is providing "Radiostructor" postal tuition courses with which the student is given components for constructional work.

Datum Metal Products Ltd. is the new title adopted by Davis & Thompson Ltd., of Watford, Herts., manufacturers of Datum instrument racks, cases, chassis and consoles. The company is a member of the Camp Bird Group.



E.M.I. ELECTRONICS are supplying this microwave link equipment to convey the B.B.C. television service from the mainland to the Orkneys' transmitter.

Telemechanics Ltd., of Hythe, Southampton, which was formed by F. M. Hills in 1946 and became part of the Pena Group, has been reacquired from the liquidator of Pena by Mr. Hills, who is managing director. The company, which is engaged in the manufacture of "Telemax" test equipment, marine broadcast receivers and power units, can offer production facilities to the industry.

Cossor airborne radar transponders for traffic identification have been ordered by B.O.A.C. for its fleet of Boeing 707 jet aircraft. The transponder, which replies to ground interrogation with a coded train of pulses, is compulsorily fitted in high-flying civil airliners in the U.S.A., and arrangements are being made for its use in Europe.

Truvox.—Because of the report which appeared in some journals regarding the liquidation of Truvox Holdings Ltd., we have been asked to state that the liquidation of this non-operative company in the Truvox Group in no way affects the activities of Truvox Ltd., manufacturers of tape recorders. The company was liquidated "for purely administrative reasons."

Pye.—The Norwich studios of Anglia Television Ltd., the programme contractors for the I.T.A.'s Mendlesham, Suffolk, station is being equipped with cameras and control gear by Pye, who are also supplying an O.B. unit. The transmitting equipment at Mendlesham is also being provided by Pye, whose transmitters are in use at the I.T.A.'s Lichfield and St. Hilary stations.

Decca harbour surveillance radar, Type 32, has been installed in the re-furbished radar station at Gladstone Dock, Liverpool. The 3-cm radar equipment, which has seven displays all fed from a common scanner, provides a composite picture of the harbour and its approaches. In bad visibility when pilots ask to be kept under observation minute-by-minute information of the exact position of the ship is passed by radio to assist the pilot in navigating the river and approach channels.

EXPORT NEWS

Microwave transmitters and associated equipment for a radio network providing a television and telephone link between Sundsvall and Boden (a distance of 300 miles) have been ordered by the Royal Board of Swedish Telecommunications from Standard Telephones and Cables. The installation, which will work in the 4000-Mc/s band, will provide six parallel two-way channels each capable of carrying 960 telephone circuits or one television transmission complete with sound.

Television cameras, specially designed by Pye for use in reactors, are being demonstrated during a tour of American and Canadian atomic energy plants by Victor Hessen, manager of Pye's Atomics Division, and Donald Jackson, chief mechanical engineer of the company's Transmission Division. The equipment was shown at the Atomic Fair which was held recently in Ohio.

Ultrasonic inspection equipment to the value of £10,000 has been ordered from Kelvin Hughes for installation in a Czechoslovakian steel works. The equipment will facilitate the rapid scanning of rolled mild steel bars for internal defects and consists of a remote control console containing the c.r.t. presentation and recording equipment and the remote operating controls for a scanning unit situated above the main feed conveyor.

Telecommunication Equipment.—As part of the programme for the expansion of the telecommunications service between East and West Pakistan and overseas, the Posts and Telegraphs Department has ordered from Marconi's three high-power h.f. transmitters for telegraph and teleprinter circuits.

Television transmitters, cameras and ancillary equipment are being supplied by Pye for two new commercial stations being built in Australia. One is in Adelaide and the other in Perth.

Lisbon Trade Fair.—Among the 350 or so manufacturers participating in he British Trade Fair, which is being held in Lisbon from May 29th to June 14th, are a number in the radio and electronics industry. Some are participating in group exhibits, but many have taken individual stands including a number of domestic sound and television equipment manufacturers. Among the 300 or more exhibits in the display staged by the Council of Industrial Design are a number of sound and television receivers.

Italy.—Industrial Products Agencies S.r.l., of Via Carlo Fea 11, Rome, are seeking agencies of United Kingdom manufacturers of electronic and nuclear instruments; microwave equipment; impulse generators; magnetic sound and vision recording equipment and servo mechanisms.

TRANSISTOR EXHIBITION

THE manufacturers and organizations listed below have taken stands at the International Transistor Exhibition being organized in conjunction with the Transistor Convention sponsored by the I.E.E. The exhibition, being held at Olympia, London, concurrently with the convention (May 21-27), opens each day at 9.0 and closes on the 21st and 25th at 6.0, the 22nd, 23rd and 26th at 8.0, and 27th at 4.0. It will not be open on Sunday. Tickets for the exhibition are obtainable free from the organizers, Industrial and Trade Fairs, Ltd., Drury House, Russell St., London, W.C.2.

Those wishing to attend the convention, which is being organized by the Electronics and Communications Section of the I.E.E., must apply to the Institution (Savoy Place, London, W.C.2) for registration forms.

Alma Components
Ashburton Resistances
Associated Electrical Industries

B.B.C.
B.T.H.
Belling & Lee
Birlec
Brush Crystal Company

Compagnie Francaise Thomson-Houston
Compagnie Generale de T.S.F.

Dawe Instruments
Dependable Relay Co.

Edwards High Vacuum
Electrovac Hacht & Huber
Elga Products
Elliott Brothers (London)
English Electric Valve Co.
Ever Ready Co.

Ferguson Radio Corp.
Ferranti

G.E.C.
G.E. Industrial Supplies
G.P.O.
Hatfield Instruments
Heraeus Quarzschmelze

I.C.I.
I.E.E.

Johnson, Matthey & Co.

Kynmore Engineering Co.

Livingston Laboratories

Mallory Batteries
Mansol (G.B.)
Mining & Chemical Products
Ministry of Supply
Mullard

Newmarket Transistors

Plessey Company
Pye

RCA Great Britain
Racal Engineering
Radio Heaters
Rank Cintel
Raytheon Manufacturing Co.
Rivlin Instruments
Roband Electronics
Roe, A. V., & Co.

Sanyo Electric Company
Semiconductor Information Service
Semiconductors
Shockley Transistor Corp.
Siemens & Halske A.G.
Siemens Edison Swan
Sintering & Brazing Furnaces
Societa Generale Semiconduttori
Solartron Electronic Group
South London Electrical Equipment Co.
Standard Telephones and Cables
Sylvania Electric Products

Tekade
Telefunken
Texas Instruments
Tokyo Shibaura Electric Co.

U.K. Atomic Energy Authority
Ultra Electric
Union Miniere Du Haut-Katanga
University of Birmingham

Venner Electronics
Vidor and Burndept

Wayne Kerr Laboratories
Welwyn Electrical Laboratories
Westinghouse Brake & Signal Co.
Whiteley Electrical Radio Co.
Wire Products & Machine Design
Wirepots

MAY MEETINGS

LONDON

5th. Brit.I.R.E.—"An experimental diode parametric amplifier and its properties" by I. M. Ross, C. P. Lea-Wilson, A. J. Monk and A. F. H. Thomson at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

8th. I.E.E. Medical Electronics Discussion Group.—"Microwave radiation hazards" by Dr. D. H. Shinn (Marconi's) and Dr. N. L. Lloyd (Ministry of Supply) at 6.0 at Savoy Place, W.C.2.

13th. I.E.E.—"The application of statistical techniques to the electronic valve industry" by E. G. Rowe at 5.30 at Savoy Place, W.C.2.

13th. Brit.I.R.E.—"Improving communication techniques—what have engineers to learn from information theory?" by Professor D. Gabor at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

14th. I.E.E.—"On the conceivable future of telecommunications" by Professor E. C. Cherry at 6.30 at Savoy Place, W.C.2.

14th. Physical Society Acoustics Group.—"High energy ultrasonics" by E. Neppiras at 5.30 at Imperial College, Prince Consort Road, S.W.7.

15th. Institute of Navigation.—"Electronic surveys in the Caribbean" by Capt. E. G. Irving, R.N., at 5.15 at the Royal Geographical Society, 1 Kensington Gore, S.W.7.

21st. Physical Society.—Presidential address by J. A. Ratcliffe at 5.45 at the Royal Institution, 21 Albemarle Street, W.1.

BIRMINGHAM

8th. Institution of Electronics.—"The design of transistor h.f. amplifiers" by L. E. Jansson (Mullard) at 7.0 in the Byng Kenrick Suite Lecture Hall, New College of Technology, Gosta Green.

BRISTOL

5th. Television Society.—Mullard Film Meeting at 7.30 at the Grand Hotel (Joint meeting with R.S.G.B. and R.T.R.A.).

CHELTENHAM

1st. Brit.I.R.E.—"Transistor amplifiers" by F. Butler at 7.0 at North Gloucestershire Technical College.

PRESTON

6th. I.E.E.—Annual general meeting at 7.15 followed by "Domestic high-fidelity reproduction" by J. Moir at the North-Western Electricity Board Demonstration Theatre, Friargate.

CONFERENCES AND EXHIBITIONS

Latest information on forthcoming events both in the U.K. and abroad is given below. Further details are obtainable from the addresses in parenthesis.

UNITED KINGDOM

Symposium on Instrumentation and Computation in Process Development and Plant Design, Central Hall, Westminster, London, S.W.1 .... May 11-13
(Institution of Chemical Engineers, 16 Belgrave Square, London, S.W.1.)

International Convention and Exhibition on Transistors, Earls Court, London, S.W.5 .... May 21-27
(I.E.E., Savoy Place, London, W.C.2.)

International Plastics Exhibition and Convention, Olympia, London, W.14 June 17-27
(" British Plastics," Dorset House, Stamford Street, London, S.E.1.)

British Computer Society's Conference, Cambridge .... June 22-25
(British Computer Society, Finsbury Court, Finsbury Pavement, London, E.C.2.)

International Convention on Television Engineering, Cavendish Laboratory, Cambridge .... July 1-5
(Brit. I.R.E., 9 Bedford Square, London, W.C.1.)

National Radio and Television Show, Earls Court, London, W.5 .. Aug. 26-Sept. 5
(British Radio Exhibitions Ltd., 49 Russell Square, London, W.C.1.)

Scottish Industries Exhibition, Kelvin Hall, Glasgow .... Sept. 3-9
(Matthew H. Donaldson, 2 Woodside Terrace, Glasgow, C.3.)

Farnborough Air Show .... Sept. 8-14
(Society of British Aircraft Constructors, 29 King Street, London, S.W.1.)

Conference on Dielectric Devices, University of Birmingham .... Sept. 14-17
(Electrical Engineering Department, The University, Birmingham, 15.)

Conference on Modern Network Theory, University of Birmingham, Sept. 21-24
(Electrical Engineering Department, The University, Birmingham, 15.)

Conference on Some Aspects of Magnetism, Sheffield University .. Sept. 22-24
(Institute of Physics, 47 Belgrave Square, London, S.W.1.)

International Scientific Research Exhibition, Olympia, London.. Oct. 3-10
(I.S.R.E. Ltd., Oswaldestre House, Norfolk Street, London, W.C.2.)

Radio Hobbies Exhibition, Royal Horticultural Hall, London, S.W.1, Nov. 25-28
(P. A. Thorogood, Museum House, Museum Street, London, W.C.1.)

OVERSEAS

Interdisciplinary Conference on Self-Organizing Systems, Chicago, May 5-6
(Scott H. Cameron, Armour Research Foundation, Chicago 16, U.S.A.)

Electronic Components Conference, Philadelphia .... May 6-8
(Brig. Gen. Edwin R. Petzing, A.G.E.P. Secretariat, University of Pennsylvania, Philadelphia, Pa., U.S.A.)

Radio Engineering Convention, Melbourne .... May 25-30
(Australian I.R.E., 157 Gloucester Street, Sydney, New South Wales.)

British Trade Fair, Lisbon, Portugal .... May 29-June 14
(British Overseas Fairs Ltd., 21 Tothill Street, London, S.W.1.)

International Air Show, Le Bourget, France .... June 12-21
(Union Syndicale des Industries Aeronautiques, 4 rue Galilée, Paris XVIe.)

International Conference on Information Processing, Paris .... June 15-20
(B.C.A.C. Group B, c/o I.E.E., Savoy Place, London, W.C.2.)

I.R.E. International Symposium on Circuit and Information Theory, Los Angeles .... June 16-18
(Richard A. Epstein, Jet Propulsion Laboratory, Pasadena, California, U.S.A.)

International Chemistry Conference and Exhibition, Paris .... June 16-30
(Conférence Internationale des Arts Chimiques, 28 rue Saint-Dominique, Paris 7.)

International Electronic, Nuclear and Cinematographic Exhibition, Rome .... June 16-30
(Rassegna Internazionale Electronica Nucleare, Via dell a Scrofa 14, Rome.)

Second International Conference on Medical Electronics, Paris .. June 24-27
(Secretariat, 131, Boulevard Malesherbes, Paris XVIIe.)

National Convention on Military Electronics, Washington .... June 29-July 1
(L. R. Evringham, Radiation Inc., Orlando, Fla., U.S.A.)

German Radio, Television and Audio Show, Frankfurt .... Aug. 14-23
(Messe- und Ausstellungs-GmbH., Frankfurt a.M.)

Western Electronic Show and Convention, San Francisco .... Aug. 18-21
(Wescon, 1435 South La Cienega Boulevard, Los Angeles 35, Calif., U.S.A.)

International Congress on Acoustics, Stuttgart .... Sept. 1-8
(Dr. Ing. E. Zwicker, Breitscheidstr. 3, Stuttgart.)

Salon Belge de l'Electronique, Brussels .... Sept. 19-24
(Comité des Expositions de la Radio-Electricité, de la Télévision et des Industries Connexes, 7 rue de Florence, Brussels, Belgium.)

National Symposium on Telemetring, San Francisco .... Sept. 28-30
(Robert A. Grimm, Dymec Inc., 395 Page Mill Road, Palo Alto, Calif., U.S.A.)

Irish Radio and Television Show, Mansion House, Dublin Sept.28-Oct. 3
(Castle Publications, 38 Merrion Square, Dublin, Eire.)

I.R.E. Canadian Convention, Toronto .... Oct. 7-9
(Convention Office, 1819 Yonge Street, Toronto, 7.)

National Electronics Conference, Chicago .... Oct. 12-14
(N.E.C., 84 E. Randolph St., Chicago, Ill., U.S.A.)

Conference on Electrical Techniques in Medecine and Biology, Philadelphia .... Nov. 10-12
(Dr. L. E. Flory, RCA Laboratories, Princeton, N.J., U.S.A.)

RANDOM RADIATIONS

By "DIALLIST"

Man-made Blackouts

ONE gathers that there has been considerable uneasiness in the U.S.A. owing to the discovery that wireless and radar signals can be blocked by bursting a nuclear bomb at a great height above the earth's surface. Before any announcement on the subject was made officially in America, Russian scientists had attributed the unexpected density of the inner radiation zone (which at the magnetic equator is 1,500-4,000 miles above the earth) to the effects of nuclear explosions. Later, an official statement was made in the U.S.A. that, as part of the I.G.Y. programme, three such bursts had taken place last year at heights of about 300 miles. In each case the flash of the explosion was followed at once by a faint luminosity extending along the magnetic line of force through the burst point. This line of force returns to our atmosphere in the northern hemisphere near the Azores. Aircraft stationed in the region for observation purposes noted a short auroral glow. The work was then taken up by the satellite Explorer IV which, travelling day after day "through the man-made 'shell' of trapped radiation," sent back to earth measurements which enabled its intensity and shape to be worked out. It has been suggested that anyone mad enough or wicked enough to start a nuclear war could put the other side's distant early warning radar system almost, if not entirely, out of action by leading off with a number of bursts in the right places.

Towards Better TV

THOUGH at the time of writing the Television Advisory Committee's report has not been completed, it seems almost a certainty that the definition recommended for Bands IV and V will be 625 lines. If 8-Mc/s channels are adopted by international agreement (6-Mc/s for vision and 2-Mc/s for sound), this should certainly mean an overall improvement in picture quality. The change would, presumably, also mean adopting negative vision modulation and f.m. sound modulation. Improvements are always to the good and one must welcome them; but I've always felt that when we do make use of Bands IV and V we should change things in a big way to, say, 1,000 lines or more and not be content with a mere fifty-per-cent rise in the number of lines. If, as the years go by, scanning remains the only practicable method of transmitting and reproducing television images, systems with a far greater number of lines than 625 are bound to come.

Stereo Sound

AT the I.E.E.'s Stereophonic Sound Recording, Reproduction and Broadcasting Convention* it was clear that nobody yet really knows all the hows and whys of the process. I think that, like other animals, we were provided with two ears to enable us to turn our eyes towards the place from which the sound comes in case it is a warning of lurking danger. If the sound lasts an appreciable time, we seem to do this by turning our heads so as to phase up the waves reaching our eardrums. But what of short sharp sounds such as the snapping of a twig? They don't last long enough for this to be done, yet we do instinctively look towards their source. Dr. Percival maintained that the directional signals are mainly in the transients and this may possibly explain our quick reactions to snappings, pops, bangs and so on. Then, as T. Somerville, of the B.B.C., pointed out, the use of two loudspeakers reproducing the right-hand and left-hand sounds would give directions in the horizontal plane only. For there to be an impression of vertical directivity three or more would be needed. Curious that; for our two ears certainly make us look up or down as the case may be for the source of any sound. No doubt it'll all be worked out in time and one of the most valuable things about a convention of that kind is that it helps people to realize just how much they don't know and stimulates them to try to find all the answers. Meantime, stereo-sound as it comes from our loudspeakers seems pretty good to me and recording it or listening to it has become one of the most popular of hobbies.

* See also p. 239 of this issue—ED.

TV on the Railways

CLOSED-CIRCUIT television is, I see, to be installed at some of the level crossings in France which can't be seen from the nearest signal box. At many of those on busy roads it has been necessary to have an employee permanently on duty; in future the man in the signal box will be able to see for himself just what's going on and to open or close the gates as required. Something of this kind would be a vast improvement in the flatter parts of this country such as Cambridgeshire, where there are many level crossings. Quite a few of these are unattended and one can't always get a view of the rails for any great distance in either direction. Fixed high up, so as to be out of harm's way, the camera could be moved by the signalman by remote control so as to let him see vehicles approaching the crossing from either direction and enable him to open or close the gates at the right moment. Actually, television is already in use on our railways for other purposes. There's a camera, for instance, at the approaches to King's Cross Station in London which enables train arrival times to be checked and in marshalling yards.

Mendlesham's TV Station

IF all goes well, the I.T.A. should be able to open its East Anglian TV station earlier than many people expected. Test signals are to start in July or August with an e.r.p. of 10kW from a temporary aerial mounted at a height of about 500ft on the unfinished mast. Full-power trade tests should start in October, provided that the 1,000-ft mast is finished by then. That must depend a good deal on the weather and I take it that what is most wanted is that there should be no high winds. I haven't been Mendlesham way lately, so I don't know yet how that gigantic mast is getting on. When finished it should indeed be worth seeing, for I believe it will be the tallest TV mast in the country. It should be visible over a largish part of the Suffolk landscape.

Guarantee Periods

SOME of the firms which rebuild cathode-ray tubes guarantee their products for seven months, others again for nine and a few for a full year. Rather a queer state of affairs, that! I expect that as time goes on they'll all adopt an agreed guarantee period. I've long felt that our valve and tube manufacturers should fall into line with those of other countries by giving a year's guarantee on all their wares. I don't think I'm wrong in believing that the bulk of British-made valves and c.r. tubes exported *do* carry such a guarantee. They certainly have to in territories where they have to compete with those manufactured in countries where this is the normal period of guarantee.

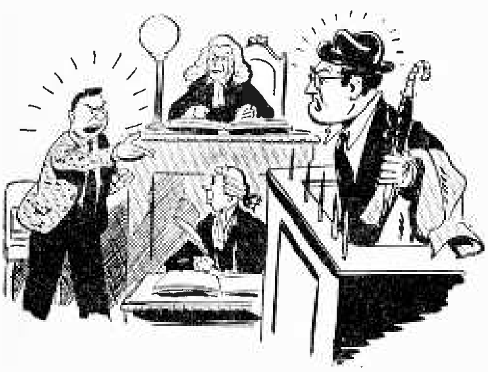
UNBIASED

By FREE GRID

What is Truth?

AS I grow older, I come more and more to share the opinion of the late Henry Ford that "history is bunk," as I am constantly reading and hearing contradictory versions of historical events. I have always supposed that the first *public* demonstration of television was given by Baird at 22 Frith Street, Soho, in January 1926, but now I see that the famous Oxford Street store, which used to house the 2LO transmitter, is claiming that TV was demonstrated on its premises in 1925.* What am I to believe?

Then again, the Editorial Comment in the April issue tells me by its title that the Editor is in a similar difficulty about the late King Canute,



" Contradictory versions of events "

or Knud as his Danish compatriots call him. The Editor obviously favours the outmoded story that Canute sat on the beach near Southampton in the year A.D. 1028, and commanded the incoming tide to recede, fondly imagining that it would do so.

Nowadays most historians are agreed that Canute was no fool, and only staged this act to prove to his sycophantic followers that he had no magic powers. I am not, of course, suggesting that the Editor is wrong; after all, he had to choose between two versions just as I shall have to do in the case of the date and venue of the first public TV demonstration.

The classic instance of this difficulty of deciding between two versions of the same thing is not concerned with history but with natural history. We often read that the foolish ostrich sticks his head in the sand, thinking that because he cannot see his approaching enemies, they cannot see him. The other version is that the ostrich is a highly intelligent bird which camouflages himself by crouching down amid the local desert scrub, and at the same time puts his head *on* the ground so that he can hear more clearly his enemy's footsteps and so decide whether he is coming or going.

You pays your money and you takes your choice.

* Both " Free Grid " and (don't let's be coy) Selfridge's are right according to whether silhouettes (such as the test bars and crosses sometimes transmitted by the B.B.C. and I.T.A.) are or are not regarded as " television."—ED.

Lawless Listening

I WAS surprised when recently reading my wireless licence, to learn that I am not allowed to use a portable set with an external l.t. battery unless I am using it on my own premises or in some vehicle, marine or territorial, occupied by me. Thus, if my l.t. battery runs out when I am having a picnic on the beach, I must not plug the set into my car's electrical circuit, nor may I stagger down with the car battery so that I can connect it up to my portable set with a suitable series resistance.

Reading the regulations has made me very nervous, and as a result I nearly caused a nasty accident to a child the other day. I was taking advantage of one of those few lovely days we had recently, and was sitting on the beach with my portable. The l.t. ran out and I stepped across the road to a local electrical shop for a replacement. All they had in stock was a large $1\frac{1}{2}$-volt dry cell which would not go into the battery compartment, but I bought this and soon had it connected up.

Unfortunately, a passing policeman saw me and as he walked in my direction I hastily disconnected the "evidence" and hurled it in the sea, narrowly missing the head of a child who was paddling. Baulked of his lawful prey, the policeman proved himself a man of resource and booked me under the Anti-litter Act. Can any of you legal pundits tell me if it would be a good defence to plead that the cell, when hurled away, fell on the seaward side of low tide mark.

Correcting the O.E.D.

I SUPPOSE every reader has heard of the Oxford English Dictionary. It is to be found even in Cambridge, and by no means always in the inner recesses of booksellers' shops, hiding its head shamefacedly among those volumes which the police periodically seize, and the magistrates order to be destroyed.

I refer to the O.E.D. here because it is proposed to issue a new supplement to it, and I have been looking at a list of suggested new words and expressions running from AL-AZ. Even in this small part of the alphabet there are more than 800 new words or phrases. In the list each word has printed alongside it the year in which it is thought it was first used.

There seems to be a large number of words and expressions wrongly dated; not only ordinary non-technical ones but also the specialized ones which concern various technologies. I give herewith over a dozen words from the list, together with the years of first usage assigned to them, which will be of particular interest to readers of *Wireless World.*

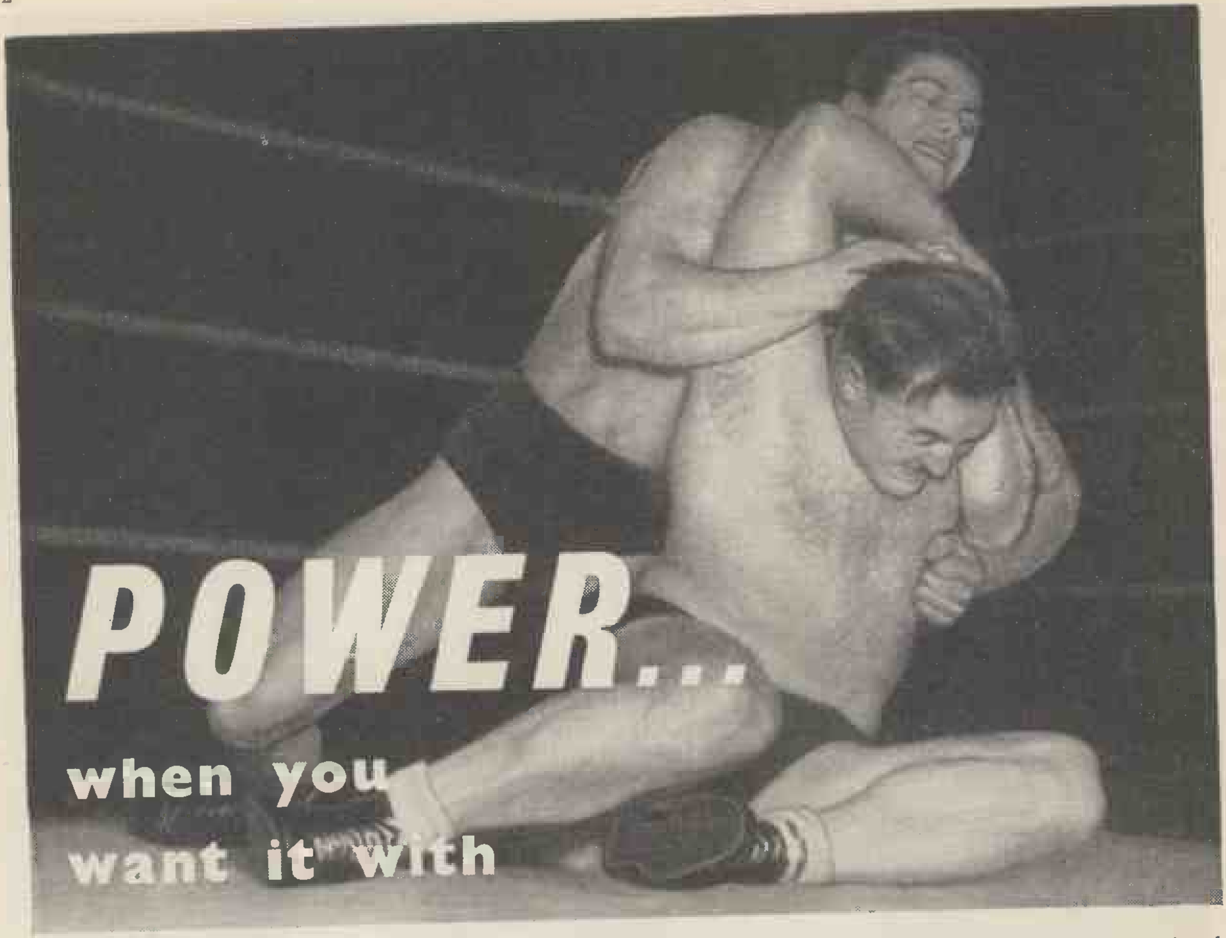
	No Date
Alive (Electricity)	1934
All-electric	1948
All-mains	1940
Ampere-hour	1902
Ampere-turn	1948
Appleton layer	1932
Appleton region	1939
Asdic	1945
A.S.V. (Radar)	1943
Attenuation (Electricity)	1940
Audio	1923
Audio-frequency	1940
Automatic gain control	1940
A.V.C.	

The Editor of the O.E.D. Supplement, 40, Walton Crescent, Oxford, seeks to know if any earlier use of these words is known. Before any of you get killed in the rush to enlighten him, I would point out that he does not want just vague memories. He wants to know exactly where the earlier usage occurs, and he wants each word dealt with on a separate sheet of paper of 6-in × 4-in dimensions, which he will supply if necessary.

Psychotrons

IN THE March issue, I was discussing the extra-spatial electrons of which I supposed ghosts and their world to be constructed. It has occurred to me that the expression "extra-spatial electrons" would be far too clumsy to come into general use as it will tend to do in years to come when some experimental research worker eventually plays Hertz to my theoretical Clerk-Maxwell. I would, therefore, suggest the word psychotrons to describe these extra-spatial electrons.

I think that in 20 years time we shall be as familiar with the science of psychotronics as we are now of electronics. At least, some of us will be; by then others will be on the far side of the psychotronic curtain.



SOLARTRON

Stabilised transistor power supplies

Solartron pre-packaged Transistor Power Supplies, either as completely enclosed bench units or as sub-units, save untold time and trouble for manufacturers who make or use equipment that employs transistors. The advantage of a Solartron unit is that it is handy, compact, adaptable, and under all circumstances absolutely reliable and tested. The output voltage is completely stable so that you can always eliminate the power unit from consideration as a possible source of trouble.

Write now for full descriptive literature, to The Solartron Electronic Group Limited.

	AS 757	AS 758	AS 759	AS 852	AS 854	AS 855
	Bench	Bench or rack	Sub-Unit	Bench or rack	Sub-Unit	Sub-Unit
Output voltage :	± 0 – 50	± 0 – 30	± 1·5 – 13·5	± 30 – 50	± 11·5 – 32·5	± 32·5 – 50
Output current :	0 – 1A	0 – 10A	0 – 1A	0 – 10A	0 – 1A	0 – 1A
Output resistance :	0·01 Ω	0·01 Ω	0·01 Ω	0·01 Ω	0·01 Ω	0·01 Ω
Output Z to 100 Kc/s:	0·2 Ω	0·2 Ω	0·2 Ω	0·2 Ω	0·2 Ω	0·2 Ω
Stability factor	200 : 1	150 : 1	200 : 1	150 : 1	200 : 1	200 : 1
Ripple and noise (peak to peak) :	1 mV	1 mV	1 mV	1 mV	1 mV	1 mV
Mains input :	90/130 Volts, 200/240 Volts. Permissible deviation ± 7%					
Dimensions :	12⅜"x 8"x 13" (33x21x33cm.)	22"x 10½"x 16" (56x27x41cm.)	7½"x 5¾"x 5½" (18x15x14cm.)	22"x 10½"x 16" (56x27x41cm.)	Appx. 8"x 6"x 6" (20x15x15cm.)	Appx. 8"x 6"x 6" (20x15x15cm.)
Appx. weight :	25 lbs. (11·5 kg.)	55 lbs. (25 kg.)	7½ lbs. (3·5 kg.)	60 lbs. (27 kg.)	8 lbs. (3·8 kg.)	8 lbs. (3·8 kg.)

AS 758

AS 757

AS 759

THE SOLARTRON ELECTRONIC GROUP LTD
THAMES DITTON · SURREY
Telephone: Emberbrook 5522
Telegrams and Cables: Solartron, Thames Ditton · International Telex: 23842 Solartron T.Dit.

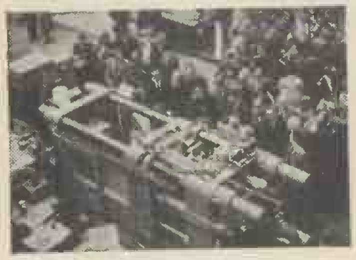
the greatest international display of plastics materials, equipment and products ever presented under one roof

1959

international plastics exhibition and convention

GRAND, NATIONAL AND EMPIRE HALLS OLYMPIA 17-27 JUNE 1959

The INTERNATIONAL PLASTICS EXHIBITION at Olympia, London, 17-27 June will provide a complete up-to-the-minute picture of plastics progress in the industries of the world. Thousands of exhibits from some 15 countries will combine to present the newest plastics materials, the most up-to-date equipment and a comprehensive range of industrial and domestic finished products. Here you can talk plastics chemistry, mechanics and merchandising with experts from many countries—see plastics machinery in action—gather new product ideas and new manufacturing methods—study new techniques. Do not miss this vitally important event.



Exhibition organized every second year by BRITISH PLASTICS—an Iliffe journal

THIS IS AN EXHIBITION YOU MUST SEE! POST THIS TODAY

TO THE EXHIBITION MANAGER, DORSET HOUSE, STAMFORD STREET, LONDON SE1

Please send me the 1959 Exhibition brochure, free season ticket, etc.

NAME .... DATE ....

FIRM ....

ADDRESS ....

....

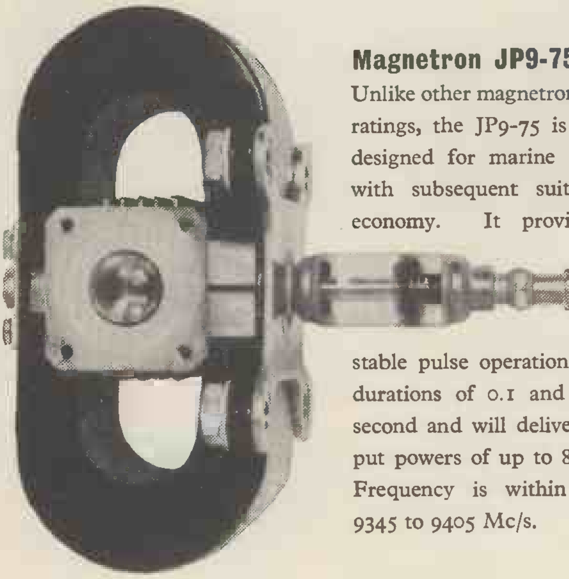
18A

For large sets . . .

A line-up of large radar valves specially designed to provide high performance and reliability at a very competitive price.

Valves for Marine

80kW



Magnetron JP9-75

Unlike other magnetrons of similar ratings, the JP9-75 is specifically designed for marine installations with subsequent suitability and economy. It provides highly stable pulse operation with pulse durations of 0.1 and 1.0 microsecond and will deliver peak output powers of up to 80 kilowatts. Frequency is within the range 9345 to 9405 Mc/s.

Pulse Modulator XH8-100 (CV1787)

Hydrogen-filled pulse modulator with a peak cathode current of 90 amps. Directly equivalent to the American 4C35.

Klystron KS9-20A (CV2792)

Mechanically tuned reflex klystron directly equivalent to the American 2K25. Frequency range 8500 to 9660 Mc/s.

Pulse Modulator QV20-P18 (CV2752)

Vacuum pulse modulator with a peak anode current of 18 amps. Directly equivalent to the American 4PR60A.

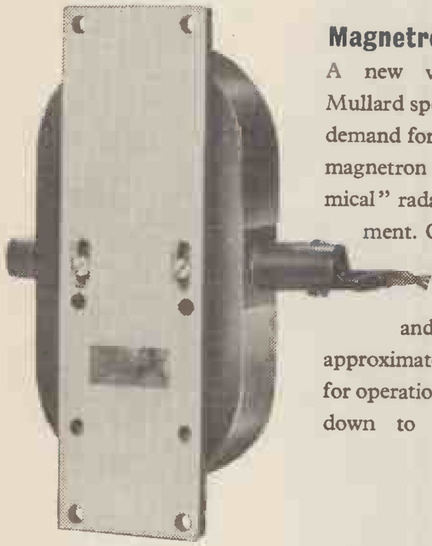
*The valves in this advertisement are **not** shown to scale.*

Radar

For small sets . . .

This Mullard line-up of radar valves is designed to achieve the maximum economies in power consumption and in the cost of associated components — both essential requirements in small ship installations.

3kW



Magnetron JP9-2.5

A new valve designed by Mullard specifically to meet the demand for a low power pulsed magnetron for use in "economical" radar navigation equipment. Operating frequency within the range 9345 to 9475 Mc/s and peak output power approximately 3 kW. Tested for operation with pulse lengths down to 20 millimicrosecs.

Pulse Modulator EL360

Another Mullard development. This vacuum pulse modulator is recommended for operation with the JP9-2.5 magnetron. Maximum peak cathode current 4.0 amps.

Klystron KS9-20 (CV1795)

Mechanically tuned reflex klystron directly equivalent to the American 723A/B. Frequency range 8702 to 9548 Mc/s.

Abridged guide to Mullard Valves for Radar

Please write to the address below for further information.

	Mullard No.	Services No.	American No.
Magnetrons	JP8-02	—	—
	JP9-01	—	—
	JP9-2.5	—	7028
	JP9-7	CV3676	2J42
	JP9-7A	CV370	—
	JP9-7B	—	—
	JP9-7D	CV1866	—
	JP9-15	CV3997	2J42A
	JP9-75	—	6972
	JP9-80	CV3569	4J52
	JP9-80A	CV5018	4J52A
	JP9-250	CV2284	4J50
	JP9-250A	CV3953	4J78
	JP16-40	—	—
	JPT6-01	—	—
	JPT8-01	—	—
	JPT9-01	CV2420	—
	JPT9-02	CV2421	—
	JPT9-60	CV3560	2J51A
Hydrogen-filled Pulse Modulators	XH3-045	CV372	3C45
	XH8-100	CV1787	6268 / 4C35
	XH16-200	CV2520	6279 / 5C22
	XH25-500	CV3521	5949
Vacuum Pulse Modulators	EL360	—	—
	QQV5-P10	CV2295 / CV3599	3E29
	QV10-P8	—	—
	QV20-P18	CV2752	4PR60A
	QYS50-P40	CV313	—
Klystrons	KS7-85	—	2K26
	KS7-85A	—	5976
	KS9-20	CV1795	723A/B
	KS9-20A	CV2792	2K25
	KT9-150W	—	—

MULLARD LIMITED
MULLARD HOUSE • TORRINGTON PLACE
LONDON • W.C.1
TEL: LANGHAM 6633

Mullard

GOVERNMENT AND INDUSTRIAL VALVE DIVISION

MVT 354a

The *NEWEST FASTEST* Transient Storage Oscilloscope

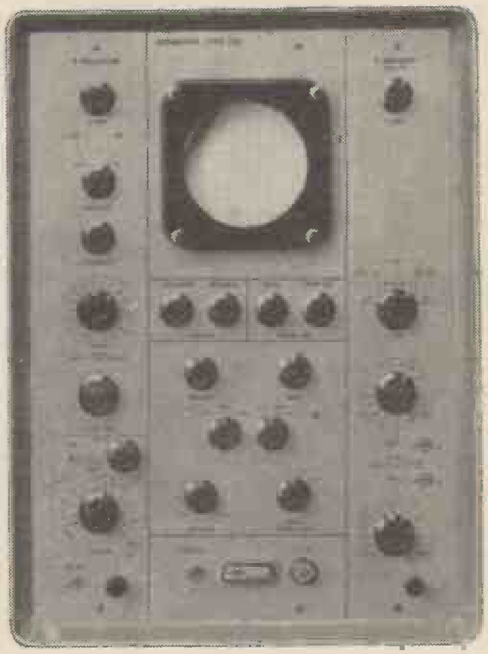
CAWKELL "REMSCOPE"

7 DAYS STORAGE ★

WRITING SPEED OVER 2 cm/μS ★

IMMEDIATE VIEWING ★

CRYSTAL TIME MARKERS ★



★ 2 HOURS VIEWING

★ RISE-TIME 0·15μS

★ EXTREME CONTRAST

★ 1% VOLTAGE MEASUREMENT

The new Cawkell "Remscope" offers all the facilities of a wide-range high-grade oscilloscope plus the ability to store fast transient signals for inspection and measurement. A new cathode-ray tube with improved performance over types previously available ensures a brilliant clear display against a dark background; moreover the tube cannot be damaged by using it at low writing speeds.

To ensure maximum usefulness an extremely wide range of time base speeds and very comprehensive and reliable triggering facilities have been provided.

Write now for full details.

CAWKELL RESEARCH & ELECTRONICS LTD

SCOTTS ROAD

SOUTHALL - MIDDLESEX

Telephone : SOUthall 3702/5881

Model P150 BQ

Model P123 BQ

Model P128 B

Model Q5

Model P160 BQ

Only PYE Dealers can handle Britain's Largest range of Transistor Portables

Last year 15% of our portable production was devoted to transistor models. This year it will be 50%. And next year the proportion will be even larger. To the great majority of the public the transistor portable means one thing . . . Pye!

Tecnico Ltd., Sydney, Australia.

Pye Limited, Auckland, C.I. New Zealand.

Deutsche Pye G.m.b.H., Berlin-Zehlendorf-West, Roonstrasse 2, Germany.

Svenska Pye A.B. Landsvagen 47, Sundbyberg, Sweden.

Pye (Ireland) Ltd., Dublin, Eire.

Pye Limited, Mexico City.

Pye (Canada) Ltd. Northline Road, Toronto.

Pye Corporation of America, 1149 Raritan Avenue, Highland Park, New Jersey, U.S.A.

PYE LIMITED OF CAMBRIDGE

Voltage Amplifiers

MODEL 1439 WIDE-BAND AMPLIFIER
for TV and VHF distribution systems.
The Amplifier is designed to provide simultaneous distribution of signals anywhere in Bands I, II and III, enabling a common aerial to be used for a number of television or VHF radio receivers or other applications requiring a wide band voltage amplifier.

Voltage gain: 20dB at 60 Mc/s.
Bandwidth: better than 40 Mc/s—220 Mc/s.
Output voltage: 3V pk-pk max.
Input and output impedance: 72Ω (matched coaxial).

MODEL 1440 PRE-AMPLIFIER

This instrument is a directly coupled pre-amplifier of high stability which has been designed for use in cascade with a further amplifier or with a recording device.

Frequency response: d.c.: 0—50kc/s, a.c.: 5c/s—50kc/s.
Gain: continuously variable 10-55 (d.c.), 165 (a.c.)
Input: balanced or unbalanced, impedance 11.2MΩ (grid-grid.)
Output: balanced or unbalanced, impedance 2000Ω (output 1—output 2).
Output voltage: 5V pk-pk max. (output 1—output 2).
Calibration signal: 1mV or 10mV.

MODEL 1442 LABORATORY HIGH-GAIN AMPLIFIER

Model 1442 has been designed for use in the Laboratory and is suitable for voltage amplification in the low frequency ranges. It can be used for special applications in Industry, Nuclear Physics Laboratories, neuro- and myo-graphic investigations and similar purposes.

Frequency response: 5c/s—5kc/s (gain 10^4 and 10^5) 25c/s—3kc/s (gain 10^6).
Gain: 10^6 Max. Switched and variable controls provide continuous variation.
Input: balanced or unbalanced, impedance 20MΩ (grid-grid).
Output: balanced or unbalanced.
Output voltage: 400V pk-pk max.
Calibration signal: 0.1 mV, 1mV or 10mV.

Write for the latest Cossor catalogue or ask for a representative to call and discuss your special requirements.

COSSOR INSTRUMENTS LTD

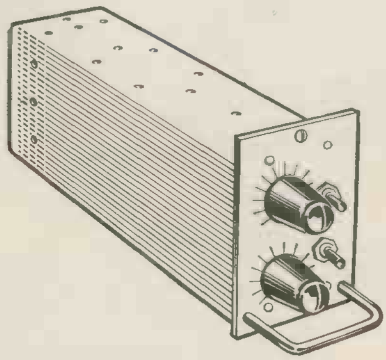
The Instrument Company of the Cossor Group

COSSOR HOUSE, P.O. BOX 64, HIGHBURY GROVE, LONDON, N.5.
Telephone: CANonbury 1234 (33 lines) Telegrams: Cossor, Norphone, London Cables: Cossor, London Codes: Bentley's Second
TAS/CI 17

A.W.A
ELECTRONICS

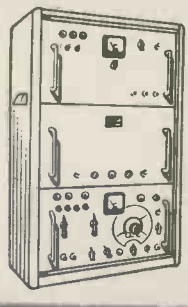
New concepts in electronics have been developed at AWA, as a result of experience with missile systems. Now they have a wider application. Here are some of the new AWA devices now available to industry.

TRANSISTOR GALVANOMETER AMPLIFIER



This Amplifier has been designed to drive viscous damped recording galvanometers which normally have a resistance of 50 ohms and a working range of D.C. to 2 Kc/s in frequency. The amplifier has a switched attenuator at its input and will accept single ended or push pull signals from ± 1 Millivolt to ± 500 volts and will feed a maximum of ±50 Milliamps to the galvanometer. There is also a range of ancillary units available for use with this Amplifier as part of a comprehensive instrumentation system. *Standard specification: Dimensions: 4¼ in. x 3¾ in. x 10 in.; Frequency response: Flat from DC to 2 Kc/s, 5% down at 3 Kc/s, 3db down at 6 Kc/s; Noise level: less than 10 Microvolts; Input impedance: 40,000 ohms on range 5, 110,000 ohms all other ranges; Gain: Maximum 7.5 Milliamps/Millivolt, minimum 0.04 Milliamps/Volt; Power requirements: ± 6 Volts D.C. 220 Milliamps each line.*

COMEL 8 & 12 SWEEP OSCILLATOR AND VIBRATION CONTROLLER



This unit is designed to drive vibrator amplifiers and has a wide frequency range. The sweep speed is variable over a range 12:1 and automatic frequency sweep facilities are provided. *Frequency range: 10 c.p.s. to 32 Kc/s in ranges of 5 octaves each. There are 7 switch speeds ranging from 5 secs./octave-60 secs./octave. Variety of Outputs available. Vibration Controller: Input: 4V r.m.s. at appropriate frequency. Output: Up to 100 mV r.m.s. into 600 ohms. Pick Off: Sensitivity 10 mV r.m.s. per "g" peak. Overall Dimensions: 35″ x 22″ x 14″. The Vibration Controller will control ± 40 "g" or as determined at low frequencies by the excursion of the vibrator table.*

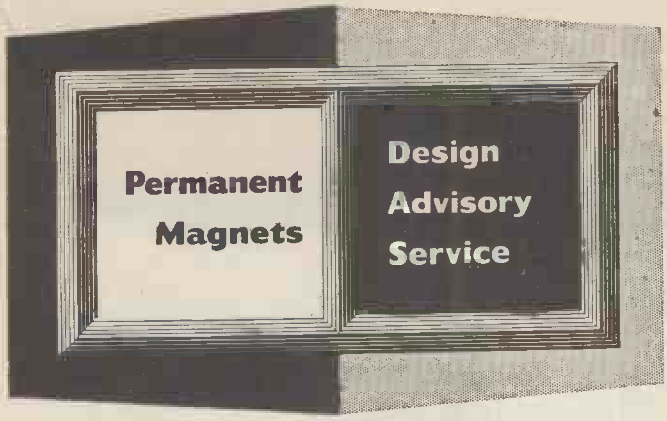
All devices are adaptable to suit customers' own requirements. For further information consult:

COMMERCIAL ELECTRONICS DEPT.

SIR W. G. ARMSTRONG WHITWORTH AIRCRAFT LTD., Baginton, Coventry

MEMBER OF THE HAWKER SIDDELEY GROUP

No. 14



Magnetic Attraction Applications – 2

Advertisements in this series deal with general design considerations. If you require more specific information on the use of permanent magnets, please send your enquiry to the address below, mentioning the Design Advisory Service.

The performance of modern magnets enables engineers to design equipment with smaller dimensions or improved performance, and has made practical the development of efficient magnetic couplings which transmit torque through hermetically sealed diaphragms.

The magnets in magnetic couplings cannot exert the same useful force as similar magnets would when in contact. This is due to two reasons:—

(a) There is of necessity, a gap in the magnetic circuit to accommodate a partition between the two sections of the coupling.

(b) The direct pull between the magnetic poles cannot be used since it is only the shearing force that transmits the torque.

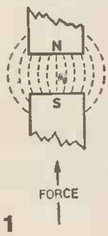


Fig. 1

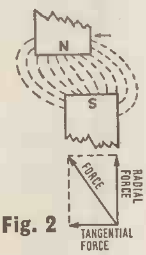


Fig. 2

When the poles are coincident there is no resultant tangential force as in fig. 1.

When the poles are displaced, the force between the poles is at an angle so that the force can now be considered to consist of two vector quantities F. (radial) and F. (tangential) as in fig. 2.

Maximum torque is generally obtained when the poles are displaced by about half a pole width.

It will be obvious from the above diagrams that torque is produced over a limited range by the angular displacement between the two sections and that the torque transmitted by a given coupling depends on the number of poles, their strength and their distance from the axis of rotation.

In the example fig. 3, the material forming the partition separating the two sections of the coupling has received considerable attention. If non-conducting materials are considered, difficulties are introduced in design and manufacture due to lack of strength and difficulty with hermetic sealing. Metals are particularly suited to manufacturing methods as they can be welded or brazed to produce really sound hermetic seals. It should be noted however, that eddy currents are produced by the moving magnetic fields and the resultant heating and loss of torque may become serious if the coupling is driven fast.

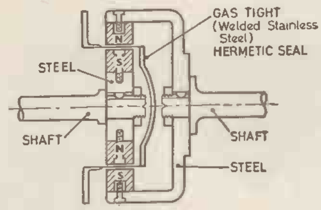
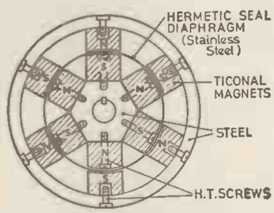


Fig. 3



For certain applications, it is advantageous to make the partition from stainless steel, which has the advantage of great physical strength so that the thickness of material may be kept to a minimum, and the reluctance of the magnetic circuit reduced. Moreover, the relatively high resistivity of stainless steel tends to keep the eddy currents and heating effects to a low and tolerable value. Stainless steel has a further advantage in that it is slightly magnetic and consequently reduces the effect of the air gap; but if the pole spacing is small, loss of flux and performance may result from direct conduction of flux between the poles by the stainless steel.

Hermetically sealed magnetic couplings are in everyday use giving effective torques up to 100 lb./ft. with pressure differences of up to 1,000 lb./sq. in. between the two sections, and larger sizes present no difficulties in design and construction.

If you wish to receive reprints of this advertisement and others in this series write to the address below.

Mullard

'TICONAL' PERMANENT MAGNETS
'MAGNADUR' CERAMIC MAGNETS
FERROXCUBE MAGNETIC CORES

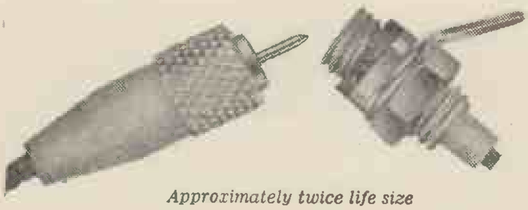
MULLARD LIMITED, COMPONENT DIVISION, MULLARD HOUSE, TORRINGTON PLACE, W.C.1. LANgham 6633

MC276A

The very best connections

. . . secured by Plessey

SUB-MINIATURE COAXIAL CONNECTORS



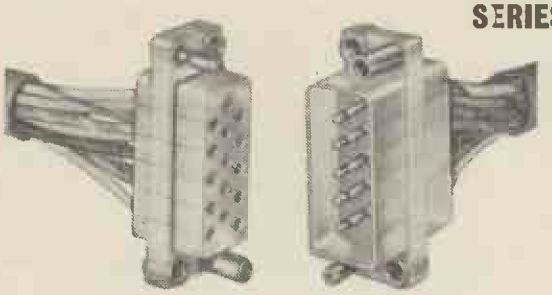
Approximately twice life size

As a contribution towards increasingly compact equipment, Plessey have introduced this new, highest quality and fully comprehensive range to allow a new approach on applications hitherto restricted by the limitations of existing connectors.

Designed for the matched impedance coupling of high frequency coaxial cables operating in the super high frequency bands, these connectors—

- have a working voltage of 650 volts Peak at sea level, and matched impedance coupling of 50 ohm lines is accommodated.
- have hard gold plated contacts on silver plate to give maximum performance with minimum voltage drop.

SERIES '110' (15- and 30-way) MINIATURE RECTANGULAR CONNECTORS



Developed specifically by Plessey to meet the demand for a safe, inexpensive connector for commercial applications, this new series embodies excellent electrical and mechanical characteristics, and the many unique features that make it really outstanding include :—

- Plug pins and socket inserts are polythene shrouded to dispense with gaskets and ensure insert anchorage.
- Mismating is prevented by corner pins and corner sockets.
- Extreme simplicity of wiring, demands less-skilled operation than the orthodox methods of soldering pins *in situ*.

For further information, please write for Publication numbers 128 and 114.

Plessey

ELECTRICAL CONNECTORS DIVISION · THE PLESSEY COMPANY LIMITED

CHENEY MANOR · SWINDON · WILTS · TELEPHONE: SWINDON 6251

Overseas Sales Organisation: PLESSEY INTERNATIONAL LIMITED · ILFORD · ESSEX

CW6a

BY APPOINTMENT
TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

PYE

PORTABLE LOUD SPEAKING EQUIPMENT

3 WATTS The Hand Portable Electronic Megaphone weighs only 5 lb. The transistor amplifier gives more than 3 watts output. It uses standard torch batteries which last about six months.

The Portable Electronic Megaphone with adjustable stand and separate microphone is suitable for all temporary occasions. It can be stood, mounted at an angle or easily carried. It is similar to the Hand Portable and is completely self-contained.

Pye Portable Public Address equipment is transistorised for maximum portability and minimum current consumption. It is the perfect answer to all situations where mobility, temporary use or lack of power supplies make it impractical to use more conventional systems.

Ideal for police, fire services, political meetings and electioneering vehicles, garden fetes and sports meetings, touring coaches and all types of ships, passenger and freight control on railways, building operations and many others too numerous to mention. Intrinsically safe versions of this equipment are available which have been certified as suitable for use in methane and pentane atmospheres by the Ministry of Power and the Ministry of Labour Factory Inspectorate.

10 WATTS The Portable Transistor Amplifier weighs only 5½ lb. and measures 8″ x 3½″ x 6″. It will deliver 10 watts output for a consumption of 1.8 amps from a 12 volt battery. It is ideal for use in moving vehicles or on sites where a mains supply is not available. A comprehensive selection of microphones and loudspeakers is available.

PYE TELECOMMUNICATIONS LTD.

NEWMARKET ROAD · CAMBRIDGE
Telephone: Teversham 3131 Telegrams: Pyetelecom Cambridge

PYE PANORAMA

FEATURING PYE TELECOMMUNICATIONS EQUIPMENT

BY APPOINTMENT
TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

Instrument Landing System

Pye Instrument Landing System is used by the Royal Air Force as the standard approach aid enabling aircraft to be safely brought down from a distance of 30 miles to within 150 feet of the runway bar lighting. Approved by the British Air Ministry and Ministry of Transport and Civil Aviation, Pye I.L.S. surpasses I.C.A.O. specification in performance, reliability and refinement and is in operation on civil and military airfields throughout the world.

PYE TELECOMMUNICATIONS LIMITED

NEWMARKET ROAD • CAMBRIDGE

Telephone: Teversham 3131. Telegrams: Pyetelecom Cambridge.

PYE PANORAMA

FEATURING PYE TELECOMMUNICATIONS EQUIPMENT

BY APPOINTMENT
TO H.R.H. DUKE OF EDINBURGH
SUPPLIERS OF
RADIO TELEPHONE EQUIPMENT
PYE TELECOMMUNICATIONS LTD.

Fan Marker Beacon

The Pye PTC 1120 Marker Beacon is designed to meet the requirements of the I.C.A.O. Specification relating to a 75 Mc/s en Route Marker Beacon for air navigation. The Beacon radiates a horizontally polarised fan-shaped vertical beam modulated at 3000 c/s.

The equipment is self-monitoring and includes automatic changeover to a stand-by transmitter. Suitable for use on 100–200 V. a.c. with a maximum power consumption of 0.75 kVA.

PYE TELECOMMUNICATIONS LIMITED

NEWMARKET ROAD • CAMBRIDGE

Telephone: Teversham 3131. Telegrams: Pyetelecom Cambridge.

"This incomparable Ferrograph of mine"

It was a letter from a customer. He was telling us how—temporarily at a loose end after selling his business—he decided to take up tape recording as a hobby. "Because for years good music had been my secret passion" he wrote, "I wanted to make sure that I bought the right machine. How glad I am to-day that I did take so much trouble, for few purchases have ever given me so much pleasure as this incomparable Ferrograph of mine. Quite literally, it has opened wide the doors to the great masters and enabled me to enjoy their music as never before."

Of course not everyone is a keen student of music and the extremely high standard of performance attainable with a Ferrograph would not be required by those content to use a Tape Recorder merely as a pleasant source of home entertainment. We make no secret of the fact that—due to a policy of restricted output (inevitable when quality instead of quantity is the controlling factor)—the Ferrograph costs more than most others. But this is the price one pays for quality without compromise—for the ultimate in performance—for the satisfaction of knowing that there is nothing better even if you are as rich as Croesus.

May we send you an illustrated Folder giving full technical details.

The Ferrograph Tape Recorder has been accepted by the Council of Industrial Design for the "Design Index".

Series 4A

With standard monaural Recording/Playback facilities

Model 4A/N	$3\frac{3}{4}/7\frac{1}{2}$ i.p.s.	81 gns.
*Model 4AN/CON	$3\frac{3}{4}/7\frac{1}{2}$ i.p.s.	81 gns.
Model 4A/H	$7\frac{1}{2}/15$ i.p.s.	86 gns.
*Model 4AH/CON	$7\frac{1}{2}/15$ i.p.s.	86 gns.

** Suffix CON denotes chassis form for building into own cabinet.*

Series 4S

With optional stereo sound playback facilities in addition (when used with Stere-Ad Unit.)

Model 4S/N	$3\frac{3}{4}/7\frac{1}{2}$ i.p.s.	88 gns.
*Model 4SN/CON	$3\frac{3}{4}/7\frac{1}{2}$ i.p.s.	88 gns.
Model 4S/H	$7\frac{1}{2}/15$ i.p.s.	93 gns.
*Model 4SH/CON	$7\frac{1}{2}/15$ i.p.s.	93 gns.
Stere-Ad Unit (when required)		30 gns.

Stereo 88

With full stereophonic recording and playback facilities

Model 88 $7\frac{1}{2}/15$ i.p.s. 105 gns.

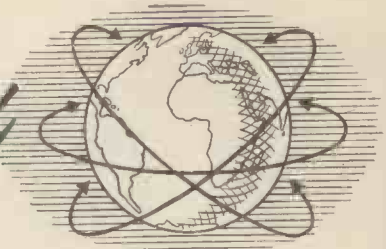
The Incomparable Ferrograph

BRITISH FERROGRAPH RECORDER CO. LTD.

(A subsidiary of The Ferrograph Company Ltd.)

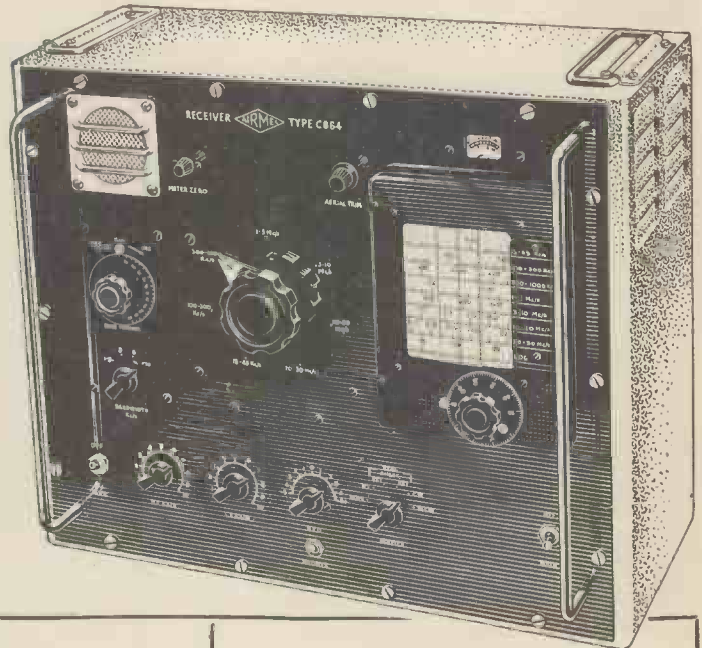
131 SLOANE STREET, LONDON, S.W.1 · Tel: SLOane 1510, 2214 and 2215

all round the world



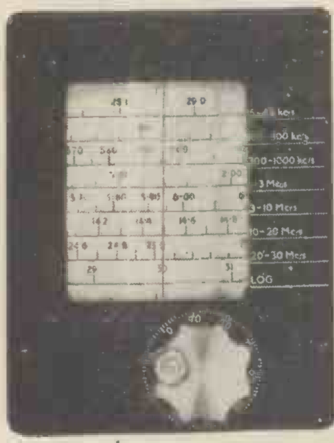
AIRMEC

COMMUNICATIONS RECEIVER Type C864



All round the World this Airmec receiver is known and used for its remarkable performance at an extremely low cost.

Superior Sensitivity
Superior Signal-to-Noise Ratio
Superior Second Channel Rejection



Main tuning control showing a portion of the seven frequency scales, the coarse and fine logging scales and the movable cursor.

- Frequency coverage from 15—45 kc/s and 100 kc/s—30 Mc/s.
- Frequency setting accuracy better than 1kc/s.
- Film scale giving actual scale length of 4ft. on each frequency range.
- 90 : 1 slow motion drive with logging scale.

ADDITIONAL FEATURES

- **Separate incremental tuning control for use with crystal calibrator.**
- **Double frequency changer circuit.**
- **Stabilised local oscillator H.T. voltages.**
- **Image rejection over 100 db.**
- **Exceptionally high sensitivity and signal/noise ratio.**
- **Variable selectivity.**
- **S meter incorporated.**
- **Very stable B.F.O.**
- **Muting facilities provided.**
- **Built-in loudspeaker.**
- **2 watts output.**
- **Turret band switching.**

SEND FOR LEAFLET 160A

Airmec

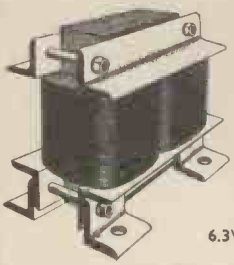
RADIO AND ELECTRONICS

AIRMEC LIMITED · HIGH WYCOMBE · BUCKS
Telephone: High Wycombe 2060

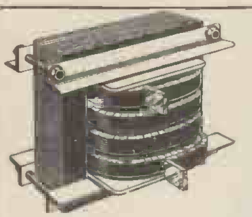
TRANSFORMERS

All for 200/250 V. Input, Other Supply Voltages as Required
CONTINUOUS RATING, Short Rating Transformers also available

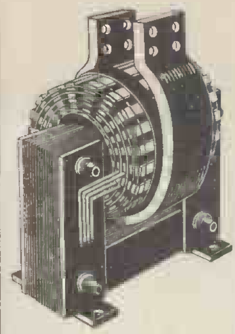
Each of the eight Transformers below:—
£6/10/-



OUTPUTS:
12 V. 40 Amps.
6-12-18-24-30 V. 12 Amps.
5 V. 80 Amps.
18 V. 30 Amps.
110-120 V. 4 Amps.
55 V. 12 Amps.
4 V. 100 Amps.
6.3V. 18 Amps. or 12.6 V. 9 Amps.

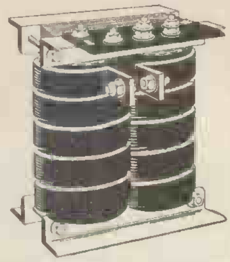


5 V. 140 Amps.	£8 10 0
110-120 V. 10 Amps.	£12 10 0
40 V. 25 Amps.	£13 15 0
5 V. 300 Amps.	£15 0 0
6-12 V. 50 Amps.	£8 10 0
12 V. 60 Amps.	£10 0 0
12 V. 100 Amps.	£15 10 0
50 V. 60 Amps.	£21 0 0
110 V. Centre Tapped 55 V. 25 Amps............	£26 0 0
10-15-25 V. 100 Amps............	£26 0 0
6-8-10-18-24 V. 100 Amps............	£28 0 0



4 V., 5,000 Amps.	£100 0 0
2 V., 10,000 Amps.	£98 0 0
3.5V., 20,000 Amps.	£127 0 0
2 V., 30,000 Amps.	£130 0 0
10 V., 2,000 Amps.	£103 0 0

10 V. 1,000 Amps....	£59
10 V. 500 Amps....	£38
10 V. 750 Amps....	£48
9 V. 900 Amps....	£49
12 V. 1,000 Amps....	£64
15 V. 1,000 Amps....	£75
20 V. 800 Amps....	£80
10 V. 300 Amps....	£28

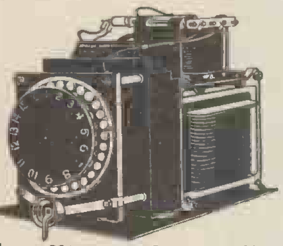


PORTABLE SHROUDED TRANSFORMERS

Each of the five Transformers below:
£8/12/-

6-12-18-24-30 V., 12 Amps.
24 V., 30 Amps.
110-120 V. 4 Amps.
12 V., 40 Amps.
55 V., 12 Amps.

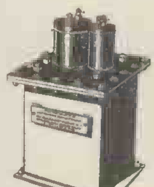
Most Transformers up to 2 kVA can be supplied in steel case with protected terminals and carrying handle.



VOLTAGE REGULATING TRANSFORMERS

£16

Input 230/240 V. Output 50 V. to 250 V. in 16 steps of 12.5 V. at 25 Amps. These are Auto Transformers with Quick Make-and-Break Tapping Switches.



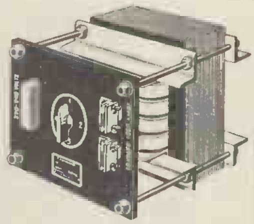
HIGH-VOLTAGE TRANSFORMERS

1450 V. 300 mA.	£8 10 0
3 kV. 2 mA.	£4 0 0
10 kV. .23 mA....	£9 0 0
4 kV. 2.5 mA. ...	£5 0 0

TRANSFORMERS WITH SWITCHED TAP CONTROL

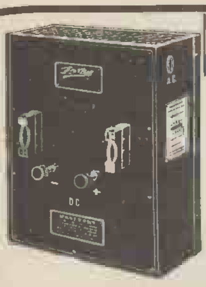
Available with one or more Switches, Ammeters, Fuses, etc.

TRANSFORMERS WITH INFINITELY VARIABLE CONTROL OF OUTPUT



Combinations of Transformer with attached Variac for very fine control.

MANY OTHER STOCK TRANSFORMERS



RECTIFIER SETS

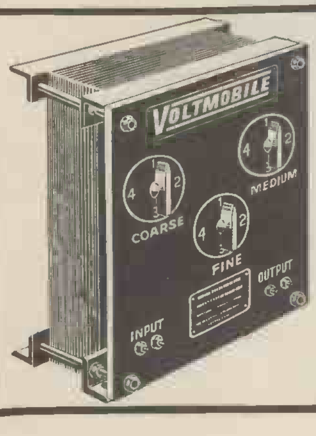
All for 200/250 V.A.C. (Other supply Voltages available)

Rectifier Sets with D.C. Output Control by internal taps.
D.C. Volts ON LOAD are stated.

110/120 V. D.C., 10 Amps....	£29 0 0
200/250 V. D.C., 10 Amps. ...	£36 0 0
200/250 V. D.C., 18 Amps. ...	£46 0 0
35/38 V. D.C., 50 Amps.	£40 0 0
34 V. D.C., 10 Amps............	£22 0 0
1,200 V. D.C., 200 mA............	£18 0 0
60 V. D.C., 5 Amps.	£22 0 0
200/250 V. D.C., 9.5 Amps. ...	£32 0 0
6.3 V. D.C. 13 Amps. and 220 V. D.C. 110 mA............	£18 10 0

Rectifier Sets with Control of D.C. Output by Tap Switches. Fitted with Fuses. D.C. Volts ON LOAD are stated.

12/25 V. D.C., 12 Amps.	£15 10 0
12/25 V. D.C., 20 Amps.	£24 0 0
110/120 V. D.C., 25 Amps. ...	£55 0 0
15 V. D.C., 5 Amps., Meter and Internal Rheo..................	£8 10 0
6.3 V. D.C., 13 Amps. and 220 V., 110 mA..................	£18 10 0
Fitted Ammeters and Voltmeters, per meter	£2 10 0
Built-in Rheostats	£3 0 0



VOLTAGE REGULATING TRANSFORMERS

Covering the range from zero Volts to supply Volts in 64 steps. This is achieved by switching ON LOAD.

INPUT 240 V. OUTPUT 0/240 V. Change per Step, 3.8 V. (1.6%)		INPUT 420 V. OUTPUT 0/420 V. Change per Step, 6.5 V. (1.6%)	
40 Amps.	£50	40 Amps.	£55
60 Amps.	£56	60 Amps.	£63
80 Amps.	£74	80 Amps.	£80

RECTIFIER SETS

350/440 V. 3-Phase input

12 V. 210 Amps. or 24 V. 105 Amps.	£78
35/38 V. D.C., 50 Amps..........	£40

SPECIFIC ENQUIRIES

are invited for Transformers and Rectifiers.

We specialise in
HEAVY CURRENT EQUIPMENT

HARMSWORTH, TOWNLEY & CO.
2 JORDAN STREET, MANCHESTER 15. CENTRAL 5069

... the art of the matter

FERRANTI

offer the widest range of

SILICON Semiconductor Devices

in the United Kingdom

Ferranti Ltd. were the first company in Britain to introduce Silicon semiconductor devices as used in magnetic amplifiers, in aircraft, guided missiles, radar and computers. Until recently they were the only firm in the United Kingdom supplying silicon diodes in quantity. Commencing their programme of research and development in 1954, they have already made outstanding contributions to technique, and are now producing at Gem Mill, Oldham well over half-a-million silicon diodes annually in the widest range offered by any British manufacturer.

Among the 120 or more different devices available for delivery are rectifiers, fast diodes, zener diodes, tetra-layer diodes and triodes, alloy junction transistors, diffused junction transistors, photo-voltaic cells, voltage variable capacitors and many new ones.

Data Sheets, Application Reports etc., advice and assistance in techniques of application are freely available.

FERRANTI

SILICON

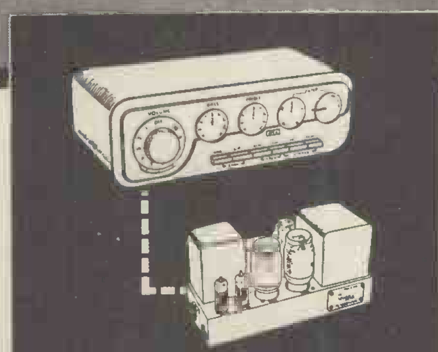
SEMICONDUCTOR DEVICES

Visit the International Transistor Exhibition promoted by the Electronics and Communications Section of The Institution of Electrical Engineers, 21-27 May, at Earls Court, London. Admission by ticket only, available from Ferranti Ltd. or from the I.E.E.

FE 189

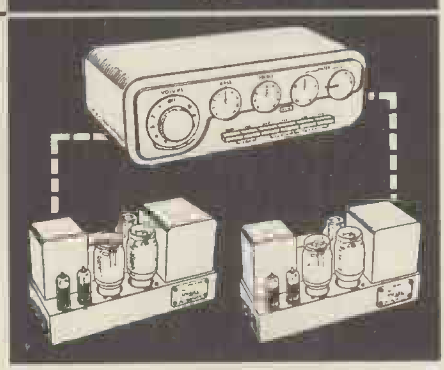
THE QUAD 22 CONTROL UNIT

. . . a new unit anticipating trends in future listening requirements



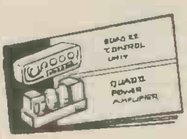
Used with a single QUAD II power amplifier

the unit provides every facility and refinement at present associated with the QUAD II control unit.



Used with two QUAD II power amplifiers,

the unit will in addition accommodate all forms of Stereo programmes with all the necessary facilities for that medium. Whilst providing extreme flexibility—the push buttons for example, provide nineteen different services—straightforward and logical control has been maintained.

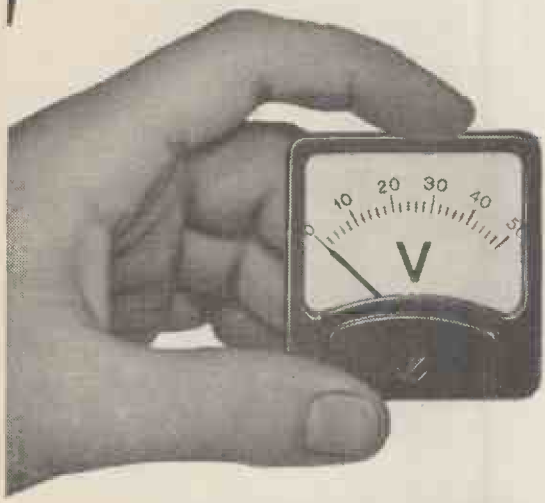


A descriptive booklet is now available—free on request.

ACOUSTICAL MANUFACTURING CO. LTD. HUNTINGDON, HUNTS. *Telephone. Huntingdon 361*

A COMPREHENSIVE RANGE OF

"Miniature" Instruments



Above: 2″ square moving coil voltmeter

★ **DESIGNED TO HARMONISE WITH ALL MODERN ELECTRONIC EQUIPMENT**

★ **FIXINGS CONFORM TO ACCEPTED PRACTICE**

★ **PRICES ARE HIGHLY COMPETITIVE**

For utmost reliability all 'ENGLISH ELECTRIC' miniature instruments have been designed with a higher-than-normal torque/weight ratio in combination with lower power consumption. All types have been successfully subjected to the following tests:

RESISTANCE TO IMPACT SHOCK OF 200g in any plane.

VIBRATION FATIGUE TEST—two million cycles at peak resonant frequency.

OSCILLATORY TEST—up to one million operations.

SPECIFICATIONS B.S. 89–1954 and other International Specifications.

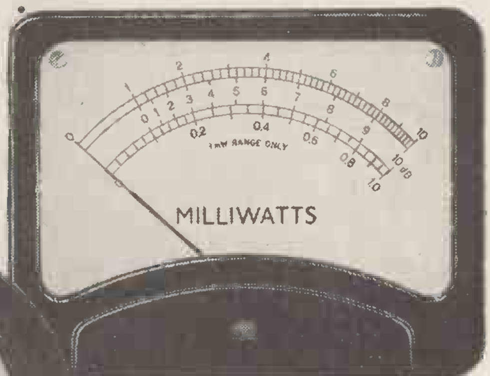
TYPES

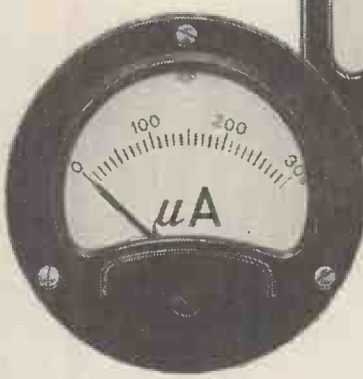
Moving coil for D.C. applications.
Rectifier moving coil for A.F. applications.
Thermo-couple operated moving coil for R.F. applications.

SIZES

Square: 2″, 2½″ and 3½″ nominal scale length.
Round: 2½″ and 3½″ nominal scale length.
Rectangular: 5″ x 6″ or 3″ x 4″ nominal case size.

Design registrations pending.





Above: 3″x 4″ rectangular absorption wattmeter

Left: 2½″ round moving coil microammeter

Over 50 standard ranges in any of the seven case types.

Delivery ex stock for standard ranges.

Non-standard ranges to customer's specification within 21 days.

Literature available on request to The ENGLISH ELECTRIC Co. Ltd., Instrument Department, Stafford.

'ENGLISH ELECTRIC'

THE ENGLISH ELECTRIC COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2

Meter, Relay and Instrument Division, Stafford

WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

INS.43A

TWO NEW COMPACT LOUDSPEAKER SYSTEMS

by Wharfedale

REGISTERED TRADE MARK

Model W3

The W3 is a three-speaker system in which compactness has been achieved without sacrificing quality of reproduction and without introducing "small box" tonal character. It is ideal for use on a stereo or single channel input where room space is limited, as the cabinet may be stood vertically on the floor or placed horizontally on a table or shelf. The sensitivity is high enough to give full domestic volume with any good commercial FM receiver with about 3 watts output.

BASS

L.F. output is produced by a special 12in. unit type WLS/12 fitted with a heavy cone and a new type of suspension which permits large linear excursions and gives a low fundamental resonance of 25-30 c/s.

TREBLE

The upper registers are handled by 5in. and 3in. units connected in parallel via a quarter section 1 kc/s. dividing network, with an extra series capacitor to protect the small speaker.

Two volume controls permit adjustment of midrange and treble to give tone control and facilitate balancing different speakers on stereo.

Cabinet size 28 x 14 x 12in.

Weight 48lb. complete. Impedance 15 ohms.

Max. input 15 watts.

Effective frequency range 30-17,000 c/s.

Price £39/10/- complete, tax free.

The elegant cabinet is fully finished on all four sides in a choice of walnut, oak and mahogany. Also available in whitewood price £36/10/-. Tropical model made with resin bonded plywood can be supplied at £2 extra.

Model W2

This two-speaker model also employs the WLS/12 unit for the bass with crossover at 1 kc/s. to a Super 5 loudspeaker fitted with volume control for adjustment of H.F. response.

Cabinet 23½ x 14 x 12in.
Weight 42lb. complete. Impedance 15 ohms.
Max. input 15 watts.
Effective frequency range 30-15,000 c/s.
Price £29/10/- complete, tax free.

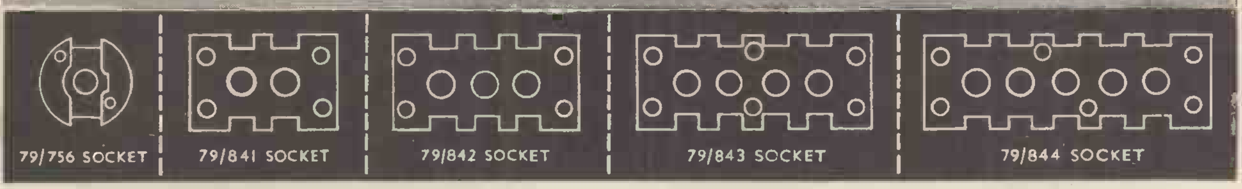
Finished in a choice of walnut, oak and mahogany. Also available in whitewood price £27/10/-. Tropical model with resin bonded plywood can be supplied at £1/15/- extra.

Wharfedale
WIRELESS WORKS LTD
IDLE BRADFORD YORKS

Catalogue giving full technical details, response curves and oscillograms of the above models, available free on request.

Telephone: Idle 1235/6. Telegrams: 'Wharfdel' Idle, Bradford.

C

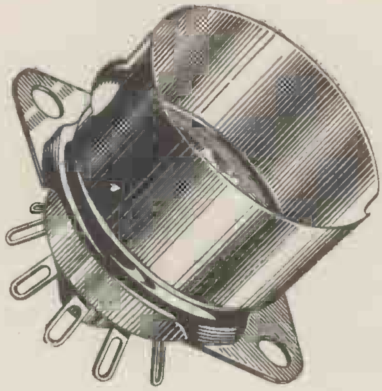


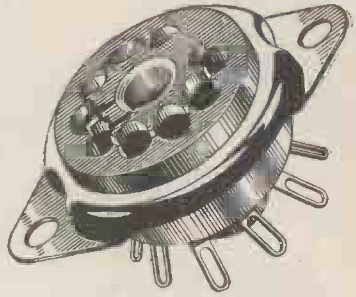
The design and dimensions are to the international standard. With the sockets, backing plates can be supplied for complete insulation from the chassis.
Please write for Leaflet No. 4992

CINCH

CARR FASTENER CO LTD

STAPLEFORD · NOTTINGHAM



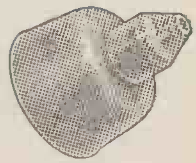


P.T.F.C.E. VALVEHOLDERS

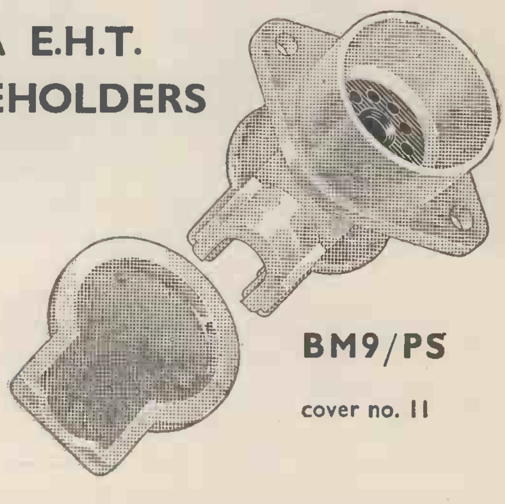
B7G and B9A

* Low Loss—Grade I. * Fully Tropicalised —Class H I. * Silver Plated Phosphor-Bronze Contacts.
P.T.F.C.E. Mouldings have similar properties to P.T.F.E. but they are less costly to produce.
Full inter-service type approval to Z.560092 —Z.560094—Z.560095—Z.560134

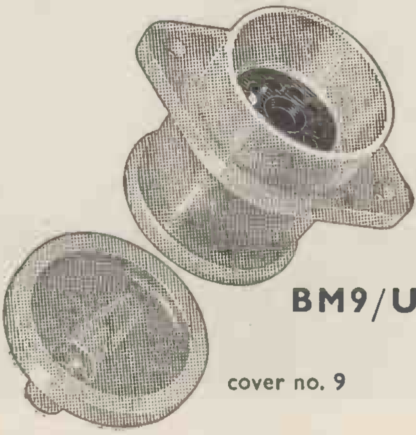
McMURDO · ELECTRONIC



TC2



B9A E.H.T. VALVEHOLDERS



BM9/UV

cover no. 9

Polythene Shrouded B9A. Valveholder for Television E.H.T. Rectifiers.

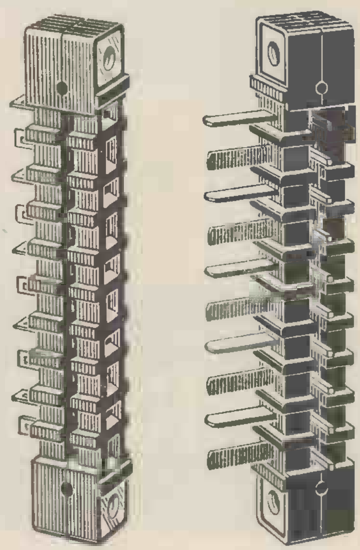
BM9/PS

cover no. 11

Send for full details to :— The McMurdo Instrument Co. Ltd.,

THE NEW "MICROCON" PRINTED CIRCUIT CONNECTORS

Microcon Printed Circuit Connectors are designed to meet the requirement for a light, compact, multi-way plug and socket, giving greater reliability and longer life than the edge connector method. Other patterns will soon be available, as well as the ten-way connector shown here.



The pitch of soldering tags is suitable for a board punched to a standard module of 0·1".

Two types of plug are available—the first has the solder tags orientated at 90° to the contact blades, the second has solder tags that are a continuation of the blades.

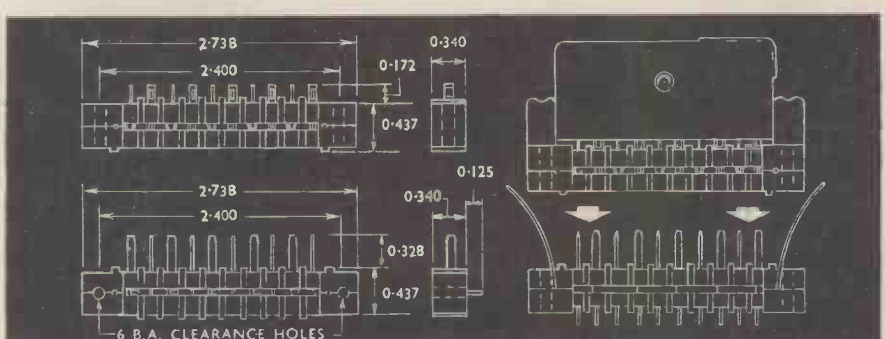
A metal cover can be fitted to either the plug with the straight blades or to the socket, and the mating unit can be supplied with wire retaining loops.

The two-part diecast cover, whose inner surfaces are insulated against short-circuiting, allows the connections to be checked physically and electrically without disturbing the clamping of the cable.

For polarizing purposes, when several connectors are mounted in close proximity, one or more contacts can be removed from each plug in various combinations, the corresponding contact in the mating socket being blanked off by special polarizing keys.

Illustrated are some of the styles available

Write for technical leaflet



Painton & Co. Ltd.
KINGSTHORPE NORTHAMPTON
Tel: 32354/7 Telegrams: 'Ceil, Northampton'

W B Stentorian

High Fidelity at realistic cost

ACCLAIMED BY THE EXPERTS

JOHN GILBERT
Technical Editor "Music Trades Review"

PERCY WILSON
Technical Editor "The Gramophone"

DONALD ALDOUS
Technical Editor "Gramophone Record Review"

MILES HENSLOW
Editor "Record News"

Outstanding success at the Audio Fair

Visitors to our Stand at the Show were enthusiastic in their praises of our enlarged range of HiFi speakers and cabinets. Never before has our slogan "High Fidelity at realistic cost" been more apt—or so comprehensive.

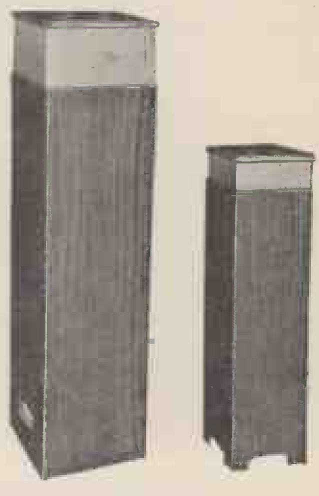
H.F.1016

Incorporates a very powerful magnet assembly, which combines with the cambric cone to provide brilliant transient response when the speaker is mounted in a bass reflex cabinet.

10″ Die-cast Chassis - 16,000 gauss magnet 10 watts handling capacity - Patented Stentorian Cambric Cone - Universal Impedance Speech Coil (instantaneous matching at 3, 7·5 and 15 ohms) 30-15,000 c.p.s. frequency response - 35 c.p.s. bass resonance.

£8 (INC. P.T.)

W.B. STEREO COLUMNS



The floor area occupied is much smaller than that for two conventional cabinet speakers of similar performance. Columns have 360° diffusion by means of a dome mounted above the loudspeaker. One unit may be used for monaural sound and a second added for stereo.

"SENIOR" for 8″ unit **£18.18.0**
H.F.816 Unit - - - £6.17.0
"JUNIOR" for 6″ unit **£9.19.6**
H.F.610 Unit £2.11.6 or £2.13.6

T.359 CONE TWEETER UNIT

Speech Coil impedance, 5 or 15 ohms. Response, 3,000 to 15,000 c.p.s.

35/- (INC. P.T.)

Demonstrations at all leading Hi Fi dealers and at our London office (109 Kingsway, W.C.2) every Saturday from 9 a.m. to 12 noon. Descriptive leaflets on all products free on request.

V.H.F. TUNER

An advanced design, employing printed circuit techniques for increased stability, ensuring stable reception up to 100 miles from the transmitter. Designed to cover 88-108 Mc/s.

£23.2.0 (INC. P.T.)

W.B.8. AMPLIFIER

Designed for use with crystal pick-ups, tuner units and tape reproducers having their own pre-amplifiers. Output: 8 watts and not less than 6 watts at all frequencies.

£19.19.0

WHITELEY ELECTRICAL RADIO CO. LTD.
MANSFIELD · NOTTS.


S.T.C. goes to extremes
to produce the best valves!
Big valves, small valves, valves with unique characteristics—S.T.C. produces all types and sizes of valves. Behind each is the technical knowledge and experience gained over 35 years and the combined resources of one of the Commonwealth's largest electronic manufacturing organisations.

Promoted by the Electronics and Communications Section of
The Institution of Electrical Engineers

INTERNATIONAL TRANSISTOR EXHIBITION

21-27 MAY • EARLS COURT • LONDON

The INTERNATIONAL TRANSISTOR EXHIBITION will be held in the same building and at the same time as the *International Convention on Transistors and Associated Semiconductor Devices.*

●

These two events, both promoted by The Institution of Electrical Engineers, are attracting world-wide interest and an overall attendance of some 60,000 is anticipated.

●

The Exhibition will cover all types of semiconductor devices and their numerous applications, and will include transistor materials, equipment involving transistors and semiconductor techniques, and also various associated and specialized components for use in transistorized equipment.

●

Part of the Exhibition will be devoted solely to transistor research and development, and will include exhibits from government, industrial and university research laboratories.

●

Manufacturers wishing to participate in this unique Scientific Exhibition are invited to contact the organizing company.

●

Two thousand scientists and engineers directly concerned with transistors and their application, and coming from all over the world, are expected to attend the International Convention on Transistors, the opening lectures of which will be given by the inventors of the transistor—Dr. W. B. Shockley, Dr. W. H. Brattain, and Professor J. Bardeen.

Full details from the organizers :

INDUSTRIAL & TRADE FAIRS LIMITED
Drury House, Russell Street, London, W.C.2. TEMple Bar 3422

No. 2 OF A SERIES OF FAMOUS BRIDGES

THE VICTORIA FALLS BRIDGE

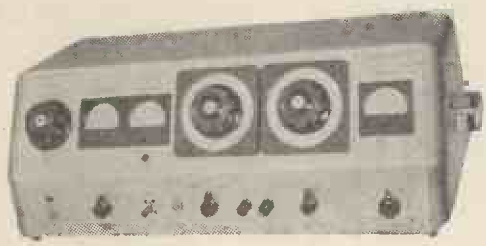
The construction of this famous railway bridge, situated immediately below the Victoria Falls, started in April 1904 and finished in July 1905. The bridge has a span of 500 feet and total length of 650 feet and its height above the River Zambezi rises to about 400 feet.

THIS BRIDGE IS ESSENTIAL TO THE DEVELOPMENT OF AFRICA. THESE B.P.L. BRIDGES ARE ESSENTIAL TO YOUR DEVELOPMENT PROGRAMME

ELECTROLYTIC CAPACITANCE BRIDGE

Model CB 154D

Capacitance range:	0.1 mFds. to 11,000 mFds (scale length 140 cms)
Power factor range:	0.4% to 75% (scale length 28 cms.)
Bridge voltage:	0.6V. r.m.s. 50 c/s.
Polarising voltage:	0-8V. D.C. to 0-800V. D.C. in 5 ranges.
Leakage current:	0-50 microamps to 0-50 mA. in 4 ranges.



NEW HIGH K CERAMIC CAPACITANCE BRIDGE

Model CB 171

Capacitance range:	100 pF. to 100,000 pF.
Accuracy:	±3%.
Power factor range:	0.2 to 10%.
Bridge frequency:	100 kc/s.
Bridge volts:	5V. r.m.s.
Polarising voltage:	0 to ± 600V. D.C. in 3 ranges.

Supplied with sample holder for extreme temperature tests.

BPL

British Physical Laboratories

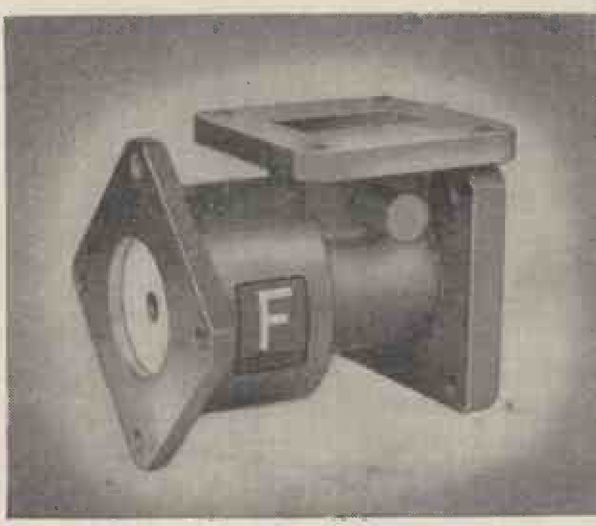
RADLETT · HERTFORDSHIRE · ENGLAND

TEL. RADLETT 4844

FERRANTI X-BAND FERRITE DEVICES

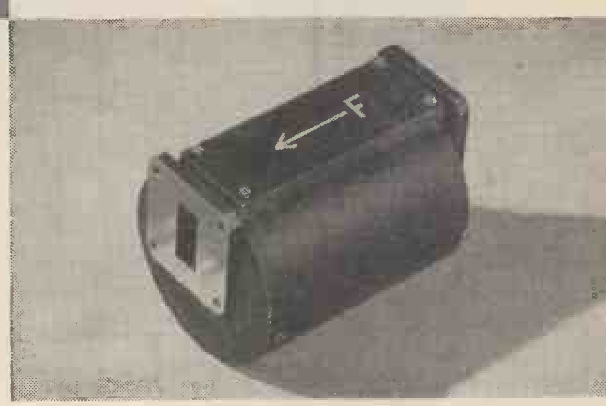
FERRITE SWITCH TYPE 3F

Frequency 9600 to 9800 mc/s. Peak attenuation 30 db min. Insertion loss ·5 db max. Power handling capacity 30 watts. Weight 3 oz.



FERRITE CIRCULATOR

A compact three port circulator capable of handling 50 kW peak, 50 watt mean. It can be pre-set to cover a bandwidth of 400 mc/s in the 3 cm. band. The magnetic field is supplied by permanent magnets. The total weight of the component is approximately 4½ oz.



FERRITE ISOLATOR

Type 2F/2. 100 kW peak, 100 watt mean.
Type 2F/3. 200 kW peak, 200 watt mean.
Isolation in both cases greater than 20 db over a bandwidth of 1000 mc/s with an insertion loss of less than 1 db.

FERRANTI

FERRANTI LTD · KINGS CROSS ROAD · DUNDEE Telephone: DUNDEE 87141

ES/T 52

... till you've heard

a TRUVOX

R2 TAPE RECORDER

From the very first replay—pre-recorded or your own home-recorded programme—you'll be thrilled with its sureness of tonal quality and ease of control. Just as you recognise the voice of a friend on the 'phone or your favourite songster on radio or record, you'll know that this is the instrument you've always wanted. Designed and built by pioneers in the development and manufacture of Tape Decks and Tape Recording Amplifiers—TRUVOX are justly proud of an instrument that lives up to "all that the name implies." Increased production at our new, modern factory now enables us to offer this famous instrument at reduced prices.

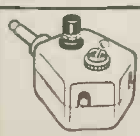
Models now available from **56 gns.**

CREDIT TERMS ARE AVAILABLE THROUGH MOST DEALERS

★ GO STEREO WITH A TRUVOX Stereophonic TWINSET

This equipment can be built up from an existing Truvox R2 (monaural) Recorder. We fit the recorder with a stereo head and supply Unit 'B' (comprising correctly matched amplifier and loudspeaker together with additional microphone and leads). Send for full details.

TRUVOX Stereophonic Head for replay of pre-recorded stereophonic tapes.



TRUVOX RADIO JACKS direct radio reception and recording.

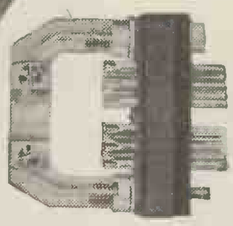
TRUVOX TELEPHONE ADAPTOR for 2-way telephone conversation recording.

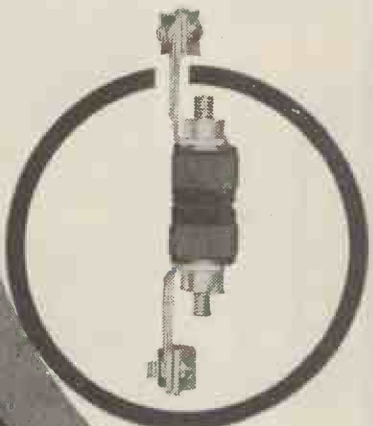
Available from all leading stores and radio dealers

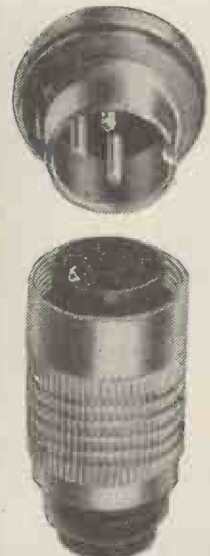
TRUVOX LIMITED, NEASDEN LANE, LONDON, N.W.10 *Telephone: Gladstone 6455*


OPERATIONAL RELIABILITY
RADIO PRODUCTS
EDDYSTONE
TRADE MARK
EDDYSTONE
VHF & UHF
(AM & FM)
Communications
Receivers
Model 770R.
19-165 Mc/s.
Model 770U.
150-500 Mc/s.
Agents in all parts of the world
Please write for full Technical Specifications to the Manufacturers
STRATTON & CO. LTD., BIRMINGHAM, 31

a firm GRIP on complex connection







From their wide selection of plugs and sockets, MODAC offer a standard range of rectangular and circular miniature connectors, to which is soon to be added a sub-miniature range with combinations of 10, 16, 28 and 34 contacts.

The main feature of this advanced design is the independently sprung, multi-point contact which provides self-cleaning, low contact resistance and is ideal under conditions of vibration.

MODAC is equipped for the design of connectors to customers' specifications and to supply any of their range as cable assemblies.

They are more than willing—at any time—to come to grips with your general wiring problems.

Modac miniature and sub-miniature connectors

'Modac' is a Registered Trade Mark

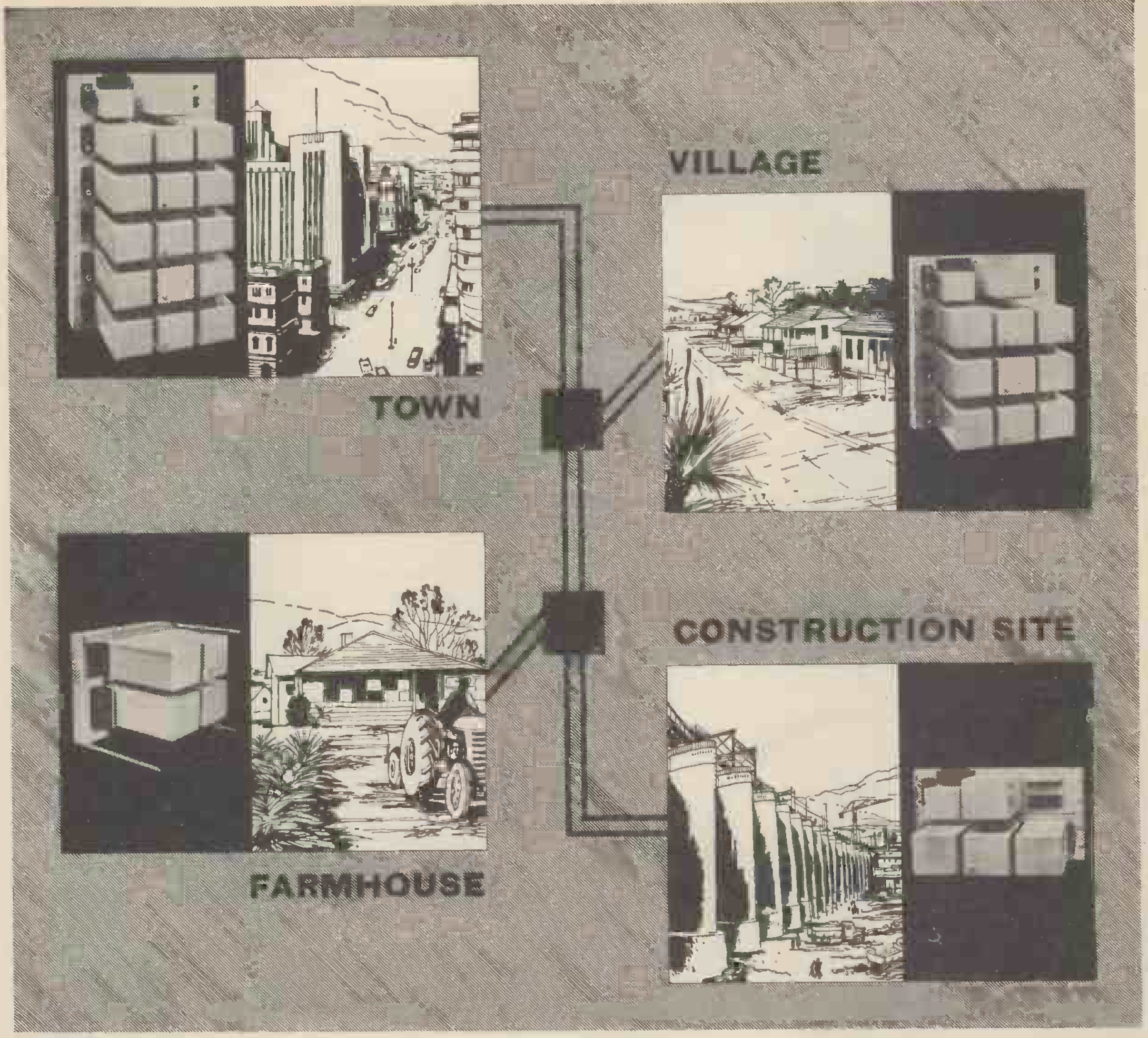
for further information and a copy of the 'Modac.' catalogue, please contact:

Modern Acoustics Limited
Contact Connectors Division

MANOR WAY · BOREHAM WOOD · HERTS · ELSTREE 3636

Agents for British Commonwealth Countries: Plessey International Limited · Ilford · Essex · Ilford 3040

MAL 2a



Transistorised rural carrier telephone system-TRC7

in service in many parts of the world

- Fully transistorised
- Simple installation
- Low power consumption
- Up to seven extra speech channels
- Ideal for temporary extra lines
- Fully tropicalised
- Pole mounted drop-off filters for greater flexibility

A PRODUCT OF

MULLARD EQUIPMENT LIMITED

A COMPANY OF THE MULLARD GROUP

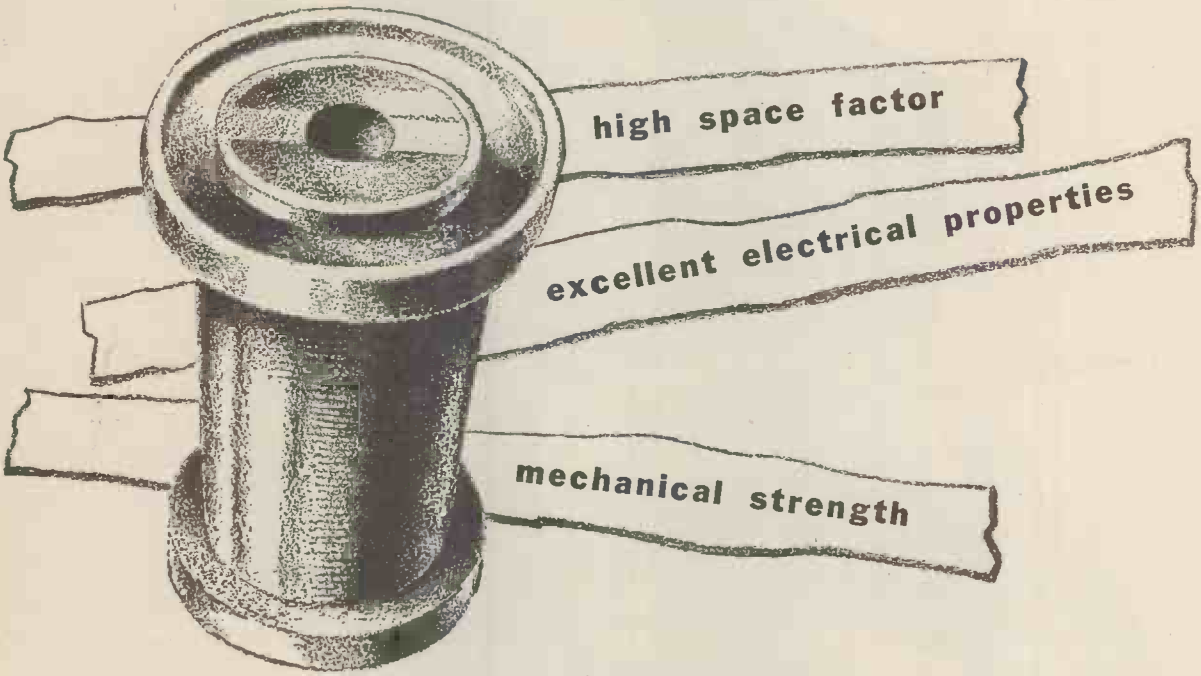
Write for descriptive literature

Mullard House · Torrington Place
London · W.C.1 · Tel: LANgham 6633

ME626C

3 BIG FACTORS

where small windings are concerned



These are three good reasons why BICC Enamelled Winding Wires are ideal for small windings. In addition, coverings are flexible, strongly adhesive to conductors and resistant to heat and damp.

For full details, write for BICC Publication No. 303. We will be glad to send you a copy.

Experienced engineers of the BICC Technical Advisory Service are always ready to assist you in the selection of the right winding wire for your purpose.

1 *Coil for Amplivox miniature magnetic earphone wound with ·001 inch enamelled wire.*

2 *Telephone Relay Coil wound with 6,900 turns of ·0036 inch enamelled wire.*

3 *Field Coil for motor car dynamo wound with 280 turns of ·030 inch enamelled wire.*

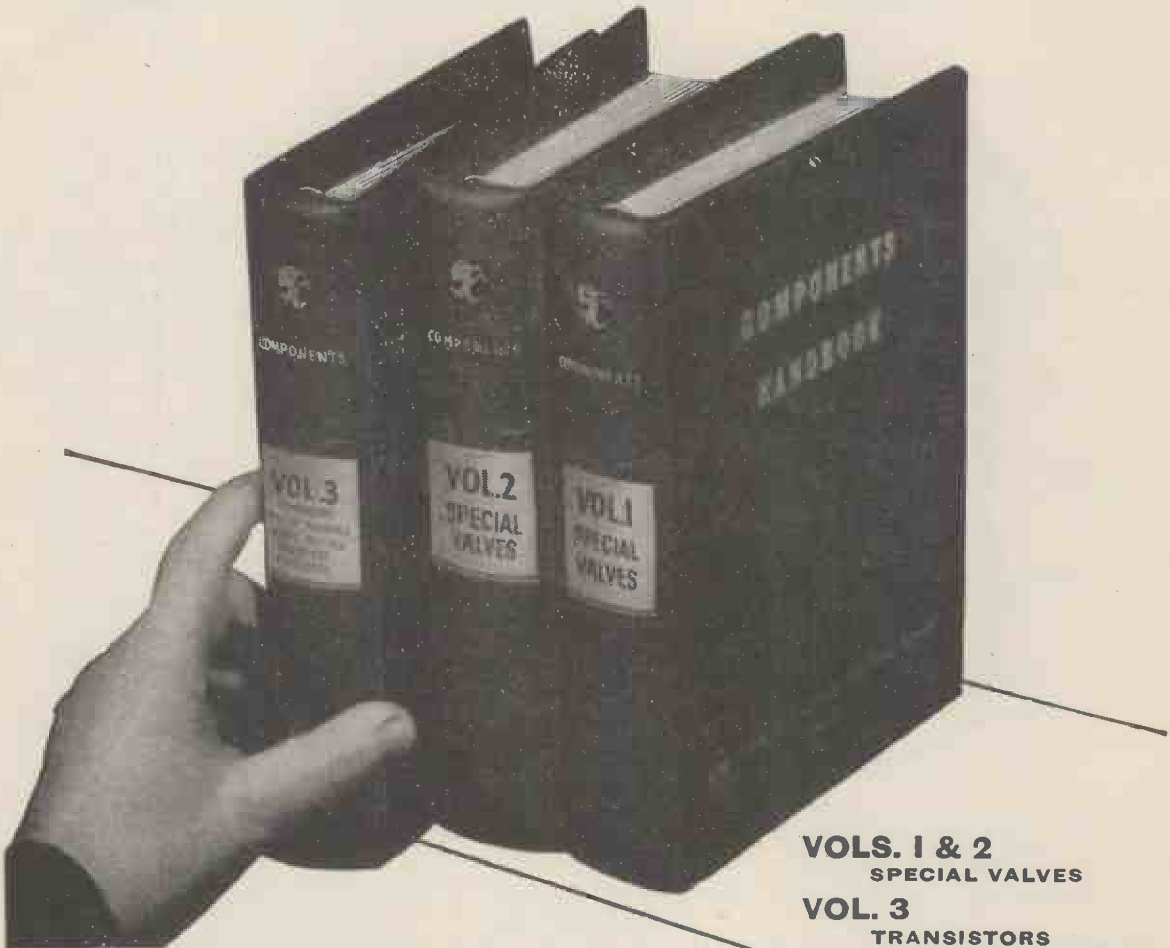
BICC

(OIL-BASE) ENAMELLED

Winding Wires

BRITISH INSULATED CALLENDER'S CABLES LIMITED

21 Bloomsbury Street, London, W.C.1


COMPONENTS
VOL.3
COMPONENTS
VOL.2 SPECIAL VALVES
VOL.1 SPECIAL VALVES
COMPONENTS HANDBOOK

YOUR EYE

says "That's a gay new box. Ah, 'SCOTCH' Brand Magnetic Tape. Eye can tell there's quality inside, just as everybody says."

YOUR EAR

says "This 'SCOTCH' Brand Tape certainly lives up to its reputation. It sounds perfect to me, and *I'm* an ear for music."

YOUR COMMON-SENSE

says "The quality suits the sound engineer—the exclusive silicone 'dry lubrication' minimises wear on magnetic heads—the price suits the pocket——well, it's 'SCOTCH' Brand for me every time!"

200 DOUBLE-PLAY

Tensilized Polyester is the wonderful new 'SCOTCH' Brand Magnetic Tape. It's extra strong, and gives you double the playing time! Resists stretching. Keeps its high quality of reproduction year after year!

Ask your supplier for the ingenious PLAYING-TIME CALCULATOR—it's free! Or write to our Head Office.

THE B.B.C. USE

TRADE MARK

SCOTCH

BRAND

MAGNETIC TAPE

PRODUCT OF 3M COMPANY RESEARCH MADE IN ENGLAND

MINNESOTA MINING AND MANUFACTURING CO. LTD.

Tape and Electrical Products Division.
Head Office: 3M House, Wigmore Street, London, W.1.
And at Birmingham · Manchester · Glasgow

RCA

SSB-L1 Fixed Station. 60 watt (500 watt double sideband equivalent) eight channels 3-15 mc/s.

SINGLE SIDEBAND

Communications system

Over 4000 RCA single sideband equipments are in use the world over as fixed and mobile stations.

- **Eight Channels.**
- **Instant Selection of Upper or Lower sideband.**
- **Compatibility with double sideband systems.**
- **Remote aerial tuning facility for SSB-L1.**
- **Mechanical Filter giving outstandingly High Selectivity.**
- **Exceptionally Stable and Reliable Operation.**
- **Rugged construction for naval and military use.**

SSB-L30M Mobile Station. 30 watt (250 watt double sideband equivalent) eight channels 3-15 mc/s.

Automatic remote antenna tuner AAT-L100

Noise limiter–clipper–filter for heavy interference conditions.

RCA

RCA GREAT BRITAIN LTD. LINCOLN WAY, SUNBURY-ON-THAMES, MIDDX. *Tel: Sunbury-on-Thames 3101*

An Associate Company of Radio Corporation of America.

SIGNAL GENERATORS
IN THE AUDIO RANGE

by *Advance* —to be sure!

The 'Advance' Types H1, J1 and J2 are the most widely used Audio Signal Generators in Great Britain for Research, Development Communications, Servicing and Education.

Type H1

- Frequency range 15 c/s. to 50,000 c/s.
- Sine or Square Wave output.
- Output Voltage (High Impedance).
  Sine Wave, 200 μV. to 20 V., r.m.s.
  Square Wave, 800 μV. to 80 V., peak-to-peak.
- Distortion less than 1% at 1,000 c/s.

List Price in U.K. **£35**

Full technical details in leaflet W41.

TYPE H1

Type J1

- Frequency Range 15 c/s. to 50,000 c/s.
- Output (Sine Wave only)
  Into 600 ohms, 0.1 mW. to 1 W. continuously variable.
  Into 5 ohms, maximum 0.5 W.
- Output Impedance
  600 ohms, unbalanced.
  5 ohms, unbalanced (one side earthed).
- Distortion, less than 2% at full output.

List Price in U.K. **£42**

Full technical details in leaflet W33.

Type J2

Identical with the Type J1 but with output voltage meter.

List Price in U.K. **£50**

Full technical details in leaflet W33.

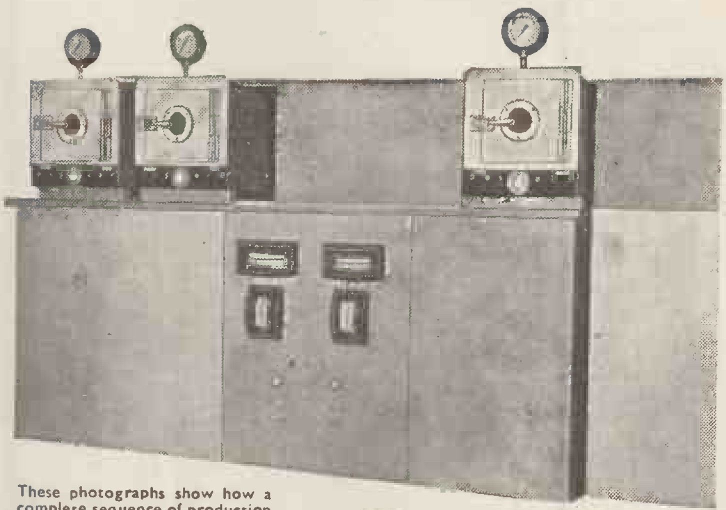
TYPE J1

Advance COMPONENTS LIMITED · ROEBUCK ROAD · HAINAULT · ILFORD · ESSEX · TELEPHONE: HAINAULT 4444

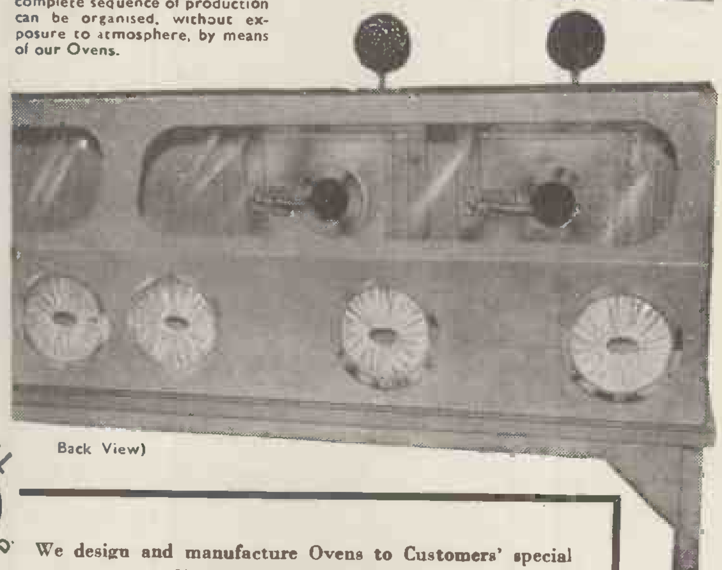
GD73

DOUBLE ENDED STAINLESS STEEL VACUUM OVENS

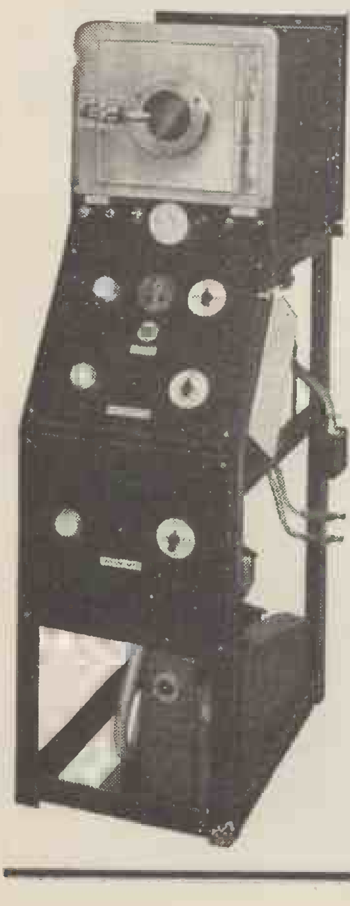
- ★ Made throughout in polished stainless steel.
- ★ Single action door openings.
- ★ Rectangular with shelf spacings to suit.
- ★ Double ended controls.
- ★ Electrical interlocking of air inlet and isolation valves.
- ★ Outer cover hermetically sealed.
- ★ Temperature range 0°-300°C or equivalent F.
- ★ Temperature Control:
  Normal $\pm 7\frac{1}{2}$°C.
  Special $\pm$1C
- ★ Internal Spacing 7in. x 8in. x 18in. (can be altered to special requirements).
- ★ Vacuum Range: To 10^{-4}.
- ★ Respective Vacuum Gauges incorporated.
- ★ Automatic air inlet valve on Backing Pump.
- ★ Visual Indicators and fuses on all switches.
- ★ Flanged for fitting into Dry Box.



These photographs show how a complete sequence of production can be organised, without exposure to atmosphere, by means of our Ovens.



Back View)



VACWELL ENG. CO. LTD.

We design and manufacture Ovens to Customers' special requirements. Should you have any problems in this field our Technical Department is always willing to help you solve them.

Vacuum Ovens with temperatures of up to 600°C are also manufactured by us on similar lines but with Sectional Heating and Water-Cooled Ends.

VACWELL ENGINEERING CO. LTD.

WILLOW LANE · MITCHAM · SURREY

PHONE . MITcham 8211 (3 lines)

LINEAR

For *HIGH SENSITIVITY!*
HIGHEST FIDELITY!
MAXIMUM RELIABILITY!
REASONABLE COST!

THE 'CONCHORD'

A HIGH FIDELITY 30 WATT AMPLIFIER INCORPORATING PRE-AMPLIFIER AND TONE CONTROLS

EMPLOYING THE LATEST MULLARD EL34 OUTPUT VALVES IN ULTRA LINEAR OPERATION AND HIGH GRADE SECTIONALIZED OUTPUT TRANSFORMER

Size approx. 13 x 8½ x 7in. Stoved gold hammered finish. Weight 14lb. For operation on 200-250 v. 50 c.p.s. A.C. mains. Or other voltages to order. A chrome-handled cover is available at 25/-.

15 GNS. Retail Price

The Following Outstanding Test Figures include Pre-amplifier and Tone Control Stages

FREQUENCY RESPONSE.
(Exc. Rumble Filter). ± 1 d.b. 20-20,000 c.p.s.

RUMBLE FILTER.
12 d.b. per octave below 50 c.p.s.

BASS CONTROL.
Continuously variable + 12 d.b. to − 12 d.b. at 50 c.p.s.

TREBLE CONTROL.
Continuously variable + 12 d.b. to − 6 d.b. at 12,000 c.p.s.

HUM LEVEL.
Referred to full output −73 d.b.

MAXIMUM POWER OUTPUT
In excess of 33 watts.

MAINS POWER CONSUMPTION.
110 watts.

STABILITY.
Entirely stable with capacity of .08 mfd. in parallel with loudspeaker load.

EFFECTIVE OUTPUT IMPEDANCE.
0.9 ohms across 15 ohms terminals.

INPUT IMPEDANCE.
Both inputs 500k plus 10 pfd.

NEGATIVE FEEDBACK.
Total 28 d.b.

SENSITIVITY.
Input (1) 20 millivolts for rated output.
Input (2) 200 millivolts for rated output.

HARMONIC DISTORTION.
0.05 ± at 10 watts. 0.1 ± at 20 watts.

OUTPUT SOCKETS.
Provide matchings for 3 ohm and 15 ohm loudspeakers.

EXTERNAL POWER SUPPLY.
300 v. 30 m/a. 6.3 v. 1.5 a. for radio tuner.

VALVES.
B.V.A. EF86, EF86, ECC83, EL34, EL34, GZ34.
Due to use of Mullard EF86 valves microphony is virtually nil.

As in our extremely successful 'Diatonic' two individually controlled inputs provide mixing facilities or microphone and gram., etc., etc.

The 'DIATONIC' HIGH FIDELITY 10-14 WATT ULTRA LINEAR AMPLIFIER

WITH INTEGRAL PRE-AMP AND TONE CONTROLS

H.T. and L.T. Supply Point is included for a radio tuner

ALL TEST FIGURES INCLUDE PRE-AMP.

FREQUENCY RESPONSE
± 2 d.b. 30-20,000 c.p.s.

MAXIMUM POWER OUTPUT. In excess of 14 watts.

RATED OUTPUT 10 WATTS.

SENSITIVITY.
Vol. (1) 22 millivolts for rated output. Vol. (2) 220 millivolts for rated output.

TREBLE LIFT CONTROL. Continuously variable + 6 d.b. to − 13 d.b. at 12,000 c.p.s.

BASS CONTROL.
Continuously variable +13 d.b. to − 18 d.b. at 50 c.p.s.

HARMONIC DISTORTION. 0.19% measured at 6 watts.

HUM LEVEL. Referred to maximum output −60 d.b.

NEGATIVE FEEDBACK. Total 32 d.b.

Size only 9-7-6½in. Weight 12½lb. Power consumption 120 watts. Outputs for 3 and 15 ohm loudspeaker.

12 GNS. Retail Price

For A.C. mains 200-250 v. 50 c.p.s. Or other voltages to order. Chassis finish stoved hammered gold, or grey blue. Attractive cover with chromium carrying handles now available at 19/6.

Full advantage has been taken of the latest component miniaturization developments to reduce unit size to a minimum. Two high impedance input sockets are provided by microphone and gram., etc. Each input has its associated vol. control. B.V.A. valves are employed. ECC83, ECC83, EL84, EL84, EZ81.

ALSO AVAILABLE

The L45. A compact High Quality 4-5 watt amplifier.
Size approx. 7-5-5½in. high. Sensitivity is 28 millivolts so that the input socket can be used for either microphone or gram. tape, radio tuner, etc. B.V.A. valves used are ECC83, EL84, EZ90. Controls are: Vol. Treble and Bass with mains switch. The Tone controls provide full compensation for long playing records. Output matching for 3 ohm loudspeaker. Retail price £5/19/6.

THE LT45 TAPE DECK AMPLIFIER. A complete unit (power pack and oscillator incorporated) ready for connection to A.C. mains. 3 ohm loudspeaker and practically any make of deck. Negative feedback equalization adjustment by multi-position switch for 3¾, 7½ and 15in. per sec. Retail price 12 gns.

THE LG3 GRAM AMPLIFIER. Overall size 6¼ x 4¼ x 2½in. Controls: Vol. and Tone (with mains switch). Output for 2-3 ohm loudspeaker. All above for 200-250 v. 50 c.p.s. A.C. mains. Retail price 55/9.

L50 50 WATT AMPLIFIER. Size approx. 13 x 9 x 7in. Sensitivity 25 m.v. Outputs for 3 and 15 ohm speakers. Retail price 19 gns.

L10 10-12 WATT HIGH FIDELITY AMPLIFIER with separate pre-amplifier. Retail price 15 gns.

L3/3 STEREOPHONIC AMPLIFIER Sensitivity 150 mv. Output 3 watts on each channel. Retail 7 gns.

L5/5 STEREOPHONIC AMPLIFIER. Sensitivity 10 m.v Output 5 watts on each channel. Retail price 11 gns.

Send S.A.E. for Leaflets. **TRADE AND EXPORT ENQUIRIES TO—**

LINEAR PRODUCTS LTD. ELECTRON WORKS, ARMLEY, LEEDS Tel.: Leeds 630-126 (3 lines)

Aspects of design

11 TRANSISTOR FREQUENCY CHANGER

This is the eleventh of a series of special features dealing with advanced problems in television and radio circuit design to be published by Siemens Edison Swan. The Ediswan Mazda Applications Laboratory will be pleased to deal with any questions arising from this or other articles, the twelfth of which will appear in the June 1959 issue.

Most portable transistorised broadcast receivers in current production use a frequency converter stage consisting of a single transistor working as a self-oscillating additive frequency mixer. Although the use of two transistors in an oscillator-mixer combination is often desirable, it is apt to be too costly at present. For normal Medium Wave tuning coverage, the local oscillator must perform satisfactorily at 2.1 Mc/s. For this reason it is usual to specify a rather better high-frequency performance for a mixer transistor than would be required in the I.F. stages. The XA102 has been designed to meet this need.

To keep the cost within reasonable limits, most designs take the form shown in the diagram. Oscillations are maintained by mutual inductance coupling between collector and emitter circuits, while the signal frequency is applied to the base. Thus the transistor is operating as a common-base oscillator, but to signal frequencies it is a common-emitter stage.

Because of the particular requirements of the circuit and the relatively high levels of voltage swing on the transistor, the small-signal parameters of the transistor are not of much assistance when designing the oscillator transformer or choosing the running conditions of the stage. The final design is best arrived at experimentally, taking the following factors into consideration:—

(a) Battery supply voltage variations

Each cell may measure 1.6 volts when new, yet it will often not be replaced until it has dropped below 1.0 volts.

(b) Bias Resistor Tolerances

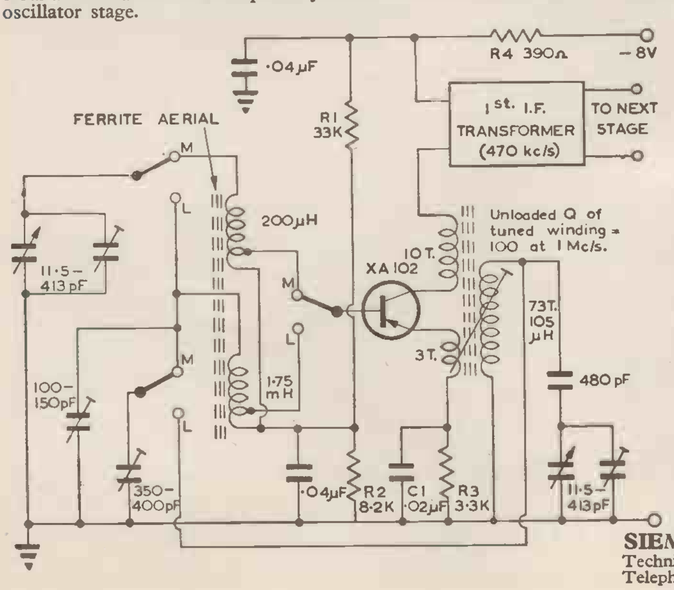
A tolerance of ±10% on resistors is desirable, ±5% resistors being disproportionately expensive.

(c) Tuning Frequency

Because a common oscillator coil is used (for reasons of economy) for the M.W. and L.W. bands, there is a considerable variation of power losses in the coil as the tuning is varied. The efficiency is lowest at the low-frequency end of the L.W. band where the dynamic resistance of the oscillator tank circuit is a minimum. The level of the heterodyne voltage is therefore lower on the long wave band than on the medium wave band.

(d) Transistor Parameters

The important parameters in this circuit are β (common-emitter current amplification), f_α (frequency of current amplification cut-off) and $r_{bb'}$ (extrinsic base resistance). Although the spread on these parameters is controlled in production there is no rigid relationship between them and it is possible for the effects of the resultant deviations to add up in any transistor used in the mixer-oscillator stage.



The circuit should accommodate all of these variables yet maintain oscillations over the tuning range without squegging.

The conversion power gain obtained with the circuit shown is nominally 31 dB at 1 Mc/s, excluding the losses in the 1st I.F. transformer. Base-emitter heterodyne voltage is approximately 250 mV peak on the M.W. band and 120 mV peak on the L.W. band.

For frequency stability the oscillator tank coil should have a high working Q, but this complicates the choice of turns ratios for the oscillator transformer. If the transistor is effectively tapped well down towards the "earthy" end of the tank coil, working Q will be high but power loss in the coil will also be high and it will be difficult to keep the circuit oscillating under the above limit conditions. If the transistor is tapped higher up the coil, oscillation amplitude may appear satisfactory but performance may vary widely with different transistor samples or with change of battery volts. Tracking between aerial and oscillator circuits may also be difficult to achieve. In the circuit shown, the turns ratios quoted are satisfactory provided there is very tight coupling between the emitter and collector windings, and the unloaded Q of the tank circuit is about 100 at 1 Mc/s.

The resistors R_1, R_2, R_3 and R_4 form a conventional bias circuit which tends to stabilise the working point. But because of the relatively large amplitude of heterodyne voltage, the stage normally operates under Class B conditions; consequently, the collector current will show a slight variation over the band because of the variation of heterodyne amplitude. The best value of working collector current for the XA102 is between 0.3 mA and 0.6 mA; a higher value than this may increase the circuit noise while a lower value will make it difficult to accommodate limit conditions.

The value of the emitter by-pass capacitor C_1 requires careful consideration. If it is made too small, the resulting phase shift in the emitter circuit may significantly raise the signal-frequency input resistance of the stage, particularly on the L.W. band, where there is a danger of the input resistance becoming negative. On the other hand, if the capacitor is too large, it increases the risk of squegging. The correct procedure is therefore to use a capacitor which is just not large enough to cause squegging under extreme high-heterodyne conditions, allowing for the production tolerance on the component. Even if this is done, the emitter circuit may still influence the L.W. input resistance, and exaggerate the spread of input resistance between transistor samples. It is then advisable to employ a L.W. aerial coil with a low unloaded Q of about 70 and to arrange a mis-matched coupling into the transistor such that the working Q of the aerial coil is not greatly influenced by variations in transistor input resistance. This arrangement may result in some loss of sensitivity but it will give a more consistent L.W. performance.

The design of the M.W. aerial coil is more straightforward, it being common practice to arrange that the transistor loading halves the unloaded Q of the coil at about 1 Mc/s. At this frequency, the input resistance of the XA102, when used in the circuit shown, is nominally 1,400Ω.

If separate coupling windings, rather than tappings, are used on the aerial coils, these must be tightly coupled to the tuned windings. This avoids spurious responses caused by "ringing" of leakage inductances.

The output resistance of the stage at I.F. is to some extent influenced by internal feedback within the transistor and also by capacity coupling between the "hot" ends of the aerial and oscillator circuits, so the tuning condenser should have a screen between the two sections. For the circuit shown the 1st I.F. transformer should be designed for a mixer output resistance of the order of 35kΩ.

EDISWAN MAZDA XA102 R.F. TRANSISTOR

The XA102 is a germanium PNP junction-type transistor particularly suitable for use as a frequency changer and/or oscillator on the medium and long wave bands. The transistor element is hermetically sealed in a small can.

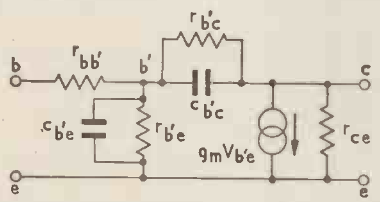
RATINGS (ABSOLUTE VALUES FOR $T_{amb}=45°C$)

Maximum Peak or Mean Collector/Base Voltage (Common Base Circuit)	(volts)	−20
Maximum Peak or Mean Collector/Emitter Voltage (Common Emitter Circuit)	(volts)	−16
Maximum Peak or Mean Emitter/Base Voltage	(volts)	−12
Maximum Collector Dissipation	(mW)	60
Maximum Junction Temperature	(°C)	65
Maximum Storage Temperature	(°C)	65

GENERAL CHARACTERISTICS ($T_{amb}=25°C$)

Maximum Collector Base Leakage Current (Emitter Open Circuit, $V_{cb}=-12v$)	(μA)	−5
Maximum Collector to Emitter Leakage Current (Base Open Circuit, $V_{ce}=-10v$) ..	(μA)	−70
Maximum Emitter to Base Leakage Current (Collector Open Circuit, $V_{eb}=-12v$)	(μA)	−10
Thermal Resistance in Free Air	(°C/mW)	0.33

HYBRID π EQUIVALENT COMMON EMITTER CIRCUIT



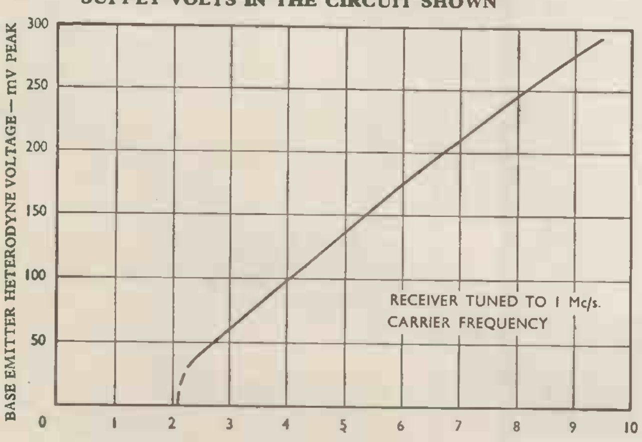
AVERAGE PARAMETER CHARACTERISTICS

($T_{amb}=25°C$) Equivalent hybrid π network. Small Signal Values.

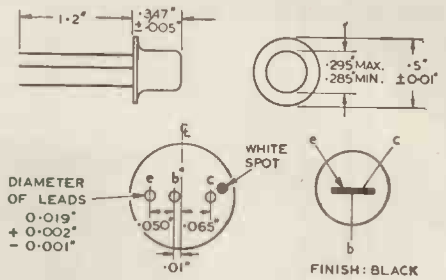
Common Emitter Circuit at $V_c=-5V$ $I_c=-1mA$.

$r_{bb'}$, approx.	(Ω)	75
$r_{b'e}$ approx.	(Ω)	1550
$r_{b'c}$ approx.	(MΩ)	6.0
g_m	(mA/V)	38.6
$c_{b'c}$ approx.	(pF)	13.5
$c_{b'e}$ approx.	(pF)	1000
Current Amplification, Common Base α..		0.984
Current Amplification, Common Emitter β		60 (25 Minimum)
Common Base Cut-off Frequency (Average)	(Mc/s)	8.0 (6 Minimum)

VARIATION OF HETERODYNE VOLTAGE WITH BATTERY SUPPLY VOLTS IN THE CIRCUIT SHOWN



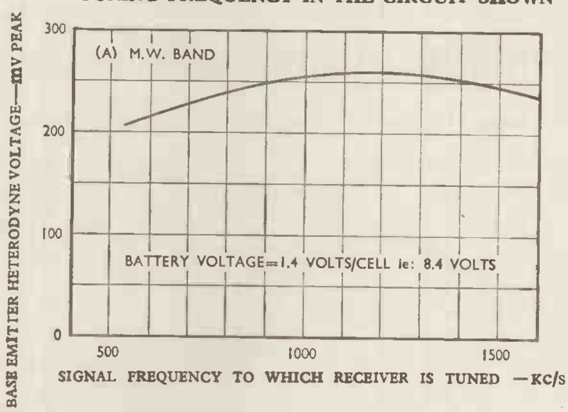
DIMENSIONS AND BASING

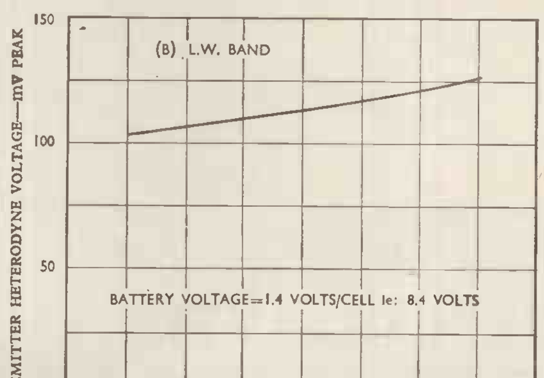


TYPICAL OPERATION AS SELF-OSCILLATING FREQUENCY CHANGER IN THE CIRCUIT SHOWN

Signal Frequency Tuning Coverage, Medium Waves	(kc/s)	530−1620
Long Waves	(kc/s)	160− 280
Intermediate Frequency	(kc/s)	470
H.T. Line Voltage (at 1.4 volts per cell) ..	(volts)	−8.0
Collector Current (at $f_{SIG}=1$ Mc/s) ..	(mA)	−0.43
Collector to Emitter Voltage	(volts)	−6.3
Base to Emitter Peak Heterodyne Voltage at ($f_{SIG}=1$ Mc/s)	(mV)	250
Conversion Gain at $f_{SIG}=1$ Mc/s (not including losses in 1st I.F. transformer)	(dB)	31
Input Resistance at Signal Frequency ($f_{SIG}=1$ Mc/s)	(ohms)	1,400
Output Resistance at I.F.	(ohms)	35,000

VARIATION OF HETERODYNE VOLTAGE WITH TUNING FREQUENCY IN THE CIRCUIT SHOWN

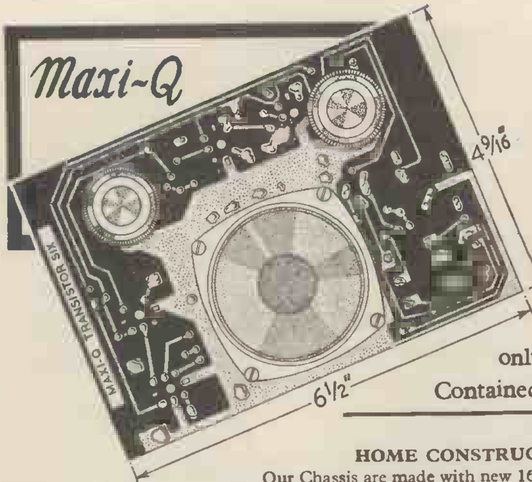




SIEMENS EDISON SWAN LIMITED *An A.E.I. Company*
Technical Service Department, 155 Charing Cross Rd., London, W.C.2.
Telephone: GERrard 8660. Telegrams: Sieswan: Westcent, London.

EDISWAN
MAZDA

CRC 15/39



SIX TRANSISTOR PRINTED CIRCUIT MEDIUM WAVE RECEIVER

Circuit Diagram, complete assembly layout and separate component price list for building this receiver will be posted on receipt of 9d. in stamps.

The Maxi-Q Transistor Six as shown on T.V. is offered assembled and aligned complete, contained in an attractive Personal Portable Book style case at £13/17/6 plus £5/11/- P.T. or Chassis only assembled and aligned at £12/15/-. plus £5/2/- P.T. Contained in hand-carved oak casket at £15/7/6 plus £6/3/- P.T.

HOME CONSTRUCTOR CHASSIS SERVICE

Our Chassis are made with new 16 s.w.g. heavy duty bright aluminium. Front Panels in 19 s.w.g. Steel with attractive Hammered Gold finish and clearly marked with neat control positions; all finishes and construction are made to enable constructors to match one unit with another.

Mullard Chassis:

Type 'C' Tape Pre-Amplifier Chassis	32/6
Type 'C' Power Pack Chassis	11/6
Chassis, Base Plate and Screen for "5-10" and "5-10A & B"	19/6
Type 'A' Pre-amp Chassis and Screens	8/6
Type 'B' Pre-amp Chassis and Screens	12/6
Complete metalwork for T.C.C. "5-10" Printed Circuit	15/-
3 Valve 3 Watt Amplifier Chassis	10/6

"20 Watt" Amplifier, Chassis, Base Plate, Transformer Covers Adaption Plate and Screws	68/6
"20 Watt" Pre-Amplifier Chassis	25/-
Tape Recorder "Type A" and "B" Pre-amplifier Chassis, ea.	31/6
7 Watt AC/DC Chassis complete with paxolin and bracket	20/-

Note: Transformer holes are not punched in chassis excepting "20 Watt" Amplifier.

Mullard Front Panels:

Type 'C' Tape Pre-Amp. with EM81 Escutcheon cut-out, 11½in. × 4½in.	8/-
"5-10" Amplifier, 15in. × 5in.	7/6
Type "A" Pre-Amplifier, 4½in. × 2½in.	2/6
Type "B" Pre-amplifier. 10½in. × 2½in.	3/6

GENERAL CATALOGUE covering full range of components send 1/4d. in stamps or P.O. PLEASE SEND S.A.E. WITH ALL ENQUIRIES

DENCO (CLACTON) LTD (DEPT. W.W.) 357/9 OLD ROAD, CLACTON-ON-SEA, ESSEX

TAKE YOUR PICK

Our wide range of capacitors, incorporating all the latest developments, are described fully in these new leaflets ...

SEND NOW for COPIES

DALY has succeeded in maintaining full capacity values and working voltages in more compact designs, specially suited to ultra modern equipment :—

PHOTO-FLASH EQUIPMENT • DEAF AIDS
PRIVATE TELEPHONE INSTALLATIONS
AMPLIFIERS • D.C. POWER UNITS
TRANSISTOR EQUIPMENT
MAGNETISATION EQUIPMENT
TEST GEAR

DALY

ELECTROLYTIC CAPACITORS

Condenser Specialists for over 20 years.

DALY (Condensers) **LTD.,** WEST LODGE WORKS,
THE GREEN, EALING, LONDON, W.5, Phone: Ealing 3127-8-9, Cables: Dalcyon, London

ADCOLA
PRODUCTS LIMITED
(Regd. Trade Mark)

SOLDERING INSTRUMENTS
& ALLIED EQUIPMENT

ILLUSTRATED
DETACHABLE
$\frac{3}{16}$" BIT MODEL
LIST NO. 64

Protective
Shield
List No. 86

CATALOGUES HEAD OFFICE SALES & SERVICE

ADCOLA PRODUCTS LTD.
GAUDEN ROAD,
CLAPHAM HIGH ST.,
LONDON, S.W.4.

TELEPHONES:
MACaulay 3101
& 4272

Quicker delivery

Better quality

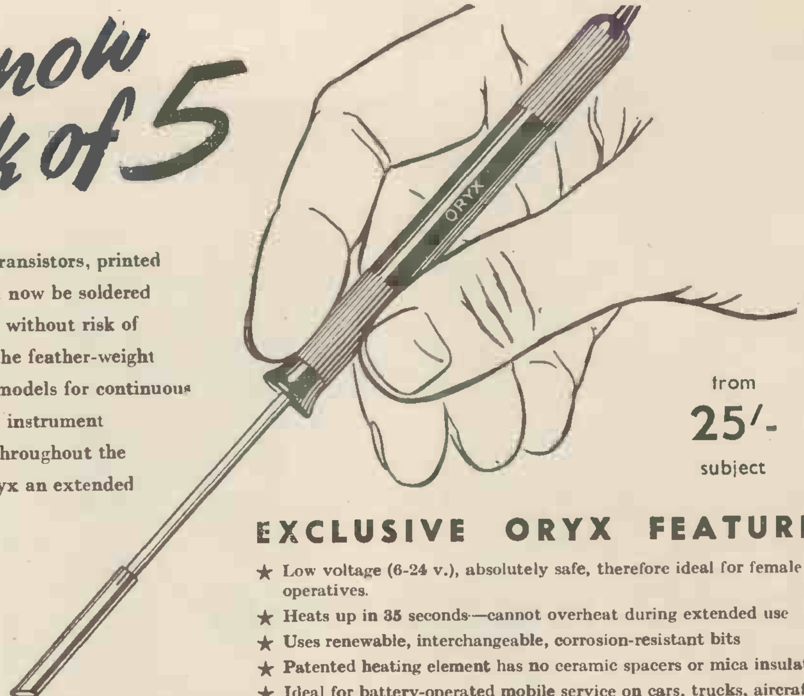
Lower prices

Suflex Nylon Glass Cord, with high tensile strength, small extensibility and good wear resistance, for tuning assemblies, etc., is being produced with quicker delivery, in better quality, and at substantially lower prices as a result of the installation of improved and increased manufacturing plant. Please write in for full details.

SUFLEX
Limited
LONDON

SUFLEX LTD., 35 BAKER ST., LONDON, W.1. TEL.: WELbeck 0791

4 girls now do work of 5



New techniques demand new tools. Transistors, printed circuits, sub-miniature components can now be soldered more accurately, with much less effort, without risk of damage to adjacent components with the feather-weight pencil-thin Oryx. Available in seven models for continuous working up to 470°C. Widely used by instrument makers, electronic equipment makers throughout the world.. It will pay you to give the Oryx an extended trial on your own production lines.

from
25/-
subject

For QUICKER.. BETTER Joints at less cost!

EXCLUSIVE ORYX FEATURES

- ★ Low voltage (6-24 v.), absolutely safe, therefore ideal for female operatives.
- ★ Heats up in 35 seconds—cannot overheat during extended use
- ★ Uses renewable, interchangeable, corrosion-resistant bits
- ★ Patented heating element has no ceramic spacers or mica insulators
- ★ Ideal for battery-operated mobile service on cars, trucks, aircraft
- ★ Efficiency equal to mains-operated 80-watt iron at fraction of weight and size
- ★ Fully guaranteed against breakdown for twelve months

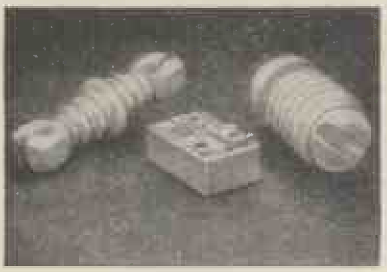
Write now for illustrated Folder and Price List

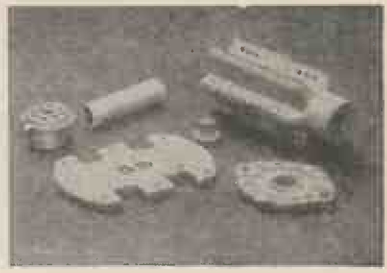
ORYX

ORYX ELECTRICAL LABORATORIES LTD.,
DOMINION ROAD, WORTHING. SUSSEX. *Tel:* WORTHING 9895

Bullers CERAMICS FOR INDUSTRY

High quality material and dimensional precision are attributes of Bullers die-pressed products. Prompt delivery at competitive prices.





We specialise in the manufacture of—**PORCELAIN** for general insulation

REFRACTORIES for high-temperature insulation

FREQUELEX for high-frequency insulation

PERMALEX & TEMPLEX for capacitors

BULLERS LIMITED

MILTON · STOKE-ON-TRENT · STAFFS
Phone: Stoke-on-Trent 54321 (5 lines) · Telegrams & Cables: Bullers, Stoke-on-Trent
Ironworks: TIPTON, STAFFS
Phone: Tipton 1691
London Office: 6 LAURENCE POUNTNEY HILL, E.C.4
Phone: MANsion House 9971

A portable T.D.M.S. that does almost everything

The A.T.E. T.D.M.S. 5B and 6B will measure distortion at any point in a radio or line teleprinter circuit without interfering with normal transmission. All types of distortion can be accurately measured and their effects observed. Similarly the testing of relays for neutrality, transit time and contact bounce is effected by direct indication of the relay characteristics on the C.R.T. Either T.D.M.S. can be used independently of the other. Primarily the 5B is a transmitter and the 6B a receiver.

Both are portable, mains operated—can be arranged for rack mounting. Dimensions: 18¼" x 11¼" x 13¾" (46.4 x 28.5 x 31) cm. Weight: TDMS 5B-38 lb. 17.1 kg. TDMS 6B-34 lb. 15.3 kg.

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

STROWGER HOUSE · ARUNDEL STREET · LONDON, W.C.2.
Telephone: TEMple Bar 9262 STROWGER WORKS, LIVERPOOL 7

AT 14781

STEREO SOUND SUPREME BY

Connoisseur

THE RESULT OF FOUR YEARS' PROGRESSIVE DEVELOPMENT

THE STEREO PICKUP

for playing 45/45 records. Miniature ceramic type with replaceable diamond stylus. Constant velocity output approximately 20mV from each channel. Frequency range 20 to 16,000 cycles. Channel separation 20/25 dbs.

(Complete as illus.) £9 plus £3/16/11 P.T.
Head only £5/10/- plus £2/7/- P.T.
Arm only £3/10/- plus £1/9/11 P.T.

STEREOPHONIC AMPLIFIER AND PRE-AMPLIFIER

Twin channel amplifier and pre-amplifier for reproducing monaural and stereophonic sound from disc, radio and compensated tape.
Ultra linear push/pull output giving 7.5 watts peak from each channel.

Amplifier £24 . 10 . 0
Pre-amp. £16 . 10 . 0

VARIABLE 3 SPEED MOTOR TYPE B

Operates at 33⅓, 45 and 78 r.p.m. Non-ferrous turntable. Built-in large stroboscope with internal light source. Precision ground and lapped spindles. Adjustable nylon graphite bearings. Synchronous motor.

£20 . 10 . 0
Plus £8/15/3 P.T.

Send for descriptive leaflets

A. R. SUGDEN & Co. (Engineers) Ltd.
Market Street, Brighouse, Yorks. *Telephone 2142*

MUIRHEAD

695 OSCILLATOR

MUIRHEAD D-695-A OSCILLATOR
Frequency Range: 10 c/s — 31 Kc/s

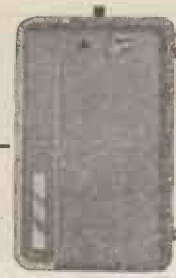
The principal features of this oscillator include high accuracy of frequency; high constancy of output level with frequency and time; and a very low harmonic content.
These features are due to the oscillator circuit design which uses automatically-controlled negative feedback. The stability achieved is such that no initial setting-up procedure is necessary, and that in less than five minutes of switching on—the oscillator is within its limits of frequency accuracy, i.e. ±0.2% (or better) above 100 c/s.
Frequency selection is by means of a three-position switch THOUSANDS, two decade controls HUNDREDS and TENS, and a continuously variable control UNITS. The frequency range is covered in two bands (x1 and x10).

*** PRECISION PERFORMANCE**
*** EASY OPERATION**
*** PRICE— —£205-0-0**
*** DELIVERY** — two weeks from receipt of order

385/1

MUIRHEAD & CO. LIMITED · BECKENHAM · KENT · ENGLAND
MUIRHEAD INSTRUMENTS INC. · 441 LEXINGTON AVE · NEW YORK 17 · N.Y. · U.S.A.
MUIRHEAD INSTRUMENTS LIMITED · STRATFORD · ONTARIO · CANADA

for those who want something more



these figures

Frequency response
at 3¾ i.p.s. 30-7000 c.p.s. ± 3dB
at 7½ i.p.s. 30-15,000 c.p.s. ± 3dB. ref to 1 Kc
Wow and flutter content—better than 0.2% peak to peak
Output 10 watts push-pull

. . . and these features

SIMON AUTOMATIC DECK fully 'push-button-controlled'
AUTOMATIC TAPE REVERSAL *without touching controls*
3-WAY MIXING FACILITIES on both record and playback
BASS AND TREBLE *LIFT AND CUT* with independent controls
REMOTE CONTROL FACILITIES on both record and playback
HIGH QUALITY MONITORING
Paired bass and treble loudspeaker units
10 WATTS OUTPUT from ultra-linear push-pull amplifier
PUSH-PULL OSCILLATOR for noise and hum suppression
ACCIDENTAL ERASURE PREVENTION
by special record 'safety button'
ACCURATE TAPE POSITION INDICATOR
based on linear tape scale
'PIN-POINT' MODULATION with cathode ray magic eye

Something really worthwhile has been achieved in the design of this fine new tape recorder. Performance of a high order has been married to a range of features, many of them exclusive to Simon, enormously increasing its value to the connoisseur of recorded sound.

Never before have all these been brought together in a portable tape-recorder—3-way mixing, lift and cut on bass and treble, a monitor with separate bass and treble units giving you high quality sound without a separate loudspeaker and, to match the superb 10-watt ultra-linear amplifier, the Simon all push-button, *automatic* tape deck.

Automatic, in the Simon sense, is meant to be taken literally: it means continuous replay—the machine stops, reverses and changes to the other track with only a two-second pause, and *with no necessity to touch any control.* Similarly, up to three hours continuous recording can be made without attention, the machine automatically stopping at the end of the second track.

Look at its elegant styling, listen to it at your local dealer—you'll decide that this is the recorder for you.

combined in the new

simon SP. 4

Incorporating the new Simon fully automatic tape deck

95 GNS

Your Simon Dealer would be pleased to arrange H.P. terms

Choose Simon for Sound

Two accessories to do justice to the SP4

THE CADENZA Ribbon microphone

Dual impedance head for flexibility in use: output sensibly flat between 50-1200 c.p.s. In handsome presentation case: head only 8½ gns. With tripod desk stand 10 gns.

THE SIMON REMOTE CONTROL UNIT

Electrically operated, gives push-button control at any practical distance. (Stop/Start and track change on either Record or Playback). Size 1⅞" x 2⅞" x 3⅞" With 25 ft. of cable 3 gns.

Write now for brochure (F5) to:

SIMON SOUND SERVICE LTD

46-50 George Street, Portman Square, London W.1

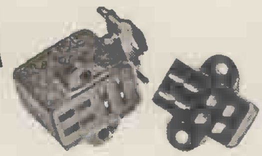
TA 1991

WE HAVE BEEN APPOINTED

SOLE LONDON DISTRIBUTORS OF

ELCOM

MINIATURE MULTI-WAY PLUGS and SOCKETS



2, 4, 6, 8, 12, 18, 24 and 33 WAY

(Trade Discounts for Quantities)

STOCKISTS OF

HIGH-FIDELITY SYSTEMS

FULL RANGE ON DEMONSTRATION OF

"MOZART", "PROCTOR", "PROVOST"

AMPLIFIERS, F.M. TUNERS, SPEAKERS.

"Q-MAX" CHASSIS CUTTERS

The easiest and quickest way of cutting holes in SHEET METAL.

		each
½" or ⅝"	(a)	12/9
¾" or ⅞"	(a)	13/9
1", 1⅛" or 1¼"	(b)	16/-
1⅜" or 1½"	(b)	18/-
1¾"	(b)	20/6
2"	(c)	30/-
2 3/32"	(c)	33/6
2½"	(c)	38/6
1" square	(b)	29/-

KEYS

(a)—1/-; (b)—1/6; (c)—2/3.

Patent No. 619178 and Patents Pending

40-Page FULLY ILLUSTRATED CATALOGUE of Electronic and Hi-Fi Stereo and Monaural Equipment 6d. POST FREE.

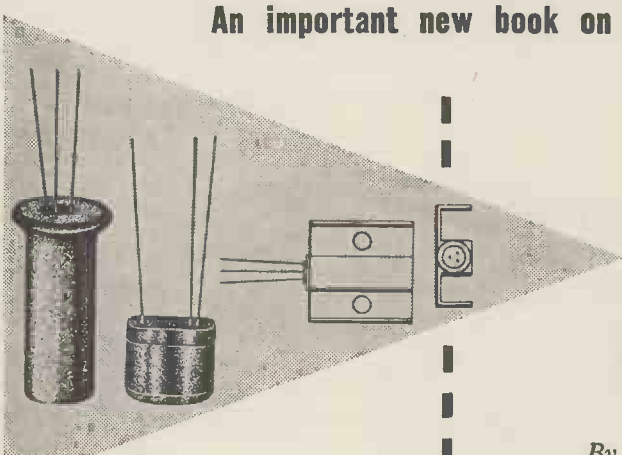
BERRY'S RADIO

25 HIGH HOLBORN, LONDON, W.C.1

Telephone: HOLborn 6231-2

(OPPOSITE CHANCERY LANE)

An important new book on the design of transistorised systems



PRINCIPLES OF TRANSISTOR CIRCUITS

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

167pp Illustrated

21s. net BY POST 21s. 11d.

NOW READY

from leading booksellers

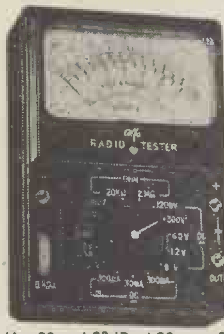
This book deals with the physical processes occurring in transistors, the main emphasis being on the application of these principles to practical problems of design, and with the determination of such quantities as input resistance, stage gain, optimum load, power output, values of coupling capacitors and transformer winding inductances. It provides an invaluable introduction to the design of transistorised equipment for professional designers, students and amateur constructors.

Published for "Wireless World"

ILIFFE & SONS LTD., DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1

BUY IT FROM LONDON'S LEADING STOCKISTS

ESTABLISHED 1943



TEST METER OFFER

ALPHA T.S.58

Multi-range, 6/12/60/300/1,200v. A.C., ditto D.C: 0-20k, 0-2 megohm: 300 microA, 30mA, 300m/A—20 to +23dB, +20 to +37dB. Accuracy ± 3% D.C., ±4% A.C. 5¼in. x 3¾in. x 1⅜in. Large clear dial, Leads. £6/19/6. (P. & P. 2/-).

MASTER LINK TAPE UNIT M2A

Exclusive Tele-Radio (1943) Ltd., product of genuinely advanced design. May be used with decks incorporating head switching. Includes playback speed equalisation signal and bias metering, output monitoring, oscillator cut-out, D.C. Solenoid supply and C.C.I.R. characteristic. Complete with external power pack. **27 gns** (P/P 4/-)

Special leaflet on request

METER CASES

STEEL, WITH ALUMINIUM PANELS

● SLOPING FRONT

4 x 4 x 4in.	9 5
5 x 5 x 8in.	14 11
6 x 6 x 12in.	24 9
SMALL	
4 x 4 x 2½in.	6 8
6 x 4 x 3in.	8 10
8 x 6 x 3in.	11 0
10 x 6 x 2½in.	13 3
STANDARD	
10 x 7 x 7in.	£1 4 9
12 x 7 x 7in.	£1 11 5
14 x 7 x 7in.	£1 15 9
14 x 9 x 8in.	£2 5 8
16 x 9 x 8in.	£2 9 6
16 x 11 x 8in.	£2 16 8
19 x 11 x 10in.	£3 3 10

● SEND FOR CASE AND CHASSIS LIST

SPECIAL OFFER 1

MAINS TRANSFORMER 550-0-550 v., 150-200 mA., 6 v. 3 a., 4 v. 3 a., 110 volts primary **20/-**

SPECIAL OFFER 2

MAINS TRANSFORMER

350-310-P-310-350 v., 220 mA., 6.7 v. 5 a., 6.3 v. 3 a., 6.3 v. 1 a., 5 v. 3 a., 6 v. 3 a., 6.3 v. 1 a. Potted 50/-

CHOKES

10 H., 250 mA., potted "C" core.	25/-
20 H., 50 mA., potted.	20/-
16 H., 120 mA.	20/-

● AMPLIFIERS	
Quad II Complete	£22 10 0
New Quad 22 Control Unit	£25 0 0
Leak TL, 12 Plus	£18 18 0
Leak Point One Plus Pre-Amp	£12 12 0
Leak Variscope, Mk. III	£15 15 0
Jason J2-10 Mk-II Stereo Amp.	£37 10 0
Rogers Junior Amplifier	£17 0 0
Rogers Pre-Amp	£8 0 0
● PICK-UPS, MOTORS	
Decca Stereo P.U.	£22 0 0
Collaro 4TR 200	£14 10 0
Garrard TPA/10 P.U.	£15 9 4
Goldring 580 Cartridge	£5 16 9
Goldring 600 Cartridge	£11 13 6
Lenco Trans. Motor GL58	£20 17 0
Garrard Trans. Motor 301	£26 8 3
● SPEAKERS	
Westrex	£169 10 0
Quad Electrostatic	£52 0 0
Goodmans 300 12in. Twin Cone	£11 5 9
Goodmans 400 12in. Twin Cone	£16 1 0
Wharfedale SFB/3	£39 10 0
Wharfedale Golden 10 FSB	£8 14 11
Kelly Ribbon Mk. II	£10 10 0
Tannoy 12in. Dual	£30 15 0
G.E.C. Metal Cone	£9 5 0
G.E.C. Presence Unit	£3 19 6
WB 1016	£8 0 0
● TAPE	
Brenell Mk. V Recorder	£67 4 0
Brenell Deck with rev. counter	£24 12 0
Ferrograph 4AN	£85 1 0
Wearite 3A Deck	£35 0 0
Wearite 3AH or 3B Deck	£40 0 0

Valves, components, accessories, materials stocked. Enquiries invited

Goods sent to any part of Britain & the world.

TELE-RADIO (1943) LTD., 189 EDGWARE ROAD, LONDON, W.2

Our only address ● Few mins. from Marble Arch ● Open all day Sat.

● *Phone: PAD 4455/6*

WEYRAD P.50 TRANSISTOR COILS AND I.F. TRANSFORMERS

FOR 2-WAVE PORTABLE WITH PRINTED CIRCUIT AND ROD AERIAL

P50/1AC M.W. OSCILLATOR COILS. For 176pF TUNING CONDENSER .... PRICE **5′4d.**

P50/2CC 1st and 2nd I.F. TRANSFORMER. 470 Kc/s OPERATION. "Q" = 150 .... PRICE **5′7d.**

P50/3CC 3rd I.F. TRANSFORMER. 470 Kc/s OPERATION. "Q" = 170 .... PRICE **6′0d.**

RA2W L.W. and M.W. ROD AERIAL 6in. long, flying-lead connections. For 208pF TUNING CONDENSER.. PRICE **12′6d.**

LFTD1 DRIVER TRANSFORMER. Split Secondary Type, fully enclosed. With 6 connecting tags PRICE **17′6d.**

PCA1 PRINTED CIRCUIT PANEL, 2¾ x 8¼in. ready drilled with component positions and references printed on rear .... PRICE **9′6d.**

BOOKLET OF DETAILED ASSEMBLY INSTRUCTIONS AND CIRCUIT DIAGRAMS FOR 6-TRANSISTOR LONG AND MEDIUM WAVE SUPERHET .... PRICE **2′0d.**

ALL IN BULK PRODUCTION—TRADE ENQUIRIES INVITED

WEYMOUTH RADIO MFG. CO. LTD., CRESCENT STREET, WEYMOUTH, DORSET

Arcolectric

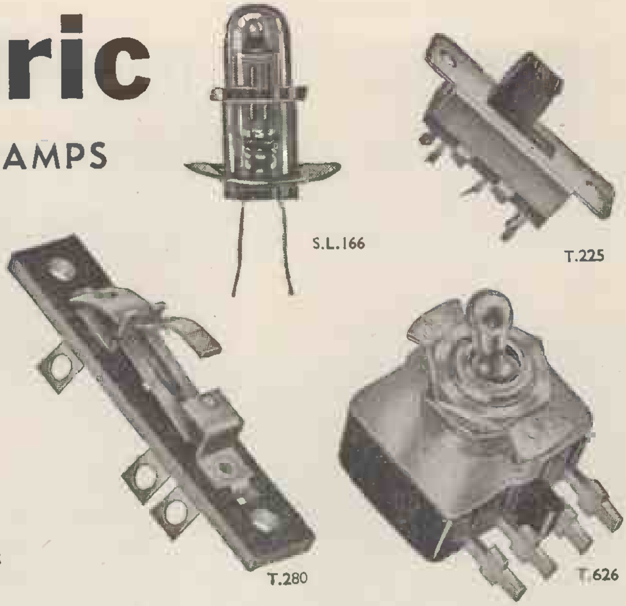
SWITCHES & SIGNAL LAMPS

T.225: Miniature Slide Switch
Ideal T.V. mains switch

S.L.166: Very small low cost
mains neon indicator

T.280: Sensitive Snap Action Switch
Popular switch for tape recorders

T.626: Double pole 3-AMP switch
with tags to fit printed circuit boards



Samples to manufacturers
For design purposes
AT ONCE—WITHOUT CHARGE

ARCOLECTRIC SWITCHES · LTD

CENTRAL AVENUE, WEST MOLESEY, SURREY. Tel.: MOLESEY 4336

Jason STABILISED POWER PACK

IN KIT FORM OR READY BUILT

Available in kit form complete with case and valves or ready built and tested.

Details of this and other Jason Test Equipment including AUDIO GENERATOR, OSCILLOSCOPE, WOBBULATOR, etc., in Kit Form or ready built on request.

MAINS INPUT
110, 205, 225, 245 volts A.C., 50/60 cycles.

OUTPUT *via Socket or Terminals*
300/350 volts at 175mA.
Unit must be derated for lower output voltages as follows:—275V, 160mA; 250V, 150mA.

POLARITY
Chassis may be connected to either positive or negative, or left floating by means of a 4-way switch ganged with Mains On-Off position.

RIPPLE—Less than 1mV.

STABILITY WITH MAINS VARIATIONS
±10% mains fluctuation produces less than 0.15% variation in output voltage.

IMPEDANCE MEASUREMENTS
D.C. Output, less than 1Ω.
A.C. measured with 10mA, A.C. at 100~ frequency, D.C. current between 40–175mA—*less than* 1Ω.
With 10mA. A.C. at 100~. D.C. current less than 40mA—*approx.* 1Ω.

METER FACILITIES
0–200mA, F.S.D.: 0–500V, F.S.D.
Meter switch ganged with H.T. OFF.

MODEL PP20
Complete Kit, **£16.5.0.**
Ready Built, **£20.6.0.**

MODEL PPM20
With Metering
Complete Kit, **£22.10.0.**
Ready Built, **£27.15.0.**

In course of preparation 240V 80 mA type with similar performance.

PP10 Kit, **£12.15.0;** Built, **£16. 0.0.**

PP10M Kit, **£19. 0.0;** Built, **£23.15.0.**

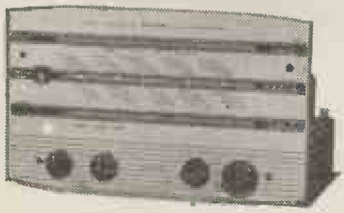
Professional Discounts.

THE JASON MOTOR & ELECTRONIC CO., 3-4 (D) GT. CHAPEL ST., OXFORD ST., LONDON, W.1 *GER 0273/4*

BRITISH DESIGNED TO HIGH TECHNICAL STANDARDS

Armstrong

QUALITY RADIO TUNERS



ST3 AM/FM TUNER
27 GNS.

A self-powered high fidelity tuner covering the full VHF, medium and long wavebands. A special type of variable feedback output control enables the output to be varied between 0 and 1,000 millivolts and the cathode follower stage means that it will match virtually any amplifier input without adjustment. On AM bands the ferrite rod aerial, two stages of I.F. amplification and the very efficient A.V.C. action ensure Continental reception of real programme value. The FM circuit is completely stable with no trace of drift and automatic frequency control provides broad easy tuning.

FM61 VHF TUNER
21 GNS.

A sensitive high fidelity tuner covering the full VHF band (87-108 mc/s.) and incorporating switched automatic frequency control. Designed to match the **A.10 Mk. II Amplifier and Control Unit** in size, style and performance, it can also be used with virtually any amplifier, radio receiver or tape recorder. The A.10 Mk. II provides ample power supplies for the FM61 but a separate power pack (£4/18/-) is available if required.

BS125T BANDSPREAD SHORT-WAVE TUNER
42 GNS.

A reliable, high performance tuner of semi-communications standard with 6 bandspread ranges (11, 13, 16, 19, 25 and 31 metre bands) and 3 general coverage bands (15-43 43-150, 190-550 metres). A tuned high gain R.F. stage and two I.F. stages ensure outstanding sensitivity and selectivity. The tuner also incorporates an audio pre-amplifier with separate bass treble and gain controls for use with existing power amplifiers. The RF125T (£31/10/-) is a similar version of this tuner except that coverage is continuous from 13 to 550 metres spread over 4 ranges and with the addition of the long waveband.

Prices of these tuners without purchase tax are **BS125T £31/10/-, RF125T, £22/10/-.**

Post this coupon or write for descriptive literature and details of Home Trial acilities, Hire Purchase Terms and Guarantee or call at our Holloway Showroom for full, unhurried demonstration and professional advice on your installation. Open 9-6 Weekdays and 9-5 Sats.

NAME .... WMT

ADDRESS ....

....

ARMSTRONG WIRELESS & TELEV SION CO. LTD.,
WARLTERS ROAD, LONDON, N.7 Tel: NORth 3213

AUTOMAT

High-Stability RECTIFIERS

TRANSFORMERS . D.C. EQUIPMENT

Specially designed to your requirements

SPEEDY DELIVERIES

Send now for your copy of Technical Bulletin 58/1

AUTOMAT · MOORSIDE · SWINTON · MANCHESTER · TEL · SWINTON 4242/4

Issued by Northworks Ltd.

. . . AND NOW —

the CAPRIOL Speaker Enclosure

The reception given to the Capriol Record Cabinet and Capriol Equipment Cabinet has been so gratifying that we have been encouraged to complete the range with the addition of a Speaker Enclosure.

The **CAPRIOL SPEAKER ENCLOSURE** has been designed, as have our previous enclosures, in co-operation with Goodman's Industries Ltd., for use with their 12in. speaker systems. Additional cut-outs (blanked over until required) are provided for the Midax, Trebax and A.R.U. Used in conjunction with the above, a flat frequency response from 30 cs to 16 kcs can be obtained.

The Enclosure is constructed of solid ¾in. blockboard, is braced, lined throughout, plus two hanging curtains of damping material, and therefore wholly free of boom or resonance.

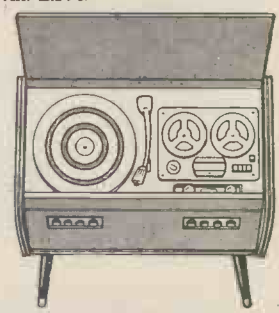
The Capriol Speaker Enclosure will match not only the other cabinets in the Capriol range, but also our well-known Polonaise Equipment Cabinet. For those who wish to save space the Enclosure can be used in the upright position, having been veneered and polished on the underside.

PRICE: £12/19/- Cabinet only.

6in. legs (for use in upright position, as illustrated above), 25/-.
12in. ferruled legs (horizontal position), 35/-.

The **CAPRIOL RECORD CABINET** (centre) will hold 300 records, with space for an additional 100 × 7in. E.P.'s.

PRICE: £10/19/-.



The **CAPRIOL HI-FI EQUIPMENT CABINET** will take every kind of turntable (auto-change or transcription) plus a tape deck, plus a radio tuner, plus amplifier and pre-amp. If no tape deck is required all the above can be housed under the lid.

RETAIL PRICE: £12/19/-.

Dimensions: Each cabinet measures 30in. wide, 17in. deep, 16in. high (plus 12in. legs).

Write today for full details, to Dept. WW95. If you can indicate your nearest main shopping centres we shall be pleased to advise you of your local stockists.

RECORD HOUSING Brook Road, London, N.22 BOWes Park 7487/8

ARDENTE make a wide range of

MINIATURE POTENTIOMETERS AND ELECTRONIC COMPONENTS

The miniature components with the big technical background

Sole Manufacturers and Exporters:

ARDENTE ACOUSTIC LABORATORIES LTD.

8-12 MINERVA ROAD, NORTH ACTON, LONDON, NW10 *Telephone: ELGar 3923*

Suppliers of components and hearing aids to the Government and manufacturers all over the world.

GOODMANS present two NEW models in the Infinite Baffle Series . . .

Models IB3 and IB2

These NEW multiple unit High Fidelity Loudspeaker Systems measure only 24" wide x 12½" deep x 14½" high, but have been designed to provide a standard of reproduction at least as high as that of systems of conventional size. The small enclosure size is a deliberate part of the design; the stiffness of the enclosed air, which is a substantial fraction of the total suspension stiffness of these systems, is linear. Bass performance is, therefore, exceptionally smooth and free from distortion even at high amplitudes.

- The NEW Model IB3 three-way reproducer incorporates the latest developments on all three loudspeaker units, and provides an even more extended bass range, with improved control at all frequencies.
- The NEW Model IB2 includes the basic features of the IB3, but is a two-way system with lower power handling capacity, and is, therefore, in a lower price category.
- Both models employ 12" bass units having extremely rigid diaphragms, pneumatic leather edge suspension, 3" diameter voice coils, and powerful magnet systems.
- Model IB3 has the Trebax as high frequency radiator and a horn loaded mid-range unit, giving extreme smoothness of response in middle and upper registers.
- Model IB2 employs an 8" mid-range and high frequency direct radiator of unique design.
- Multiple section 12 db/octave crossover networks are used in both models.
- Continuously variable constant Impedance L-pads are provided for the control of mid-range and high frequency output.

SPECIFICATIONS	IB3	IB2
Frequency Range:	*30-16,000 c/s*	*40-15,000 c/s.*
Power Handling Capacity:	*25 watts.*	*12 watts.*
Bass Unit:	*12"*	*12"*
Bass Resonance:	*20 c/s*	*20 c/s.*
Voice Coil Diam:	*3"*	*3"*
Total Flux:	*308,000 maxwells*	*240,000 maxwells*
Mid Range Unit:	*Pressure driven horn*	*8"*
High Frequency Unit:	*Pressure driven horn*	*8"*
Crossover points:	*950 c/s. & 5,000 c/s.*	*950 c/s.*
Enclosure Acoustic Treatment:	*Glass Fibre filling*	*Absorbent lining*
Enclosure size:	*24" wide 12½" deep x 14½" high.*	
Enclosure Finish:	*Walnut veneer.*	
PRICE	**£63:10:0**	**£41:0:0**

Goodmans High Fidelity Loudspeaker Manual, which contains full information on Goodmans High Fidelity products, free on request.

GOODMANS ...Europe's largest Manufacturers and the World's largest Exporters of High Fidelity Loudspeakers

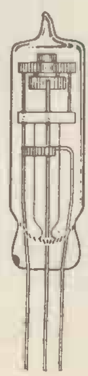
GOODMANS INDUSTRIES, LIMITED, AXIOM WORKS, WEMBLEY MIDDLESEX.
Wembley 1200 (8 lines) Grams: Goodaxiom, Wembley, England

A question of control

In furthering the modern trend towards electronic, rather than electro-mechanical techniques, cold cathode tubes offer :

low cost, small size, flexibility, extremely long life, reliability and self indication.

You can count on Hivac Cold Cathode Tubes.



Calculating Machines
Automation
Control Systems
Telephone and Telegraph Switching
Timing Circuits
etc.

Hivac Limited

A member of the Automatic Telephone & Electric Group

STONEFIELD WAY, SOUTH RUISLIP, MIDDLESEX. Tel: Ruislip 3366.

C13

Reduce your press tool costs with the HUNTON UNIVERSAL BOLSTER OUTFIT

In addition to the range of Punches and Dies $\frac{1}{8}$in. to 3$\frac{3}{4}$in. dia. available from stock, some of the tools usually required in the Radio and Electronic Industries have been standardised for use with the Hunton Universal Bolster Outfit. Illustrated here are a few which can be supplied quickly or from stock.

In London and Home Counties, ask for a practical demonstration in your own works.

Write for illustrated brochure W.W.1

HUNTON LTD.

Phoenix Works,
114-116, Euston Road, London, N.W.1

Telephone: *EUSton 1477 (3 lines)* *Telegrams:* *Untonexh, London*

MAIN DISTRIBUTORS FOR LANCASHIRE, YORKSHIRE AND CHESHIRE

JAS. H. VICKERY & CO. LTD.
21 Bradshaw Street, Manchester, 4
Telephone: Blackfriars 3221. Telegrams: Vickery, Manchester

ACCURATE FREQUENCY MEASUREMENT of Bands I, II, III, IV

by a British Manufactured

HETERODYNE FREQUENCY METER

Designed and built to rigid services specifications.

TYPE T75.
Frequency Range: 85 to 1,000 megacycles.
TYPE T74.
Frequency Range: 20 to 250 megacycles.
Frequency calibration accuracy: .002% at 25°C. (or .01% between −20°C. to +70°C.).

Crystal-controlled, portable heterodyne-type Frequency Meters used for Field testing and measurement of pulsed, modulated, or C.W.R.F. transmitters, receivers and signal-generators.

Mains Operated Power Unit available as optional extra and designed to fit into the battery compartment.

Enquiries invited for instruments with higher frequency ranges. Limited supply of B.C.221 reconditioned and calibration checked frequency meters, range 125 Kc/s to 20 Mc/s.

A **TELEMAX** NSTRUMENT

Complete Specifications on application to:—

Makers of High Voltage Test Sets and other Electronic Equipment for H.M. Government.

Sole Manufacturers **TELEMECHANICS LTD**
(Instrument Division Dept. W.W.7)
SHORE ROAD, HYTHE, SOUTHAMPTON, ENGLAND.
Telephone: Hythe, Hants 3376 Cables: 'Teleset', Hythe, Southampton.
Agents: Some overseas territories still available.

NEW—Taylormeter Model 100A

SUPER-SENSITIVE!! UNIQUE!!
WORLD'S FOREMOST!!

100,000 o.p.v.

OUTSTANDING FEATURES:

Sensitivity 100,000 o.p.v. D.C., 5,000 o.p.v. A.C.
Current readings from 0.2 microamps—10 amps. D.C. (10µA, 50µA, 250µA, 1mA, 100 mA, 1 Amp, 10 Amps).
D.C. Volt readings from 10mV—2,500V (25kV by probe) (0.5, 2.5, 10, 25, 100, 250, 1,000, 2,500).
A.C. Volt readings from 0—2,500V. (10, 25, 100, 250, 1,000, 2,500).
Ohms from 0—200 megohms in 4 ranges (self-contained).
5 Decibel Ranges.
5 Output Ranges. Many other advantages.
Accuracy 2% D.C. 3% A.C. 5% Ohms.
5in. Mirror Scale meter.
Automatic Mechanical Cut-out protects against overloads.
Reverse Polarity facility.
Robust and suitable for everyday use.

HIRE PURCHASE OR CREDIT SALE TERMS AVAILABLE

LIST PRICE
£31.10.0

Taylor

Write for full details

NOW AVAILABLE! New edition of VALVE MANUAL FOR TAYLOR TESTERS
Gives over 5,000 settings and characteristics. Price 7/6 post free

TAYLOR ELECTRICAL INSTRUMENTS LTD.
MONTROSE AVENUE · SLOUGH · BUCKS Telephone - Slough 21381

NOW—a miniature microphone that's 'MADE IN GT. BRITAIN'

Photograph showing actual size

BESSON BALANCED ARMATURE MICROPHONE Type LE

This Microphone incorporates the design and manufacturing skill that is characteristic of all Besson micro-components. And the financial advantages over imported microphones are obvious.

The Type LE Microphone is designed to operate with transistor amplifiers and will match into the average transistor which may have a resistance of 1,500–3,000 ohms. The microphone impedance is 3,000 ohms measured at 1,000 cycles and the resistance is 360 ohms. It is made to operate within a temperature range of 20 to 115°F, but can be specially treated to operate at much higher temperatures if required.

It is ideal for hearing aids, dictating machines, tape recorders, lapel microphones, walkie-talkie sets, etc.

Send for technical leaflets to the SOLE SELLING AGENTS:

WESTOOL LIMITED

ST. HELEN'S AUCKLAND, CO. DURHAM
Phone: West Auckland 551/5 Grams: Solenoid, West Auckland
Birmingham Office: 7 Newhall Street, Birmingham 3
Phone: Central 3901

Manufactured by:
A. P. BESSON & PARTNER LTD., *St. Josephs Close Hove 4, Sussex.*

BESSON
MOVING COIL RELAY Type SB2

This robustly made relay will stand up to the wear and tear of industrial use. The powerful coil movement gives a high contact pressure and the contacts themselves can be adjusted from outside over the whole scale.

AN IDEAL FULL RANGE SPEAKER COMBINATION

THE FANE H.F. LOUDSPEAKER UNIT

TECHNICAL SPECIFICATION

Overall diameter	3in.
Overall depth	$1\frac{3}{4}$in.
Power handling	15 watts Instantaneous Peak
Voice coil diameter	$\frac{3}{4}$in.
Flux density	17,000 gauss
Frequency response	1,500–18,000 c.p.s.
Input impedance	8–15 ohms.

MODEL 301
Reg. Design App. for

The FANE H.F. Unit is a pressure type high frequency loudspeaker. It will handle the high note portion of 15 watts of music. The response is level over the range 2,000 to 14,000 c.p.s. beyond which there is a gradual roll-off giving a useful range of 1,500 to 18,000 c.p.s.

The special hardened aluminium diaphragm with its unique loading system gives a clean distortionless output at all frequencies in its range which is completely free of resonances or colorations.

The FANE H.F. Unit may be used with advantage to extend the range of any existing speaker system. Its use will greatly increase the transient response and "realism".

Price £3/15/-

THE FANE 12" H.D. LOUDSPEAKER UNIT

TECHNICAL SPECIFICATION

Diameter over lugs	$12\frac{3}{4}$in.
Overall depth	$6\frac{1}{4}$in.
Power handling	20 watts R.M.S.
Voice coil diameter	2in.
Flux density	12,000 gauss
Total flux	160,000 lines
Main resonance	30/35 c.p.s.
Frequency response	25–5,000 c.p.s.
Input impedance	15 ohms

MODEL No. 121

This 12in. unit is fitted with a curvilinear cone, foam plastic surround and an extra long voice coil winding which permits large amplitude movements without Introduction of harmonic distortion. It is recommended for use as a single speaker for any heavy duty requirement such as public address or home cinema or as the bass unit in a multi-speaker system. Suitable for use in all types of reflex enclosure horn loading or open baffle mounting.

Price £9.

MODEL No. 121A

As above but with aluminium wire voice coil giving improved transient response and useful range extended up to 10,000 c.p.s.

Price 9 gns.

These items are not subject to Purchase Tax
(Carriage paid in U.K.)

Further details available from the makers

FANE acoustics LIMITED

BATLEY ● YORKSHIRE

M. R. SUPPLIES, LTD.

(Established 1935)

We offer only first-class material at the most attractive prices and with prompt delivery. Careful packing. Satisfaction assured. Prices nett.

SHORT INTERVAL TIME SWITCHES (Smith's) spring driven. Closed circuit period continuously adjustable from 1 to 15 minutes. 15-amp. (250 v. A.C.) switching. 2in. dia., $2\frac{1}{2}$in. long. Not calibrated. Limited supply at only **17/6** each (despatch 1/6).

T.C. AMMETERS (or Millivoltmeters). Supplied with external thermo-couple for deflection of 0/30 amps. R.F. Basic movement is 0/6 Millivolts f.s.d. $3\frac{1}{4}$in. flash panel mount, **17/6** (des. 1/6).

BLINKER SWITCHES for car R. & L. indicators. Compact units for one-hole dash mount. Blinking period up to 15 seconds each setting with automatic "off." Single switch-arm control for either R. or L. Precision made, brand new, remarkable value **10/6** (des. 1/-).

> **SMALL GEARED MOTORS**—our well-known speciality—over 1,000 different final speeds and torques. Series wound (variable speed) and induction (constant speed). Speed range 0.2 to 840 r.p.m. and torques up to 75 lbs./in. Full details in our List GM/357—copy on request. Useful range for immediate delivery from stock.

SYNCHRONOUS TIME SWITCHES (Sangamo). For accurate pre-set switching operations on 200/250 v. 50 c. Providing up to 3 on-off operations per 24 hours, with day-omitting device (use optional). Capacity 20 a m.p.s. Apart from industrial uses these are eminently suitable for tape recorders, radio, immersion heaters, fires, etc. Compactly housed 4in. dia. $3\frac{1}{4}$in. deep. With full instructions, **£5/8/6** (despatch 2/-).

6-VOLT MOTORS (ex Ford car heater blowers). 3in. long, $2\frac{1}{4}$in. dia Shaft proj. $\frac{3}{8}$in. Very quiet running **13/6** (des. 2/-). (Please note that all complete blowers are now sold).

SYNCHRONOUS ELECTRIC CLOCK MOVEMENTS. 200/250 volts 50 cycles. Fitted with spindles for Hours, Minutes and Seconds hands. Central hole fixing, allowing up to $\frac{3}{8}$in. thickness of dial. Diameter $2\frac{1}{4}$in., depth behind dial only 1in. With dust cover, **29/6** (des. 1/6). Sets of three hands to fit, in good style, for 5/7in. dial, **2/6** set, for 8/10in. dial, **3/6** set.

MINIATURE AMMETERS, scaled 4-0-4 amps. D.C.—charge and discharge. Dial $1\frac{3}{4}$in. diameter, round flush mount, many uses include model railways, **9/6** (des. 1/-).

SYNCHRONOUS INDUCTION MOTORS (G.E.C.). 220 × 240 v. 50 c., 1,500 r.p.m. Body 4 × $3\frac{1}{2}$in., with 1in. shaft proj. With capacitor, **57/6** (des. 2/6).

AIR BLOWERS, fitted B.T.H. induction motor, 220/250 v. A.C. 2,800 r.p.m. Duty 150 CFM (free air), 50 CFM at $1\frac{1}{2}$in. W.G. Overall length 8in. Dia. inlet $3\frac{1}{4}$in., outlet 2in. Efficient, quiet running units, very limited supply, **£4/15/-** (des. 3/6).

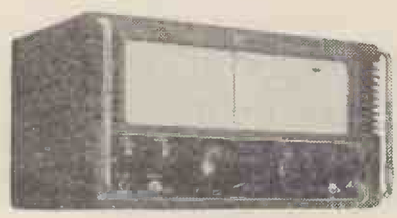
MAINS RELAYS (Magnetic Devices). 230 v. A.C. coil, with 2-pole change-over 4 amp. switching. Brand new, compact units, approx. $2\frac{1}{4}$in. by $1\frac{3}{4}$in. by 1in. Limited supply at **22/6** each (des. 1/-).

EXTRACTOR FANS. Very well made units at much lower than normal price. 200/250 v. A.C., induction motor, silent running, no interference. With mounting frame and back grille, ready for easy installation. With 8in. impeller, 200 cu. ft./min., **£5/5/-**. 10in. impeller, 240 cu. ft./min., **£5/12/6.** Also new minor model with 6in. impeller, 75 cu. ft./min., **£4/12/6** (despatch of any one 3/-).

We invite enquiries for Electric Pumps, B.P.L. Measuring Instruments, Variable Transformers—immediate delivery.

M. R. SUPPLIES, LTD. 68 New Oxford Street, London, W.C.1

(Telephone MUSeum 2958)



EDDYSTONE COMMUNICATIONS RECEIVER

Model "840A" for A.C./D.C. Mains

The "840A" receiver is a general purpose model for professional and amateur communication purposes. It employs seven miniature valves and is capable of an excellent all-round performance. The tuning mechanism incorporates high reduction ratio gearing, bandspread being provided by an auxiliary scale.

The four tuning ranges are as follows:—

Band 1 .... 30 Mc/s to 10.5 Mc/s   Band 3 .... 3.8 Mc/s to 1.37 Mc/s
Band 2 .... 10.6 Mc/s to 3.7 Mc/s   Band 4 .... 1400 Kc/s to 480 Kc/s

The tuning dial is calibrated in frequency to an accuracy better than 0.5%. The Amateur bands are distinctly marked in blue and the shortwave broadcast bands in red, both on the basis of the International allocations made at the Atlantic City Conference. It is of interest to note that range 4 covers the 500 Kc/s (600 metres) shipping and distress band. The receiver works equally well off A.C. or D.C. mains supplies (110 and 200/250 volts) and special attention has been paid to high insulation.

CASH PRICE £55, or 12 monthly payments of £5.

Carriage paid per passenger train.

Descriptive Literature of this and other models gladly forwarded.

The Eddystone Specialists

A.P. RADIO SERVICES LTD.

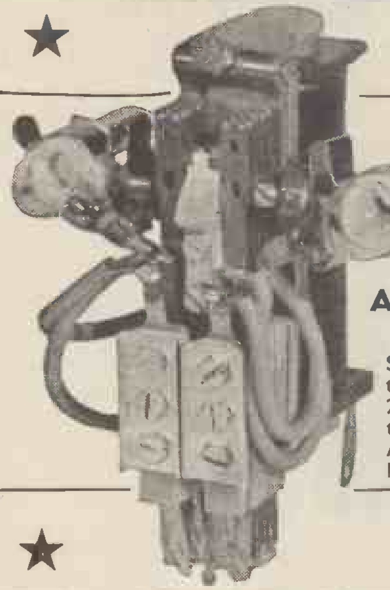
51, COUNTY ROAD, LIVERPOOL, 4

Telephone: AINTREE 1445. ESTAB. 1935

DEPENDABLE RELAY CO. LTD.

8A AINGER RD., CAMDEN TOWN, LONDON, N.W.3. PRImrose 8161
Head office, 12a Tottenham Street, W.1

Have you a Relay problem?



AUTOMATION RELAYS

Standard 3000 T contact assemblies + 1 or 2 Mercury Switches up to 50 amps. at 440 V. A.C. or 20 amps. 230 D.C.

TRANSISTOR RELAYS

PACKAGED UNITS ready to connect to any A.C. Mains. Fitted 2 C/O. 5 amp. and screw-type terminal outlets. Sensitivity 300 micro amps. and 3 micro amps.

HUNDREDS OF USES including:—

- OVEN CONTROL
- CONTACT THERMOMETERS
- BRIDGE CIRCUITS
- PHOTO-ELECTRIC CELLS
- LIQUID CONTROL

etc., etc.

P.O. TYPE 3000 & 600 RELAYS

Manufactured to your specification to Post Office or Interservice standards.

Have you seen our NEW CATALOGUE?

Current Supplement and Bargain List gives full details of our wide range of Speakers, Cabinets, Tape Recorders, etc.

"SYMPHONY" STEREOPHONIC AMPLIFIER

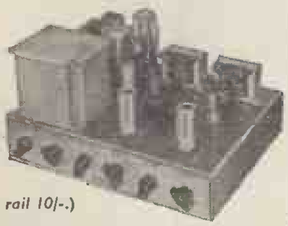
"Symphony" Stereophonic Amplifier with independent control not only of the treble and bass but the middle frequencies also.

As reviewed in "The Gramophone" March.

Price at present only

19 GNS

(Carriage and packing by road or rail 10/-.)



NO. 1. "SYMPHONY" AMPLIFIER	£12 12 0
NO. 2. "SYMPHONY" AMPLIFIER	£18 18 0
NO. 1. "SYMPHONY" FM TUNER (tuneable)	£15 8 0
"SYMPHONY" SWITCHED FM TUNER KIT	£9 19 6
Ready Built	£15 15 0
"SYMPHONY" AM/FM TUNER	£27 6 0
DULCI H3-S STEREO RADIOGRAM CHASSIS	£29 3 10
A.M.C. STEREOPHONIC AMPLIFIER *Complete in steel cabinet*	£10 10 0
"SYMPHONY" BASS REFLEX CABINET KITS	
8in. speaker size	£4 15 0
10in. speaker size	£5 7 6
12in. speaker size	£5 17 6

Ready Built 15/- extra.

"SYMPHONY" INFINITE BAFFLE CABINET (RJ ENCLOSURE)	£5 10 0
"SYMPHONY" COLUMN CABINET	£13 13 0
"SYMPHONY" CONCERT GRAND EQUIPMENT CABINET	£19 0 0
"SYMPHONY" DE LUXE COMPLETE STEREOPHONIC REPRODUCER including two speakers	£90 0 0
"SYMPHONY" DE LUXE CONCERT GRAND STEREOPHONIC REPRODUCER incl. tape and speakers	£170 0 0
GOLDRING/LENCO TRANSCRIPTION UNITS	
Model GL58 with Ronette TX88 and 2 Sapphires	£23 5 6
With Ronette BF40 Stereo Cartridge and Diamond	£29 3 10
With Goldring 600 cartridge	£32 10 6
With ELAC Stereo cartridge	£40 4 7

Model GL60 fitted with any of the above cartridges £8/2/8 extra to the above prices.

SPECIALLY RECOMMENDED SPEAKERS IN STOCK
WHARFEDALE GOODMANS W.B.

SPECIALLY RECOMMENDED CABINETS IN STOCK
"Symphony" Nordyk W.B.

SPECIALLY RECOMMENDED RECORDERS IN STOCK
Truvox Ferrograph Grundig Telefunken Reflectograph

Conversion to Stereo

Owners of "Symphony" amplifiers will be pleased to know that we can undertake the conversion to Stereo of their monaural amplifiers, promptly and at reasonable cost. *Example.*

No. 2. "Symphony" Amplifier Mark III or IV converted to our latest Stereo Amplifier **10 gns**

All these items are fully described and illustrated in the New Catalogue

SEND NOW FOR YOUR COPY
Free and Post Free

NORTHERN RADIO SERVICES

11 King's College Road, Adelaide Road, London, N.W.3

Business Hours 9—6 p.m., Monday to Saturday inclusive. PRImrose 3314

LET US DEMONSTRATE

PILOT

this fine craftsman made

STEREOPHONIC AMPLIFIER AND CONTROL UNIT

Send for FREE information leaflet

Power Output: Stereo 7.5 w. each channel. Monaural 15.0 w. Total.

Frequency Response: 20-20 Kc/s $\pm$ 1db.

Negative Feedback: 20 db.

Audio Inputs: Gram. 1 & 2, radio, tape auxiliary.

Dimensions: 13$\frac{3}{16}$in. $\times$ 8$\frac{5}{8}$in. (excl. Knobs) $\times$ 5in.

32 GNS. E.P. Deposit **£5.12.0.** Plus 12 monthly repayments of **£2.10.8.**

CITY SALE & EXCHANGE LTD

The High Fidelity Specialists

93-94 FLEET STREET, LONDON, E.C.4 *Phone: FLEet Street 9391-2*

Quartz Crystals of any shape and size cut and ground precisely to specification and coated, if required, with Gold, Silver or Aluminium, etc.

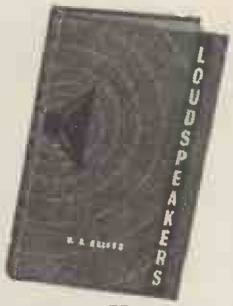
BROOKES CRYSTALS LTD

Suppliers to Ministry of Supply, Home Office, B.B.C., etc.

LASSELL STREET, GREENWICH, S.E.10

Phone: Greenwich 1828/4482

Grams: Xtals, Green, London *Cables:* Xtals, London



THREE "SOUND" CLASSICS

Which are a "must" for the sound reproduction enthusiast and music lover. G. A. Briggs is the versatile author of these interesting and entertaining books.

LOUDSPEAKERS. Fifth edition, 336 pages, 230 illustrations. Standard reference work on loudspeakers. 31 chapters including: Reminiscences—Frequency Responses—Directional and Phase Effects—Baffles, Cabinets and Horns Electro-static Speakers—Stereo—Audio Fairs and Concert Halls. Sales to date over 50,000. **PRICE 19/6** (20/9 Post Free)

SOUND REPRODUCTION. Third edition, fourth impression, 368 pages, 315 illustrations. Chapters on Resonances—Cabinets—Room acoustics—Response curves with Oscillograms—Crossover networks—Recording Systems—Records—Pick-ups, etc. Total sales exceed 35,000. **PRICE 17/6** (18/6 Post Free)

PIANOS, PIANISTS AND SONICS. A book for sound enthusiasts and music lovers written in G. A. Briggs' entertaining style. Chapters on piano history and construction—Harmonic analysis—Touch—Tone—Tuning, etc. 192 Pages, 102 illustrations. **PRICE 10/6** (11/- Post Free)

Sold by radio dealers and bookshops

Wharfedale

WIRELESS WORKS LTD
IDLE BRADFORD YORKS

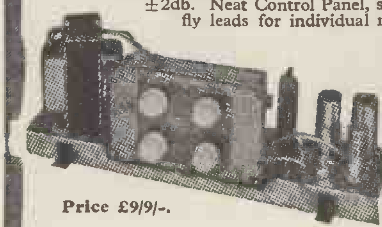
Published by
WHARFEDALE WIRELESS WORKS LTD.
Telephone: Idle 1235/6
Grams: "Wharfdel" Idle Bradford

you'll like the sound of

DULCI

"HI-FI" PRECISION-BUILT EQUIPMENT

GA4 High Fidelity Amplifier. 4 watt 4-valve circui with a frequency response of 40-18,000 c.p.s. ±2db. Neat Control Panel, size 6in. × 4in., on fly leads for individual mounting. Input selector switch matching to Radio, L.P., and 78 r.p.m. records. Separate bass and treble controls giving wide range of cut and lift. Volume Control. Rotatable transformers for hum cancellation.



Price £9/9/-.

MODEL DPA 10 AND PRE-AMPLIFIER

10-15 watts ultra linear push-pull power amplifier and pre-amplifier. A superb instrument, modern styled and of precision quality. Incorporates every facility for the reproduction of high quality sound, from radio, records, tapes or microphones.

DPA 10 only £12/12/-. With pre-amplifier, £19/19/-.

MODEL H4T2 SELF-POWERED AM/FM TUNER

For clear, clean reception of the B.B.C. high fidelity transmissions on the VHF/FM Band and customary Long, Medium and Short wave broadcasts. Magic eye tuning — Audio Stage incorporating negative feedback—dual output for high and low sensitivity amplifiers. Simple "through" cabinet mounting — full automatic volume control and limiting on 2 IF stages. Price £24/19/- inc. P.T.

AND HERE'S THE SUPERIOR TAPE UNIT FOR THE SERIOUS ENTHUSIAST MODEL TU1

for superb performance and presentation. It's all ready for addition to a Hi-Fi system. Recording amplifier incorporated with erase and bias oscillator. Playback equaliser and pre-amplifier integrated with deck. 2 speeds—7½in./sec. and 3¾in./sec. Price £57/15/-.
This deck when fitted with a "Stereo" Replay Head costs £63/15/- and as such is designed for use with the DULCI "Stereo Eight" pre-amplifier.

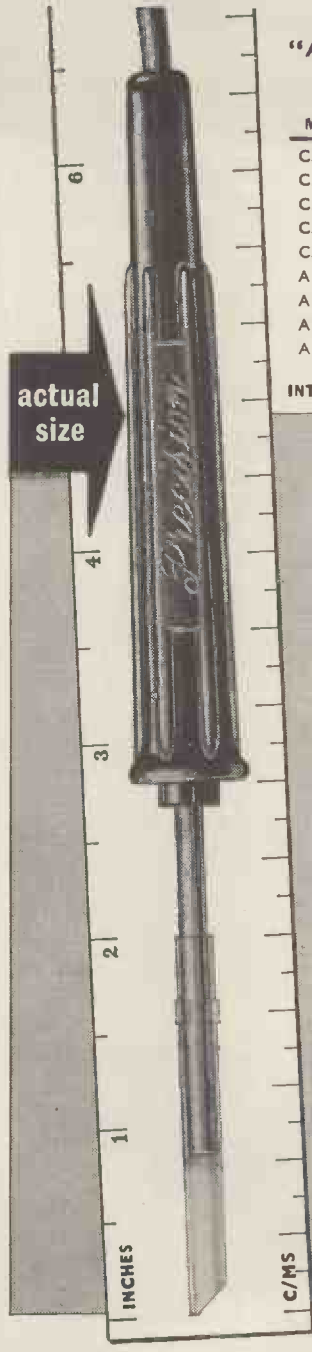
Our complete range includes Pre-Amplifiers, Power-Amplifiers, Tape Recorders and all Hi-Fi and Stereo equipment.

Write for comprehensive illustrated literature to:—

THE DULCI COMPANY LIMITED
97-99 Villiers Rd., London N.W.2 Tel.: WILlesden 6678/9

PIN POINT SOLDERING

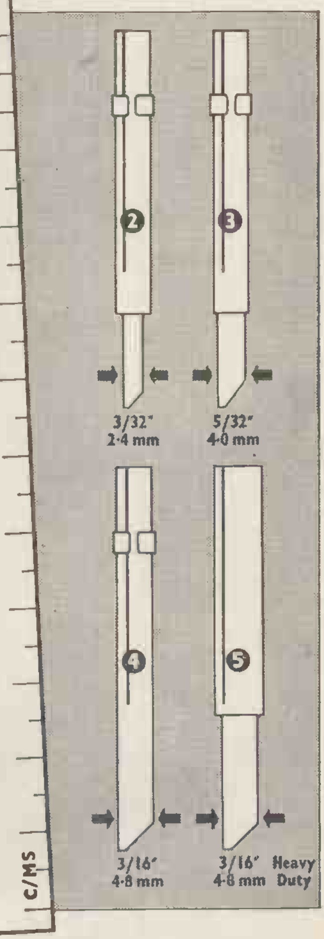
Transistors · Printed Circuits · Miniaturized Equipment



"AS LIGHT AS A PEN"

MODEL	VOLTAGE	LIST PRICE
C.240	230/240	29/6
C.220	220/230	29/6
C.125	120/130	29/6
C.115	110/120	29/6
C.50	48/52	29/6
A or B.6	6	25/-
A or B.12	12/13	25/-
A or B.24	22/26	25/-
A or B.28	26/28	25/-

INTERCHANGEABLE SPARE BITS



Precision
SOLDERING IRON

A.N.T.E.X LIMITED

3 TOWER HILL · LONDON · E.C.3.
Telephone: ROYal 4439. Cables: Antexlim, London.

SILVER

DISPERSIONS

As part of their service to the electronics industry, Acheson Colloids Limited now offer a range of 'dag'* dispersions of silver for applications where high conductivity is essential.

Air-dried silver coatings can be used as screening media, starters for the electroplating of plastics, as contact material, or as conducting inks. Among other applications for these Acheson products, the silvering of ceramics and mica at relatively low temperatures deserves special mention.

Here are two outstanding examples of their use. First, a 'dag' dispersion of silver was adopted by the G.P.O. after a long series of tests as a screening coating for the repeater valves of the first transatlantic telephone cable. Second, following two years of research and testing by Acheson technicians working in collaboration with a well known component manufacturer, a special silver coating for potentiometer low-end contacts was developed. The Acheson dispersion has now been adopted as a standard material for this purpose.

The Acheson Organisation is backed by fifty years' experience in the development and application of colloidal dispersions. If your interest is in conducting coatings, whether of silver or graphite, get in touch with Acheson's first.

dag
REGD TRADE MARK

dispersions

of

silver

Registered trade mark of Acheson Industries (Europe) Ltd; licensed user—Acheson Colloids Ltd.

Acheson Colloids

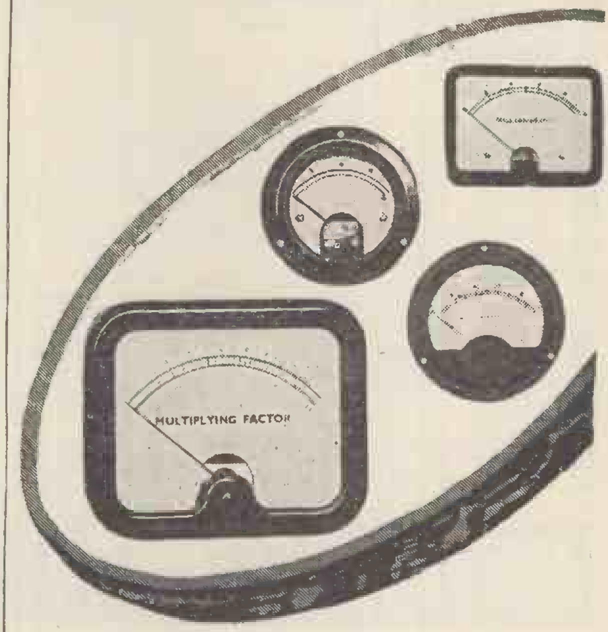
LIMITED

(Subsidiary of Acheson Industries (Europe) Limited)

P.O. Box No. 12, PRINCE ROCK, PLYMOUTH, DEVON

Also Acheson Colloiden N.V., Scheemda (Gr.) Netherlands
& Acheson Colloids Company, Port Huron, Michigan, U.S.A

meters



à la Anders

Meters *à la Anders* are meters *à la carte:* Any desired non-standard meter, prepared specially in the required size, shape, current or voltage level and range. All leading makes. Dials individually drawn. Singly or in batches. All calibrations personally checked by the *Chef* engineer. All patrons' requests—however exotic—carried out without delay: standard ranges from stock, special meters 7-14 days.

Meters, Electronic & Test Equipment to individual specifications.

Anders *electronics* LTD

103 Hampstead Road, London, N.W.1 · Tel: EUSton 1639

Contractors to G.P.O. and Government Departments


WANTED
THE WORLD OVER...
Monarch
There is no other choice
...if you insist on stereo and monaural perfection
...if you demand trouble-free performance
...if you appreciate fine styling
BE SURE THE 'GRAM OR 'PLAYER YOU CHOOSE IS FITTED WITH THE
Monarch
BSR
WORLD'S FINEST 4-SPEED AUTOCHANGER
BIRMINGHAM SOUND REPRODUCERS LIMITED

Wireless World

ELECTRONICS, RADIO, TELEVISION

MAY 1959

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

Editor:
F. L. DEVEREUX, B.Sc.

Assistant Editors:
H. W. BARNARD
T. E. IVALL

VOLUME 65 No. 5

PRICE: TWO SHILLINGS

FORTY-NINTH YEAR
OF PUBLICATION

Offices: Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager, or Publisher, as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month) by ILIFFE & SONS LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* "Iliffepres, Sedist, London." *Annual Subscriptions: Home and Overseas,* £1 15s. 0d. *Canada and U.S.A.,* $5.00. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 26B, Renfield Street, C.2. *Telephone:* Central 1265. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

Transistor Transmitter for 500kc/s

The recently introduced Mullard OC24 power transistor is suitable for high-frequency applications and it can dissipate several watts at the collector. The combination of these qualities has made possible the design of a 500kc/s push-pull amplifier capable of delivering an output of 4 watts into a resistive load. This amplifier can be used as the output stage of a transmitter such as that shown in the accompanying circuit.

The transmitter was designed for operation in the International Marine Frequency Band. It is particularly useful for lifeboats and life rafts, but it can be adapted, using an automatic-keying system, for life-jackets, air-sea rescue equipment, helicopters and radio beacons for coastal stations. The long life and reliability of the transistors make them particularly suitable for the type of apparatus suggested above, in which standby conditions of long duration are experienced. The low-consumption, light weight and compactness add to these advantages. A 4 ampere-hour accumulator will power the transmitter for some 60 hours. For emergency applications a self priming battery, which requires no attention (other than charging and sealing) until it is needed for use, is suitable.

The transmitter comprises an oscillator, a modulator, a driver and a power amplifier stage. The oscillator is crystal controlled and uses an OC45 transistor. The resonant circuit in the collector line is tuned to the series-resonant frequency of the crystal. The crystal is connected in series with the feedback winding to control the frequency of oscillation.

The modulator is a silicon transistor (OC201) also recently announced. The output from the modulator is applied to a driver amplifier and then to a push-pull power amplifier which feeds an aerial. The modulator, driver and power-amplifier stages are all operated under Class B conditions.

The design of the Class B push-pull amplifier follows the same basic technique as that for an audio amplifier except that, as the collector circuit is tuned, no bias is required to eliminate cross-over distortion. The use of a shared emitter resistor reduces the effect of variations in base-emitter voltage V_{be}, and reduces the lengthening, caused by hole storage, of the collector-current pulse. This reduction of the hole-storage current gives a marked improvement in the efficiency of the amplifier. The winding details for the output transformer are shown on the circuit.

The design procedure for the driver and modulator stages is similar to that for the output stage. A 6V supply is used for the modulator because of the voltage limitations of the oscillator transistor. This supply is also used because it is convenient for the modulator, and because of the keying system adopted.

A crystal-controlled oscillator with a tuned collector is used. Feedback is obtained by a transformer coupling from the parallel-tuned circuit in the collector circuit, to the base. The crystal is connected in series with this feedback winding. The collector circuit is tuned to the series-resonant frequency of the crystal. The series resistance of the crystal is low enough for the feedback current to start oscillation. The oscillator operates under Class A conditions, the base bias is provided by a potentiometer (R1R2). The emitter resistor is bypassed to r.f. signals.

It is hoped to publish details of the modulation arrangements and the automatic keying system (transmitting SOS signals) at a later date.

The tuning procedure adopted is the usual one of rough tuning at reduced power, followed by adjustment at full power. A resistor of 27Ω is connected in the emitter lead of the modulator amplifier Tr2, the 12V supply is then connected to the transmitter, and the oscillator tuned-circuit is adjusted to the series-resonant frequency of the crystal. The modulator amplifier is tuned next. The driver and power-amplifier stages should then be tuned for a maximum power output (about 2 watts) across the 68Ω load.

The emitter resistor of Tr2 should then be short-circuited. The complete transmitter, from the oscillator to the power amplifier, should be progressively readjusted. Careful tuning of the power amplifier is necessary, because excessive collector current flows if the stage is off tune. The full output of 4 watts should now be obtained.

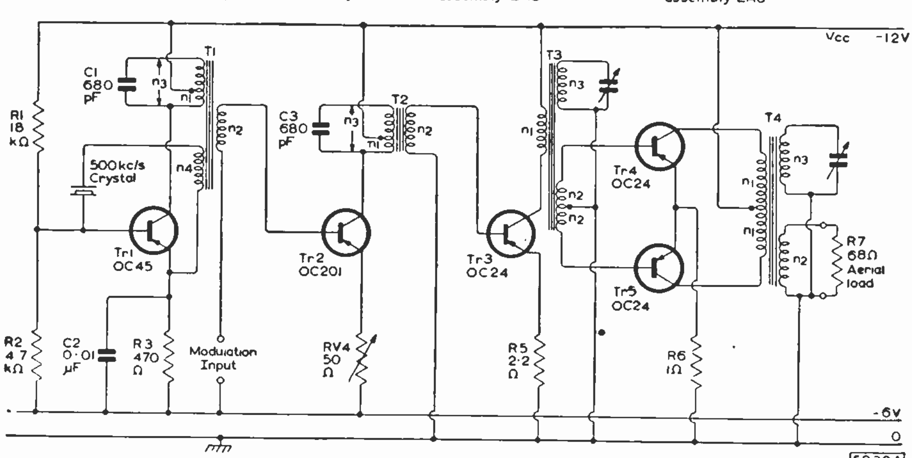
An experimental transmitter was built and the performance tested over a temperature range from 0 to 60°C. The output falls gradually at temperatures above 25°C, although quite reasonable output is still available at 60°C. Field tests were carried out under licence using a 520kc/s crystal, the transmitter being retuned to this frequency. A transmitting aerial 30ft high and a receiving aerial of about 30ft of wire were used. Strong signals were received within 12 miles across land. This is not the maximum range over land, and a range of at least 50 miles can be expected at sea.

Oscillator Transformer T1
n_1 18 turns, n_2 7 turns, n_3 52 turns, n_4 6 turns — 9/0024 bunched conductors
Ferroxcube adjustable pot-core assembly LA35

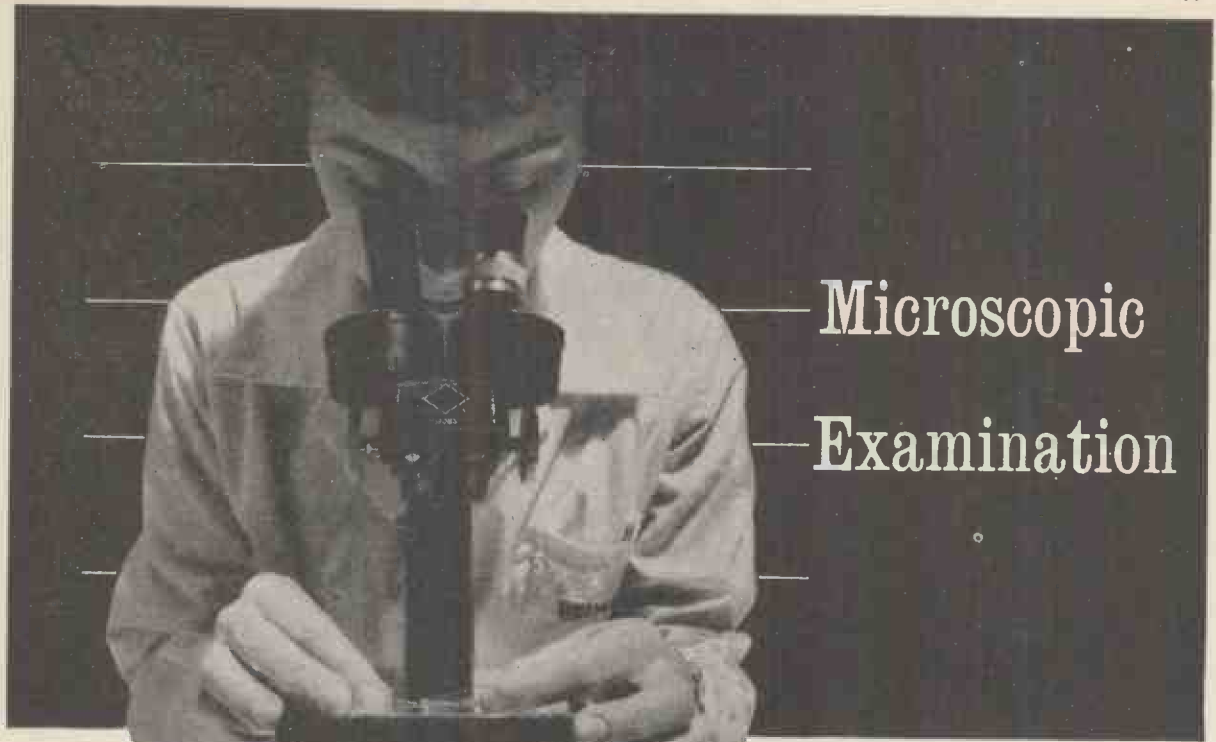
Modulator Transformer T2
n_1 6 turns, n_2 4 turns, n_3 52 turns — 9/0024 bunched conductors
Ferroxcube adjustable pot-core assembly LA35

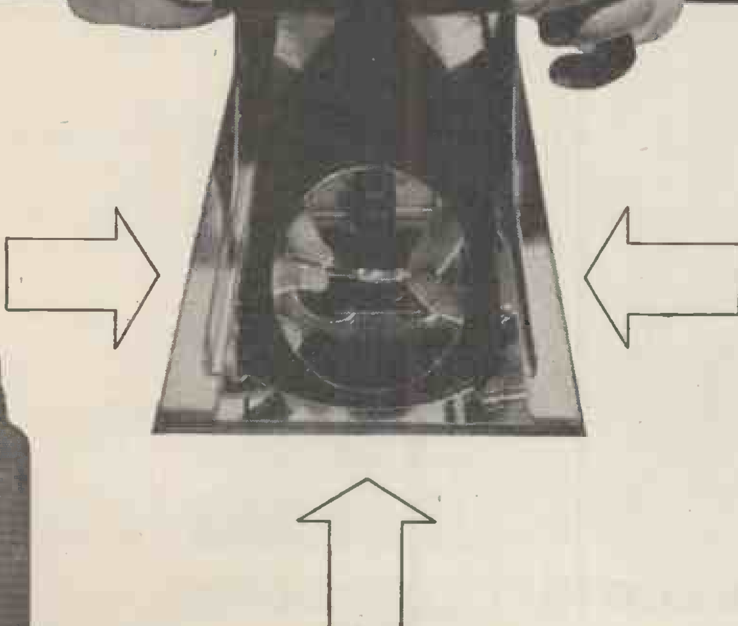
Driver Transformer T3
n_1 4 turns, n_2 3+3 turns, n_3 30 turns — 19/0028 bunched conductors (n_1, n_2) 3 strands
Ferroxcube pot-core assembly LA3

Output Transformer T4
n_1 2+2 turns, n_2 4 turns — 21 s.w.g enamelled copper; n_3 33 turns 19/0028 bunched conductors
Ferroxcube pot-core assembly LA6



Complete Circuit of the Transmitter





The reliability of the Brimar 'T' range of valves has been "built-in" as the result of experience gained from a programme of examination and testing. One of these tests is illustrated. Sub-miniature valves for use in guided missiles are being microscopically examined for mechanical defects. The degree of magnification is more than sufficient to ensure that no flaw in the structure can escape detection—a vital precaution in equipment which is subjected to extreme stress and strain. The information derived from this and other tests on valves for special applications is used to improve manufacturing techniques on commercial types, so making Brimar the obvious choice when the demand is for a *reliable* valve.

better make it BRIMAR

STC COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

VALVE DIVISION: FOOTSCRAY · SIDCUP · KENT · FOOTSCRAY 3333

Acos products for better listening:

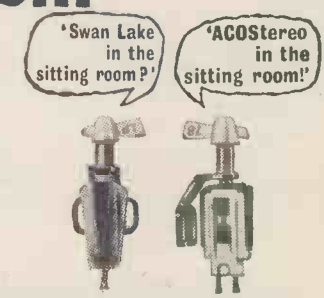
ACOStereo Type 73
Turn-over cartridge for stereo, LP and standard records.

Acos Changer Dust Bug
Fits most arms. Increases stylus life up to six times. Protects your records.

Acos Styli
x500 tested, diamond and sapphire, for all Acos and many other makes of cartridge.

Swan Lake in the sitting room

Swans dancing (Tchaikovsky), infernal (Sibelius) or even dying (Saint-Saens) — they all come dramatically to life with ACOStereo equipment. ACOStereo Type 71* cartridge for instance, fits many popular arms and plays a key part in converting conventional players into stereo. ACOStereo Type 73 is an outstandingly successful universal cartridge for stereo, LP and standard records, extensively used in many leading instruments.



* ACOStereo Type 71 is now fitted with a diamond stylus at no increase in price.

acos ARE DOING THINGS IN STYLI

COSMOCORD LTD WALTHAM CROSS HERTS · TEL: WALTHAM CROSS 5206 (London subscribers please dial WA4 5206)

"BELLING-LEE" NOTES

Parameters of design

The insulants that hold the contacts

No. 5 of a series

Capacity is a property possessed by two conductors separated by an insulant, and is dependent upon the physical arrangement of the conductors and the dielectric contact of the insulant. Capacity is an essential feature of any R.F. circuit, but can be disastrous in the wrong place, e.g. between certain contacts in a valve socket or between certain contacts and earth. This is just another fact that a young designer must be aware of, and take into account. It is generally advisable to keep capacity as low as possible in valve sockets. With plugs and sockets for use in R.F. circuits, the impedance and not capacity becomes the important factor.

Phenolic moulding powders are available in considerable variety, each to a close specification. It is therefore possible to choose a powder best suited for most applications. The range is very wide both mechanically and electrically. For electrical work consideration must be given as to whether or not a material will "track" following a voltage breakdown between contacts or contact and earth, if so, subsequent breakdowns will occur at lower voltage—following the carbonised track of the first flash.

Some of the mineral filled powders have excellent electrical properties, they are very hard, non absorbent and track resistant, but as they are abrasive, their use causes excessive tool wear, and as tools can be very expensive, they are not very popular, and if practicable, other suitable insulants are preferred.

Nylon filled powders are exceptionally good and not brittle, though they are slightly absorbent.

Power factor is important when losses in R.F. circuits have to be considered and for high insulation resistance, e.g. in high impedance circuits such as valve voltmeters and electrometers.

Few phenolic mouldings can be described as ante-wetting, but certain glazed electrical ceramics and the waxy insulants like polythene are particularly resistant to the coalescence of droplets.

Polythene has a low melting point, and an important contour could easily be deformed when soldering to an adjacent contact. Polytetrafluorethylene (Fluron, P.T.F.E.) has a much higher melting point, is harder, and can be machined or moulded. The raw material is much more expensive to buy than polythene, and it is expensive to process.

Nylon—we have seen, is used as a filler in phenolic mouldings—or it may be injection moulded by itself. Although it is to some degree absorbent, its surface does not "wet." This "wet ability" is important when a component is subject to condensation, e.g. in unsealed equipment in an aircraft.

Polystyrene has very good R.F. insulation properties. It can be machined—with care, or it will craze—but it is now generally moulded. It is a brittle substance, but a tougher high-impact material is available with somewhat degraded electrical properties as a co-polymer of styrene with other resins.

Polyvynal Chloride (P.V.C.) is useful as an insulant for mains, has a very long life and good mechanical properties, but should not be used where R.F. is present.

We have said nothing about rubber, but the chemistry of rubber and rubber-like substance, has made great strides. Most natural rubber contains free sulphur and if used in close proximity to silver-plated contacts, they will tarnish. Remember, this tarnish is silver sulphide and not an oxide. Although this tarnish is not high resistance, it is undesirable, and can increase the difficulty of soldering. It is possible to obtain a grade of natural rubber containing no free sulphur. Natural rubber will breakdown and crack after long exposure to ultra violet light, so one of the synthetic rubbers is usually specified where an article will be exposed to sunlight, for instance when used as the centre insulator of a V.H.F. dipole. When rubber is used in a situation where oil is present, neoprene (synthetic) should be specified. Neoprene is also used for certain seals.

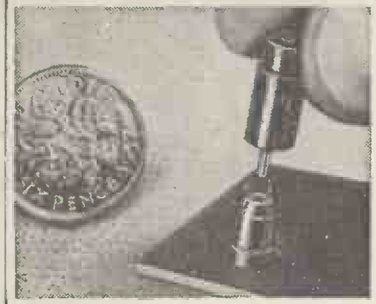
Silicone rubber is, of course, a synthetic, it is a silicone polymer which withstands exceptionally high temperatures without deterioration. Very useful for seals.

What is meant by Sealing

We have mentioned sealing on several occasions. Perhaps it would be useful to explain this for the benefit of the younger students and junior engineers. Why is it necessary? Let us look at a simple case. Wherever there is a temperature differential, "breathing" tends to take place. Where seals are imperfect, damp, grit or fungus spores can be sucked in to contribute to degradation of an equipment. Seals and the, sealing of electrical equipment, is a very difficult problem. Particularly if for use under tropical conditions, as if imperfectly sealed, moulds will develop if there is any substance present to support their growth, which there should not be. Where moisture gains access condensation takes place. It is easy to seal a corned beef can, but try to take two or more leads through it and the trouble begins. Sealing and the testing of seals will be dealt with next month.

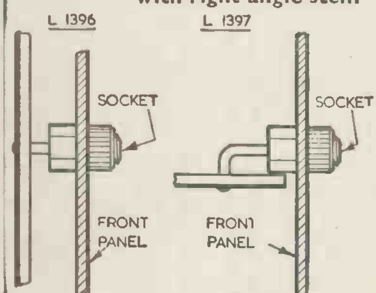
Advertisement of
BELLING & LEE LTD.
Great Cambridge Rd., Enfield, Middx.
Written 1959

"BELLING-LEE" MINIATURE SOCKETS FOR PRINTED CIRCUITS



L.1396 Miniature Socket with straight stem

L.1397 Miniature Socket with right-angle stem



These miniature sockets can be used as test points for printed circuits. The L.1396 has a straight stem for soldering at right-angles to a printed circuit board so that the miniature socket emerges on the engraved control panel which is parallel with the board.

The L.1397 is a similar socket, but with right-angle stem. When the stem is soldered through the board the socket is in the same direction as the board emerging on an engraved control panel at the end of the board. This makes it possible to stack printed circuits one above the other, with close-spaced rows of test points on engraved panels similarly stacked.

The body and nut of these sockets are nylon and available in a standard range of colours; black, red, green, yellow, blue, white, although other colours can be supplied to order. The contact surface is either gold- or silver-plated (-/Au or -/Ag, respectively), the contact resistance being less than 2 milliohms.

The breakdown voltage is 8 kV. under dry conditions and the weight of the component is 0.7 gm.

Most "Belling-Lee" products are covered by patents or registered designs, or applications therefor

BELLING & LEE LTD
GREAT CAMBRIDGE ROAD, ENFIELD, MIDDX., ENGLAND
Telephone: Enfield 3322 • Telegrams: Radiobel, Enfield

FERRAMIC is a registered trade mark

A ferrite to remember

Cores made of Plessey 'Ferramic' material, only ·050″ in diameter, make possible the intricate memory planes used in modern computer design. The electrical properties of these microscopic cores have to be critically accurate and 'Ferramic' readily meets the demands.

Other grades of 'Ferramic' are also being made in large quantities for many components requiring a core material of the highest efficiency—television transformers, scanning coils and aerial rods among them.

Designers still seeking a core material which will realise the performance they want, at an economical price, are invited to write for data sheets on available grades of 'Ferramic'.

Shown is an enlarged section of a typical Plessey memory plane. Each core is only ·050″ in diameter.

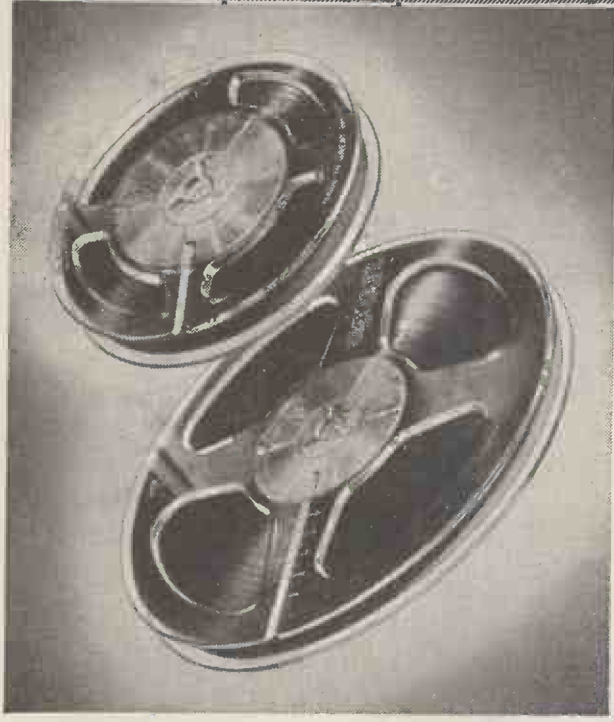
Plessey

CHEMICAL AND METALLURGICAL DIVISION • COMPONENTS GROUP
THE PLESSEY COMPANY LIMITED • WOOD BURCOTE WAY • TOWCESTER
NORTHANTS • TELEPHONE: TOWCESTER 312

Overseas Sales Organisation:
PLESSEY INTERNATIONAL LIMITED · ILFORD · ESSEX · TELEPHONE: ILFORD 3040

TC9a

Emitape



the magnetic recording tape with the highest technical standards

* High sensitivity
* Low noise level
* Low 'print through' factor
* Anti-static
* Freedom from curl and stretch

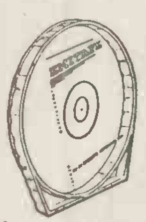
"88" GENERAL PURPOSE "99" LONG PLAY

Type No.	Title	Size	Length approx.	Price in EMICASE	Price without EMICASE
88/3	"Message"	3" dia.	175'	—	7 6
99/3	"Message"	3" dia.	250'	—	9 6
88/3N	"Message"	3¼" dia.	175'	—	7 6
99/3N	"Message"	3¼" dia.	250'	—	9 6
88/6	"Junior"	5" dia.	600'	£1 3 6	£1 1 0
99/9	"Junior"	5" dia.	850'	£1 10 6	£1 8 0
88/9	"Continental"	5¾" dia.	850'	£1 10 6	£1 8 0
99/12	"Continental"	5¾" dia.	1200'	£1 17 6	£1 15 0
88/12	"Standard"	7" dia.	1200'	£1 17 6	£1 15 0
99/18	"Standard"	7" dia.	1800'	£2 12 6	£2 10 0
88/18	"Professional"	8¼" dia.	1750'	—	£2 17 6
99/24	"Professional"	8¼" dia.	2400'	—	£3 12 6

Emicase

now available separately!

the polystyrene container that solves tape storage problems, protects spools from dust and allows easy identification of leader tapes.



7" – 4s. 0d; 5¾" – 3s. 6d; 5" – 3s. 6d.

E·M·I SALES & SERVICE LTD
(Recording Materials Division)
HAYES · MIDDLESEX
Tel: SOUthall 2468

ES/R/46

the name to remember for

INDUSTRIAL TYPE TRANSISTORS

BIDIRECTIONAL GERMANIUM TRANSISTORS

(Effectively symmetrical in significant parameters)

TYPES TK 20 B, TK 25 B

For high frequency switching circuits (8 Mc/s and above with the TK 25 B), or small signal amplification.

TYPES TK 21 B, TK 24 B

For intermediate frequency, high voltage switching circuits, or small signal amplification.

ASYMMETRICAL GERMANIUM TRANSISTORS

TYPE TK 23 A

For general purpose low and intermediate frequency applications, and telephone and telegraph carrier systems.

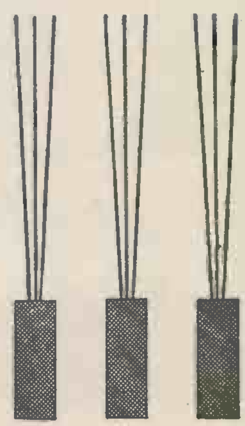
TYPE TK 40 A

For audio and intermediate frequency oscillators and amplifiers requiring high gain and a power output of several hundred milliwatts.

SILICON TRANSISTORS

TYPES TK 70 A, TK 71 A

For amplification, switching and control in extremes of ambient temperature; and having excellent saturation characteristics at high collector currents, unusual in silicon transistors.



STC COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

TRANSISTOR DIVISION: FOOTSCRAY · SIDCUP · KENT

Vortexion quality equipment

All models now have provision for Stereo or for easy conversion at a later date.

Conversion units are also available. The regular models are retained with additions and improvements. Our high standard which has made these recorders famous has been maintained resulting in their being chosen for the foremost musical centre in this country.

TWELVE-CHANNEL ELECTRONIC MIXER

★ This is similar to the 4-channel, but is fitted with 12 hermetically sealed controls, 12 balanced line microphone transformers potted in mu-metal boxes, and a mains transformer also potted in mu-metal. All components which can affect noise are tested and selected before insertion. It is supplied in standard steel case or 7in rack panel.

30/50 WATT AMPLIFIER

★ Gives 30 watts continuous signal and 50 watts peak Audio. With voice coil feedback distortion is under 0.1%, and when arranged for tertiary feedback and 100 volt line it is under 0.15%. The hum and noise is better than — 85 db referred to 30 watt.

It is available in our standard steel case with Baxendale tone controls and up to 4 mixed inputs, which may be balanced line 30 ohm microphones or equalised P.U.s to choice.

120/200 WATT AMPLIFIER

★ Will deliver 120 watts continuous signal and over 200 watts peak Audio.

It is completely stable with any type of load and may be used to drive motors or other devices to over 120 watts at frequencies from 20,000 down to 30 cps in standard form or other frequencies to order. The distortion is less than 0.2% and the noise level — 95 db. A floating series parallel output is provided for 100-120 V. or 200-250 V. and this cool running amplifier occupies 12¼ inches of standard rack space by 11 inches deep. Weight 60lb.

Full details and prices of the above on request

VORTEXION LIMITED,
257-263, The Broadway,
Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3
Telegrams: "Vortexion, Wimble, London."

RADIO · TELEVISION · TRANSMITTING & INDUSTRIAL TUBES

EXPORT

RADIO
WALRAD
TUBE

ONLY

ALL TUBES OF BEST BRITISH AND CONTINENTAL CURRENT PRODUCTION, BRANDED AND BOXED "WALRAD"

HIGHEST QUALITY

LEADING BRITISH MANUFACTURERS' PRODUCTION ALSO AVAILABLE WITH THEIR OWN BRAND & BOXES

LOWEST PRICES

ALSO IN STOCK LARGE RANGE OF AMERICAN TYPES

WALMORE ELECTRONICS LTD.

PHOENIX HOUSE · 19-23 OXFORD STREET · LONDON · W.1

Telephone : GERrard 0522-3 | Cables : VALVEXPOR-LONDON | Telex. : LONDON 28752

Now . . . in your own home, LEARN

RADIO – TELEVISION – ELECTRONICS

NO PREVIOUS TECHNICAL EXPERIENCE NEEDED!

PRACTICAL EQUIPMENT (INCLUDING TOOLS) GIVES YOU A REAL LABORATORY TRAINING

"The trained electronics engineer has a great career ahead of him."

Valuable FREE Book shows how E.M.I. Institutes School of Electronics can train you for today's wonderful opportunities

Radio, Television and Electronics provide a new and exciting field of opportunity for the trained man—high pay, fascinating work, a prosperous future—or if you prefer it—independence in your own business. And, if you are trained at home by E.M.I. Institutes School of Electronics, you will be in the hands of *specialists* who know just what is needed and the quickest way to get you ready for one of the ever-growing number of fine jobs open to trained electronics-men. Whether you are a complete beginner or an advanced student with an examination in mind, E.M.I. Institutes School of Electronics has a Course exactly suited to your needs—with or without practical equipment—from electricity and magnetism to automation techniques.

- Practical Radio
- Radio & Television Servicing
- Practical Electronics
- Electronics Engineering
- Automation
- Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, etc.
- A.M.Brit.I.R.E.
- City & Guilds Radio Amateurs' Exam.
- R.T.E.B. Certificate
- P.M.G. Certificate
- "NO PASS—NO FEE"

We definitely Guarantee NO PASS—NO FEE

Full details of the Courses, Practical Equipment, convenient monthly payments, our Employment and Advisory Depts. and much other helpful information is given in our Guide to Careers in Electronics. Write for *your* copy today. There is no obligation and the book will be sent to you quite free of charge.

FREE BOOK – POST NOW !

Please send me a free copy of your "Guide to Careers in Electronics"

NAME ....

ADDRESS ....

....

Subject or Exam of Interest..

E.M.I. INSTITUTES

SCHOOL OF ELECTRONICS

The Specialist Electronics Division of the British Institute of Engineering Technology.

(Dept. SE/22) COLLEGE HOUSE, 29-31 WRIGHT'S LANE, KENSINGTON, LONDON, W.8.

TRANSISTOR POWER AMPLIFIERS

Audix

- FOR BATTERY/MAINS OPERATION
- LOW CURRENT CONSUMPTION
- EXCELLENT FREQUENCY RESPONSE
- COMPACT AND ROBUST
- TRULY PORTABLE POWER

MODEL TA/5B £27.18.0

BRIEF SPECIFICATION

MODEL TA/5B. Power Output 18 watts max. Supply voltage 12 volts D.C. Max. current 2 amps. Quiescent Current 200 mA. Input Sensitivity better than 1 mV. Dimensions 5in. x 2¾in. x 6in. deep.

MODEL TA/5M. Power supply 200-250 volts A.C. and 12 volts D.C. (All other details as per Model TA/5B). Dimensions 5in. × 6in. × 6in. deep.

Write for Tech. Literature

Export & Trade Enquiries

MODEL TA/5M £33.6.0

AUDIX LTD., STANSTED, ESSEX. STANSTED 3132

Chapman Stereo

Elegance coupled with outstanding performance have already earned an enviable reputation for the Chapman 305 Control Unit (illustrated above) and 305 Power Amplifier.

- ★ 8 watts per channel at 0.1%.
- ★ Direct from Tape Head CCIR.
- ★ Any low output magnetic P/U RIAA.
- ★ Distortion negligible all levels.
- ★ Spare power for Tuner.
- ★ Main Amplifier only 12×7×5in.
- ★ Separate balance control.
- ★ Elegant in black and gold.
- ★ For shelf or cabinet mounting.

305 Control Unit 18 gns. Main Amp. 20 gns. Matching FM or AM/FM Tuners available.

Full specification from your hi-fi dealer or

C. T. CHAPMAN (Reproducers) LTD.

HIGH WYCOMBE · BUCKS.

Telephone: **High Wycombe 2474**

Are you looking for

HIGH MECHANICAL STRENGTH at LOW COST?

The illustration shows moulded TV Cabinet Backs made for United Components Ltd. and for Pye Ltd. Their strength, dimensional stability and good appearance make them vital components of the cabinet design.

FIBRE FORM is a new material based on the combination of strong cellulose fibre with synthetic resins. There are other reinforced plastics, but FIBRE FORM mouldings are not only LIGHTER and STRONGER, they are CHEAPER.

Leading manufacturers use FIBRE FORM for TV portable cabinets, portable radios, TV cabinet backs (right up to 21in. console model), radiogram backs. TV tube end protectors, etc., etc.

WE CAN IMPROVE YOUR PRODUCTS AND REDUCE YOUR COSTS

FIBRE FORM LIMITED

GARRATT MILLS, TREWINT STREET, LONDON, S.W.18

Tel.: Wimbledon 3946.

and

LOWER GORNAL, Nr. DUDLEY, WORCS.

Tel.: Sedgley 3486

NEW LIMITED PURCHASE STILL A BARGAIN ! !

TERMS CASH WITH ORDER

LEAFLET AVAILABLE ON REQUEST

BRAND NEW AND **FULLY GUARANTEED** RADIOGRAM CHASSIS

FEATURES

- ★ 5 Valve Superhet.
- ★ Long-Medium-Short Waves.
- ★ 3-4 Watts Output.
- ★ Ferrite Rod Aerial.
- ★ Latest Type Valves.
- ★ Dual Controls.
- ★ A.C. Mains 200-250 Volts.
- ★ Size 12" Long, 6" High, 7" Deep.

NEW PRICE

£8-5-0 EACH

PLUS 10/- CARR./PACKING

THE "SUPEREX 55" PORTABLE

A superb home construction 4-valve Battery Superhet Attache Case Receiver. Twin colour rexine case size 10¾" × 8¾" × 4¾" with gilt fittings.

All parts available separately.

Building Cost

£7-15-0

Plus 5/- p. & p.

Send 1/6 for Circuit Diagram.

4-SPEED RECORD UNITS

B.S.R UA8 Autochanger ..	£7	0	0
B.S.R. UA12 Autochanger ..	£10	10	0
Collaro Conquest Autochanger	£7	19	6

All above plus 7/6 Carriage

2-3 OHM P.M. SPEAKERS

All suitable for above chassis.

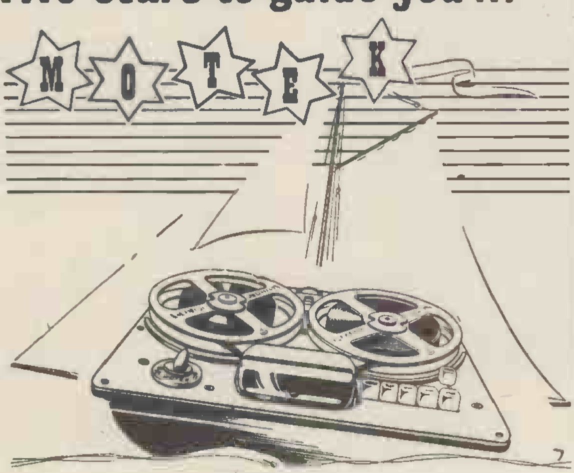
6½" @ 17/6, 8" @ 21/-, 10" @ 30/-, 7" × 4" @ 19/6, 8" × 5" @ 22/6, 10" × 6" @ 30/-.

All above plus 3/6 p. & p.

SUPERIOR RADIO SUPPLIES LTD.

37, HILLSIDE STONEBRIDGE, LONDON, N.W 10. Tel ELGAR 3644

Five stars to guide you ...



The deck of the 'Five Star" is always ship-shape and Motek fashion—for it has been designed for the absolute minimum of maintenance. From port to starboard the superstructure has five perfect points which make Motek the finest of the line.

Push Button Operation makes for ease of control, the Counter gives you dead reckoning, the Safety Erase Button prevents errors in erasing, the Pause Control functions easily and Three Speeds adapt the machine to the fidelity required. Keep your tapes on Motek Five Star.

Details on request.
Patents Pending

List **21 gns.**

MODERN TECHNIQUES

Wedmore Street London N.19. Tel: ARChway 3114

DBB 6613

MIDLAND INSTRUMENT CO.

HUGHES MOTORS, shunt wound 12 v. 1¼ amp speed 5,000 r.p.m., reversing, size 3¾in. long, 1¾in dia, ¼in. shaft, weight 20 oz., very superior motor design for anti-radar equipment, new unused 10/-, post 1/6. Ditto fitted reduction gear giving a final drive (¼in shaft) of either 320 or 150 r.p.m. state which required, 17/6, post 1/9.

CHASSIS, U.S. manufacture all aluminium 12¾ × 8 × 5½in., complete with top cover, some items have been removed remaining are—25 Amphenol midget ceramic B7G. type v/holders, complete with cans, over 70 colour coded 5% resistors also many ceramicons and other conds., trimmers, padders fixed and variable inductances, transformer, v/control etc new unused bargain 10/-, post 3/6

TELEPHONE SETS, consist of two combined microphone and receivers which, when wired up by ordinary twin flex, provide perfect 2-way communication, excellent results at 1 mile range have been reported, self-energised, no battery required set complete new unused, 7/6, post 1/3; suitable twin 14/36 p.v.c. up to 300ft lengths at 1d. per ft supplied, postage each 20ft. flex 3d extra.

CAMERA CONTROLS TYPE 35. Fitted with the popular small motor actuating the repeating exposure timer mechanism with variable setting control knob, red and green indicators complete with lamps also solenoid start switch etc., in grey finish metal case size 8 × 4¼ × 3in. New unused contained in usual wood instrument case fraction of original cost 20/-, post 3/-

Many other Bargains; send stamped addressed envelope for lists

MIDLAND INSTRUMENT CO. MOORPOOL CIRCLE BIRMINGHAM 17

Tel. [illegible]AR 13[illegible]

SHORT-WAVE RADIO & THE IONOSPHERE

By T. W. BENNINGTON *Engineering Division, BBC*

Long-distance communication by means of short waves is dependent on the state of ionosphere, which changes during the day and at different seasons of the year. This book explains simply the reasons for these changes and shows how they influence the choice of wavelength for signalling between different points of the earth's surface. *Published for the "Wireless World."*

8¾" × 5½" 138 pp. *2nd Edition* **10s 6d net** **By post 11s 4d**

Obtainable at all booksellers or by post from

The Publishing Dept., Iliffe & Sons Limited
Dorset House, Stamford Street, London, SE1

AVOMETER MODEL 40

Just purchased from the Ministry of Supply, these famous A.C./D.C. Test Meters are a "snip" for anyone requiring a First-Grade Instrument. The overall size is 7½in. x 6½in x 3¾in., indication being given on a 5in. Mirror Scale. Thoroughly overhauled, and complete with heavy Leather Carrying Case, Batteries and Instructions. Provides 40 ranges of Current. Voltage and Resistance, as follows:

D.C. Voltage	A.C. Voltage	D.C. Current	A.C. Current
60 mV.	6 V.	3 mA.	6 mA.
120 mV.	12 V.	6 mA	12 mA.
600 mV.	60 V.	12 mA	60 mA.
1.2 V	120 V.	60 mA	120 mA.
6 V.	240 V.	120 mA.	600 mA.
12 V.	480 V.	600 mA	1.2 A.
60 V.	600 V.	1.2 A.	6 A.
120 V.	1200 V	6 A.	12 A.
240 V.		12 A	
480 V.			Resistance
600 V.			1,000 Ohms.
1200 V.			10,000 Ohms.
			100,000 Ohms

ONLY **£10.19.6** Carriage, etc. 5/6

RCA AR 88 RECEIVERS. Re-conditioned and in perfect working order. "LF" Model, covers 75-140 kcs. and 1.2-30 mcs., ONLY £50. "D" Model, covers 500 kcs.-31 mcs., ONLY £55 (Carriage etc., 25/-).

POWER UNITS TYPE 234: Primary 200/250 v. 50 cycles. Outputs of 250 v. 100 mA., and 6.3 v. 4 amps. Fitted double smoothing. For normal rack mounting (or bench use) having grey front panel size 19in. x 7in. BRAND NEW. ONLY 59/6 (carriage etc., 7/6).

H.R.O. MAINS POWER UNITS: Input 115/230 v. A.C. Output 230 v. 75 mA., and 6.2 v. 3.5 Amps. Complete in black crackled case. ONLY 69/6 (carriage 3/6).

SPRAGUE CONDENSERS. Metal cased, wire ends. New, .01 mfd. 1,000 v., and .1 mfd. 500 v. 7/6 dozen. Special quotes for quantities.

MAINS TRANSFORMERS. Normal Primaries 250-0-250 v. 80 mA. 6.3 v. 3 a., 4 v. 4 a. 0-4-5 v. 2 a., 20/-; 350-0-350 v. 80 mA., 6.3 v. 3.5 a., 4 v. 4 a., 0-4-5 v. 2 a., 20/-; 0-30 v. 2 a., tapped to give 13 different voltages, 20/-.

O/P. TRANSFORMER 5/-.

EHT TRANSFORMERS. 5.5 kV. (Rect.) with 2 v. 1 a., 79/6. 7 kV. (Rect.) with 2 v. 1 a., 89/6. 2.5 kV. (Rect.) with 2-0-2 v. 1.1 a., 2-0-2 v. 2 a. (for VCR 97 tube etc.). 42/6 (postage 2/- per trans.).

COMMUNICATIONS RECEIVER R.1155

The famous Bomber Command Receiver known the world over to be supreme in its class. Covers 5 wave ranges: 18.5-7.5 mcs., 7.5-3.0 mcs. 1,500-600 kcs., 500-200 kcs., 200-75 kcs., and is easily and simply adapted for normal mains use, full details being supplied. All sets thoroughly tested and in perfect working order before despatch, and on demonstration to callers. Fitted with latest type Super Slow Motion tuning assembly. Have had some use, but are in excellent condition. ONLY £7/19/6.
A.C. MAINS POWER PACK OUTPUT STAGE, in black metal case to match receiver, enabling it to be operated immediately by just plugging in, without any modification. With built-in 6½in. P.M. Speaker £5/10/-, or De Luxe version with 8in. speaker £6/10/-.
DEDUCT 10/- IF PURCHASING RECEIVER AND POWER PACK TOGETHER. Send S.A.E. for illustrated leaflet, or 1/3 for 14 page booklet which gives technical information, circuits etc., and is supplied free with each receiver. Add carriage, 10/6 for Receiver, 5/- for Power Pack.

METERS

F.S.D.	SIZE AND TYPE	PRICE
25 microamps D.C.	2½in. Flush circular	69/6
25 microamps D.C.	2½in. Proj. circular	59/6
50 microamps D.C.	2½in. Flush circular	59/6
50 microamps D.C	3½in. Flush circular	80/-
1 mA. D.C.	2in. Flush square	22/6
1 mA. D.C.	2½in. Flush circular	25/-
1 mA. D.C.	3½in. Flush circular	50/-
150 mA. D.C.	2in. Flush square	7/6
200 mA. D.C.	2½in. Flush circular	12/6
20 amps. D.C.	2in. Proj. circular	7/6
40 amps. D.C.	2in. Proj. circular	7/6
15-0-15 amps D.C.	3½in. Flush square	25/-
300 volts A.C.	2½in. Flush circular	25/-
500 volts A.C.	2½in. Flush circular	25/-

AMERICAN RECEIVER R45/ARR7 Has 6 switched Bands covering 550 kcs.—42 mcs. Valve line up 4 of 6SK7 2 of 6SA7, 1 ea. 6H6, 6SQ7, 6J5, 6BA7, 6V6GT, OD3/VR150 2 stages of RF & 2 of IF. Controls include "S" Meter, RF Gain, BFO, Audio Gain, Pitch, Automatic Noise Limiter, AVC, Phasing, and Selectivity Control for Xtal or IF Adjustment to "Broad-Medium-Sharp". Output to Phones, but more than ample for Speaker. Exceedingly fine Vernier Tuning, with directly calibrated dial of tremendous scale length. Also incorporates 24 v. Motor for driving unique pre-set Tuning Device. Power Supply required 6 v & 250v. DC. Size 10½in. x 7¾in. x 20in. BRAND NEW AND UNUSED. ONLY £42/10/- (carriage etc., 20/-).

R1155 SUPER SLOW MOTION TUNING ASSEMBLY. As used on all late model 1155s. Easily fitted to "A" sets etc. ONLY 12/6.

ROLA 6½in. P.M. SPEAKER. Mounted in grey crackled metal cabinet 9 x 9 x 4½in., and with volume control. BRAND NEW AND UNUSED. ONLY 27/6.

MAINS ISOLATING TRANSFORMER. Manufactured by Vortexion. Fully shrouded. Will provide true 1 : 1 Ratio from nominal 230 v. Primary. Rated at 100 watts. BRAND NEW. ONLY 22/6 (post 2/6).

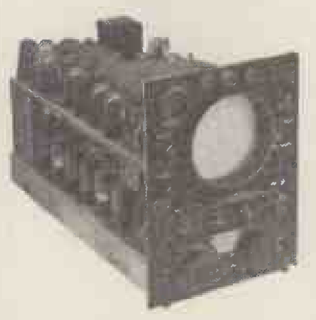
6 v. VIBRATOR PACKS. Out put approx. 130 v. at 30 mA., fully filtered and smoothed. Complete ONLY 12/6.

HETERODYNE FREQUENCY METERS
TYPE LM14

Designed and built to United States Navy specification, these Crystal Controlled instruments combine all the advantages of the well known BC.221 Frequency Meter, plus many additional features which increase their usefulness.

★ Frequency range 125-20,000 kc/s in 2 bands.
★ Accuracy better than .02% in 125-2,000 kc/s. band, and better than .01% in 2,000-20,000 kc/s band.
★ Voltage stabilisation circuit ensures accuracy not affected by power supply fluctuation.
★ Separate power switches allow standby filament operation without HT supply.
★ Modulation switch enables instrument to be used as a Signal Generator.
★ Has corrector for WWV.
★ Supplied with removable shock protection mounting.
★ Size only 8½in. x 8in. x 8½in Weight 11½lb.
★ Brand New and Unused. Further details on application.

OSCILLOSCOPE UNIT



American Loran Indicator APN4. A magnificent piece of equipment which is recommended for the **"Wireless World Television Oscilloscope"**, a copy of which publication is supplied with each unit, and gives full details of necessary modifications. Contains 5CP1 Cathode Ray Tube and Screen, 14 valves 6SN7, 3 of 6SL7, 8 of 6H6, 1 of 6SJ7, 100 kc/s. Crystal and hundreds of condensers, resistors, etc.

BRAND NEW IN MAKERS' CASES ONLY £5/19/6 (carriage 10/6)

Cash with order please, and print name and address clearly
PLEASE ADD POSTAGE OR CARRIAGE COSTS ON *ALL* ITEMS

HARRIS ELECTRONICS
(LONDON) LTD.

Radio Corner, 138 Gray's Inn Road, London, W.C.1 *Phone: TERMINUS 7937*

Open until 1 p.m. Saturdays. We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross

CONSTRUCTORS' PARCEL FOR TRANSISTOR POCKET RADIO

Size 5¼ x 3¼ x 1¼in.

SPECIAL PRICE

55/- P.P. 2/6

Component lists supplied.

★ Attractive moulded cabinet (blue, red or cream) with gold. 12/6.
★ J.B. 208 and 176 pf screened tuning gang. 10/6.
★ 3 ohm miniature 2½in. Speaker to fit. 21/6.
★ 20 : 1 output Transformer to match Speaker. 10/-.
★ 5 transistor printed circuit board. 5/6.
★ Circuit of 5 transistor radio. 1/-.

THE IDEAL BASIS FOR A POCKET TRANSISTOR RADIO

THE TELETRON "TRANSIDYNE"

★ 6 EDISWAN TRANSISTORS
★ TCC printed circuit.
★ 120 mW output push-pull.
★ Med. and long waves.
★ Components identified.
★ Long-life batteries.
★ EASY TO BUILD.
★ 2½in. high flux Speaker.

Size 6¼ x 3¼ x 1¾in.
Weight 20 ozs.

All components for construction including cabinet, printed circuit, etc., can be supplied for

£11 . 19 . 6 P.P. 2/6.

All parts sold separately.

SEND 9d. FOR CIRCUIT, PLANS AND PRICES

THE "TRANSISTOR – 8" COMBINED CAR-RADIO/PORTABLE

PUSH-PULL SUPERHET

Now in its third year!

★ Medium and long wave tuning.
★ All Ediswan transistors.
★ Internal Ferrite aerial.
★ 250 mW output push-pull.
★ 7 x 4in. high flux Speaker.
★ Ready drilled paxolin chassis.
★ Transistor holders supplied.
★ Point to point layout diagrams.
★ Economical and highly sensitive.
★ Size 9 x 7 x 4in.; weight 4 lb.

Complete set of components including cabinet, speaker, etc.

£11 . 10 . 0 P.P. 2/6.

All parts sold separately.

Car Radio Conversion 8/-.
AVC 4/3.
325mW version, £13/10/-. P.P. 2/6.

SPECIAL 2-watt PERMANENT POWER STAGE FOR CAR OR CARAVAN USE, etc. including Speaker, £3/5/-. P.P. 1/6.

SIX TRANSISTOR POCKET SUPERHET

★ Medium and Long Wave tuning.
★ 6 Selected Transistors.
★ Easy to follow Printed Circuit.
★ 100 mW output on new push-pull.
★ Internal Ferrite Aerial.
★ 30 ohms 2½in. Speaker.
★ Comprehensive Instruction Booklet.
★ Low consumption on 9-volt battery.
★ Attractive Plastic Cabinet with gold (red, blue and white colours).
★ Easy to Build.

This set is recommended as an ideal Portable. Highly sensitive, selective, containing the latest features giving simplicity in construction with amazing results.

All items supplied special inclusive price of

£9 . 19 . 6 P.P. 2/6.

ALL COMPONENTS SOLD SEPARATELY.
SEND FOR FREE LIST. Instruction Book, 5/6.

4-WATT TRANSISTOR POWER AMPLIFIER

Requires less room that a 1½-watt valve amplifier!
★ Crystal pick-up input.
★ 12-volt operation (mains or battery).
★ Pre-cut chassis.
★ Layout diagram and circuit.
★ Uses XB105 and V15/10P transistors.

Suitable 7 x 4in. high flux Speaker, 20/-.
Collaro Conquest 4-speed Auto-changer, £7/19/6. P.P. 4/6.
Garrard 4-speed single player, £6/19/6. P.P. 3/6.
B.S.R. 4-speed Auto-changer, £6/19/6. P.P. 4/-.

Complete set of components

£5 . 7 . 6 P.P. 2/6.

Built and tested, £6/2/6. P.P. 2/6.

Suitable Mains Kit

22/6 P.P. 2/-.

Built and tested, 30/-. P.P. 2/-.

FREE CIRCUIT DIAGRAMS AND LISTS ON REQUEST.

"THE MAJOR-2"

2-transistor Portable Radio

★ No aerial or earth.
★ Variable tuning over medium waveband.
★ Internal Ferrite aerial.
★ Drilled and mounted chassis.
★ Four-stage reflex circuit.
★ Highly efficient.
★ Economical (1½ mA. consumption).
★ May be assembled within an hour.
★ Complete layout diagrams.

Size 4¼ x 3 x 1¾in.
Weight less than 4 oz.

We can supply all items including 2 **EDISWAN TRANSISTORS,** case and personal earphone for... **72/6** post free

All parts sold separately.

Circuit, layout diagrams and shopping list free.

NEW! The "Major-3." A three transistor version of the above with volume control fitted. Fantastic output! 90/- post free.

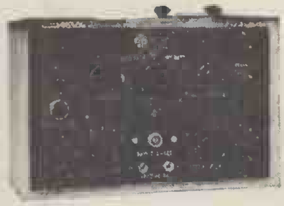
HENRY'S RADIO LTD.

(Dept. W/WMY)

5, HARROW ROAD, PADDINGTON, W.2
(Opposite Edgware Road Tube Station) PAD 1008/9

1. PIRANI CONTROL UNIT
Includes:
- ★ 6in. 1 mA movement meter with mirrored scale.
- ★ Fully set Wheatstone Bridge.
- ★ Complete in best quality case.
- ★ Built-in galvo-shunt.

ONLY **£5/19/6** P.P. 5/-
Including Circuit diagram.



2. PIRANI DIFFERENTIAL LEAK DETECTOR
Includes:
- ★ 2-arm Wheatstone Bridge.
- ★ Masses of high quality switches and controls.
- ★ Best quality wood case.
- ★ Galvo-shunt.
- ★ Circuit diagram.

ONLY **59/6** P.P. 5/-

3. PYE SCALAMP GALVANOMETER
Includes:
- ★ Pye Scalamp Galvo type 2000.
- ★ Mains or battery operation.
- ★ Sensitivity (typical) 33.5 mm/μA. 0.670 mm/μV.

ONLY **£12/10/-** P.P. 5/-

ADMIRALTY TEST SET TYPE 229. 600 Mc/s Brand new, in cases. £5/10/-. P.P. 7/6.

EVERSHED VIGNOLES WEE MEGGER
500 volt 50 Meg. BRAND NEW sealed in cartons with leather case and handbook.
£12/10/- P.P. 2/6
100-volt type used but in new condition. With leather case. **£6** Post free

RADAR UNIT TYPE 1683
Complete with the following valves: 2—6C40; 832A; 0829B; 2—5R4G; 3—6AC7; 6V6GT0; 931A photo multiplier with associated network. Also 2-blower motors. Input 30-115 volt 400 to 2,600 c/s. cd 26 v. d.c. BRAND NEW and boxed. **£6/10/-** Post free

RCA 6½-inch P.M. SPEAKER in Cabinet. With vol. control and 600 ohm Line Trans.
27/6 P.P. 2/6

RF UNITS TYPE 25 Switched Tuning 30 to 40 Mc/s. Includes 3 SP61's. Carriage 2/6 **10/-**
TYPE 26: Variable tuning, 50 to 65 Mc/s. Including 2 EF54's and 1 EC52. Carriage 2/6 **25/-**
(Circuits in stock for both types 9d. each.)

STROBE UNIT
Complete with: 6—EF50; 5—EA50; SP61. Relays, etc. **35/-** P.P. 2/6

159 UNIT
Containing EA50, VR91, CV66, VR65, Relay Coils, etc., 12/6. P.P. 2/-.

PACKARD BELL PRE-AMP.
Complete with screened case with 6SL7GT; 28D7; relay; leads, jack plugs; handbook, etc. Sealed in carton.
ONLY **12/6** P.P. 2/-

SCR522 TRANSMITTER/RECEIVER
All complete in new condition less valves.
35/- P.P. 5/-

RADIO AND TV VALVES ETC.
OVER 400 DIFFERENT TYPES IN STOCK: SEND FOR NEW FREE LIST.

QUARTZ CRYSTALS
A large range of frequencies in stock from 100 Kc/s. upwards. Fundamentals: 54th and 72nd harmonics, etc. Send for NEW free complete list.

PYE 45 Mc/s STRIP TYPE 3583
Complete with 12 valves. 10—EF50; EB34; EA50, with modification data.
ABSOLUTE BARGAIN **39/6** Carriage 5/6

"372" MINIATURE IF STRIP 9·72 Mc/s

The ideal F.M. conversion unit as described in "P.W." April/May, 1957. Complete with 6 valves, three EF91's, two EF92's and one EB91.1.I.F.T's, etc., in absolutely new condition. With circuit and conversion data.
12/6 (less valves) **37/6** (with valves)
Postage and Packing 2/6 (either type).
FM AT ITS CHEAPEST!

ROTARY CONVERTER
24 v. D.C. to 230 v. A.C. 50 cycles. 100 watts. Brand new and unused.
£5/10/- Carr 7/6

426 CONTROL UNIT
Includes: 4—EF50; 2—SP61; EB34; multibank switches; pots; transformer, etc.
ONLY **30/-** P.P. 3/-

TRANSISTORS:—
(Junction Type PNP)

Ediswan XA104 6 Mc/s osc/mixer, RF	18/– ea.
Ediswan XA103 4 Mc/s RF and IF amp.	15/– ea.
Ediswan XB104 Audio Output, etc.	10/– ea.
Matched pair XB104 for up to 250 mW audio output	20/– pr.
Continental OC44 12 Mc/s osc/mixer, RF amp.	30/– ea.
Continental OC45 6 Mc/s IF and RF amp.	25/– ea.
Continental OC72 up to 350mW push-pull	20/– ea.
New Market power transistors:	
V15/10P; 15 volt 10 watts	17/6 ea.
V15/20P; 15 volt 10 watts	39/– ea.
V15/30P; 15 volt 10 watts	48/– ea.
V30/10P; 30 volt 10 watts	48/– ea.
V30/20P; 30 volt 10 watts	54/– ea.
V30/30P; 30 volt 10 watts	57/– ea.
V15/201P; 15 volt 2 watts	25/– ea.
V30/201P; 30 volt 2 watts	35/9 ea.
Red spot 800 kc/s Audio amp.	7/6 ea.
White spot 2 to 5 Mc/s RF, etc.	12/6 ea.
Green/Yellow Audio Amplifier	7/6 ea.
Red/Yellow 1.5 to 8 Mc/s R.F. or IF etc.	15/– ea.

Data sheets available on all types.
LARGEST RANGE OF TRANSISTORS AND COMPONENTS FOR THE HOME CONSTRUCTOR IN THE COUNTRY. SEND FOR NEW FREE LISTS.

WAVE-GUIDE WATTMETER
Type W8921 10 cm. Complete in transit case.
BRAND NEW **£5/10/-** P.P. 7/6

VHF TRANS/RECEIVER Type TR1920, 100 to 120 Mc/s. IF frequency 9.72 Mc/s; Bandwidth 40 Kc/s, 4 channel crystal controlled VHF airborne trans/rec. Complete with 21 valves, transmitting crystal and 24-v. rotary unit, all contained in metal case. In new condition with full circuit diagram. Circuits sold separately, 1/9 post free. **£8/19/6** P.P. 10/6

VHF 10-CHANNEL TRANS/REC Type 1986. Frequency range 124.5/156 Mc/s. IF frequency 9.72 Mc/s; Bandwidth 23 Kc/s.

Sub-units	Type	With valves	Less valves	P.P.
TRANSMITTER	81	75/–	25/–	2/6
RECEIVER	...114	27/6	7/6	2/6
IF Amplifier	... 476	37/6	12/6	2/6
24 v. Rotary unit	3	15/–	—	2/6
10-way Control unit	382	6/–	—	9d.

All the above are in absolute new condition. Full circuits available, 1/9 post free.

CRYSTAL CALIBRATOR For No. 19 Set
10 Kc/s; 100 Kc/s; 1 Mc/s; spot frequencies; Crystal controlled oscillators; includes 5—12SC7 valves, neon modulator handbook, etc.
BRAND NEW **£4/19/6** Post free

MIXER UNIT TYPE 79
Frequency range 172 to 190 Mc/s. Comprising: VCR139A Cath. ray tubes; 7—EF50; EF55; 4—EA50; 2—EB91; 5U4; VU120 and EC52. Standard main input 200-250 volts 50 c/s. Ideal Scope Basis.
£5/10/- Carriage 5/-

WALKIE/TALKIE TYPE 38 TRANSMITTER/RECEIVER
Complete with 5 valves. In new condition. These Sets are sold without Guarantee, but are serviceable. **22/6** P.P. 2/6
H/phones 7/6 pair. Junction Box 2/6. Throat Mike 4/6. Canvas Bag 4/-. Aerial Rod 2/6.

TRANSMITTER/RECEIVER, Army Type 17 Mk. II

Complete with Valves, High Resistance Headphones, Handmike and instruction Book and circuit. Frequency Range 44.0 to 61 Mc/s. Range approximately 3 to 8 miles. Power requirements: Standard 120 v. H.T. and 2 v. L.T.
Ideal for Civil Defence and communications. BRAND NEW **45/-** P.P. 5/-.
44-61 Mc/s. Calibrated Wavemeter for same, 10/- extra.

SYNCHRONIZER UNIT
Includes: 3—6L6M; 12—6AC7; 6SQ7; 5—717A; 6—6SN7GT; 6H6; slow motion drive, blower motor, transformer, etc. **£4/19/6** P.P. 5/-

HENRY'S RADIO LTD.
(DEPT. W/W34Y)

5, HARROW ROAD, PADDINGTON, W.2
(AT JUNCTION OF EDGWARE ROAD AND HARROW ROAD) **PAD 1008/9**

See and Hear all the latest STEREO & Hi-Fi

LASKY'S RADIO

IN LONDON'S FINEST

DEMONSTRATION STUDIO

42 TOTTENHAM COURT ROAD, W.1

The most satisfactory way of choosing your hi-fi equipment, or adding to it, is to listen to, compare and judge a fully comprehensive range of leading makes and types. Our Studio provides unique facilities for doing so and our specialist staff will be pleased to assist you with their up-to-the-minute knowledge of high fidelity technicalities. If unable to call, write us. Our Technical and Mail Order Depts. are at your service.

AMPLIFIERS, QUAD, ROGERS, LEAK, RCA, JASON, LINEAR, PAMPHONIC, DULCI, W/B, AVANTIC, ARMSTRONG, etc.

SPEAKERS, WHARFEDALE, GOODMANS, LOWTHER, G.E.C., LORENZ, PHILLIPS, TANNOY, etc.

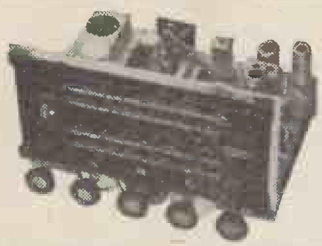
PICKUPS. COLLARO, GARRARD, CONNOISSEUR, LEAK, B/J, ORTOFON, GOLDRING, etc.

TRANSCRIPTION TURNTABLES. COLLARO, GARRARD, LENCO, CONNOISSEUR.

TAPE RECORDERS. GRUNDIG, ELIZABETHAN, BRENELL, TRUVOX, SOUND, VORTEXION, FERROGRAPH, HARTING, ELON, REFLECTOGRAPH, SIMON, STELLA, STUZZI, TANDBERG, TELEFUNKEN, WALTER.

CABINETS. Wide selection including the NEW G-PLAN, CAPRIOL and NORDYK Contemporary Cabinets.

HIRE PURCHASE. Deposit and monthly terms to suit you. Call or write stating requirements.



COMBINED AM/FM TUNER, CONTROL UNIT AND AUDIO PRE-AMPLIFIER

(self-powered)

Mdl. H11 by famous manufacturer. Note these star features:

★ FM plus Long, Medium and Short reception
★ High Fidelity Audio Pre-Amplifier
★ Independent Bass and Treble Controls
★ Pickup Matching Device and Switch positions for LP and 78
★ Tape Record and Replay facilities
★ For use with any Hi-Fi Amplifier
★ Magic Eye Tuning Indicator

For A.C. 200-250 v. 7 B.V.A. glass miniature valves, ECC85, ECH81, EBF89, two EF86, EM81, EZ81, and two matched Diodes. Glass dial, $11\frac{1}{2}$in. × $5\frac{1}{2}$in., fine readings and 'LOG' scale. Dimensions: length 12in., depth 9in. from dial front, 10in. including knobs and spindles, height $7\frac{3}{4}$in.

LISTED AT £29/3/10.
LASKY'S PRICE **20 GNS.**
Carr. and Ins. 12/6.
Available on H.P. terms to suit you. Full details post free on request.

Foreign

TAPE RECORDER SNIP!

THE LOWEST-PRICED TAPE RECORDER EVER OFFERED

Limited number, brand new in maker's cartons. 2-spd., $3\frac{3}{4}$ and $7\frac{1}{2}$, twin track, using a 5in. speaker. 60 min. playing time at $3\frac{3}{4}$; 30 min. at $7\frac{1}{2}$. Inputs for mike and tuner. Smart duotone blue/grey carrying case. Dimensions: $12\frac{1}{2}$ x $9\frac{1}{2}$ x $7\frac{1}{2}$in. Weight: approx. $16\frac{1}{2}$ lb. TODAY'S VALUE £35.

LASKY'S PRICE including 5in. Spool of Tape and empty Spool, Carr. and Insurance 12/6. **19 GNS.**

CRYSTAL HAND MICROPHONE, 19s 6d. extra.
SPECIAL OFFER for this Recorder. A 2-station RADIO JACK supplied at 30/- extra.

7-VALVE AM/FM RADIOGRAM CHASSIS

Famous make, for 200-250 v. A.C. Output 4 watts matched to 3 ohms speaker, 7 valves: ECC85, ECH81, EF89, EABC80, EL84, EZ80, EM81. Magic eye tuning indicator. Covers medium, long and FM bands. Length 12in., height $7\frac{3}{4}$in., front to back $8\frac{3}{4}$in. Limited number only. Brochure on request.

LISTED AT 22 GNS. LASKY'S PRICE **£17 . 19 . 6**
Carr. and Insurance, 12/6.
Available on H.P. terms to suit you.

SPECIAL TAPE OFFER

Famous make, P.V.C. base on latest type plastic spools. Brand new, perfect, boxed and guaranteed.

1200ft. (7in.) 21/-
850ft. ($5\frac{3}{4}$in.) 16/6
Gevaert L.P. Plastic.
1700ft. (7in.) 35/-
850ft. (5in.) 18/6
210ft. (3in.) 6/6
Post: 1 spool, 1/6.
Orders over 60/- post free.

SPECIAL OFFER

TRUVOX TAPE DECK

Mark III. New and unused, in maker's cartons. Limited number, fully guaranteed. 2-spd., $3\frac{3}{4}$ and $7\frac{1}{2}$, 3 shaded pole B.T.H. Motors. Simple drop-in tape loading (no threading); takes standard 7in. spools. Twin track, high impedance heads, attainable response 50-10,000 c.p.s. with suitable amplifier. Push-button controls. Size: $14\frac{3}{4}$in. x $12\frac{3}{4}$in.

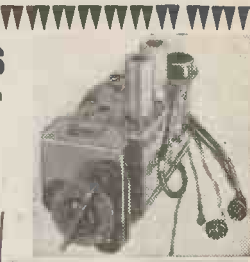
LIST 22 GNS. LASKY'S PRICE **£14 . 19 . 6**
Carr. & Insurance 12/6.
Full instruction booklet with curcuit diagrams for amplifiers with each deck.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

LASKY'S RADIO

SPECIAL OFFERS OF TURRET TUNERS

By Cyldon and other well-known makers. New and unused in maker's cartons. List price 7 gns. A few examples:—
P.10.L. (series heaters), I.F. 9-14 mc/s. 59/6.
P.16.H. (series heaters), I.F. 16-19 mc/s. 99/6.
E.10.L. (parallel heaters). I.F. 9-14 mc/s. £5/19/6.
Post 3/6.
All other types in stock. List on request.



BARGAINS IN 4-SPEED MIXER AUTO-CHANGERS

Collaro RC.456. Incorporating auto and manual control. Complete with Studio crystal p.u. and sapphire stylus. LIST £13/17/-.
LASKY'S PRICE £7.19.6 Post 3/6.

B.S.R. 4-spd. mixer Auto-Changer type UA8, manual and auto-control, complete with latest B.S.R. "ful-fi" pick-up. Carr. & Pkg. 5/- **£6.19.6**

Garrard 120, Mk. II, £9/19/6.
Garrard 121, Mk. II, £10/19/6.

COLLARO 4-SPEED SINGLE PLAYER Model 4/564 with Studio T or O p.u.
£6.9.6 Post 3/6

Garrard 4SPH Single Player, £7/19/6. Post free.

COLLARO "JUNIOR" 4-spd. motor and pick-up complete with cartridge and styli.
MOTOR only, 59/6 post free.
PICK-UP only, 29/6 post free.
SPECIAL OFFER
Motor and Pick-up together, **75/-** Post 2/6.

GARRARD Auto-Changers, Transcription Motors, Pick-Ups, all latest models in stock.

CARRYING CASES

Large range of cases for single record players, auto-changers and tape decks, at bargain prices. Call or send for list.

3-3 AMPLIFIER

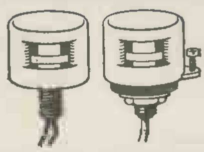
Built to Mullard's exact specification, with 3 Mullard valves EL84, EF86, EZ81, complete with front panel.
Post free. **£8.8.0**

SPECIAL OFFERS OF MULTI-TEST METERS

AN/20. Pocket size Microtester. An **18-range multi-test meter** for amateur or service engineer. 5,000 ohms per volt A.C. and D.C. with accurate linear scales for the lower A.C. ranges. In black leatherette-covered case, 3¾ × 3¾ × 1⅞in. deep.
LIST 9 GNS. LASKY'S PRICE £5.19.6
Post 3/6. Leads 3/9 extra.

AN/27. Accurate, highly sensitive **27-range** Test Meter. 5,000 ohms per volt A.C. and D.C. In black leatherette-covered wood case, 7¾ × 9¼ × 3¾in. deep, with carrying handle and ample room for small tools as well as leads.
LIST 15 GNS.
LASKY'S PRICE £11.19.6
Post 5/-. Leads 7/6 extra.
Volts (D.C. & A.C.) 0-2.5-10-100-250-500-2,500.
Milliamps D.C. 0-500 Amperes D.C. 0-1-5.
Ohms (on internal batteries). 0-2,500-25,000-250,000-2,500,000.
Decibels...0, +20, +28, +34. (ODB=6mW into 500 ohms).
Available on easy terms.

SPECIAL OFFER
HIGH FIDELITY TAPE RECORDER HEADS



Leading make, new and unused, upper or lower track RECORD/PLAYBACK, high impedance. Double wound and will reproduce up to 12,000 c.p.s. at 7½ i.p.s. Azimuth adjustments. Output 5 millivolts at 1 Kc. at 7½ i.p.s. ERASE, low impedance.
LIST £4 PAIR
LASKY'S PRICE
Per pair **39/6** Post 1/3.
Please specify upper or lower track.

MULLARD 510 AMPLIFIER KIT

All specified components and your choice of transformers and chokes by Partridge, Haddon, W/B, Ellison or Gilson.
COMPLETE KIT of parts and printed circuit as low as **£9.9.0**
Details on request.
Printed Circuit separately 22/6.
Also available built ready for use.
Price according to transformers used.

"LINEAR" TAPE DECK AMPLIFIER. Type LT45. A complete unit (power pack and oscillator incorporated) suitable for Collaro, Truvox, Brenell, Motek, Lane, etc.
Post & Pkg. 5/-. **12 Gns.**

"LINEAR" "DIATONIC." High fidelity 10-14-watt ultra linear Amplifier with integral pre-amp. and tone controls.
Post & Pkg. 5/-. **12 Gns.**

"LINEAR" "CONCHORD." A high fidelity 30-watt amplifier incorporating pre-amplifier and tone controls.
Post & Pkg. 7/6. **15 Gns.**

ALL TYPES OF CHASSIS

We hold the largest selection of leading makes including all models ARMSTRONG, EMPRESS, DULCI, etc.
A.M. chassis, L.M.S. from **7 Gns.**
A.M./F.M. chassis from **14 Gns.**
A.M./F.M. STEREO from **22 Gns.**

MOVING COIL P.M. SPEAKERS

2½in. 17/6, 3in. and 3½in. 19/6
5in. 14/6. 6½in. 17/6. 8in. 19/6
10in. 29/6. 12in. 29/6
6½in. with transformer...... 21/-
7×4in. Elliptical 19/6
10×7in. Elliptical 32/6
8×5in. Elliptical 25/-
10×2½in. Rectangular ... 27/6

TAPE DECK OFFERS

COLLARO TAPE TRANSCRIPTOR, Mk. III, fitted with digital counter. Limited quantity only. LIST £22.
LASKY'S PRICE 15 Gns.
COLLARO Mk. IV £17/19/6.
Carr. & Ins. 21/-.

TAPE RECORDER AMPLIFIER for use with Collaro Tape, Deck. Manufacturer's surplus complete with 4 valves and power supplies.
Post 3/6. **£7.19.6**

COLLARO 4-spd. Transcription Turntables, 4T200/PX, with Studio trans. p.u. Brand new and unused. LIST £19/10/-.
Lasky's Price Carr. paid. **£16.19.6**

MICROPHONE BARGAINS

ACOS MIC 39-1. Crystal Stick Microphone for use as a hand, desk stand or floor stand unit for high quality recording, broadcasting and public address work.
LIST £5/5/-.

LASKY'S PRICE Less Stand **39/6**
With Stand **49/6.** Post 1/6.

ACOS type 33/1, Crystal hand or table Microphone. Incorporates specially designed acoustic filter. Flat response 30-7,000 c.p.s. Omni-directional. Suitable for tape recording public address, etc. Attractive dark brown plastic case. Brand new in maker's cartons. LIST 50/-.
LASKY'S PRICE Post 1/6. **29/6**

COLLARO high fidelity super sensitive crystal Miniature Hand Microphone. Sensitivity at 1,000 c.p.s. 1.8 millivolts/u.b. Freq. range 30-10,000 c.p.s. LIST 45/-. Post 1/6.
LASKY'S PRICE 35/-

PICK-UP CARTRIDGES
BELOW HALF PRICE!

Your choice of ACOS HGP.59, GARRARD GC2, B.S.R. "ful-fi" TC8, COLLARO Studio O or T, turnover crystal p.u. Cartridges, complete with L.P. and standard styli. All listed at £2/1/7.
LASKY'S PRICE Post 1/-. **18/-**

ACOS GP43 t.o. crystal cartridge complete with L.P. and standard styli 15/-
GARRARD GC4 ceramic cartridge complete with styli 19/6
GARRARD TOM2 magnetic cartridge. LIST 57/-.
Laskys Price 25/-
GARRARD turnover head shells MPM1 ...... 4/6. MPM2, 5/6 ea.

All Makes of RECORDING TAPE in stock. Standard, L.P. and double play. Write for our special Tape List. All mail orders promptly despatched post free.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

MUIRHEAD PRECISION, 4 bank, 1 pole, 24 position Stud Switch. Heavy duty contacts, brand new, original boxes. Price 17/6 each, P. & P. 1/-.

MINIATURE MOVING COIL DIFFERENTIAL RELAY. Two coils 350 ohms each. Operating current minimum 140 microamp, nominal 400 microamp, maximum 8 milliamp. One pole two way, or, centre stable. Two way contact current 100 mA at 50 V A.C. or D.C. Size 1¼ x ⅝ x ⅞in. Price: 22/6 each.

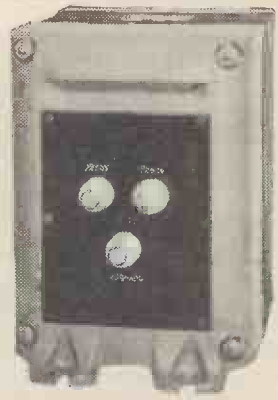
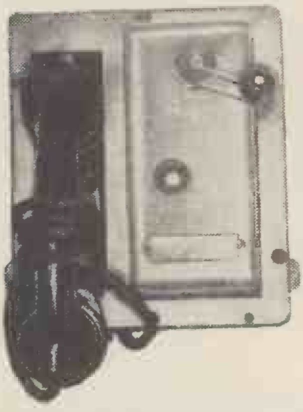


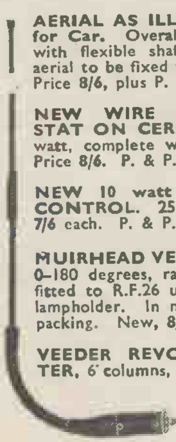
PLATE TRANSFORMER of very best U.S.A. make, brand new, original manufacturers' cases. Input tapped at 190/210/230/250 V. Output 2250–0–2250, centre tapped 400 mA. Nett weight 76lb., size 13in. x 9in. x 6½in. Price £6/10/- each, plus carr. 10/-.



SOUND POWER TELEPHONE UNIT. No batteries required. Fitted with neon indicator lamp and high pitched buzzer, operated by built-in generator. Entirely self-contained, ex Admiralty. Rebuilt and guaranteed working. Effective up to half a mile, waterproof.

£3 Unit or £5/17/6 pr. Carr. 7/6. Master Units to take five extensions also available. £4 each.

SOUND POWER TELEPHONE HANDSETS. New, 17/6 each, P. & P. 2/-.



AERIAL AS ILLUSTRATED. Ideal for Car. Overall length 33in., khaki, with flexible shaft which enables the aerial to be fixed firmly in any position. Price 8/6, plus P. & P. 1/6.

NEW WIRE WOUND RHEOSTAT ON CERAMIC. 58 ohms, 50 watt, complete with instrument knob. Price 8/6. P. & P. 1/6.

NEW 10 watt DUAL VOLUME CONTROL. 25 ohms, plus 25 ohms, 7/6 each. P. & P. 1/6.

MUIRHEAD VENIER DRIVE. Scaled 0–180 degrees, ratio 31/1, dia. 3in., as fitted to R.F.26 units. Complete with lampholder. In manufacturers' original packing. New, 8/6 each. P. & P. 1/6.

VEEDER REVOLUTION COUNTER, 6 columns, fitted reduction drive, built inside small unit. New 8/6 each. P. & P. 2/-.

HIGH SPEED RELAY. Siemens, two bobbins, 1,000 ohms each. New, 10/6 each, P. & P. 1/-.

U.S.A. 27-volt 4-pole CHANGE-OVER RELAYS. Brand new and boxed, 5/6 each. P. & P. 6d.

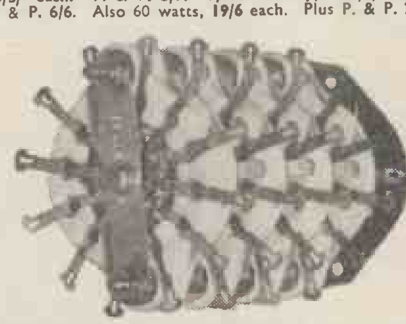
PACKARD BELL RELAYS. 12/24 volt, 650 ohms coil, 2 pole changeover, 1.5 amp contacts. Brand new. Price 5/6 each. P. & P. 6d.

EVERSHED AND VIGNOLES. Circuit testing Ohms Meter, pattern "S" complete with testing prods, inst. book, etc. Two ranges: 0–3 and 0–30 ohms. Brand new, guaranteed perfect, as illus. Offered at fraction of maker's price. £4/17/6 each. P. & P. 2/6.

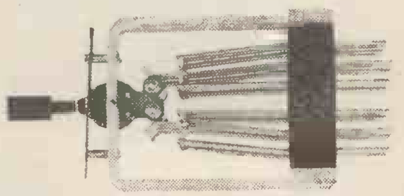
TRIPODS. Solid wooden legs 38in. long, metal top and metal toes. As new. Price 10/6 each, plus 3/- carriage.

TRIPLE RANGE VOLTMETER, 0-5 25-250V D.C M/C 3½" meter 3" scale, mounted in bakelite carrying case 7½" x 4½" x 3" complete with handle and test leads. 27/6 each. P. & P. 2/-.

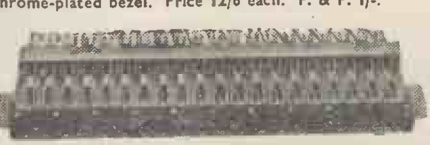
AUTO TRANSFORMERS, step up, step down. 110–200–220–240 v. Fully shrouded. New. 300 watt type £2/2/- each. P. & P. 2/6. 500 watt type £3/3/- each. P. & P. 3/9. 1,000 watt type £4/4/- each. P. & P. 6/6. Also 60 watts, 19/6 each. Plus P. & P. 2/-.



CERAMIC PRECISION SWITCH 2 pole, 6 way, 4 banks. New in manufacturers' boxes. Price: 10/6 each. P. & P. 1/6.



MUIRHEAD PRECISION KEY SWITCHES. Low capacitance, 6 single pole c/o each side. Brand new. Chrome-plated bezel. Price 12/6 each. P. & P. 1/-.

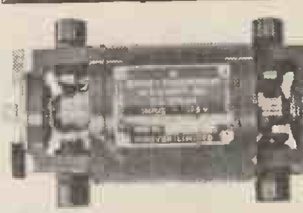


20 WAY STRIP containing standard Post Office telephone Jack Sockets, overall size 11 x 3½ x ½in. New. Price 15/- each. P. & P. 1/6.

METERS BRAND NEW GUARANTEED PERFECT

Charging Types	
2½ amp DC M.I. 2in. fl. rnd.	7/6
5 amp. D.C. M.I. 2½in. fl. rnd.	11/6
7½in. D.C. M.I. 3½in. proj. rnd.	12/6
9 amp. D.C. Hot Wire W.R. 2½in. fl. rnd.	6/6
Voltmeters	
12 V. D.C. M.C. 2½in. proj. rnd.	8/6
20 V. D.C. M.C. 2in. fl. sq.......	9/6
25 Volt D.C. M.C. 2in. fl. rnd.	7/6
30 Volt M.I. 3in. proj. rnd....	10/6
40 Volt M.C. 2in. fl. sq..........	9/6
250 Volt A.C. rectified moving coil linear scale 3½in. fl. rnd.	35/-
300 Volt A.C. M.I. 2½in. fl. rnd.	22/-
400 Volt A.C. M.I. 4½in. fl. rnd.	35/-
Milliammeters	
5 mA. M.C. 2in. fl. sq..........	12/6
30 mA. M.C. 2½in. fl. rnd.......	9/6
50 mA. M.C. 2in. fl. sq..........	7/6
200 mA. M.C. 2½in. fl. rnd.......	9/6
500 mA. M.C. 2½in. fl. rnd.......	9/6
1 MA. M.C. 2in. sq. fl............	19/6
500 Microamp latest type Ernest Turner 2in. fl. rnd. with mounting ring and scaled 0–5 moving coil......	19/6
Thermo-coupled	
350 mA. 2in. rnd. plug-in.........	3/6
500 mA. 2in. rnd. plug-in......	3/6
POSTAGE ON ALL METERS	1/-.

U.S.A. PRECISION SERIES 834S MULTIRANGE TESTERS for A.C. and D.C. volts, ohms and milliamps., basic movement 400 microamps., in wooden carrying case, complete with test prods, new batteries, guaranteed perfect. Price £5/19/6. P. & P. 2/6.



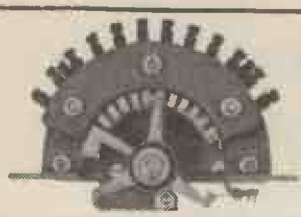
MIDGET ROTARY TRANSFORMERS. 2¼in. dia. x 4½in. Input 11.5 volt Output 310/365 volts at 30 mA. Brand new. 12/6 each. P. & P. 1/6.

DYNAMOTOR (Rotary Converter). 6 volt in, 250 volt out at 100 mA., ex new equipment, 25/- each. P. & P. 3/-.

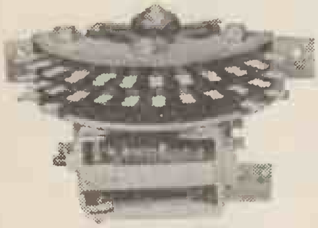
MICROPHONES — NEW. Throat, British, magnetic, 4/6. P. & P. 1/-.

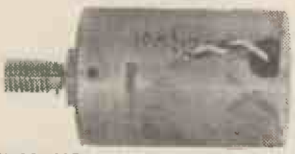
HEADPHONES. 4,000 ohms, imported, new, 15/-.

SERVICE TRADING COMPANY →

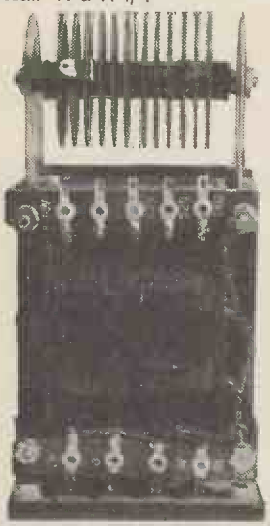


MINIATURE UNISELECTOR SWITCH, two banks of ten plus home contacts, one bank continuous of normal. 30 ohms coil for 24 volt operation. Brand new, manufacturer's packing. Price 22/6 each. P. & P. 2/6. Illustrations above and below.



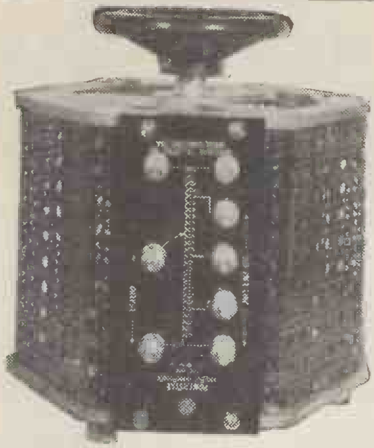


MINIATURE P.M. MOTOR 12/24 volt, reversible, 1½in. dia. New Price 9/6 each. P. & P. 1/-.



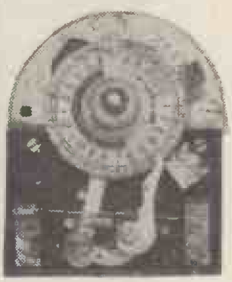
TWELVE PLATE F.W. BRIDGE CONNECTED RECTIFIER mounted on 200/250 volt A.C. input transformer. Output 36/40 volt D.C. at 1.2 amps. New, perfect. Price 16/6. P. & P. 3/6.

200/250 v. A.C. MOTORS. New 1/80 h.p., 2 drives, direct 6000 r.p.m., reduction 300 r.p.m. 22/6 each. P. & P. 2/6.



VARIABLE VOLTAGE TRANSFORMERS, as illustrated above. Brand new in manufacturers' original cases. Input 230-volt A.C., output variable from 0 to 270 volt at 9 amperes. Price £15 each, plus carr. 12/6.

NEW UNCHARGED UNFILLED 12 VOLT ACCUMULATOR 9 ampere in unspillable plastic cases. Comprises 6 × 2 volt separate cells connected by terminal strips. 6 × 5½ × 4¼in. over terminals. Price 19/-, plus P. & P. 2/9. Wooden carrying case for same with lid and strap price 3/6.



VENNER 8-day clockwork Time Switch. Contacts 1 amp. 230 volt. 24 hour phase, ½ hour divisions, allows setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 1/6.

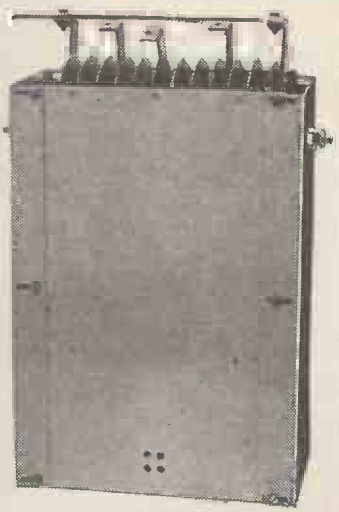
12 v. D.C. AMPLIFIER, as new, for operation on 12 v. car battery, 10 watts undistorted output, with 6L6 valves in push-pull. Mike/Gram input, tapped output 7½, 15, 62, 100, 250 or 500 ohms. £12/10/- each. Carr. 15/-.

NEW GALVANOMETERS, solid brass, 3in. dial, in polished wooden case. 70 degree scale, 35 mA either side. 100 ohm coil. Price: 12/6 each. P. & P. 1/6.

NEW CARPENTER'S TYPE POLARISED RELAYS. 2 × 9500 turns at 1,685 ohms.

Price 22/6 ea. P. & P. 1/-.

NEW MOVING COIL HEADSETS, complete with Tannoy carbon hand microphone, with plug suitable for No. 19 set. Price: 12/6 each plus P. & P. 2/-.



BRAND NEW SELENIUM FULL WAVE BRIDGE TYPE RECTIFIERS, in manufacturers' original packing. D.C. output 36 v. 10 amp., made up of 12 × 110 mm. dia. plates. These fitted in cooling funnel (removable), size 11¼in. × 8in. × 4¼in. Price 45/-. P. & P. 3/3.

WE ARE EXPERTS AT OVERSEAS PACKING & SHIPPING!

SERVICE TRADING Co.

PERSONAL CALLERS ONLY : **9 Little Newport Street, London, W.C.2.** *Tel : GER 0576*
(Early Closing Thursday)
ALL MAIL ORDERS :
47-49 High Street, Kingston-on-Thames.
Telephone : KINgston 4585

AMPLIFIERS PRE-AMPLIFIERS

COMPLETE KITS OF PARTS FOR THE "HI-FI" ENTHUSIAST

Designed by MULLARD—Presented by US strictly to their specification

MULLARD DESIGNS FOR THE HOME CONSTRUCTOR

MODEL 510/M

THE VERY POPULAR MULLARD "5-10" MAIN AMPLIFIER

Undoubtedly the most successful amplifier yet designed, and used in conjunction with the new Mullard Pre-Amplifier, an undistorted power output of up to 10 watts is obtained. Thoroughly recommended to the "HI-FI" enthusiast who contemplates a very high quality home installation. In addition the versatility of the equipment makes it quite suitable for use in small halls, etc. We supply complete to MULLARD'S SPECIFICATION with specified valves and components and including the latest PARMEKO Ultra-linear Output transformer and the Parmeko mains transformer which has power available to drive Radio Tuning Unit.

Price for COMPLETE KIT OF PARTS **£10.0.0**

Alternatively we supply ASSEMBLED and TESTED **£11.10.0**

(Carriage and insurance 5/- extra).

We also offer this "5-10" incorporating the latest PARTRIDGE ULTRA-LINEAR OUTPUT TRANSFORMER for £1/6/- extra.

MULLARD'S NEW 2-STAGE PRE-AMPLIFIER TONE CONTROL UNIT

A completely new design employing two EF86 valves, and in particular designed to operate with the Mullard range of Power Amplifiers, but also perfectly suitable for other makes.

Briefly it incorporates:—

- Equalisation for the latest R.I.A.A. characteristics.
- Input for variable reductance. Magnetic Pick-ups.
- Input for Crystal Pick-ups.
- Input for Tape replay.
  - (a) Direct from High Impedance Tape Head.
  - (b) From a Tape Amplifier or Pre-amplifier.
- Sensitive Microphone Channel.
- Wide range BASS and TREBLE Controls.
- Attractive Perspex front control panel.
- Our Kit is strictly to MULLARD'S SPECIFICATION.

Price, COMPLETE KIT OF PARTS **£6.6.0**

Alternatively we supply ASSEMBLED AND TESTED **£8.8.0**

(Carriage and Insurance 5/- extra).

MODEL 3-3/M

THE NEW MULLARD "3-3" MAIN AMPLIFIER

Based entirely on the present very popular "3-3" model and designed to operate in conjunction with the new 2-stage PRE-AMPLIFIER (shown here) thus providing all the facilities associated with the more expensive "Hi-Fi" equipment. We recommend it as the IDEAL SMALL HOME INSTALLATION where very high quality is desired at the lower volume level (up to 3 watts).

We supply completely to MULLARD'S SPECIFICATION INCLUDING the latest PARMEKO Output Transformer specified Valves and Components. Has Power available to drive a Radio Tuning Unit.

Price for COMPLETE KIT of PARTS **£7.0.0**

Alternatively we supply ASSEMBLED and TESTED **£8.0.0**

(Carriage and Insurance 5/- extra).

Special Price Reductions WE OFFER

Only NEW HIGH GRADE Components and Mullard Valves are supplied with these kits—we DO NOT use "Surplus or Cheap" components

(a) THE COMPLETE KIT OF PARTS to build both the "3-3" MAIN AMPLIFIER and the 2-stage PRE-AMPLIFIER-CONTROL UNIT **£12.10.0**

(b) THE COMPLETE KIT OF PARTS to build both the "5-10" MAIN AMPLIFIER and the 2-STAGE PRE-AMPLIFIER-CONTROL UNIT **£15.15.0**

*ALL PRICES QUOTED FOR THE "5-10" ARE SUBJECT TO £1/6/- EXTRA IF THE PARTRIDGE TRANSF. IS REQUIRED.

Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required . . . alternatively the COMPLETE ASSEMBLY MANUALS containing component Price Lists and practical Drawings, etc., are available at 1/6 each.

(a) THE "3-3" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£15.0.0**

H.P. TERMS: DEP. £3 and 12 monthly payments of £1/2/- or DEP. £5 and 12 monthly payments of 18/4.

(b) THE "5-10" and the 2-STAGE PRE-AMPLIFIER both ASSEMBLED and TESTED **£18.18.0**

H.P. TERMS DEP. £3/16/- and 12 monthly payments of £1/7/8 or DEP. £6/6/- and 12 monthly payments of £1/3/1

When ordering please include an extra 7/6 to cover the cost of carriage and insurance

THE NEW COMPLETE MULLARD "5-10" AMPLIFIER

MODEL 510/RC

We offer this popular and very successful design COMPLETE to MULLARD'S SPECIFICATION, but incorporating some improvements in the general layout. HIGH QUALITY REPRODUCTION up to a maximum of 10 watts output. The CONTROL UNIT is separate and completely enclosed; it is normally fitted to the Main Amplifier Chassis as shown in the illustration but, if it is desired to use the unit remote from the Main Chassis, it can be quite easily detached and used up to 2 yards distance. We incorporate SPECIFIED COMPONENTS and NEW MULLARD VALVES. We also give the purchaser the choice of two of the best ULTRA-LINEAR OUTPUT TRANSFORMERS made—first the latest by PARMEKO LTD., and also the latest by PARTRIDGE (£1/6/- extra), which is generally recognised as the best U/L Output Transformer made today and ensures maximum undistorted output and the widest frequency range. We also supply the PARMEKO MAINS TRANSFORMER, and this has extra power available to supply a Radio Tuning Unit amounting to 250 volts at 35 mA. and a separate heater winding giving 6.3 volts 2½ amps. Price COMPLETE KIT OF PARTS (PARMEKO TRANSFORMER) MODEL 510/RC **£11.10.0**

(Plus 6/6 Carriage and Insurance).

Alternatively we supply ASSEMBLED and TESTED (plus 6/6) **£13.10.0**

H.P. TERMS: Dep. £2/14/- and 12 monthly payments of 19/10.

Send S.A.E. for ILLUSTRATED LEAFLET or 1/6 for the COMPLETE ASSEMBLY MANUAL.

THE NEW COMPLETE MULLARD "3-3"

MODEL 3-3/RC

A VERY HIGH QUALITY 3-WATT AMPLIFIER PROVIDING EXCELLENT REPRODUCTION AND HAVING AN ATTRACTIVE ENGRAVED PERSPEX FRONT PANEL.

Price for COMPLETE KIT OF PARTS **£7.10.0**

(plus 6/6 carriage and insurance).

Alternatively supplied ASSEMBLED and FULLY TESTED **£8.19.6**

(Plus 6/6 carriage and insurance).

H.P. Terms deposit £2 and 8 monthly payments of £1.

Developed from the very popular 3-valve 3-watt Amplifier designed in the Mullard Laboratories. Our kit is complete to the Mullard specification including supply of specified components, valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available:—

THE COMPLETE ASSEMBLY MANUAL AVAILABLE FOR 1/6.

Please enclose S.A.E. with all enquiries

STERN RADIO LTD. 109 & 115 FLEET ST., LONDON, E.C.4 Telephone: FLEET STREET 5812/3/4

THE BEST VALUE ON THE MARKET

Stern's "fidelity" TAPE RECORDER

PRICE
£49.10.0

Terms: Dep. £9/18 and 12 monthly payments of £3/12/7 or Dep. £16/10/- and 12 monthly payments of £3/-/6

THE LEGS SHOWN IN THE ILLUSTRATION ARE READILY DETACHABLE AND ARE AN OPTIONAL EXTRA AT £1/2/6.

DIRECT—MANUFACTURER to USER

NO "MIDDLEMAN'S" DISCOUNT IS INCLUDED IN OUR PRICES

IT INCORPORATES:

- The latest COLLARO TRANSCRIPTOR TAPE DECK.
- The model HF/TR3 "Fidelity" AMPLIFIER. (Described below).
- HIGH QUALITY 7in. x 4in. P.M. Speaker.
- 1,200ft. reel High Quality Emitape.
- ACOS Crystal Microphone.

BEFORE CHOOSING YOUR TAPE RECORDER YOU SHOULD HEAR THIS MODEL—TRULY "Hi-Fi" RECORDINGS ARE OBTAINABLE and it is comparable to much higher-priced Recorders. ALTERNATIVELY send S.A.E. for ILLUSTRATED LEAFLET.

(Plus £1/10/- carriage and insurance of which £1 is refunded on return of packing case.)

THE MODEL HF/TR3 TAPE AMPLIFIER

ncorporating
3-SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.

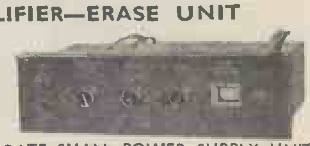
PRICE for COMPLETE KIT OF PARTS......... **£12/15/-**
FULLY ASSEMBLED AND TESTED **£16/10/-**
HIRE PURCHASE: Deposit £3/6/6 and 12 months at £1/4/2.

A very high quality amplifier based on the very successful Type "A" design completed in the MULLARD LABORATORIES. ONLY NEW HIGH-GRADE COMPONENTS are incorporated including MULLARD VALVES and a GILSON OUTPUT TRANSFORMER . . . other features are: Magic Eye Recording Hand Indicator—Effective Tone Control—Monitoring and Extension Speaker Sockets—has own Power Supply and can be used as independent Amplifier for direct reproduction of Gram Records or from Radio Tuner. Overall size 11 x 6 x 6in.—Truvox—Collaro—or Brenell—please specify which. Send S.A.E. for leaflet or 2/6 for Assembly Manual.

THE NEW MULLARD TYPE "C"

TAPE PRE-AMPLIFIER—ERASE UNIT

INCORPORATING THE NEW FERROXCUBE POT CORE PUSH-PULL OSCILLATOR and 3 SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.



PRICES . . . INCLUDING SEPARATE SMALL POWER SUPPLY UNIT
COMPLETE KIT OF PARTS **£14.0.0** ASSEMBLED AND TESTED **£17.0.0**
Deposit £3/8/- and 12 months of £1/4/11. Assembled unit only.
ALSO AVAILABLE EXCLUDING POWER SUPPLY UNIT FOR **£11.15.0** and **£14.10.0** respectively. (Carr. and Ins. 5/- extra, Send S.A.E. for leaflet or 2/6 for Complete Assembly Manual.

WHEN ORDERING PLEASE STATE MAKE OF TAPE DECK TO BE USED

We present this "Hi-Fi" Pre-amplifier strictly to Mullards specification, etc. incorporating ONLY NEW HIGH GRADE COMPONENTS and the SPECIFIED NEW MULLARD VALVES. It comprises a COMPLETELY SELF-CONTAINED UNIT, all components and valves being contained in a well ventilated Box—Chassis neatly finished in Hammered gold with a very attractively engraved PERSPEX FRONT PANEL.

HOME CONSTRUCTORS

YOU CAN BUILD THIS PORTABLE TAPE RECORDER from £39.15.0

WE HAVE IN STOCK THE NEW 2-SPEED TWIN TRACK TRUVOX Mk.VI TAPE DECK **£26.5.0**
It incorporates PRECISION REV. COUNTER and PAUSE CONTROL and operates at 3¾ or 7½ in/sec.

WE OFFER THIS SELECTION

(a) The COLLARO Mk. IV TAPE DECK with the assembled and tested HF/TR3 Amplifier **£34.10.0**
H.P. Deposit £6/18/- and 12 months £2/10/8.
(b) As above but the HF/TR3 supplied as KIT OF PARTS... **£30.15.0**
NOTE: Messrs. Collaro when supplying the Mk. IV Deck do not wire up the Deck Switch backs. We will do this for £1 or supply a wiring diagram to the Home constructor.
(c) The TRUVOX Mk. VI TAPE DECK with the assembled and tested HF/TR3 amplifier........ **£37.0.0**
H.P. Deposit £7/8/- and 12 months £2/14/3.
(d) As above but the HF/TR3 supplied as KIT OF PARTS ... **£33.10.0**
(e) The BRENELL Mk. V DECK with the assembled and tested HF/TR3 amplifier **£45.0.0**
H.P. Deposit £9 and 12 months £3/6/-.
(f) As above but the HF/TR3 supplied as KIT OF PARTS... **£42.0.0**
(g) The PORTABLE CASE illustrated here (£5), 1,200ft. EMITAPE (35/-), ACOS CRYSTAL MIKE (35/-), ROLA 10 x 6in. LOUDSPEAKER (30/-) ALL FOR........ **£9.0.0**
Carriage and Insurance on each above 10/- extra.

TO ADD FULL TAPE RECORDING FACILITIES

To any modern "Hi-Fi" AUDIO AMPLIFIER (such as our Mullard "5-10" and 2 valve Preamplifier) ALL YOU NEED IS . . THE TYPE "C" PREAMPLIFIER and a TAPE DECK . . WE OFFER

(a) The COLLARO Mk. IV TAPE DECK and the MULLARD TYPE "C" PREAMPLIFIER & Power Unit assembled, tested **£35.0.0**
H.P. Deposit £7 and 12 months £2/11/4.
(b) As in (a) above but the Type "C" supplied as COMPLETE KIT OF PARTS........ **£32.0.0**
(c) The TRUVOX Mk. VI TAPE DECK and the assembled Type "C" Preamplifier and Power Unit........ **£37.10.0**
H.P. Deposit £7/10/- and 12 months £2/15/-.
(d) As above but the Type "C" supplied as complete KIT OF PARTS **£34.10.0**
(e) The BRENELL Mk. V DECK and the assembled Type "C" PREAMPLIFIER and POWER UNIT **£46.0.0**
H.P. Deposit £9/4/- and 12 months £3/7/6.
(f) As above but the Type "C" supplied as complete KIT OF PARTS **£43.0.0**

(Carriage and Insurance on above quotes 10/- extra.)
PLEASE ENCLOSE S.A.E. WITH ALL CORRESPONDENCE.

STERN RADIO LTD.

109 & 115 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

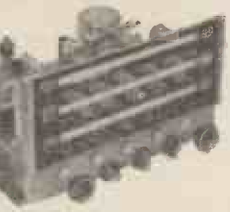
MODERNISE YOUR OLD RADIOGRAM

It is CHEAPER and BETTER VALUE TO REPLACE YOUR OLD CHASSIS and GRAM UNIT

! ! RADIOGRAM CHASSIS ! !

ARMSTRONG "STEREO TWELVE" - £38.17.0

The most complete unit yet produced for Stereo giving 6 watts high fidelity push-pull output on each channel, 12 watts for monaural. Full VHF band, medium and long wavebands. Stereo and monaural inputs or records, tape and radio and a tape output for stereo and monaural tape recording. Comprehensive matching for all types of crystal pick-ups. The perfect basis for a complete monaural reproducing system or for a complete stereophonic system now or later.



ARMSTRONG "JUBILEE"

An AM/FM chassis with nine valves and two diodes and with push-pull output stage providing 6 watts. Full VHF medium and long wavebands with automatic frequency control on FM and ferrite aerial on AM. Tape record and playback facilities. Can be adapted for stereo at any time by the addition of our compact, easy-to-fit converter amplifier **£30 . 9 . 0**

ARMSTRONG "STEREO 44" - - £29.8.0

Provision is made for Stereo and monaural playback from pick-up or tape. Outputs provided for Stereo or Monaural tape recordings. Alternative inputs enable the use of most crystal pick-ups, together with tape recorders or tape preamplifiers (such as our type "C" unit). 8 watts output. Radio covers med. waveband and the complete VHF/FM transmissions 87-108 M/cs.

DULCI "H4PP" - - - - £29.3.10

An 8 valve AM/FM 4 waveband chassis giving 6 watts ultra linear output. Covers short, long, medium wavebands plus the VHF/FM band and has internal aerial on the medium and long wavebands. Tape outlet incorporated and suitable for 3 to 15 loudspeakers.

DULCI "H3" - - - - - £20.17.0

A 6 valve AM/FM chassis giving 4 watts output. Covers medium and long wavebands, on which an internal aerial operates, plus the VHF/FM band. Full AVC on all wavebands and tape outlet incorporated.

NEW HIRE PURCHASE TERMS are available on all above. Illustrated leaflets available—send S.A.E.

AM/FM RADIO TUNING UNITS

Incorporating own Power Supply Units.

ARMSTRONG "S.T.3" - - - £28.7.0

A self-powered high fidelity tuner covering full VHF, medium and long wavebands with automatic frequency control on VHF. Excellent in combination with our MULLARD AMPLIFIERS but the cathode follower stage and variable feedback output control enable this tuner to be used with virtually any amplifier available.

DULCI "H4/T" - - - - £24.19.0

A 4 waveband self-powered high fidelity tuner covering the VHF/FM transmissions plus the long, medium and short wavebands. Excellent performance in combination with our MULLARD AMPLIFIERS and also all high quality designs.

ILLUSTRATED LEAFLET showing recommended HIGH QUALITY LOUDSPEAKERS is available—send S.A.E.

STERN'S FOR STEREO

OUR POPULAR MULLARD MAIN AMPLIFIERS ARE RECOMMENDED FOR USE WITH THE DULCI DUAL CHANNEL STEREO PREAMPLIFIERS

The "STEREO EIGHT" PREAMPLIFIER **£23.2.0**
(Carr. & Ins. 5/- extra)

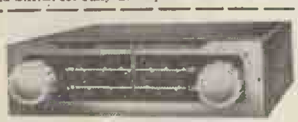
The "STEREO TWO" PREAMPLIFIER **£9.9.0**
(Carr. & Ins. 5/- extra)

Both Preamplifiers can be supplied to correctly operate with our very popular MULLARD "3-3" and "5-10" MAIN AMPLIFIERS (described on page 131). For Stereo reproduction TWO Main Amplifiers are necessary but for normal "Hi-Fi" reproduction the "Stereo Eight" and the "Stereo Two" are perfectly suitable to operate with ONE Main Amplifier and the second Main Amplifier can then be added at any time thus transforming a standard "Hi-Fi" installation over to the Stereo.

WE OFFER PREAMPLIFIERS and AMPLIFIERS AT SPECIALLY REDUCED PRICES Send S.A.E. for fully descriptive leaflets.

STERN'S 12 VOLT "CAR RADIO"

★ PRINTED CIRCUITS
★ POWER TRANSISTOR
★ MEDIUM & LONG WAVEBANDS



BY . . .

UNIT ASSEMBLY . . . CONSISTING OF . . .

THREE SEPARATE UNITS FULLY WIRED, ALIGNED and TESTED, requiring only 12 solder points to complete the Receiver.

A versatile design with low current consumption. Does not require a separate vibrator power Unit.

PRICE for the THREE COMPLETELY ASSEMBLED UNITS **£15.0.0**

Send 1/6 for the complete design data.

SPECIAL CASH ONLY BARGAIN

A bulk purchase enables us to offer this very useful INTERCOM SET or BABY ALARM *For only* **£5.5.0**

Consists of MASTER UNIT (illustrated) and one EXTENSION, providing 2-way TALK-LISTEN facility. Complete in polished wood cases, size of each only $7\frac{1}{2} \times 4\frac{1}{2} \times 6$in. high.

! ! RECORD PLAYERS ! !

The LATEST MODELS are in Stock. Many at REDUCED PRICES!!!

Send S.A.E. for ILLUSTRATED LEAFLET

A FEW CASH BARGAINS

B.S.R. MONARCH UA8 4-spd. Mixer Autochanger with Crystal Pick-up. **£6.19.6**

The COLLARO "CONQUEST" 4-speed autochanger Studio "O" Pick-up **£7.19.6**

The latest COLLARO "CONTINENTAL" 4-speed MIXER Autochanger, Studio "C" Pick-up **£8.19.6**

The COLLARO model 4/564 4-speed Single Record Player, Studio Pick-up	£6 . 6 . 0
THE NEW B.S.R. model UA12 is in stock. A4 "SPEED" MIXER AUTOCHANGER	£8 . 19 . 6
UA12 also available incorporating the B.S.R. STEREO Pick-up plays L.P. and 78 records	£11 . 17 . 6
GARRARD RC121/4 4-speed Autochanger fitted with latest Crystal Pick-up	£10 . 10 . 0
B.S.R. Model TU9 4-speed single record player, complete with separate crystal pick-up	£4 . 10 . 0

(This high output pick-up is available separately for £1/12/6.)
Carriage and Insurance on each above 5/- extra.

HIGH FIDELITY UNITS IN STOCK

The latest GARRARD TRANSCRIPTION MOTOR "301" with Stroboscopically marked turntable	£28 . 0 . 11
The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.8 Crystal Cartridge	£19 . 7 . 10
As above but fitted with the G.M.C.5 Moving Coil Pick-up and T.P.1 Transformer	£27 . 14 . 7
GARRARD Model TA/MK II Single Record Player fitted with high output Crystal Pick-up, detachable head	£9 . 15 . 8

The GARRARD T.P.A. 12 TRANSCRIPTION PICK-UP ARM is available separately or with Crystal or Moving Coil Pick-up Heads.

HIRE PURCHASE TERMS available on all units £8/19/6 and over.
Send S.A.E. for Leaflet

SPECIAL CASH ONLY OFFER ! !

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY **£8.7.6** (plus 7/6 carr. and ins.). The Amplifier consists of a 2-stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-stage (plus Rectifier) AMPLIFIER £4 2 6
(b) The PORTABLE CARRYING CASE £3 17 6
(c) $6\frac{1}{2}$in. P.M. SPEAKER 18 9
(Carriage and Insurance 4/- extra)

We also have a smaller PORTABLE CASE ideal for Record Players. PRICE ONLY £3/3/- (plus carriage and ins.).

! ! HOME CONSTRUCTORS ! !

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS

Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high-quality equipment. The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" Speakers give really first-class reproduction and are well recommended. Models are also available to accommodate high-quality Amplifiers, Preamplifiers, Tuning Units, Record Players, etc. All models are very easily assembled, in fact only a screwdriver is required.

Fully illustrated leaflets are available including complete specifications of the various STENTORIAN LOUDSPEAKERS. Please enclose S.A.E.

STERN'S MK II *"fidelity"* F.M. TUNING UNIT

(Plus 5/- carr. and ins.) PRICE **£15.0.0**

HIRE PURCHASE: Deposit £3 and 12 months at £1/2/-. Incorporates the latest MULLARD PERMEABILITY TUNING HEART and the corresponding MULLARD VALVE LINE UP comprising ECC85, 2 type EF85s (or EF89s), EM84 Tuning Indicator, plus 2 type O.A. 79s Germanium Diodes. A really first-class Tuner very attractively presented and comparable to many offered at much higher prices. Power consumption is only 1.5 amps at 6.3 volts and 25 m/a at 250 volts.

HOME CONSTRUCTORS!

YOU CAN BUILD THIS TUNING UNIT FOR ONLY.............. **£11 . 0 . 0**
(Plus 5/- carr. and ins.)
Please send S.A.E. for fully descriptive leaflet, or the Assembly Manual is available for 1/6.

The JASON "MERCURY" Switched F.M. TUNER IS IN STOCK

PRICE ASSEMBLED AND TESTED **£13.10.0**

CREDIT SALE Deposit £3/7/6 and 9 monthly payments of £1/4/10.

ALTERNATIVELY THE COMPLETE HOME CONSTRUCTORS KIT IS available for £9/19/6 (carr. and ins. is 5/- extra).

CAR BATTERY CHARGER

A COMPLETE KIT OF PARTS FOR ONLY **£2.19.6**

Will charge 6 or 12 volt batteries at max. $2\frac{1}{2}$ amps. The design incorporates Reliant Resistor and Fuse and we supply complete with Metal Box container. EASY-TO-FOLLOW ASSEMBLY INSTRUCTIONS ARE INCLUDED

STERN RADIO LTD. 109 & 115 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

WESTON MODEL 772 TESTMETER

A.C. VOLTS	D.C. CURRENT	A.C. CURRENT
2.5 v.	100 micro/a.	500 ma.
10 v.	1 ma.	1 amp.
50 v.	10 ma.	5 amp.
250 v.	50 ma.	RESISTANCE
1,000 v.	100 ma.	100 ohms
D.C. VOLTS	500 ma.	1,000 ohms
2.5 v.	OUTPUT METER	100 k. ohms
10 v.		10 megohm
50 v.		
250 v.		
1,000 v.		

Supplied in perfect working order complete with rexine carrying case, internal batteries and instructions, £8/19/6 each. P/P 4/-.

COSSOR DOUBLE BEAM OSCILLOSCOPE TYPE 339

Operation 110/200/250 volts A.C. 120 watts. Time Base 10 positions. 6 cps. to 250,000 cps. Amplifier 10 cps. to 2,000,000 cps. Sensitivity, Y1.Y2.3.1 v. D.C. 1.1 v. rms. X. 2.25 v. D.C. .8 v. rms.

Supplied in good working order complete with handbook and circuit. £27/10/- each. P/P £1.

AN/ARN-5D GLIDE PATH RECEIVERS

Three channel U.H.F. receiver operating on 332.6, 333.8 and 335 mc/s by plug-in crystals (not supplied). Contains 11 valves, 1 28D7, 2 12SN7, 7 6AJ5, 1 12SR7, relays, etc. Operation from 24/28 volts D.C. Size 5½ x 6½ x 14in. Supplied brand new and boxed. ONLY 59/6 each. P/P 5/-.

300FT. COPPER AERIAL WIRE. Ex-U.S.A. 3/6 per reel. P/P 1/-.

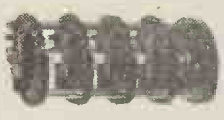
LEACH AERIAL CHANGEOVER RELAYS. 12 v. D.C. double pole transmitter type. New, boxed, 7/6 each. P/P 9d.

MARCONI SIGNAL GENERATORS TF-517. Frequency coverage 10–18 Mc/s. 33–58 Mc/s and 150–300 Mc/s. Operation 200/250 volt A.C. Supplied in good working order. £12/10/- each. P/P 10/-.

750-WATT AUTO TRANSFORMERS. Ex-Admiralty, fine jobs. Tapped from 110 to 230 volts. Brand new, 69/6 each. P/P 5/-.

HEAVY DUTY MAINS ISOLATION TRANSFORMERS. 230 volt input. Output 230 volts 5 amps. Housed in ventilated metal case, unused, £5 each. P/P 10/-.

MUIRHEAD PRECISION STUD SWITCHES



4 banks, 1 pole 24 positions each bank. Self cleaning heavy duty contacts. Brand new, 17/6 each. P/P 1/-. Ditto, 2-bank, 10/6.

AMERICAN SUPER LIGHTWEIGHT HEADPHONES. Res. 50 ohms. Fitted with rubber earmoulds, extremely good quality, ideal if used for long periods. 15/- per pair, brand new, boxed P/P 1/3.

C.R.100 SPARES KITS

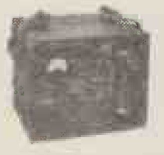
Complete set of new valves 2 X66, 2 U50, 2 DH63, 2 KT63, 6 KTW61. Also set of resistors, condensors, pots, toggle switch and output transformer. Supplied new and boxed. 59/6 each. P/P 4/6.

FERRANTI TESTMETERS TYPE Q

D.C. VOLTS	A.C. VOLTS	D.C. Current	Ohms
3 v.	15 v.	7.5 ma.	25,000
30 v.	30 v.	30 ma.	
150 v.	150 v.	150 ma.	
600 v.	600 v.	750 ma.	

500 ohms per volt on all ranges. B.S.S. first-grade accuracy on all self contained ranges. Supplied in perfect working order complete with leads, battery, instructions and rexine covered carrying case. Price 72/6 each. P/P 2/6.

ROTARY CONVERTORS

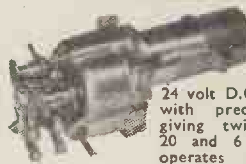


12 v. D.C. input, 230 volt A.C. 150 watts, 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance, switch, plugs and A.C. mains voltage output check meter. Supplied in perfect condition, individually tested, £9/19/6 each. P/P 10/-.

PARMEKO MAINS TRANSFORMERS. Input 230 volts. Output 350/0/350 volts 150 mA. 6.3 v. 4 amp., 5 v. 4 amp. Brand new, 32/6 each, P/P 2/6.

R.1155 "N" TYPE SUPER SLOW MOTION DRIVES. Brand new, 12/6 each. P/P 1/-.

AMERICAN GEARED MOTORS



24 volt D.C. motor fitted with precision gearbox giving twin outputs of 20 and 6 r.p.m. Also operates on 12 volts. ¼in. shafts. Brand new, 19/6 each. P/P 1/6.

CV9671 in. C.R.T. 4 v. HEATER. Suitable for oscilloscopes, etc., 25/- each. P/P 1/-.

CRYSTAL MICROPHONE INSERTS. Only 4/6 each. P/P 6d.

ALKALINE NIFE ACCUMULATORS

Banks of 10 cells giving 12 v. 45 A.H. Unused in wooden crates, £5/10/- each. P/P 7/6. Size 26½ x 8½ x 5½in.

MIDGET NIFE ACCUMULATORS. Single units, ideal for models, etc., 2/3 each. P/P 9d.

12-VOLT MOBILE AMPLIFIERS. Ex-Admiralty. Mic. or gram. inputs, 10 watts output to 3 or 15 ohm speakers. Not new but in good working order. £8/19/6 each. P/P 5/-.

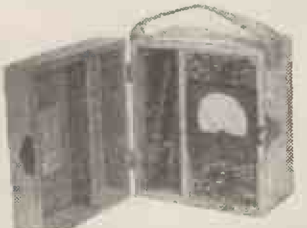
RCA ET 4336 PLATE TRANSFORMERS. Special release, brand new in original transit cases. Primary tapped 200/250 v. 50 cycles. Secondary, 2,000/0/2,000 v. 400 ma., tapped 1,500/0/1,500 v. Price £12/10/- each. P/P £1.

COLLARO CONQUEST 4-SPEED AUTO CHANGERS

Turnover crystal pickup with permanent stylus. Mixed loading, manual or auto. Brand new, complete with all instructions, etc.

£6/19/6 each. P/P 4/6.

AMERICAN MULTI-RANGE TESTMETERS

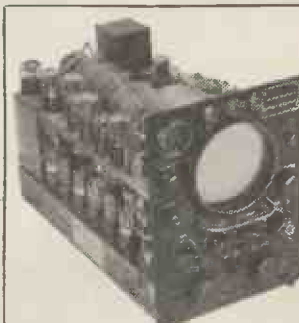


1,000 ohms per volt, 400 microamp basic movement.

A.C. VOLTS	D.C. VOLTS
2.5 v.	2.5 v.
10 v.	10 v.
50 v.	50 v.
250 v.	250 v.
1,000 v.	1,000 v.
5,000 v.	5,000 v.
D.C. CURRENT	RESIST'CE
1 ma.	500 ohms
10 ma.	100k. ohms
100 ma.	1 megohm
1 amp.	DECIBELS
	−10 to +69

ALL BRAND NEW. COMPLETE WITH INTERNAL BATTERY TEST PRODS AND INSTRUCTIONS. £5/19/6 EACH. P/P 3/-.

LORAN INDICATORS APN4



Another release, all brand new. These units contain a 5CP1 C.R.T. 14 6SN7 valves, 8 6H6, 3 6SL7, 1 6SJ7 and a 100 kc/s. crystal, also many thousands of useful components. Ideal for conversion to an oscilloscope. £5/19/6 each. Carriage 10/-. Circuitry supplied.

ADMIRALTY POWER UNITS 234A.

200/250 volt A.C. input. Output 250 volts 150 mA. and 6.3 volts 6 amps. Fully smoothed, double choke and paper condensers, fused and fitted with input and output plugs. Sockets are provided on the front panel for meter check. Housed in grey metal case for standard 19in. rack mounting. Supplied brand new, 59/6 each. P/P 7/6.

TINSLEY D.C. PHOTOCELL CURRENT AMPLIFIERS

These special units will give an amplification of 10,000, i.e. 1 microamp input, 10 ma output. Circuit incorporates a 1 MICROAMP GALVONOMETER, photocell, GTlc thyratron and a vacuum thermal relay. Operation is from 200/250 volts A.C. Housed in metal case size 20 x 15 x 15in. Supplied brand new and crated Price £10/10/0 each. Carriage 12/6.

COSSOR 343 GANGING OSCILLATORS. A.M./F.M. signal generators covering 70 kc/s to 21 Mc/s 400 cycles int. mod. F.M. sweep 0 to 50 kc/s. Operation 110/200/250 v. A.C. Supplied in perfect condition externally and internally, complete but not tested. £5/19/6 each. P/P 7/6.

HOOVER MIDGET ROTARY TRANSFORMERS. 2¼ x 4½in. Input 12 v. D.C. Output 310 v. 30 ma. Brand new and boxed, 12/6 each. P/P 1/3.

6-VOLT VIBRATOR POWER PACKS. Output 120 v. 30 ma. Fully smoothed, uses standard Mallory 4-pin vibrator. New and boxed. 12/6 each. P/P 2/-.

METER BARGAINS

50 Microamp. D.C. M/C., flush sq. in.	119/6
50 Microamp. D.C. M/C., proj. rd. 2½in	49/6
100 Microamp. D.C. M/C., flush rd. 2½in.	42/6
500 Microamp. D.C. M/C., flush rd., 2in.	15/6
500/0/500 Microamp. D.C. M/C., proj. rd. 2½in.	19/6
1 Milliamp. D.C. M/C., flush rd. 2½in.	25/-
50 Milliamp. D.C. M/C., flush sq. 2in.	7/6
200 Milliamp. D.C. M/C., flush rd. 2½in.	9/6
30 Amp. D.C. M/C., flush rd., 2½in.	9/6
15 Volt D.C. M/C., flush rd., 1½in.	10/6
25 Volt D.C. M/C., proj. rd. 2in.	8/6
120 Volt D.C. M/C., flush rd., 3½in.	32/6
300 Volt A.C. M/I., flush rd., 2½in.	25/-
300 Volt A.C. M/C., rectifier. flush rd., 2½in.	25/-
500 Volt A.C. M/I., flush rd., 2½in.	25/-

ALL BRAND NEW AND TESTED

BARGAIN GRAM MOTORS. Garrard centre drive motors complete with turntable, 220/250 v. A.C Adjustable mechanically from 0–45 r.p.m. Only 22/6 each. P/P 3/-

MINE DETECTORS No. 4a

Complete equipment comprises Search Head, Amplifier, Headset, Control Box Telescopic Rods for Search Head, Search Head Test Unit and Test Depth Measure, and Haversack.

Operation is from a standard 60 v./1.5 v. combined dry battery. The unit will detect ferrous or non-ferrous metals to a depth of 24in. giving maximum signal but can be used at greater depths giving lower output. Ideal for tracing underground pipes or cables and any hidden metallic objects.

Complete equipment supplied brand new in original transit cases complete with circuit and operating instructions.

PRICE
99/6 EACH
Carriage 10/6

100-WATT ROTARY CONVERTORS. Input 24 v. D.C. Output 230 v. A.C. 50 cycles, 100 watts. Housed in grey metal case with input/output plugs. Supplied brand new, 92/6 each. P/P 7/6.

150-WATT ROTARY CONVERTORS. Two models available, either 12 or 24 v. D.C. input. Output 230 v. A.C 50 cycles, 150 watts. Brand new £7/10/- each. P/P 7/6 ea.

PARMEKO TABLE TOP TRANSFORMERS. Input 230 v. 50 cycles. Output 620/550/375/0/375/550/620 volts 250 mA. Also 2–5 volt 3 amp. windings. Size: 6¾ x 6¼ x 5½in. Brand new only 45/- each. P/P 5/-.

FERRANTI POTTED FILAMENT TRANSFORMERS. Hermetically sealed, ceramic terminations. All new and boxed. Type 1: 200/250 v. input. Output 6.3 v. C.T 5.6 a. tapped 5 v. 6.3 v. C.T 4 8a. tapped 5 v. 6.3 v. CT, 1 a., tapped 4 v., 19/6 each. Type 2: Input 200/250 v. Output 6.3 v. CT, 3.3 a., tapped 5 v. 6.3 v. CT, 1 a., tapped 4 v. 6.3 v. CT, 9 a. 6.3 v. CT, 6 a., 15/6 each. P/P 2/-, each type.

GRESHAM POTTED LT. TRANSFORMER.

Input 230 volts. Output tapped 80 v., 75 v. and 70 v. at 4 amps. Supplied brand new, boxed, 42/6 each P/P 3/6.

HALLICRAFTER S.27 COMMUNICATION RECEIVERS. F.M. or A.M. coverage 27 to 143 Mc/s on 3 bands. Incorporates S meter, var. sel. B.F.O., etc., output for phone or speaker. Operation 110 or 230 volt A.C. Supplied reconditioned in perfect working order, £32/10/- each. P/P 10/-.

R.1155 COMMUNICATION RECEIVERS. Trawler Band Models L & N. Supplied in perfect working condition, £12/19/6 each Standard model B receiver, fitted with improved N-type drive, in perfect working order, £7/19/6 each. 7/6 carr. extra on both receivers. **Combined A.C. Mains Power Pack and Audio Output Stage, 85/- extra.** Illustrated instruction book with each receiver

EDDYSTONE MAINS POWER PACKS. 200/250 volts input. Output 175 volts 60 ma. and 12 volts 2.5 amps. Double choke and condenser smoothed, 5Z4 rectifier. Housed on grey metal case. Supplied new and unused 32/6 each. P/P 3/6.

VORTEXION PORTABLE AMPLIFIERS Operation from 200/250 volts A.C. or 12 volts D.C. Separate inputs for microphone or gram. Output matched to 7.5, 15, 250 or 500 ohms. Incorporates volume control and full switched tone control. Valve line-up: 6Q7, 6J5, 6V6, 6V6, 5Z4. Size 8½ x 6½ x 17½in., not brand new but supplied in perfect working order, fully tested £10/10/- each. P/P 6/-.

45 AMPERE NIFE ACCUMULATORS. Single cells, 1.2 v., 12/6 each. P/P 2/-.

POTTED MAINS TRANSFORMERS. Primary 230 volts. Secondary 350/310/0/310 volts 220 ma., 6.3 volts 13 mps. 5 volts 3 amps., 49/6 each. P/P 3/-.

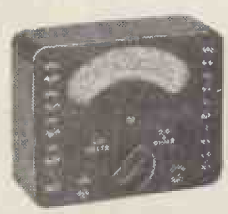
R.1294 V.H.F. RECEIVERS. Coverage 500 to 3,000 Mc/s. Perfect condition, with handbook, £35 each. P/P 10/-.

PORTABLE PRECISION VOLTMETERS BRAND NEW instruments by famous manufacturer. Housed in polished teak case. Moving iron movement reading A.C. or D.C. volts on 2 ranges, 0–160 v. or 0–230 v., 8in. mirror scale. Accuracy within 2%. Supplied at a fraction of original cost, £5/19/6 each. P/P 3/6.

A.C. MAINS VOLTAGE REGULATOR TRANSFORMERS. Input 230 v. Output variable from 185 to 250 v. at 24 amps., or 185–250 v. input. 230 v. output, £12/10/- each. P/P 10/-.

UNIVERSAL AVOMINOR TESTMETERS

Small, compact, accurate instrument. Resistance measurements from 0 to 20k. ohms, D.C. volts from 0 to 500 v., A.C. volts from 0 to 500 v., D.C. current from 0 to 500 mA. Supplied in perfect working order, complete with leather case and leads. £5/10/- each. P/P 2/6.



G.W. SMITH & CO (RADIO) LIMITED

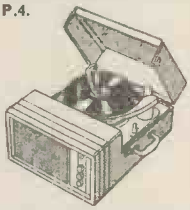
Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

SAVE MONEY AT DUKE & CO.

R.P.6. **49/6**

Elegant cabinet, cloth covered in grey or red with sunken control panel, and speaker fret. Size 13 x 17 x 8in. deep. Takes a B.S.R. Monarch 4-speed autochanger: 7 x 4in. elliptical speaker and most of the modern portable amplifiers. Carr. and Ins. 4/6.

79/6 R.P.4.



Stylish cabinet by famous manufacturer. Cloth covered in contrasting colours (red and grey). Grilled front controls panel. Size 15 x 19 x 8¾in. deep. Beautifully made—a cabinet of which you can be really proud. Takes 4-speed B.S.R. Autochanger. 6½in. round or elliptical speaker. Room for any amplifier of your own choice. Carr. and Ins. 4/6.

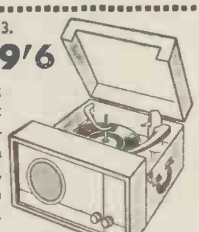
R.P.2.

69/6

A beautifully styled cabinet. Made by a famous manufacturer. In polka dot cloth with clipped lid and carrying handle. Size 16 x 14½ x 8½in. deep. Will take a B.S.R. Monarch 4-speed autochanger and 4 x 7in. elliptical speaker and most of the modern portable amplifiers. Carr. and Ins. 4/6.

R.P.3.

79/6



A delightful looking cabinet 14¾ x 17¾ x 8¾in. in 2-tone leatherette, will take a B.S.R. Monarch 4-spd. autochanger and 6½in round speaker. Carr. and Ins. 4/6.

R.P.7 **35/6** **SINGLE PLAYER CABINET**

Smart cabinet. Size 14½ x 12½ x 6½in. deep. Various 2-tone colour schemes with white handle and piping. Takes T.U. 9 B.S.R. single player unit, 4 x 7in. elliptical speaker and amplifiers D.1 or D.2. Carr. and Ins. 4/6.

★**STEREOPHONIC AMPLIFIERS** 12 months' guarantee **£7/19/6**

Beautifully made for portable stereophonic record players. Latest design with printed circuit. Dimensions 3 x 5½ x 9¾in. A.C. only. Mains isolated. Twin amplifiers each side giving 3-4 watts output. Incorporating ECL82 triode pentode valve. Full tone, volume and balance controls. Complete and ready to fit. Knobs 3/6 per set extra. P.P. and Ins. 4/6.

B.S.R. MONARCH 4-SPEED AUTOCHANGER

£6/19/6

Incorporating auto and manual control complete with turnover crystal p.u. and sapphire stylus. P.P. & Ins. 5/6.

COLLARO 4-SPEED AUTOCHANGERS **£7/19/6**
Incorporating auto and manual control complete with studio crystal p.u. and sapphire stylus. P.P. & Ins. 5/6.

T.U.9 B.S.R. 4-SPEED SINGLE PLAYER **£4/9/6** P. & P. 5/6.

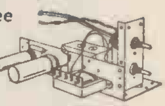
U.A.12 *LATEST* **B.S.R. MONARCH 4-SPEED MIXER** **£8/9/6** P. & P. 5/6.

COLLARO CONQUEST STEREO AUTOCHANGERS **11 GNS.**
With turnover cartridge for stereo L.P. and standard. Carr. & Ins. 5/6.

MOTOR BOARDS 2/6.
For 4-speed autochangers. P. & P. 1/3.

★ AMPLIFIERS ★

12 months' guarantee

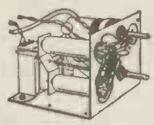


PORTABLE AMPLIFIER MARK D.1. 59/6
Brand new. Latest design with printed circuit. Dimensions 7 x 2¼ x 5in. A.C. only. Mains isolated. 2-3 watts output. Incorporating EL84 as high gain output valve. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MARK D.2. 79/6
Printed circuit. Latest design Dimensions 7 x 2¼ x 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving higher undistorted output. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

PORTABLE AMPLIFIER MARK D.3. 89/6
De luxe model. Printed circuit. Latest design. Dimensions 7 x 2¼ x 5in. A.C. only. Mains isolated 3-4 watts output. Incorporating the latest ECL82 triode pentode output valve giving high undistorted output. Volume, treble and bass control. Knobs 3/6 extra. P. & P. 3/6.

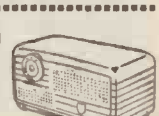
PORTABLE AMPLIFIER MARK D.4. 69/9



Brand new. By famous manufacturer. Especially built for portable record players. Dimensions 4½ x 3½ x 4in. A.C. only. 2 valves; EL84 as high gain output valve; EZ80 as rectifier. Volume and tone controls. Knobs 2/6 extra. P. & P. 3/6.

B.S.R. FUL-FI CRYSTAL TURNOVER CARTRIDGES **19/6**
Brand new. Including sapphire needles for L.P. and Standard, giving fullest range and finest tone obtainable for any player. Can be fitted to all standard pick-up arms. P. & P. 9d.

BAKELITE CABINETS **5/9**



Brand new. Colour brown. Attractive design. Size 12 x 7 x 5½in. Ideal for small receivers, convertors, etc. P. & P. 3/9.

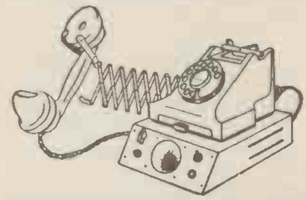
★ **IDEAL FOR STEREOPHONIC SOUND** ★

EXTENSION SPEAKERS

Polished oak cabinet of attractive appearance. **19/9**
Fitted with 8in. P.M. Speaker W.B. or Goodmans of the highest quality. Standard matching to any receiver (2-5 ohms). Switch and flex included. Ins. carr. 3/6.

8in. P.M. Speakers	8/9
With O.P. transformer fitted 10/-.	
6½in. P.M. Speakers	12/6
4 x 7in. elliptical speakers	19/6
8 x 5in. elliptical speakers	22/-

P. & P. 2/9.

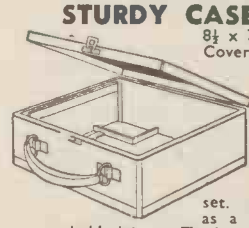


89/6

TELEVOX TELEPHONE AMPLIFIER

Invaluable in a noisy office or workshop. 3 valves UY41; UF41; UL41. 3in. speaker and a suction type vibration microphone AC/DC. Size of amplifier 7 x 11 x 3in. Fits any type of G.P.O. telephone. P.P. & Ins. 4/6.

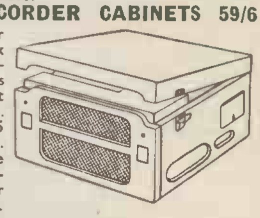
STURDY CASE 12/6



8½ x 7½ x 3½in. deep. Covered in burgundy and grey washable rexine. Strong clasp, hinges and handle. Ideal for Portable Radio Chassis or Transistor set. Can be adapted as a record carrying case to hold eighteen 7in. long playing records. P. & P. 2/6.

A "must" for the build your own tape recorder enthusiast:—

TAPE RECORDER CABINETS 59/6



Suitable for the Truvox Tape Recording deck. Less front cast speaker panel. Size 13¾ x 15 x 8½in. deep. Detachable lid with compartment for spare tape. Covered in green washable plastic material. P.P. & Ins. 4/6.

DUKE & CO.
(DEPT. C.5)

621/3 ROMFORD ROAD, MANOR PARK, E.12.

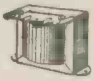
TERMS AVAILABLE

Send for FREE catalogue

Closed Thursday 1 p.m.
Open all day Saturday

Tel. ILFORD 6001/3

HEATER TRANSFORMER
12 volt at ½ amp. 0-200-250 volts primary. P.& P. 1/9. **12/9**

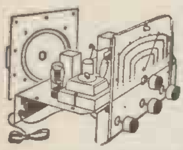


HEATER TRANSFORMER 3/9
2-1 Ratio or 1-2 Ratio auto transformer. 2 volt at 1.4 amp. primary. 4 volt secondary. P. & P. 1/9.

T.V. AERIALS 25/6.
For all I.T.A. channels. Outdoor or loft. 3 elements. P. & P. 2/6.

AERIALS 15/9.
B.B.C. indoor type. Folded dipole with 12ft. Co-ax cable fitted. Post 1/9.

T.V. AERIALS 7/9.
For all channels. Complete with Co-ax cable. For use indoors or in the loft. Postage 1/3.



SUPER CHASSIS 99'6

5 valve superhet chassis including 8in. P.M. speaker and valves. Four control knobs (tone, volume, tuning w/change switch). Four w/bands with position for gram. p.u. and extension speaker. A.C. ins. carr. 5/6.

14in. T.V. CHASSIS, TUBE AND SPEAKER ★ 11 GNS.
With 14in. Rectangular Tube. 12 months' guarantee on Tube. 3 months' guarantee on chassis and valves. Chassis with Tube and Speaker (less valves) 11 guineas. Complete and working with valves and Turret Tuner 19 gns. Ins. Carr. (incl. tube) 25/–.

POPULAR 12in. PLESSEY T.V. CHASSIS 39/6
This is a real bargain for anyone wanting to make up their own T.V. at a very low cost. I.F.'s 10.5–14 Mc/s. Simply adapted for a 12 channel Turret Tuner and can be modified to take a larger tube. A chassis in one unit. Untested. Less valves, tube, speaker and scanning coils. (All can be supplied as extras). Circuit diagram available at 3/6 or free with order. Carr. & Ins. 10/6.

12in. T.V. CHASSIS 29/6.
Complete chassis by famous manufacturer. R.F. E.H.T. unit included. Easily fitted to table or console model owing to this chassis being in three separate units (power s/vision strip, t/base interconnected). This chassis is less valves and tube. Speaker FREE. I.F.'s 16–19.5 Mc/s vision. Channels 1-5 easily converted to I.T.A. by use of a Turret Tuner. Drawings available at 2/6 or free with order. Ins. carr. 10/6. 12in. tube available at £6. Plus Ins. carr. 15/6.

SOUND/VISION AND I.F. STRIP 25/6
Plessey. Tested. I.F.'s 10.5 Mc/s. sound. 14 Mc/s. vision. 8 valve holders. Less valves. Size 8½ x 5 x 4½in. circuit incl. The tuner unit plugs directly into this chassis. P. & P. 2/6.

SOUND/VISION AND I.F. STRIP. 5/9.
Salvaged. Complete sound and vision strip. 8 valve holders. Less valves. I.F.'s 16–19.5 Mc/s. Size 8½ x 4½ x 4½in. Drawings free with order. P. & P. 2/6.

SOUND/VISION AND I.F. STRIP. 5/9.
Salvaged. Superhet. 8 valveholders. Less valves. I.F.'s 7.25 Mc/s. sound. 10.75 Mc/s. vision. Vision complete from input up to video output. Sound complete from input to A.F., Amplifier. P. & P. 2/6.

TIMEBASE. 4/9.
Containing scanning coils, focus unit, line transformer etc. Less valves. Drawings free with order. P. & P. 2/6.

DUKE & CO.
For QUALITY at the RIGHT PRICE

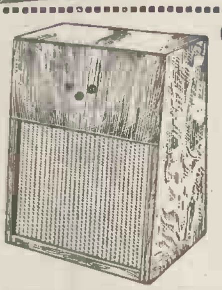
REGETTERED *IMPROVED VACUUM* T/V TUBES

17in. Rect.	**£7'10'-**	12 months'
14in. Rect.	**£5'10'-**	guarantee.

Our 12 months' guarantee (6 months full replacement, 6 months progressive) illustrates our wholehearted confidence in the Tubes we offer. We sell many hundreds a week throughout the country and have done so for the past 8 years. Many of them go to the Trade i.e., to Insurance Companies, Renters and Retailers who are thoroughly satisfied with our supplies. Remember they also hold a 10 days' money back guarantee.

9in., 10in., 14in., 15in., 16in. Round tubes.
Our special offer of these sizes £5. 12in. T.V. Tubes £6. Three months' guarantee on round tubes. Ins. carr. 15/6.

★ EXPRESS DESPATCH SERVICE ★
Please 'phone to confirm Tube in stock. Send Telegraph Money order. Tube despatched Passenger Train same day. This service only available with remittance by a Telegraph Money order.



Contemporary EXTENSION SPEAKER 32'6
18 x 7 x 15in. Dark veneered walnut cabinet. Attractive speaker fret. High quality 8in. P.M. speaker. On and off switch and volume control. P. & P. 3/6.

MAINS TRANSFORMERS
DROP THROUGH TYPE 12/9
350-0-350 volts at 250 mA., 6.3 volt at 4 amp., 6.3 volt at 4 amp. 4 volt at 3 amp., 22 volt at .3 amp., 4 volt centre tapped at 1.5 amp. Primary 200-250 volt. 50 cycles. P. & P. 3/9.

UPRIGHT TYPE 3/9
350-0-350 volt at 80 mA., 12 volt at 1.5 amp., 4 volt at 2 amp. Primary 100-120-200-250 volt. Fully shrouded. Ideal for mains auto transformers. P. & P. 2/9.

MAINS AUTO 12/6.
0-205-225-245 volts at 300 mA. Isolated windings of 6.3 volt at 2-6 amp. 6.3 volts at 3-6 amp. 2 volt at 1-4 amp. P. & P. 3/9.

O.P. TRANS 1/3.
Standard size 2–5 ohms. Post 1/–. 20 for £1. P. & P. 5/6.

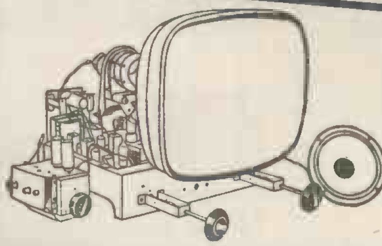
POWER PACK AND AMPLIFIER 19/6.
R.F. E.H.T. Not tested. Amplifier stage 6V6 with O.P. trans. 3 ohms matching. Smoothed H.T. 350 volt at 250 mA., 6.3 v. at 5 amp. 22 v. at 3 amp., 6.3 v. at 4 amp. and 4 v. centre tapped. Less valves. Drawings free. Size 14½ x 8 x 7in. Ins. carr. 5/6.

POWER PACK AND AMPLIFIER 9/9.
Output stage PEN45. O.P. trans. choke. Smoothed H.T. 325 volt at 250 mA. 4 v. at 5 amp. 6.3 v. at 5 amp., 4 v. at 5 amp. centre tapped. Valve base for rectifier. Octal or 4 pin. Output is taken from standard plugs. Less valves. Ins. carr. 5/6.

CLOCKWORK MECHANISM 1/9.
A perfectly engineered clockwork unit, with a fully enclosed clock-type spring, gear train and escapement. Ex. W.D. (type ROF (B) 40 SL). Can be modified for use as a darkroom timer, clock or any mechanism requiring activation. For the amateur mechanic with ideas, it offers considerable scope. Drawings free with order. Post 1/–.

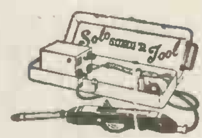
INSULATING TAPE 1/6.
75ft. of ½in. tape in sealed metal container. Post 9d.

T.V. TUBES, CHASSIS & SPEAKERS



17" T.V. CHASSIS, TUBE & SPEAKER 16 GNS.
17in. Rectangular tube on modified chassis. Supplied as single channel chassis covering B.B.C. channels 1–5, or, incorporating Turret Tuner, which can be added as an extra, at our special price to chassis purchasers of 50/– giving choice of any 2 channels (B.B.C. and I.T.A.). Extra channels can be supplied at 7/6 each. Chassis size 12 x 14½ x 11in. less valves. Similar chassis are used by well known companies because of their stability and reliability. With tube and speaker (less valves) 16 guineas. Complete and working with valves and Turret Tuner 24 guineas. 12 months' guarantee on the Tubes. 3 months' guarantee on the valves and chassis. Ins. Carr. (incl. tube) 25/–.

SOLO SOLDERING TOOL
110 v. 6 v., 12 v. (special adaptor for 200/240 v. 10/– extra). Automatic solder feed including a 20ft. reel of Ersin 60/40 solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Instantly ready for use and cannot burn. In light metal case with full instructions for use. Post 2/9. **12/6**



SOLDER REELS 1/6.
On plastic spools. 60/40 3-core Ersin. 20ft. for 1/6. Will fit the Solo Tool. Post 4d.

STRONG PHOTOGRAPHIC SLIDE CASE
(List price £2/10/-). Rexine covered. **17/6** Size 8 x 12¾ x 2¾in. deep. Will hold 150 of those expensive coloured transparencies in numbered partitions.

This is the answer to that aggravating search for that particular photograph, and will, of course, keep them safe from damage. P. & P. 2/6

COLVERN PRESET POTENTIOMETERS 2/9
Brand new. 200 ohms. 10 K. and 20 K. P. & P. 6d.

FOCUS MAGNET 9/9
Brand new. 38 mm. Incorporating picture shift control. P. & P. 1/3.

SCANNING COILS 10/6
Low impedance. 38 mm. Brand new. P. & P. 1/3.

GANG CONDENSERS 1/9
Salvage guaranteed. Standard size two gang. .0003 and .0005. All tested and guaranteed. P. & P. 1/3.

R.F. E.H.T. COIL 7/9.
7-10 KV R.F. frequency approx. 200 K/cs. Uses 6V6 or P61 as osc. suitable for ULTRA model V600, W700 and many other sets or replacing E.H.T. mains transformers. Ideal when using a larger tube. Size 4½ x 2in. dia. base. 4 x 4½in. Circuit drawing available with order. P. & P. 2/6.

CHASSIS 1/-
6 or 8 valve latest type midget valve design for A.M. or F.M. Brand new. Cadnium plated. Size 12½ x 7½ x 2¾in. P. & P. 1/9.

T.V. MASKS 17in.
White 9/9. Grey 10/9. Post 2/–.

T.V. MASKS 12in.
Soiled 1/9. Post 1/6.

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

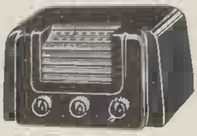
LEADING THE FIELD—

in equipment for

THE CONSTRUCTOR & HI-FI ENTHUSIAST

SEND STAMP FOR FULL LIST including F.M. Tuners, Receivers, Amplifiers, Stereo Amplifiers, Tape Pre-Amplifiers, Transistor Portables, Crystal Receivers, Battery Charger, Baby Alarm, etc.. etc.

Special Summer Offer!!



Our super-sensitive "FAMILY FOUR" T.R.F. Receiver for home construction. Covers Long and Medium Wavebands, is housed in very smart plastic table cabinet in Brown or Black. For A.C. Mains 200/250 v. Comprehensive assembly instructions provided, including practical and theoretical diagrams, which are easy to follow and will enable **you** to complete this receiver which will be the envy of your friends. ALL NECESSARY COMPONENTS ARE BEING OFFERED FOR LIMITED PERIOD ONLY AT THE REMARKABLE PRICE OF ONLY **79/6**, plus 2/6 p. & p. Instruction book available separately if you wish to study before purchase at 1/6 post free.

MULLARD 510 HIGH-FIDELITY AMPLIFIER

Printed circuit version with ULTRA LINEAR PUSH-PULL output stage, giving excellent output of 10 watt (max.). Built-in controls. Will suit all types of high impedance input. All required components of best quality to Mullard Spec. are offered at **special inclusive price of £9/9/-** plus 3/6 p. & p. Instruction Book with full constructional details, diagrams, etc., and itemised price list available separately at **3/6** post free.

SUPER 5 WAVE BAND CAR RADIO

(By world famous manufacturer)

This excellent receiver is very easily fitted in any car with 12 v. system. Comprising: power unit, 6½in. speaker on baffle and tuner unit. Valve line up: 2-EF41, ECH42, EBC41, EL42, EZ41. THREE SHORT WAVE BANDS (16-31 m.), MEDIUM (190-550 m.) and LONG (1,000-2,000 m.), variably tuned. Controls: volume on/off/tone, wave change/tuning. Horizontal dial with chrome surround. BRAND NEW, FULLY G'TEED AND UNREPEATABLE AT £17/19/6 plus 5/- p. & p. Terms available.

A QUALITY RECORDER FOR 39 GNS.

Collaro Mark IV Tape Transcriptor Deck...	£25 0
Special amplifier......	£14 14
8×6in. loudspeaker...	£1 10
De luxe Cabinet with gilt fittings...........	£4 10
Collaro Mike (or similar)	£2 5
1,200ft. EMI tape	£1 15
TOTAL	**£49 14**

OUR SPECIAL INCLUSIVE PRICE ONLY 39 GNS. if all items purchased together.

Terms: £4/19/- dep. and 12 monthly payments of £3/3/-. C. & p. 15/- extra. Full assembly instructions provided. Note: We shall be pleased to wire the tape deck switches at extra charge of £1. Send stamp for further details.

THE NEW LOOK RAMBLER ALL DRY BATTERY PORTABLE

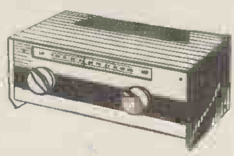
(By popular demand)

This wonderful receiver (the ideal companion for your summer holiday) with the "hall-mark" of quality, is housed in a most attractive cabinet finished in two-tone RED/GREY "Lionide" with chrome fittings. The very neat appearance is set off by the smart cream plastic top panel engraved in red and green. Employing modern miniature valves: 1R5, 1T4, 1S5, 3V4, and a good quality 5in. loudspeaker, this receiver has everything—quality, sensitivity, volume, tone and economy. Uses all-dry batteries AD35 (1/6), B126 (9/-). **All necessary components** (less batteries) **are offered at a special inclusive price of only £7/7/-** plus 2/6 p. & p., or. **Special extra-economy version with latest range of low consumption valves** (DK96, DF96, DAF96, DL96), £7/15/6, plus p. & p. Easy-to-follow Instruction Book, containing full description, itemised price list, practical and theoretical diagrams, available separately at 1/6 post free.

RAMBLER MAINS UNIT enabling the above receiver to be run directly off any A.C. mains supply 200/250 v. Fits snugly into the battery compartment (dimensions 7in. × 2¾in. × 1¼in. overall). All necessary components supplied at **ONLY 47/6**, plus 1/6 p. & p., or can be supplied assembled and tested at **£3/5/-**, plus p. & p. (Also suitable for many other portables.)

THE NEW JASON FM TUNER

This is the latest addition to the impressive **JASON** range, and like all **JASON** equipment, can be depended upon for QUALITY, RELIABILITY and PERFORMANCE. Incorporates



the very latest features in design to ensure simplicity of operation and faultless performance. Housed in smart metal shelf mounting cabinet in pastel green with grey plastic dial. Built-in power supplies are provided, enabling connection to any amplifier or radio fitted with Pick-up sockets, without complication. Two versions are available, i.e. Standard or Fringe Area. ALL NECESSARY COMPONENTS SUPPLIED AT SPECIAL INCLUSIVE PRICE OF: **STANDARD TUNER £8/19/6; FRINGE AREA TUNER £10/19/6**, both plus 3/6 p. & p. Comprehensive Assembly Instructions with full description and itemised price list are available separately if required at 2/6 post free.

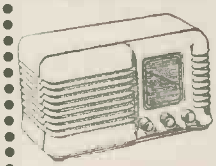
ACOS MIC 39-1

Crystal stick microphone. List price 5 gns. **Our price 39/6**, plus 1/6 p. & p.

A SUPERB NEW TRANSISTOR PRINTED CIRCUIT POCKET PORTABLE (BY PERDIO)

A most attractive receiver employing 6 selected transistors and covering Medium and Long wave bands. Housed in smart cream plastic case, size 5⅝in. × 3¼in. × 1¼in. with gilt table stand and control knobs. All necessary components for construction of this beautiful receiver are available at a special inclusive price of **£9/19/6**, plus 2/6 p. & p. including comprehensive, easy-to-follow instructions (available separately. 2/6 post free.)

THE CLYNE RADIO "DE LUXE" PRINTED CIRCUIT SUPERHET



A new two waveband (L and M) Superhet using the latest miniature valves: ECH81, EF85 and ECL80, plus contact cooled Rectifier. Incorporates Ferrite Rod Aerial and is of unit construction. Exceptional sensitivity and selectivity. Outstanding performance and quality T.C.C. condensers throughout. Easily constructed in one evening. Brown Ivory Bakelite or wooden Walnut finish cabinet. A.C. mains 200/250 v. All necessary components at special inclusive price of **£7/19/6** plus 3/6 p. & p. Instruction Book with itemised price list available separately at 1/6 post free.

If not stated, please add postage on orders under £1. Cash with order or C.O.D. (charges extra).

Our advantageous H.P. and Credit Sale terms are available on any single item over £5. Your enquiries invited.

CLYNE RADIO LTD.

162, HOLLOWAY ROAD, LONDON, N.7. NORth 6295/6/7.
18, TOTTENHAM COURT ROAD, W.1. MUSeum 5929/0095.
(50 yards only from Tottenham Court Road Tube).

Open: Tottenham Court Rd: 9 a.m. to 6 p.m. Mon. to Fri. Sat. 1p.m.
Holloway Road: 9 a.m. to 6 p.m. daily. Thurs. 1 p.m., Sat. 5.30 p.m.

All post orders and correspondence to
162 HOLLOWAY ROAD, LONDON, N.7.

R.S.C. HI-FI TAPE RECORDER

For space conservation Lid is omitted from illustration.

The unit is housed in an attractive walnut veneered cabinet as illustrated. Size approx. 18 × 17 × 14in. high.

INCORPORATING THE LATEST MK. IV COLLARO TAPE TRANSCRIPTOR. THE LINEAR LT45 HIGH QUALITY TAPE AMPLIFIER AND A HIGH FLUX 8 × 5in. LOUDSPEAKER.

39½ GNS. Carr. 15/-

A spare tape spool and reel of first quality Tape is included.

A Collaro Studio Microphone can be supplied with the recorder only at a special price of 37/6.

YOU CAN PAY TWICE THE COST FOR THE SAME QUALITY. Full descriptive leaflet supplied on receipt of S.A.E.

H.P. TERMS. DEPOSIT 3 gns. and 12 monthly payments £3/10/6.

HI-FI 8 WATT AMPLIFIER

SPECIAL PURCHASE DUE TO CANCELLED EXPORT ORDER **£4-19-6**

For 200-250 v. A.C. mains. Carr. 7/6.

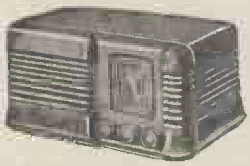
A REMARKABLE OPPORTUNITY!

Push-pull output. Latest high efficiency B.V.A. valves. Dual separately controlled inputs for mike and gram. Separate bass and treble controls. High sensitivity. Output for 15 ohm loudspeaker. Guaranteed brand new, tested, and in perfect working order.

AUTO-CHANGER
COLLARO RC54 3-SPEED MIXER

Fitted Studio pick-up with turnover head. Brand new, cartoned, but for 110 v. 50 c.p.s. A.C. mains. So that the unit can be operated from normal 200-250 v. A.C. mains we are supplying free with every changer a suitable auto-transformer with input and output voltage clearly marked. Limited number only. £5/19/6. Carr. 5/6.

THE SKY FOUR T.R.F. RECEIVER



A design of a 3 valve 200-250 v. A.C. mains. L. and M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, SP61, 6F6G, and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-point wiring diagram. Instructions and parts list. 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all dry battery eliminator. Size 5½ × 4½ × 2in. approx. Completely replaces batteries supply 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s is available. **Suitable for all battery portable receivers requiring 1.4 v. and 90 v.** This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 46/9.

Type BM2. Size 8 × 5½ × 2½in. Supplies 120 v., 90 v. and 60 v., 400 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed. THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND K.T. 2 v. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator. Complete kit with diagrams and instructions. 49/9 or ready for use 59/6.

SIX TRANSISTOR POCKET RADIO RECEIVER

All parts including cream or coloured plastic case, printed superhet circuit, ferrite aerial. Transistors, 2½in. P.M. speaker. Long and medium wavebands. Size of unit 5¾ × 3¼ × 1¼in. Detailed construction booklet supplied.

Total cost of parts.

£9-19-6

A working unit can be demonstrated at our County Arcade premises. All items are available separately.

EXTENSION SPEAKERS

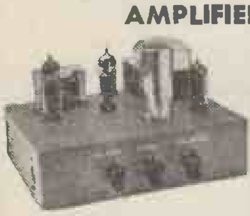
Limited number in handsome Walnut veneered cabinets. 2-3 ohm speech coils, 6½in. 29/9. 8in. 35/9. 10in. 56/9.

DRY SHAVERS. Brand new in carrying case. Operation from 3 U2 batteries, fitted in case. Just the thing for travel. Only 59/6 (approx. half price).

RECORDING TAPE. 600ft. reels, 8/9. 1,200ft. reels 14/9.

ELECTRIC SOLDERING IRONS with neon indicator. Lightweight type for radio work, 19/9.

LINEAR L3/3 STEREO AMPLIFIER



Sensitivity 150 m.v. for 3 watts output on each channel. Ganged Vol. and Tone Controls. Pre-set balance control. Outputs for two matched 2-3 ohm speakers. (Can be used as straight 6-watt amplifier.) Provides remarkably realistic output when connected to 200-250 v. A.C. mains point. Stereophonic pick-up head and good quality speakers. Instructions and guarantee included. Carr. free. **7 gns.**

Send S.A.E. for leaflet.

Or deposit 27/9 and 5 monthly payments of 27/9.

COLLARO JUNIOR 4-SPEED RECORD PLAYER

with separate pick-up having dual point sapphire stylus. Brand new, cartoned. For 200-250 v. A.C. mains only. Only £4/10/-. Post 3/6.

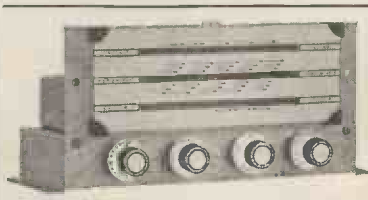
R.S.C. A12 STEREO AMPLIFIER KIT

A complete kit of parts to construct a good quality 3+3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. Suitable for use with all stereo, pick-up heads at present available. Ganged volume and tone controls. Preset balance control. Outputs for matched 2-3 ohm speakers. For 200-250 v. A.C. mains. Astonishing value.

£3-19-6 Carr. and packing 7/6.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts 15 ohms (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. £4/10/9. Please state whether 3 ohm or 15 ohm required.



AM/FM RADIOGRAM CHASSIS, HIGH QUALITY. PUSH-PULL. 6-8 WATTS OUTPUT. Current manufacture. 12 months guarantee. For 200-250 v. mains. Covers L. and M. wavebands plus F.M. Includes 8 latest type miniature B.V.A. valves. Only 22 gns. plys 7/6 carr. Or deposit £2/12/- and 9 monthly payments of £2/12/-.

COLLARO AC/4/564 4 Speed Single Players £6/9/6. Carr. 4/6.

R.S.C. TRANSFORMERS

FULLY GUARANTEED
INTERLEAVED AND IMPREGNATED

MAINS TRANSFORMERS

Primaries 200-230-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a., suitable for Mullard 510 Amplifier	33/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9
350-0-350 v. 150 mA., 6.3 v. 2 a., 6.3 v. 2 a., 5 v. 3 a.	33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	22/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 4 v. 3 a.	23/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9

ELIMINATOR TRANSFORMERS

Primaries 200-250 v. 50 c/s.

120 v. 40 mA., 5-0-5 v. 1 a.	14/9
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS

Primaries 200-250 v. 50 c/s

6.3 v. 1.5 a.	5/9	6.3 v. 3 a.	8/11
6.3 v. 2 a.	7/6	6.3 v. 6 a.	17/6
0-4-6.3 v. 2 a.	7/9	12 v. 3 a. or 24 v. 1.5 a.	17/6
12 v. 1 v.	7/9		

OUTPUT TRANSFORMERS

Midget Battery Pentode 66:1 for 3S4, etc.	3/6
Small Pentode 5,000Ω to 3Ω	3/9
Standard Pentode 5,000Ω to 3Ω	4/6
Standard Pentode 8,000Ω to 3Ω	4/9
Push-pull 8 watts 6V6 to 5 ohms	8/9
Push-pull 10-12 watts 6V6 to 3Ω or 15Ω	15/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω	16/9
Push-pull EL84 to 3 or 15 ohms	16/9
Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc., or 3 to 15 ohms	21/9
Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω	47/9

SMOOTHING CHOKES

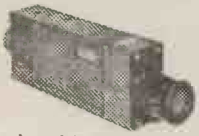
250 mA., 5 H., 100 ohms	11/9
150 mA., 7-10 H., 250 ohms	11/9
100 mA., 10 H., 200 ohms	8/9
80 mA., 10 H., 350 ohms	5/6
60 mA., 10 H., 400 ohms	4/11
1 amp. 0.5 ohm L.T. type	6/6

PHILCO F.M. RADIO FEEDER UNITS

(With self-contained power pack)

A De-Luxe unit housed in a beautiful walnut veneered cabinet. 110-200-250v. A.C. operation, Magic-eye tuning indicator. 6 valves. List price £21. **12½ GNS.** Carr. 5/-

Cine Cameras

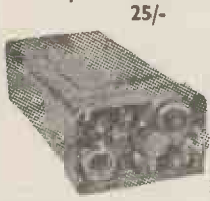


16 mm. motorised (24 VAC) for 16 frames per second, contains fine f/3.5 triple anastigmatic lens and spool to carry 25ft. of film—probable cost around £150, brand new and in sealed carton **£6/10/-** or **20/-** deposit and 13 fortnightly payments of **10/-**, post and insurance 3/6.

Band III Converters

Suitable Wales, London, Midlands, North, Scotland, etc. All the parts including 2 EF80 valves, coils, fine tuner, contrast control, condensers and resistors. (Metal case available as an extra). Price only **27/6**, plus 2/6 post and insurance Data free with parts or available separately, **1/6**.
Please send two more kits, the one you sent last week is performing magnificently. We receive this sort of letter every day of the week, so if you have hesitated because you thought our kits too cheap you need hesitate no longer.

Complete Walkie-Talkie 25/-



This is the 46 Walkie-Talkie. It has a range of approx. 5 miles—just right for search parties, fire brigades, etc. Operates from dry batteries. Complete with six valves and in metal case. Size approx. 12in. × 6in. × 3½in. Complete but less crystal, not tested nor guaranteed, 25/-, plus 2/6 carriage.

A.C./D.C. Multimeter Kit

Ranges: D.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. A.C. volts 0-5, 0-50, 0-100, 0-500, 0-1,000. D.C. milliamps 0-5, 0-100, 0-500. Ohms 0-50,000. with internal batteries. 0-500,000 with external batteries. Measures A.C./D.C. volts. D.C. current and ohms. All the essential parts including metal case, 2in. moving coil meter, selected resistors, wire for shunts, range selector, switches, calibrated scale and full instructions, price **19/6**, plus 2/6 post and insurance.

Insulated Terminal Heads

Always useful—special bargain price, **2/-** dozen.

Miniature Microphone

American made. Dynamic type, real bargain at **2/6**, plus 6d. postage.

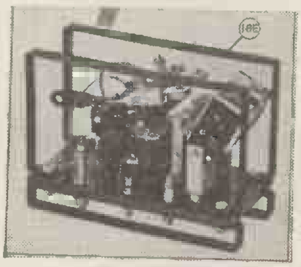
Assure your future

The ownership of a good instrument has been the turning point in many a famous career. You can own the latest Pullin Series 100 Test Set which is undoubtedly a most useful instrument by a firm long famous for fine instruments, entirely redesigned, it has a square movement with diacon plastic cover, this makes for a brighter, more readable scale, extra scale length and wider angle of vision. With the test set is included a pair of combined test prods and crocodile clips also a stand for inclining the meter at the best reading positions. Ranges A.C. Volts: 0-10, 0-25, 0-100, 0-250, 0-500, 0-1,000, ditto D.C. A.C. Current 0-100 mA. D.C. Current 0-2.5, 0-10, 0-100, 0-500 mA. Resistance: 0-1M and 0-10K. All at 10,000 ohms per volts—Price **£12/7/6** or **£1** deposit and 24 fortnightly payments of **10/-**, non callers add **5/-** carr. and insurance.
FREE GIFT.—All purchasers of the above item this month will receive Range Extender scale and data which add: capacity 2pF—1mFd., in two ranges. Inductance 0-100 henrys, etc., etc.

THIS MONTH'S SNIP

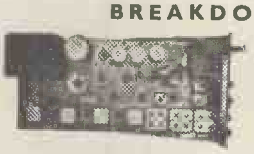
Terrific Manufacturer's Surplus Offer

Constructor's parcel: to build Pocket 6 Transistor Set as currently being sold at **£17/17/-**.
Parcel comprises Motiffed two-tone cabinet as illustrated, tuning dial, two gang tuning condenser, combined bakelite chassis/printed circuit and easy to follow circuit. Costing value 57/6—offered while supplies last at only **29/6** plus 2/6 post. Suitable for your own circuit or to build original circuit. All the additional necessary parts available at highly competitive prices. Do not miss this tremendous bargain.

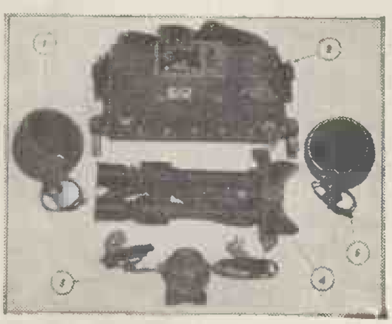


18E. Remote Control Contactor. Double pole, rated for 30 amps. D.C. but suitable for much higher current on A.C. magnetic arch blow-outs and asbestos arch shields. Coil wound for 220 v. D.C. but take turns off and it will be suitable for A.C. or if you prefer, work off A.C. with rectifier. Many applications such as remote switching of motors, banks of lamps, banks of heaters, etc., etc. Energising coil can be operated off Thermostat, Toggle Switch, Push Button or our vacuum delay switch. Size overall is 10in. × 8in. × 4½in. Original cost probably over **£5**, our price **27/6** each plus **3/6** carriage and insurance.

BREAKDOWN SNIP



American Radar Unit/ANAP1, this unit which cost a small fortune to make as illustrations show contains a wealth of components including switches, transformers, pot meters, resistors, condensers, valveholders, etc., etc. Offered while stocks last at the very low price of **8/6** plus 3/6 post and packing.

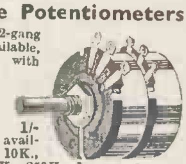


TABBY EQUIPMENT COMPLETE

Complete equipment for seeing in the dark, as fitted to Army vehicles for night driving etc. Complete working equipment comprises: 2 Infra Red Radiators, adjustable binoculars, powerpack for 6 or 12 volts, control units and inter-connection cables. Original cost probably around £100. Unused and in perfect order—**£6/19/6** or **10/-** deposit and 15 fortnightly payments of **10/-**.

17E. Dimmer or Regulator.
Total resistance 1,000 ohms maximum current of .59 amps. This is a beautiful unit which uses a 32 position stud switch. resistance is divided into 31 sections each approx. 30 ohms. In ventilated metal case, size approx. 7in. × 7in. × 5½in. with wall mounting brackets and large control knob, **27/6**, plus 2/6 post and insurance.

Morganite Potentiometers

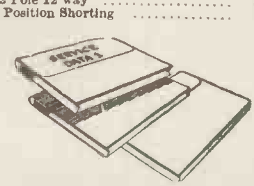


Single and 2-gang types available, standard size with good length spindle, all bewand boxed. Single types **1/-** each, valves available: 5K, 10K., 25K, 50Kl, 100K., 250K., 1 meg., 2 meg., Gang type **3/-** each—valves available: 5K + 5K., 100K. + 100K., ½ meg. + ½ meg., 2 meg. + 2 meg.

14E. Instrument transformer primary 230 v. secondaries: 6.3 at 3/4 amp. and 2 of 85 v. at 10 mA. **8/6** plus 1/6 p. & p.

Yaxley Switches

3 Pole 2 way	1/6
12 Pole 2 way	2/-
3 Pole 3 way	1/6
9 Pole 3 way	2/-
2 Pole 4 way	2/-
6 Pole 4 way	2/9
4 Pole 6 way	3/6
2 Pole 6 way	2/6
1 Pole 7 way	2/6
1 Pole 11 way	2/6
2 Pole 11 way	3/6
1 Pole 12 way	3/6
2 Pole 12 way	4/6
6 Position Shorting	2/-



T.V. Service Sheets

200 sheets covering most popular post-war televisors by leading makers—Cossor, Ekco, Ferguson, Pye, etc. **£2** post free. PREVIOUS PURCHASERS OF THESE SHEETS PLEASE NOTE: WE CAN SUPPLY SHEETS Nos. 100-200, **£1**, or 150-200, **10/-**.

All items advertised can be obtained from the following Companies.
If ordering by post, address your order to the Company nearest to you and please include postage.

Instrument Co.,
6, High Street, Thame, Oxon
Tel.: Thame 182

Electronics (Ruislip) Ltd.
42-46, Windmill Hill,
Ruislip, Middx.
Phone: RUISLIP 5780.
Half day, Wednesday.

Electronics (Croydon) Ltd.
266, London Road,
Croydon.
Phone: CRO 6558.
Half day Wednesday.

Electronics (Finsbury Park) Ltd.,
29, Stroud Green Rd.,
Finsbury Park, N.4.
Phone: ARChway 1049.
Half day, Thursday.

RADIO TRADERS LTD.

23 WARDOUR ST., LONDON, W.1. (Coventry Street end)
Phone No.: GERrard 3977/8 *Grams: "Radiotrade"*
STOCKISTS OF CARR FASTENER COMPONENTS

ALL POPULAR TYPES OF *Cinch* Reg'd. **COMPONENTS SUPPLIED FROM STOCK**

SPECIAL OFFER OF CURRENT MANUFACTURE ELECTROLYTIC CONDENSERS (tubular wire and P.V.C. sheathed). 8 mfd. 450 v., 2/6 each; 16 mfd. 450 v. 3/-; 32 mfd. 450 v. 4/-; 8 x 8 mfd. 450 v. 3/9; 8 x 16 mfd. 450 v. 4/-; 16 x 16 mfd. 450 v. 4/6; 32 x 32 mfd. 350 v. 5/-.
BIAS CONDENSERS. 2, 500 mfd. 3 v. 3/6; 250 mfd. 25 v. 2/-; 100 mfd. 25 v. 1/6; 50 mfd. 12 v. 1/6; 25 mfd. 25 v. 1/6.
ELECTROLYTIC CONDENSERS. Manufacturers' surplus, in perfect condition. 100 mfd. x 200 mfd. 350 v. surge 5/6 each; 100 mfd. x 100 mfd. 425 v. surge 5/6 each; 150 mfd. 450 v. wkg. 5/6 each.
2 mfd. 150 v. Size 2in. x 1¼in. suitable for crossover 1/9 each or 18/- doz.

TRANSISTORS: Junction type Red Spot by well-known manufacturers 10/- each.
TRANSISTOR CONDENSERS: Miniature Electrolytic Capacitors. 32 mfd. 3 v. 25 mfd. 25 v., 25 mfd. 6 v., 16 mfd. 12 v., 8 mfd. 6 v., 5 mfd. 12 v., 2.5 mfd. 25 v 1.6 mfd. 6 v., 1 mfd. 12 v. All these types of condensers are 3/6 each. SPECIAL DISCOUNTS FOR QUANTITIES.

AIR-SPACED TRIMMERS, 5, 10, 15, 25, 50 and 75 or pre-set and spindle types 2/- each....doz. 21/-
MIDGET MICA CONDENSERS. .0001, .0002, .0003, .0004, .0005 5/- per dozen.
200 Assorted Moulded Mica Condensers, popular values......... £2 10 0
200 Assorted Silver Mica Condensers, popular values........... £2 10 0
200 Assorted Carbon Resistors, ¼, ½ and 1 watt. Good selection £1 10 0
PAXOLIN SHEET. 18 x 4½ x 1/16in. 1/6; 10 x 10 x 1/32in. 1/6; 20 x 20 x 1/32in. 3/-; 10 x 10 x 1/16in. 2/-; 20 x 10 x 1/16in. 4/-; minimum P. & Pkg. 1/6.

T.V. TUBES. A limited quantity of 9in. and 12in. Magnetic T.V. Tubes, brand new and boxed, by famous maker. Specification: 12in. will replace most MAZDA 12in., 2 v. tubes. Flat face, white fluorescence triode 1.5 a. heater current, anode voltage 10 kV. £8/19/6 including mask. **9in. Tube,** round face, white fluorescence, 4 v. lamp heater, max. anode volts 7 kV. Price £5/17/6. Both items plus 11/6 carr. & pkg.

W.W. RESISTORS. 5 watt 1/6; 10 watt 2/6; 15 watt 3/-; 20 watt 3/6. We carry stocks of resistors from 2 watts to 150 watts W.W. Your enquiries invited.
HIGH STABILITY RESISTORS. ½ watt 5% 6d.; ½ watt 5% 9d.; 1 watt 5% 1/-. A few values in 1% and 2% still available.
ALL ORDERS FOR RESISTORS C.O.D. PLEASE, AS WE CANNOT GUARANTEE TO STOCK ALL VALUES.
GROMMETS. 1 gross assorted ⅛in. to 1in.......... 8/6
WESTECTORS. WX6, WX12, W4, 1/- each.......... per doz. 9/-
SIGNAL LAMP HOLDERS. Panel mounting, complete with Adjustable Lamp Holder 2/- each..........per doz. 21/-
FUSEHOLDERS. B/Lee L.356 single hole 2/6 each; B/Lee L.1033/C4 double pole 3/6 each. SPECIAL PRICES FOR BULK QUANTITIES.

A GIFT FOR THE SERVICE MAN. Brand new in wooden case. The Weston Model 772 Type 6 super sensitive analyser. This precision designed multi-range test instrument has a large visible finely divided scale giving some of the range shown.
Range: D.C. volts 20,000 ohms per volt or 1,000 per volt. 2.5 volt range 50,000 ohms. 10 volt range 200,000 ohms. 50 volt range 1 megohm, 250 volt range 5 megohms. 1,000 volt range 20 megohms.
Ohms: 0-3,000 ohms. 0-30,000 ohms. 0-3 meg. 0-30 meg. **D.C. milliamps:** 10, 50, 250 1 M/A 100 micro amps. or 50 micro amps.
A.C. Volts: 1,000 ohms per volt. Price £12/10/-. Post & Pkg. 7/6.

WEARITE COILS. PA4, PO4, PA5, PO5, 1/3 each ....per doz. 12/-
4-WAY PUSH-BUTTON UNITS 2/6 each. Knobs for same, 3d each.
POINTER KNOBS. Small black with white line, 7/6 per doz. Small white with black line 8/- per doz. Both types ¼in. spindle. Large price reductions for 1,000 lots and over.
VALVE HOLDERS. Moulded B9A 7/6; B7G 6/-; Int. Oct. 9/-; Eng. Oct. 4/6. Valve holders fitted with lower can 1/6 per doz. extra.
SCREENING CANS for B7G and B9A 6/- per doz.

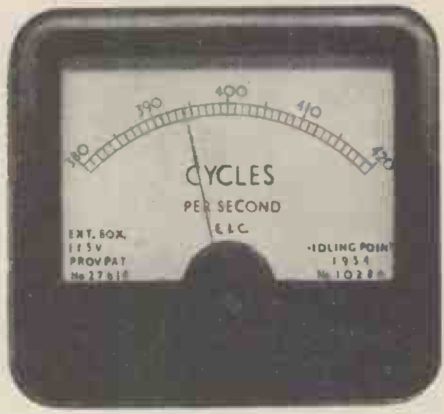
CO-AXIAL PLUGS, SOCKETS AND CONNECTORS, PYE TYPE. 10H/3911, 1/6 each; 10H/701, 1/6; 10H/628, 1/6; "Tee" con. 2/-; F. & E. Type: JS-1-PF 2/- each; JP-1-250 c.c.t. 2/-; JS-1-BHF 4/6; PL259 DE 4/6. LARGE QUANTITIES AVAILABLE. SPECIAL PRICES FOR 100 and 1,000 lots.

JONES PLUGS AND SOCKETS. 4 pin 2/6 pair; 6 pin 3/6 pair; 8 pin 4/6 per pair; 12 pin 6/6 per pair. If cover required send 1/6 extra per cover.
WANDER PLUGS. Red and black.......... doz. 2/-
PHILIPS TRIMMER TOOLS 1/- each .... doz. 10/6

CASH WITH ORDER OR C.O.D. ALL ORDERS DEPT. W.1
ALL ORDERS FOR LESS THAN £2 ADD POSTAGE
We invite your enquiries for items not listed.
Trade Counter open 9 to 6 Monday to Friday
Also 9 to 1 Saturday. Callers welcomed
WHOLESALE MANUFACTURERS' AND EXPORT ENQUIRIES INVITED

FREQUENCY METERS

SIZES: 2½" to 8"
UP TO 5000 CYCLES
PROMPT DELIVERY



also the new SYNCHROSCOPE and Phase SEQUENCE METER both up to 5Kc.
and full range of Switchboard Instruments
Ask for illustrated Catalogue

THE ELECTRICAL INSTRUMENT CO. (Hillington) LTD.
HILLINGTON GLASGOW
London stockists, H. A. Patterson & Ptnrs., Ltd., Oxford House, 23 West Wycombe Rd., High Wycombe.
Telephone: High Wycombe 2769

BLICKVAC

HIGH PRESSURE & VACUUM IMPREGNATORS

BLICKVAC Impregnators are used by Marconi, Pye, S. Smith & Sons, N.C.B., M.O.S., and many other well-known organisations. A full range of standard models is available—capacities 4in. by 9in. to 3ft. by 3ft.—suitable for Varnish, Wax, Potting Resins, etc. Plants can be designed for special requirements. Blickvac Impregnators are designed to give simplicity in control, outstanding performance and ease in cleaning. A second autoclave can be added at low cost when needed.

BLICKVAC products include:—Epoxy Resin Vacuum Mixing and Casting Plants, Electric Ovens, Vacuum Ovens, Mixing Vessels, Dipping Tanks, etc.

BLICKVAC ENGINEERING LTD.
Bede Trading Estate, Jarrow, Co. Durham. Jarrow 89/7155
96/100 Aldersgate Street, London, E.C.1. Monarch 6256/8

Wilkinsons

EST. 1921

ELECTRONIC BARGAINS BY MAIL

QUANTITIES AVAILABLE ● CALLERS WELCOME

HOME INTERCOM

★ ROOM TO ROOM

★ HOUSE TO WORKSHOP

SET No. 5 TELEPHONE HAND SET as illustrated with sound-powered earpiece and battery operated mouthpiece. Simply connect two instruments with twin flex and a 1½ volt battery in series. "Press to talk" button prevents waste of current whilst not in use. Two instruments with cords and plugs. 25/-. Post 2/6.

SET No. 7. Consisting of two P.O. type handsets as illustrated with press button in the handle for ringing bell at other end. The instruments are entirely sound-powered and are supplied with two bells and batteries with full instructions for installing. Simply connect with four wires. 75/-. Post 3/6.

10 AMP BATTERY CHARGER

HERE IS YOUR CHANCE TO PURCHASE A BRAND NEW UNIT WORTH £40! FOR OUR SPECIAL PRICE £17.10.0 Carriage 20/-. Input 200/250 v. A.C. 50 cy. Output 10 amps., 22 volts D.C. Controlled by two 4-position switches for fine and coarse control which enables 6 to 24 volt batts. to be charged. Brand new with 0/12 ammeter. Fused A.C./D.C.

BULGIN TEST-PRODS, red and black retracting points with replaceable fuses flex and spade terminals. 5/6, Post 6d.

BULKHEAD FITTING. 9in. diam., flat tripod type, suitable for lamps up to 100 watt, complete with pushbar switch lampholder. Ideal for farm buildings, garages, greenhouses, etc. Brand new. 17/6. Post 3/-.

LOUDSPEAKERS

Elac 5in. P.M. 3 ohms 9700 gauss. **Our Price 15/6.** Post 1/6.

Axiom 150 Mk. II Double Cone 12in. 15 watts, 15 ohms. Fully Dustproof. **Our Price £7/19/6.** Post 7/6.

Pye 10in. Portable 3 ohms Complete with flex and plug, 50/-. Carr. 7/6.

P.M. SPEAKERS. 10in., in portable case with flex and plug. 50/-. Carr. 5/-.

TANNOY LOUD HAILERS. In slope front wood case, with 180 ohm line transformer and condenser. Speech coil impedance 7.5 ohms. 19/6. Carriage 5/-.

VARIABLE VOLTAGE TRANSFORMERS

INPUT 230 volts and 115 volts A.C.
OUTPUT INFINITELY VARIABLE. 0-230 volts and 0-270 volts. 9 amperes.

Suitable for bench or panel mounting.
Our price £15 only. Carr. 12/6.
BRAND NEW IN MAKER'S CARTONS.

CATHODE RAY TUBES 2AP1. 25/-. Post 2/6.
CATHODE RAY TUBES 139A. 35/-. Post 3/-
CATHODE RAY TUBES 5BP1. 55/-. Post 3/6.
TRANSMITTER TUBE 212E. 70/-. Post 3/6.

MAINS MOTORS. Capacitor, 230 volts A.C. 1/40th h.p., 1,400 r.p.m., D.E.S. 55/-. Post 3/-.

GEARED MOTORS. 220/240 volts A.C., 175 r.p.m., torque 15lb. in. Klaxon, £10. Carr. 15/-.

SMALL MOTORS. 12 volts D.C., 3,000 r.p.m. with speed governor in end cap. Size 2 x 1⅞in. 12/6. Post 2/-.

RELAYS P.O. TYPE 3000

BUILT TO YOUR SPECIFICATION
QUICK DELIVERY, KEEN PRICES
CONTACTS UP TO 8 CHANGEOVER

KEY SWITCHES

PROMPT DELIVERY ALL TYPES UP TO 4co/6co

MINIATURE RELAYS

Siemens High Speed. Sealed.			
2.2Ω+ 2.2Ω	1 C O	H96A	15/6
500Ω+ 500Ω	1 C O	H96D	22/6
1700Ω+1700Ω	1 C O	H96E	25/-
S.T.C. Sealed			
700Ω	2 C O	4184GD	19/6
2500Ω	1 make HD	4186EE	22/6
2700Ω	2 C O	4184GE	21/6
G.E.C. Sealed.			
180Ω	2 make 2 break	M1087	19/6
670Ω	4 C O	M1092	21/6
2500Ω	1 C O	M1022	22/6
5000Ω	2 C O	M1052	25/-

Competitive range available from stock.

METERS GUARANTEED

F.S.D.	Size	Type	Price
50 Microamps	2½in.	MC/FR	70/-
100 Microamps	2½in.	MC/FR	50/-
500 Microamps	2in.	MC/FR	25/-
500 Microamps	2½in.	MC/FR	37/6
1 Milliamps	2in.	MC/FS	27/6
1 Milliamps	2½in.	MC/FR	35/-
5 Milliamps	2in.	MC/FR	17/6
30 Milliamps	2½in.	MC/FR	12/6
100 Milliamps	2½in.	MC/FR	12/6
200 Milliamps	2½in.	MC/FR	12/6
250 Milliamps	2½in.	MC/FR	12/6
500 Milliamps	3½in.	MI/FR	30/-
5 Amperes D.C.	2½in.	MI/FR	17/6
5 Amperes	2in.	MC/FS	27/6
15 Amperes	2in.	MC/FR	10/6
25 Amperes D.C.	2½in.	MI/FR	7/6
50-0-50 Amp.	2in.	MC/FS	12/6
30-0-30 Amp.	2in.	MC/FR	15/6
20 Volts	2in.	MC/FS	10/6
40 Volts	2in.	MC/FS	10/6

Postage 1/6 extra for above meters.

CROSS POINTER METERS. With 2 separate 100 microamp movements. Brand new. 22/-. Post 2/-.

VOLTMETERS. 0/300. Moving iron, A.C., 2½in. Flush Round. 25/-. Post 1/6.

MICROAMMETER. 250 F.S.D., 3½in. Flush Round, Sangamo Model S37. Scaled for valve voltmeter, circuit available free. 55/-. Post 1/6.

SOLENOIDS. 12 volt D.C., with 3½in. lever. Ideal for remote control, model railways, etc. 5/- each. Post 1/6. 26 in unit, £4/6/8.

ROTARY CONVERTERS

Input 12 volt D.C. Output 230 volts A.C., 50 cycles, 135 watts. In fitted case with variable resistance, 0/300 voltmeter, mains switch. The ideal job for television where A.C. mains are not available. £10. Carriage 15/-. Special Connectors 5/- pair.

GENERATORS ONLY 12 volt or 24 volt £8/10/-. Carr. 7/6.

HEADPHONES. Balance Armature Type DHR. 17/6 per pair. Post 1/6.

HEADPHONES. High resistance 4,000Ω type CHR, 12/6 pair. Post 1/6.

JACK PLUGS. Cylindrical bakelite screw-on cover. 2 contact. 2/6. Post 6d.

SOCKETS. One hole fixing for above. 3/6. Post 6d.

AVO TEST BRIDGES. 220/240 volt A.C. Measure capacities from 5 pf. to 50 mfd. and resistances from 5 ohms to 50 megohms. Valve voltmeter range 0.1 to 15 volts and condenser leakage test. BRAND NEW. Full working instructions supplied with instrument. £9/19/6. Post 3/-.

AIR BLOWER powered by a 230 volt A.C. motor, 15in. fan. Volume of free air at max. r.p.m. is 1,250 cu. ft. per min. At maximum efficiency 900 cu. ft. per min. Brand new, £25. Carr. 20/-.

FANS INDUSTRIAL TYPE 230/240 volt A.C. 16in. blades. In housing with adjustable louvres and filter. Brand new, £19/10/-. Carr. 20/-.

WHEATSTONE BRIDGE. 1 to 210 ohms in 1Ω steps with built-in galvo, 4 stud switches, in wood case with spare compartment. Ideal for extending range. 50/-. Post 3/6.

VENTAXIA EXTRACTION FANS. 230 volt A.C. 6in. blades. Ideal for ventilating kitchens, etc. Easy to fix. Silent running. 130/-. Post 3/-.

XPELAIR EXTRACTION FANS. 7½in. blades, with baffle outlet. 190/-. Carr. 5/-.

SWITCHES. 1 hole fixing, 3 amp. 250 volt. Single pole change over, 1/6 each. 12/- doz. £37/10/- per 1,000.

THERMOSTAT SATCHWELL 12in. stem 0/250 volt A.C./D.C. 15 amps A.C. 10 to 90 degrees Cent. 25/-. Post 2/6.

OSCILLOSCOPE. Type 43. With 3½in. CRT. 4-6J7, 3-VR54, 1-5Z4, 1-VU120. Brand new with power pack and leads. £10/10/-. Carr 12/6.

INSPECTION LAMP. Fits on forehead, leaving hands free, battery case clips on belt. 7/6. Post 1/6. Takes E.R. Battery No. 1215, 2/9. Post 9d.

MAINS TRANSFORMER with selenium rectifier fitted on top. From 200-250 v. A.C. mains, 30-40 v. DC, can be obtained at 1 amp. 27/6. Post 2/6.

ELECTRO-MAGNETIC COUNTERS

COUNTING UP TO 9999

Type 16A	Type 17A
2300 ohms 75/230 v. D.C.	3 ohms 2/6 v. D.C.
15/- each. Post 1/6.	15/- each. Post 1/6.

VARIABLE RESISTANCE 140Ω 2.4 amps. in ventilated case, 10 x 7in., stud type. 35/-. Carr. 7/6.

APQ9 H.F. UNIT. Brand new, contains many valuable components (less photo-multiplier). 90/-. Carr. 7/6.

RACKS—POST OFFICE STANDARD. 6ft. high with U-channel sides drilled for 19in. panels, heavy angle base, 4ft. 10in. in stock.

TERMINAL BLOCKS. 2-way fully protected. No. 5C/430. 4/- doz. or box of 50 for 15/-, 3-way 6/- doz., 50 for 22/6, post 1/6.

NIFE BATTERY. Nickel cadmium. 6 volts 75 amp. crated and connected. Alkaline filled. Brand new. £7/10/-. Carr. 15/-

L. WILKINSON (CROYDON) LTD.

19 LANSDOWNE RD. CROYDON SURREY

Phone: CRO 0839 Grams: WILCO CROYDON

SAMSON'S SURPLUS STORES LTD.

LONDON'S GREATEST DEALERS IN RADIO AND ELECTRONIC EQUIPMENT

VARIAC TRANSFORMERS. Input 115 v. Output 0-130 v. 5 amp. continuous 7.5A max. Ex equipment but in perfect condition. **69/6.** Carr. 5/-.

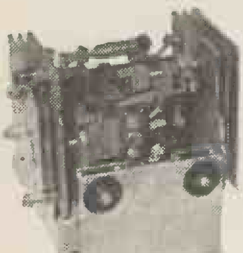
HEAVY DUTY L.T. TRANSFORMERS. Brand new STC Pri. 200–260 v. Sec. 26-41 volts in one volt steps 15 amp., tropically rated and one HT winding tapped **120–136–152–168** volts 700 m/a. **£4/5/-.** Carr. 7/6. Pri. 220–240 volts. Sec. tapped 42 v., 45 v., 50 amps., tropically rated. **£9/15/-.** Carr. 10/-. RCA Pri. 115–230 v. Sec. 5 v. 13 amps., tropically rated, insulated for 15 kV. Brand new. **37/6.** Carr. 7/6. Pri. 230 v. Sec. tapped 4 v., 6 v., 11 v. 200 amps. **£8/10/-.** Carr. 7/6. Pri. 200–250 v. Sec. 50 v. 30 amps. **£6/10/-.** Carr. 10/-. Pri. 200–250 v. Sec. 50 v. 20 amps. **£4/10/-.** Carr. 7/6. Pri. 200–250 v. Sec. tapped 28, 29, 30, 31 volts 21 amps. **£4/10/-.** Carr. 7/6. Pri. 100–260 v. Sec. two separate windings. Tapped 15, 16, 17 v. 4 amps., tropically rated. **35/-.** Carr. 4/-. Pri. 200–250 v. Sec. two separate windings 50 v. 2 amps. 6 v. 2 amps. **27/6.** Carr. 3/6. Pri. 200–250 v. Sec. 45 v. 2 amps. **17/6.** Carr. 3/6. Pri. 200–250 v. Sec. 6 v. 8.5 amps., tropically rated. **17/6.** P.P. 3/-. Pri. 200–250 v. Sec. 6.3 v. 15 amps. **25/-.** P.P. 25/-.

VENNER HEAVY DUTY TIME SWITCHES. A.C 200–250 v. Switch contacts. 200 amps. Two available only. **£8/10/-** ea. Carr. 10/-.

HEAVY DUTY A.C. 200/250 v. ALARM BELLS. Twin gong. Brand new, 35/-. Carr. 5/-.

RF UNITS No. 25B. Complete with valves, supplied brand new. **12/6.** Carr. 3/6.

CARBON PILE VOLTAGE REGULATORS. LILIPUT MINOR MK. II.



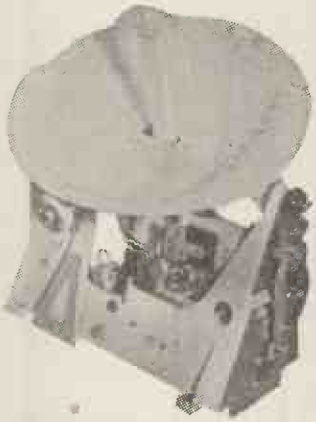
Load 3/0.73 amps 11 v. Supply voltage 19/25 v. With spare pile. Brand new. **12/6.** P.P. 3/6.

SPECIAL OFFER. H.D. TWO CIRCUIT TYPE AUTO WOUND TRANSFORMERS A.M. TYPE No. 2773. Input 225–230 v. with switch in run position. Output 225, 230, 235, 240, 245, 250, 255, 260, 270 volts, 75 amps. With either switch in start position. Output No. 1 or 2. 270 v., 290 v., 310 v., 100 amps. 1 minute in two hours. Other outputs as in run position but at 50 amps. The transformers are built in heavy metal cabinets approx. weight 3¼ cwt. with sloping desk front on which the start/run switches and 2 0–100 M.I. ammeters are mounted. With an alteration of the exterior wiring 100 volts at 35 amps can be obtained. **£25** ex warehouse.

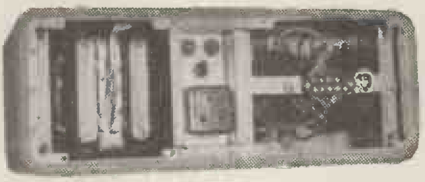
MIRROR GALVANOMETER MARK II. On levelling and rotating base, with fitted spirit level. Manufactured by Venner Time Switch, Ltd. 45-second period. Instrument resistance 188 ohms. External resistance for aperiodic damping 1,200 ohms. Supplied brand new with spare suspension helix and strip wire. In teak carrying cases. **79/6.** Carr. 5/-.

METRO-VICKERS 0-20 MASTER VOLTMETER. A.C. 50 cy. M.I. 6in. round mirrored scale. **15/-.** P.P. 2/6. Brand new in maker's carton.

We now have London's largest and most comprehensive walk-round dept. This enables you to see our enormous stocks of electronic and radio equipment too numerous to advertise. We invite you to browse without any obligation. Open all day Saturday. Official monthly account orders accepted.



AMERICAN NAVY SCANNERS TYPE APS4. Freq. 3 centimetres, operate on 12–24 volts. Contain geared motors, relay switch equipment, heavy gear trains, etc. Supplied new in original packing cases at a fraction of maker's price. **£3/19/6.** Carr. 10/-.



L.T. SUPPLY UNIT No. 19 YA 8087. A.C. input 100–250 v. D.C. output tapped 12/24 volts, continuous tropical rating, 3 amps. Built in metal case 17 x 7 x 6½in., with fuses and switch. An ideal L.T. supply unit for operating relays, contactors, battery charging, etc. In perfect condition. **£3/17/6.** Carr. 7/6.

SMOOTHING UNIT No. 2 FOR ABOVE. Containing two L.T. chokes, one 2½in. M.C. D.C. 0–50 voltmeter and 6-way terminal block built in metal case. Size 17 x 7 x 6½in. **35/-.** Carr. 7/6.

PORTABLE SUPPLY UNIT TYPE. To operate from A.C. 100–250 v. or 12 volt accumulator. Ouptut 250 v. 25 m/a. 125 v. stabilised and 12 v. heater supply. An ideal power pack for oscillators or small transmitter. Built in bakelite case with spare vibrator, stabilising valve, leads and circuit. **47/6.** Carr. 5/-. Brand new.

A.M. L.T. SUPPLY UNIT TYPE 115. A.C. input 200-250 v. D.C. output 24 v. 26 a. Rating continuous. Ideal for charging 24 v. batteries at a high current. Size 1ft. 8in. x 1ft. 7in. x 1ft. 5in. **£15** ex warehouse.

TELEPHONE CABLE. Single D3. 1/3rd mile drums **19/6.** Carr. 4/6. Commando telephone cable, PVC, 1,000-yard drums. Ideal field tele. cable and very useful in the home and garden. Cheaper than string. 8/11. P.P. 3/6. Five drums in maker's carton **42/6.** Carr. 7/6.

HEAVY DUTY SLIDING RESISTORS. 11Ω 4.5A **12/6.** 3Ω 10A **12/6.** 1.2Ω 15A **10/6.** 1Ω 12A **8/6.** All single tube slider control. 12Ω 4A horizontal sweep control **12/6.** 26Ω 6A double tube slider control **45/-.** 1.25Ω 20A double tube slider control **27/6.** 0.4Ω 25A geared drive **17/6.** 79Ω 2.9–0.65A double tube geared drive **32/6.** 76Ω 6-0.5A slider control **22/6.** Carr. on all resistors 3/-. We have one of the largest stocks of sliding resistors in the country. Let us know your requirements.

BRAND NEW AMERICAN VARIAC TRANSFORMERS. Input **230** v. Ouput 0–260 v. 9 amps. Complete with control handle. Supplied in maker's sealed cartons. Limited number only **£15.** Carr. 10/-.

ADMIRALTY THREE-PHASE TRANSFORMERS. Pri. 400–440 v. 50 cycles. Sec. 50 v. 6 amp. Completely tropicalised. Size 7½ x 14 x 5in. Weight approx. 60lb. **85/-.** Carr. 7/6. Brand new in maker's cases.

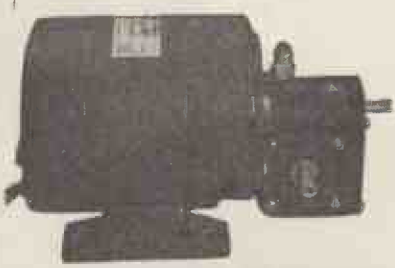
STC RECTIFIER SUPPLY UNIT No. 11. A.C. input 100–250 volts, 45-65 cycles. D.C. output 24 volts 11 amps and 130 volts 600 M/A. Very conservatively rated. L.T. and H.T. completely smoothed. All circuits fused. Mains on/off switch. Built in grey metal cabinet, height 5ft., width 1ft. 7½in., depth 1ft. 1¼in., weight 200lb. An ideal L.T. supply unit for the electronic industry, research laboratories and schools, etc. Supplied new with instruction manual. **£17/10/-** ex warehouse.

ADMIRALTY VOLTAGE CONTROLLERS

1,000 ohm. 0.59/0.16 amps. Rotary switch type with 32 contacts. Completely enclosed with metal control handle. New in maker's carton at a fraction of manufacturer's price. **10/6.** P.P. 3/6.

ROLLS-ROYCE COOLANT PUMPS. A heavy-duty turbine pump driven directly from a splined socket, 1,000–1,500 g.p.h. 1¼in. bore outlet. Brand new in maker's cartons. **47/6.** Carr. 4/-.

SPECIAL OFFER OF BA SCREWS, STEEL. 4 BA ⅞in. C.S., 15 gross **27/6.** P.P. 3/-. Or **2/6** per gross. Post free. 4 BA ⅜in. steel C.S., 20 gross cartons **32/6.** P.P. 3/-. Or **2/6** per gross. Post free. 2 BA brass 1in. C.S., 5 gross cartons **15/-.** P.P. 2/-. 4 BA steel R.H., 1¼in., 5 gross cartons **15/-.** P.P. 2/-. **NUTS, BOLTS, WASHERS.** Special bargain offer. **5/-** carton of 2, 4, 6 nuts, bolts and washers.



CROYDON ENG. CO. GEARED CAPACITOR INDUCTION MOTORS. A.C. 200-240 volts 30 watts, geared right angle, 300 r.p.m., motor shaft 1,400 r.p.m. continuous rating, complete with capacitor. Overall size 7½ x 4½ x 4in. **£3/15/-.**

169-171 EDGWARE RD., LONDON, W.2. Telephone PAD 7851, AMB 5125

Gilson Transformers for Industrial Equipment

Comply with the requirements of standard specifications such as RCS214, BSS171, etc., as required. In addition they all possess the built-in extra reliability that comes only from years of experience combined with the constant effort to maintain a high reputation.

GILSON

U.L. OUTPUT TRANSFORMERS

bring the same high standards to the high fidelity enthusiast.

8KΩA-A 40% taps 3, 8, 15 ohms sec.	6-6KΩA-A 40% taps 4 sec sections
WO 892	**WO 866**
15 Watt	**30 to 50 Watt**

Please write for information leaflets on the above.

R. F. GILSON LTD. Phone: WIM 5695

11a ST. GEORGE'S RD., WIMBLEDON, S.W.19

Makers of HEAVY DUTY MAINS, NEON and FLUORESCENT LIGHTING TRANSFORMERS

Wireless Fundamentals

By E. ARMITAGE, M.A. (Cantab.), B.Sc. (Lond.). This important book develops the theory of radio from the fundamentals to an explanation of the superheterodyne principle. The physical and experimental side is kept to the fore throughout the book, while purely mathematical treatment of the more theoretical parts of the subject is provided in the Appendixes. Over 300 illustrations. 20/-.

PITMAN TECHNICAL BOOK

Parker St., Kingsway, London, W.C.2

THERMOSTATIC SOLDERING IRON

CECO — 70 watt

Instrument size

HEATS UP QUICKLY—1¼ mins.—STAYS HOT—but NEVER OVERHEATS—BIT DOES NOT CORRODE OR NEED CLEANING

WEIGHT—4¼ ozs. (Excluding Flex)

ALL PARTS INTERCHANGEABLE

The Thermostat is easily adjusted to suit the grade of solder and keeps the temperature to within 15°C. It incorporates a micro-switch giving snap action on-off with minimum electrical interference. Eliminates dry joints and damage to insulation. Element and bit last much longer.

LIST PRICE 85/- each

BRITISH PATENT No. 663214

Available from Manufacturer—

CARDROSS ENGINEERING CO. LTD.

LEVENFORD WORKS DUMBARTON

Phone: Dumbarton 655

SOUTHERN RADIO'S SPECIAL BARGAINS

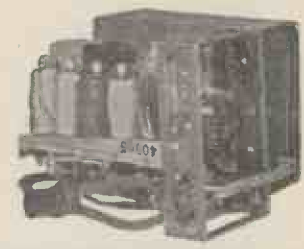
TRANSPARENT MAP CASES. Plastic 14in. x 10¾in. Ideal for Maps, Display, etc., 5/6.
STAR IDENTIFIERS. Type I A-N Covers both Hemispheres, 5/6.
CONTACTOR TIME SWITCHES. 2 impulses per sec., in case, 11/6.
REMOTE CONTACTOR. For use with above, 7/6.
MORSE TAPPERS. Midget type, 2/9; Standard, 3/6; Heavy type on base, 5/6. ALL BRAND NEW.
MORSE PRACTICE SET. TAPPER with BUZZER on base. Complete with battery, 12/6. BRAND NEW.
MAGNETS. Strong Bar type, 2 x ⅛in., 1/6 each.
PACKARD-BELL AMPLIFIERS. Complete. BRAND NEW, with valves, relay, etc., etc., 17/6 each.
SPECIAL OFFER. 12 ASSORTED METERS. Slightly damaged. Mainly broken cases (perfect movements). Including 3 BRAND NEW Aircraft Instruments. 12 for 45/-.

SPECIAL OFFER

TRANSMITTER - RECEIVER

TYPE 38 MK II

★ WALKIE-TALKIE ★



Complete in Metal Carrying Case. 9in. x 6⅝in. x 4in. Weight 6lb. Frequency 7.3 to 9 Mc/s. Five valves. £1/2/6. Post paid.

These TX-Rs are in NEW CONDITION, but owing to demand they are not tested by us and carry no guarantee, but should prove SERVICEABLE.

ATTACHMENTS for Type "38" Transreceivers. ALL BRAND NEW. Headphones 15/6; Throat Microphones 4/6; Junction Boxes 2/6; Aerials, No. 1 2/6; No. 2 5/-; Webbing 4/-; Haversacks 5/-; Valves—A.R.P.12 4/6; A.T.P.4 3/6; Set of FIVE VALVES 19/- the set.

OFFER No. 2:
"38," as above, complete with set of external attachments, 42/6, post paid.

OFFER No. 3:
Transmitter-Receiver "38" Mk. II. Brand new with complete set of external attachments including Webbing Haversacks and Valves, 57/6 post paid. Fully guaranteed.

RESISTANCES. 100 assorted useful values. New wire end 12/6. NEW.
CONDENSERS. 100 assorted Mica; Tubular, etc., 15/-. NEW.
LUFBRA HOLE CUTTERS. Adjustable ¾in. to 3¼in. For Metal, Plastics, etc., 7/-.
QUARTZ CRYSTALS. Types F.T.241 and F.T.243. 2-pin, ½in. spacing. Frequencies between 5,675 kc/s and 8,650 kc/s. (F.T.243), 20 Mc/s and 38.8 Mc/s (F.T.241, 54th Harmonic) 4/- each. ALL BRAND NEW, TWELVE ASSORTED CRYSTALS, 45/-. Holders for both types 1/- each. Customers ordering 12 crystals can be supplied with lists of frequencies available for their choice.
TRANSRECEIVERS. Type "18" Mark III Two Units (Receiver and Sender). Six valves, Micro-ammeter, etc., in Metal Case, untested, without guarantee but COMPLETE, £2/18/6.
ATTACHMENTS for "18" Transreceivers. ALL BRAND NEW. Headphones 15/6; Hand Microphone 12/6; Aerials 5/-; Set of 6 Valves 30/-.
T1154 TRANSMITTERS. Complete in transit case. New condition, £2/5/-.
RECORDING BLANKS. Brand new. "Emidisc." Ready for cutting. 13in. 6/- each or 15 complete in metal case £4.

Post or carr. extra. Full list Radio Books, etc., 3d.

SOUTHERN RADIO SUPPLY, LTD.

11, LITTLE NEWPORT STREET, LONDON, W.C.2 GERrard 6653

Visit the City's new acoustically designed

HI-FI Centre

COME AND HEAR THE LEADING MAKES IN AMPLIFIERS, TUNERS AND SPEAKER SYSTEMS

AMPLIFIERS BY:		V.H.F. TUNERS BY:		HI-FI SPEAKERS BY:	
VERDIK	GOODSELL	ARMSTRONG	T.S.L.	GOODMAN	W.B.
ARMSTRONG	QUAD	LEAK	DULCI	PLESSEY	T.S.L.
ROGERS	LEAK	QUAD	GOODSELL	WHARFEDALE	G.E.C.
DULCI	W.B., etc.	ROGERS, etc.		LORENZ, etc.	

A FEW LEFT ONLY

The Famous COLLARO Mk. 3 Transcriptor Tape Deck. Twin track, 2 record/playback, 2 erase heads on 2 levels, pause control, digital counter, 3 speeds, 2 balanced motors of low wattage input. 15 gns.

WHILE STOCKS LAST. Crating and carr. 17/6.

Build yourself a HI-FI TAPE RECORDER. The Collaro pre-amp and bias oscillator complete with power pack for the above deck, with instructions. Price £15/19/6. Post and pkg. 7/6.

The above two items at a special price of £29/17/6. Carr. and pkg. 22/6 the two units.

BUILD YOURSELF A HI-FI TAPE RECORDER

The Collaro Mk. 3 Tape Deck as above. A completely assembled tape deck amplifier with power pack and oscillator incorporated negative feedback adjustment, switched for 3¾, 7½ and 15in. per sec., and an 8in. P.M. speaker. The three items for only £29/5/-. Crating and carriage 22/6.

ANOTHER SNIP OFFER

Acos 39/1 crystal pencil mic. List price 5 gns., our price **37/6** Post and packing 1/6.

SPECIAL OFFER

HI FIDELITY TAPE HEADS

Made by famous manufacturer. Brand new.

Upper or lower track, record/playback, high impedance giving up to 12,000 CPS at 7½ I.P.S., output 5 m/volts at 1 KC at 7½ I.P.S. Erase heads low impedance.

Only **39/6** per pair. Post 1/-.

State upper or lower track.

LIMITED NUMBER AT THIS PRICE

for the Hi-Fi enthusiast. Collaro 4-speed transcription motor and p/up using the new T x 88 studio cartridge. Brand new. List price £19/10/-, our price £15/19/6. Crating and carr. 12/6. Easily wired for stereo and use Ronette stereo T/O cart.

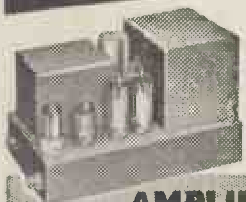
HURRY! NOW COMING TO THE END OF THIS WONDERFUL OFFER DUE TO CANCELLED EXPORT ORDER

ORIGINAL MANUFACTURER'S PRICE 20 GNS.

LIMITED NUMBER ONLY AT

£14.19.6

Complete
Post & pkg. 7/6.
Fully guaranteed



AMPLIFIER AND PRE-AMPLIFIER

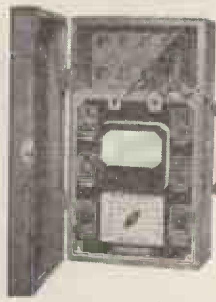
Beautifully finished in Grey-Green Stove Enamel. Provision for tuner, bass and treble, 5-position selector for radio, mic., tape, LP and std. records.

A RECOMMENDED REPLACEMENT GRAM OR RADIO CHASSIS

Due to the popularity of this chassis, we have been able to reduce production costs and can now offer our 1958 AM/FM R/G Chassis at 19 gns. complete.

Eight-valve AM/FM chassis with printed circuit FM tuner section. Illuminated dial: 4 waveband; coverage 1,000-2,000 metres, 200-550 metres, 15-50 metres, 88-100 Mc/s. Dimensions 13 x 9 x 6in.; fully guaranteed. Exceptional value—only 19 gns., plus 7/6 post and insurance.

A GIFT FOR THE SERVICE MAN

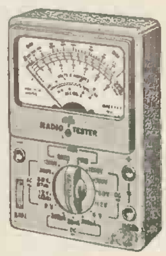


BRAND NEW IN WOODEN CASE

The Weston Model 772 Type 6 super sensitive analyser. This precision designed multi-range test instrument has a large visible finely divided scale giving some of the range shown. *Range:* D.C. volts 20,000 ohms per volt or 1,000 per volt. 2.5 volt range 50,000 ohms. 10 volt range 200,000 ohms. 50 volt range 1 megohm. 250 volt range 5 megohms. 1,000 volt range 20 megohms. *Ohms:* 0-3,000 ohms. 0-30,000 ohms. 0-3 meg. 0-30 meg. *D.C. milliamps:* 10, 50, 250 IM/A or 50 microamps. *A.C. volts:* 1,000 ohms per volt. ONLY £12/10/- plus cost and pkg. 7/6.

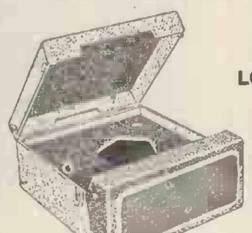
THE ALFA MULTI-RANGE POCKET METER

IDEAL FOR ROVING SERVICE MAN.



Resistance ranges: 0-20K ohms. 0-2 Meg ohms.
Voltage ranges: 0–6 v. D.C., 0–12 v. D.C., 0–60 v. D.C., 0–300 v. D.C., 0–1,200 v. D.C., 0–6 v. A.C., 0–12 v. A.C. (23 DB), 0–60 v. A.C. (37 DB), 0–300 v. A.C., 0-1,200 v A.C.
Current ranges: 0–300 V.A.-D.C., 0–30 MA.-D.C., 0–300 MA.-D.C., complete with test leads £6/19/6 and batts Post and packing 3/6.

ANOTHER SNIP OFFER



AT THE LOW PRICE

37/6

and 4/- post and packing.

Surplus to manufacturers requirements, well made 2-tone colour portable player cabinets, will take non-auto player. Amplifier and 4in. or 5in. speaker.

Electronics (FLEET ST.) Ltd

DEPT. B,
152/3 FLEET ST., LONDON, E.C.4.
Telephone : FLE 2833
Business hours : weekdays 9-6 Saturdays 9-1.

POST OFFICE LINE EQUIPMENT

TELEPRINTERS: Perforators, Reperforators, Auto Transmitters 5-unit system. New Condition.
POWER SUPPLY RECTIFIERS: For Telegraph systems.
FILTERS: Filters Band-Pass, cut-off frequencies from 300 cps. to 112 kc/s.
SPARES AND ACCESSORIES OF ALL TYPES FOR LINE EQUIPMENT: Attenuators, Line EqualizerUnits. Recording Bridges, Telegraph Relays, Spark Gap Protectors, Coils Inductance, Repeating, Retardation.
SWITCHBOARDS: P.O. Mobile type AD-1240 (3-6-9), Universal Call 10-line, Magneto 10-line.
FIELD TELEPHONES: Types EE-8, D, F and L.
CARRIER TERMINALS AND REPEATERS: 1+1. 1+4, Speech & Duplex, Apparatus 2/4 Tone No. 5. Diversity Combining Units and spares of all types.

LOW POWER RADIO STATIONS
(Ground use)

COLLINS 18Q SERIES 1½ to 12 Mc/s. RF output 25 watts. Power units for 12 v., 24 v., 115 v. D.C. and 115 v. and 230 v. A.C. Spare Antennae Coils.
WIRELESS SET No. 19: 2-8 Mc/s and 235 Mc/s, all ancillary equipment and R.F. Amplifiers No. 2, Mk. 2.
WIRELESS SET No. 31: Manpack Walkie-Talkie 40-48 Mc/s.
WIRELESS SET No. 62: Lightweight Communication Set 1½-10 Mc/s.
WIRELESS SET No. 88: Manpack or Truck Walkie-Talkie 40/42 Mc/s, 4 Channel.
SCR-193 40-75 watt output Radio Station HF.

LOW POWER RADIO STATIONS—
(Airborne use)

SCR-522 4-Channel 100/156 Mc/s. complete with all operating and test equipment.
REBECCA DISTANCE MEASURING EQUIPMENT Mk. VIII.
STR9X type 100-124 Mc/s. 118-135 Mc/s., 124-156 Mc/s.
RADIO COMPASS SCR-269G. All ancillaries and spares stocked in large quantities.
COMPONENTS: Capacitors, variable and fixed up to 2 mfd. at 10,000 volts. Transformers, Heavy Duty, Rectifier various, Carbon Brushes, Magslip Hunters, Ball-races, Potentiometers Test Meters.
TRANSMITTERS Rediton Type G12T—Output 2 kilowatts C.W. 500 watts phone Frequency coverage 100 Kc/s to 1,200 Kc/s in 4 bands. Operates from 230 volts 50 cycles supply. V.F.O. and crystal control with switch selection of 6 Spot Frequencies. Air Ministry Type T1509—Output 300 watts A1, A2 and A3, Frequency coverage 1,500 Kc/s to 20,000 Kc/s. Operates from 230 volts, 50 cycles supply.

R. GILFILLAN & CO. LTD.
National Provincial Bank Chambers
29 South Street, Worthing, Sussex.
Tel.: Worthing 8719 and 30181.
Cables : "GIL WORTHING" **Codes : "BENTLEY'S 2nd"**

EDDY'S (NOTTM) LTD

DEPT. W.W.

172 ALFRETON ROAD, NOTTINGHAM

GUITAR PICK-UP "THE PLECTRO." Super Hi-Fi non-acoustical universal fitting. 3 x 1¼ x ¼in. High output. Complete with lead and plug. Full instructions. **39/11.** Post 1/-.

NEON MAINS TESTER/SCREWDRIVERS. 4/6 each. Post 6d.

RECTIFIERS. Contact cooled miniature 250 v. 60 m/a., 9/6. Post 1/-.

ROTARY CONVERTER for electric trains etc. Converts 200 v. D.C. to 12 v. D.C. **19/11.** Post 2/-.

ACOS CRYSTAL PICK-UPS. Turnover 2 sapphire styli. **29/11.** Post 2/6.

GERMANIUM DIODES. 1/- each, 10/- doz. Post 4d.

JACK PLUGS. Standard type, **1/11.** Post 6d.

TRANSISTORS. Yellow/green spot, **6/11.** R.F. Yellow/red, 13/11. Post 4d.

ACOS CRYSTAL MIKE INSERTS. 4/11 each. High quality. Can be used for tape recorders, baby alarms, etc. Post 6d.

TUBULAR WIRE END CONDENSERS (not ex Govt.). 8 mfd. 450 v. 1/9; 8-8 mfd. 450 v. 2/6; 16 mfd., 450 v. 2/9; 16-16 mfd. 450 v. 3/9; 32 mfd. 450 v. 3/9; 32-32 mfd. 350 v. 4/-; 16-8 mfd. 450 v. 3/11. Post 9d.

ELECTROLYTIC CONDENSERS. Metal can 50-50 mfd. 400 v. **5/6.** Post 1/-.

25 x 25 mfd. MIDGET CONDENSERS. Size 1in. 1/3. Post 4d.

NIFE ACCUMULATORS. Midget single unit. Size 3×2¾×⅞in. 1/11. Post 1/6.

MORSE TAPPERS. Plated Contacts. Adjustable caps. Heavy duty. 3/6. Post 9d.

RECTIFIERS. RM1 4/9, RM2 5/6, RM3 7/6, RM4 15/6, RM5 19/6. Post 1/-.

ALL ABOVE ARE NEW and GUARANTEED

NEW AND SURPLUS GUARANTEED VALVES

1A7GT	14/6	7C5	8/–	ECC83	8/–
1C5GT	12/–	7C6	7/9	ECC84	9/6
1H5GT	10/6	7H7	8/–	ECC85	9/–
1R5	7/6	7S7	9/6	ECF80	12/6
1S5	7/–	7Y4	7/11	ECH42	9/–
1T4	5/6	10F1	9/6	EF36	2/6
3Q5GT	9/–	10F9	10/6	EF37	5/–
5U4G	6/6	12AT6	9/6	EF40	14/–
5Z4G	9/–	12AT7	6/–	EV41	9/–
6A7	12/6	12AX7	8/6	EF42	11/–
6AG5	5/–	12AH7	7/6	EF50	2/6
6AM6	5/–	12K7	7/6	EF50(R)	3/6
6B8G	2/11	12Q7	7/6	EF80	7/–
6BJ6	7/6	20P1	14/–	EF85	7/–
6C4	4/6	25A6G	8/–	EF86	14/–
6C6	4/6	25L6GT	9/6	EF91	5/–
6CH6	10/6	25Z4G	8/6	EL41	9/6
6D6	5/–	35A5	10/6	EL42	11/6
6F1	9/6	35L6GT	9/6	EL84	9/–
6F6M	7/6	35W4	7/11	EL85	11/6
6F13	9/6	42	7/6	EY86	13/–
6F15	11/–	80	6/6	EZ80	8/6
6F33	6/6	807(B)	3/9	EZ81	9/–
6H6M	7/6	807(USA)	5/6	GT1C	15/–
6J5G	2/11	954	1/6	KT36	11/–
6J5GT	3/11	955	3/11	L63	3/–
6J5M	4/6	956	2/11	MU14	8/11
6K7G	2/6	AZ1	12/6	PCC84	8/6
6K8G	6/11	AZ31	9/–	PCF80	9/–
6L6G	6/11	B36	11/–	PCL82	12/–
6P28	11/–	CY31	12/11	PL33	11/–
65A7M	7/–	DAF96	8/6	PL82	6/6
6SG7M	7/–	DF96	8/6	PL83	10/6
6SH7M	5/–	DK96	8/6	PY31	8/6
6SJ7M	7/–	DL96	8/6	PY81	8/6
6SK7GT	7/–	DM70	7/6	PZ30	12/–
6SL7GT	7/–	EB34	1/6	U35	9/6
6SN7GT	4/11	EB91	4/6	UCH42	9/–
6V6G	5/11	EBC41	9/–	VR/150/30	7/6
6V6GT	6/6	EBF80	9/–	Z66	9/6
6X5GT	6/6	ECC81	8/–	Z77	6/6
7B7	8/–				

ALL TESTED BEFORE DESPATCH.

Any parcel insured against damage in transit, for only 6d. extra per order. All uninsured parcels at customers risk. C.O.D. or C.W.O. only. Postage and packing 6d. per valve extra. Over £3 free. S.A.E. with enquiries. Trade enquiries invited.

NEW G.E.C., S.T.C. AND "WESTALITE" SELENIUM RECTIFIERS. Largest L.T. range in Gt. Britain. **ONLY Makers' LATEST GOODS supplied NOT Surplus.** **S.T. & C.** E.H.T. K3/15, 5/-; K3/45, 9/4; K3/50, 9/10; K3/100, 16/8; all post 4d. extra.

BRIDGE CONNECTED FULLWAVE. 17 v. 1 a., 13/4; 1.5 a. 26/6; 3 a., 30/6; 4 a., 38/-; 5 a., 38/6, all post 6d. 33 v. 1 a., 22/9; 1.5 a., 45/-; 3 a. 54/-; 5 a., 68/-; all post 1/6. 54 v. 1 a., 33/-; 1.5 a. 62/-; 2 a. 74/-; 3 a. 74/-; 5 a. 97/-; 72 v. 1 a. 42/-; 1.5 a. 78/-; 2 a. 95/-; 3 a. 95/-; 5 a. 124/-; 100 v. 1 a. 61/-; 1.5 a. 112/-; 2 a. 134/-; 3 a. 134/-; 5 a. 180/-; all post 2/-.

BRIDGE CONNECTED WITH 7⅜in. SQUARE COOLING FINS 17 v. 6 a. 53/7; 10 a. 61/-; post 2/6.

BRIDGE CONNECTED HEAVY DUTY FUNNEL COOLED or 7⅜in. SQUARE COOLING FINS. Both types, same price. 17 v. 20 a. 120/-; 30 a. 172/-; 50 a. 280/-; 33 v. 6 a. 89/-; 10 a. 102/-; 20 a. 202/6; 54 v. 6 a. 124/-; 10 a. 144/-; 72 v. 6 a. 160/-; 10 a. 186/-; 100 v. 6 a. 227/6; 10 a. 270/-; all post 3/-.

"WESTALITE" (BRIDGE) 12-15 v. D.C. 0.6 a. 12/-; 1.2 a. 30/-; 2 a. 32/6; 5 a. 37/6; 10 a. 64/6; 20 a. 117/6; 30 a. 171/-; 50 a. 278/-; 24 v. 1.2 a. 30/-; 5 a. 60/-; 10 a. 109/6; 20 a. 208/-; 36 v. 1.2 a. 47/6; 5 a. 82/6; 10 a. 154/6; 100 v. 1.2 a. 82/6; 2.5 a. 154/6; 5 a. 195/6; 10 a. 391/-; 170 v. 1.25 a. 135/-; 195 v. 1.25 a. 144/6. All post extra 1/6-3/6 E.H.T. Rects. 14D.134, 25/-; 36 E.H.T. 60 35/10; post 4d. 1 ma. AC/DC meter rects. 14/6.

"SALFORD" (BRIDGE). 6 and 12 v. D.C. 1 a. 7/6; 1.5-2 a. 8/6; 2.5 a. 11/9; 3 a. 14/9; 4-5 a. 16/6; 6 a. 23/6; 10 a. 34/-; 14 a. 42/-; 24 v. 1 a. 12/6; 1.5 a. 14/3; 2 a. 15/6; 3 a. 26/-; 4 a. 29/6; 6 a. 36/6; 10 a. 75/-; other sizes. Post, under £1 add 1/-, over £1 add 1/6.

Some Transformers now stocked.
Wholesale and Retail.

T. W. PEARCE
66 Great Percy Street, London, W.C.1
Off Pentonville Road. Between King's Cross and Angel

TRANSISTOR POCKET RADIO By well - known manufacturer. Blue or Red plastic case. 5¾×3¼×1¼in. Weight 12 oz. Printed circuit with 6 Transistors and tested components. You will be pleased to own this fine commercial set. **£10/10/-.** P.P.

FAMOUS MAKE LIGHTWEIGHT PENCIL BIT SOLDERING IRON, 220/240 v. 25 w. Indicator light in handle (list price 24/6). Price **17/6.** P.P.

SCOOTER BATTERIES. 6 v. 10 A.H. Hard rubber case. Size 5×5×1¾in. Weight 3 lb. **15/-.** P.P. Also ideal for model use.

NEW AND BOXED COLLARO CONQUEST 4-SPEED RECORD AUTO CHANGERS. 200/250 v. A.C. **£6/19/6.** Carriage 5/-.

OUR FAMOUS TRANSFORMERS. Input 200/250. Output tapped 3 to 30 v. 2 a. and tapped 5, 11, 17 v. 5 a. each. **24/6.** P.P.

F.W. METAL RECTIFIERS. 1 a., **7/6;** 3 a., **13/-;** 4 a., **17/6;** 6 a., **27/6.** P.P.

All items new and guaranteed.

UNISELECTOR SWITCHES. 50P, 3B, 50 v. D.C. 25/-.

RELAYS. We hold large stocks. Any contact combination and operating coil voltage supplied from 3/-.

LISTS SENT ON REQUEST.

Post orders only to

THE RADIO & ELECTRICAL MART
27 PRINCES COURT, WEMBLEY, MIDDX

THIS MONTH'S OFFERS

TEST GEAR. British and American test gear, rebuilt, laboratory tested and guaranteed.

SIGNAL GENERATOR "X" Band Type TS.13/A.P. Frequency Range 8400/9600 Mc/s. incorporating resonant cavity wavemeter piston attenuator and thermistor bridge, mains operated.

BEAT FREQUENCY OSCILLATOR. Type TF.195L/4 by Marconi Instruments; frequency range 10 c/s. to 150 Kc/s., low level input, 1 micro-volt to 100 milli-volts continuous variable high level, built-in attenuator.

TEST OSCILLATOR. Type TS.170/ARN.5.

ATTENUATORS with "T" type ladder network overall attenuation 80 db., arranged to give steps of 20 db., 20 db., 20 db., 10 db., 5 db., 2 db., 1 db., 600 ohms impedance input and output, in metal case with lid.

PYROMETER RECORDER. Type C.R. by Ether 2-stage model 120 micro-amps full scale with 230 volt A.C. S.P. drive, bench or wall fixing.

CAMBRIDGE THERMO RECORDER. 2-station type, 70 micro-amps full scale, 24 hour clock spring drive, bench or wall fixing, black enamelled all-diecast case.

L.O. 50.A. By B.S.R. in two ranges, 0-600 cycles and 0-16 Kc/s. Output impedance 600 ohms. Metered.

WAVEMETERS. Type 724.B by General Radio. 16 Kc. to 50 Mc/s. Type TE.149 by R.C.A. 200 Kc. to 30 Mc/s. TS 69/AP, 300/1000 Mc/s.

TEMPERATURE CONTROL OVENS. Admiralty type, 230 volts A.C. give stability of 2 parts in a million with suitable crystals, fitted thermostat and thermometer. Temperature adjustable 40/60 degrees Cent.

E.T.4336 TRANSMITTERS. Complete in working order.

Leslie Dixon & Co.
Dept. A, 214 Queenstown Road, London, S.W.8.
Telephone: MACaulay 2159

GEE Bros RADIO Ltd.

15, LITTLE NEWPORT STREET, LONDON, W.C.2. *GER 6794/1453*
ADJOINING LEICESTER SQUARE TUBE STATION ● Open 9-6 Weekdays 9-1 Sat.

GEE'S BARGAIN COLUMN

19in. G.P.O. RACKS. Heavy duty U channel, 6ft. high. £4/19/6. Carr. 15/-

5 C.P.I CATHODE RAY TUBE. 5in. dia. (U.S.A. make), new and unused. 35/-. P. & P. 5/-. Bases for same if required. 5/- extra.

TRIPOD STANDS—Heavy Duty, All Steel. Adjustable every 6in. to approx. 9ft. 6in. when fully extended. (Folds up to only 4ft. 6in. for storage.) Suitable for outdoor speakers, public address systems, floodlighting, etc., etc. Ideal for our RE-ENTRANT LOUD HAILER as illus. OUR PRICE £3/10/-. Carr. 5/-.

AIRBORNE TRANSMITTER RECEIVER. Type 1986. A mobile 10-channel crystal controlled V.H.F. Tx./Rx. covering 124.5/156 Mc/s. I.F. bandwidth 23 kc/s. Complete (less external attachments), in metal case, with all valves and 24-volt rotary power unit. Used, but in first-class condition. ONLY £8/10/-. Carr. paid.

TANNOY LOUDHAILERS. With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case. Brand new and unused. 18/6. P. & P. 3/6. 2 for 42/-. Post paid.

TELEPHONE SETS (TELE "F"). Housed in bakelite cases, complete with built-in ringing generators and batteries. Ideal between two or more positions up to practically any distance. Tested before despatched. ONLY 65/-. P. & P. 3/6. 2 sent for £6/5/-, carr. paid.

BATTERY CHARGER REGULATOR 12 ohm, 6 amp resistor on porcelain base. Knob control. Ideal for Battery Chargers and all types of low voltage regulation. 12/6. P. & P. 1/6.

20-WAY TELEPHONE PLUG BOARDS. Standard G.P.O. fitting. New and unused in sealed cartons. 15/- each. P. & P. 1/6.

ELECTRIC LIGHT CHECK METER. For 200/250 v. A.C. mains at 5 amps. Capable of carrying 50% overload. Good condition. Only 25/-. P. & P. 3/6.

C.M.G. 25 PHOTO CELLS (OSRAM). Brand new, 15/-. P. & P. 1/-.

MINIATURE 373 I.F. STRIPS for F.M. tuner as described in "Practical Wireless." Complete with all valves and circuit. BRAND NEW. ONLY 37/6.

TELEPHONE CABLE. Twin one mile drums (Don 8), £5. Carr. 20/-. Single one-mile drums (Don 3), 50/-. Carr. 7/6.

RECORDING WIRE, ¼lb. spools, 3½in. dia. New and unused, 7/6. P. & P. 1/-.

ACCUMULATORS. Bakelite cased. 2 v. 100 A.H., 75 actual. Ex Govt. New and unused. Complete with carrying handle. Size 6½ x 6½ x 3½in., 15/- each. Carr. 3/6. 3 sent for 50/-, or 6 for £5. carr. paid. Ditto 16 A.H., 5/-. P. & P. 2/-; 6 for 24/-. P. & P. 10/-; ditto 14 A.H. less handle, 5/-. P. & P. 2/-; 6 for 24/-, P. & P. 10/-.

12 v. 25 A.H. ACCUMULATORS. New and unused. Housed in strong wooden case for extra protection. 45/-. Carr. 7/6.

TWIN BARREL SLIDING RESISTOR 26 ohms at 6.5 amps, very liberally rated. Brand new and unused, 25/-. P. & P. 3/6.

TRANSMITTER RECEIVER No. 19, Mk. II. Complete station comprising transmitter/receiver, power supply unit, aerial, variometer, control box, headphones and microphone and all connecting leads. Air tested, £9/19/6. Carr. 20/-. Two complete stations £20 carr. paid. Any items available separately except Trans/Receiver.

AMPLIFIER. 12 v. D.C. for Mobile and Outdoor operation. Powered by Converter 2-EL35's or 6L6's in push-pull. Output 12 watts fitted for mike and gram inputs. A sound and practical unit in good condition for only £10/10/-. Carr. 5/-.

A.C.-D.C. RECTIFIER POWER SUPPLY UNIT. 110-230 v. A.C 50 cycles input, 100/110 v. D.C. output max. 2½ amp. £4/10/-. Carr. 7/6.

SELENIUM METAL RECTIFIERS FB 6 or 12 v. 1 amp. 7/6; 24 v. 1 amp. 13/6; 12 v. 2 amp. 10/-; 24 v. 2 amp. 20/-; 12 v. 2½ amp. 15/-; 24 v. 2½ amp. 25/-; 12 v. 4 amp. 16/6; 24 v. 4 amp. 30/-; 12 v. 6 amp. 23/6; 24 v. 6 amp. 35/-; 12 v. 10 amp. 40/-; 24 v. 10 amp. 80/-.

RE-ENTRANT LOUD HAILERS (Ex-Govt.)

Heavy duty 20 watts all-metal 15 ohms. Diameter 15in., length 15in., (approx.). Perfect condition. £6/10/-. Carr. 10/-.

AVO MODEL 40

Admiralty Pattern No. 47A. Complete in specially made wooden carrying case with leads and batteries, ready for use. Perfect cond. £12/10/-. Carr paid.

★ BAKERS SELHURST SPEAKERS ★

12in. P.M. 15 ohms 15 watts, 30–14,000 c.p.s. Our price £4/10/-.
"HI-FI MASTER" 12in. 15 ohms, 12 watts, 20–16,000 c.p.s. Flux density approx. 14–15,000. OUR PRICE £7/10/-.
"SUPER HI-FI 25" 12in. 15 ohms, 25 watts, 25–20,000 c.p.s. Flux density 17,600. OUR PRICE £9/9/-. All the above speakers are Brand New and full descriptive specification is available.

BRIDGE MEGGERS

Evershed and Vignoles Series 2. In perfect condition. 250 v. £22 carr. paid. Leather case available at 20/- extra.

D.C./A.C. ROTARY CONVERTERS

ROTARY CONVERTER. 230 v. D.C. input to 230 v. A.C. output at 230 watts. Brand new and unused. £15. Carr. 10/-.

ROTARY CONVERTER. 110 v. D.C. input, 230 v. A.C. output, 50 cycles, 50 watts approx. Complete in waterproof steel case, £3/17/6. Carr. 5/-.

ROTARY CONVERTER. 24 v. D.C. to 230 v. A.C. 50 cycles, 150 watts. Brand new and unused. £8/10/-. Carr. 7/6. Ditto, 100 watts, £6/9/6. Carr. 7/6.

ROTARY CONVERTER. Ex-Govt. 12 v. D.C. input 230 v. A.C. Output 50 cycles at 135 watts. Complete in carrying case with lid. Voltage control, sliding resistance, mains switch and 0–300 v. A.C. flush meter. In good condition, £10. Carr. 10/-. Motor only, without case, etc. Brand new and unused, £8/10/-. Carr. 5/-.

TWO SPECIAL ITEMS

WESTALITE RECTIFIER UNIT. Type 925. A.C. input 200/250 v. or 440/440 v. 50/60 cycles, 3 phase. D.C. output 13–0–13 v. by 1 volt steps to 16–0–16 v. at 120 amps. Metered, switched and fused throughout. Brand new and unused. £75 ex-stores.

WESTALITE TRANSFORMER RECTIFIER Oil filled. Primary 380–440 v. 50 cycles. 3 phase. Supply 20 v. D.C. at 200 amps. Complete with original control panel. Perfect condition, unused. £200 ex-stores.

TRANSFORMERS

E.H.T. TRANSFORMER. 9,500–0–9,500 at 2.9 kVA. Pri. 230 v., 50/60 cycles. New and unused. £25. Carr. paid.

E.H.T. TRANSFORMERS. 3,850 v. at 50 mA. with two additional 4 v. L.T. windings for 230 v. 50 cycles primary. New and boxed, £3/15/-. Carr. 5/-.

E.H.T. TRANSFORMER. 1,800–0–1,800 at 1 kVA 230 v. 50 cycles primary. Fully tropicalised. New and boxed. £8/15/-. Carr. 10/-.

HEAVY DUTY L.T. TRANSFORMER. 230 v. 50 cycles pri. 11–12.6 v. at 70 amps. sec. Ditto 13–15 v. sec. at 60 amps. Both capable of carrying 25% over actual rating. Perfect condition. ONLY 135/- each. Carr. 5/-.

RCA MODULATION TRANSFORMER. Heavy duty. Pri. 10,400 ohms. Sec. 4, 350 ohms. New and unused. £5. Carr. 10/-.

RCA PLATE TRANSFORMERS. 190 to 250 v. primary. 50–60 cycles. Secondary 1,500–0–1,500 or 2,000–0–2,000 at 1.75 kVA. Brand new and boxed. £12/10/-. Carr. 10/-.

20 kVA AUTO-TRANSFORMER. 230/115 v. 50-60 cycles, by Jeffries Transformer Co. U.S.A. Perfect condition. £12/10/-. Carr. 10/-.

CONSTANT VOLTAGE TRANSFORMER. 190–260 v. primary, sec. 115 v. at 1½ kVA (listed at 2 kVA). Brand new and unused. £25 or £45 per pair. Carr. 20/- each.

BARGAINS IN TEST EQUIPMENT

MARCONI SIGNAL GENERATOR TYPE TF517. Covering 10-18 Mc/s., 33–58 Mc/s., 150–300 Mc/s. Used but in very good condition. Complete with full technical data and instructions. Limited quantity. Unrepeatable at only, £12/10/-. Carr. 20/-.

VALVE TESTER TYPE 4. 200/230 v. A.C. input. Ex-Govt., in good condition, with descriptive book containing circuit diagram of instrument and how to test valves from 1.4 v. to 40 v. With valve holders for Brit., 4, 5, 7 pin and Octal, U.S., 5 and 7 pin, I/Octal side contact large Brit., 4 and 9 pin. Acorn and diode. Housed in substantial wooden case with hinged lid, £7/19/6. Carr. 10/-.

TEST SET TS-26/TSM. This volt ohmmeter is the correct tester for EE- telephones and all standard telephone equipment. Brand new and boxed with full technical data and calibration charts. £7/10/-.

PRECISION SERIES 834-S (U.S.A.). Multi-range tester for A.C./D.C. volts, ohms and milliamps. Basic movement 400 microamps. Housed in wooden box with lid and carrying strap. Overall size 7¼ x 7in. x 5in. Complete with test prods, batteries, etc. Ready to use. £6/19/6. Post 2/6.

EVERSHED & VIGNOLES MEGGER CIRCUIT TESTER (low reading ohmmeter). 2 ranges. 0–3, 0–30 ohms. The perfect meter for continuity and polarity testing. Complete with test leafs and ready to use. Brand new. Only £4/17/6. P. & P. 3/-.

EVERSHED & VIGNOLES 100 v. MEGGER. Good working order. Limited quantity. ONLY £4/15/-.

EVERSHED & VIGNOLES. Series II 500 v. Megger insulation Tester, with leather carrying case. Good order, £12/10/-. Carr. 10/-.

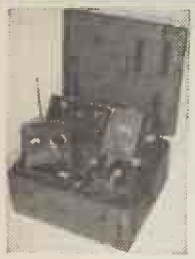
RECORD MEGGERS. 500 v. insulation tester, 0-20 megohms. In leather case, good condition, £8.

EVERSHED & VIGNOLES WEE MEGGER 500 v. New and unused. Only £12/10/-. Ditto 250 v. £10/10/-. P. & P. 3/- on each.

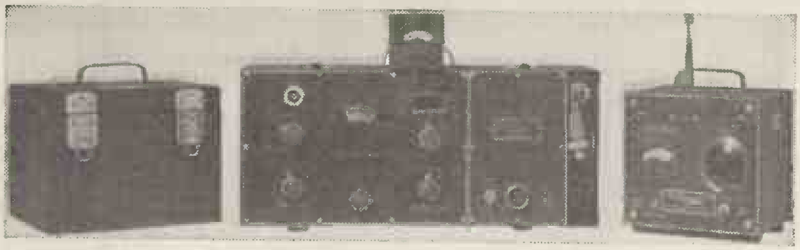
AVO TEST BRIDGE. A.C. mains operated from 200–250 v. Will test resistance from 5 ohms to 50 megohms and capacity from .0001 to 50 mfds. A most useful instrument fro everyday uses. Our price ONLY £7/19/6. P. & P. 3/6.

"THE BEST" BUY AT "GEE'S!"

PROOPS Walk-around Store
and MAIL ORDER SERVICE



2 METER TEST KIT BARGAIN IE-19-A 100-156 Mc/s. £7 . . .



Another Proops exclusive special bargain . . . Complete, Portable, Modern, American Bendix test kit in handsome black crackle cases comprising . . .

SIGNAL GENERATOR I-30-A

Battery operated, five RCA B7G valves. Crystal or master oscillators, meter resonated. Five step and variable attenuator. Large directly calibrated dial with precision slow motion drive.

Circuit Summary:

9002 Hartley Master Oscillator grid tuned over 33.3-52 Mc/s. coupled to 9003 power amplifier anode tuned to third harmonic by twin ganged capacitors OR ALTERNATIVELY Colpitts crystal oscillator anode tuned to 2nd harmonic of crystal feeds a 9003 distortion amplifier which is anode tuned to pass the 3rd harmonic of the oscillator output to the power amplifier. Anode voltage of master and crystal oscillator is variable from zero to 20% of five progressive steps to control RF output between almost zero and 5,000 microvolts. Carrier modulated with 1,000 c/s. note by 9002 Hartley oscillator on screen of P.A.

FIELD STRENGTH METER I-95-A

Self-contained, tunable-input valve-voltmeter with telescopic aerial and battery fed diode rectifier and pentode voltage amplifier for measuring field and modulation strength and frequency of transmitter. Compensating circuit for state of 1½ and 45 v, batteries.

TEST SET I-139-A

Suitably shunted 1 mA. meter in fully screened case with lead for plugging into signal generator and associated receiver and transmitter.

BATTERY BOX BX-33-A

Portable power supply with 10ft. output cable that plugs into front panel of generator.

CHEST CH-93-A

An extraordinarily robust transport and storage chest with separate compartments for each of above, cable, etc.

BRAND NEW or HARDLY USED £7. The Whole Kit, *plus 7/6 carriage.*

Sorry! Full instruction books with the first few only, thereafter circuit diagrams only—or specially reproduced full description, use, and particularly comprehensive voltage and resistance tables, fault finding analysis, etc. 15/- extra, by order only.

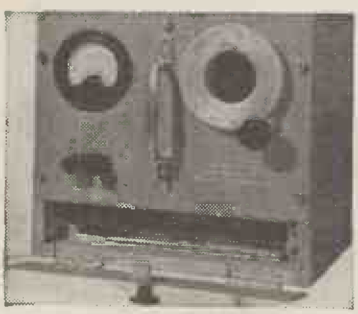
ALSO: A small number of the mains/battery version of this equipment with built-in stabilised mains (115 v.) power pack (and battery box as 33A) plus additional separate crystal controlled IF generator (2 × crystal frequency) plus extra compartment with selector switch and 2 meters (instead of 139A), but no 1-95-A with this set. Same price.

MARCONI WIDEBAND WAVEMETER TF643B

Note the 'B'—a superior version to earlier models previously released, which require power supply for metalised valve.

A modern professional instrument of sub-standard precision with continuous coverage from 20-300 Mc/s. in 4 fully calibrated bands: 20-37, 37-70, 70-130 and 130-300 Mc/s., easily readable to 100 Kc/s., 200 Kc/s., 500 Kc/s. and 1 Mc/s. respectively, with a declared accuracy of 1% between 20-150 Mc/s. and 2% between 150-300 Mc/s.

Employs a crystal voltmeter in a basic absorption wavemeter circuit using immensely rigid plug-in inductors tuned by a substantial ceramic body, soldered-brass-plate variable capacitor. Housed in ½in. thick polished oak cabinet with grey panel having terminals for phone monitoring. 2½in. 50 microamp. meter, and 4in. dial with 15 : 1 slow motion drive. Snap open compartment houses coils, instruction chart, and individual framed calibration charts for each range. Original cost £60. Offered brand new, in massive, sealed, rubber buffered transport case, still carrying final inspection certificate, for only £5/5/-, *carriage paid.*



3IN. CIRCULAR SCALE MILLIAMMETER

American panel mounting "Radio Altitude" meter with modern (coil round magnet) movement giving beautifully steady deflection to reading on large dial boldy marked 1 to 4 with sub-divisions in tenths.

Supplied with suppressed zero which requires 6.5 mA. for full scale deflection (0 = 1.5 mA.) but pointer is easily re-set to zero by moving conventional hair spring adjuster behind dial, when 5 mA. gives f.s.d. Rear housing incorporates on/off switch (operated by rotating small knob on front face) and 5-pin plug, two pins direct to meter and two to switch. Brand New, boxed, 12/6, *post free.*

SPECIAL VALVE OFFER

CV136-6AM5-7D9-8D3, miniature B7G 6.3 volt power pentode (two in parallel at 250 volts give 4 watts) (18/1 each list). 5/- per pair, *post paid.* CV135 Miniature B7G 6.3 volt half-wave rectifier, 75 mA., 750 peak inverse voltage. 2/6, *post paid.*

5IN. MAGNETIC C.R.T.

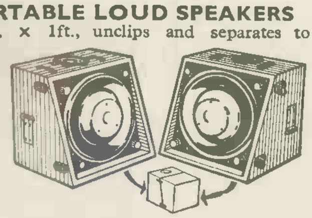
Suitable for monitoring amateur television. Heater 6.3 v. at 0.6 A. Anode 7,000 v. Grid 250 v. Cut-off 25-75 v. Brand new, boxed, 15/-, *post free.*

APNI TRANSDUCER

Well known wobbulator unit. Brand new, 7/6, *post free.*

TANNOY TRANSPORTABLE LOUD SPEAKERS

A stout "box," 9in. × 9in. × 1ft., unclips and separates to provide two powerful free standing loudspeakers with flush mounted, weather protecting, re-entrant horns. Speech coil impedance 7½ ohms each, 15 ohms in parallel. Handling capacity 8 watts. Each case contains a small line transformer and filter condenser. Brand new, £1 each, or 35/- the "stereo" pair, *carriage paid.*



MORSE SET COMPONENTS

All mounted on 3 × 6½in. insulated base. Contains Admiralty pattern key, with variable return pressure and adjustable front and back stops to suit operator's "hand"; a 1,000 ohm earphone which can serve as the sounder of a remote buzzer (not supplied); a two-pin, small-bayonet-cap lamp or neon bulb holder; and small round single pole on/off switch; all wired in base to four substantial terminals opposite three way cable clamp at front of block. A useful piece for the parts alone at 7/-, *post free.*

ELECTRIC ALARM BELLS

Ex U.S. Government warning bells with twin solenoids driving a fast acting piston which strikes the rim of a chromium plated gong. The 12 v. solenoids are series wired for 24 v. d.c. operation, but 6 v. will ring bell if wiring is re-arranged to give parallel feed. Solid cast baseplate for three screw fixing to rear of door, etc. Brand new, 5/-, *plus 1/- postage.*

PROOPS BROTHERS LTD. 52 TOTTENHAM COURT ROAD, LONDON W.1

LANgham 0141. Shop Hours 9-6 Thursday 9-1 OPEN ALL DAY SATURDAY

"DIPLOMA" HEADPHONES

Lightweight High Resistance (4,000 ohms). Complete with cord
17/6
Ideal for CRYSTAL SETS
The 'TYANA' Standard Soldering Iron

- Adjustable Bit.
- Weight approx. 4 oz.
- Heating time 3 min.
- 40 Watt economy Consumption.
- Standard Voltage Ranges.

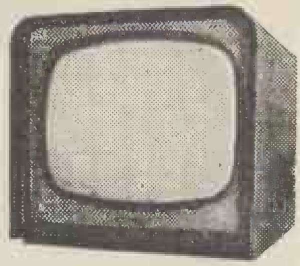
16/9

Replacement Elements and Bits always available.

KENROY LIMITED
152/297 UPPER ST., ISLINGTON LONDON, N.1
Telephone: CANonbury 4905-4663

---

59 GNS.—"17"



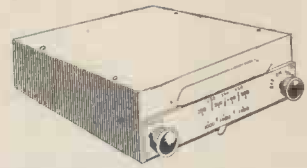
A full specification 17" Television Receiver to Spencer-West standards now available at your Dealers.

Remarkable performance and priced at 59 Gns. only complete.

For leaflet apply to:

SPENCER-WEST LTD.
GT. YARMOUTH, NORFOLK

REPANCO
SEVEN TRANSISTOR
CAR RADIO



- COMPLETE COVERAGE LONG & MEDIUM WAVE BANDS.
- 2 WATT OUTPUT.
- SEPARATE R.F. STAGE.
- A.G.C. AND AUXILIARY A.G.C. CIRCUITS.

EASY WIRING PLANS AND STEP BY STEP INSTRUCTIONS **2/6** (Post Free)

Mail Order and Trade:
RADIO EXPERIMENTAL PRODUCTS LTD.
33 Much Park St., COVENTRY
Tel.: 62572

Wholesale Enquiries and Export:
REPANCO, LTD.
O'Brien's Buildings, 203-269 Foleshill Rd., COVENTRY
Tel.: 40594

A.DAVIES *LOUDSPEAKER ENCLOSURES FOR*

GOODMANS WESTREX WHARFEDALE JENSEN G.E.C. W.B. B.T.H. B.B.C.

AMPLIFIER CONSOLE CABINETS
QUALITY AMPLIFIERS CHASSIS
LOUDSPEAKERS LP RECORDS

YOU CAN SEE YOUR CABINET BEING MADE IN OUR WORKSHOPS

Demonstrations Without Appointment **Open till 5.30 Saturdays**

A. DAVIES & CO. (Cabinet Makers)
3 PARKHILL PLACE (off Parkhill Road), LONDON, N.W.3. GULLIVER 5775
Few minutes walk Belsize Park Underground

PRECISION SHEET METALWORK

We specialise in manufacturing of Chassis in all metals, large or small quantities to your own specifications

V. W. BEAMISH
Shardeloes Garage, Shardeloes Rd., New Cross London, S.E.14
Telephone: TIDeway 4795

NEST OF DRAWERS

Overall: 6½in. wide × 5in. deep × 10½in. high. 12 drawers, each 3in. wide × 4½in. deep × 1¼in. high. Useful storage for radio components, nuts, bolts and other small parts. Green enamelled, sheet steel 20/-. P. & P. 3/-

HARMSWORTH, TOWNLEY & CO.
2 JORDAN STREET, MANCHESTER 15

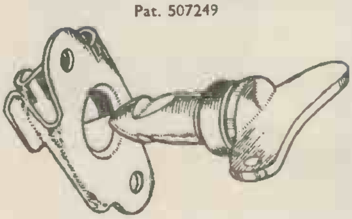
PROVED **The finest method for cleaning records**
Already over 200,000 enthusiastic users

THE **"Dust Bug"**
AUTOMATIC GRAMOPHONE RECORD CLEANER
PATENT APPLIED FOR

Price reduced to 17/6 (plus 7/- purchase tax)
from your local dealer or

CECIL E. WATTS LTD.
Consultant and Engineer (Sound Recording and Reproduction)
Darby House, SUNBURY-on-THAMES, MIDDX

ODDIE FASTENERS
Pat. 507249



THE FASTENER WITH ENDLESS APPLICATIONS—SIMPLE—POSITIVE SELF-LOCKING. MADE IN A VARIETY OF TYPES AND SIZES. SPECIAL FASTENERS TO SUIT CUSTOMERS' REQUIREMENTS. WIDELY USED IN THE RADIO INDUSTRY

Illustrated brochure and other information will gladly be sent on request.
DEPT. "W.W."

Oddie, Bradbury & Cull Ltd., Southampton
Tel.: 55883 Cables: Fasteners, Southampton

NEW BOOKS ON RADIO & TELEVISION

The Technology of Printed Circuits by Eisler. Postage 1/6.	60/-
Circuits for Audio Amplifiers, by Mullard. Postage 9d.	8/6
Principles of Transistor Circuits, by Amos. Postage 1/-.	21/-
The A.R.R.L. Radio Amateurs Handbook 1959. Postage 1/9.	32/6
The All in one Tape Recorder Book, by Lloyd. Postage 9d.	12/6
An Electronic Organ for the Home Constructor, by Douglas. Postage 1/-.	15/-
Radio Controlled Models, by Camm. Postage 9d.	12/6
Guide to Broadcasting Stations 1959, by "Wireless World." Postage 6d.	2/6
Radio Valve Data, by "Wireless World," 6th, edition. Postage 8d.	5/-
TV Fault Finding, by Radio Constructor. Postage 6d.	5/-
Transistors and Crystal Diodes, by Bettridge. Postage 6d.	5/-

A full range of Slide Rules and Drawing Instrument Sets in Stock. Send for lists.

UNIVERSAL BOOK CO.
12 LITTLE NEWPORT STREET LONDON, W.C.2 (adjoining Lisle Street)

COPPER WIRE
ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED
RESISTANCE WIRES
EUREKA - CONSTANTAN
MOST GAUGES AVAILABLE
NICKEL-CHROME - MANGANIN
B.A. SCREWS, NUTS, WASHERS, soldering tags, eyelets and rivets. EBONITE and BAKELITE PANELS. TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES, ALL DIAMETERS
Latest Radio Publications.
SEND STAMP FOR LIST. TRADE SUPPLIED.

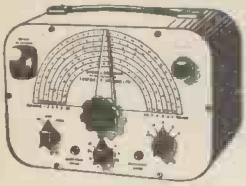
G.E.C., B.T.H. & WESTINGHOUSE GERMANIUM CRYSTAL DIODES

1/- each. Postage 3d.

Diagrams and three Crystal Set Circuits Free with each diode.
A large purchase of these fully GUARANTEED diodes from the manufacturers enables us to make this attractive offer

POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4
Phone: CLIssold 4688

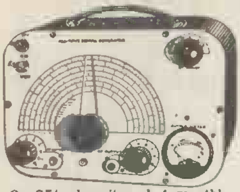
SIGNAL GENERATOR



Coverage 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. × 6¾in. × 5¼in. grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains. 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated on unmodulated R.F., output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.

£6/19/6 Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

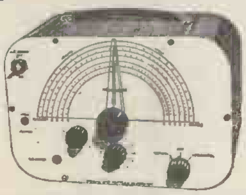
SIGNAL GENERATOR



Coverage 120 Kc/s—230 Kc/s., 300 Kc/s.—900 Kc/s., 900 Kc/s.—2.75 Kc/s., 2.75 Mc/s.—8.5 Mc/s., 8 Mc/s.,—28 Mc/s., 16 Mc/s.—56 Mc/s., 24 Mc/s.—84 Mc/s. Metal case 10in. × 6½in. × 4½in. Size of scale 6½in. × 3¾in. 2 valves and rectifier A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F., Output continuously variable 100 millivolts C.W. and mod-switch, variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%. **£4/19/6**

Or 25/- deposit and 4 monthly payments 21/6. P. & P. 5/- extra.

SIGNAL & PATTERN GENERATOR



£6/19/6 P. & P. 5/-

Or 25/- deposit, P. & P. 5/- and 6 monthly payments of 21/6.
Coverage 7.6 Mc/s.-210 Mc/s. in five bands, all on fundamentals, slow motion tuning audio output, 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy ±1% A.C. mains 200-250 v.

PORTABLE AMPLIFIER

Size 6½in. long, 5in. high, 2½in. deep. Will suit any type of crystal pick-up. Output approx. 2 watts. Incorporated ECC 83 double triode. Cossor 142BT output pentode and contact-cooled rectifier. Fully isolated mains transformer for 250-250 A.C. mains. Bass, treble and volume controls.

49/6 Plus P. & P. 3/6.

5" SPEAKER WITH O.P. TRANSFORMER

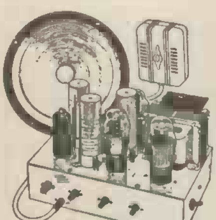
purchased with the above 18/6. Plus P. & P. 1/6.

B.S.R. MONARCH UA8

4-speed plays 10 records 12in., 10in. or 7in. at 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12¼ × 10¾in. Space required above baseboard 4¾in., below baseboard 2¾in. Fitted with Full-Fi turnover crystal head.

£6/19/6 Plus 5/- postage & packing.

8 WATT PUSH-PULL AMPLIFIER



COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER

A.C. mains 110/250 v. Size 10½in. × 6½in. × 2½in. Incorporating 6 valves, H.F. pen., 2 triodes, 2 output pens., and rectifier. For use with all makes and types of pick-up and mike. Negative feed back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. For use with Std. or L.P. records, musical instruments such as Guitars, etc.

£4.19.6 Plus P. & P. 7/6.

Or 35/- deposit. Plus P. & P. 7/6 and 3 monthly payments of 25/-.

PLAYER CABINET

Finished in 2-tone leatherette, will take B.S.R. UA8 with room for amplifier and 7in. × 4in. speaker. Overall size 15½in. × 13½in. × 9½in.

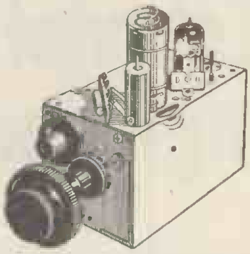
£2.19.6 Plus 5/- P. & P.

COLLARO MIXER 4-SPEED AUTOMATIC CHANGER

Model 457. Type "O" Pick-up, size 12in. × 13½in. Minimum clearance above baseboard 5in., below 2¾in., 10 records. A.C. mains 200-250 v. Turnover crystal head. BRAND NEW. Fully guaranteed.

Cash **£8/19/6** Plus P. & P. 5/-.

13 CHANNEL TUNER



34 to 38 Mc/s. complete with PCF80 and PCC84. These have been removed from chassis.

23/- complete with knobs. P. & P. 3/6 extra.

16-19. Mc/s complete with knobs less valves. 13/- Plus P. & P. 2/6.

AC/DC POCKET MULTI-METER KIT

Comprising 2in. moving coil meter, scale calibrated in A.C./D.C. volts, ohms and milliamps. Voltage range A.C./D.C. 0-50, 0-100, 0-250, 0-500. Milliamps. 0-10, 0-100. Ohms range, 0-10,000. Front panel, range switch, wire-wound pot (for ohms zero setting), toggle switch, resistors and rectifier. Basic movement, 2 mA. In grey hammer finish case.

19/6 Plus P. & P. 1/6 Built and tested 7/6 extra.

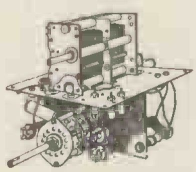
Point to point wiring diagram 1/- free with kit.

6 watt PUSH-PULL AMPLIFIER

A.C. mains 220/250 v. Incorporating 4 valves and metal rectifier, 2 inputs, high and low, and controls for same. Separate controls for Bass and Treble lift. Size of chassis 11in. × 4½in. × 2½in.

59/6 Plus P. & P. 5/-.

4 WAVE BAND COIL UNIT



Complete with tuning condenser. Separate sections for short wave. Coverage 10-21 m., 21-45 m., 44-100 m., and 190-545 m. I.F. 470 Kc., BRAND NEW, by famous manufacturer. Completely assembled on sub-chassis. With circuit diagram. **19/6** Plus P. & P. 3/6.

CONSTRUCTORS' PORTABLE PARCEL

Comprising case, chassis, top plate, scale, 5in. P.M. speaker with O.P. trans., twin gang, 2 470 Kc/s. I.F.s., trimmers, four valve holders, wavechange switch and volume control with switch.

39/6 Plus 3/6 Postage and packing.

LINE E.H.T. TRANSFORMER

By famous manufacturer. 14 Kv. Complete with built-in line and width controls. Winding for EY51 Rectifier. **19/6** Plus P. & P. 2/6.

MAINS TRANSFORMERS

All with tapped primaries 200-250 volts.
0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps. 10/6. 320-0-320 v. 75 ma., 6.3 v., 2.5 amp., 5 v., 2 amp., 10/6. 350-0-350 250 ma., 6.3 v. 7 amp., 5 v. 2 amp., 19/6. Postage and packing on the above 3/-.

RADIO AND T.V. COMPONENTS (ACTON) LTD.

23, ACTON HIGH STREET, LONDON, W.3

GOODS NOT DESPATCHED OUTSIDE U.K. ALL ENQUIRIES S.A.E.
TERMS OF BUSINESS C.W.O.

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short-circuit and for C.R. Tubes with falling emission.
Type A. Low Leakage windings. Optional Boost 25% and 50%. Tapped mains primaries.

2 volt	12/6 each	
4 volt	12/6 each	with Tag.
6.3 volt	12/6 each	Panel and
10.8 volt	12/6 each	Solder Tag
13.3 volt	12/6 each	

OUR LATEST SUPERIOR PRODUCT. Type A2. High Quality. Low capacity, 10/15 pf. Optional boost 25%, 50%, 75%. **16/6** each
Type B. Mains input. Low Capacity. Multi Output 2, 4, 6.3, 7.3, 10 and 13 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes, 21/-.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ¼ w. 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d.; 2 w., 1/-. HIGH STABILITY, ½ w., 1%, 2/-. Preferred values 100Ω to 10 meg. Ditto 5%, 9d. to 5 meg., 10%, 6d. to 10 meg.

WIRE-WOUND RESISTORS 25 ohms—10,000 ohms: 5 watt 1/3; 10 watt 1/6; 15 watt 2/-
15,000 ohms—50,000 ohms 5 w., 1/9; 10 w. 2/3

WIRE-WOUND POTS, 3 w. Pre-set Min. T.V. Type Knurled Slotted knob. All values 25 ohms to 25 K. 3/- ea., 30 K., 50 K., 4/-. Ditto Carbon Track 30 K. to 2 Meg., 3/-.

WIREWOUND POTS, 4 w. Standard size Pots., 2¼in. Spindle High Grade. All Values 100 ohms to 50 K., 6/6; 100 K., 7/6. W/W EXT. SPEAKER CONTROL 10Ω, 3/-.

O/P TRANSFORMERS. Heavy Duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Miniature 3V4, etc., 4/6. Hygrade Push-pull 10 watts, 15/6. MULLARD "510" 6k or 8k 30/-. L.F. CHOKES 15/10H 60/65 ma., 5/-. 10H 85 ma. 10/6. 10H 150 ma. 14/-. 5H 250 ma. 16/6.

MAINS TRANSFORMERS 200/250 v. A.C.

STANDARD 250-0-250, 80 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a., tapped, 5 v. or 4 v. 2 a. Ditto 350-0-350	22/6
MINIATURE 220 v. 20 mA., 6.3 v. 1 a.	10/6
MIDGET, 250 v. 45 mA., 6.3 v. 2 a.	15/6
SMALL, 250-0-250 100 mA., 6.3 v. 3.5 a.	19/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a.	17/6
HEATER TRANS., 6.3 v. 1½ a. 7/6. 3 amp.	10/6

ALADDIN FORMERS and cores, ¼in. 8d.; ⅜in. 10d.
0.3in. FORMERS 5937/8 and Cans TV/2. ⅜in. sq. × 2⅜in. and ⅜in. sq. × 1⅜in. 2/- complete with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
TYANA. Midget Soldering Iron. 40 w. 16/9.
REMPLOY INSTRUMENT IRON, 25 w., 17/6.
MAINS DROPPERS. 3 × 1½in. Three Adj. Sliders, .3 amp. 750 ohms, 4/3. .2 amp., 1,000 ohms, 4/3.
LINE CORD. .3 amp., 60 ohms, per foot, .2 amp., 100 ohms, per foot, 2 way, 6d. per foot, 3 way, 7d. per foot.

CRYSTAL MIKE INSERT by Acos 6/6

Precision engineered. Size only ⅞ × $\frac{3}{16}$ in. Bargain. ACOS CRYSTAL DESK MIKE, 33-2, switched, 35/-.

MIKE TRANSF. 50:1, 3/9 ea.: 100:1 Potted, 10/6.
LOUDSPEAKERS P.M. 3 OHM. 2½in. and 5in., 17/6
6in. × 4in. Rola, 18/-. 7in. × 4in. Goodmans 21/-
10in. × 6in. Rola, 27/6. 8in. Plessey, 19/6
6½in. Rola, 18/6. 10in. R.A., 30/-.
HI FI TWEETERS, 25/-. 12in. Plessey, 30/-.
12in. Baker 15 wt. 3 ohm and 15 ohm models 105/-.
12in. 15 ohm Plessey 10 wt. with Tweeter, 97/6.

I.F. TRANSFORMERS 7/6 pair

465 kc/s. slug tuning miniature can 2½ × 1 × 1in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.
Wearite M800 I.F. Miniature 465 kc/s. 12/6 pair.
Wearite 550 I.F. Standard 465 kc/s. 12/6 pair.

CRYSTAL DIODE G.E.C. 2/-. GEX34, 4/-. 40 Circuits, 3/-.
H.R. HEADPHONES, 4,000 ohms, brand new, 16/6 pair.
SWITCH CLEANER Fluid, squirt spout, 4/3 tin.

TWIN GANG CONDENSERS. 365 pf. Miniature, 1⅞in. × 1½in. × 1¾in., 10/-. .0005 Standard with trimmers, 9/-; less trimmers, 8/-. Midget, 7/6; Single 50 pf., 2/6; 100 pf, 150 pf., 7/-. Solid Dielectric 100, 300, 500 pf., 3/6.

VALVE HOLDERS. Pa. int. Oct., 4d. EF50, EA50, 6d. B12A, CRT, 1/3. Eng. and Amer. 4, 5, 6, 7 pin, 1/-. MOULDED Mazda and Int. Oct. 6d., B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6; B12A, 1/3. B9A with can, 2/6. CERAMIC, EF50, B7G, B9A, Oct., 1/-. B7G with can, 1/9.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-, 25in. × 35in., 10/-. Expanded metal, Silver 15¾in. × 9½in., 2/-. Tygan 54in. wide, 10/- ft. 27in. wide, 5/- ft. Samples.

WAVECHANGE SWITCHES.

2 p. 2-way, 3 p. 2-way, short spindle	2/6
5 p. 4-way, 2 wafer, long spindle	6/6
2 p. 6-way, 4 p. 2-way, 4 p. 3-way, long spindle	3/6
3 p. 4-way, 1 p. 12-way, long spindle	3/6

Wave change "MAKITS" 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer 16/-; 4 wafer 19/6; 5 wafer 23/-; 6 wafer 26/6.
TOGGLE SWITCHES. S.P., 2/-; D.P. 3/6; D.P.D.T., 4/-.
MORSE KEYS. good quality, 2/6.
SUB-MINIATURE ELECTROLYTICS (15 v.), 1, 2, 4, 5, 8, 25, 50 mfd., 3/- each.

GOLTOP TRANSISTORS JUNCTION TYPE P.N.P.

AUDIO V.10/15a. for amplifiers, and output stages up to 250 milliwatts in push-pull. PRICE **10/-**

R.F. V.6/R2 for oscillators, frequency changers and I.F. amplifiers cut off, 3 Mc/s. average. PRICE **18/-**

Power V15/10P, up to 10W with heat sink 20/-.

1959 RADIOGRAM CHASSIS FINEST VALUE

THREE WAVEBANDS
S.W. 16 m.—50 m.
M.W. 200 m.—550 m.
L.W. 800 m.—2,000 m.

FIVE VALVES
LATEST MULLARD
ECH. 42, EF41, EBC41, EL41, EZ40

12 month Guarantee. A.C. 200/250 v., 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative Feedback. 4.2 watts. Chassis 13½in. × 5½in. × 2¼in. Glass Dial 12¼ × 5¾in. horizontal or 10 × 4½in. vertical. 2 Pilot Lamps. Four Knobs, Walnut or Ivory, aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9.10.0 Carr. 4/6

TERMS: Deposit £5/5/- and 5 monthly payments of £1. MATCHED SPEAKERS 8in., 17/6; 10in., 25/-; 12in. 30/-

★ GARRARD 4-SPEED RECORD CHANGERS RC121/D MKII MODELS ★

Brand new and fully guaranteed 12 months.

AUDIO PERFECTION

Designed to play 16, 33, 45, 78 r.p.m. Records 7in., 10in., 12in. With plug in. NORMAL HEAD.

OUR PRICE **£10.15.0** each. Post Free.

Optional Plug in STEREO HEAD £2 extra.

★ COLLARO ★ HIGH-FIDELITY AUTOCHANGER

Latest Model
4-SPEEDS—10 RECORDS
With Studio "O" pick-up
BRAND NEW IN MAKER'S BOXES
OUR PRICE **£7.19.6** post free

B.S.R. MONARCH UA8 4-SPEED AUTOMATIC RECORD CHANGERS

Brand new and fully guaranteed 12 months.
OUR PRICE **£6.19.6** post free
STEREO MODEL UA8, £9/19/6, UA12, £11/17/6.

AUTOCHANGER ACCESSORIES

Suitable player cabinets (uncut boards) ...	49/6
Amplifier player cabinets with cut boards	63/-
2 valve amplifier and 6½in. speaker for above	72/6
3 valve amplifier and 6½in. speaker for above	95/-

Wired and tested ready for use.

EXCEPTIONAL OPPORTUNITY

COLLARO 4-speed MODEL 4/564 Single Player, heavyweight turntable and lightweight Studio O Pick-up with turnover Xtal mounted on baseplate. Autostop fitted.
OUR PRICE **6gns.** Carr 4/-.
Amplifier Player Cabinets, 45/-.

★ GARRARD 4-SPEED SINGLE RECORD PLAYER 4SP ★

£8 AUDIO PERFECTION POST FREE

De luxe Cabinet with amplifier and 6½in. speaker £6/15/-, or complete kit £14/10/-.

Teletron Transistor Pocket Radios

Designers' Specified Kits

COMPANION PRINTED CIRCUIT 3
Local station receiver kit, 4½x3x1½in. **£4.19.6**
3 Mullard or Goltop transistors; plans 6d.

Transidyne Superhet Six 6 x 4 x 1¾in.

T.C.C. Printed Circuit, internal Ferrite aerial, Rola loudspeaker, push-pull output. All parts, cabinet and 6 Mullard or Goltop transistors.
£11.19.6 Plans, etc., 9d.
No surplus reject transistors supplied

THE HI-GAIN BAND 3 PRE-AMP

Cascode circuit using Valve ECC84. 17db gain. Kit 29/6 less power; or 49/6 with power pack kit. Plans only 6d.
Also Band I version same Prices.

Volume Controls

Midget size: Long spindles. Guaranteed 1 year. All values 5 K. ohms to 2 Meg.
No Switch. 3/- D.P. Sw. 4/9
Linear or Log Tracks.

80 ohm CABLE Coaxial

Semi-air spaced Polythene insulated ¼in. dia. Stranded core. Ideal Band III Losses cut 50%. 9d. yd.

FRINGE QUALITY AIRSPACED .... 1/6 yd.

COAXIAL PLUGS	1/-	DOUBLE SOCKET	1/3
SOCKETS	1/-	OUTLET BOXES	4/6

BALANCED TWIN FEEDER per yd. 6d. 80 Ω or 300Ω.
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohm.
TRIMMERS, Ceramic, 30, 50, 70 pf., 9d. 100 pf., 150 pf., 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Phillips, 1/- ea.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled with 4 sides, riveted corners and lattice fixing holes, with 2½in. sides, 7 × 4in., 4/6; 9 × 7in., 5/9; 11 × 7in., 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 15 × 14in., 12/6; and 18 × 16 × 3in., 16/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, 8 colours, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE 3 yds. 9d. ¼lb. 2/6.
PAXOLIN SHEET, 8in. × 10in., 1/6. ION TRAPS 5/-.

"GEVAERT GEVASONOR"

50% Extra Long Play Plastic Tape, 1,700ft. 7in. Reel 35/-, 850ft. 5in. Reel 21/-.
SUPERIOR 1,200ft. 7in. Plastic Tape 21/-
Spare Reels Plastic, all sizes 3/- ea.
"INSTANT" Bulk Tape Eraser, 200/250 v. A.C. For any make and size of tape 27/6.

SENTERCEL RECTIFIERS. E.H.T. TYPE FLY-BACK. VOLTAGES. K3/25 2 kV., 5/-; K3/40 3.2 kV., 7/-; K3/45 3.6 kV., 7/6; K3/50 v. 4 kV., 8/-; K3/100 8 kV., 14/6. 50 c.p.s. Voltage 30% of above.
MAINS TYPE. RM1, 125 v., 60 mA., 5/-; RM2, 100 mA., 6/-; RM3, 120 mA., 8/-; RM4, 250 v. 275 mA., 16/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA., 7/6; 60 mA., 8/6; 85 mA., 9/6. 200 mA., 21/-; 300 mA., 27/6. Full Wave 120 mA., 15/-.
COILS. Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.
TELETRON. L. and Med. T.R.F. with reaction, 3/6.
FERRITE ROD AERIALS. M.W., 8/9; M. & L. 12/6.
T.R.F. COILS A/HF 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET, 26/-. H.F. coil, aerial coil, Oscillator coil, two I.F. transformers 10.7 Mc/s., Detector, transformer and heater, choke. Circuit and component book using four 6AM6 2/-. Complete kit with Jason Calibrated dial and 4 valves. £6/15/-. Mercury Switched FM Tuner 5 valve Kit, £8/19/6. Mullard 3-3 quality Amplifier. Ready built, £7/17/6.

CONDENSERS. New Stock. .001 mfd: 7 kV. T.C.C. 5/6. Ditto 20 kV., 9/6; 100 pf. to 500 pf. Micas, 6d., Tubular 500 v. .001 to 0.1 mfd., 9d.; .05 .1 1/-; .25 1/6; .5 1/9; .1/350v., 9d.; 0.1 mfd., 2,000 v., 3/6; 0.01 mfd., 2,000 v., 1/9.
CERAMIC CONDS. 500 v., .3 pf. to .01 mfd., 9d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3.
CLOSE TOLERANCE (±1pf.) 1.5 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf. 1/9; 1,000 pf. to 5,000 pf., 2/-.

NEW ELECTROLYTICS. FAMOUS MAKES.

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	64/350 v.	5/o	8/500 v.	3/-
2/450 v.	2/3	100/25 v.	2/-	16/500 v	4/-
4/450 v.	2/3	250/25 v.	2/6	32/350 v.	4/-
8/450 v.	2/3	500/12 v.	3/-	100/270 v.	5/6
8/500 v	2/9	8+8/450 v.	4/6	2,500/3 v.	4/-
16/450 v.	3/6	8+8/500 v.	5/-	6,000/6 v.	5/-
16/500 v.	4/-	8+16/450 v.	5/-	8+16/500 v.	7/-
32/450 v.	5/6	8+16/500 v.	5/6	32+32/350 v.	4/6
25/25 v.	1/9	16+16/450 v.	5/6	50+50/350 v.	7/-
50/25 v.	2/-	16+16/500 v.	5/-	64+120/350 v.	11/6
50/50 v.	2/-	32+32/350v.	4/6	100+200/275v.	12/6

FULL WAVE BRIDGE SELENIUM RECTIFIERS. 2, 6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a. 17/6; 6 a. 22/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v. 1½ a., 15/6; 2 a., 17/6; 4 a., 22/6. Charger circuit free. AMPMETERS, 4 a. and 5 a., 14/6.

NEW and boxed VALVES 90 day guarantee

1R5	8/6	6L6G	10/6	EA50	1/6	EZ81	11/6
1S5	8/6	6N7M	7/6	EABC80	10/6	E1148	1/6
1T4	8/6	6Q7G	10/6	EB91	6/6	HABC80	12/6
2X2	2/6	6SA7M	10/6	EBC33	8/6	HVR2A	7/6
3S4	8/6	6SJ7M	10/6	EBC41	10/6	MU14	10/6
3V4	8/6	6SN7	8/6	EBF80	10/6	P61	6/6
5U4	8/6	6V6G	7/6	ECC84	12/6	PCC84	12/6
5Y3	8/6	6X4	7/6	ECF80	11/6	PCF80	11/6
5Z4	10/6	6X5	7/6	ECF82	11/6	PCF82	11/6
6AM6	8/6	7S7	10/6	ECH42	10/6	PCL82	11/6
6BE6	7/6	12AH8	10/6	ECL82	12/6	PEN25	6/6
6BH6	10/6	12AT7	10/6	EF39	7/6	PL82	10/6
6BW6	10/6	12AU7	9/6	EF41	10/6	PY80	10/6
6D6	7/6	12AX7	9/6	EF50	5/6	PY81	10/6
6F6G	7/6	12BE6	9/6	EF50	8/6	PY82	10/6
6H6GT	3/6	12K7	8/6	Sylv.		SP61	5/6
6J5M	6/6	12Q7	8/6	EF80	10/6	UBC41	10/6
6J6	7/6	35L6	9/6	EF92	5/6	UCH42	10/6
6J7G	8/6	35Z4	9/6	EL32	5/6	UF41	10/6
6K6GT	6/6	80	10/6	EL84	10/6	UL41	10/6
6K7G	5/6	807	6/6	EZ40	10/6	UY41	10/6
6K8G	8/6	954	1/6	EZ80	9/6	U22	10/6

RADIO COMPONENT SPECIALISTS

OUR ONLY ADDRESS 337 WHITEHORSE RD., WEST CROYDON

POSTAL SERVICE 1/-, OVER £2 FREE. C.O.D. 1/6 (EXPORT C.W.O. POST EXTRA.) Wed. 1 p.m. Catalogue 1/6. THO. 1665. Buses 133 or 68

COTTAGE LABORATORIES LIMITED

require

ELECTRONIC and ELECTRO-MECHANICAL ENGINEERS

with

good qualifications, and experience, capable of playing a senior part in the design and development of electronic equipments and associated control gear.

If you would like an interesting, permanent and progressive job in a small and lively company, backed by the resources of a large international group, then write or telephone:

COTTAGE LABORATORIES LTD.,
PORTSMOUTH ROAD, COBHAM, SURREY.
(Cobham 3191)

W. H. SANDERS (ELECTRONICS) LIMITED
GUNNELS WOOD ROAD, STEVENAGE, HERTS.
REQUIRES A

SENIOR DEVELOPMENT ENGINEER

aged between 25 and 35 years, with at least five years' experience in the Design of Electrical Control Systems, knowledge of Magnetic Amplifiers would be an advantage.

Applicants should have degree, A.M.I.E.E. or H.N.C. (Elec).

The salary offered will be assessed according to age and qualifications. Housing accommodation available.

Please write giving full details of age, qualifications and experience to:—
Personnel Officer at the above address.

ENGINEER

with Radio and Radar experience, required for servicing and demonstration of portable electronic distance measuring instruments. Applications from Ex-Service Senior N.C.O. Radio Fitters welcomed. State experience and salary expected. Replies to Cooke, Troughton & Simms Ltd., Tellurometer Dept., Broadway Court, London, S.W.1.

THE BROADCASTING DIVISION of MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD

is expanding its television studio sales section.

Remunerative and interesting vacancies exist for sales engineers who have experience in the planning, installation or operation of television studios and who are willing to travel to all parts of the world at short notice. Preference will be given to candidates with a working knowledge of at least one foreign language. Posts are permanent and pensionable.

Please apply, giving full details and quoting reference **2022C, to Mr. J. L. Scott,**
Dept. C.P.S., Marconi House, 336-7 Strand, W.C.2.

MIDDLESEX COUNTY COUNCIL
Education Committee

TWICKENHAM TECHNICAL COLLEGE

Egerton Road, Twickenham, Middlesex

Required for 1st September, 1959:—

LECTURER in ELECTRICAL ENGINEERING subjects for Ordinary and Higher National Certificate Courses. Ability to teach Electronics essential. Applicants should have had good industrial and preferably some teaching experience. A degree or equivalent qualification desirable.

Salary in accordance with the Burnham (Technical) Report, i.e. £1,260 × £31/10—£1,417/10 per annum plus London allowance. Application forms and further particulars (foolscap S.A.E.) from the Principal. Closing date 7th May, 1959.

C. E. GURR, M.Sc., Ph.D.,
Secretary to the Education Committee.

RADIO & ELECTRONIC ENGINEERS . . .

The MORSE CODE is still, and always will be, the basic Code for individual Signalling, whether on visual or telecommunication circuits. So add this simple and interesting subject to your qualifications. Apart from the pleasure derived from this extra knowledge, it counts for much when a step up the ladder is under consideration. *Write for the CANDLER BOOK OF FACTS and see for yourself how fascinating the Candler method of teaching the Morse Code will prove.*

CANDLER SYSTEM CO.
(56W) 52b ABINGDON ROAD, LONDON, W.8
Candler System Co., Denver, Colorado, U.S.A.

BRADFORD INSTITUTE OF TECHNOLOGY

A full time course of 6 months for the INSTITUTION OF ELECTRICAL ENGINEERS PART III Examination will commence in November, 1959.

Further details and forms of application may be obtained from the Registrar, Bradford Institute of Technology, Bradford, 7.

LATEST DATE OF APPLICATION, 1st JUNE

MICROWAVE ENGINEERS

PYE TELECOMMUNICATIONS LTD. have a number of vacancies for development engineers with experience in the design of microwave radio relay systems for the transmission of television and multi channel applications.

Letters quoting age, experience, salary required, etc., should be addressed to:—

The Personnel Manager,
Pye Telecommunications Ltd.,
Ditton Works, Newmarket Road, Cambridge.

ELECTRONIC ENGINEER

We require an experienced practical electronic engineer to handle the installation and running-up of high voltage electronic gear at present unknown in this country. There will be an initial training period in the U.S.A. after which he will be expected to supervise the installation of the equipment in this country and to train suitable operating and maintenance personnel. Following on this he will be required to carry out the same function in other countries and therefore MUST have reasonable fluency in German and preferably another language

The successful candidate will probably be between 30 and 40 and should be essentially a practical man although a degree or other qualification would obviously be an asset. He MUST have had experience in either the Services or civilian life of the maintenance of complicated electronic equipment and whilst managerial experience is also an asset, we are more concerned with a man who is himself accustomed to locating and rectifying faults, who is able to transmit knowledge to other people and who possesses both drive and imagination.

To such a man we can offer a unique well-paid job having a considerable technical challenge, opportunities for travel and sufficient scope for growth to satisfy the most ambitious. If you have the above qualifications, write giving details of experience age, etc., to Box No. 2811 c/o "Wireless World" If you lack any of the essentials please do not waste either your time or ours

Hawker Siddeley

GUIDED WEAPONS DIVISION

A. V. ROE & CO. LTD.,

have vacancies for

ELECTRONIC ENGINEERS

in the Computer Group of their

WEAPONS RESEARCH DIVISION,

as follows:—

(1.) SENIOR ENGINEERS

(a) for circuitry design on simulators,
(b) for circuitry design on digital computers with special knowledge of transistor circuitry.

(2.) JUNIOR ENGINEERS

to assist in the above projects.

(3.) TECHNICIANS

to assist in design development and to take maintenance responsibilities on existing machines.

QUALIFICATIONS

Applicants for positions 1 and 2 should possess a Degree or Higher National Certificate and have had experience in the design of electronic apparatus and preferably in the design of simulators and digital computers. Applications for position 3 must have either a Higher National Certificate or have had experience with electronic apparatus in general.

Applications, quoting ref. WRD/EE/R.62/W should be sent to:—

Post 1 The Chief Engineer, A. V. ROE & CO., LTD. W.R.D., Woodford, Cheshire.

Posts 2 & 3 The Personnel Manager, A. V. ROE & CO., LTD. Greengate, Middleton, Manchester.

THE INDEPENDENT TELEVISION AUTHORITY

has vacancies for

ENGINEERS

for the operation and maintenance of television transmitters and ancillary equipment. The Authority is in a position to offer appointments with opportunities to suitably qualified young men who have either some experience in this field or who have had a good basic training in radio, radar or television. There would be opportunities for further training and all appointments are pensionable after the initial period of probation has been satisfactorily completed.

Service with the Authority may involve transfers to various locations in the British Isles, but preference for a particular area will always be considered.

Appointments will be made in the grade of Shift Engineer with a salary scale starting at £725 with regular annual increments. The starting salary would be determined, to a certain extent, by qualifications and experience. Applications giving details of age, academic qualifications and experience, quoting Ref. No. E4 should be addressed to the

Personnel Officer,
62 Brompton Road, London, S.W.3.

ASSISTANT INSTRUMENT ENGINEER

for

CHAPELCROSS NUCLEAR POWER STATION

to work in the Instrument Department which is responsible for installation, servicing and testing of all Works instrumentation, including nuclear, electronic, physical, electrical, pneumatic, health, physics and industrial television equipment.

This is an opportunity for an engineer to gain experience of reactor and associated power plant instrumentation and control. He will be responsible to the Instrument Engineer for liaison with the Reactor Operations and Technical Department during reactor start-up tests and for subsequent instrumentation tests and experiments, organisation and co-ordination of a planned maintenance system, investigation of operational and servicing problems on instrumentation and other duties, which may include responsibility for the acceptance of instrument installations from the Consultant Engineers and installation and calibration tests.

A recognised engineering apprenticeship or comparable training and corporate membership of a senior engineering institution, or equivalent, are essential. Industrial instrumentation experience is required together with the ability to lead and co-ordinate the activities of technicians and mechanics. Physics, radar or light electrical background may be an advantage. Where necessary, training in nuclear aspects of the work will be given.

Salary between
£845 (at age 25) and £1,315

Contributory Superannuation. Staff housing scheme.

Send postcard for application form quoting Reference 2977 J48 to

Works Secretary
UNITED KINGDOM ATOMIC ENERGY AUTHORITY INDUSTRIAL GROUP
Chapelcross Works, Annan, Dumfriesshire, Scotland

Closing date 4th May, 1959

ELECTRICAL ENGINEER

OR

PHYSICIST

required for Cathode Ray Tube Development Laboratory. This is an attractive opportunity for a suitably qualified engineer to concentrate on the development of C.R. Tubes, with new applications, in an expanding field. There are, at present, also openings for more junior technical staff, with a minimum qualification of O.N.C. or Inter. B.Sc. Please write, giving details of your previous posts, and qualifications, and quoting CR/W to

Personnel Officer,
M.O. Valve Co. Ltd.,
Brook Green,
Hammersmith, W.6.

ULTRA ELECTRIC LIMITED

Radio & Television Division.

Require

SENIOR TELEVISION ENGINEERS

for their Research and Development Laboratories

Applications are invited from engineers with research and development experience qualifying for work on projects such as:

- **Wide Angle Scanning**
- **Colour Television**
- **Experimental Receivers—Higher Definition Systems**
- **Combined TV/FM Radio Receivers**

The Laboratories are well equipped, modern, conveniently and pleasantly situated in a West London district, where opportunities exist for advanced technical development work.

The Company operates a good Pensions/Life Assurance Scheme.

All applications will be regarded as strictly confidential; should give age, qualifications; experience; salary desired; addressed in the first instance to:

The Personnel Manager,
Ultra Electric Ltd.,
Western Avenue, Acton, London W.3.

THE INDEPENDENT TELEVISION AUTHORITY

invites applications for the appointment of Assistant Engineer at its Headquarters in London. The successful applicant will be required to assist the Senior Engineer responsible for siting transmitting stations. Applicants should possess good qualifications in electrical engineering and should have had previous experience in radio, radar or television. Experience of V.H.F. propogation problems would be a distinct advantage. The appointment will be based in London, but will involve much travelling and frequent contact with local authorities, land owners, etc. Salary scale for this appointment is £1,330 × £100 — £1,630 × £105 — £1,840. There is a contributory pension scheme. Applications giving age and full particulars should be submitted to the Personnel Officer, 62, Brompton Road, London, S.W.3, quoting Ref. No. E/3.

Z. & I. AERO SERVICES LTD.

14, South Wharf Road, London, W.2 Telephone: AMBassador 0151/2

A.R.B. Approved Stockists

RETAIL BRANCH: 85, TOTTENHAM COURT ROAD, W.1 (near Goodge Street Station)

TWIN PEN SWITCHBOARD PATTERN RECORDING MILLI-AMMETER

(made by Evershed & Vignoles)
Sensitivity: 5 mA. D.C. Damping: Oil Dashpot. Chart width: 6in. Chart drive: Electric motor, 230 v. A.C. Chart Speed: ½in. per minute. Interior light.
PRICE, unused, complete with two gravity type pens, two syphon pens with trough, two bottles of ink, two bottles of dashpot oil and two charts, fully guaranteed... £65 0 0
Packing & carr. £1.
This model can also be supplied for 1mA Range at an extra charge of.................... £5 0 0

EVERSHED 12-PEN TIME RECORDER

Portable 12-channel instrument for simultaneous recording of 11 events with time marks provided by 12th pen. The recording is presented in the form of "on-off" pulses. Chart Speed 2 inches per second.
PRICE, unused, in original packing, complete with accessories and a supply of charts £30 0 0

EVERSHED TRIPLE PEN RECORDING MILLIAMMETER AND MAGSLIP TESTER

The Recorder consists principally of three M.C. 6-0-6 mA. F.S.D. Centre Zero movements, supplied through phase sensitive valve rectifiers, which will accept magslip signals at 50, 60, 400 and 1,000 c/s. Adjustable sensitivity and damping. Chart drive 230 V. A.C. Chart speed 1 inch per minute. Provision for Teledeltos recording. Approx. 10 V. R.M.S. F.S.D. when fed through the rectifiers.
PRICE, unused and complete with accessories £135 0 0
Packing and carriage £2 0 0

SULLIVAN WHEATSTONE BRIDGES

Four switched decades .1-1.0-10-100 ohms. Switched ratios: .001-.01-.1-1.0-10-100-1000. Built-in galvanometer and key. Provision for use with an external galvanometer.
PRICE, fully overhauled and guaranteed £38 0 0
Packing and carriage 15 0

MARCONI TF-943 F.M. DEVIATION METER

Frequency range: 2.5 to 100 Mc/s.; Deviation range: 5, 25 and 75 kc/s. Minimum input: 55 mV. Input impedance 75 ohms. Power supplies 100/150 and 200/250 V. £95 0 0
Carriage and packing £1 0 0

INSULATION TEST SET TYPE CT-91

Maximum voltage 40 kV. Trip circuit adjustable to trip at any leakage current between 1 and 250 μV. Power Supplies 100-150 V. and 200-250 V. Mains.
PRICE, complete and in perfect cond. £90 0 0
Packing and carriage £1 10 0

VARIACS

Variable auto-transformers, made by General Electric type 100R, or equivalent "Powerstat" made by Superior Electric Co. Rating 2kVA. Input Voltage 230 V. Output Voltage 0 to 270 V. Max. current 9 Amps. New and guaranteed. P.P. 12/6 .... £15 0 0
General Radio Variable Auto-transformers model 200CU. Rating 0.86 kVA. Input Voltage 115 V. Output Voltage 0 to 135 V. Rated Current 5 Amps. New and guaranteed. P.P. 7/6. .... £5 10 0

SIGNAL GENERATORS

MARCONI "STANDARD" TF-144G, 85 kc/s. to 25 Mc/s.; output 1μV to 1 V.; complete with mains lead and output lead £85 0 0
Packing and carriage £1 0 0
GENERAL RADIO 605B: 9.5 kc/s to 30 Mc/s.; output 0.5μV. to 0.1 V. and fixed output of 1 V. Complete with mains lead and output lead £65 0 0
Packing and carriage £1 0 0
RCA TYPE 710A. 360 to 560 Mc/s.; output 1μV. to 90 mV.; complete with output cable, frequency correction chart and attenuator calibration chart £45 0 0
Packing and carriage 15 0
TYPE 101 SIGNAL GENERATOR. 400 to 650 Mc/s. Output power from 7.5 to 11 dB. above 1 microwatt. Output impedance 72 ohms. Internal square wave modulation; power supplies 230V. A.C. Complete with output calibration charts, frequency charts and accessory cables £55 0 0
Packing and carriage £1 0 0
MARCONI TYPE CT-218 FM and AM. Carrier Frequency Range 85 kc/s to 30 mc/s; Deviation Range: 5-90 kc/s; Crystal Check at 200 kc/s. and 2 mc/s; Internal Mod. at 400-1000-1600-3000 c/s.; Output 1 μV to 100 mV. through an attenuator and 1 volt direct. As new, complete with accessories ...£125 0 0
Packing and carriage £1 0 0

OSCILLOSCOPES

COSSOR TYPE 339 DOUBLE BEAM OSCILLOSCOPE £30 0 0
Packing and postage 15 0
ERSKINE DOUBLE BEAM TYPE 13 HIGH SPEED OSCILLOSCOPE. Time base from 2 c/s. to 750 kc/s., 1 and 10 microsecond time markers. Mains operation £58 0 0
Packing and postage.................... £1 0 0
TS-34/AP PORTABLE HIGH SPEED OSCILLOSCOPE. 2in. tube magnified to 3in. field; time base 10 c/s. to 50 kc/s.; single sweep duration 5, 50 and 250 microseconds. 115 V. Mains A.C. operation. Total weight only 26 lb. £55 0 0
Packing and postage.................... £1 0 0
DUMONT MODEL 241 SINGLE BEAM OSCILLOSCOPES. 5¼in. Tube; Time Base up to 30 kc/s. Brightness Modulation. 115 V. A.C. Mains operation.
PRICE, fully overhauled and guaranteed £35
Packing and carriage.................... £1 0 0

COMMUNICATION RECEIVERS

MARCONI CR-150, 2 to 60 Mc/s., dual superhet, "S" Meter; Crystal calibration. Fully overhauled and guaranteed ... £50 0 0
Packing and postage £1 0 0
HALLICRAFTER S-27, 27-143 Mc/s., FM/AM., in good working order £32 10 0
Ditto, fully overhauled and guaranteed £60 0 0
Packing and postage £1 0 0
AR-88D RCA RECEIVERS, 50 kc/s-31 Mc/s., fully overhauled and guaranteed ... £85 0 0
Packing and postage £1 5 0
Large quantity of spares available.
AR-88LF RECEIVERS, 75-140 kc/s. and 1.2-30 Mc/s., fully overhauled and guaranteed £75 0 0
Packing and postage £1 5 0

SPECIAL RECEIVERS

R-1359, 130-520 mc/s. £90 0 0
R-1294, 500-3,000 mc/s. £85 0 0
R-1619, 1250-5000 mc/s. £70 0 0
R-111/APR5, 1000-6000 mc/s. £125 0 0
AN/APR4, 38-1000 mc/s., or equivalent model RDO, complete with three tuning units £260 0 0
Ditto, complete with model RD Panoramic Adaptor £320 0 0
Further details on request.

CATHODE RAY TUBES

VCR-97—picture tested	12 6
3BP1, new in cartons	12 6
3BP1, new, loose	10 6
5CP1, new	£1 10 0
5FP7, new, in cartons	£2 10 0

Packing and carriage 3/6 per tube.

MICROWAVE 3 CM EQUIPMENT

TS-13 SIGNAL GENERATOR WITH SELF-CONTAINED WAVEMETER AND POWER MONITOR. Range 9305 to 9445 Mc/s. Internal pulsing. Peak Power output 50 microwatts.
TS-45/APM3 SIGNAL GENERATOR. Frequency range 9,300-9,450 Mc/s. Power output 10 mW. average; Power meter range 5 watts. Details and prices on application.
M-V TYPE 57 3-CM STANDING WAVE INDICATOR. Range 9,100-9,700 mc/s.; Contains 723A/B Oscillator, Calibrated Wavemeter, Attenuator, and Standing Wave Indicator. V.S.W.R. indicated on a Cathode Ray Tube.
PRICE, fully overhauled and guaranteed £130
Packing and carriage..................... £2 0 0
KLYSTRONS 723A/B, fully tested and guaranteed—price on application.

MICROWAVE 10CM EQUIPMENT

TS-14/AP SIGNAL GENERATOR, 3,200 to 3,370 mc/s.; Power output —20 to —100 dbm.; Power measurement range 20-200 mW. Pulse modulation with variable pulse width and phasing; power supplies 115 V. A.C. £85 0 0
Packing and carriage £1 10 0

WAVEGUIDE WATTMETER TYPE APW-7283

For Power measurement in the range of 40 to 500 kW. peak, V.S.W.R. measurement and Wavelength in the range of 8.9 to 10.2 cm.; Waveguide inter-service type 10A £5 0 0
Packing and carriage 15 0

MARCONI TF-984/1 SPECTRUM ANALYSER

"S" Band (2,900-3,150 mc/s.). Spectrum width 1 to 10 mc/s.; Details and prices on application.
KLYSTRONS 417-A, F-9.10 cm.; Vernier tuning 100 mc/s.; Ers 1,000 V. max.; Heater 6.3 V.; Prs-50 watts £2 0 0
Packing and postage 5 0

POWER UNITS, TYPE 234

A.C. mains operation 230 V.; output may be tapped at 180 to 270 V. D.C. at 80 mA. L.T.—6.3 V. at 4 amps. Brand new £2 19 6
Packing and carriage 10 0
Ditto complete with built-in 6V6 output stage, suitable for R-1155 and R-1132 Receivers £4.

14 V. DYNAMOTORS. Output 250 v. 50 mA., for Command Receivers. Suitable for running a radio set or a shaver from car battery..................................... £1 15 0
Packing and postage 2 6

MAINS TRANSFORMERS

Input 100 to 250 V.; output 6.3 V. 0.6 A.; 6.3 V. 2.5 A.; 275-0-275 V. 80 mA....... 17 6
Packing and postage 2 6

ANTENNA RELAY UNITS

For Command Transmitters.
Contain expanded scale 20 mV. F.S.D. meter 2in. round flush mtd., Antenna Relay, Thermocouple and 50 pF Antenna Series Condenser 15 0
Packing and postage 2 9

VALVES

All tested and guaranteed
VR54, VR91—all at 1/-; 6H6, 1/3; 956, 2C26—all at 1/9; 2X2, 2/-; 6C4, 9006, AC/HL, VR65A, all at 2/6; 6J6, 3/-; 6AG5, 3/6; 6A3, 1215GT, ARD12, all at 4/-; 12AH7GT, 9001, AW3, SP61, VR56, all at 4/6; 6J5, 12A6, 12SR7, 2051, EAC91, P61—all at 5/-; OD3/VR150, 6AC7, 6AJ7, 6K7, 6K7G, 6SS7, 6X5G, 12SG7—all at 6/-; 5U4G, 6SJ7, 6SL7GT, 6SN7GT—all at 7/-; 5R4GY, 12C8—all at 7/6; 6AM5, 6L7—all at 8/6; 2D21, 12/6; 12E1, QVO4-7, 15/-.
Please add 2/- in £ for packing and postage. Please write for full price list of valves covering few hundred types.

METERS

Please write for price list of our large range of meters.

All test equipment offered above is fully serviced before despatch and guaranteed for six months from the date of purchase.

Wireless World Classified Advertisements

Rate 7/- for 2 lines or less and 3/6 for every additional one or part thereof, average lines 6 words. Box Number 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World" Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day June 1959 issue, Wednesday, April 29th. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components and valves which may be offered for sale through our displayed or classified columns carry no manufacturers' guarantee: Many of these items will have been designed for special purposes making them unsuitable for civilian use, or may have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

NEW RECEIVERS & AMPLIFIERS

AM/FM stereo chassis, 6w output, only £20.—Bel Sound Products, Marlborough Yard, N.19. [0182

RECEIVERS AND AMPLIFIERS SURPLUS AND SECONDHAND

R.C.A. AR88, 14 valves, Hallicrafter S36 fm/am u.h.f., 14 valves, rack mounting, offers.—Neago, 2, Talbot Sq., London, W.2. [8438

HRO Rx's, etc., AR88, CR100, BRT400, G209, S640, etc., etc., in tock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0053

TV RECEIVERS—SURPLUS AND SECONDHAND

TV bargains, B.B.C. only from £5, B.B.C./I.T.A. from £15, all fully guaranteed; others complete but not guaranteed from 25/-; projection sets, £5; callers only; also see below under "Components."—T.C.S., Ltd., 28, Brockley Cross, S.E.4. [8471

TEST EQUIPMENT—SURPLUS AND SECONDHAND

MARCONI valve voltmeter complete with diode head, perfect; £12/10.—Box 2819. [8468

AVO A.W. oscillator, 95kc-80mc, new condition; £8/10.—Whiteley, 17, Vernon St., Newark. [8439

SIGNAL generators, oscilloscopes, output meters, valve voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0056

RECENT release by the Admiralty; Performance Meters; each consists of a self-contained unit with 230 volt 50 cycle power supply and including 5Z4G Rectifier, Magic Eye Tuning Indicator, 2 EF50, 1 EF54 and 1 EA50 valve, pots, fuses, condensers, etc.
ALL are brand new or as new and packed in original wooden cases, special price 29/6 plus 7/6 part packing and carriage.
WALTONS WIRELESS STORES, 46, 47, 48 & 49, Stafford St., Wolverhampton. [0105

NEW COMPONENTS

ALUMINIUM chassis, 5 different types, 720 standard sizes; write for catalogue.—25, Leach St., Prestwich, Manchester. [8469

COMPONENTS—SURPLUS AND SECONDHAND

MAGSLIPS at low prices, fully guaranteed, 3 in Resolver No. 5 (AP 10861), 50v, 50c/s, unused each in tin, 35/-, post 2/1; large stocks of these and other types.—P. B. Crawshay, 94, Pixmore Way, Letchworth, Herts. Tel. 1851. [0087

BREAKING hundreds of TVs for spares; L.O.P.T. from £1; scanning coils from 15/-; valves from 2/6, etc.; complete chassis from 25/-; no lists; send requirements for immediate attention.—T.C.S., Ltd., 28, Brockley Cross, S.E.4. Money-back guarantee. [8472

SAVE on repairs using our salvaged TV and radio components, valves, tubes, transformers (EHT, line, frame, speaker), droppers, sliders, pots, electrolytics, coils, etc., spares for thousands of sets, all makes, all ages, many obsolete, unobtainable elsewhere at a fraction of usual price; speakers 5/-, EF80, EF91, UF42, 3/6; EF50, SP61, EB34, 2/6.
TUBES: Mullard, Mazda, Emiscope, etc., 9in-10in, projection, 30/-; 12in-14in, £3/10; 17in £5; all good picture tested, fitted free or sent subject to 7 days money back guarantee: for free list or with enquiries, s.a.e. please.—St. John's Radio, 156, St. John's Hill, S.W.11. Bat. 9838. [8475

CATHODE ray tubes, used, but in good working order, with 3 months' full guarantee, Mullard and Mazda or equivalent types, 14in and 17in, at £4/10, plus 12/6 carr. and ins.; also other sizes and types available on application to:—B.H.P. Distributors (London), Ltd., 379, Staines Rd., Hounslow, Middx. Tel. Hou. 5144. [0170

NEW GRAMOPHONE AND SOUND EQUIPMENT

GLASGOW.—Recorders bought, sold, exchanged, cameras, etc., exchanged for recorders or vice versa.—Victor Morris, 406, Argyle St., Glasgow, C.2. [0201

NEW GRAMOPHONE AND SOUND EQUIPMENT

TAPE recorders: Ferrograph, Vortexion, Brenell, Telefunken, Truvox, Reflectograph, and M.S.S.
TAPE decks: Wearite, Brenell, Truvox, Bradmatic, Dulci-Harting. Amplifiers and tuners: Leak, Quad, R.C.A., Dynatron, and Dulci. Microphones: Reslo, Lustraphone, Philips, Acos, Grampian, etc. All tapes and accessories. Audio service department and recording studio.
HIRE purchase facilities available.
LAMBDA Record Company, Ltd., 95, Liverpool Rd., Liverpool, 23. Great Crosby 4012. [8404

CINE-VOX disc recording mechanisms for L.P. or standard operation from 30gns.-56gns.; also complete tape/disc or direct channels from 50gns.-112gns.
DEMONSTRATIONS can be arranged in London.—For full details write to K.T.S., Ltd., "Coplow," Park Rd., Braunton, N. Devon. Callers by appointment only. [0210

OUR May recommendation, a Unimixer, 3-way mixing unit, see p. 180, to go with the tape recorder you buy from us.—Sound News. [0131

"EROICA" RECORDING STUDIOS (Est. 1949).—Recorders (Stereo as required) by Ferrograph, series IV, etc., Brenell (Mk. V and the marvellous lightweight Three-Star); pocket 5-way mixer, £3 posted; installations for industry and the home; tape/disc, etc.—Recorder House, Peel St., Eccles, M/c. Eccles 1624. Director, Thurlow Smith, A.R.M.C.M. [0122

GRAMOPHONE AND SOUND EQUIPMENT—SURPLUS AND SECONDHAND

CONNOISSEUR 3-speed varigroove disc recorder, one year old, very little used: £130.—Hunter 1635. [8431

ALSO from us! Post free, insured: Gevaert 1,700ft, new LP tape, 31/-, 850ft 22/6; EMI-strd 1,200ft on strong Ferrospools, boxed, 25/-; Collaro 4T200 transc. unit in sealed carton, 18gns; Truvox Mark III (guaranteed), 16gns; Ferrograph 3AN and AH dem. models occas. also available.—Sound News, see p. 180. [0194

ONLY from us! Famous make stick mike, listed 5gns., only £2/14; save 15/- on 7in. L.P. Gevaert tape, 35/-; 5in L.P. Geveart, listed 28/-, only 19/6; 7in. 1,200ft. Ferotape, ex-M.O.S., listed 42/-, only 25/-; 5¾in. 250ft. for Grundig, etc., 19/6; many other tape bargains—our list will save you ££'s! Outstanding secondhand tape recorder bargains from Ferrograph to Walter; all new recorders supplied; we buy for cash or exchange recorders, Hi-fi equipment, radios, cameras, etc; specialist repair service.—E. C. Kingsley & Co., 132, Tottenham Court Rd., London, W.1. Eus. 6500. [0320

TAPE RECORDING, ETC.

RENDEZVOUS RECORDS offer comprehensive 78/LP tape to disc recording facilities.—Leaflet from 19, Blackfriars St., Manchester, 3. [8168

TAPE to film . . . film to tape . . . your 16mm film striped and recorded.—Edric Films, Ltd., 34/36 Oak Tree End Way, Gerrards Cross, Bucks. (Tel. Gerrards Cross 2908.) [0124

TAPE to disc recording; Microgroove LP from 27/6, 78 r.p.m. from 11/-, also 45 r.p.m.; 48-hour service; s.a.e. for comprehensive leaflet to.—A. D. Marsh, "Deroy" Sound Service, Little Place, Moss Delph Lane, Aughton, Ormskirk, Lancs. Aughton Green 3102. [8133

TAPE/DISC/TAPE transfer, editing, copying. If quality and durability matter (especially with LP-s from your own tapes) consult Britain's oldest (not cheapest!) full-time transfer service.—Sound News, 10, Clifford St., London, W.1. Reg. 2745. [0192

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A. Boxmakers, 75a, Godwin St., Bradford, 1. [0172

VALVES WANTED

NEW valves wanted, any quantity, best cash price by return.—Stan Willetts, 43, Spon Lane, West Bromwich, Staffs. Tel. Wes. 2392.

ALL types of valves British or American, transmitting and receiving; keenest cash prices paid. What have you to offer?—Write or call Lowe Bros., 9a, Diana Place, Euston Rd., N.W.1. Tel. Euston 1636-7. [7848

WANTED, EXCHANGE, ETC.

FERGUSON "403" Hi-Fi reproducer or similar wanted.—Billings, 206, Queensway, Rochdale, Lancs. [8466

FOR SALE AND WANTED ADVERTISEMENT FORM TURN TO PAGE No. 181

CAPACITY AVAILABLE

ASSEMBLY, wiring, testing, H.F. and V.H.F. Equipment. Encapsulation. metalwork, machine engraving. Suppliers to M.W.T., S.T.C., etc. R.E.E. Telecommunications, Ltd., Crewkerne, Somerset. [8265

CAPACITY available, work wanted: Armature winding and coil winding.—R. Gilfillan & Co., Ltd., 29, South St., Worthing, Sussex. Tel. Worthing 8719. [8446

WORK WANTED

£10 purchases 100VA magnetic amplifier! For new catalogue; Clerkenwell 3695.—Write Able Engineering, Ltd., 12, Singer St., E.C.2. [8481

SERVICES OFFERED

AUTHORS. For all illustrating of technical publications consult specialist, G. W. Dilks, 64, Fitzjohn's Ave., N.W.3. Tel. Ham. 4744. [8443

SITUATIONS VACANT

ANTARCTICA.

VACANCIES exist for wireless operator mechanics to serve with the Falkland Islands Dependencies Survey in the Antarctic for two years. Candidates must be able to transmit and receive Morse at 20 w.p.m. (plain language or code) and be capable of elementary maintenance of wireless transmitting and receiving equipment. Salaries are at a basic rate of £500 a year with extra allowances for qualifications and experience. Persons appointed will be expected to leave the U.K. in October/November. Whilst in the Antarctic everything is provided free of charge, including clothing, cigarettes, etc. Liberal leave on full salary. While on duty in U.K. an extra allowance of £150 a year is paid before departure and £200 a year on return.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote N2C/50534/WF. [8482

DAVY AND UNITED ENGINEERING COMPANY LIMITED.

INVITE applications for vacancies in their rapidly expanding Instrument Division, for electronic engineers for design and development of industrial controls and instruments. Applicants should have a degree in physics or electrical engineering with several years experience on the design of electronic circuits. Successful candidates will be expected to spend a certain amount of time away from Sheffield in commissioning new equipment.

GOOD conditions. Dining facilities. Contributory pension scheme.

APPLY in writing with full details of age, experience, etc., to: Personnel Department, Davy and United Engineering Co., Ltd., Darnall Works, Sheffield, 9. [8454

W. BRYAN SAVAGE, Ltd., invite applications for the following appointments:—

TECHNICIAN tester: preferably H.N.C., with some experience of vibration and/or environmental test techniques, and should have served a recognised apprenticeship.

TECHNICIAN draughtsman: preferably with H.N.C. with at least three years drawing office experience and should have served a recognised apprenticeship; knowledge of vibration test techniques would be an advantage.

APPLY by letter in the first instance to—W. Bryan Savage, Ltd., No. 2 Factory, Dalston Gdns., Stanmore, Middlesex. [8463

YOUNG man required to manage showroom specialising in the sale of high fidelity equipment; London area; technical knowledge essential, good prospects, references would be required.—Box 2865. [8480

TELEVISION bench and field engineers required at all times for vacancies in most parts of the British Isles; permanent positions with highest salaries plus bonus for suitable applicants, 5½ day week.—Box 1757. [0251

TECHNICIAN for clinical and research work in Cardiological Department of St. Thomas' Hospital, S.E.1; experience in use of blood-gas apparatus and electro-manometry desirable.—For full particulars, apply Personnel Officer. [8425

REQUIRED, for servicing of electrical equipment, a young technician having made special study of high-frequency engineering, or amateur radio enthusiast with experience in mechanical engineering; living in London area; some knowledge of German useful.—Box 2841. [8474

TELEVISION engineers first-class, experienced men required immediately for field service; competence and efficiency will be rewarded with a salary in the range of £700-£950 p.a., and a permanent position.—Apply at once to The Secretary, Leytonia Radio, Ltd., Head Office, 784-8, H'gh Rd., Leyton, E.10. [8375

WANTED, agents for all parts, with connections, for a new product, "Hand Protector Alarm"; sample can be carried in your pocket as an additional line; wonderful scope for good salesman.—Particulars of contacts to Adler Alarm Co., 3, Cork St., London, W.1. [8444

MINISTRY OF SUPPLY, Royal Aircraft Estab., Aberporth, Cardigan, requires experimental officers (min. age 28), as (a) launcher officers for firing of missiles and (b) displays officer. Quals. H.S.C. (Science), H.N.C. or equiv. and for (a) engineering background with knowledge of electronics or elec. eng. and explosives, (b) experience in design of radar displays of electronic computer circuits or of centimetric radar equipment. Salary £954-£1,166 (male). Forms from M.L.N.S. Technical and Scientific Register (K), 26, King St., London, S.W.1 (quote D 157/9A). Closing date 12 May, 1959. [8476

ASK TO HEAR DUODE

AT YOUR LOCAL MUSIC OR RADIO SHOP

IF FOR ANY REASON IT CANNOT DO THIS THEN DON'T WAIT OR BE PUT OFF.

WRITE AT ONCE TO US FOR DETAILS OF OUR HOME TEST PLAN.

INSIST ON HEARING THE NEW DUODES.

DUODE LTD.
24 Dingwall Road, Croydon Surrey

BRASS, COPPER, DURAL, ALUMINIUM, BRONZE

ROD, BAR, SHEET, TUBE, STRIP, WIRE
3,000 STANDARD STOCK SIZES
No Quantity too Small. List on Application.
H. ROLLET & Co. Ltd.
6 Chesham Place, S.W.1. *SLOane* 3463
ALSO AT LIVERPOOL, BIRMINGHAM, MANCHESTER, LEEDS

---

you can build a quality

TAPE RECORDER
with the
'ASPDEN'
Tape Recorder Kits

TAPE DECK KITS
Two models, 5in. or 7in. spools, two speeds, twin track, ferroxcube heads, finest motor, and complete assembly instructions.
Compact model 582 kit.............. £8 5 0
Standard model 782 kit.............. £9 5 0
Assembled and tested 30/- extra.

And the
RECORD/REPLAY AMPLIFIER KIT, 2¼ watt, neon indicator, without valves, £5/18.
POWER PACK KIT for above, less valve, £2/18/6. Carr. extra.

Mr. R. White of Ireland writes:
" The performance of the recorder is very good and I recommend it to all those who wish to get 1st class performance at approx. half cost."

NEW:—'STANLEY' TAPE POSITION INDICATOR Clock Type £2/5/0.

Send STAMP for full particulars to:—
W. S. ASPDEN
Stanley Works, Clevedon Road, Blackpool, Lancs.

SITUATIONS VACANT

"A" licensed radio engineer required; good salary.—Apply Chief Engineer, Morton Engineering Services, Ltd., Croydon Airport, Surrey. [0251

TECHNICAL foreman required by well-known firm in Surrey area, age 30-35; previous experience in supervision of amplifier and preferably transformer production essential.—Full details of experience and salary required, Box 2276. [8421

TANNOY PRODUCTS, Ltd., have vacancies in London for qualified bench and field engineers, experience of high-quality audio reproduction essential, progressive posts.—Apply in writing stating details of experience, etc., Norwood Rd., West Norwood, S.E.27. [8434

SENIOR Draughtsmen for electronic and electro-mechanical work to sevice requirements; permanent positions, ideal working conditions, 5-day week, all amenities.—Write or tel., Cottage Laboratories, Ltd., Portsmouth Rd., Cobham, Surrey. (Cobham 3191). [8436

ENGINEERS with some five years practical experience of radio frequency design work required for interesting new project in laboratory situated in South West outskirts of London, pension scheme.—Write giving full particulars of experience and salary required to Box 2409. [8433

GENERAL Manager for new semi-national television maintenance company; must be fully qualified T.V. engineer and have ability to develop, organise and control large outside and bench staff; remuneration by salary and profit sharing will produce £2,000 per annum. —Box 2651. [8445

ELECTRONICS technician required for chemistry teaching and research laboratories; responsible for design, construction and maintenance of equipment; salary according to qualifications but on the scale £440 p.a. to £590 p.a.—Apply in writing to the Bursar, the University, Sheffield, 10. [8450

DEVELOPMENT engineers and technical assistants required for interesting work on communications, test, and industrial control equipment; applicants should have degree or national certificate; progressive, pensionable appointments.—Apply Personnel Officer, Airmec, Limited, High Wycombe, Bucks. [8423

ELECTRONICS technician required to construct and service amplifiers and control equipment; successful candidate will become member of a team studying the biological effect of fast neutrons.—Full particulars to Administrative Officer, Radiobiological Unit, Medical Research Council, A.E.R.E. Harwell, Berks. [8455

WORKS manager required for old-established electrical measuring instrument manufacturing company on the South Coast; excellent prospects, good salary to the right man; applicants must have at least 10 years' actual experience of manufacture of indicating electrical measuring instruments.—Full details of experience to Box 2385. [8429

ELECTRONIC engineers wanted to train as project leaders to take charge of overseas contracts; candidates should be single, medically fit, and in age group 24-30, and be willing to work abroad for periods up to 2 years; qualifications B.Sc., H.N.C. or equivalent; practical experience in hydrographic or other survey work an advantage.—Box 2398. [8430

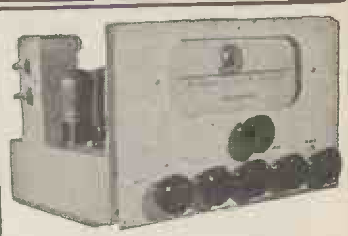
INSPECTION foreman required by a large London engineering company; applicants should have had previous experience on the test and inspection of electronic and television components and up-to-date knowledge of modern techniques desirable; a good salary and company superannuation scheme available. Please reply, giving full details to—Box 2786. [8464

TEST Engineers: vacancies exist for senior Test Engineers with previous industrial experience of testing radio communication transmitters and receivers: positions are permanent and progressive; starting salaries will be commensurate with qualifications and experience.—Apply giving full details to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18. [8465

RADIO Technicians required by International Aeradio Ltd. for overseas service. Permanent and pensionable posts. Normally tax-free, inclusive salary in local currency varying with location, and additional marriage and child differentials. U.K. leave, free air passages and insurance. Kit allowance. Qualified candidates to whom replies will be sent write to Personnel Officer, 40, Park St., W.1. [0262

OPPORTUNITY for smart educated youngster to join (as a trainee) small sound recording company covering all aspects of sound reproduction; London area W.1; essential qualifications—practical basic knowledge of electronics, loyal with sporting outlook, drive and energy; interested in sales, office and practical work; commencing salary £260 p.a.—Full details to Box 2842. [8473

A PHYSICIST or engineer is required for development work on a wide range of acoustic problems including ultrasonic pulse transducers, electro-acoustic filters and ultrasonic flaw detection, the applicant must have a good academic record and a thorough background of experience in this or allied fields; he must be capable of initiating work and carry it through without close supervision; a progressive salary will be paid and pension scheme is in operation.—Please send details immediately to Glass Developments, Ltd., Sudbourne Rd., S.W.2. [8391



The Fidelia Major design has provided the answer to many customers who were looking for something better. It has a tuned R.F. stage on all wavebands and uses a four gang tuning condenser for the Short-Medium and Long wavebands, as well as a completely separate tuning section for the VHF/FM band. The circuit has a full tone control network with separate bass and treble controls. The gramophone replaying facilities include a pre-amplifier and input attenuator that enable any type of pick-up generally available to be used, and compensation is provided for L.P., R.I.A.A. and 78 characteristic curves. This model costs £28/10/- as a tuner unit and £44 complete with our Major amplifier. Models can also be built for stereophonic record reproduction.

Some other models in our range are:—

Imperial (Illustrated), VHF reception plus the full gramophone replaying facilities of a fine pre-amplifier/tone control unit. Price £20, or with our Major 10 watt amplifier, £38.

Preciton. VHF tuner unit £15, with pre-amplifier/tone control facilities, £20, or as a small radiogram chassis, £22.

Fidelia, Mk. 1 Stereophonic amplifier with control Unit, £25.

All Hand-built in the Fidelia tradition.

Demonstrations by appointment any time including weekends.

Catalogue willingly on request. (6d. for postage is appreciated.)

ELECTRO Acoustic DEVELOPMENTS

2 AMHURST ROAD, TELSCOMBE CLIFFS
Nr. Brighton, SUSSEX
Tel. Peacehaven 3156

A. K. & L. G. SMITH LTD.
CONSULTANTS & AGENTS

For the Sale, Licensing and Exploitation of Patents and Inventions.

38 Nunhead Lane, Peckham, London, S.E.15
Telephone: NEW Cross 7325

METERS

WE CAN SUPPLY WITHIN 7-14 DAYS

a complete range of moving coil—moving iron—electrostatic—thermocouple—also multirange meters—meggers—pyrometers and laboratory test instruments, etc.

All to B.S.89

Instruments tested and standardised on our premises, and replacements supplied from our stock.

REPAIRS

Delivered 7-14 days

Our skilled craftsmen carry out repairs or convert any types and makes of single and multirange meters.

Where desired repairs are accepted on contract.

THE V.Z. ELECTRICAL SERVICE
9, NEWPORT PLACE, LONDON, W.C.2.
Telephone: GERrard 4861 *(Retail 2613)*

SITUATIONS VACANT

INSTALLATION and commissioning engineer a vacancy exists for an engineer who has had previous experience of the installation and commissioning of V.H.F. radio-telephone systems, knowledge of frequency modulated V.H.F. equipment essential; experience on telephone switching methods would be an advantage; the post entails extensive travel overseas.
THIS post is pensionable. State previous experience, age and whether married or single. All applications will be treated in confidence.—Box 2759. [8461

THE RANK ORGANISATION requires the services of an electronic engineer for work on relay systems in laboratories at Kew; about 20-25 years old, with some technical training and experience; good starting salary; pension scheme, etc.; write with full note of education, training and experience to the—Personnel Adviser (B117), The Rank Organisation, 11, Belgrave Rd., London, S.W.1. [8460

RADIO technicians of all grades are invited to apply for interesting and varied positions in car radio servicing; a high standard of practical and theoretical knowledge is required; excellent conditions of service, 5-day week, pension scheme.—Write in strict confidence to The Staff Manager, S. Smith & Sons (England), Ltd., Cricklewood Works, London, N.W.2, quoting reference SM/170. [8452

ELECTRONIC engineer required for design and proving equipment used for testing radio valves, cathode ray tubes, transistors, etc.; experience of stabilised power supply units and electronic circuitry necessary, together with technical education to H.N.C. standard.—Apply to Group Personnel Officer, Siemens Edison Swan, Ltd., Cosmos Works, Brimsdown, Enfield, Middlesex. [8426

UNIVERSITY Medical School requires an electronic engineer to work with psychologist dealing with problems in experimental psychology; this post calls for flair in apparatus design and construction; candidates should have good background in general workshop practice; salary scale £675-£820.—Applications should be sent to the Secretary, Institute of Psychiatry, The Maudsley Hospital, Denmark Hill, S.E.5. (Ref. U.S.A.P.) [8427

RADIO operators.—Air Ministry have vacancies for temporary radio operators (male) good prospects of permanent pensionable appointments and promotion initial appointments in U.K. but subsequent tour of duty in Far East likely; trainees £422 10s to £605; qualified operators £507 10s to £975 (these rates are subject to a small deduction at provincial stations and a small increase in London and overseas); special allowances payable for overseas service.—Apply Air Ministry C.E.4m., Cornwall House, Stamford St., S.E.1. [8432

A VACANCY has arisen in the design laboratory for an engineer to assist in the mechanical design of radio and television receivers for home and export; applicants should have a good knowledge of designing receivers for mass-production, and preferably with experience of plastics and moulding techniques; an appointment will be made at a salary commensurate with age, experience and qualifications, details of which should be forwarded in writing in the first instance to the Personnel Manager (R.17), Murphy Radio, Ltd., Welwyn Garden City, Herts. [8470

ASSOCIATED-REDIFFUSION invites applications from television or broadcasting engineers to fill future vacancies in the company; the duties include operation and maintenance of the company's broadcasting equipment; successful applicants will be required to work shift hours and will be based either at Television House, Kingsway, or at the company's Wembley studios; applicants must have at least 3 years' experience in television broadcasting or transmission, or hold recognised electrical engineering qualifications. —Applications should be made in writing to A.G.M. (Staff), Associated-Rediffusion, Ltd., Television House, Kingsway, London, W.C.2. [8424

PATENT examiners and patent officers.—Pensionable posts for men or women for scientific, technical and legal work on Patent applications; age at least 21 and under 28, with extension for regular Forces Service and Overseas Civil Service. Qualifications; normally first or second class honours degree in physics, chemistry, engineering or mathematics, or equivalent attainment, or professional qualification, e.g., A.M.I.C.E., A.M.I. Mech.E., A.M.I.E.E., A.R.I.C. London salary (men) £635-£1,410; provision for starting pay above minimum; promotion prospects.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application form, quoting S128/59. [8458

RADIO Technician required by the Meteorological Department United Kingdom of Libya on contract for 3 years in the first instance; probationary period one year. Fixed salary £1,000 a year. Liberal leave on full salary. Free passages for officer, wife and 3 dependent children under 18 years. Candidates, preferably single, must have considerable recent experience in use of lower power communications equipment, in setting up stations in the field and in maintenance of all radio, aerial and power equipment, and must have capacity for improvisation when necessary.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2C/50550/WF. [8442

SITUATIONS VACANT

WORKS manager, to control small Electronics business in central London area; give full particulars of experience and salary required.—Box 2535. [8435

SMART young man required as radio and T.V. engineer for Wisbech, able to drive; good wages and prospects.—State age and details of experience to Fells, Ltd., Nene Quay, Wisbech. Cambs. [8422

MINISTRY OF TRANSPORT AND CIVIL AVIATION requires electrical engineers (assistant signals officers) for aviation telecommunications and electronic navigational aids. Minimum age 23, 1st or 2nd class degree in physics or engineering, or A.M.I.E.E. or A.F.R.Ae.S. (candidates with Parts I, II & III of A.M.I.E.E. or Parts I and II of A.F.R.Ae.S. or equivalent, or of very high professional attainment without these qualifications considered); salary £665 (age 23) to £1,085 (age 34) maximum £1,250, slightly lower outside London and for women, 5-day week.—Further details and forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1; quoting D.70/9A. [0322

SENIOR scientific officers (a); Scientific officers (b).—Pensionable posts for men or women in all major scientific fields, including physics, chemistry, biology, meteorology and mathematics. Age limits: (a) at least 26 and under 31 (b) at least 21 and under 28; extension for regular Forces Service and Overseas Civil Service. Qualifications: normally first or second class honours degree in science, mathematics or engineering, or equivalent attainment; additionally for (a), at least 3 years' relevant (eg., post-graduate) experience. London salaries (men): (a) £1,190-£1,410; (b) £635-£1,110; provision for starting pay above minimum; promotion prospects.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application form, quoting (a) S53/59. (b) S52/59. [8459

UNIVERSITY OF SOUTHAMPTON.—Instrument mechanic or tool maker, preferably under 30, required for the mechanical workshop of the electronics department; applicants should be able to do their own milling and turning and be capable of producing mechanical apparatus on a "one-off" basis; experience of precision work is desirable but no experience of electronic techniques is required; excellent working conditions, hours and holidays; salary scale £420×£20 to £570 per annum, starting salary according to age and experience; staff superannuation scheme.—Applications in writing, giving full details of experience and qualifications, together with the names of 2 persons to whom reference may be made, should be sent to the Secretary and Registrar, as soon as possible. [8451

TELECOMMUNICATIONS inspector required by British Railways at York; applicant must have wide practical experience, including theoretical knowledge of electronic equipment including V.H.F. radio, line transmission, overhead line and cable construction, carrier telephone and automatic telephone exchange systems; applicant will be required to test all types of telecommunications apparatus and instruct personnel in the maintenance of equipment throughout the North Eastern Region; a technical standard of Higher National Certificate or equivalent is desirable, but consideration will be given to an otherwise suitable applicant; pension scheme, free travel facilities; salary £798 to £857 per annum.—Apply in writing to Signal Engineer, British Railways, York, giving full details of experience, qualifications and age, etc. [8457

SIGNAL Technician required by Kenya Government Police Force on agreement for tour of 24-45 months in first instance with prospect of permanency. Commencing salary according to age and experience in scale (including Inducement Pay) £813 rising to £1,341 a year. Outfit allowance £40. Free passages for officer and wife and assistance towards cost of children's passages. Liberal leave on full salary. Candidates, preferably not over 40 years of age, must have wide knowledge of installation, running and maintenance of H.F. communication equipment, fixed and mobile V.H.F. equipment and installation and maintenance of ancillary equipment. Experience with V.H.F. multi-channel equipment, teleprinters or facsimile equipment would be an advantage.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/50288/WF. [8441

TECHNICAL officers required by Kenya Government Broadcasting Department on contract for one tour of 24/45 months in first instance. Commencing salary according to qualifications and experience in scale (including Inducement Pay) £1,056 rising to £1,341 a year. Gratuity at rate of 13½% of total salary drawn during contract. Outfit allowance £40. Free passages for officer and wife and assistance towards cost of children's passages. Liberal leave on full salary. Candidates, between 30 and 45 years of age, must have had considerable practical experience in the operation and maintenance of High Power medium and short wave transmitters and associated equipment or of modern Broadcasting Studio apparatus including tape and disc recorders and line equipment. They should preferably be graduates of a recognised radio or electrical institution and/or possess appropriate C. and G. Certs.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2C/50467/WF. [8477

SITUATIONS VACANT

EXPERIENCED radio salesman required for service in Aden by large, old-established company, must have technical knowledge of radio receivers and be good organiser; good salary and prospects, free accommodation, living allowance.—Apply with full details Box 2687. [8453

SITUATIONS WANTED

RADIO engineer requires position, Ayr or Prestwick, abroad, Commonwealth or overseas, with firms of repute; Radio I, II, III.—55, Prestwick Rd., Newton on Ayr, Ayr. [8479

RETURNING immigrant, Scottish (last 4 years Canada), 45, desires position as service engineer; have been working Canada on radio, valve and transistor, and t.v. servicing; prefer South Coast or South-West coast location.—Box 2734. [8456

TECHNICAL TRAINING

BRIT.I.R.E. and City and Guilds Examinations in Telecoms, Radio Amateurs and Radio Servicing (R.T.E.B.).—Learn at home from world-famous International Correspondence Schools, 71, Kingsway (Dept 442B), London, W.C.2. [0359

CITY & GUILDS (electrical, etc.) on "No Pass—No Fee" terms; over 95% successes. —For details of modern courses in all branches of electrical engineering, applied electronics, automation, etc., send for our 148-page Handbook—free and post free.—B.I.E.T. (Dept. 388A), 29, Wright's Lane, London, W.8. [0017

TUITION

FULL-TIME courses for P.M.G. Certificates, C.G.L.I. Telecommunications and Radar Maintenance Certificates.—Information from College of Technology, Hull. [0111

WIRELESS.—See the world as a radio officer in the Merchant Navy; short training period, low fees, scholarships, etc., available, boarding and day students; stamp for prospectus.—Wireless College, Colwyn Bay. [0018

ALL examinations easier to pass by I.C.S. home-study methods. A.M.Brit.I.R.E., C. & G. Telecoms, P.M.G. Cert. in Wireless, Telegraphy, Radio and TV Servicing, etc.—Write for free prospectus: International Correspondence Schools, 71, Kingsway (Dept. 442A), London, W.C.2. [0033

LEARN-AS-YOU-BUILD course in basic radio, electronic and electrical theory with practical training building a 4-valve TRF and 5-valve superhet radio receiver; signal generator and high-quality multi-tester; write for free book.—International Correspondence Schools, 71, Kingsway (Dept. 442), London, W.C.2.

A.M.I.Mech.E., A.M.Brit.I.R.E., City & Guilds, G.C.E., etc., bring high pay and security: "No Pass—No Fee" terms; over 95% successes.—For details of exams and courses in all branches of engineering, building, electronics, etc., write for 148-page Handbook—free.—B.I.E.T. (Dept. 387B), 29, Wright's Lane, London, W.8. [0118

T/V and Radio.—A.M.Brit.I.R.E., City and Guilds, R.T.E.B., Cert., etc., on "No Pass—No Fee" terms; over 95% successes.—For details of exams and home training courses (including practical apparatus) in all branches of radio, T/V and electronics, write for 148-page Handbook—free.—B.I.E.T. (Dept. 397A), 29, Wright's Lane, London, W.8. [0116

AUTOMATION. Authoritative courses are now available in Digital and Analogue Computer Technology. Applied Electronics, Data Processing and Instrumentation up to professional level by home study. Individual enrolment or industrial group scheme enrolments accepted. Syllabuses and prospectus sent on request. Write (Dept. S.E.11), E.M.I. Institutes School of Electronics, College House, Kensington, London, W.8. [0114

INCORPORATED Practical Radio Engineers home study courses of radio and TV engineering are recognised by the trade as outstanding and authoritative; moderate fees to a limited number of students only; syllabus of instructional text is free; the Practical Radio Engineer, journal, sample only 2/-; 6,000 alignment peaks for superhets, 5/9; membership and entry conditions booklet 1/-, all post free, from the Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8. [0088

BOOKS, INSTRUCTIONS, ETC.

OSCILLOSCOPE Book, 5/4; Television Faults, 5/4.—Fuller, 72, Leeds Rd., Shipley, Yorkshire. [8478

THE Radio Amateur's Handbook (39th edition/1959), standard manual of amateur radio communication from the American Radio Relay League, now available at 32/- post free from.—Bailey Bros. & Swinfen, Ltd., West Central St., London, W.C.1. [8437

CLASSIFIED ADVERTISEMENTS

Use this Form for your Sales and Wants

To "Wireless World" Classified Advertisement Dept., Dorset House, Stamford Street, London, S.E.1

PLEASE INSERT THE ADVERTISEMENT INDICATED ON FORM BELOW

- **RATE: 7/- for TWO LINES. 3/6 every Additional Line. Average six words per line.**
- **Name and address to be included in charge if used in advertisement.**
- **Box No. Allow two words, plus 1/-.**
- **Cheques, etc., payable to Iliffe & Sons Ltd., and crossed "& Co."**
- **Press Day, Wednesday April 29th for June 1959 Issue.**

NAME ....

ADDRESS ....

....

			REMITTANCE VALUE..........ENCLOSED		

Please write in block letters with ball pen or pencil.

NUMBER OF INSERTIONS ....

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14.

Up to 10 times longer bit life

with SAVBIT *Type 1 Alloy*

The left hand bit was used with Savbit alloy and has made 10,000 joints. The centre bit was used for 1,000 joints and the bit on the right for 7,500 joints, each with a standard tin/lead alloy.

Ersin Multicore Savbit Type 1 Alloy incorporates a small percentage of copper, thus preventing absorption of copper from the soldering iron bit and extending the life of copper bits up to 10 times.

Savbit does not reduce soldering speed; in fact, by keeping the soldering iron bits in good condition it actually increases soldering efficiency. It has been tested and proved on many production lines. Write for further information to the Multicore Service Department.

Ersin Multicore Savbit Alloy is used by Bush Radio Ltd., in the manufacture of their new push button television receivers.

SAVBIT FOR FACTORIES

Ersin Multicore Savbit Type 1 alloy containing 5 Cores of non-corrosive flux is supplied to factories at bulk prices on 7 lb. reels. 16 and 18 s.w.g. are the diameters most suitable for the majority of soldering processes. Supplies are also available on 1 lb. reels.

SAVBIT FOR THE SMALL USER

The Size 1 Carton contains approximately 53 ft. of 18 s.w.g. SAVBIT. It is also supplied in 14 s.w.g. and 16 s.w.g. Obtainable from radio and electrical stores. Ersin Multicore 5-Core Solder is also supplied in 4 specifications of Standard Tin/Lead alloys.
Price 5/- each (subject).

SAVBIT FOR THE SERVICE ENGINEER

Approx. 170 ft. of 18 s.w.g. SAVBIT is supplied on a 1 lb. reel packed in a carton. Price 15/- each (subject).

SPECIAL HIGH AND LOW MELTING POINT SOLDERS

Comsol (Melting point 296°C)
P.T. (Melting point 232°C)
L.M.P. (Melting point 179°C)
T.L.C. (Melting point 145°C)

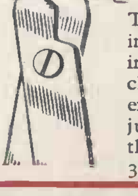
STANDARD TIN/LEAD ALLOYS

Ersin Multicore 5-core Solder is available in the following standard alloys:
60/40, 50/50, 45/55, 40/60, 30/70, and 20/80 and in 9 gauges on 7 lb. and 1 lb. reels.

HOME CONSTRUCTOR'S 2/6 PACK

Now available containing alternative specifications: 19 ft. of 18 s.w.g. 60/40 alloy or, for soldering printed circuits, 40 ft. of 22 s.w.g. 60/40 alloy. Both wound on Reels. 2/6 each (subject).

Bib WIRE STRIPPER AND CUTTER



This 3 in 1 tool strips insulation without nicking the wire, cuts wire cleanly and splits plastic extruded twin flex. Adjustable to most wire thicknesses.
3/6 each (subject).

Bib RECORDING TAPE SPLICER

Recording enthusiasts can effect considerable tape economies with this splicer. It makes the accurate jointing of tape so simple and quick that every scrap can be used.
18/6 each (subject).

A free copy of an interesting article "How to Edit Tape Recordings" will be sent you if you will kindly send us a stamped addressed envelope.

MULTICORE SOLDERS LIMITED, MULTICORE WORKS, HEMEL HEMPSTEAD, HERTS. (BOXMOOR 3636)