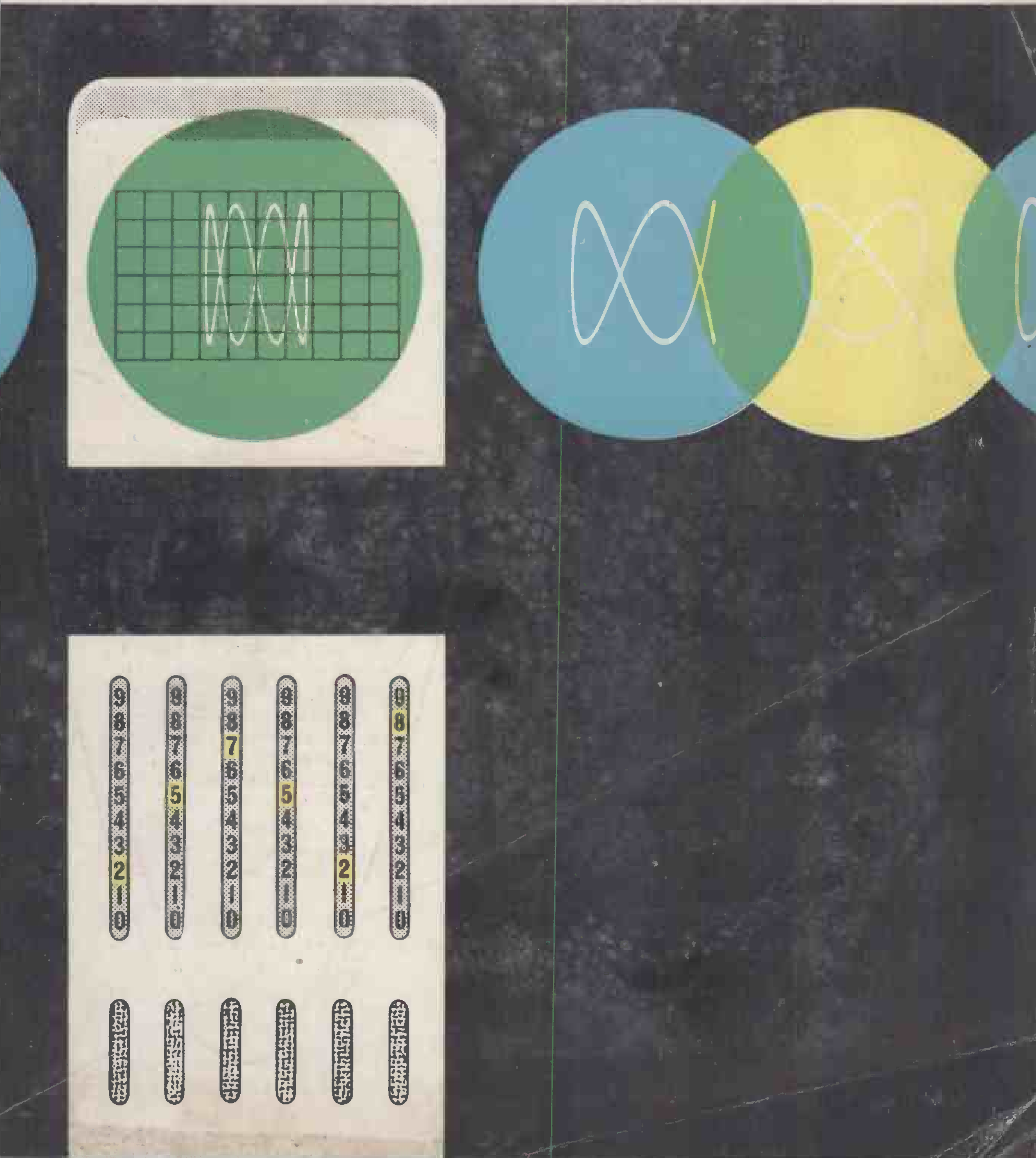
/2 Fullerwood

Wireless World

ELECTRONICS
RADIO
TELEVISION

DECEMBER 1961 Two Shillings and Sixpence



iia 73

Wireless World

ELECTRONICS, RADIO, TELEVISION

DECEMBER 1961

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

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

Assistant Editor:
H. W. BARNARD

Editorial:
P. R. DARRINGTON
M. G. LAZENBY
R. H. OLIVER
W. J. A. WOODYER

Drawing Office:
H. J. COOKE

Production:
D. R. BRAY

Advertisement Manager:
G. BENTON ROWELL

VOLUME 67 No. 12.
PRICE: 2s. 6d.

FIFTY-FIRST YEAR
OF PUBLICATION

Iliffe Electrical Publications Ltd. *Managing Director:* H. S. Pocock, M.I.E.E.
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). *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* "Ethaworld, London-SE1." *Annual Subscriptions: Home and Overseas,* £2 0s. 0d. *Canada and U.S.A.*, $5.50. Second-class mail privileges authorized 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:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

Wireless World

VOL 67 NO. 12 DECEMBER 1961

Over the Hump

THIS month the 60th anniversary is being celebrated of one of the most famous and, let us face it, controversial events in the history of wireless communication. It was in December, 1901, that Marconi announced that he had been able to receive at St. Johns, Newfoundland, the succession of triple dots sent out by the 20-kW spark station at Poldhu on a daily schedule from 3 p.m. G.M.T. onwards. The signals were heard at 12.30 p.m., 1.10 p.m. and 1.20 p.m. local time on 12th December and again less distinctly on the following day. On the 14th December Marconi abandoned further experiment owing to the weather, cabled the news of his success to his Company and informed the Press.

The whole project had been carried through under a certain amount of stress—of time (in order to ensure priority over possible rivals) and of weather. Widespread gales had brought down the original Poldhu aerial and a smaller temporary aerial had to be used; the balloons and kites used instead of tall masts at St. Johns had proved to be well nigh unmanageable in the winds then prevailing, and the variation of capacitance with the pitching of the kites prevented the use of the latest syntonic (tuned) receiver. The experimenters did have, however, a variety of sensitive coherers (detectors). These included "microphone" types consisting of loose carbon granules or a mixture of carbon dust and cobalt filings (Marconi's own formulation) and a sensitive self-restoring type, due originally to Tomassina and later used by the Italian navy, in which a globule of mercury was contained between carbon and iron electrodes. All these were used in series with a battery and a telephone earpiece—a far more sensitive arrangement than the earlier "tapper" coherer, relay and morse inker.

The news which Marconi gave to the world was received with astonishment and by his competitors with incredulity. But his confidence was unshaken. Within three months he had set out to repeat the experiment, this time on board the s.s. *Philadelphia*, outward bound, using this time the syntonic receiver and the self-restoring Italian navy coherer. In daylight signals from Poldhu could be received only up to 700 miles, but at night messages were recorded on tape up to 1,550 miles, and the letter S signals up to 2,099 miles.

So the scientific sceptics, whose calculations of diffraction over a curved surface had predicted failure of any attempt to span the Atlantic, were refuted. The Canadian Government was sufficiently confident to advance £16,000 for a transmitting station at Glace Bay and by successive increases of wavelength and power during the next year or two good contact was established at night, but it was not until the summer of 1905 that reliable signals were recorded at Poldhu from Glace Bay, with both stations in daylight. Eventually the Clifden station took over the transmission from this side of the Atlantic and a limited public telegraph service was opened in October, 1907, and an unlimited service from February, 1908, continued until the Clifden station was burnt down in 1922.

Looking back to that boisterous day in 1901, with our present knowledge of radio propagation and of the trials and difficulties which followed, we must be grateful for the fluke which gave Marconi the optimism and courage to persist. He was extremely lucky. No one then knew that daylight was the worst time to conduct such experiments, but this "mistake" was offset by the fact that he could not have chosen a better year than 1901, which was at sunspot minimum, or a better month of that year, when the absorbing D layer of the ionosphere was to all intents and purposes non-existent. The difficulties in repeating the initial success could be partly accounted for by the rise in sunspot activity in the following years and it was probably not until increasing absorption had been overtaken by the rate of increase of powers and wavelengths, that the fruits of the 1901 experiment were safely gathered.

To commemorate the anniversary the Science Museum, South Kensington, is arranging an exhibition of early Marconi apparatus which will be on view from 13th December to 25th January, and on the 12th December the Cornish Group of the R.S.G.B. in conjunction with the Newfoundland Radio Club are planning to exchange messages on the amateur bands between Signal Hill and Poldhu. This is a most imaginative gesture, and we congratulate all concerned in advance on what will undoubtedly be a successful and enjoyable event. Would it be asking too much to suggest that on a future occasion, near sunspot minimum, they endeavour with the permission of the P.M.G. to repeat the contact on some wavelength between 1,000 and 2,000 metres, using at the receiving end all the modern techniques, but making the transmitted power as near as can be estimated to that of the original Poldhu? It is unlikely that the powers that be would take kindly to a 20-kW spark but might be lenient towards a temporary c.w. transmitter of equivalent and therefore lower spectral power level. The results would be illuminating and would, we think, give added force to Sir Oliver Lodge's assessment of Marconi's achievement that "it constituted an epoch in human history on its physical side, and was itself an astonishing and remarkable feat."

OPEN LETTER TO

THE PILKINGTON COMMITTEE

Dear Committee

CONCERNED as you are to advise about the future of our broadcasting service you will doubtless have looked closely at its past. And having done so you may have concluded that the technical means by which broadcasting is consummated has been a dominant factor in determining the ends to which it has been put. Assuming this is an agreeable conclusion then it follows that the future of broadcasting will be shaped, in large measure, by the available technical facilities. The acceptance of this important generality should excuse the intromission of one who was a Founding Father of the B.B.C. and who, *circa* 1925, as the B.B.C.'s first Chief Engineer, planned a technical system for programme distribution which accorded with the ideological policies laid down by Lord Reith.

The creation of the B.B.C. was not, as some have pompously stated, "a wise measure of sociological planning" it was in fact a means to solve an intractable technical problem. The original demands from private enterprise to be given channels for the purpose of advertising greatly exceeded the number which could be used simultaneously without mutual interference. In these circumstances it was decided to grant a monopoly to one organization which was ordered to do broadcasting "to the satisfaction of the Postmaster General." This organization was to be known as the British Broadcasting Company, later on it became the British Broadcasting Corporation.

A strange beast this B.B.C.! By civil service, out of compromise, tended in its youth by rich uncles, handed over in adolescence to public trustees, obedient to a constitution which defies a basic principle of democracy, it yet became the fervent supporter of free speech; strongly opposed to radio advertising yet making large profits through a publications department, sailing on "heedless of the gulls screaming round its mast," and as sensitive to criticism as a newly fledged debutante, the B.B.C. (may it live for ever!) is quintessentially British; and it came into being solely because of the limitations of communications technology.

Is a Monopoly Desirable?

But the B.B.C. no longer enjoys a complete monopoly; to the great sorrow of many sincere folk commerce has taken over part of the service (television) and is now insinuating its persuasions to have a similar control over a parallel sound-broadcasting service; it is up to you to recommend what to do, whether to give or to withhold.

In this connection you are in my opinion asked to answer an unanswerable question, namely, is a vicious principle justified by an admirable practice? The vicious principle is that which gives a single authority control over a powerful medium of propaganda, the admirable practice is demonstrated by the way the B.B.C. performs its duties.

But suppose that technical advances have abolished the channel shortage, what then! It might be said that, in these circumstances, the justification for the B.B.C. no longer exists and private enterprise might just as well take over. Assuming the abolition of channel shortage I am sure that the abolition of the B.B.C. would be an altogether retrograde step; while the B.B.C.'s institution was fortuitous its demonstrations have earned it a respect which should ensure its continuance.

It is of course possible and moreover, in my opinion, essential to preserve the B.B.C. but not necessarily by a continuance of its sound-broadcasting monopoly. It is my belief that freedom, in all its implications, is more important than the certainty of its abuse; the price of liberty is high but worth paying. If the channel shortage could be abolished or alleviated then broadcasting could be refreshed from more and more contrasted sources and would therefore match the pattern of liberal democracy more closely than it can today.

Criteria for a Democratic Service

When, some 35 years ago, I was acting as the authority's first Chief Engineer, I laid down certain principles and, with the limited means at our disposal, did my best to see them put into practice. These principles, which I consider to be sound even today, were that the transmission service should be planned so that

(1) everyone receiving the programmes should be assured of a reproduction of them free from interference;

(2) the quality of reproduction, in its faithfulness to the original, should, given a good receiver, be capable of reaching a high standard;

(3) that the listeners (in today's set-up the viewer as well) should be given a wide range of choice between contrasted types of programme. This implies that the claims of minorities are of paramount importance.

It may be of some interest to examine today's broadcasting service in the light of these principles.

Interference

As to clear reception, reception that is free from interference, my own experience makes me say that while there is a vast improvment now that the v.h.f. service for sound broadcasting has been instituted the very fact that quality has greatly improved makes the occasional unwanted noise and variabilities that accompany reception the more annoying. Passing motors too often cause plucking fingers to tweak my loudspeaker, passing aeroplanes pulse-modulate reproduction, a local electric motor sometimes imposes a whine while the mains hum drugs the ears. I use a low-priced receiver, which I suppose is typical of that used by a majority and so my judgment is not that of the high-fidelity enthusiast which could well be more favourable. I do not own a television set but often, by courtesy of friends and relations, watch the programmes. From time to time I am annoyed by the sudden intrusion of snow storms blotting out the picture; it could all be better, it has all been worse.

Quality of Reproduction

Still making it quite clear that I get my reception of sound programmes by the use of a low-priced receiver I would say that the quality of reproduction, while it gives a potent reminder of music in the original does not allow critical judgment of performance. Speech is clear and, apart from occasional interference and continuous hum, the latter being no fault of the sender, all reproduction has a silent background.

The small screen of a television set is its handicap. Because of its more comprehensive technical characteristics the larger cinema screen and the associated tricks of loudspeaker placing and conditioning makes a contrast to television in its more convincing effects upon an audience. This is not to say that television is necessarily second rate, it is to say that its technical limitations impose a greater strain upon the producer to get his effects than were more abundant facilities available.

Range of Choice Between Programmes

Coming to my third principle, that demanding a greater number of and a greater contrast between the character of programmes, it seems to me that the present lack of choice and the consequent failure to cater for minorities, in anything like the degree I would favour, constitutes the major criticism of the existing set-up.

There is a large and respectable body of opinion which denies the justification for the wide range of choice that I believe to be desirable. Strange, is it not, to hear the same voices deploring the shrinking of the provincial press and at the same time denying the need for local broadcasting? The liberal mind is often open but, when it receives an impression, it is inclined to snap shut and not let go; like those flowers which catch flies. It is wrong to assume that an increase of facility must imply an increase of futility; it can also favour serious causes. Those likely to turn up a scornful nose at what they consider would be the vulgarities which would invade a more provident technical system of broadcasting will be more likely to welcome the suggestion to increase the time given to, for instance, educational programmes. My occasional overhearing and overseeing these programmes has convinced me of their value and, believing as I do, that the most important aim of present day sociological organization should be in furthering education, in the full meaning of that term, I therefore believe that the provision of more channels and their use for education would be a major contribution to the community's eventual health and happiness.

The B.B.C. has given us a fine example in catering for a minority by its institution of the Third Programme, but it is sad that lack of channels makes it necessary to use the Third Programme wavelength for other purposes. Not that these other purposes are inferior, they too cater for minorities, but if only there were more channels there would be no reason to dilute one type of programme by another and another by one.

Is it not true that there is constant compromise with respect to the demands of Welsh cultural bodies to possess an exclusive channel for their use, and is it not desirable that they should?

The vulgarities which would doubtless invade other channels would seem to me to be an inevitable consequence of satisfying a majority. Why baulk the fact that the majority is not cultured and why not see that the problem of making it more appreciative is much deeper than shoving "cultchar" at it? The way to abolish the gutter press is to abolish the gutter, not the press.

Summary of Desirable Characteristics

Summarizing the examination of contemporary practice in the light of my three principles shows that interference, while not a serious matter, too often dilutes the pleasures of looking and listening, that the quality of reproduction given by an ordinary set, while adequate, leaves a good deal to be desired and that the range of contrasted types of programmes available for choice is woefully limited. Thus we could make an embracing summary by saying that what is needed is the provision of not only more channels but channels relatively clear of interference to which are coupled receivers which do more justice to the potentialities of good quality, inherent in the transmission, than do the average types in use today. How to achieve these aims demands some clear thinking.

Wire Broadcasting

It is obvious that the use of conductors (wire networks) to join the output from microphone (or camera and microphone) to the household receiver has potential merit. Interference can be virtually done away with, aeroplanes cannot modulate waves passing in conductors, induced voltages from domestic machines are of such relatively low intensity as to be dominated by the wanted signals, while the authority responsible for the design and maintenance of the receiver can assure the user good quality reproduction. A further merit of the use of wires is that the number of channels that can be made available is certainly greater than that provided by radio as it exists today. These are purely technical advantages; there are contrasting disadvantages.

Objections to Wire Broadcasting

Concerned only with technical issues the disadvantage of the use of conducting networks for the dissemination of programmes is that the wires will not reach economically beyond the confines of a densely populated area. Concerned with commercial vested interests there is opposition to wire broadcasting by those who profit from the manufacture and sale of radio receivers.

If for no other reason than that portable sets and car radios cannot be served by the wire it would be plain silly to consider shutting down the radio senders. This must set a limit to the oppositions of vested interests, but without doubt it persists. Perhaps it may be lessened by the popularity of the transistor portable.

But some of the arguments advanced against wire broadcasting demonstrate in their futility how fearful its opponents can be. When I was proselytising wire broadcasting a serious writer, whose strictures were published in a respectable technical journal, argued how dangerous it was to suggest setting up a system which could be so easily seized by a dictator, or a would-be one. This argument neglected the point that a pirate radio station could be far more widely heard than transmissions through wires and that once a dictator had power it would not only be the broadcasting services that he commandeered. And as to the use of radio receivers to pick up encouraging messages from abroad, if the country were enemy-occupied it is certain that jamming would be used if the occupying authorities thought it to be worth while.

Use of the Electric Power Network

R. E. H. Carpenter and I devised, *circa* 1930, a system for diffusing sound programmes through the electric power network. Fortunately for the Trade, it was found that an Act of 1882 forbade the practice, and in a Parliamentary debate Members demonstrated their loyalty to vested interests and refused to repeal the Act. So much for the liberty of inventors.

I see from your terms of reference that you, as a committee, are required to consider the use of wires for disseminating programmes. Well! Well!

Use of the Telephone Network

It was suggested, *circa* 1930, notably by the British Post Office, that the telephone network could be used for distributing programmes. The frequencies of the carrier waves injected into the network were to be within the long-wave band, i.e. those used by radio senders such as Droitwich, Hilversum, Paris. The reception would be available on an ordinary radio set equipped with a long-wave switch which was plugged into the network. It would appear that the Italian authorities already have such a system.

The limitations of the scheme are, of course, that it is available only to telephone subscribers. I should think also that if the subscribers' telephones were served by open-wire conductors that there would be severe interference from long-wave senders of telegraph signals but I am prepared to be wrong. Also, of course, the quality of reproduction would be typical of the ordinary radio set.

Overlapping in the Absence of Planning

The fact that the wire broadcasting method is chiefly practicable in urban areas makes one ask if it is reasonable to deny a facility to some because it cannot be given to all. The Corporation understandably considers it as a duty to spread its radio service throughout the territory for which it is responsible, but it is questionable whether this practice need be carried so far as to cause overlapping and, therefore, in a national sense, unnecessary expenditure. In recognizing this problem I suggest in my summing up, the formation of a technical committee of all the talents to plan a national system of programme distribution, taking into account local conditions and modern technology.

Potentialities of Centrimetric Wave Broadcasting

In contrast to the use of wire networks to increase facility it may be of interest to consider a scheme, impractical, perhaps, but worth describing, relying upon the use of centimetric-wave radio. The telecommunications engineer will agree, other problems inherent in the scheme assumed solved, that the use of centimetric waves to carry programmes would allow the simultaneous diffusion of enough programmes to satisfy the most importunate desire for increased facility. The basic problem would be to avoid shielding, meaning the casting of radio shadows by buildings, hills and so forth. There is an analogy with light. A single source of light suspended above a densely populated area would illuminate some parts but cast shadows in others. A canopy of light over the whole area would disperse the shadows and create a uniform illumination everywhere below it. Centrimetric waves would not, to their advantage, cast such clear-cut shadows as light, but the analogy is a fair one.

According to my suggestion a number of senders, transmitting centimetric waves, would be installed on high buildings, towers, hills and high ground, and would thus spray the houses of an urban area with their radiations. The sending aerials would comprise a number of half-wave types interconnected by folds of conductors not contributing to radiation and would be extremely efficient. Only the receiving aerials would be directional, looking like pudding basins and oriented to catch the strongest signal; they would be coaxially connected to the householders' receiving sets. These aerials would be less conspicuous than those picking up television transmissions today.

Interference would be negligible and quality of a high standard. The simplicity of the senders would make it practicable to leave the installation unattended as is successfully done with more complex equipment.

The disadvantage of the scheme, assuming that the effects of shielding could be wholly overcome (which is doubtful) is that the area over which the signals would be received would be limited to urban areas. But as I read the last sentence it struck me that we need not be too pessimistic about rural areas; on a clear day and standing on the heights of hills and mountains it is surprising how far one can see. Centimetric waves penetrate fog and rain and so the analogy of sight need not deny the practicability of the suggestion to serve rural as well as urban areas by these very short waves. There would be shielding everywhere but in what degree? The experts will give you the answer.

The adoption of centimetric waves would, of course, mean radical and costly changes to our present-day transmission system; perhaps in time the medium- and long-wave stations might be shut down leaving only those using v.h.f. to serve portables and car radios.

It is said, moreover, that there are more important uses for centimetric waves than their employment in the broadcasting service—one can guess what these more important uses might be and feel that in a sane world. . . . But the world is not, in some aspects, sane.

Television—Lines and Colour

On other issues the future of television and recommendations about lines and colour must engage your attention—I saw a comparison of pictures using 405 and 625 lines. My impression was that there was a distinction without much difference. It would seem to me to be advisable to recommend the 625-line system for no better, but no worse reason than that the majority of other systems throughout the world use the greater number of lines—export and all that.

And colour! No sane person would argue that, other things being equal, the introduction of colour to television would be anything but desirable. But other things are not equal and should make one pause.

I was particularly struck by the implication of a polemical question put to me by an American engineer: "Would you," he asked, "pay two to three times more to see a colour film than you would to see a black and white?" I said, "Certainly not" and so drew the obvious conclusion that it was not worth paying two or three times the cost of a normal type of television receiver to get colour reproduction. If it cost no more to produce colour the debate would hinge upon the quality of the picture, but in the circumstances the cost factor is dominant.

Eckersley's Law

In spite of the dominance of the cost factor I go further in questioning the advisability of setting up a colour transmission service in what I consider to be the present inadequate state of its development. I cite Eckersley's law defining an enjoyment factor. The law is that the product of the value of two numerics one proportional to the fidelity of reproduction and the other to the intrinsic interest in the matter reproduced is equal to a constant. Thus delight in the fidelity of reproduction of a dull programme compensates precisely for its dullness; conversely the outpourings of transcendental talent, or the demonstrations of dramatic interest, heard through distortion, has an enjoyment constant of equal value to that derived from "dull" multiplied by "hi-fi."

The impact of an exciting programme can be considerable, colour or no colour, and if the colour is of poor quality it subtracts from not adds to excellence. I have seen silent films in black and white which have stirred far more emotion in me than the most orchidaceous all-talking, all-singing, all-dancing affairs the impact of which is made by exuberance and elaboration. "The play's the thing" and one's sensibilities can be awakened by simplicity allied with taste without need for adventitious aids. Putting aside considerations of cost and quality the potential delights of witnessing a colour television broadcast from, for instance, the Chelsea Flower Show can be sympathetically appreciated but, as I see it, the result, in present-day colour, would be an oleographic horror; I would not pay an extra penny piece to see it. So let us wait a while, wait for technical developments reducing cost and improving quality.

These views will be unpopular but may perhaps seem the sounder when my critics are confronted by a dealer whispering the cost of a colour receiver.

In my view the efforts expended in developing colour television would be better devoted first to increasing the area of the television screen. While agreeing that there is a practical maximum to screen size I feel it has not yet been reached. I have listened with respectful attention to theories about subtended angles related to distance separating viewer and picture and have been told that a bigger screen viewed at a larger distance gives no better impression than a smaller looked at from a lesser distance, but I remain unconvinced. Has it not been said that it can be proved from a law of aerodynamics that a bumble bee cannot fly but the bee, not knowing the law, goes on flying?

Improvements in television technology, namely, colour and larger screens demand a wider sideband. Thus my basic plea for more channels, if accepted, would imply a wider total spectrum to contain all broadcast transmissions. If this spectrum were wide enough then there would be room not only for more but for wider channels; and centimetric waves would provide this wider spectrum.

A Committee of All the Talents

Have I by now succeeded in drawing a single thread of argument through the warp and woof of my discursions? Have I convinced a reader that the potentialities of broadcasting have not yet been fully realized because of the restrictions of its technology? The sheer weight of tradition has so far confined the service within narrow limits and deprived it of a full exhibition of its powers. And if restriction has been inherent in tradition can we dismiss tradition and discover a way to expand the technical means at our disposal so as to give a new stimulus to broadcasting?

Had I my way I would attempt to gather together a technical committee of all the talents and ask it to frame a plan capable of giving a majority of listeners a multi-programme service.

The basic difficulty in achieving a plan is the rivalry of vested interests be they of prestige or profit. I see the B.B.C. is anxious to demonstrate an ability to provide local programmes and estimates that it will cost £30,000 a year to stir the blood of Bournemouth. Would not a local committee be the right authority to provide occasional local programmes and get the money to run them from local advertising? This in passing, but as an example of rivalry rather than combination.

Is it necessary to be so tender about vested interests be they of commerce or prestige? To form our technical committees we have bodies skilled in installing and running wired systems; the Independent Television Authority could surely subscribe ideas, the B.B.C. stands in its integrity as the most experienced body concerning all aspects of broadcasting, the Post Office could add its quota of experience in the linking of studio output with transmitter input; in sum could not a combination of authorities frame a national plan of broadcasting to provide a wider range of programme distribution than exists today?

Conclusions

In all I have said the principle that liberty is of paramount importance rules my thinking. That its abuse is often nauseating is obvious but for the sake of principle must be tolerated. The B.B.C. sets an admirable example and because it must choose it must also refuse; without selection it would be formless. I doubt very much whether a continuing insistence upon uplift lifts up anything, but I passionately support the B.B.C.'s policy. But there are other policies; let us benefit by them as well.

Open up the channels then and let the flood of opinion, the phases of art, the dichotomies of politics, the shocks of minority opinion be diffused to the public and broadcasting will be the greater for it. But find the best advice how to achieve these ends technically.

Yours sincerely,

P. P. Eckersley

BEGINNINGS OF THE B.B.C.

The History of Broadcasting in the United Kingdom: Vol. I.—The Birth of Broadcasting. By Asa Briggs. Pp. 425 + xiii; 50 illustrations. Oxford University Press, Amen House, Warwick Square, London, E.C.4. Price 42s.

This is the first volume of a projected series on the history of broadcasting which will carry the story up to the ending of the B.B.C. monopoly in 1955. The present book covers the background, origins, organization and administration of the service up to the end of 1926, when the British Broadcasting Company became the Corporation.

In writing this volume Professor Briggs has drawn on much unpublished material, including Lord Reith's diary. He has produced a highly detailed and extremely well-documented study which puts order into the confused and confusing story of how broadcasting started.

Even before the B.B.C. was formed at the end of 1922, opposition had come from every conceivable quarter; the press and news agencies, the Services, the entertainment industry, the gramophone companies and others voiced their objections. The opposition "displayed a remarkable variety of fears and prejudices". Just as America had "blundered into chaos", so, it seemed, "British broadcasting was to be forced into a strait jacket". Highly restrictive rules were either proposed or put into effect at various stages; for example, the ban on controversy and on the broadcasting of news which had not already been published in the press. Hours of transmission were severely restricted and frequent breaks in programmes were required.

There were money troubles as well. The Company was "arbitrarily and inequitably financed", partly by a share of the licence fees and partly from royalties on receivers sold by member-firms. But "piracy" was widespread; for this the public was not entirely to blame, as there was great confusion over the different forms of licence, particularly that for home constructors.

In the face of all these difficulties a lesser man than the first General Manager might well have given up the struggle. "Reith did not make broadcasting, but he did make the B.B.C." He emerges from this book, not as the ruthless autocrat of popular fancy in the mid-1920's, but as the skilful, patient and resilient negotiator and administrator who set the pattern for the public corporation while the B.B.C. was still a commercial company.

If Reith (ably backed on the technical side by P. P. Eckersley, the B.B.C.'s first chief engineer) emerges as the hero of the book, it is pleasing to observe that Prof. Briggs finds no real villain, though clearly he considers the Post Office control to have been at times rather heavy-handed. Of the radio-electric companies who put up the money at the start, he says: "For bearing [the risk of initiating a broadcast service] the 'Big Six' received no concessions. Together they made up a monopoly, but it was a monopoly which enjoyed no monopoly profits and few monopoly privileges. It was the Post Office who did best financially out of the deal".

H. F. S.

"RADIO AND ELECTRONIC LABORATORY HANDBOOK"

THE widening sphere of activities encompassed by the term "radio experimenter" is reflected in the title of the seventh edition of this very popular work. "Radio and Electronic Laboratory Handbook," by M. G. Scroggie, B.Sc., M.I.E.E., is a completely revised and enlarged version of the earlier editions. The no-nonsense approach is retained, and although the discussion is as thorough and complete as in many more self-consciously "long-haired" books, the treatment is considerably more lucid and unobscured by jargon than is usually the case.

The author discusses the setting-up of an experimental laboratory, with suggestions for the choice of relevant instruments. The latest types of measuring instruments are described, with many references to commercial products, and several circuits for items of test gear are included. A chapter on the provision and use of standards is followed by discussions of the measurement of circuit parameters, equipment characteristics and signal measurements, at all frequencies up to v.h.f. The recording, examination and interpretation of experimental results are dealt with, and an extremely comprehensive, 80-page reference section contains most of the information that one never seems to be able to find when it is wanted. New sections include those on digital equipment, and the testing of semiconductors and f.m. receivers.

The book is published for "Wireless World" by Iliffe Books Ltd., and costs 55s.

TECHNICAL NOTEBOOK

New Distortion Criterion discussed in an article under this title by E. R. Wigan in the April and May 1961 issues of *Electronic Technology* is that the subjective unpleasantness of a distorted sound is assessed from the rate of deviation (with time) of the distorted sound from what the listener considers to be a normal undistorted sound. If we interpret this criterion simply as the rate of change of the difference between the distorted and undistorted signals, the unpleasantness should increase both with signal frequency and amplitude and both these effects were confirmed (the latter indirectly). The effect on the criterion of the listener's opinion of normality was shown by presenting him with a distorted background. This he took to be normal, thus reducing the subjective unpleasantness of other more distorted sounds. When, with an unknown language, very little opinion of normality was possible, listeners found it very difficult to make any assessment of the distortion. By changing the background, the memory time for such impressions of normality was found to be of the order of four seconds. A subjective grading of unpleasantness suggested that this was proportional to the square of the rate of deviation from normality. A suggested mathematical criterion which is consistent with these and other results is $C_t = n^2(p_n - t)\%$ summed for all terms from $n=2$ onwards for which $p_n > t$, where n is the harmonic number, p_n the percentage amplitude of the nth harmonic compared with the undistorted signal, and t the just audible percentage harmonic distortion (under the conditions of the experiment). The rate at which the individual terms decrease due to a finite t can be found by comparing signals of different bandwidth. In this way the minimum audible 500c/s distortion was estimated as 0.3%.

Fire and Water, especially salt water, are two of the classic elements which are usually regarded as fatal to electronic apparatus. But this is not necessarily true, as has been recorded in the February 1961 issue of the American *Naval Research Reviews*. The first step in the process is the immersion of the equipment which has been damaged by fuel oil, smoke and tars from fires or salt water in an emulsion of chemicals containing a hydrocarbon solvent (to remove the "greasy" substances) and water (to dilute and carry away the salt water). A surface active agent holds the solvent and water in emulsion until an oil-fouled surface is contacted when the solvent is released. Ultrasonic agitation is employed to "scrub" the apparatus and, when primary cleaning is complete, the emulsion is flushed away either by a water sprayer or again by ultrasonic agitation in an immersion tank.

The majority of the flushing water is then blown out by oil-free compressed air and the remainder is removed by a water-displacing compound. This either physically displaces the water or, in deep interstices, combines with it to form a substance known as an azeotrope, which has a lower boiling point than water and, when it evaporates, carries off the water with it. A drying period in a warm "oven" completes the process and the water-displacing composition leaves behind a corrosion- and moisture-resistant film. More than 90 per cent of equipment damaged by fire but not actually burned in the U.S.S. Constellation is being recovered satisfactorily by this rehabilitation process.

"Aperture Distortion" occurring in television systems causes lack of sharpness in the picture: the effect is due to the finite width of the camera spot "gradually" moving across a black-white boundary and so "slowly" changing the output signal from black through grey to white. This is corrected by electronic artificial sharpening of transitions, but usually the technique is applied only to the higher frequencies, that is, those representing vertical transitions. In *Journal of the S.M.P.T.E.* for June 1960 W. G. Gibson and A. C. Schroeder suggest correction for the effect of the aperture in the vertical direction, i.e. on horizontal edges.

Correction is achieved by deriving a "detail" signal by subtraction of adjacent lines from each other (thus leaving only the change that has occurred between the lines), and this signal is mixed with the original signal so as to reinforce the transition. Naturally, this involves the delaying of whole lines of the picture so that the detail signal can be derived and used: quartz-crystal mechanical lines are used, operating at about 30 Mc/s.

The technique does not suffer from some of the defects inherent in correction for vertical edges: for instance, the signal-to-noise ratio is not markedly degraded. Also it has the advantage that it can be used on a composite signal (including colour) so that only one unit is required for all signal sources at a station. The authors hold out the hope that the system may help to reduce the "lininess" of images by compensating at the transmitter for a display-tube spot expanded in the vertical direction.

First Colour TV Receivers available for sale from the Zenith Radio Corporation in U.S.A. use a new colour demodulator system. This employs two "sheet-beam" valves (Type 6JH8) which have, additional to the usual valve structure focus, accelerator and deflector electrodes and two anodes. The electron beam, controlled in intensity by the first grid, is forced into flat or sheet-like form by the focusing section and speeded up by the positive potential on the accelerator. Potentials applied to the deflectors switch the beam from one anode to the other.

For colour demodulation two colour-difference signals, R-Y and B-Y, are applied to the control grids of the two valves. These signals are, of course, on the 3.58 Mc/s sub-carrier and are in phase-quadrature (90° difference) with one another. The deflector plates are energized from the local oscillator synchronized with the "burst," or colour phase-reference, signal, the R-Y stage with a direct push-pull output, and the B-Y with a push-pull quadrature output. Thus the beams modulated with the colour difference amplitudes are switched from one anode to the other of the sheet-beam valves, so giving outputs which are of opposite polarity. The four outputs consist of B-Y and R-Y signals direct and two "negative" signals, from which G-Y is obtained, for application to the c.r.t. control grids. The luminance or Y signal is applied to the c.r.t. cathode. The use of the sheet-beam valves saves two waveform inverter stages which are otherwise necessary to obtain the G-Y signal.

Meter Relay—the MagTrack—introduced by the Weston Instrument Division of Daystrom increases the normally rather low contact pressure produced between a moving meter pointer and a fixed contact pointer both by attaching to the pointer a soft iron bead which is attracted by a magnet attached to the fixed pointer, and by means of a second aiding coil (suitably wound on the same frame as the measurement coil) which is energized on contact. The magnet provides sufficient force ($\approx$30 mgm) to break through any insulating film which may have accumulated on the contacts and the additional pressure ($\approx$2 gm) provided on contact by the aiding coil moves the flexible contact to provide a wiping action.

I.T.A. Plan for V.H.F. and U.H.F.

EXPANDING THE TELEVISION SERVICE AND CHANGING LINES WITHOUT DUPLICATION

THE Television Advisory Committee in their 1960 report emphasized the importance "of planning the use of Bands IV and V (and when the time comes the re-engineering of Bands I and III) from the start as an integrated whole." They also stated (paragraph 32) "If 625-line standards were adopted for the higher bands then eventually they would need to be introduced into Bands I and III in order to achieve a single standard. We [the Committee] consider that such a changeover is capable of achievement given a long-term programme in which the aim and phases are made clear to all concerned and as a consequence have the full co-operation of the broadcasters, the viewers and the radio industry."

The drafting of a detailed plan did not come within the terms of reference of the T.A.C., but there has subsequently been no lack of proposals and counter-proposals from various authorities and from industry. Some of these have been quite complex and have involved the starting of a third service in Band III, duplication of the existing services in Bands IV and V and an eventual reshuffle of these services between u.h.f. and v.h.f.

The Independent Television Authority, while not dissenting from the T.A.C. recommendations for an eventual change to 625-line standards, has in the past advocated delay in its adoption, until a scheme could be evolved which, as it was one of the first to point out, avoided "the absurdity that, if we changed the national line system, we must approach the point at which we have emptied our best television frequencies in Bands I and III of all television." It now puts forward a scheme which permits an early start of new programmes on 625 lines (which it now positively endorses as desirable for the future), which avoids any transfer of the two established national services from Bands I and III and which gives a practicable interpretation of the T.A.C. recommendations.

The I.T.A. proposals contained in a pamphlet "405:625. A plan for changing to 625 lines while retaining v.h.f. transmission" issued last month are basically as follows (and we quote):

So that we may continue to use the v.h.f. bands with their substantial advantages and avoid the duplication of services, the Authority proposes for consideration that there should be designated a "405-625 transition period," during which existing 405-line sets would wear out physically. This period would last for seven to eight years. At the end of the period, all transmissions would become 625-line, and all 405-line transmission would cease. This change would take place on an "appointed day." During this transition period, the following arrangements should be systematically introduced:

(i) At all the existing v.h.f. transmitting stations of both the B.B.C. and I.T.A., "shadow" plant, consisting of new transmitters and aerials arranged for 625-line operation on their appropriate new v.h.f. channels, should be installed. This would enable the two existing services to be switched simultaneously and without interruption to 625-line transmission on the appointed day.

(ii) There should be placed on sale from the start new dual standard receivers capable of 625-line reception in v.h.f. and u.h.f., and also capable of receiving the existing services as they are today transmitted. It should be the plan that these dual standard receivers, by the normal process of replacement, should have supplanted the existing 405-line v.h.f. receivers by the appointed day.

(iii) As early as possible, the planning and building of a national network of u.h.f. stations should begin, and arrangements be made for the introduction area by area of one or two new programmes on 625 lines. The network of u.h.f. stations should be progressively expanded to give as much coverage as possible, making the best pace that proved practicable.

The I.T.A. point out that the pace will be governed by the success or otherwise of acquiring sites for the thirty or more u.h.f. stations, additional to those on existing v.h.f. sites, which will be needed to give national coverage. It is estimated that nine of these lie within the boundaries of National Parks and at least five more near areas of natural beauty. These are difficulties which face any extension of the television services into Bands IV and V.

Advantages claimed for the I.T.A. proposals are:

(i) The superior v.h.f. bands are retained in permanent use without interruption for two of the national services.

(ii) The temporary duplication of two services, with the formidable waste of capital, revenue, and manpower involved, is avoided. New v.h.f. transmitters and aerials must, of course, be installed at the existing v.h.f. stations to provide the "shadow" equipment eventually to be used to take over and transmit the present two services on 625 lines on their new v.h.f. channels, but this provision is far less costly than the transfer of these services to a u.h.f. network of stations, only some twenty main v.h.f. stations for each of the present two programmes needing to be so equipped compared with the sixty-four main u.h.f. stations required to give approximately the same coverage.

(iii) The permanently heavier running costs of an all-u.h.f. transmission system are avoided, and so is the liquidation of the v.h.f. stations.

(iv) Duplicated transmissions require standards conversion, which further degrades the picture quality of the already lower grade 405-line service, and this degradation is also avoided.

(v) The transition to 625 lines could be achieved much more quickly, perhaps in half the time, for the termination of 405-line transmission would not have to wait for the completion of coverage by the u.h.f. 625-line transmissions. The shadow plant could be installed comfortably within seven or eight years. It is difficult to see how the building of the u.h.f. network could take less than twelve to fifteen years.

(vi) The new type of dual standard v.h.f.-u.h.f. receiver produced during the transition would be basically similar to those required by Continental and

Commonwealth countries, so their export would be assisted. The 405-line facility would simply be left out for export and finally, after the switch to 625 lines, it would be left out for the home market as well.

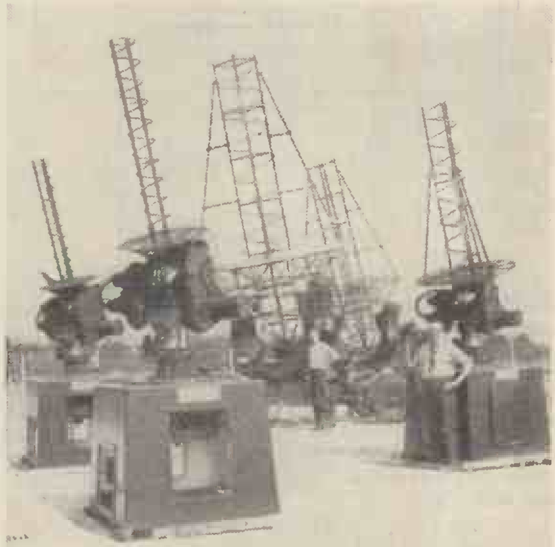
The design of the proposed new British receiver and the sequence of events in the changeover plan are envisaged in the following terms:

It is, of course, an essential part of the plan for retaining v.h.f. for the main British services that the standard receiver becomes and remains a v.h.f.-u.h.f. set if there are also to be u.h.f. services. The method of transition here proposed requires the incorporation of a small but essential additional piece of equipment in the new dual standard receiver. Over and above its ability to receive, or be converted to receive, the new 625-line u.h.f. services, the new set must also be capable of receiving, or of being converted to receive, the present two services when, on the appointed day, they are switched to 625 lines on their new v.h.f. channels. Provided that the parameters (the vision-sound carrier spacing, the width of the vestigial side-band, the polarity of vision modulation and the choice of frequency or amplitude modulation for the sound channel) adopted for the 625-line transmissions in both v.h.f. and u.h.f. are the same, this addition is both easy and cheap to provide, the cost being in terms of shillings rather than pounds. It involves no more than the equipment of the normal v.h.f. turret tuner with two additional "unchristened" channel positions, marked "X" and "Y," not initially fitted with coils. During a period of a year or more before the appointed day for changing the present two services to 625 lines on their new v.h.f. channels, local dealers would progressively clip in to these "X" and "Y" positions the coils or "biscuits" needed for the two new 625-line v.h.f. channels to be used in the area of the set. The task of the dealers would be eased by arranging for the "shadow" 625-line transmitters to radiate trade test transmissions on their new v.h.f. channels each morning, instead of the 405-line transmitters as at present, this practice being put into operation in all areas a year or so in advance of the appointed day. This is no new process for dealers. They have already experienced it several times on a smaller scale for, when the I.T.A. has opened new transmitting stations, many thousands of so-called multi-channel sets in the new area needed coils to be clipped in to unequipped positions on their v.h.f. turret tuners to enable them to receive the new channel. In these areas the dealers were able to accomplish this task in a few weeks, but no one will wish to underestimate the careful and efficient planning, by manufacturers and dealers alike, necessary to repeat the process on a national scale. Indeed, the feasibility of the plan rests on this particular operation. It would be a substantial alleviation that all receivers sold a few years before the appointed day would already have had their "X" and "Y" positions fitted with the necessary coils by the manufacturers, for the new channels would by then have been made known to them.

Whatever method of transition is chosen, it is little use to pretend that the complications will not be painful for the broadcasters, the manufacturers and the public alike. Equally, whatever method is chosen, the operation will be expensive. These considerations make it all the more important that, when the end is reached, it should be the ideal end, and not the second best end, shortsightedly determined by the choice of what might seem the easiest way out during the transition. History already contains a bitter lesson for us. Our present dilemma is the direct result of the great technical catastrophe of sixteen years ago, when television broadcasting was resumed on 405 lines at a time when refined line systems were perfectly feasible. The choice of the relatively coarse line system with which we are already technically dissatisfied then seemed the easiest way out. It will now cost many millions to correct matters. It would be tragic to fall into a second error by finding ourselves, at the end of the period of transition, with a broadcasting system that was still technically defective. If we are to make the change at all, we should steadily ask what it is we wish to have in the end, and we should accept whatever transitional complications are necessary in order to reach it. This end, it is the argument of this present paper, is a 625-line broadcasting system making full and continuous use of the v.h.f. bands, in which the two main services have been uninterruptedly contained.

We do not go all the way with the I.T.A. in condemning the restarting of television in 1946 on 405 lines. Nor are we convinced that the advantages of a change now to 625 lines will outweigh the disadvantages of the "expensive and painful complications" which will bear heavily on all concerned—not least on the public. It is true that we might have adopted a higher standard in 1946, but we could not have been expected to guess that the figure of 625 would be the one to find favour. If any other standard than 405 had been adopted it would have been the American 525, the only other higher standard then in the running.

Whatever may be the final conclusions about our line standards, we have no doubts about the desirability of extending the television services by the provision of more channels, the case for which has been so ably stated by Capt. Eckersley elsewhere in this issue. This will certainly cost a lot of money, and if the need for larger pictures and a higher line standard are part of the bargain, then there can be little doubt that the I.T.A.'s latest proposals provide the best solution so far advanced.



FRAME-GRID AERIALS?—These five helical aerials have been designed by Cossor Radar & Electronics and are for use by the War Office at the Guided Weapons Trials Establishment on the coast of Anglesey. They will operate in the frequency range 100—400Mc/s employing circular polarization and will be for telemetering missiles.

AIRBORNE HOMING SYSTEM

USE OF A PHASE-SHIFTING NETWORK

BY H. M. BOYLE,* B.Sc., A.Inst.P.

THE principle of measuring phase difference to provide direction finding information is well known. A new method for achieving the measurement was developed by Johnson and Beresford of R.A.E. in 1952 and is covered by British Patent No. 787,894. It involves the use of a phase-shifting network between two aerials used for the reception of the transmission on which it is required to home. Subsequent developments by the Plessey Co. have used the phase-shifting network principle in airborne homing equipments but the associated circuitry, both of the phase-difference measurement and of the equipment as a whole, has been much simplified and is described below.

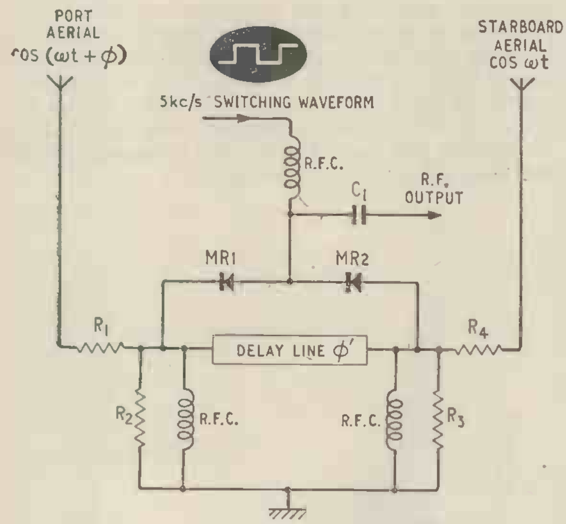


Fig. 1. Circuit for modulating a receiver carrier to provide homing information

The method of phase measurement takes the following form, the circuit being shown in Fig. 1. The diodes MR1 and MR2 are made to conduct alternately by the application of a low frequency switching waveform. The r.f. output can therefore be expressed as:

$\cos(\omega t) + \cos(\omega t + \phi + \phi')$—
Diode MR2 conducting .. .. (1)

$\cos(\omega t + \phi') + \cos(\omega t + \phi)$—
Diode MR1 conducting .. .. (2)

where ω refers to the carrier frequency of the received transmission, ϕ is the phase delay of the signal at the port aerial relative to that at the starboard aerial and ϕ' is the delay contributed by the phase shift network. This results in a square wave modulation of the carrier at the switching frequency and at a depth depending on ϕ. When $\phi = 0$ the two expressions above are equal and the modulation depth is zero. For any other value of ϕ, positive or negative, the modulation depth will increase, and the modulation is in phase, or in anti-phase, with the switching waveform according to the sign of ϕ. Thus the phase difference has been transformed into a modulation of the carrier and homing information provided. This can be seen by expanding expressions (1) and (2) above:

$$\text{i.e. } 2\cos\frac{(2\omega t + \phi + \phi')}{2}\cos\left[-\frac{(\phi + \phi')}{2}\right] \qquad (3)$$

$$\text{and } 2\cos\frac{(2\omega t + \phi + \phi')}{2}\cos\left[-\frac{(\phi - \phi')}{2}\right] \qquad (4)$$

These can be rewritten as:

$$A\cos\left[\frac{(\phi + \phi')}{2}\right] \quad .. \quad .. \quad .. \qquad (5)$$

$$\text{and } A\cos\left[\frac{(\phi - \phi')}{2}\right] \quad .. \quad .. \quad .. \qquad (6)$$

For negative values of ϕ expressions (5) and (6) may be written as:

$$A\cos\frac{(-\phi + \phi')}{2} \quad .. \quad .. \quad .. \quad .. \qquad (7)$$

$$\text{and } A\cos\frac{(-\phi - \phi')}{2} \quad .. \quad .. \quad .. \qquad (8)$$

which become:

$$A\cos\left[-\frac{(\phi - \phi')}{2}\right] = A\cos\frac{(\phi - \phi')}{2} \qquad (9)$$

$$\text{and } A\cos\left[-\frac{(\phi + \phi')}{2}\right] = A\cos\frac{(\phi + \phi')}{2} \qquad (10)$$

These expressions are (5) and (6) reversed and the phase of the modulation is therefore changed for negative values of ϕ.

For completely satisfactory operation of this circuit in the u.h.f. band (225-400Mc/s) several points were investigated and a summary of these, and their solution, is now outlined.

It can be seen that it is essential to maintain the symmetry of the circuit, so that the indication of heading zero is not affected. At these frequencies, lead inductance and stray capacitance assume major importance and it was with a view to controlling these and maintaining symmetry that a "block" form of assembly was adopted. This method has the added advantage that the block acts as its own

* The Plessey Co. Ltd.

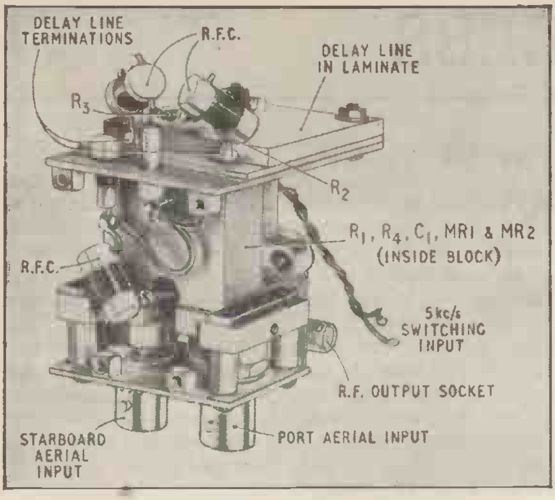


Fig. 2. Practical assembly of the circuit in Fig. 1

jig during assembly. Briefly, the resistors R_1 and R_4 and the diodes MR_1 and MR_2 are mounted in holes bored in a block of aluminium, the hole dimension being chosen to give an air-spaced transmission line, in association with the components and their leads, to give optimum performance over the band. The delay line consists of a brass horseshoe embedded in a dielectric of glass fibre laminate and spaced by the dielectric from the ground plane (the aluminium block) to give the required characteristic impedance. The assembly is shown at Fig. 2.

The choice of diode in itself constituted a major problem at the time (1956). The requirements are low forward resistance and high back impedance. The Transitron T19G diode was chosen finally, having a mean forward dynamic resistance of 6Ω and a minimum back impedance of 400Ω (capacitive). Germanium diodes were found more suitable than silicon because of their lower cut-on voltage in the forward direction, which eases the requirements for the switching waveform. Failure to cut the diode on quickly will result in "holes" in the carrier at 10kc/s, which were considered undesirable.

The choice of ϕ and ϕ' is affected by a number of factors, but in practice the aerial spacing was chosen to be 20 cm, which gives ϕ a value of approximately 96° at 400Mc/s at 90° heading. The delay ϕ' was chosen as 13.6 cm, giving 65° at 400Mc/s.

Some points of interest are worth noting before leaving this part of the circuit.

The switching frequency, although uncritical, is chosen to be approx. 5.0kc/s, which is outside the normal audio pass band of the associated receiver.

The circuit introduces a certain r.f. loss which is of no importance except in areas of weak signal. If it is desired to restore the signal to its previous level, an r.f. amplifier of good noise figure must be incorporated. This was done in one of the Plessey developments, the amplifier being tunable and controlled by the associated transmitter-receiver.

It should be noted that the circuit in no way affects the normal intelligence on the carrier and that only very heavy modulation will affect the homing function, resulting in a loss of homing sensitivity.

The complete system is shown in Fig. 3. The 5kc/s modulated carr er is passed into the associated receiver for demodulation. The demodulated 5kc/s square wave is taken out via a stage provided specifically for the purpose and passed back to the Homing Unit, where the signal is fed to a phase sensitive bridge. The 5kc/s switching waveform is also applied to the bridge, via a delay, to compensate for the phase delay suffered by the signal waveform in passing through the receiver. The resulting d.c. ouput is proportional to the amplitude of the signal wave form (provided that the signal waveform is small compared with the switching waveform) and of a polarity depending on the sign of ϕ. The d.c. output is applied to a Standard Service I.L.S. Indicator (Type 7 or 9024) for display in the pilot's cabin.

The Homing equipment derives its power supplies from the associated receiver and is controlled by the receiver's control unit. The power requirements are small, being 0.37A at 28V for heater supplies and approx. 12mA at 225V h.t.

It can be seen that having chosen ϕ' to be satisfactory at 400Mc/s, the phase delay introduced by the delay line is less at 225Mc/s. In addition, the fixed spacing of the port and starboard aerials means that for a given heading error, the value of ϕ is also less at the lower frequencies than at the high. Thus there is an inherent change in homer sensitivity (d.c. output versus heading error) over the band. Since it is desirable to have a sensibly constant output for a particular heading, regardless of operating frequency, a potentiometer has been fitted to the receiver, controlled by the frequency setting elements of that receiver. This potentiometer is used to control the gain of the 5kc/s signal amplifier in the Homing Unit, as the carrier frequency is varied.

It should be borne in mind that the system just described is not necessarily restricted to the u.h.f. band, although modifications to the delay line length and the aerial spacing would be required.

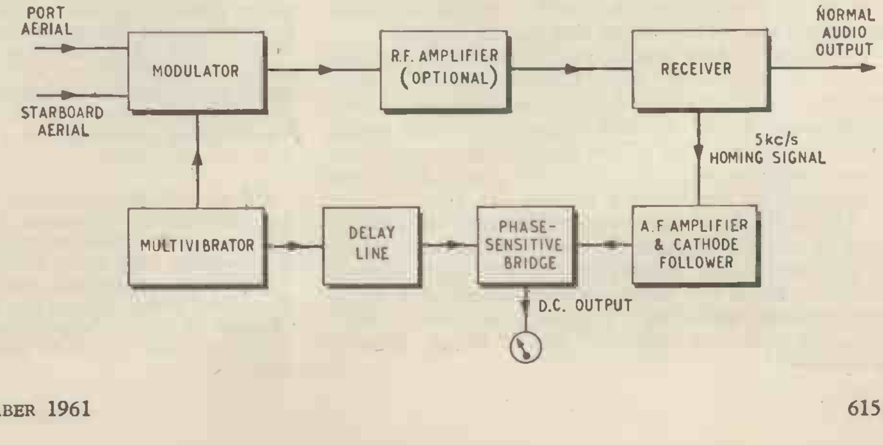


Fig. 3. Block diagram of homing system

WORLD OF WIRELESS

I.E.E. and Electronics

THE scheme put forward some months ago by the I.E.E. for the reorganization of the Institution to give a stronger emphasis to its "electronics" activities has now been approved by its members. Privy Council permission has to be sought but, in the meantime, plans are going ahead for the introduction of the scheme next October.

The present four Specialized Sections (Measurement and Control, Electronics and Communications, Supply, and Utilization) will be replaced by three Divisions: (i) Electronics, (ii) Power, and (iii) Science and General. Each Division will work through about ten relatively specialized Professional Groups. The number and scope of these groups "can be modified quickly to reflect any change of emphasis in the technological scene."

Dual-Standard TV in Eire

TELEFIS EIREANN (Irish Television Service) as already announced will ultimately adopt the 625-line television standard and their first two stations will therefore be equipped for both 405- and 625-line transmissions. They have placed a £175,000 contract for four 625-line television transmitters and associated equipment with the Pye Group. At two of the Eire stations, at Mount Kippure, near Dublin, and at Truskmore Mountain in Co. Sligo, a "combining unit" will be used to allow radiation of 405- and 625-line transmissions simultaneously from a "dual standard" aerial. The other two 625-line equipments ordered are for stations at Mount Leinster, Co. Carlow, and Mullaghanish Mountain, Co. Cork. Proposed date for the commencement of 405-line programme transmissions from the television station at Kippure is December 31st. Test transmissions are being radiated in Channel 7 with horizontal polarization, between the hours of 11.30 a.m. and 1 p.m., also from 3 p.m. to 5 p.m. and 6.30 p.m. to 7 p.m.

"*Random Radiations*"

THIS is the first issue since January 18th, 1935, in which "Diallist's" contribution "Random Radiations" has not appeared. As a result of ill health, and at his own request, he has felt obliged to relinquish the task of sustaining this regular feature.

As some readers may know, "Diallist" is the pen name of Major R. W. Hallows, M.A.(Cantab.), M.I.E.E., who, in addition to his regular contribution to *Wireless World*, has also frequently written under his own name. One of his special interests is batteries, and he was, for some 30 years, European consultant to the Burgess Battery Co. Inc.

Throughout the war Major Hallows, who is 76, was in the Royal Artillery and was for some time Chief Instructor, Radar, at the 6th A.A. Group School. He is the author or joint author of a number of books, including "The Oscilloscope at Work," "Introduction to Valves" and "Radar Simply Explained."

Pay TV Tests?

A PLEA to the Postmaster General for a licence to allow relay undertakings to conduct an experimental field test of Pay TV by wire was made by Barry King, chairman of the Council of the Relay Services Association, at the Association's annual luncheon on November 14th, at which Miss Mervyn Pike, Asst. P.M.G., was principal guest. Miss Pike had herself referred to the potentialities of Pay TV in her speech. The number of homes in this country served by wire television systems is now over 500,000; about 95% of all subscribers to television and sound relay systems in the U.K. are served by members of the Association.

Instruments for Export

SOME 150 delegates, representing over 70 scientific instrument manufacturers and a number of Government research establishments, attended the tenth annual convention of the Scientific Instrument Manufacturers' Association at Eastbourne from November 15th-18th. The theme was "export." After the opening session, which was addressed by Sir Charles Fitton, past president of the Institute of Export, and representatives from the governments of the U.S.A., Sweden and Australia, the delegates were free to attend the meetings of the three specialized panels (technical, marketing and economics) which ran concurrently.

The first session of the technical panel was addressed by G. W. A. Dummer, of the Royal Radar Establishment, on the subject of design for export. By way of introduction he mentioned that 6·3% of all equipment delivered to the R.R.E. under contract was outside tolerance or not working. Manufacturers may be interested to learn that the results of the R.R.E.'s specialized tests on a variety of apparatus are readily available.

Other sessions of the technical panel dealt with the "requirements of the overseas user," "problems of overseas manufacture" and "after sales service."

B.B.C. Portsmouth Exhibition.—The B.B.C. is staging a public exhibition at the Guildhall, Portsmouth, from November 29th to December 2nd, from 12 noon to 10 p.m. daily. B.R.E.M.A. are supporting the show and nineteen manufacturers will be exhibiting their radio and TV receivers. The B.B.C. is to relay TV and sound programmes direct from the Guildhall and the f.m. signal from Rowridge will also be provided for demonstrating radio.

I.T.A. Selkirk Station.—A temporary 200ft mast at the Independent Television Authority's Selkirk station will come into operation at the beginning of December. A permanent 750ft tower is being built which it is hoped will become operational not later than March 1962. The signal radiated from the temporary mast will be on Channel 13, vertically polarized, and e.r.p. will be 4kW, to be increased to 25kW when the permanent mast is used.

Microwave Valves Conferences.—September 1963 has been chosen as the date for a Conference on the Design and Use of Microwave Valves and an associated scientific exhibition, which is being organized by the Electronics and Communications Section of the Institution of Electrical Engineers. It will be held at Savoy Place, London, W.C.2. The next in the series of international conventions on microwave valves is to be held at The Hague, Holland, from September 3rd-7th, 1962. The I.E.E. also announces that a Conference on Components in Microwave Circuits will take place in London in September 1962.

Radio & Television Servicing.—The report on the servicing examinations held in May by the City and Guilds of London Institute and the Radio Trades Examination Board records that of the 2,068 candidates who sat the intermediate written exam. 1,108 (53.6%) passed. The 1960 figures were 560 entrants, 336 (60%) passes. Of the 717 who took the final examination in May 285 (29.8%) got a first class and 367 (51.2%) second class pass. This is the first year of the combined sound radio and television syllabus.

Radio Amateurs' Examination.—The Standard of papers submitted at the examination, conducted by the City and Guilds in May, "showed a welcome improvement over that of last year", says the report. A total of 1,251 entered and 866 (69.2%) passed compared with 1,274 and 699 (54.9%) in 1960.

The Physics of Semiconductors is the subject of an international conference, which is to be held at the University of Exeter from July 16th-20th, 1962. It is being organized under the auspices of the International Union of Pure and Applied Physics by the Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1. Provisional programmes and application forms may be obtained from the Administration Assistant at the aforementioned address.

The F.B.I. and its Japanese counterpart, Keidanren, are to make efforts "to realize at an early date a freer flow of trade between the two countries by progressively reducing and ultimately eliminating import restrictions and conducting orderly marketing, and to promote economic co-operation and technical links between the two countries by encouraging closer contact and fuller understanding between the industrialists of both countries." Following a visit by Sir Norman Kipping, Director-General, and J. R. M. Whitehorn, Deputy Overseas Director, the Federation has published a report entitled "A Look at Japan." Copies, price 10s, are available from the F.B.I., at 21 Tothill Street, London, S.W.1.

Domestic Receiver Design.—Papers of particular interest to those in the "entertainment radio and television industry" are being sought for the I.R.E. Chicago Spring Conference on Broadcast and Television Receivers, arranged for June 18th and 19th. Offers of papers, including a 50-100-word summary, should be sent to Al Cotsworth, Zenith Radio Corporation, 6001 West Dickens Avenue, Chicago 39, Ill., as soon as possible.

Television in South Africa will not arrive for at least another five years owing to the heavy cost of installation, stated Dr. P. J. Meyer, chairman of the board of the South African Broadcasting Corporation, on his return from a two-month trip abroad to study radio and television techniques.

The B.B.C. has placed an order for ten Marconi 250-kW short-wave transmitters which use vapour-cooled triodes made by the English Electric Valve Company. The new transmitters form part of a re-equipment programme for the B.B.C.'s External Services transmitting stations; six will be installed at the Woofferton station, which is used to relay the Voice of America, and two each at Daventry and Rampisham, Dorset.

U.S.S.R. Academy of Sciences were hosts to Professor T. Kilburn and Dr. D. B. G. Edwards of the University of Manchester, when they travelled to Moscow recently to deliver a series of lectures on the Ferranti Atlas electronic digital computer. Ten lectures were given altogether, over a period of five days, to an audience of technologists and engineers at the Institute of Precise Mechanics and Computing Technique in Moscow. Discussions showed that the Russians have a different approach on the general philosophy of computer design. Their policy is to build separate machines for scientific and data processing applications, and they are putting a great deal of effort into the development of faster storage and other components.

Colour Television test transmissions on 405 lines from the Crystal Palace transmitter were restarted by the B.B.C. in October. They are conducted from 1600 to 1630 on Mondays to Fridays. A simplified explanation and also a detailed specification of the system employed are available from the Engineering Information Department, Broadcasting House, London, W.1. The detailed specification is given on Information Sheet 2202/2.

The Scottish Electrical Training Scheme, launched some six years ago to train executives for the member firms in Scotland, has made outstanding progress, reports J. S. Hastie, of Scottish Cables Ltd., current chairman of directors. He said the 119 graduates and students attending the recent fifth annual conference was the highest figure since the start of the scheme, and it was planned to encourage volunteers for higher advanced courses to qualify graduates for the top posts in the industry and a start would be made shortly on an advanced mathematics course to meet this need. S.E.T.S. also plans to train one overseas student each year, returning him to his own country to work, as a gesture to the electrical industry abroad.

Westinghouse Schools Training Course.—A further "Introduction to Industry" training course will be held by Westinghouse at their Chippenham Works during the week January 8th-12th inclusive. This is for sixth-form boys taking G.C.E. "A" level examinations in science subjects in 1963. Applications should be addressed to the Personnel Superintendent, Westinghouse Brake & Signal Co. Ltd., Chippenham, Wilts., by December 1st.

Norwood Technical College, London, S.E.27, is introducing the first of two six-lecture evening courses on transistors on January 16th. The first course covers fundamentals and the second, beginning on February 27th, applications. The fee for each course is 10s.

Medium-wave DX.—A "set listening period" from 0100 to 0300 G.M.T. on December 2nd has been arranged by the group of DX enthusiasts which issues the monthly duplicated news sheet "Medium-wave News". Reports of long-distance reception will be welcomed by K. Brownless, 7 The Avenue, Clifton, York, who edits the news sheet.

WHAT THEY SAY

Component Research.—"It is perhaps not widely known that the British Electronics Industry spends out of its own resources a greater percentage of its gross turnover [on reasearch and development], approximately 12%, than any other industry in the United Kingdom." —*A. F. Bulgin, president of R.E.C.M.F., at the opening of the Stockholm component exhibition.*

Problems for Pilkington.—"Never in the long history of committees and commissions have so many problems been compressed into so few words."—*Miss Mervyn Pike, Assistant P.M.G., referring to the terms of reference of the Pilkington Committee at the Relay Services Association luncheon.*

Personalities

Sir Gordon Radley has succeeded **Lord Nelson of Stafford** as chairman of Marconi Instruments, Marconi Marine, and English Electric Valve Company and has also been appointed deputy chairman of Marconi's W/T Company. Lord Nelson has also retired from the chairmanship of Marconi's W/T and is succeeded by his son the **Hon. George Nelson.** Other appointments to the Boards of the subsidiaries of the English Electric Company include:— **F. N. Sutherland** as deputy chairman and **Dr. E. Eastwood** as a director of Marconi Instruments; **P. L. de Laszlo** as deputy chairman of E.E. Valve Co.; and **D. P. Furneaux** as managing director designate of Marconi Marine in succession to **R. Ferguson** who retires at the end of the year.

J. H. Westcott, B.Sc., D.I.C., Ph.D., M.I.E.E., who is 41, has had the title of Professor of Electrical Engineering in the University of London conferred on him in respect of his readership at Imperial College. Dr. Westcott, after post-graduate research on servo-mechanisms at the college and at the Massachusetts Institute of Technology, joined the Government scientific service in 1942 and was for some time at what is now R.R.E., Malvern. He was on the Control Commission for Germany in 1945/6. Dr. Westcott, who is chairman of Feedback Ltd., of Crowborough, Sussex, was responsible for the setting up of the control systems laboratory at Imperial College which he joined in 1950.

R. J. Hitchcock, M.A., A.M.I.E.E., consultant to Cable and Wireless where he was for some time engaged on radio-frequency allocations and radio propagation problems in general, has recently visited the Bell Laboratories in America to study the problems of satellite communications. Mr. Hitchcock, who has represented C. & W. at many international conferences and is a member of several study groups of the C.C.I.R., has contributed articles to *Wireless World* on various aspects of international telecommunications. He is a member of the committee set up by C. & W. to consider "what part, if any, the company should take in the provision of satellite relays." The committee is presided over by **H. C. Baker,** a director, and among the eight members is **P. A. C. Morris,** who is in charge of the company's radio propagation section.

John V. Dunworth, C.B.E., M.A., Ph.D., F.Inst.P., A.M.I.E.E., the new deputy director of the National Physical Laboratory, was throughout the major part of the war working on the development of radar; first with the Admiralty and later with the Ministry of Supply at R.R.E. He succeeds **Dr. G. G. Macfarlane,** who, as announced recently, is going to Malvern as director of R.R.E. Dr. Dunworth, who is 44, graduated at Cambridge University in 1937 and did post-graduate research under Lord Rutherford. After the war he returned to Cambridge to take up his Fellowship at Trinity College and was appointed a demonstrator in physics in the Cavendish Laboratory. He joined the Atomic Energy Research Establishment in 1946, and since 1959 has been deputy director of the Atomic Energy Establishment, Winfrith.

R. E. Fischbacher, B.Sc., A.M.I.E.E., has been appointed an assistant director of the British Scientific Instrument Research Association which he joined in 1957 as head of the Electronics Department. Educated at the Royal College of Science and Technology, Glasgow, and the University of Glasgow, Mr. Fischbacher served for 12 years in the Admiralty Signal and Radar Establishment as a member of the Royal Naval Scientific Service before joining the B.S.I.R.A.

Air Comdre. A. G. P. Brightmore, M.Brit.I.R.E., Director of Electronics Research and Development (Air) in the Ministry of Aviation, and **Air Comdre. F. E. Tyndall,** B.Sc., Director of Radio at the Air Ministry, have exchanged posts. Air Comdre. Brightmore, who is 53, has been in the Ministry of Aviation since 1958 having previously served for two years as chief signals officer of the 2nd Tactical Air Force. At one time he commanded No. 3 Radio School, R.A.F., at Compton Bassett, Wilts. Air Comdre. Tyndall, who is a member of the Post Office Frequency Advisory Committee, has been in the Air Ministry directorate of radio since April, 1959. He is 48.

Frank Poperwell, Assoc.Brit.I.R.E., who recently joined the Derritron group of companies as technical sales supervisor, has now been appointed general manager of Reslosound Ltd. (a member of the group). Prior to joining the group a few months ago he was with the G.E.C. for 35 years where he was technical supervisor of the Sound Equipment Division. **L. W. Murkham,** founder of Reslosound recently sold his interest in the company to the Derritron group.

C. J. Salvage contributes to this issue a constructional article on a transistor communications receiver which he designed for use with a 6-band miniaturized transmitter. He is a keen s.s.b. amateur transmitter (his call is G3HRO) and in 1956, using his own s.s.b. equipment, participated in the first six-continent R/T link-up on 20 metres. The receiver described, and its associated transmitter, was awarded first prize at the National Mobile Rally at Woburn Abbey in September. Mr. Salvage is chairman of the Aquila Radio Club of the Inspection Branch of the Ministry of Aviation where he has been employed since 1940.

T. H. Whitaker, who has been with Cossor Radar & Electronics since 1957, is going to New Zealand early next year to supervise the installation of eight meteorological radars, three of which will be on the islands of Fiji, Funafuti, and Rarotonga. He will also instruct staff of the N.Z. Civil Air Administration on the handling and servicing of the equipment. Mr. Whitaker, who is 32, was trained as a radar mechanic in the R.A.F.

T. H. Whitaker

W. P. Raffan

W. P. Raffan, B.Sc., A.Inst.P., has been appointed head of the newly formed Solid State Division of 20th Century Electronics. He was formerly with Rank Cintel where, during the past three years he has been engaged in the development of solid state devices.

Eric K. Cole, C.B.E., M.Brit.I.R.E., has resigned from the position of deputy chairman of British Electronic Industries Ltd. (the holding company formed on the merger of Pye and Ekco a year ago) and also from the chairmanship of E. K. Cole Ltd. and its subsidiaries, which include Ekco Electronics Ltd. and 20th Century Electronics Ltd. Mr. Cole, who was elected an honorary member of the Brit.I.R.E. in 1959 "in recognition of his services to the radio and electronics industry and profession," founded the company bearing his name in 1926 when he was 25. He was appointed a Commander of the Order of the British Empire in 1958. The chairman of B.E.I. is **C. O. Stanley,** chairman and managing director of the Pye Group.

C. J. Maurer, B.Sc.(Eng.), A.M.I.E.E., of Romford, Essex, and **W. T. Warnock,** A.M.I.E.E., A.M.Brit.I.R.E., of Stone, Staffs., both Post Office engineers, have received the Insignia Award in Technology from the City and Guilds of London Institute (C.G.I.A.). Mr. Maurer joined the Post Office Engineering Department in 1939, where he returned in 1946 after war service as a radar mechanic in the R.A.F. He is now an executive engineer and for the past six years has been working on the introduction of "international subscriber dialling". Mr. Warnock, who joined the Post Office in 1933, has been on the staff of the P.O. Central Engineering Training School at Stone since 1958, where he is now deputy principal.

News from Industry

Associated Television has formed a new wholly owned subsidiary, Planned Holdings Ltd., to integrate the technical and marketing resources of all the firms in its Planned Group of companies. This new company will be responsible for the future development of the Group into the field of sound and music services. Member companies of the Planned Group are Planned Music Ltd. (Muzak background music system), Planned Communications Ltd. (line networks) and Planned Equipment Ltd. (Audiomatic automatic audio-visual selling and communication system). J. B. C. Bennett, B.Sc. (Eng.), A.M.I.E.E., has joined the board of Planned Music Ltd. D. Humphriss and H. F. Mould, who were until recently in the Sound Equipment Section of the G.E.C., have joined the Planned Group of companies. Mr. Humphriss is regional liaison engineer and Mr. Mould public address engineer.

G.E.C. Telecommunications Group.—Two new operating companies, G.E.C. (Telecommunications) Ltd. and G.E.C. (Electronics) Ltd., have been formed by the General Electric Company to take over the activities of its Telecommunications Group. Co-ordination and direction of these companies will be undertaken by a newly formed holding company, G.E.C. (T. & E.) Holdings Ltd. O. W. Humphreys has been appointed executive chairman of the holding company and chairman of the two new operating companies. W. A. C. Maskell is director of the holding company, C. Riley director and general manager of G.E.C. (Telecommunications) Ltd., and R. J. Clayton director and general manager of G.E.C. (Electronics) Ltd. Brigadier John Clemow has been appointed engineering director of the latter company. The headquarters of G.E.C. (Telecommunications) Ltd. will be at G.E.C. Telephone Works, Coventry, and of G.E.C. (Electronics) Ltd. at Union Works, Wembley.

Cossor Board Appointments.—As a result of the purchase of A. C. Cossor Ltd. by Raytheon Company, of Massachusetts, U.S.A., the following have been elected to the board of A. C. Cossor:—Charles F. Adams, chairman of the board of Raytheon; Richard E. Krafve, president of Raytheon; and Dr. Carlo L. Calosi, vice-president of Raytheon. Raytheon have already announced their intention of preserving the identity of the Cossor Group. Major-General Sir Miles Graham continues as chairman and James S. Clark as managing director.

English Electric in France.—A new company, La Compagnie Continental D'Equipements Electriques (C.E.E.) has been formed by the English Electric Company and the French firm, Les Exploitations Electriques et Industrielles, to manufacture electric and electronic control equipment for France and the Common Market countries.

Plessey—A.T.E.—Ericsson Merger.—Completion of the merger between the Plessey Co. Ltd., Automatic Telephone & Electric Co. Ltd., and Ericsson Telephones Ltd., has been effected, and it is announced that A. F. Roger, A.T.E. chairman, and Sir Harold A. Wernher, chairman of Ericcson, have been appointed to the Plessey board of directors.

Decca Record Company's group net profit for the year ended March 31st is £1,249,229 as compared with £1,260,729 for the previous twelve months. Consolidated trading balance was higher at £3.7M (£3.4M), but exports, including £1.4M (£2.3M) to the U.S. and Canada, were lower at £7.1M (£8.1M).

International Rectifier Corporation.—Consolidated sales and earnings for the year to June 30th show a sales increase of 11% over the previous twelve-month period, and a profit margin of 7.4% after taxes. The Corporation, with headquarters at El Segundo, California, U.S.A., has a 50% share in International Rectifier Co. (Great Britain) Ltd. with Metal Industries Ltd. having a similar interest.

Solartron Sold To Schlumberger.—Firth Cleveland have sold for just under £2M their 56.7% holding in the Solartron Electronic Group to Schlumberger of Houston, Texas, who themselves were linked recently with the American Daystrom company. Firth Cleveland acquired their controlling interest in Solartron two years ago. Schlumberger has other interests in electronics and instrumentation both in the U.S.A. and Europe.

Console of the 34-channel sound mixer manufactured by Pye for the Elstree Studios of Associated Television. In addition to providing mixing facilities for studio microphones it also provides echo effects and talk-back facilities.

S.I.M.A. Delegation to Italy.—In 1960, only 8% of the scientific instruments imported into Italy came from the U.K. compared with 35% from west Germany and 21% from the U.S.A. In an effort to remedy this a delegation of the Scientific Instrument Manufacturers' Association of Great Britain visited main Italian cities recently to discuss marketing problems and to collect information on the instrument needs of Italian research programmes and industry.

Cambridge-C.G.S. is the title of a new company formed jointly by Cambridge Instrument Co. Ltd. and Istrumenti Di Misura, C.B.S. Located at Casoria, near Naples, the company will initially manufacture instruments based on Cambridge designs. English members on the board of Cambridge-C.G.S. are Dr. P. Dunsheath, H. C. Pritchard and W. E. Lamb.

T.C.C.—Sprague Exchange.—The Telegraph Condenser Company and the American Sprague Electric Company have recently agreed to a mutual exchange of technical "know-how," whereby the two organizations will share their research and manufacturing experience. T.C.C. are the sole distributors in the U.K. for Sprague products.

Raytheon Company are to acquire all of the assets of Rheem Semiconductor Corp., a subsidiary of Rheem Manufacturing Company, at Mountain View, California.

Marconi Cameras For ITN.—Four Marconi Mark IV television cameras ordered by Independent Television News are now in use at the ITN headquarters in Television House, Kingsway. This is part of a general re-equipment of ITN's facilities to enable them to carry out more ambitious programmes. The installation has been designed by ITN's own engineering staff and will be their first use of 4½in image orthicon cameras.

Hudson Electronic Devices Ltd., who specialize in the design and manufacture of v.h.f. radio-telephone equipment, have received an order from the Home Office, worth nearly £30,000, for 200 of their Type AM112 mobile 15-W equipments to be used by the Police. This follows a similar order last year.

E.M.I. Electronics Ltd. have been awarded a £30,000 contract by the Independent Television Authority for the installation of a 450ft tower and aerial array in Jersey, Channel Islands.

I. S. B. Transmitters.—Marconi's are to supply to the Admiralty a large number of 500-W m.f./h.f. independent sideband communication transmitters of a new type, NT204, which embody continuous tuning from 240kc/s to 24Mc/s. Value of order is about £90,000.

Manchester Minicabs have been equipped with Storno-Southern f.m. transistor radio telephones. A 25-W base station at Gorton feeds a standard centre-fed dipole aerial mounted on an 80ft mast, and ranges of up to 30 miles are being obtained.

British Communications Corporation, a subsidiary of Radio & Television Trust, has recently obtained a large contract for the supply of v.h.f. transmitter/receivers Type A.40 to the British Army.

Pickering Cartridges.—Goldring Manufacturing Company, of Leytonstone, London, E.11, advise that they are now marketing certain items of the American Pickering range of audio equipment in this country. These include the Unipoise 198 integrated arm and cartridge and a selection of Pickering cartridges.

Walmore Electronics Ltd., of 11-15 Betterton Street, London, W.C.2, have been appointed by Siemens & Halske A.G., west Germany, as U.K. representatives for their transmitting and special receiving valves.

Metal oxide film resistors developed in the U.S.A. by Corning Glass Works, are being manufactured in the U.K. by Jobling and marketed by Electrosil Ltd., of Colnbrook By-Pass, Slough, Bucks. The latter company was formed recently by Corning in association with James A. Jobling & Co. Ltd.

Tape heads manufactured by Wolfgang Bogen G.m.b.H. of Berlin, previously available through Gopalco Ltd., are now obtainable from R. H. Cole (Overseas) Ltd., 2 Caxton Street, Westminster, London, S.W.1. (Tel.: Sullivan 7060), who have been appointed sole U.K. agents. Components made by Bogen include mono and stereo heads for domestic tape recorders, erase heads and a range of single and multiple heads for professional applications.

ETEL Sales Move.—Electronic Tubes Ltd. advise that the sales and technical information office of their Instrument Cathode-Ray Tube Division is now at 80 New Oxford Street, London, W.C.1 (Tel.: Langham 0800).

New Telephone Numbers.—The Gresham Lion Group of Companies, Gresham House, Hanworth, Middx., advise their new number is Feltham 3655. (The telephone number of Gresham Transformers Ltd. continues as Feltham 6661.) Mullard Equipment Ltd., Crawley New Town, Sussex, have had their number changed to Crawley 28787.

Ampex Great Britain Ltd., which is responsible for the sales of Ampex equipment in the U.K., has moved to 72 Berkeley Avenue, Reading (Tel.: Reading 55341).

Dawe Instruments Ltd. have moved from Harlequin Avenue, Brentford, to Western Avenue, Acton, London, W.3 (Tel.: Acorn 6751).

Lee Products (Gt. Britain) Ltd. have transferred from Longford Street, N.W.1, to new offices at 10-18 Clifton Street, London, E.C.2 (Tel.: Bishopsgate 6711).

OVERSEAS TRADE

1962 Near East International Fair is to be staged in Tel Aviv, Israel, from June 5 to July 5, when Western visitors will find the opening times a little strange. They are 4 p.m. to midnight except on Saturdays, when they will be sunset to midnight. Electrical, cooling, heating and radio and TV products will be exhibited in a wide range of merchandise. British participation is being organized by Industrial & Trade Fairs Ltd., Commonwealth House, New Oxford Street, London, W.C.1.

Marconi's were responsible for equipping Ghana's new external broadcasting station, with its four 100-kW transmitters capable of world coverage. Marconi's have also been awarded a contract by the Ghana Posts & Telegraphs authorities for the supply and installation of a twin-path v.h.f. multichannel radio-telephone system to link the Volta river dam area with Accra, the capital. The carrier equipment will be provided by the Automatic Telephone & Electric Company.

W. G. Pye Get Russian Order.—Following an enquiry received at the British Trade Fair in Moscow this year, an order for industrial pH measuring, recording and controlling equipment worth £15,000 has been obtained by W. G. Pye & Co. Ltd. from the official U.S.S.R. buying agency, Mashpriborintorg.

Danmarks Radio, the Danish state broadcasting service, has placed an order with E.M.I. Electronics Ltd. to supply four 4½in image orthicon camera channels for use in the Copenhagen studios.

The Royal Malayan Navy has selected Decca True Motion marine radar for the six new fast patrol craft now on order from Vosper's.

Transistor High-Fidelity Pre-Amplifier

By R. TOBEY, M.A. and J. DINSDALE, B.A.

COMPREHENSIVE INPUT/EQUALIZING CIRCUITS, TONE CONTROLS AND FILTERS

IN the following article details are given of the design of a pre-amplifier, incorporating all the usual facilities, for use with the transformerless transistor power amplifier described in last month's issue.

This pre-amplifier may also be used with sensitive valve power amplifiers, such as the Mullard 510, when compactness, complete absence of hum and (with suitable transistors) improved signal-to-noise ratio, are required.

A two-stage circuit (Fig. 1) conforming fairly closely to standard valve practice, is used. The first stage provides equalization by frequency-selective negative feedback, and a wide variety of inputs may be catered for. The second stage is an adaptation of the well-known Baxandall tone control circuit, giving an ample range of control of both treble and bass by negative feedback. High- and low-pass filtering is also provided, again by the use of negative feedback.

Input Equalizing Stage.—The basic circuit is shown in Fig. 2. Any equalization curve consisting of slopes not exceeding 6 dB per octave may be produced by a suitable choice of components R_1, R_F, C_1, C_2. A typical curve is shown in Fig. 3.

The value of R_F sets the current sensitivity of the stage, and R_1 sets the input impedance (equal to R_1) and hence the input voltage sensitivity. Where maximum input sensitivity is not required, the equalizing networks may be derived directly from those used in valve circuits, but using component values suitable for transistors. Fig. 4 and Table I give typical values for the most usual applications.

This approach, however, does not lead to the best exploitation of transistor characteristics, since the transistor is a current-operated device, and the lower the input impedance which can be used, the greater the sensitivity. When used with low-output magnetic pickups and tape heads, valve pre-amplifiers are arranged to have an input impedance which places the L/R integration beyond the audio pass-band. For example, for a 500-mH pickup, most manufacturers specify an input impedance of at least 68kΩ, giving attenuation starting around 20kc/s. Greater sensitivity can be produced from a transistor pre-amplifier by using a lower impedance,

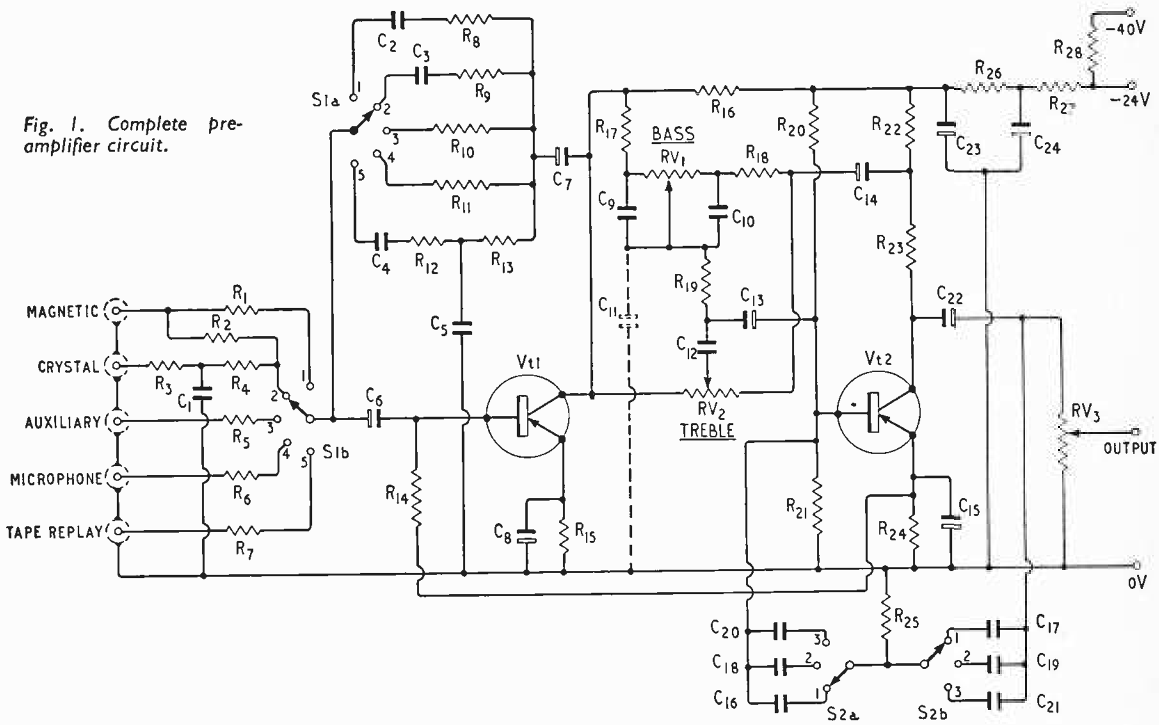


Fig. 1. Complete pre-amplifier circuit.

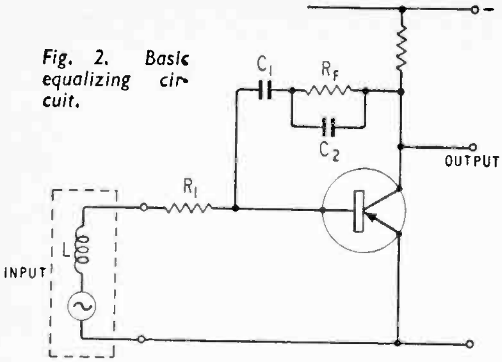


Fig. 2. Basic equalizing circuit.

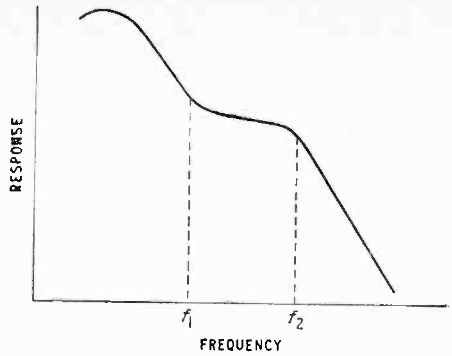


Fig. 3. Response given by equalizing circuit of Fig. 2. $f_1 = 1/2\pi C_1 R_F$ and $f_2 = 1/2\pi C_2 R_F$ or $R_1/2\pi L$.

Table 1

Component Values for Pre-Amplifier (Figs. 1, 4, 8)

Resistor	Value (kΩ) All Resistors are ¼W, 5%	Capacitor	Value (F) and Working Voltage
R 1	3.9	C 1	2,000p
R 2	5.6	C 2	5,000p
R 3	47	C 3	0.01μ
R 4	47	C 4	0.01μ
R 5	100	C 5	8,200p
R 6	1	C 6	10μ 12V wkg
R 7	1	C 7	2μ 25V wkg
R 8	47	C 8	100μ 6V wkg
R 9	39	C 9	0.1μ 5%
R10	33	C10	0.1μ 5%
R11	180	C11	0.01μ 5%
R12	18	C12	0.01μ 5%
R13	12	C13	25μ 12V wkg
R14	22	C14	2μ 25V wkg
R15	2.7	C15	100μ 6V wkg
R16	10	C16	1,000p
R17	3.3	C17	1,000p
R18	3.3	C18	2,000p
R19	3.3	C19	2,000p
R20	39	C20	5,000p
R21	10	C21	5,000p
R22	1	C22	5μ 12V wkg
R23	2.2	C23	50μ 25V wkg
R24	1.5	C24	50μ 25V wkg
R25	2.7	C25	5,000p
R26	2.7	C26	1,500p
R27	2.7	C27	0.01μ
R28	6.8	C28	1,000p
R29	47	C29	2,000p
R30	180	C30	100μ 6V wkg
R31	220		
R32	100		
R33	22		
R34	47		
R35	62		
R36	47		
R37	33		
R38	150		
R39	47		
R40	2.2		
R41	2.2		
R42	1.8		
R43	1.5		
R44	1.5		
R45	3.9		
R46	0.33		
RV1	50 lin		
RV2	25 lin		
RV3	10 log		
RV4	5 lin		

and a value can be chosen in conjunction with the inductance of the input source which gives part of the required equalization characteristic.

For example, the standard l.p. characteristic calls for de-emphasis above 2kc/s which can be produced by feeding a 500mH-pickup into 6.8kΩ-resistor. The bass emphasis required during the playback of tape may also be produced in this way. The complete circuit diagram (Fig. 1), together with Table 1, give component values for the most widely used types of equalization, assuming in the case of the magnetic pickup and tape head, an inductance of 500mH, which is the value most commonly used. For other inductances the input resistance should be changed to keep the same L/R ratio. The performance of the record equalizing networks is shown in Fig. 5.

If it is desired to use the same equalizing networks for non-inductive pickups (e.g., a crystal pickup), the treble de-emphasis must be provided at the input. In Fig. 1 this is done by R_3 and C_1.

Tone Controls.—The tone-control circuit gives a mid-frequency gain set by the values of R_{22} and R_{23},

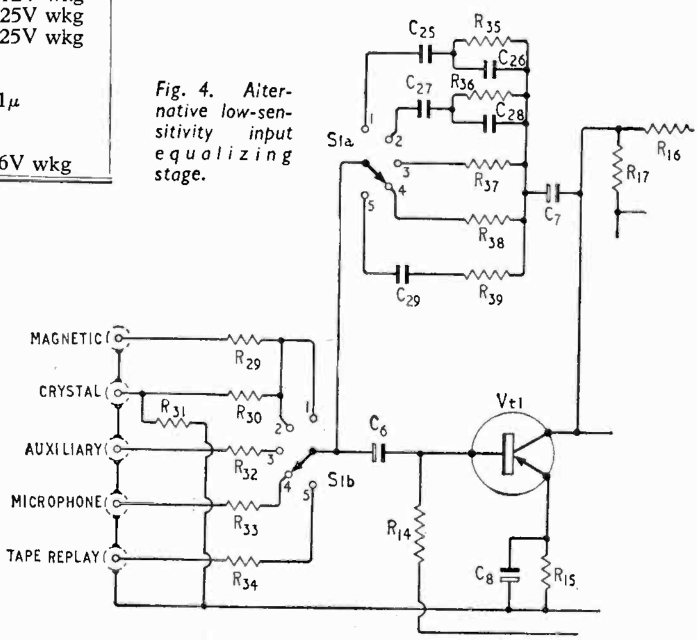


Fig. 4. Alternative low-sensitivity input equalizing stage.

a stage gain of about three being convenient. For a fuller description of the operation of this type of circuit the reader is referred to the original article (by P. J. Baxandall in the Oct. 1952 issue of *Wireless World*). The tone-control characteristics of the pre-amplifier are shown in Fig. 6. A different form of the treble characteristics, giving less severe control of the highest frequencies, is shown dotted, and these may be obtained by removing C_{11}. Without C_{11}, the "star" formed by R_{17}, R_{18}, R_{19} is equivalent at high frequencies to a "delta"-connected configuration of resistors which shunts each portion of the treble control, giving additional feedback and feed forward of current to the virtual-earth point (Vt 2 base). C_{11} earths the centre-point of the star at high frequencies and eliminates the shunting effect, hence allowing the treble control to operate as expected.

Filters.—The pre-amplifier can be designed to give a frequency response extending well outside the audio band, but in practice this is often an embarrassment. Many wide-range pickups produce peaks of considerable amplitude at frequencies above the audio band, which can give rise to audible intermodulation effects; also the modern trend to stereo pickups with their high vertical output, and small speaker enclosures giving little loading of the extreme bass, may make high-pass (or rumble) filtering a necessity. The slope of attenuation of frequencies above and below the audio band given by the filters varies with the setting of the corresponding tone control (see Fig. 6), since both filtering and tone control are achieved by feedback around the same transistor. The maximum boost position of the tone control gives the greatest slope of the corresponding filter. This ensures maximum discrimination against frequencies outside the audio band, when they would otherwise prove most objectionable.

The low-pass filter shown in Fig. 1 is provided by R_{25} and C_{16} to C_{21}. Although two passive R-C lags would have the same ultimate slope of 12dB per octave, the circuit of Fig. 1 has a sharper turnover. In theory this circuit would tend to peak below the turnover frequency, but in practice the finite output and input impedances of the transistor, in conjunction with the values used, prevent this happening.

The switch is normally in position 1, giving a turnover frequency of 20 kc/s, while positions 2 and 3 (with turnovers at 10 and 6 kc/s respectively) may be used to deal with programme material such as worn shellac discs or a.m. radio.

A smooth roll-off of frequencies below 20c/s is provided in the pre-amplifier, and below 40c/s in the power amplifier described in last month's issue. In the pre-amplifier (Fig. 1), the d.c. base current for Vt 1 is supplied from the top end of the emitter by-pass capacitor of Vt 2, so that increasing negative feedback via R_{14} results as the frequency is lowered. The input stage of the power amplifier is also arranged to give increasing feedback below 40c/s.

The overall characteristic of the filters is shown in Fig. 7.

Stereophonic Version.—The circuit diagram of part of one half of a stereophonic version of the pre-amplifier is given in Fig. 8. RV_4 is the channel-balance control, which forms part of the potentiometer R_{22}, R_{23} in Fig. 1. Rotation of this control

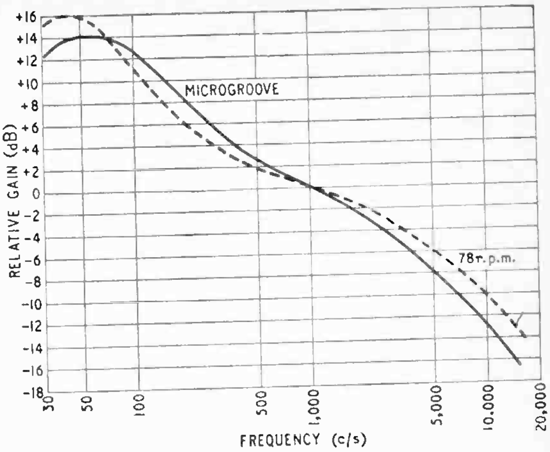


Fig. 5. Response of record equalizing circuits of Fig. 1 (magnetic pickup input).

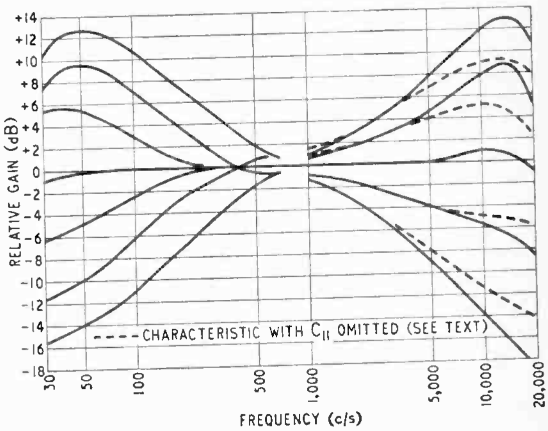
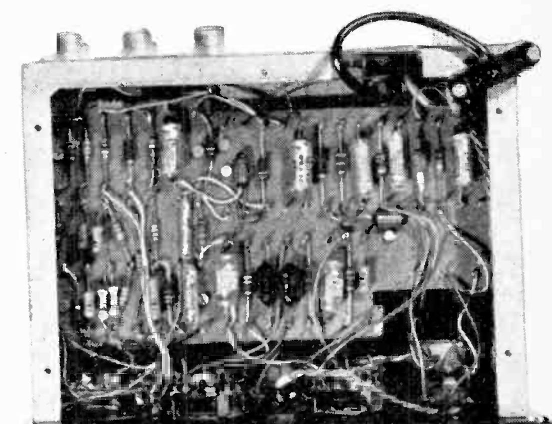


Fig. 6. Tone control characteristics with (full lines) and without (dotted lines) C_{11}. The low-pass filter was switched to 20kc/s.

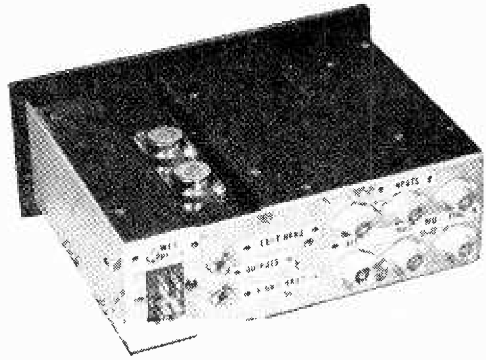


One channel of the pre-amplifier viewed from the top (power amplifier and screen removed).

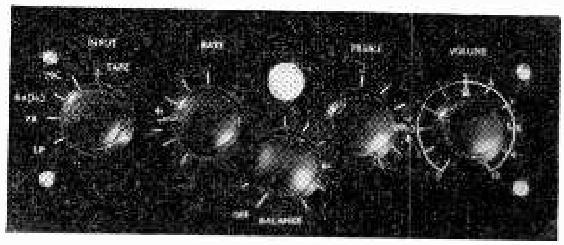
increases the gain of the tone-control stage of one channel, and decreases that of the other channel, hence correcting for any slight out-of-balance in other parts of the equipment. A difference of $\pm$3dB in gain between channels is catered for. Gross differences in channel sensitivity, such as might by produced by using amplifiers and speakers of different types in the two channels, should be eliminated by an attenuator in the most sensitive channel.

In the prototype, switched tone controls and a single position low-pass filter were used, for the sake of compactness.

Transistors.—The transistors used in the pre-amplifier should have as high a gain as possible (greater than 80 at 1mA), to ensure close agreement between the theoretical and practical operation of the circuits. Suitable types for both Vt 1 and Vt 2 are the OC44, OC75, GET874, GET113 or XA102, but this list is merely a guide, and is by no means exhaustive. Two low-gain transistors as a "*super-alpha*" pair might, however, be used instead of one high-gain transistor, with appropriate changes of biasing resistors. (For a discussion of the *super-alpha* pair see, for example, p. 388 of the article by F. Butler in our Aug. 1960 issue.)



Rear view of stereo pre-amplifier and power amplifier showing one pair of power output transistors.



Front panel of stereo power amplifier and pre-amplifier.

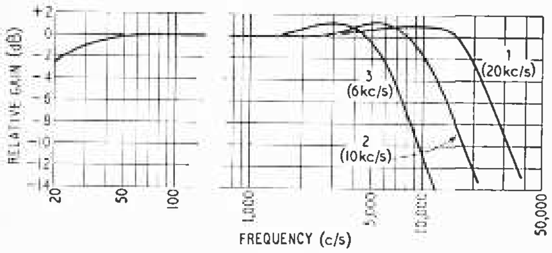


Fig. 7. Characteristics of high- and low-pass filters.

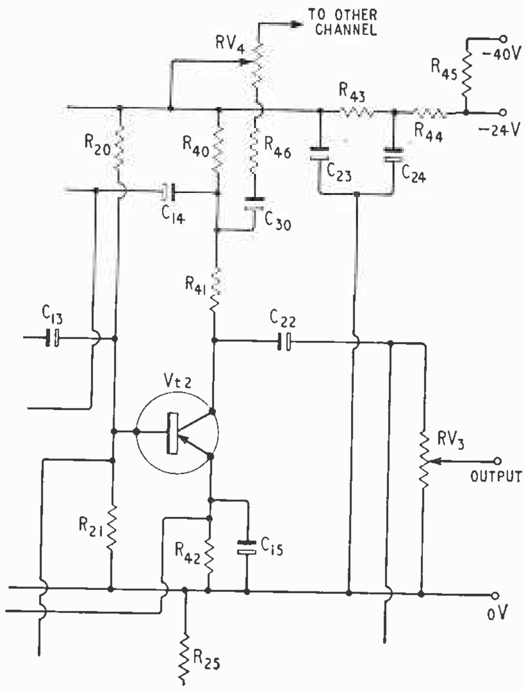


Fig. 8. Part of one half of stereophonic version of pre-amplifier.

The noise factor of the first transistor determines to a large extent the noise produced by the overall equipment. Though most transistors have proved satisfactory in this application, the occasional specimen may be found which is not, since large variations of noise factor exist between different transistors even of the same type. The signal-to-noise ratio is 70dB with the tone controls level, or 60dB with maximum treble boost.

Power Supply.—The pre-amplifier is designed to work off a nominal 12-volt supply but it will tolerate supply variations between 9 and 15 volts. When the pre-amplifier is being used with a valve power amplifier, the negative voltage required by the pre-amplifier may be conveniently supplied by a dry battery, since the current drain of 2½mA is small enough to ensure very long battery life.

When compared with a valve pre-amplifier, the transistor pre-amplifier has less capacity to tolerate over driving, since the voltage swing which can be accommodated within the circuit is limited by the lower supply voltage. The present design will not significantly distort signals corresponding to 20dB above those needed to give full output from the power amplifier, which gives a reasonable margin of safety. However, inputs requiring a sensitivity much less than the design values (see Tables 2 and 3) should be attenuated at the input, rather than by having the volume control turned right down.

Layout.—The layout is not critical though normal commonsense precautions should be observed. When the power amplifier and pre-amplifier are mounted in close proximity, a screening plate must

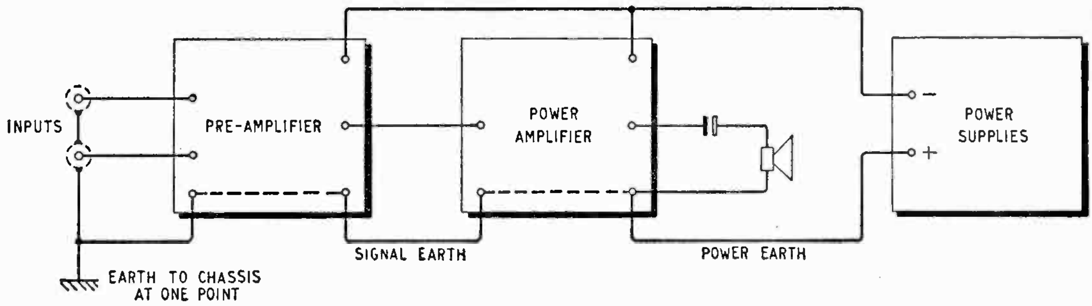


Fig. 9. Earthing diagram of pre-amplifier and associated equipment.

be used to prevent coupling between the output of the power amplifier and the input of the pre-amplifier, which may be troublesome at high frequencies, especially when treble boost is applied. The low-pass filter also helps to prevent trouble from this source.

The photographs show one channel of the pre-amplifier, and two views of the completed prototype stereo version. This was built up on a chassis 8in × 3in × 7in. The pre-amplifiers were built up on fibre-board with terminal pins. By arranging the layout of components and wiring in such a way that no wires cross each other, it is very easy to transfer the layout to a printed circuit form of assembly. The boards for the stereophonic version were made of opposite hands to facilitate connections to the controls.

The importance of correct earthing, owing to the high currents flowing in the output stage, was stressed in the previous article (Fig. 9).

In conclusion, this article shows that in domestic high-fidelity apparatus, transistors can give just as good results as valves.

(In the article on the transistor power amplifier in last month's issue, in line 11 of the left-hand column of p. 568 R_{10} should read R_9.)

TABLE 2
Input Data for Fig. 1

Switch Position	Function	Sensitivity (mV at 1 kc/s)	Input Impedance (kΩ)
1	Microgroove	Mag 5 Xtal 100	6 100
2	78 r.p.m.	Mag 8 Xtal 150	7.5 100
3	Auxiliary	150	100
4	Microphone	1.5	1
5	Tape replay 7½in/sec	2.5	1

TABLE 3
Input Data for Fig. 4

Switch Position	Function	Sensitivity (mV)	Input Impedance (kΩ)
1	Microgroove	Mag 25 Xtal 100	47 100
2	78 r.p.m.	Mag 30 Xtal 120	47 100
3	Auxiliary	100	100
4	Microphone	4	22
5	Tape replay 7½in/sec	30	47

Characteristics of Whole Stereophonic System

Output power	10 watts per channel.
Frequency response	45c/s to 20kc/s within 3dB.
Total harmonic distortion ..	0.25% at 10 watts output.
Signal-to-noise ratio (at 10W output) ..	70dB (with controls level) 60dB (with max. treble boost).
Negative feedback in power amplifier	60dB.
Power requirements ..	Version 1: 40 volts d.c. at 800mA (max) or 150mA (average) for 10 watts in 15 ohm speakers. Version 2: 24 volts d.c. at 1.6A (max) or 300mA (average) for 10 watts in 3 ohm speakers and 24 volts d.c. at 500mA (max) or 100mA (average) for 3½ watts in 15 ohm speakers.
Controls	Input Selector (Microphone, Radio, Tape, l.p., 78 r.p.m.), Treble, Bass, Filter, Volume, Balance.
Size	8in × 3in × 7in.
Weight	3lb 2oz.
Maximum ambient temperature	40°C.

"Guide to Broadcasting Stations"

NEW edition of the *Wireless World* book "Guide to Broadcasting Stations" lists 500 v.h.f. sound broadcasting stations and 250 TV stations in Europe with an e.r.p. of 5kW and over. Completely revised this 13th edition includes, as usual, details of all European long- and medium-wave broadcasting stations and over 2,000 s.w. transmitters throughout the world which are listed both geographically and in order of frequency.

Tables covering standard time, wavelength-frequency conversion and the international allocation of call signs, are included in the new Guide, which costs 3s 6d (by post 4s).

"ALL-BAND" TRANSISTOR COMMUNICATIONS RECEIVER

By C. J. SALVAGE, (G3HRO)

Design Suitable for Mobile Use

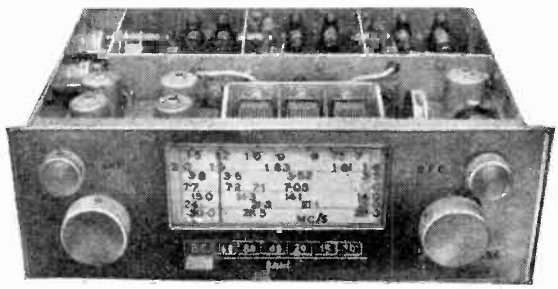
THE introduction of transistors has opened a new field to the amateur constructor and now the " drift " types have made possible the construction cf an all-band all-transistor communications receiver. The set described here was designed primarily as a car radio and operates in the broadcast and six amateur bands. A b.f.o. is included for reception of s.s.b. and c.w. transmissions.

Circuit

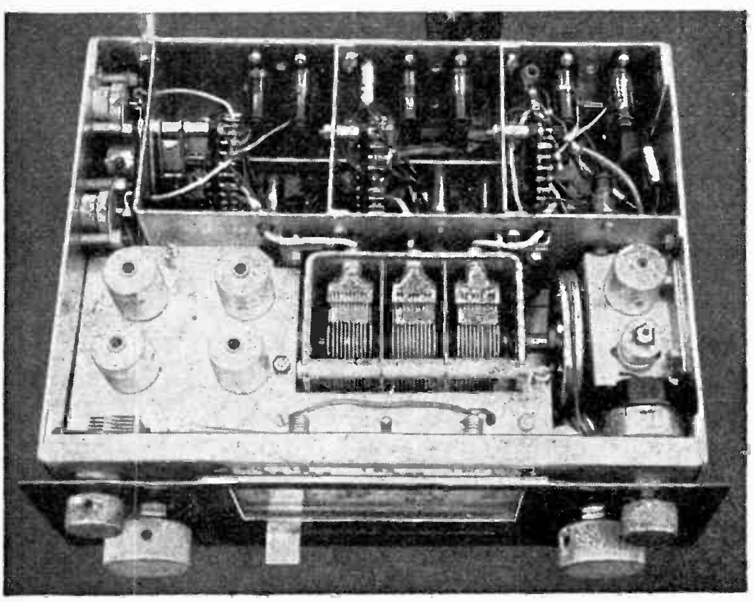
As can be seen from the circuit diagrams (Figs. 1, 2 and 3) the line up follows closely that of a conventional communications receiver using valves.

R.f., Mixer and Oscillator Stages.—The aerial circuit has seven coils, either tapped at a suitable position from earth or bearing a coupling winding to give an input impedance of approximately 50 Ω, as the receiver is designed to operate from a whip aerial. The broadcast-band coils L_1, L_8 and L_{15} in the aerial, r.f. and oscillator sections are tuned by the 310-pF three-gang capacitor C_1, C_2 and C_3 giving a coverage of 1.5-0.7Mc/s. For the amateur bands 22-pF fixed capacitors C_4, C_{10} and C_{11} are switched in series with the main 310-pF tuning capacitors in order to provide the necessary bandspread. The capacitive dividing circuit C_5 and C_6 provides an impedance match to the base of V1 (OC171) the r.f. amplifier. V1, V2 and V3 are supplied from the 6-V Zener-diode (Mullard OAZ203) stabilizing circuit via the 470-Ω resistor R_{10}, thus reducing the operating voltage to 4. No useful purpose is served by raising the supply above this value which was found to be the optimum working point for all bands. High values for decoupling capacitors are necessary as all the circuits are of low impedance compared with the corresponding valve circuitry.

I.f. Amplifier.—The output from the mixer stage (V3), at a frequency of 470kc/s, passes to the i.f. amplifier (Fig. 2) which employs three stages. Two stages of amplification can provide sufficient gain if the d.c. supply is increased; but the extra stage was added in order to increase selectivity as the i.f. transformers have only one tuned winding, the secondary being untuned and providing an impedance step-down to match the base of the i.f. transi-



Above: Front view of tuner showing slider control for band switch below dial. Travel of switch " tab " is about two-and-a-half inches.



Left: Plan view of " tuner " unit. Chassis and compartments are 18s.w.g. aluminium; at top of photograph are, left to right, aerial, r.f. and oscillator compartments each containing seven coils. I.f. transformers are bottom left with b.f.o. stage to right of tuning capacitor drum.

stors V4, V5 and V6. Transformer T_4 has a secondary winding designed to match the detector diode (OA70) which supplies the a.g.c. to V5 and the demodulated signal for subsequent audio-frequency amplification. I.f. neutralizing feedback is provided by the R-C network connected to Pin 1 of each of the i.f. transformers (C_{23} and R_{16} with T_2 etc.).

First A.f. Stage.—The audio output from the $5k\Omega$ potentiometer RV_2, which forms the volume control, is taken to the first a.f. amplifier. The receiver up to this point is all included in the main chassis; the loudspeaker, second and final push-pull a.f. stages are all mounted on a separate panel which is conveniently placed adjacent to the main "tuner" chassis.

Beat-frequency Oscillator.—A b.f.o. stage is included for reception of s.s.b. and c.w. transmissions. Now a drawback of transistors, especially

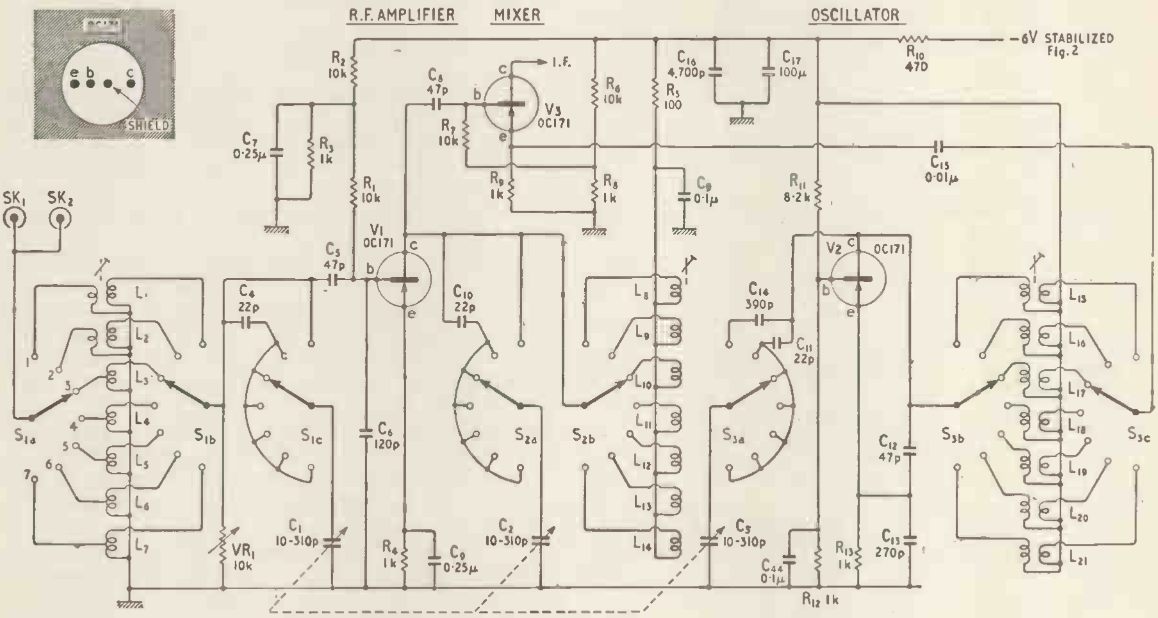
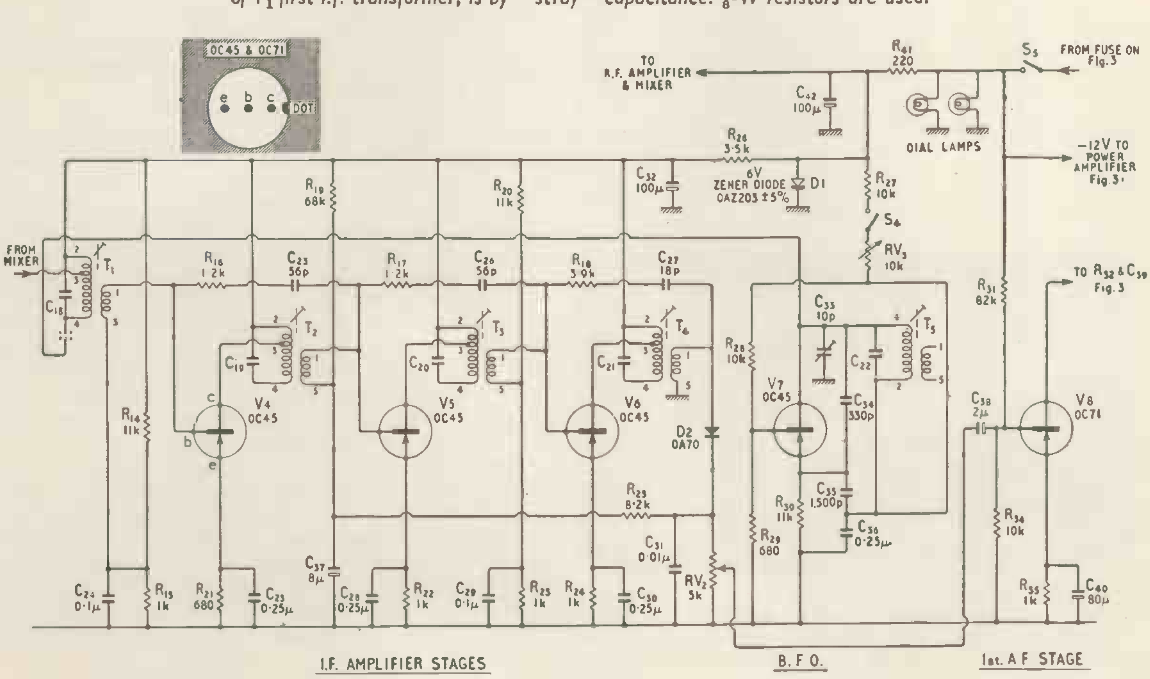


Fig. 1. R.f., mixer and local-oscillator stages. $\frac{1}{8}$-W resistors are used.

Fig. 2. I.f., detector, b.f.o. and first a.f. stages. Note that b.f.o. coupling to Pin 4 of T_1 first i.f. transformer, is by "stray" capacitance. $\frac{1}{8}$-W resistors are used.



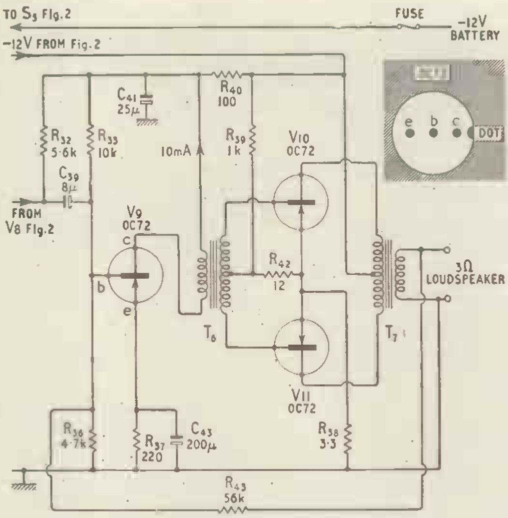


Fig. 3. Power amplifier unit.

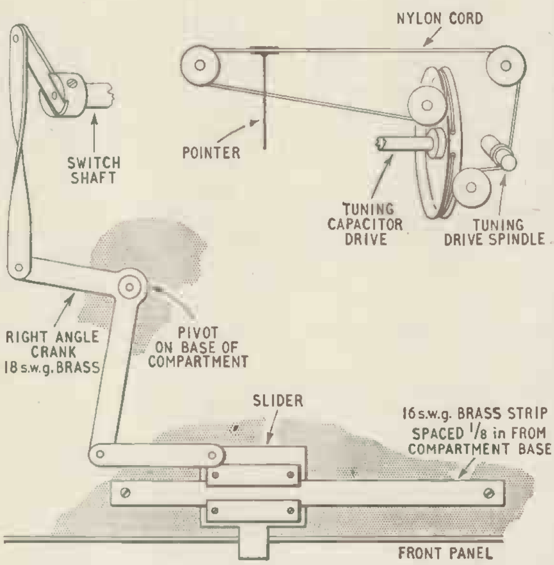
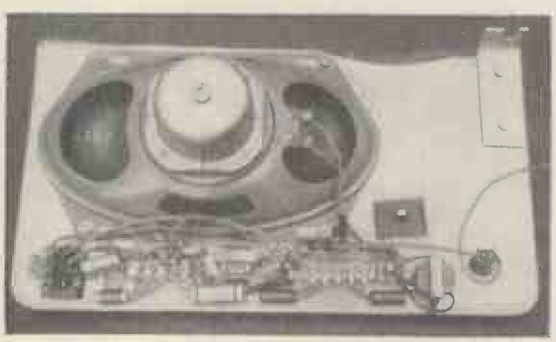


Fig. 4. Arrangement of tuning drive cord and levers actuating band switch from slide on front panel.



Back of loudspeaker and power amplifier panel. Fuse for power supply is at extreme right. First a.f. stage collector resistor and coupling capacitor to driver transistor are connected to socket at extreme left.

in oscillators, is that they are sensitive to supply-voltage variations. This, however, can be used to advantage here and adjustment of the rheostat (RV_3, 10kΩ) in series with the supply to V7 can provide sufficient change of frequency for upper or lower sideband reception of s.s.b. signals or c.w. operation. C_{33} (a 10-pF trimmer) allows fine pre-setting of b.f.o. frequency. The coupling from the b.f.o. to the i.f. amplifier is provided by a lead running from the " hot " end of T_5 to a point near Pin 4 of the first i.f. tranformer T_1.

Construction & Layout

As will be seen from the photographs the set was designed for fitting into a recess that is normally provided for a broadcast receiver in a car and, as this space is different in different cars, no exact dimensions have been given. The versatility of the receiver makes it very suitable for mobile operation.

The front view of the receiver shows the general lay-out of the front panel. The large knob on the left is the a.f. gain control RV_2, with the on-off switch S_5 incorporated, and the small knob near it is the r.f. gain control RV_1. The tuning control is the large knob on the right and a cord drive transfers the motion to the tuning capacitor. The small knob adjacent is for control of the b.f.o. (RV_3) and is ganged to the associated b.f.o. on-off switch S_4. The sliding band switch can be seen under the dial, which is lit by two low-consumption lamps (12V, 50 mA).

The plan photograph shows the two aerial sockets (top left) with the three screened compartments to the right for aerial, r.f. and oscillator coils. Holes for the adjustment of the cores of coils in the second row near the tuning capacitor are located between the coils at the rear of the compartment. The eight-pole seven-way switch used for band selection is operated by the sliding control whose motion is transferred to a right-angled crank fastened to the base of the compartment. In turn the crank transfers the motion to an arm on the rotating spindle of the band-change switch.

The switch itself is a nine-position type, two positions remaining unused, of three banks of three poles each. The small space available and the need for a very smooth mechanical action indicated that something rather different from the ordinary type of wavechange switch was wanted: thus a "Winkler" type switch made by Painton was used.

The small aerial trimming capacitor, shown on the left near the i.f. transformers, has now been replaced by the 10-kΩ potentiometer RV_1 and provides r.f. gain control. This control was incorporated as it was found that cross modulation occurred when receiving a very strong signal. The b.f.o. coil T_5 is to the right of the tuning capacitor and next to it is the trimmer C_{33}.

The layout of the output panel and speaker is simple, with the amplifier ranged along a tagstrip. The socket for connection to the main tuning unit is to the left of this strip. V9, the driver transistor, and its associated transformer are on the left with the two push-pull output transistors (V10 and V11) and their output transformer to the right, feeding into the 3-Ω loudspeaker. Negative feedback is

(Continued on page 629)

supplied from the secondary of this output transformer *via* the 56-kΩ resistor R_{43} to the base of V9. All resistors are of ¼W rating in this section.

Performance

The set has a sensitivity of 1μV on the lower frequency and on 10 and 15 metres this falls to 5μV. The power consumption is about 150mA at 12V for normal reception, increasing to 400mA at full output. Even this current can be conserved when used with transmitter as the whole set is switched off in the transmit condition, rather than, as with a valve receiver, leaving the heaters running. A separate switch for the dial lamps would be worthwhile for dry-battery operation.

Components Specifications

Coils.—All coils are wound on "Neosid" Type 358/8BA formers 0.3in. dia., with Grade 900 cores.
(Neosid Ltd., Stonehills House, Welwyn Garden City, Herts.).

Coil	Band	Aerial
L1	Broadcast	180μH, wave-wound (about 3/16in wide) with 40 s.w.g. d.s.c. wire: coupling coil 15 turns close-wound adjacent to main coil, 30 s.w.g. d.s.c.
L2	160 metres	90μH, wave-wound (about 3/16in wide), 40 s.w.g. d.s.c.: coupling coil 10 turns close-wound adjacent to main coil, 30 s.w.g. d.s.c.
L3	80 metres	76 turns, close-wound, 38 s.w.g. enamelled (en.), tapped 7 turns from bottom.
L4	40 metres	28 turns, close-wound, 36 s.w.g. en., tapped 5 turns from bottom.
L5	20 metres	19 turns, close-wound, 30 s.w.g. en., tapped 5 turns from bottom.
L6	15 metres	12 turns, close-wound, 30 s.w.g. en., tapped 2 turns from bottom.
L7	10 metres	8 turns, close-wound, 30 s.w.g. en., tapped 1 turn from bottom.
		R.f. Amplifier
L8	Broadcast	200μH, wave-wound (about 3/16in wide), 40 s.w.g. d.s.c.
L9	160 metres	100μH, wave-wound (about 3/16in wide), with 40 s.w.g. d.s.c.
L10	80 metres	80 turns, close-wound, 38 s.w.g. en.
L11	40 metres	32 turns, close-wound, 36 s.w.g. en.
L12	20 metres	21 turns, close-wound, 30 s.w.g. en.
L13	15 metres	14 turns, close-wound, 30 s.w.g. en.
L14	10 metres	10 turns, close-wound, 30 s.w.g. en.
		Oscillator
L15	Broadcast	120μH, wave-wound (about 3/16in wide), 40 s.w.g. d.s.c.: coupling coil, 15 turns close-wound adjacent to main coil, 36 s.w.g. d.s.c.
L16	160 metres	80μH, wave-wound (about 3/16in wide), 40 s.w.g. d.s.c.: coupling coil close-wound adjacent to the main coil, 36 s.w.g. d.s.c.
L17	80 metres	55 turns, close-wound, 38 s.w.g. en., tapped 8 turns from bottom.
L18	40 metres	28 turns, close-wound, 36 s.w.g. en., tapped 8 turns from bottom.
L19	20 metres	14 turns, close-wound, 30 s.w.g. en., tapped 5 turns from bottom.
L20	15 metres	8 turns, close-wound, 30 s.w.g. en., tapped 4 turns from bottom.
L21	10 metres	5 turns, close-wound, with 30 s.w.g. en., tapped 2 turns from bottom.

All coils are covered with polystyrene cement to secure turns.

I.f. Transformers.—T_1, T_2, T_3 and T_5 are identical and are "Weymouth" Type P50/2CC. The detector transformer T_4 is "Weymouth" Type P50/3CC. C_{18} to C_{22} inclusive are supplied as part of the transformer.

(Weymouth Radio Manufacturing Co. Ltd., Regent Factory, Weymouth, Dorset.).

Band Switch.—Painton "Winkler" Type AS/3P/9/33 three-pole wafers, nine-position, make-before-break, three-bank with Type "A" spindle

(Painton & Co. Ltd., Bembridge Drive, Kingsthorpe, Northampton.)

A.f. Transformers.—Details of these are given below; but if home design and construction is not contemplated Radiospares Type T/T1, ratio 1 : 1, is satisfactory for T_6 and Type T/T2, ratio 6.6 : 1, for T_7.

(Radiospares, Ltd., 4-8, Maple Street, London, W.1.)

T_6 Turns ratio 2 : 1+1
Primary inductance 1H
Primary resistance 20Ω
Secondary resistance 10Ω (each half).

T_7 Turns ratio 3.2+3.2 : 1
Primary inductance 50H
Primary resistance 1.0Ω (each half).
Secondary resistance 0.2Ω.

Commercial Literature

Controller-Indicator is a moving coil meter movement, with its pointer moving between two parallel plates, one plate being divided into sections. If the two plates are compressed, a circuit is made between one plate and whichever section of the other is under the pointer. Applications are alarms, recording and control, and many variations on the basic form are available. The equipment is part of the Canadian Bach-Simpson range of instruments. including testmeters, panel meters and engine-testing equipment, now marketed by Aveley Electric, Ltd., South Ockendon, Essex.

Chopper Type D introduced by Ericsson is capable of handling signals down to 10μV. Minimum noise pick-up is achieved by terminating the coil and contact leads at opposite ends of the unit. Units are supplied to work at 40-60c/s, but can be adjusted to operate at any frequency up to 100c/s. The standard coil is for 6.3V at a resistance of 500Ω. Full details from Ericsson Telephones, Ltd., 22 Lincoln's Inn Fields, London, W.C.2.

Universal C/tan δ Bridge by Siemens and Halske offers measurement of capacitance from 10pF to 2000μF at charging currents up to 1000A (with shunts). Direct reading of capacitance and loss factor is provided and there is provision for recording readings of crest voltage, loss angle and ΔC/Δ. Details from R. H. Cole (Overseas), Ltd., 2 Caxton Street, Westminster, London, S.W.1.

Phase-sensitive Voltmeter is described in a leaflet from Theta Instrument Corporation, 520 Victor Street, Saddle Brook, New Jersey. The instrument is panel-mounting and takes the form of a cylinder 5-in long, 3-in in diameter. Sensitivity 1mV f.s.d., frequency response 60 c/s-20 kc/s.

Position Control system—the EMICON B100—is described in a leaflet from E.M.I. Electronics Ltd., Industrial Division, Hayes, Middlesex. The system will control machines driven by electric or hydraulic motors, Ward Leonard controls or a.c. motors with clutches. Details are given of peripheral equipment for use with the system.

Components in the wide ranges made by Bulgin are listed in a new 174-page catalogue (No. 202) from A. F. Bulgin and Co. Ltd., Bye Pass Road, Barking, Essex.

Integrator Series 5300 is the subject of a leaflet from Electromethods Ltd., Coxton Way, Stevenage, Herts. The integrator, driven by the company's low-inertia integrating motor, employs a lamp and photocell with a rotating shutter to produce pulses. Motors are available to work at voltages between 1.5V and 24V.

Paralleling Transistors

AUTOMATIC DRIVE CURRENT EQUALIZATION

By F. BUTLER, O.B.E., B.Sc., M.I.E.E., M.Brit.I.R.E.

ALTHOUGH very high power transistors are now becoming available it is still quite common practice to use paralleled banks of smaller units in amplifiers and inverters designed to give a large power output. Parallel operation of small transistors has special advantages when the equipment is required to operate at high frequencies since the cut-off frequency of most high power units is unacceptably low. Matched pairs of power transistors can be supplied on demand by most manufacturers, but the provision of larger groups calls for special selection and this may delay delivery or result in increased costs. Replacements cannot be supplied to match earlier samples. When using unmatched transistors it is good practice to equalize the driving currents by the use of external resistance large enough to swamp the variations of input impedance of the individual units. The virtue of this technique is that it tends to linearize the driving currents as well as ensuring strict equality. Its drawback is that it is wasteful of driving power.

A recent paper[1] has shown how transformers of novel and unusual construction may be used to supply nearly equal currents to a number of loads of different, variable or ill-defined impedance. The author describes two distinct types of transformer which are equally effective in securing the desired equality of drive currents. In the simpler type the leakage inductance is rather larger than in a normal transformer which tends to reduce the operating bandwidth and may be objectionable on other counts, e.g. transient response. The second form of construction employs multiple cores with both individual and common windings. Good characteristics are thus assured but at the expense of increased production costs.

In power engineering it is frequently required to operate rectifiers in parallel and to provide some automatic means of load sharing between them. The usual way of doing this is to make use of small centre-tapped reactors or auto-transformers and the idea is readily adaptable for use in transistor power amplifiers or inverters.

Load Sharing by Tapped Reactors.—Fig. 1 shows an alternator of e.m.f. E supplying power to the unequal load resistances R_1 and R_2 through a centre-tapped reactor. Each half-winding has an inductance L with mutual inductance M between the windings. In practice an iron core is used and the windings are so closely coupled that M is virtually equal to L.

The action is best understood by first considering the case of equal load resistances. From the symmetry of the circuit it is clear that the input current to the reactor centre-tap will split so that each load resistor carries half the total current. The reactor core magnetization produced by current in one half-winding is exactly cancelled by that due to the oppositely directed current in the other half-winding. The net core flux is zero and no voltage appears across the outer ends of the reactor windings. On the other hand, if the reactor currents are unbalanced due to the use of unequal load resistances, there is an incomplete cancellation of core flux and the residual flux changes result in the induction of an e.m.f. in the windings of such a polarity as to cause an increase in the current in the high impedance arm of the network.

It is not difficult to determine the exact ratio of the two currents (see Appendix). Using the notation in Fig. 1 it can be shown that :—

$$i_1/i_2 = \frac{R_2 + j\omega(L+M)}{R_1 + j\omega(L+M)} \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

For close-coupled windings L = M and :—

$$i_1/i_2 = \frac{R_2 + 2j\omega L}{R_1 + 2j\omega L} \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (2)$$

Provided the choke reactance is much larger than the load resistances it is clear that the current ratio is almost unity. In general, the two currents are out of phase but the phase difference is negligible in the case where the choke reactance is substantially larger than the load resistances.

It is instructive to look at the circuit of Fig. 1

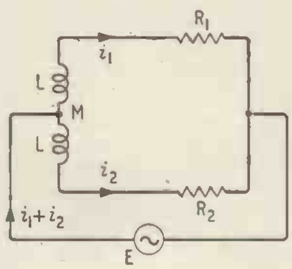


Fig. 1. Equal current division using centre-tapped reactor.

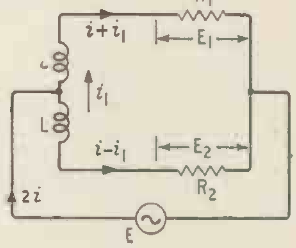


Fig. 2. Alternative treatment of Fig. 1.

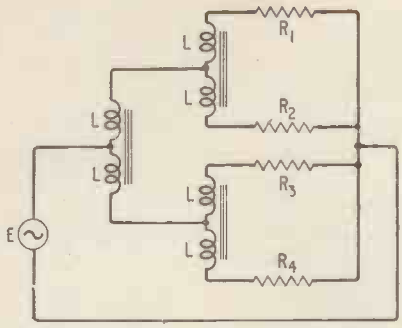


Fig. 3. Extension of current-sharing principle.

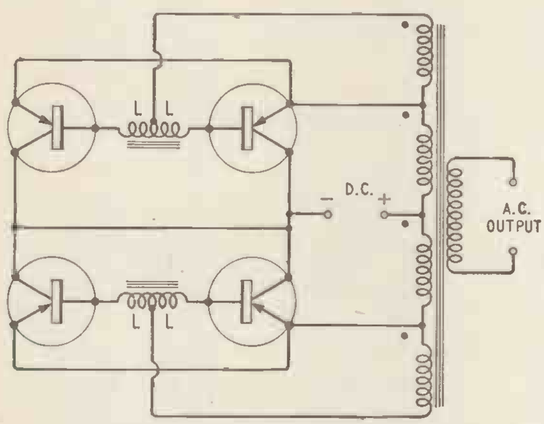


Fig. 4. Inverter using parallel push-pull circuit.

from a slightly different point of view. This has been redrawn in Fig. 2 in which a circuit current $2i$ is shown dividing equally at the reactor centre-tap. The current unbalance due to unequal load resistances is represented by a fictitious make-up current i_1 which adds to i in the low impedance arm and subtracts from i in the other. This of course calls for a reactor current i_1 flowing in the direction shown. The magnitude of this current i_1 depends on the choke reactance and on the net voltage between the outer choke terminals. In turn, this is the difference in the voltage drops across the two load resistors. If the choke is of high inductance it is clear that a large difference of voltage across the two resistances will be required to cause a significant current to flow. This is the unbalance current i_1.

A mathematical study of the arrangement of Fig. 2 leads to exactly the same conclusion as before and to the same expression for the current ratio $(i + i_1)/(i - i_1)$.

By making use of additional centre-tapped reactors it is possible to supply nearly equal load currents to 4, 8, 16 or, in general, 2^n different load impedances. The principle is shown in Fig. 3. At each stage of division the actual current to be handled becomes smaller and smaller so that finer gauges of winding wire may be used as the working current becomes smaller.

Construction of Reactors.—In most applications the tapped reactors will only be required to equalize the currents in moderately unbalanced loads. The working currents will seldom exceed one or two amperes and quite small magnetic cores are adequate. To provide maximum inductance with minimum physical size it is worth using cores of high grade magnetic material. Grain-oriented silicon-steel C-cores are suitable for high power 50 c/s equipment but for other applications it may be preferable to choose nickel alloy laminations of the HCR type.

As regards the windings, close magnetic coupling is best achieved by two-ply, bifilar winding, the two half-sections being connected series-aiding. To do this involves connecting the start of one winding to the finish of the other and regarding the junction as the centre-tap. The two free ends then become the outer terminals.

The wide variety of requirements makes it impossible to give useful winding specifications. In any event the design tolerances are very wide. As a rough guide it will be found that a few hundred turns of wire wound on a core with a cross-section about half an inch square will be adequate for most audio-frequency applications. For use in high frequency inverters it is sufficient to wind a few dozen turns of wire on a very small core, say about ¼ inch square section.

Practical Circuits.—Fig. 4 shows a typical d.c.-a.c. inverter circuit using four transistors in parallel push-pull. Two centre-tapped reactors serve to equalize the base drive currents. For simplicity, the normal starting-bias circuits have been omitted, but any standard arrangement can be incorporated.

The output stage of a typical Class B audio amplifier is shown in Fig. 5. Here again, the tapped reactors ensure equal base currents in the paralleled transistors. Finally, a full-wave rectifier circuit is illustrated in Fig. 6.

In all three cases two separate equalizing reactors have been shown. In the rectifier circuit both reactor windings may be placed on a single common core with suitable inter-winding insulation. With minor reservations, this technique is permissible in audio

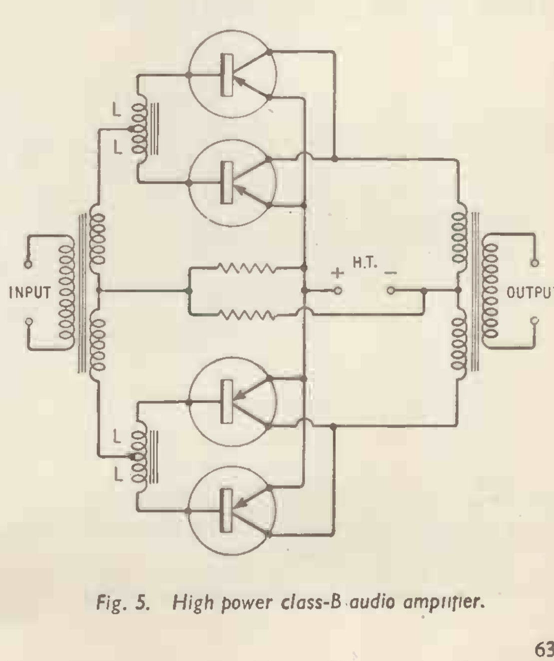


Fig. 5. High power class-B audio amplifier.

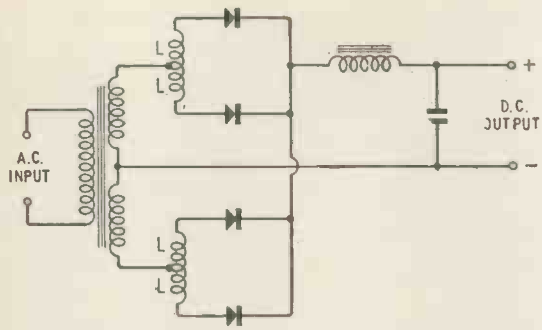


Fig. 6. Rectifier unit with current-equalizing reactors.

amplifier and inverter circuits. If a common core is used it may be found that current-sharing is imperfect near the cross-over point where the instantaneous driving currents are low. This disadvantage is not important, since the current division becomes more exact as the drive amplitude increases and the peak currents will be accurately equalized.

Conclusion.—The provision of small, simple and inexpensive reactors allows the use of unmatched transistors in paralleled groups. There is no degradation in the performance of equipment using them and few if any circuit modifications are called for. Such reactors are extensively used in high power rectifier circuits and are ideally suited for use with germanium or silicon rectifiers which can then be operated in paralleled groups without de-rating.

Reference

[1] H. G. Bassett, " Novel Transformer Suitable for the Parallel Opera'ion of Current Driven Devices," *Radio and Electronic Components*, March, 1961, p. 129.

APPENDIX

From Fig. 1,

$$E = (R_1 + j\omega L)i_1 - j\omega M\, i_2,$$
$$= (R_2 + j\omega L)i_2 - j\omega M\, i_1,$$

Hence:—

$$\{R_1 + j\omega(L + M)\}i_1 = \{R_2 + j\omega(L + M)\}i_2.$$
$$\therefore \frac{i_1}{i_2} = \frac{R_2 + j\omega(L + M)}{R_1 + j\omega(L + M)}.$$

For a reactor with close-coupled windings L = M so that:—

$$\frac{i_1}{i_2} = \frac{R_2 + 2j\omega L}{R_1 + 2j\omega L}. \quad \ldots \quad (1)$$

From Fig. 2, total choke inductance (end to end) is L + L + 2M, with L = M. Thus, total inductance = 4L.

$$i_1 = \frac{E_1 - E_2}{4j\omega L},$$
where $E_1 = R_1(i + i_1)$,
$E_2 = R_2(i - i_1)$.

$$\text{Current ratio} = \frac{i + i_1}{i - i_1} = \frac{1 + \frac{i_1}{i}}{1 - \frac{i_1}{i}}$$

$$= \frac{R_2 + 2j\omega L}{R_1 + 2j\omega L}, \text{ as before.}$$

The impedance seen by the source voltage E is $Z = E/(i_1 + i_2)$. Again taking M = L,

$$Z = \frac{R_1 R_2 + j\omega L(R_1 + R_2)}{R_1 + R_2 + 4j\omega L} \quad \ldots \quad (2)$$

Some special cases are:—

(a) $L = O$ so that $Z = \frac{R_1 R_2}{R_1 + R_2} = \frac{R}{2}$ if $R_1 = R_2 = R$.

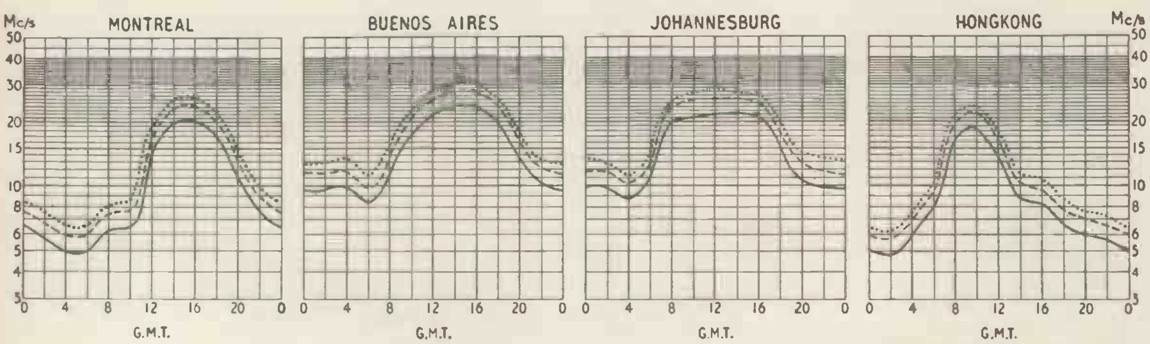
The load impedance is simply R_1 and R_2 in parallel.

(b) $L = \infty$, $Z = \frac{R_1 + R_2}{4}$,

(c) $R_1 = R_2$, $Z = R/2$ and is independent of L.

SHORT-WAVE CONDITIONS

Prediction for December



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

— — — PREDICTED MEDIAN STANDARD 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 December.

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

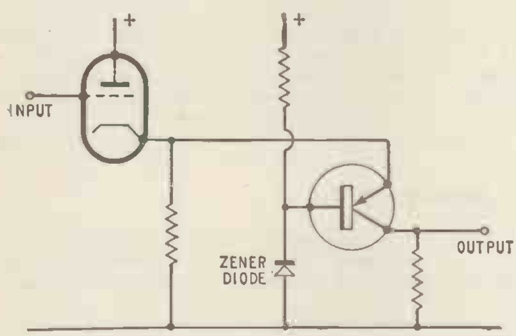
LETTERS TO THE EDITOR

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

Hybrid Amplifiers

THE accompanying circuit which appeared in the *Hewlett-Packard Journal* for April, 1961, is interesting. This hybrid is used in the X and Y amplifiers of an oscilloscope to provide high gain with a bandwidth of 22 Mc/s. The designers point out that the circuit is useful in a direct-coupled amplifier, since the difference in the steady voltage levels at the input and output is only 3 volts, compared with 60 volts for an all-valve circuit. As a result, the power supply can be simplified, and heater-cathode potentials can be kept low.

My article on hybrid amplifiers was written in January, and since then the cost of transistors has dropped considerably For example, the Texas Instruments 2G301, an r.f. transistor with a cut-off frequency of 6 Mc/s and a current gain of 60, is listed at under five shillings. This is less than the price of a triode valve, so hybrid circuits should now be a more attractive economic proposition. The intrusion of transistors into mains television receivers reported in *W.W.'s* Radio Show Review seems to confirm this.

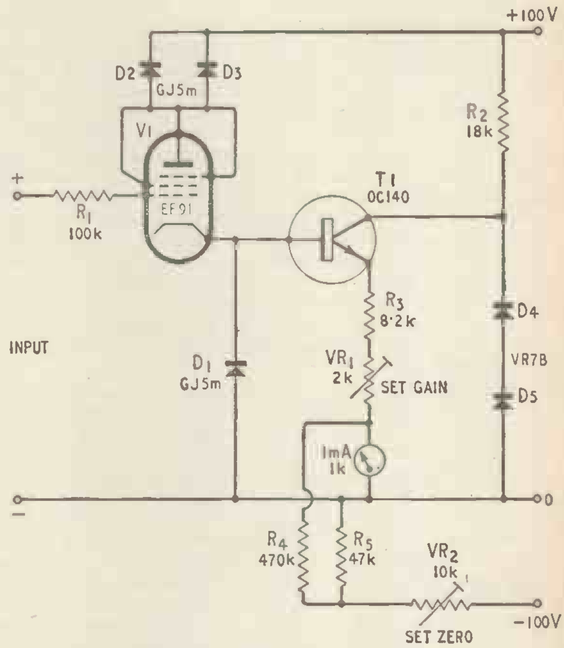


Croydon. G. W. SHORT.

IN your October issue, G. W. Short has analysed two of the many connections possible with a valve—transistor combination. In my work, a requirement arose for a high-impedance amplifier with good linearity for measuring the voltage stored on a $0.1\mu F$ capacitor, without discharging the capacitor unduly. The voltage range was 0-10V, and the amplifier was required to drive a 1000-ohm load at up to 1mA. A hybrid amplifier has proved ideal for this, using the common-anode plus common-collector combination.

In a simple cathode-follower circuit, low grid current can be obtained by operating the valve at low anode voltage and low cathode current. This results in poor linearity, but this can be improved by operating the valve with a constant cathode current. A germanium junction diode, operating in its reverse current direction, is a suitable cathode load, and the circuit is completed by an emitter follower driving the output load.

The accompanying diagram shows the practical circuit. The only additions necessary to the basic circuit are zero setting arrangements and the use of components R_1, D2 and D3 to protect the transistor in the event of the input voltage exceeding about 12V. Diodes D2 and D3 are operating on the reverse part of their characteristic and limit the valve anode current under abnormal operating conditions.



The linearity obtained with the circuit was ±0.1% of maximum input and the input current was less than 10^{-10} amps over the range 0-10 V.

No attempt was made to compensate the circuit for temperature changes and the voltage drift referred to the input is therefore rather large. This has not proved troublesome for the 0-10 V range chosen.

The work described in this letter is published by permission of the Director, Central Electricity Research Laboratories.

Leatherhead. A. E. T. NYE.

Safety of Life at Sea

THE Ministry of Transport announced in August that as from 1st September, 1961, direction-finding facilities from British coast radio stations would be suspended. While these services offered by the coast stations have not been patronized to any appreciable extent, the ability of a wireless station to take the bearing of a transmission is a facility that should not readily be withdrawn.

That it is not the desired intention of the Post Office, who staff and operate the stations, to curtail this facility seems apparent from the reservation of a four-acre site for direction-finding aerials at the new Ilfracombe radio station and also from their action in resiting the aerials at Humber Radio within the past few years.

At a coast station the M/F watch, on 500 kc/s, is conducted by the Post Office for the Ministry of Transport, who pay for the service. This is considered to be a non-commercial activity. The direction-finding equipment consists, the present tense is used, of large triangular loop aerials erected at a site about half a mile away from the station. The loops are unscreened and are centrally supported from a wooden pole. The site for the direction-finder aerials has to be on suitable elevated ground well clear of buildings, trees, wire fences and overhead lines. Long term preservation of the site is usually secured by the Post Office becoming the landowner of surrounding territory that then may be leased for agricultural use. At the operating position, which is manned by the operator listening on 500 kc/s, there is a radiogoniometer and a receiver that can be switched at will to either the radiogoniometer or a receiving aerial. A.g.c. is automatically removed from the receiver when it is connected to the radiogoniometer. At frequent and regular periods throughout the day bearings are taken on other coast stations and by this means the operational efficiency of the system is checked.

The prime purpose of radio apparatus on board ship and of the coast radio stations is the safety of life at sea. In the past it has always been the automatic action of an operator at a coast station to take a bearing of a distress signal on 500 kc/s; most often this information is unnecessary but occasionally it has proved of great value and assistance in guiding rescue craft to the location of the distress. Information of this kind is generally only required when weather conditions are foul and only one transmission is made from the vessel in distress. The Ministry of Transport notice, issued from St. Christopher House, states " . . . there is not sufficient demand for navigational purposes to justify the retention of the service, and the needs of ships in distress are met by other methods." What these methods are is not stipulated.

What could they be? Bearings taken by other vessels? This is unlikely to happen if only one call is made from the station in distress because ships at sea do not normally keep watch on a D/F receiver and circumstances can arise, as was the case in the rescue operations subsequent to the foundering of the *Princess Victoria* in January 1953, when the search vessel is unable to take a reliable bearing owing to the extreme yawing of the vessel. Additionally, transmission of the distress message may occur when the ships' operators are not on watch, or the direction finder may be in the chartroom. Bearings provided by naval stations? These stations have not contributed directly in such operations in the past and it does seem unlikely that the D/F facilities would be transferred to the Service at this stage. The use of other modern aids to navigation? If a ship runs aground it would appear that these aids had failed and that it is uncertain of its position. How, then, is assistance to be directed to it promptly?

It seems that the cost of maintenance of these installations, compared with the revenue for the particular service rendered, is considered to be out of proportion. Another factor of influence will be that, in recent years, other countries have abandoned this service; not, however, countries with strong maritime interests. That the facility is not required for navigational purposes is not disputed; but it should be retained for distress purposes and even extended.

The D/F system just abandoned worked in the band 410 to 500 kc/s. This was, perhaps, its greatest disadvantage because the majority of ships using the coastal waters about the United Kingdom, fishing and home-trade vessels, are fitted with radiotelephone equipment that operates in the band 1,625 to 2,850 kc/s. D/F coverage in this band would be difficult to provide over the entire coastal area unless the facilities of the Coastguard Service were linked into the scheme. The segregation of marine communication into two bands without ready means of contact from one band to the other has, in the past, hampered rescue work; the most recent instance of this nature occurred after the collision involving the *Crystal Jewel* in the English Channel. It is peculiar that a modern ocean-going vessel cannot communicate directly with a lifeboat or coastal vessel that is coming to its assistance. The Merchant Shipping (Radio) Rules, 1952, make no provision for circumstances like these. Would it be unfair to hint that there seems to be a lack of complete assessment of practical conditions?

If the measures taken by the Ministry are unable to prevent accidents taking place, at least all facilities should be provided for rescue operations; and while it is not anticipated that they will in any way rescind their decision, the usefulness of permanent D/F installations, capable of reception over a wide frequency range, should not be overlooked. Who could help the crew of an aircraft in a rubber dinghy in the North Sea at 0130 G.M.T.? German coast stations, Dutch coast stations and, we are told, "other methods," but not British coast stations.

South Shields. A. T. FERGUSON.

Hearing High Frequencies

MR. MAWSON'S conclusion (November issue), that the most acceptable type of radio receiver for the elderly is one which has plenty of built-in top cut, would indicate that at high frequencies not only does the absolute level of hearing threshold increase with age but that also the absolute level of the threshold of pain reduces with age.

This would account for the often observed phenomena that such persons are the first to reach for the top cut and/or filter controls in reproduced music.

Many eminent elderly musicians, however, although ardent top-cut fans at home, make no complaint about the top from a live orchestra, even sitting in the middle of it. Can it be that with the experience of advancing years one becomes more discerning and thus less prepared to accept the imperfections which most transducers exhibit at high frequencies?

Huntingdon. P. J. WALKER.

Telemetry

I WAS pained to read in your November issue of the abuse of the word "Telemeter." A magazine with as much influence as yours should realize that some confusion will arise from its use.

Unless action is taken, followers of the noble science of measurement at a distance will become identical in the public image with gas company inspectors, and will have to coin a new word to cover their activities. I leave suggestions to Mr. F. Grid. I can only think of "Slotelly" for them.

One group will have to change. We have got classical justification and we got there first.

Cambridge. S. H. SALTER.

[While we sympathize with our correspondent's point of view, we think that "abuse" is perhaps too strong a word. After all the coins *are* measured, and at a distance from the company's headquarters.—ED.]

Degrees of Definition

THE suggestion in your November editorial, to use the word "Mark" in distinguishing different degrees of television, is astonishing.

Present day use of "Mark . . .", by individuals or commercial firms, suggests adherence to a style which became familiar to many in war time, or alternatively a snobbish attempt to suggest that the items referred to have a large "official" backing.

In the early days of multiple production, mainly in the gun industry I believe, when designs were modified for improvements or economies, it was found convenient to put on a distinguishing number, letter or other mark. When referring, in writing, to such distinctions, to avoid referring to "Gun II" or "Tank III," the reference became Gun or Tank "MARK II," sometimes abbreviated to "Mk. II." For consistency the word "Mark" or its abbreviation was then added on the articles themselves. Incidentally not all Armament and Government work makes use of the "Mark" system. I met it first as a curiosity of another branch when connected with Naval work in the early 1930's.

For a system to distinguish different standards of television definition, I suggest "Definition I," etc., for it will always be necessary to note that definition is referred to and the word "Mark" is superfluous. Subsequently in a single article, abbreviation to "I," "II," etc., would be reasonable. It is interesting for comparison to note that there seems no tendency to further abbreviate "Band I," etc., no matter how often repeated.

As the editorial also refers to "hair-splitting" about "service," it might not be wise for me to go on and list some of the ways in which "service" is used portmanteau fashion, like "thingamajig" to cover careless lack of discrimination.

However, as an engineer I like to avoid quibbling which is liable to waste time, like redundant reference symbols.

London, N.W.6. W. G. EALY.

Electronic Music

SINCE it is not possible in a short article to outline fully the artistic or manipulative techniques necessary to extract real value from electronic music, I append some references which readers will find useful. Mr. Judd, in his article in September, did not give sufficient credit to the father of *musique concrète*, Pierre Schaeffer, or his colleagues Olivier and Pierre Messian, whose musical knowledge enabled the art to be launched.

The same applies to the monumental work of Prof. W Meyer-Eppler and his colleagues Herbert Eimert, Fritz Enkel and Karlheinz Stockhausen, at Cologne. The immense amount of research into musical notation, composition, and apparatus for electronic music research cannot be fully appreciated without reference to the literature cited below.

Radcliffe-on-Trent. ALAN DOUGLAS.

Schæffer, P. "A la Recherche d'une Musique Concrète." Edition du Seuil, 1952.

Poullin, J. "Son et Espace." Editions Richard Masse, 1954.

Moles, A. "Les Machines à Musique." Editions Richard Masse.

Moles, A. "Studium und Darstellung des Complexen Tones in der Musikalischen Akustik. *Funk und Ton*, 1953.

Bernhart, J. "Deux Applications de la Notion de Distortion Spatiale." *L'Onde Electrique*, No. 304. July, 1952.

Articles in the special number "*Elektronische Musik*," Vol. 6, No. 1/2, 1954, of *Technische Hausmitteilungen des Nordwestdeutsche Rundfunks.*

TUNED COUPLED CIRCUITS

USE OF MAXIMUM POWER TRANSFER THEOREM

By B. J. AUSTIN

THE theory of tuned coupled circuits is a straightforward example of elementary circuit analysis and is adequately treated as such in many text books. However, in view of the importance of such circuits, it seems worth while to review the situation in a way which focuses attention on the underlying physics, not on the algebraic manipulations.

The purpose of the article is not, then, to carry out a complete analysis of the circuit of Fig. 1. This would be unrewarding and without much interest. Instead, let us try to see just why tuned coupled circuits behave as they do. In particular, let us attempt to explain, from basic physical principles, the observation that the secondary current I_2 can never be made to exceed V/2R, however large the coupling M may be. Familiarity with this fact may detract from its striking character, but could we, on a first acquaintance with the problem, merely write off such strange behaviour as accidental? Would we not contrast the docile increase of I_2 with M, up to the critical value V/2R, with its stubborn refusal to increase beyond this point, and begin to suspect the workings of a hidden law? Of course we would, and this article is intended to show how well-founded our suspicions would have been. Any of our readers who have read the subtitle will know that the law involved is one about maximum power transfer.

First of all, we must know what the Maximum Power Transfer theorem states. Imagine that we have a voltage generator V with internal resistance R. We connect, in turn, load resistances of various values and measure, in each case, the power which is dissipated *in the load*. The theorem then simply states that this power is greatest when the load resistance is equal to R, the internal resistance of the generator. The reader will be able to show that the maximum power available for dissipation in the load is then $V^2/4R$, corresponding to a current of V/2R. The theorem applies to steady or alternating voltage generators and, if necessary, it could be extended to include generators having complex internal impedances. We will not require this extension.

The theorem is still valid when the load is separated from the generator by a tangle of L's and C's. Indeed, in this situation, it is more flexible since it is possible to "match" any value of load resistance to the generator by means of a suitable lossless coupling network. The network must be chosen so that the generator "sees" a load equal to R, while the real load thinks that the generator has an internal resistance equal to itself. Fortunately, the second half follows from the first, so that we can forget about it. A well-known example of this technique is the matching of a loudspeaker coil

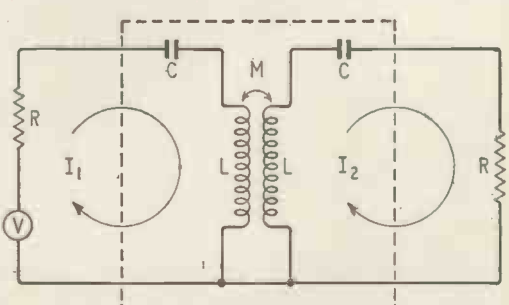


Fig. 1. Basic tuned coupled circuit. The dotted box contains a network which couples a "load" to a "generator".

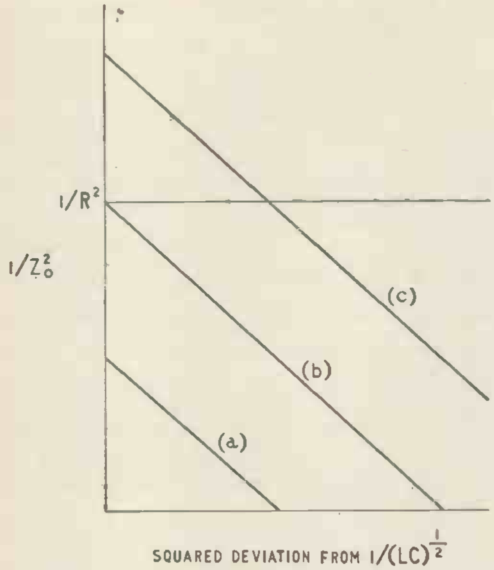


Fig. 2. Squared deviation from $1/(LC)^{\frac{1}{2}}$ plotted against $1/Z_o^2$ (for high-Q circuits). Graph (a) is for small M, when $1/Z_o^2$ never reaches $1/R^2$ (undercoupling), (b) is when $1/Z_o^2$ just reaches $1/R^2$ (critical coupling) and (c) is for large M (over coupling).

(resistance 15 ohms, say) to a power output valve (internal resistance 5000 ohms, say) by a transformer with a suitable turns ratio.

To see the application to tuned coupled circuits, let us view the circuit of Fig. 1 in an unusual way. Let us think of the resistance R in the primary as the internal resistance of the generator, and the secondary resistance as a load. Of course, this is an artificial dodge because the R's are inseparably bound up with the transformer, and, anyway, we are not using the tuned circuits merely to dissipate power in the secondary. These objections are not fundamental however, so we may lay them aside. Our problem is to find the condition for greatest secondary current, which amounts to finding the condition for maximum power dissipation in the "load". The properties of the coupling network are in this case frequency dependent, and we are seeking the frequencies at which a load R connected to the output terminals gives rise to a resistance R at the input terminals. (The point here is that the resistance "seen" at the input must be the same as the internal resistance of the generator, i.e. also R.)

At first sight, this problem may seem quite impossible to solve, but actually it can be done. At least, it is always possible to find an *impedance* (called Z_o) which, when connected to the output terminals of a symmetrical four-terminal network, causes the input impedance to be Z_o as well. Z_o is called, among other things, the iterative impedance, and it is a concept much used in some branches of circuit theory (e.g. the theory of filters). We need not worry about this, but merely remark that our problem is to find the frequencies at which the iterative impedance of the coupling network is equal to R.

It can be shown (and this stock phrase hides quite a lot of algebra) that in our case Z_o is given by:—

$$1/Z_o^2 = -[\omega C - 1/\omega(L+M)][\omega C - 1/\omega(L-M)] \quad (1)$$

Hence, the frequencies at which the secondary current is a maximum are the solutions of:—

$$1/R^2 = 1/Z_o^2 = -[\omega C - 1/\omega(L+M)][\omega C - 1/\omega(L-M)] \quad .. \quad .. \quad .. \quad .. \quad .. \quad (2)$$

The reader may be tempted to feel that this is the end. After all, we have only to find what frequencies satisfy equation (2) for any given values of the parameters (M in particular), and we have the frequencies at which the load power is a maximum, and hence the secondary current is greatest. Disappointingly enough, we have not quite finished, since it is not always possible to satisfy equation (2). This is most easily seen by reference to Fig. 2. A word of explanation about this figure is in order here. The abscissa is plotted in terms of the squared frequency obviation from the centre frequency i.e. from $1/(LC)^{\frac{1}{2}}$. Thus each point to the right of the origin represents *two* frequencies, one above and one below the centre frequency. Negative points have no meaning. When plotted against this variable, for high Q circuits, the graph of $1/Z_o^2$ is practically a straight line in the region which concerns us.

For a given value of M, $1/Z_o^2$ is greatest at the centre frequency (remember that negative values of the abscissa are not allowed). If the highest value attained is less than $1/R^2$, as will happen if we make M sufficiently small, we will not be able to find a solution of equation (2). This is, of course, the situation known as "undercoupling". The secondary current has a single maximum at the centre frequency (i.e. where matching is most nearly achieved). The current is always less than V/2R since we can never have the theoretical maximum power transfer.

If we make M large enough, we arrive at the situation called "overcoupling". We now have the line representing $1/Z_o^2$ rising above $1/R^2$ at some real (positive) abscissa value. Hence we will have *two* solutions of equation (2) and thus two frequencies at which I_2 is a maximum. We can now see that the value of these maxima will be V/2R, for all values of M greater than the critical value. Thus, the obstinate refusal of I_2 to exceed V/2R can be seen to be a consequence of the maximum power transfer theorem.

At last we have reached the end of the road. It may seem that an undue amount of effort has been expended to arrive at rather meagre scraps of information, especially as the method cannot be extended to include the case of unequal primary and secondary resistances. We could, however, have worked out one more detail, namely the critical value of M, but this is left as an exercise for the reader.

CLUB NEWS

Bexleyheath.—W. J. Green (G3FBA) will give a talk entitled "Bandspreading HRO Coils" at the meeting of the North Kent Radio Society (G3ENT) on December 14th at 8.0 at the Congregational Hall, Clock Tower, Bexleyheath, Kent.

Birmingham.—The subject for discussion at the December 1st meeting of the Slade Radio Society (G3JBN) is d.f. developments. Meetings are held on alternate Fridays at 7.45 at Church House, High Street, Erdington, Birmingham, 23.

Bradford.—"The development of time measurement" is the title of the talk to be given by W. Barton at the December 12th meeting of the Bradford Radio Society. The club headquarters are at Cambridge House, 66, Little Horton Lane, Bradford, 5, where meetings are held at 7.30. Instruction for junior members is given at 7.0.

The D.C. Feedback Pair

A USEFUL TRANSISTOR AMPLIFIER CIRCUIT

By G. W. SHORT

THE circuit shown in Fig. 1 has several virtues. Not the least is economy: it gives good temperature stability with fewer components than the conventional one (Fig. 2(b)). It is useful in low-level audio stages, and it lends itself to negative feedback arrangements.

It has been called the transistor d.c. feedback pair,

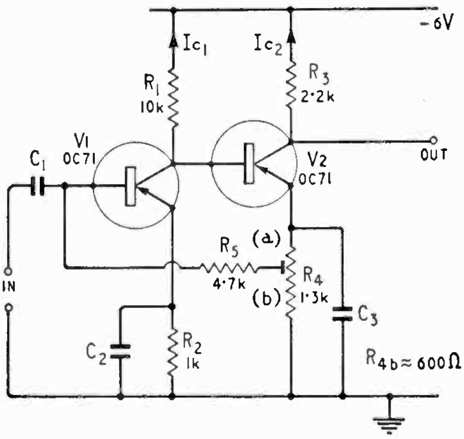


Fig. 1. Transistor d.c. feedback pair.

because it contains two transistors in a d.c. feedback circuit. The operation is complicated. Interested readers can look up reference (2) which contains a full circuit analysis. But they are warned that the formulæ are so complex that they mean very little to ordinary mortals.

A rough qualitative picture of what happens can be arrived at without any mathematics. Suppose that, as the result of a temperature change, there is a change in the base current of V1. The increment of base current is amplified by V1, which causes phase inversion as well. Part of the amplified increment is passed to V2, where it is further amplified, and finally a portion is fed back to V1 via R_5. Since there is no phase reversal in V2, which is a common-collector circuit as far as this feedback is concerned, the overall feedback is negative.

What about the temperature drift of V2? Assuming that ambient temperature, not the heat of internal power dissipation, is the controlling factor, then both transistors will be subject to the same temperature fluctuations. Their collector-base leakage currents (I_{cbo}) will drift in the same direction. Since there is phase inversion in V1, its amplified drift current appears at the base of V2 in opposite polarity to V2's own drift current. Thus some cancellation of V2's drift takes place. In practice, with two similar transistors, the drift in V2 is overcompensated by V1. As the temperature increases, the collector current of V2 decreases.

The behaviour of a practical circuit is shown in Fig. 3. This compares the performance of the d.c. feedback pair with the more conventional arrangements of Fig. 2. The same transistor was used for V1 and for the two conventional arrangements, and the operating current at room temperature was arranged to be the same in each case. A water bath was used to control the temperature: the transistor envelopes were immersed for about three-quarters of their length.

Simplified Circuits:—The d.c. feedback pair can be simplified by connecting the emitter of V1 straight to " earth ", and increasing R_5. This has

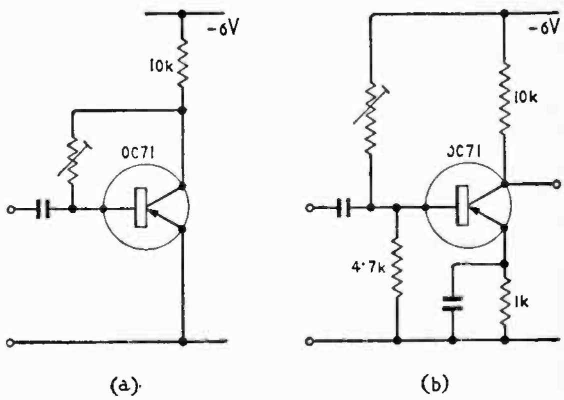


Fig. 2. Conventional temperature-compensated circuits; (a) with shunt feedback, (b) with emitter resistor and base bias potentiometer.

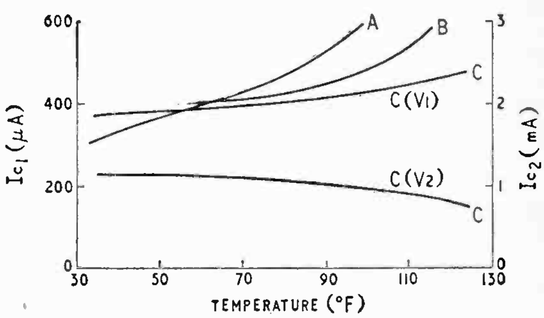
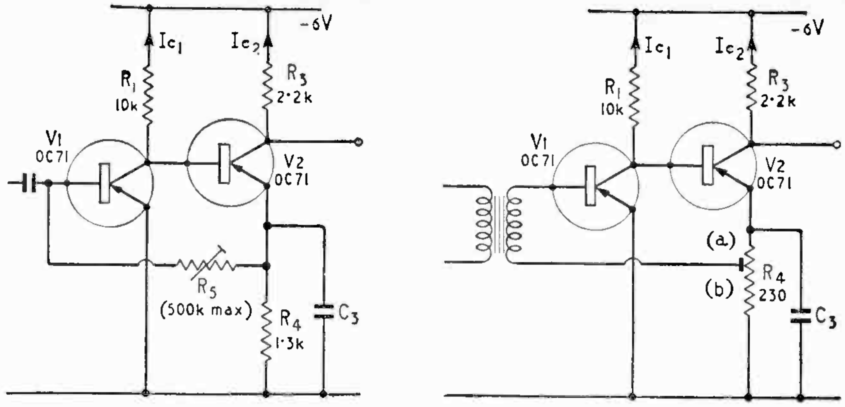


Fig. 3. Variation of collector current with temperature. Curve A refers to the circuit of Fig. 2(a), Curve B to that of Fig. 2(b), and Curve C to the d.c. feedback pair of Fig. 1.

the advantage of getting rid of R_2 and C_2. (It also increases the input impedance of V1 slightly, but this is hardly important, since R_5 can usually be made at least twice as big as the input impedance of the transistor V1 itself.)

Two simplified circuits are shown in Fig. 4. The first one (Fig. 4(a)) is applicable when the input is connected through a capacitor. The second (Fig. 4(b)) has too low an input resistance for this (in the particular set-up investigated by the writer, $R_{4(b)}$ was only about 30Ω) but it can be used with transformer input-coupling, as indicated.



(a) (b)

Fig. 4. Simplified feedback-pair circuits.

The temperature responses of these circuits are compared with that of full circuit in Fig. 5. The immediate conclusion is that the Fig. 4(a) type of circuit is no good: in this particular instance it is worse than the simple circuit of Fig. 2(a). In fact the trouble with this particular circuit was caused by an over-large R_4, which in turn made necessary an over-large R_5. For good stability, R_5 should be as small as possible.

Measurements taken on the circuit of Fig. 6, in which R_5 is reduced to 4.7kΩ, are shown in Fig. 7, along with those of the full circuit for comparison. The simpler circuit gives quite a good performance. ($R4_{(b)}$ was 37Ω.)

In general, then, all the variants of the d.c. feedback pair can be made to provide good enough temperature stability for use in domestic equipment, at any rate in a temperate climate. We shall now review some specific applications of the circuit.

Low-Level Input Stages.—Transistor noise can be serious in audio work. In order to minimize it, the transistor should be operated at a low current. In addition, the collector voltage (V_{ce}) should be kept small, though this is not so important as low current.

The temperature-stability curves show that the feedback-pair circuit is a good one for this application. The current in V1 is low and fairly constant, so that the transistor can be operated at a low voltage without the risk of "bottoming" at the higher temperatures. The OC71 is not conspicuously good from the point of view of noise. A special low-noise transistor such as the Mullard AC107 should give less noise, and also less temperature drift: its base leakage current is an order of magnitude less than that of the OC71. It would be reasonable to use an OC71 in the second stage, where noise and I_{co} are less important.

Negative Feedback.—The d.c. feedback pair behaves also as an a.c. feedback circuit at frequencies at which the capacitor which decouples the emitter of V2 has an appreciable impedance. The effect of this feedback is twofold. It reduces the input impedance of the amplifier as a whole, and it increases the input impedance of V2. Both effects can cause a reduction of gain as the frequency decreases. The magnitude of this "bottom cut" depends on the signal-source impedance and on the size of the collector load of V1. If the signal source has a very high impedance (constant-current drive) then the input current divides between the base of V1 and the feedback resistor R_5. Under these conditions the maximum amount of bottom cut is obtained. Note, however, that the process does not go on for ever. As the frequency is reduced, a stage is reached at which the reactance of the V2 emitter-decoupling capacitor becomes so great compared with the emitter resistance (R_4) that the feedback is virtually independent of frequency. The response then levels out again.

If the amplifier is driven from a low-impedance source (constant-voltage drive) the overall feedback has no effect. There is still the local feedback, however. The input impedance of V2 increases as the frequency is reduced. If V2 were driven from a source with a very high impedance, its base current would be unaffected, and there would be no bottom cut. In fact, the source impedance is the collector load of the first stage in parallel with the output impedance of V1, and it is unlikely to be very high compared with the input impedance of V2. The latter becomes approximately βR_5 at very low frequencies.

As in all transistor circuits, the two effects can-

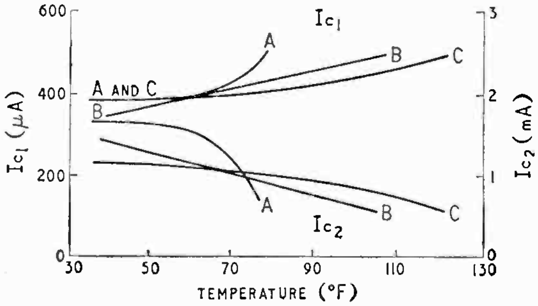


Fig. 5. Temperature performance of various feedback-pair circuits. Curve A refers to the circuit of Fig. 4(a), Curve B to Fig. 4(b), Curve C to one like Fig. 1, but with R_5 = 10kΩ.

not be completely separated. The output impedance of V1 is influenced by the signal-source impedance, for instance. But in typical audio circuits the signal-source impedance has only a small effect on the output impedance of V2. One can then get an idea of the effect of the second type of feedback by taking frequency response using a constant-voltage source.

Measurements on a practical circuit showed a low-frequency fall-off of about 5dB per octave with constant-voltage drive, and 8dB per octave with constant-current drive. These values were obtained when the capacitance C_3 was big enough to bypass the second emitter more or less completely above about 10 kc/s. If, on the other hand, C_3 is so small that it only begins to bypass the second emitter at frequencies near the upper cut-off frequency of a normal amplifier, a compensation effect occurs, and the frequency response is improved. In a particular instance, a 0.005μF capacitor doubled the bandwidth of the amplifier compared to that when *no*

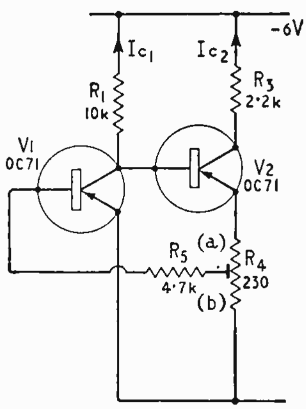


Fig. 6. Improved version of Fig. 4(a). By fixing R_5 and adjusting R_4 to obtain the right operating conditions the resistance in the base circuit of V1 is kept fairly low.

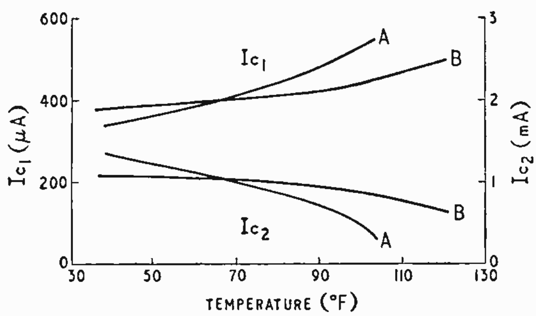


Fig. 7. Temperature performance of Fig. 6 (curve A) compared with full feedback-pair circuit with $R_5 = 10\ k\Omega$.

capacitor was used, the gain remaining almost the same.

Tape Recorder Equalization.—Readers may remember an article in the December, 1958, issue in which P. F. Ridler[3] showed that the circuit of Fig. 8 produced playback equalization for a tape recorder. In this case the inductance was that of the playback head, which was 500 mH.

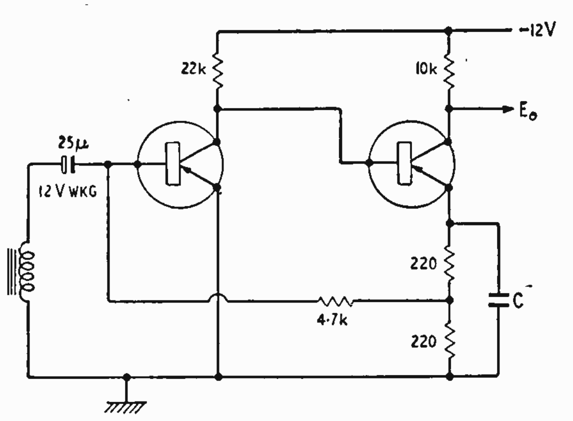


Fig. 8. Ridler's tape-recorder playback equalization circuit.

In tape-recording, two effects occur which modify the frequency response—a bass cut and a top cut. The bass cut arises simply because, as the frequency is reduced, the rate-of-change of flux at the playback head is reduced. The result is a bass cut of 6dB/octave. The top cut arises from more than one cause.

If the response of the recording amplifier is flat, and the recording *current* is constant, then, because of the low-frequency effect, the voltage induced in the playback head by the moving tape is proportional to the frequency. The lower the frequency, the lower the voltage, other things being equal. If, as is usual, the playback head is worked into a high-resistance load, so that it acts as a voltage generator, l.f. boost is necessary somewhere in the system.

If, however, the playback head is connected to a load with such a *low* resistance that it can be considered a short circuit, the output *current* does not fall off as the frequency is reduced. It remains constant. The reason is simple. The voltage induced in the head falls with frequency, as before. But the impedance of the head also falls, since the head is an inductor. These two effects cancel one another, and the output current is not a function of frequency.

Thus, in principle, the need for l.f. equalization can be avoided. The system fails if there is an appreciable amount of resistance in the circuit, either in the winding of the playback head or in the load. While a common-emitter transistor has a lowish input resistance (say 1 kΩ), this is by no means a short-circuit. The l.f. *current* response is 3dB down when the total resistance is equal to the reactance of the head. Assuming a 1 H head, then for a loss of no more than 3dB at 30 c/s the total resistance of winding and load must not exceed about 200Ω. While the winding resistance of the head may be less than 200Ω, the input resistance of a common-emitter transistor is much greater. One must either use a common-base transistor, or artificially reduce the input resistance of a common-emitter circuit. Since the feedback pair does this for us if we omit C_3, and since negative feedback brings other advantages, it is reasonable to use the feedback pair in equalization circuits.

The mechanism by which the equalization works is then as follows. The input resistance of V1 is unaffected by the feedback. What the feedback

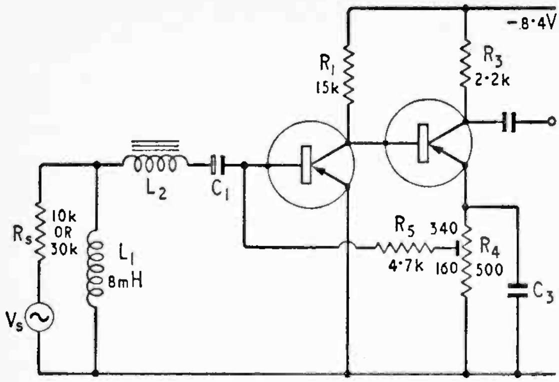


Fig. 9. Test circuit for playback equalization.

does is to make R_5 look smaller to the signal source, so that the input current mostly flows through R_5. If the amount of feedback is the same at all frequencies, the ratio in which the input current is shared by V1 and R_5 remains constant. (By reducing the feedback at high frequencies, one can produce top lift. With reduced feedback, R_5 looks more like its real value, and V1 gets more current from the source.)

The Mullard OC71 transistors used by the writer had a higher current gain than the transistors used by Ridler (about 50, compared with 30). In addition, the supply voltage available was less than Ridler's (8.4 V compared with 12 V). These factors prevented the use of an exact copy of Ridler's circuit. The one actually used is shown in Fig. 9. No test tape was available, so instead of using a tape recorder to generate an input voltage proportional to frequency, the effect was simulated by the method suggested by Murray.[1] This is to force a constant signal current through a small inductance (L_1 in Fig. 9). At low frequencies, R_s was 10 kΩ, and above about 1 kc/s it was 30 kΩ. In each case the condition $R_s \gg \omega L_1$, which is necessary if the current is to approach constancy, is satisfied, since L_1 is only 8 mH. (It might be mentioned that hum pick-up by L_1 and L_2 was somewhat troublesome at first, but was eliminated by carefully orienting the two chokes.)

Measurements were made using two different components for L_2. One was a choke of 800 mH, with a zero-frequency resistance of 70 Ω, and the other was an actual tape head of 200 mH inductance with a resistance of 100 Ω. The results are shown in Figs. 10 and 11. To begin with, the frequency response of the amplifier itself was measured; i.e., without any chokes at all. This is shown by the curve in Fig. 10 labelled $L_1 = L_2 = 0, C_3 = 0$. In theory, exact l.f. equalization is obtained using the full circuit with $C_3 = 0$, and this is borne out by the measurement. Note, however, that when the tape head has an appreciable resistance compared with its reactance, the system fails at really low frequencies (Fig. 11, 200 mH, 0 μF).

Referring again to Fig. 10, it can be seen that, by including C_3, and so reducing negative feedback at high frequencies, a rising response is obtained. This is used by Ridler to compensate the h.f. losses of the head. With his particular circuit, he found a distinct peak at the h.f. end. Such a peak is beginning to appear in the Fig. 10 curves. If the gain of the amplifier is much higher, it can oscillate at the peak frequency. Ridler's remedy for the peak of inserting a low resistance in series with C_3 stops this and gives the designer additional control over the h.f. response.

The effect of changing C_3 is to shift the response curves bodily. The slope remains nearly the same (about 6dB per octave). This suggests that, simply by switching in different capacitors, one might change the equalization to suit different tape speeds. The amount of equalization is sufficient to compensate

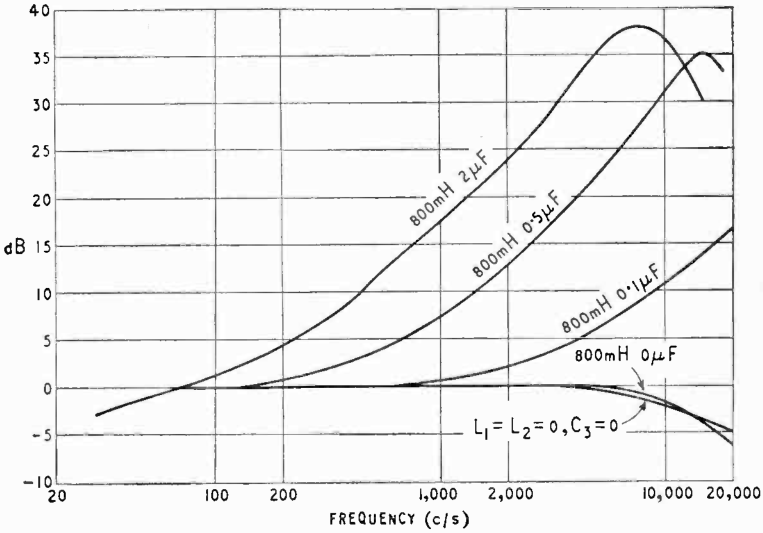


Fig. 10. Response of test circuit with simulated high-impedance playback head (800 mH). The capacitance values refer to C_3.

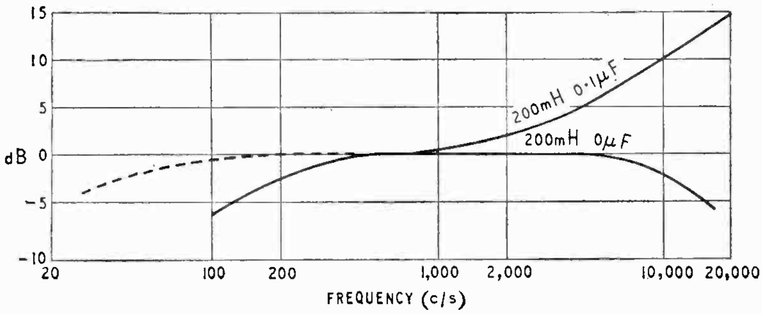


Fig. 11. Response of test circuit with low inductance head (200 mH, 100Ω d.c. resistance). The dotted curve shows how the l.f. response was restored by connecting 2kΩ in series with 0.5μF across the collector load of the first transistor.

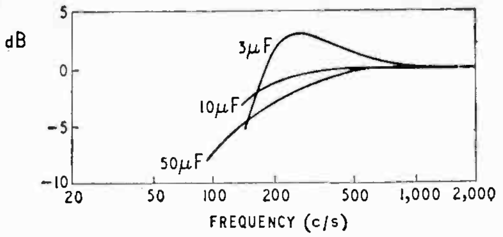


Fig. 12. Effect of C_1 on the low-frequency response of the test circuit, using the low-impedance tape head.

the l.f. tape loss completely. No pre-emphasis of low frequencies should be required when recording. If, as is probable, the same amplifier has to be used for recording and playback, one might wish to take advantage of the full gain for recording purposes. All one needs do to get it is to switch a large capacitor across the second emitter resistor—say 100μF. This will remove negative feedback at all significant frequencies. On the other hand, one might not need the full gain. The opportunity then presents itself of using some high-frequency pre-emphasis by leaving a small capacitor across the second emitter resistor. By suitable choice of values it should be possible to use the same capacitor during recording and playback and end up with a flat overall response.

The bass loss due to the head winding-resistance can be compensated, at the expense of gain, by connecting a series RC network across R_1. The effect of 2kΩ and 0.5μF is shown by the dotted curve in Fig. 11. With $C_3 = 0$, the shape of the h.f. response was unaffected, but with $C_3 = 0.1\mu F$ the h.f. lift at 10 kc/s was reduced by about 4dB. Partial l.f. compensation can be obtained by selecting a value for C_1 which resonates with L_2 near the l.f. end of the response curve. The effect is shown in Fig. 12. As the resonant frequency is reduced, the circuit Q falls, and there is no peak in the response.

High-Impedance Input.—If the feedback loop is broken, the impedance looking into the break is high. This can be useful if one has a high-impedance signal source which must not be loaded appreciably by the amplifier. One then connects the signal source in place of R_5.

The input impedance can be measured by means of the circuit of Fig. 13. In this, there is no d.c. feedback, because to measure the impedance it is necessary to alter R, and this would upset the static conditions if R were carrying the base current of V1. With R = 0, apply an input signal big enough to produce a sizeable meter reading. Then adjust R so that this reading is halved. R is now the same as the input impedance. It can easily be a few hundred kilohms. An a.c. feedback pair along the lines of Fig. 13, but preferably with proper temperature stabilization of V1, may be useful when the signal source is a crystal pickup or crystal microphone. It is, of course, arguable that it may be just as good to use a straightforward amplifier without a.c. feedback and connect the crystal device to the input in the ordinary way, but with a series resistance big enough to provide an adequate load. For all the writer knows, this arrangement may be satisfactory. There is, however, one apparent virtue in doing it the other way. If the signal source is in the feedback path, the amount of feedback is controlled by the source impedance. As the latter decreases, the frequency response improves. This appears to work out the right way for crystal transducers, since their impedance falls as the frequency is raised.

Some evidence is provided by the following test results. The circuit used was like Fig. 9, but without the inductors, R_5, or C_3. V1 was biased by a resistor from base to the collector supply, and set up with $V_{ce} = 1V$. The input was applied between the emitter of V2 and the free end of C_1. The input resistance was over 500 kΩ. When the input signal was applied from a low-impedance source in series with 1000pF (this simulates a crystal device) the output was 3dB down at 250 c/s and 16 kc/s.

Conclusion.—Now that the writer has shown, to his own satisfaction, at least, that the d.c. feedback pair is a useful circuit, he will attempt to parry the inevitable question. If a feedback pair is good, why not a feedback triple, or quadruple? Let me say right away that circuits with d.c. feedback over three stages exist (Fig. 14). Readers can look up details in Reference 4. But there are a couple of snags. One is that, with germanium transistors, the temperature drift may be so great that the third transistor bottoms as the temperature rises. The point is that, with three stages, the drift of the first transistor gets amplified rather a lot before it reaches the third transistor, and may overload it. It's all right with

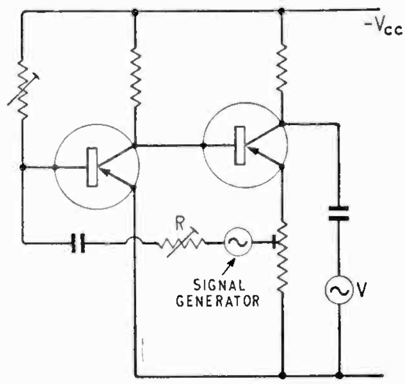


Fig. 13. Circuit for measuring imput impedance, looking into the feedback loop.

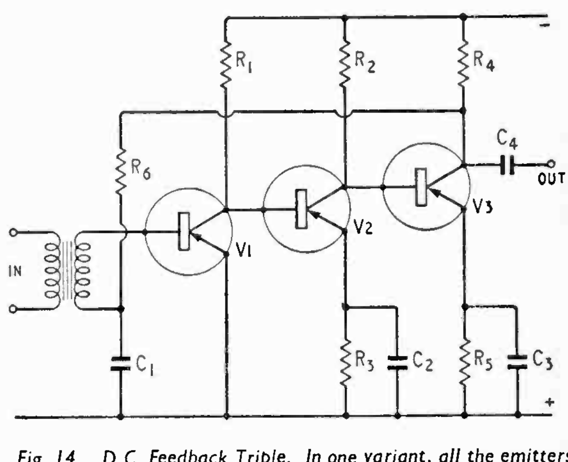


Fig. 14. D.C. Feedback Triple. In one variant, all the emitters are returned to earth directly.

silicon, but hardly with germanium transistors. Before readers who are familiar with Reference 4 rush to get pen and paper to write me rude letters, let me say that two of the germanium transistors in the three-transistor direct-coupled hearing aid described in it are not operated on the linear part of the V_c–I_c characteristics, but below the knee.

The other snag is that negative feedback over three stages isn't always practicable. If audio transistors are used, internal phase shifts may turn the amplifier into an oscillator if one attempts to apply a substantial amount of feedback. However, this objection is less valid if transistors with cut-off frequencies in the r.f. region are used, as for example in the amplifier described by R. C. Bowes in the July issue.

References

[1] J. S. Murray, "Transistors Bias Stabilization," *Electronic and Radio Engineer*, May, 1957.

[2] S. D. Berry, "Transistor Amplifiers for Sound Broadcasting," *B.B.C. Engineering Monograph No.* 26, Aug., 1959.

[3] P. F. Ridler, "Transistors Tape Pre-amplifier," *Wireless World*, Dec., 1958 (correspondence, March, 1959).

[4] "Mullard Reference Manual of Transistor Circuits," pp. 165-6 and pp. 268-270.

BOOKS RECEIVED

Audio Biographies, by G. A. Briggs. With the collaboration of 64 of his contemporaries and friends the author has penetrated the façade of "hi fi" and explored the background, the upbringing and the motives which drive and sustain those who practise the art of sound recording and reproduction, either as professionals or amateurs. Quite apart from the human interest and the entertaining wit of the author/editor there is a wealth of technical information which should be invaluable to present and future historians. Pp. 343; Fig. 113. Wharfedale Wireless Works Ltd., Idle, Bradford. Price 19s 6d.

Printed Circuits, by J. M. C. Dukes. The book provides the background knowledge necessary for the engineer to undertake the electrical and mechanical design of printed-circuit assemblies at all frequencies up to the microwave region. A useful chapter contains design information for printed inductors, capacitors and resistors, and the bibliography is extensive. Pp. 228; Figs. 91. Macdonald and Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 40s.

Two-Way Radio, by Allan Lytel. A comprehensive, practical book on the theory and installation of voice-modulated radio-communication systems. The two main types of modulation, f.m. and a.m., are compared, and the later methods of amplitude-modulation such as single-sideband working are described. Information is given on power supplies, test equipment and servicing, and a chapter on selective-calling is included. Pp. 291; Figs. 277. McGraw-Hill Publishing Company, Ltd., McGraw-Hill House, 95, Farringdon Street, London, E.C.4. Price 74s.

Brimar Valve and Teletube Manual No. 9 is the latest in the series of manuals published by the Brimar Commercial Division of Thorn-A.E.I. Valves and Tubes, Ltd., Rochester, Kent (formerly Brimar Division of S.T.C.). Costing 6s, the new edition incorporates data on many new devices (including bonded-faceplate television c.r.ts) and has a tabular section listing characteristics of obsolete and obsolescent valves. Circuits included in this edition encompass a.f. amplifiers from 1.5 to 75W output, a crystal-controlled f.m. receiver and an R-C a.f. oscillator.

The Advance Science Master's Handbook, compiled by Ivan L. Muter. Intended to help the science teacher concerned with electricity and electronics. The first part of the book contains reference material and basic theory, while the second section is a set of nearly fifty experiments and demonstrations ranging from elementary a.c. theory to pulse circuits. Experiments to illustrate the nature of sound and wave motion are also included. Pp. 124; illustrated. Advance Components Ltd., Roebuck Road, Hainault, Ilford, Essex. Free to science teachers; otherwise available at 12s 6d.

Dictionary of Electronics, by Harley Carter. A cross-indexed, illustrated dictionary. Appendices contain lists of graphical symbols, colour codes and other tabulated data. Pp. 337; illustrated. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 35s.

Elsevier's Telecommunication Dictionary, compiled by A. Visser. Nearly ten thousand words and expressions are arranged in alphabetical order, using English as the base, with translations in five languages set out underneath. Following the main table, alphabetical lists of the terms in each language are given, and each term is linked to the main table by a reference number. The languages given are German, Spanish, French, Italian and Dutch. Pp. 1011. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price £7 7s.

The Mobile Manual For Radio Amateurs. Selected articles on mobile radio equipment, taken from past issues of "QST." Articles on s.s.b. equipment are included, and there is a complete section on portable and emergency units. Pp. 282. Profusely illustrated. American Radio Relay League, Inc., West Hartford 7, Connecticut, U.S.A. Price $2 (in U.S.A.), $3 (elsewhere).

Communications (Progress of Science Series), by Charles A. Marshall. Affords the younger reader an overall view, in non-technical language, of the field of telecommunications, including radar and television. A chapter on careers is included. Pp. 64; Figs. 19; plates 28. Phœnix House, Ltd., 38, William IV Street, Charing Cross, London, W.C.2. Price 9s 6d.

Sensitometric Control in Film Making, by L. J. Wheeler. Describes the system of sensitometry used to control the continuous processing of films used in B.B.C. Television news programmes. Pp. 22; Figs. 14. A B.B.C. Engineering Monograph. B.B.C. Publications, 35, Marylebone High Street, London, W.1. Price 5s.

Shortwave Propagation, by Stanley Leinwoll. Directed at both the amateur and the engineer, the book presents the basic principles of propagation on short waves, with chapters on circuit analysis and the preparation of m.u.f. curves. Mathematics are avoided wherever possible. Pp. 151; Figs. 75. John F. Rider (Publisher) Inc. Available from Chapman and Hall, 37, Essex Street, London, W.C.2. Price 36s.

Sound Recording Works Like This, by Clement Brown. An introduction to the subject for the layman, which describes in an unselfconscious way the working of all types of equipment, both domestic and professional. Pp. 62; Figs. 60. Phœnix House, 10-13, Bedford Street, Strand, London, W.C.2. Price 9s 6d.

Radio-Frequency Measurements

2.—LISSAJOUS FIGURES AND COUNTING TECHNIQUES

By R. BROWN

THE low difference frequency which is the output from some of the comparison systems has to be measured. A quick check through some of the standard textbooks reveals an almost bewildering number of ways in which such a measurement can be made. Many of the techniques described, however, seem now to be of only historical interest, and there seems to be only one or two of these methods of measurement in current use.

Lissajous Figures

By far the most common method is the one based on the use of Lissajous figures. This is an extremely accurate method, and it is one which calls for no other test equipment than the oscilloscope and a low frequency oscillator. It is a comparison method, the basic set up of which is shown in Fig. 9a.

The frequency to be measured (f_2) is fed to the "Y" plates of the oscilloscope, the "X" plates of which are fed from a reference oscillator (f_1). A figure will be traced on the oscilloscope, and the shape of this figure will depend upon the ratio of the frequency of f_1 to f_2.

The simplest case is where $f_1 = f_2$, and the shape the figure will take can be found with the aid of Fig. 9b. Here f_1 is represented by the equation

$$X = A \sin \theta \quad \ldots \quad (7)$$

and f_2 is represented by the equation

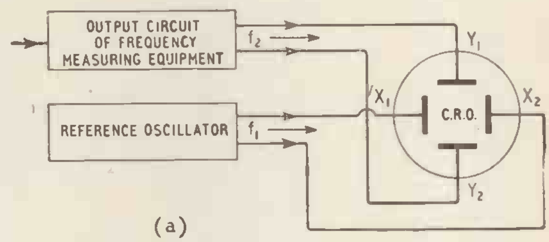
$$Y = B \sin (\theta + \alpha) \quad \ldots \quad (8)$$

where α is the phase difference between f_1 and f_2.

The two vectors in Fig. 9b, being of the same frequency will rotate at the same speed, and the figure is constructed by marking off the projection of the rotating vector B on the vertical axis—this represents Y in equation (8)—and marking off the projection of the rotating vector A on the horizontal axis—this represents X in equation (7).

The shape will vary with the phase difference α. In Fig. 9b this is 45°: when the two signals are in phase the ellipse of 9b closes to a straight line, broadening out again to an ellipse, and then to a full circle as the phase angle increases through 45° to 90°. This is shown in Fig. 10a.

The procedure when measuring the frequency of f_2 is simply to adjust the frequency of the reference oscillator (f_1), until a stationary figure is obtained on the oscilloscope screen. f_1 and f_2 are then equal, and their frequency can be read off the reference oscillator tuning dial. This should be known with sufficient accuracy, for most commercial oscillators are accurate to within about 1%, and if the frequency being used is, say, 100 c/s the error will only be one cycle, and this is one cycle error in the measurement of the high frequency signal. So if the high frequency signal were say, 10 Mc/s this one cycle would amount to one part in 10^7.



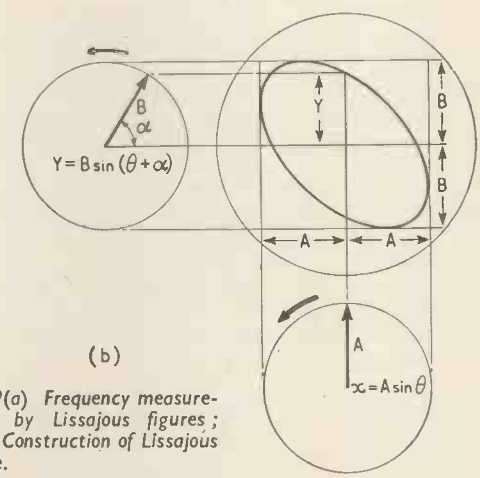


Fig. 9(a) Frequency measurement by Lissajous figures; (b) Construction of Lissajous figure.

Where the two frequencies f_1 and f_2 are fixed, and differ by only a fraction of a cycle, as is usually the case when checking fixed frequency oscillators against a standard oscillator for example, a stationary pattern will not be obtained. The phase angle between the two frequencies will slowly change, the rate of change depending upon their frequency difference. The figure on the oscilloscope screen will thus be of the form shown in Fig. 10, but it will change from a straight line, to an ellipse, then a circle and so on as the phase difference changes. If Fig. 9b is redrawn with vector Y say, rotating slightly faster than vector X and the results repeated as the phase difference increases from 0° to 360° it will be seen that the rate of rotation of the figure is equal to the frequency difference between f_1 and f_2. Frequency difference of as small as a cycle every few minutes can be measured in this way. It is not necessary to use an oscilloscope to time these slow rotations of the Lissajous figures; some quite simple device such as a magic eye tuning indicator can be used.

So far we have only considered the case where f_1

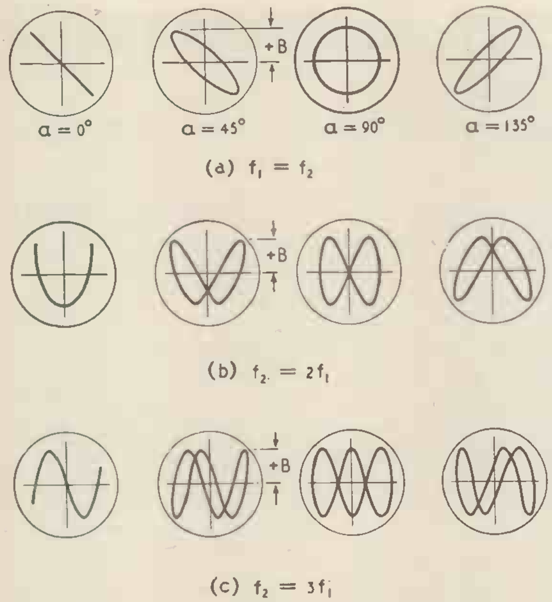
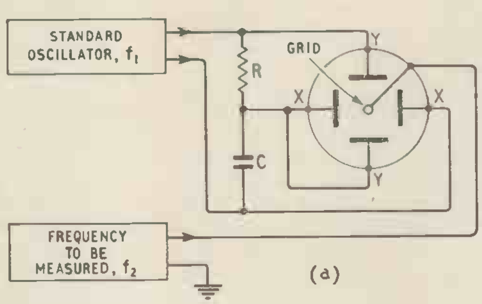


Fig. 10a, b, c. Some standard Lissajous figures.

is equal to, or very nearly equal to f_2. It is often more convenient, however, to have f_1 a sub-multiple, or a multiple of f_2. Stationary figures will be obtained when the ratio of f_1 to f_2 is 2 : 1, 1 : 2, 3 : 1, 1 : 3 etc. Examples of some of these figures are shown in Fig. 10b and 10c. They are all constructed in a similar manner to which Fig. 9b was constructed. Frequency ratios of four, five, six and higher can also be displayed; the figure becomes very complex with high ratios, however, and a ratio of six is about the highest that can be easily distinguished.



An important rule for determining the ratio of f_2 to f_1 can be found from these figures. Examining the three left-hand figures of each frequency ratio, that is the figures in which the go and return traces are separate, it can be seen that the number of times the curve intersects with the line +B is the same as the frequency ratio. That this must be so may be seen from the following:—

Let f_1 be represented by

$X = A \sin \theta$ .. .. (9)

as before, and let f_2 be represented by

$Y = B \sin (p\theta + \alpha)$ .. .. .. (10)

where p is the frequency ratio f_2/f_1

From Fig. 9b these intersections can only occur when Y = +B, i.e. from (10) when

$\sin (p\theta + \alpha) = 1$ .. .. .. (11)

i.e. when $p\theta + \alpha = \pi/2, 3\pi/2$ etc. .. .. (12)

Now the figure has a period of 2π. That is, the figure will be traced out once as θ goes through 360° (one revolution of the vector X). When p = 1 there will be only one value of $p\theta + \alpha$ lying between 0° and 360°, and so the curve will intersect with the line +B only once. When p = 2 there will be two values of $p\theta + \alpha$ lying between 0° and 360°, and the curve intersects with the line +B when $\theta = \frac{\pi}{4} - \frac{\alpha}{4}$ and when $\theta = \frac{5\pi}{4} - \frac{\alpha}{4}$. In the same way when p = 3 there will be three values of $p\theta + \alpha$ lying between 0° and 360°, and the curve will intersect with the line +B when $\theta = \frac{\pi}{6} - \frac{\alpha}{6}$, when $\theta = \frac{5\pi}{6} - \frac{\alpha}{6}$ and when $\theta = \frac{9\pi}{6} - \frac{\alpha}{6}$.

And so on for high values of p.

As has been said the highest frequency ratio p that can be easily distinguished, at least by people who don't spend the whole of their lives looking at Lissajous figures, is about six to one. One way of viewing high frequency ratios is by connecting the lowest frequency to both the 'X' and 'Y' plates, and the higher frequency to the grid or cathode of the cathode ray tube so that it intensity modulates the beam. The lower frequency signal is connected to the tube via a resistance-capacitance phase shifting network as shown in Fig. 11a. The 'X' and 'Y' plates will thus have connected to them signals of the same frequency, but which have a large phase difference, approaching 90°. Hence an ellipse, which is very nearly a circle, will be displayed on the oscilloscope. The time taken to

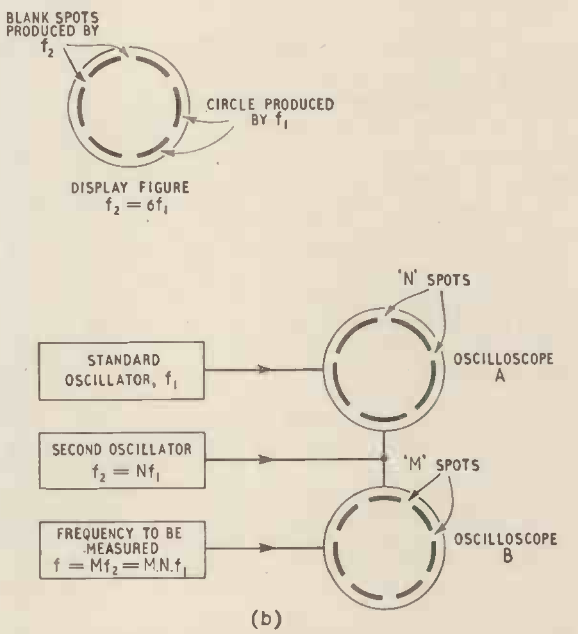


Fig. 11 (a). Determining frequency ratios up to 50:1. (b) Determination of frequency ratios greater than 50:1.

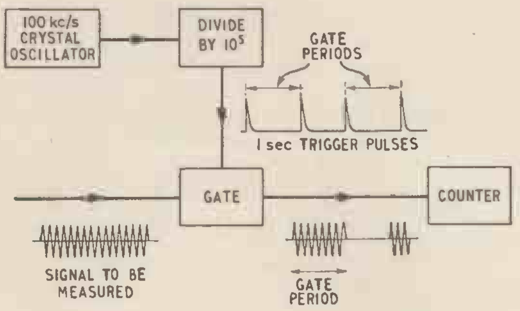


Fig. 12. Digital frequency meter—the counter displays frequency directly.

display the figures once will, as before, be the period of one cycle of the low frequency. The high frequency signal, which is being used to intensity-modulate the tube will shut off the beam on the peaks of the positive or negative half cycle (depending upon how it is connected). The result will be to produce a figure of the form shown in Fig. 11b, a broken circle. Since the circle is being displayed once for every cycle of the low frequency the number of blank spots must be equal to the ratio between the two frequencies.

As with Lissajous figures a stationary figure will only be obtained when one frequency is an exact multiple of the other. When the frequency is close to, but not an exact multiple the pattern will rotate slowly. Using this method frequency ratios of up to 50 : 1 can be determined. Much higher ratios can be determined by using a second oscillator, whose frequency need not be accurately known, and a second oscilloscope. This is shown in Fig. 11c.

A number of other similar comparison techniques use an oscilloscope,[18] and stroboscopes are also used to measure low frequencies.

Counter-type Frequency Meters

Frequency measuring techniques based on counters are being increasingly used. Where the accuracy required lies between about one part in 10^4 and one part in 10^6 the use of counters is becoming almost universal. This is largely because of the extreme simplicity of operation of the counter-type frequency meter.

A simple arrangement is shown in Fig. 12. The signal to be measured is connected to the input of the counter via a gate. When the measurement is to be made a trigger pulse is used to open the gate. The counter starts to count the individual cycles of the signal being measured; after one second a second trigger pulse closes the gate, and the counter stops counting. There will thus be displayed on the counter the number of cycles in one second of the signal being measured—that is its frequency. This count is usually repeated automatically. One small snag with this arrangement is that while the count is being made no information is presented to the operator, and conversely when the count is being displayed no information can enter the counter. This can be avoided if the counting and display sections are separate and if a memory device is included.[19] The memory system holds a count and displays it continuously while the new count is being accumulated. At the end of each counting interval the new count is transferred to the display in a very brief time—100μs in a commercial instrument. Thus the frequency is displayed practically continuously and the counter is collecting information on the frequency also almost continuously.

The trigger pulses, since they determine the width of the gate, must occur at accurately known intervals of time. A 100 kc/s crystal oscillator is usually the basic standard for determining this, the one per second trigger pulses being obtained by successive division of the 100 kc/s signal.

The highest frequency that can be measured is limited by the speed of the counter. In commercial instruments it is usually one megacycle or ten megacycles.[20, 21]

Any frequency within the range of the counter can, however, be measured simply by connecting it to the input of the counter, no adjustments being required.

To measure frequencies above the top limit of the counter, heterodyne techniques can be used. A suitable arrangement is shown in Fig. 13. The

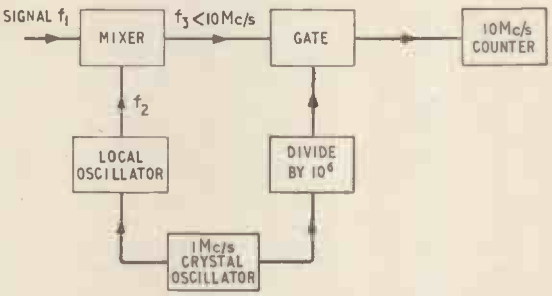


Fig. 13. Measuring frequencies above the upper limit of the counter by means of a heterodyne unit.

local oscillator can be locked, at 10 Mc/s intervals in the case of a 10 Mc/s counter, to the harmonics of the crystal oscillator. If the frequency to be measured was, say, 26 Mc/s, the local oscillator would be tuned to 20 Mc/s and locked to one of the crystal harmonics. The local oscillator output is then mixed with the signal in the mixer, and the difference frequency, 26 Mc/s—20 Mc/s = 6 Mc/s, is passed on to the counter and displayed.

With this sort of arrangement the signal frequency is given by the sum of the local oscillator frequency, and the frequency displayed on the counter. Some adjustment is now necessary when making measurements, but once the local oscillator has been set up any frequency over a 10 Mc/s band can be measured without any further adjustment.

This type of frequency meter suffers from two types of error. There is first of all the effects of an error in the standard 100 kc/s frequency which produces errors in the gate period. When using a heterodyne system, however, the local oscillator frequency will also be in error, and this error will add to the error in the gate period. If the 100 kc/s signal was for example slightly high, the gate period would be shorter than it should be. The local oscillator frequency would then be higher than it should be, causing the difference frequency to be low. The error in the standard frequency would thus result in low difference frequency and a short gate period. It is shown in the appendix, however,

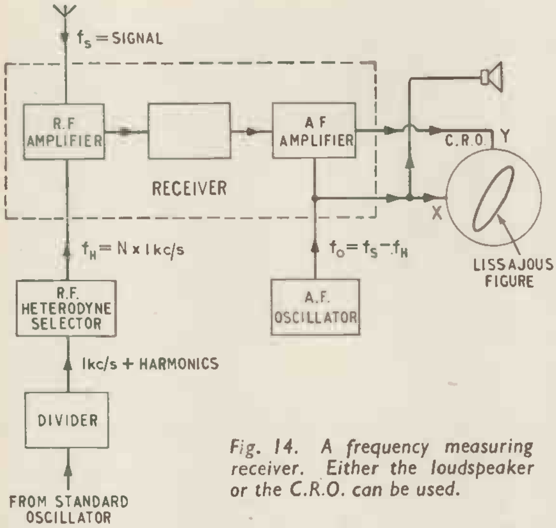


Fig. 14. A frequency measuring receiver. Either the loudspeaker or the C.R.O. can be used.

that the total error can never be greater than the error in the local standard.

The second source of error, and this is peculiar to counters, is what is called gate error. There is no direct relationship between the signal being measured and the trigger pulses that open the gate; the point in time when the trigger pulses arrive can be at any point on the signal waveform. Whether or not the first cycle is counted will depend upon what point on the waveform the gate opens, and an error of ± 1 digit is possible.

This error is the same, one digit, whatever the length of the gate period, so its effect can be considerably reduced by lengthening the gate period. A ten second gate can be used, for instance, and if the frequency being measured was, say, 10 Mc/s, then 10^8 cycles would be counted in the gate period and the gate error of one digit would then be equivalent to only 1 in 10^8. The displayed count must then be divided by ten, of course, and this does rather increase the possibility of errors due to misreading.

Counters with much higher counting rates seem to be just around the corner, and counter-type frequency measuring systems using computer techniques have also been described.[22]

Frequency Measuring Receivers

Errors due to misreading are always a possibility with frequency measuring systems, particularly the more sophisticated ones. Where readings have to be taken over a long period this can become a serious problem, and special care has to be taken with the design of the operating controls and read-out sections.

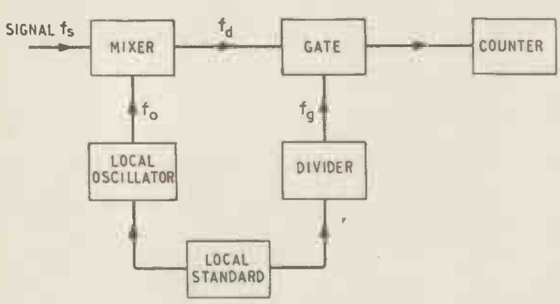
A technique which while covering a wide frequency range is almost free of misreading errors is the frequency measuring receiver. A simple type is shown in Fig. 14. The receiver, a conventional one, is tuned accurately to the signal to be measured. The heterodyne oscillator is then tuned until it is set to a frequency corresponding to the nearest whole number of kilocycles below the frequency to be measured, the accuracy of the oscillator setting being checked against the harmonics from the 1 kc/s multivibrator.

The heterodyne note produced in the receiver output will thus be below 1 kc/s. The output from

(*Continued on page 647*)

APPENDIX

That the total error can never be proportionately greater than the error in the local standard when using a counter in a heterodyne set-up can be seen in the following way. Any error in the local standard will cause the frequency of the local oscillator to



be in error and the gate interval to be in error. Suppose this error is a small fraction e, and the nominal local oscillator frequency is fo, then the possible limits of the local oscillator frequency will be

$$f_o' = f_o(1 \pm e) \quad \ldots \quad (1)$$

The difference frequency f_d between the local oscillator frequency and the signal frequency f_s will, therefore, be somewhere between the limits

$$f_d = f_s - f_o(1 \pm e) \quad \ldots \quad (2)$$

Next consider the effect of the error in the local standard on the gate interval. If f_g is the nominal gate frequency then the actual gate frequency will vary between the limits

$$f_g' = f_g(1 \pm e) \quad \ldots \quad (3)$$

But the gate time interval t_g' is given by $1/f_g'$.

Hence

$$t_g' = \frac{1}{f_g(1 \pm e)} \quad \ldots \quad (4)$$

For a frequency f_d counted for a time interval t_g the counter display will be N where N is given by $f_d \times t_g$, and the actual indicated count will vary between the limits

$$N = f_d t_g (1 \mp e) \quad \ldots \quad (5)$$

The indicated frequency N/t_g will thus vary between the limits

$$f = N/t_g = f_d(1 \mp e) \quad \ldots \quad (6)$$

The actual indicated value of the signal frequency f_s can now be found by adding the nominal value of the local oscillator frequency to this, or

$$f_s = f_o' + f_d(1 \mp e)$$

Substituting for f_d in equation (2) we get

$$f_s = f_o + [f_s - f_o(1 \pm e)](1 \mp e)$$
$$= f_s \mp ef_s + e^2 f_o$$

If we ignore the second order terms, which we can do since e is normally a very small fraction, then the limits of error in the measurement are given by $\mp ef_s$.

an audio oscillator is then mixed with the heterodyne note, and the audio oscillator tuned until it zero beats with the heterodyne note. The reading of the audio oscillator tuning plus the reading of the heterodyne oscillator tuning then gives the signal frequency.[23]

A counter can be included in the receiver to further increase the simplicity of operation, and one such arrangement is shown in Fig. 15. A receiver covering the desired range in 1 Mc/s bands is used. If the frequency to be measured was, say, 6.3 Mc/s, the receiver would be switched to the 6 Mc/s band, and tuned to 6.3 Mc/s. The range switch will have caused the first local oscillator to be locked to the 50th harmonic of the standard, that is to 5 Mc/s. The signal is mixed with this to give a difference frequency of 1.3 Mc/s. The output from a variable frequency oscillator, covering 900 kc/s to 1.9 Mc/s, is mixed with this, and the oscillator tuning is set to give an accurate difference frequency of 100 kc/s. This tuning is checked by comparing the 100 kc/s difference frequency with the standard 100 kc/s using Lissajous figures. The variable oscillator output at 1.2 Mc/s is now mixed with the 9th harmonic of the 100 kc/s standard to produce a 300 kc/s difference frequency which is displayed on the counter. The frequency of the signal is thus given by the frequency range in use, 6 Mc/s, and the counter reading, 300 kc/s, as 6.3 Mc/s.

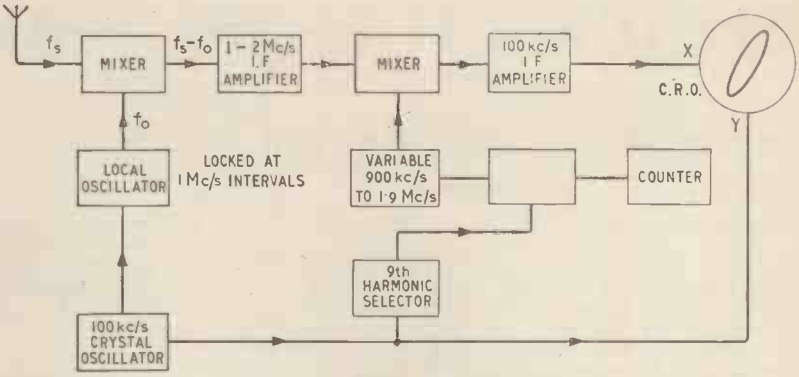


Fig. 15. A frequency measuring receiver using a counter.

Practical counter type frequency measuring receivers are usually more complicated than this; but despite the high inherent accuracy of such a system frequency measurement is no more difficult than tuning the receiver to the signal to be measured. Quite an improvement on some of the earlier high accuracy systems where a training period of anything from three to six months was usually required.

References

18. F. R. Stansel, "An Interpolation Method for Setting Laboratory Oscillators", *Bell Laboratories Record*, 1940, Vol. 19, p. 98.

19. "A Frequency Counter with a Memory and with Built-in Reliability", *The General Radio Experimenter*, Vol. 35, No. 5, p. 3, May 1961.

20. D. W. Bissett, "10 Mc/s Electronic Counter Type TF 1345", *Marconi Instrumentation*, Vol. 7, No. 5, p. 133, 1960.

21. A. S. Bagley, "A 10 Mc/s Scaler for Nuclear Counting and Frequency Measurements", *Hewlett-Packard J.*, Vol. 2, p. 1, October, 1950.

22. J. Stevenson, "Digital Rate Synthesis for Frequency Measurement and Control", *Proc. I.R.E.*, December 1959.

23. J. Treeby Dickenson, "International Monitoring", *Wireless World*, Vol. 59, p. 422, Sept. 1953.

HORN RADIATOR

ON a 1,000-acre site near Rumford, Maine, U.S.A., Bell Telephone Laboratories is installing what is said to be the world's largest horn aerial as part of a new experimental space communications station. The 250-ton steel and aluminium structure will be a rotating aerial—177ft long, 94ft high, and will be protected from the weather by an inflated spherical cover, or radome, 210ft wide, 161ft high.

The huge horn will rotate on two concentric circular tracks on the ground. It will also "roll" about its horizontal axis so that it can follow a satellite from low to high angles of elevation.

Carried around on the structure with the horn will be two "houses" for equipment including a travelling-wave maser.

The radome will be supported by air pressure of one tenth of a pound per square inch greater than the outside atmospheric pressure. It will be anchored to the top of a 14-foot wall that will encircle the base of the aerial. Double doors provide an "air lock" to avoid losing pressure.

Cut-away drawing of the Bell horn radiator inside its radome. Eventually five such structures may be built on the Rumford site.

MANUFACTURERS' PRODUCTS

NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Capacitance-Type Moisture Meter

SIMPLICITY of operation is afforded by the single knob control of the "Varsity" moisture meter, in which the capacitance method of measurement is employed at a frequency of 100 Mc/s. Readings are obtained by noting the combined readings of a 10-turn calibrated control and a moving coil meter. The meter reading can be converted to moisture content by means of a graph or a transparent scale placed over the meter. The

Shaw "Varsity" moisture meter. Material sample is placed in 2,000cm^3 container on top of the instrument.

instrument is fully stabilized for mains variations of 190V-260V. Details are obtainable from Shaw Moisture Meters Ltd., Rawson Road, Westgate, Bradford.

Direct Writing Recorder

A SINGLE-CHANNEL recorder, the R.1, with a choice of two writing systems, is announced by Devices Ltd. Either a hot stylus on heat-sensitive paper using rectilinear co-ordinates, or an ink pen on curvilinear co-ordinates may be used, and any of six paper speeds can be selected. The sensitivity is 0.5V/cm or with pre-amplifier 0.5 mV/cm, giving a linear excursion of 5 cm.

Devices R.1. recorder, with hot stylus unit in use. This may quickly be interchanged with an ink pen system.

A differential feedback amplifier is employed, and the frequency response of the complete instrument is 0-65 c/s (−3dB). Full details of the instrument, which uses transistors throughout, may be obtained from Devices Sales Ltd., 13-15 Broadwater Road, Welwyn Garden City, Herts.

Polar Recording Turntable

IN conjunction with level recorder Type 2305, the Brüel and Kjaer turntable Type 3921 enables directional measurements to be made on aerials, microphones, loudspeakers, etc., and the results automatically recorded on polar co-ordinate graph paper. The item under test may be either bolted to the table by means of the threaded holes provided, or may be mounted centrally in the chuck. The specimen can be provided

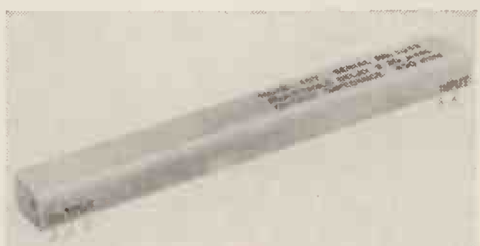
Brüel and Kjaer polar recording turntable.

with power or signals via a slip-ring arrangement below the table. Full details are obtainable from B. and K. Laboratories, Ltd., 4 Tilney Street, Park Lane, London, W.1.

Adjustable Delay Line

VARIABLE magnetostrictive delay lines with delays between 2 μsec and 20 μsec are announced by Sealectro. The unit is contained in a hermetically sealed steel case, and adjustment of the delay is by means of a single screw. The maximum pulse repetition rate is 500 kc/s, with a pulse width of 1 μsec. Input and output impe-

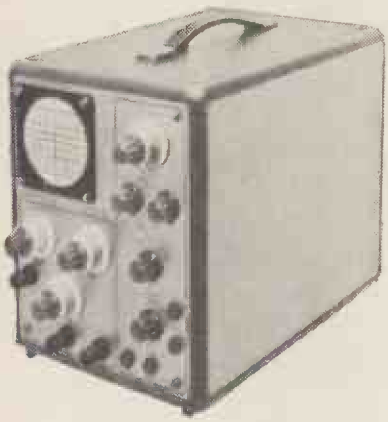
Sealectro Deltime Type 157 variable delay line. Adjustment screw is at left-hand end.



dances are 400 ohms and insertion loss is 45 dB. A complete description can be obtained from Sealectro Corporation, Hersham Factory Estate, Walton-on-Thames, Surrey.

Inexpensive Oscilloscope

ALTHOUGH marketed at the very low price of £36, the Model 381 general-purpose oscilloscope is capable of a high performance. The Y-amplifier has a band-



Dartronic Model 381 oscilloscope.

width of 0-9 Mc/s, a rise time of 40 nsec. and a sensitivity of 100 mV r.m.s./cm. Input impedance is 1 M and 20 pF. The timebase speed is from 0.55 μsec/cm to 0.15 sec/cm and the waveform is made available at the front panel. Accessibility for servicing is assured by the sensible construction; the top, bottom and side panels are removable, and most of the circuitry is mounted on two vertical panels. The instrument is made by Dartronic Ltd., 3, 5 and 7 Windmill Lane, London, E.15.

Sensitive Millivoltmeter

ALTERNATING voltages from 300μV in the range 100c/s to 900Mc/s may be measured by means of the Airmec Type 301. Measurement of direct voltages may be made in the range 100μV to 10V.

Airmec millivoltmeter Type 301.

The amplifier is direct-coupled throughout, stability being achieved by the use of chopper. A semiconductor rectifying probe allows the use of a simplified attenuator which needs no frequency-compensation. The input impedance is 5MΩ on d.v. ranges and when measuring alternating voltage varies from 120kΩ+2pf at 100kc/s to 3kΩ+2pf at 200Mc/s and above. Fluctuation of reading with ±10% mains variation is less than ±1.5% on all ranges. Full details are obtainable from Airmec Ltd., High Wycombe, Bucks.

Wobbulator Attachment

TO extend the coverage of currently-available sweep-frequency generators to the Bands IV and V region, Grundig have introduced their VS-2 u.h.f. converter. The output of the existing generator is set to 55Mc/s and applied to the converter, where it is mixed with

Grundig VS-2 u.h.f. converter for wobbulators.

the output of a u.h.f. oscillator. The resultant signal covers the range 460-795Mc/s and the level is −13dB on the output of the sweep frequency generator. Input and output impedances are 60Ω unbalanced. The converter costs £30, and is available from the British distributors, Wolsey Electronics, Ltd., Cray Avenue, St. Mary Cray, Orpington, Kent.

Cable Identifier

DESIGNED for application without tools, the Helagrip is a flexible p.v.c. sleeve supplied in sizes to fit cables of $\frac{1}{8}$-in to $\frac{7}{8}$-in dia. The indented edge of the sleeve prevents adjacent pieces twisting relative to each other, and the special section prevents sliding. The sleeving is supplied partially cut in lengths of identical coding (A-Z, 0-9).

Further details may be obtained from Hellermann, Ltd., Gatwick Road, Crawley, Sussex.

"Helagrip" cable identifier.

DECEMBER MEETINGS

Tickets are required for some meetings; readers are advised, therefore, to communicate with the secretary of the society concerned.

LONDON

4th. I.E.E.—Discussion on "Backward waves in waveguides" opened by Dr. P. J. B. Clarricoats, R. A. Waldron and G. H. B Thompson at 5.30 at Savoy Place, W.C.2.

6th. Brit.I.R.E.—Discussion on "Possible uses of computers in medical diagnosis" opened by Dr. A. D. Booth at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

8th. Institute of Physics and Physical Society.—"Electron microscopy in Japan" by T. Mulvey and Dr. M. Whelan at 2.30 at 47 Belgrave Square, S.W.1.

8th. Television Society.—"Remote control operation of television cameras" by H. C. Nickels at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

11th. I.E.E. Graduate and Student Section.—"The professional engineer and an expanding industry" by G. S. C. Lucas at 6.45 at Savoy Place, W.C.2.

12th. I.E.E.—"Diversity reception and automatic phase reception" by L. Lewin at 5.30 at Savoy Place, W.C.2.

12th. Institute of Physics and Physical Society.—"Integrated electronics" by Dr. W. J. Granville at 5.30 at 47 Belgrave Square, S.W.1.

14th. Brit.I.R.E.—Symposium on "Constant luminance colour television" including papers by I. J. P. James and W. A. Karwowski, W. N. Sproson, A. V. Lord, K. Hacking and G. F. Newell at 6.0 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

14th. Radar & Electronics Association. —"Loudspeaker enclosures" by J. Gough and Prof. F. Landgrebe at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.

15th. Television Society.—"The 'Nev-Eye' vidicon camera" by N. S. Rutherford at 7.0 at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, W.C.2.

15th. B.S.R.A.—"Problems in telephone transmission" by D. L. Richards at 7.15 at the Royal Society of Arts, John Adam Street, W.C.2.

18th. I.E.E.—"Large microwave steerable aerials for communication with artificial earth satellites and space probes" by F. J. D. Taylor at 5.30 at Savoy Place, W.C.2.

20th. I.E.E.—"Satellite instrumentation" by Dr. R. L. F. Boyd at 5.30 at Savoy Place, W.C.2.

ARBORFIELD

11th. I.E.E. Graduate & Student Section.—"Design of service equipment" by B. W. Norman at 7.0 at the Unit Cinema, 3(Tels.) Training Bn., R.E.M.E.

BIRMINGHAM

4th. I.E.E.—"The banana-tube display system—a new approach to the display of colour-television pictures" by Dr. P. Schagen at 6.30 at the College of Technology. (Joint meeting with the Institution of Post Office Electrical Engineers.)

8th. Society of Instrument Technology.—"Instruments in clinical chemistry" by N Crawford and "Electronics in surgery" by R. Lightwood at 7.0 at the College of Technology, Aston Street.

12th. Institute of Physics and Physical Society.—"The observation of radio stars" by Dr. P. F. Scott at 6.30 at the Midland Institute.

14th. Brit.I.R.E.—"The R.R.E. radio-telescope interferometer" by H. Gent at 6.15 at the Electrical Engineering Department, The University.

BRADFORD

5th. I.E.E.—"The potentialities of artificial earth satellites for radiocommunication" by W. J. Bray at 6.30 at the Institute of Technology.

BRISTOL

14th. Society of Instrument Technology.—"The atomic clock" by Dr. L. Essen at 7.30 at the Department of Physics, the University.

20th. Brit.I.R.E.—Annual general meeting of the South-Western Section followed by "Transistors in transmitters and communications receivers" by D. C. Carey at 6.0 at the School of Management Studies, Unity Street.

CAMBRIDGE

12th. I.E.E.—"The banana-tube display system—a new approach to the display of colour television pictures" by Dr. P. Schagen at 8.0 at the Cavendish Laboratory, Free School Lane.

CARDIFF

6th. Brit.I.R.E.—"Microwave valves" by R. W. White at 6.30 at the Welsh College of Advanced Technology.

CHELTENHAM

1st. Brit.I.R.E.—"Electronic telephone exchanges" by J. F. Hesketh at 7.0 at the North Gloucestershire Technical College.

EDINBURGH

5th. I.E.E.—"Precision Measurement" by G. H. Rayner and A. Felton at 7.0 at the Carlton Hotel.

13th. Bri.I.R.E.—"Jodrell Bank" by J. B. Wilson at 7.0 at the Department of Natural Philosophy, The University, Drummond Street.

FARNBOROUGH

7th. I.E.E. Graduate and Student Section.—"The synthesis of speech for communication purposes" by H. L. Chesters at 6.30 at the Technical College.

FAWLEY

1st. Society of Instrument Technology.—"Applications of transistors and diodes" by D. Osborne at 5.45 in Room 4a, Administration Building, Esso Petroleum Co.

GLASGOW

4th. I.E.E.—"Precision measurement" by G. H. Rayner and A. Felton at 6.0 at the Royal College of Science and Technology.

14th. Brit.I.R.E.—"Jodrell Bank" by J. B. Wilson at 7.0 at the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent.

GRANGEMOUTH

21st. Society of Instrument Technology.—"Instrumentation of space vehicles" by Dr. A. E. Roy at 7.0 at the Leapark Hotel, Bo'ness Road.

LEICESTER

6th. Brit.I.R.E.—"Transistors in computers and control equipment" by P. James at 6.45 at the University.

12th. I.E.E.—"Altitude control of earth satellites" by B. Stewart at 6.30 at the Lecture Theatre, E.M.G.B. Showrooms, Charles Street.

LINCOLN
7th. I.E.E.—Discussion on "Semiconductors for light-current engineering" opened by L. Rushforth at 7.30 at the E.M.E.B. Showrooms, 191 High Street.

LIVERPOOL
4th. I.E.E.—"Simulation of intelligence" by Prof. D. M. MacKay at 6.30 at the Royal Institution.
13th. Brit.I.R.E.—"Nuclear power station instrumentation" by M. W. Jervis at 7.30 at the Walker Art Gallery.
14th. Society of Instrument Technology.—"The versatility of the electronic potentiometer" by F. W. J. Howard at 7.0 at the Merseyside and North Wales Electricity Board Industrial Centre, Paradise Street.
18th. I.E.E.—"Education of an electrical engineer" by Prof. M. R. Gavin and "The place of formal study in the post-graduate training of an electrical engineer" at 6.30 at the Royal Institution.

MAIDSTONE
7th. I.E.E.—"Electronics in the postal mail services" by G. P. Copping at 7.0 at the "Wig and Gown."

MANCHESTER
6th. I.E.E.—"Generation and amplification in the millimetre wave field" by W. E. Willshaw at 6.25 at the Engineers' Club, Albert Square.
7th. Brit.I.R.E.—"Radar for civil aviation purposes" by K. F. Slater at 7.0 at the Reynolds Hall, College of Technology.

NEWCASTLE-UPON-TYNE
4th. I.E.E.—"Planning and installation of the sound broadcasting headquarters for the B.B.C.'s Overseas and European Services" by F. Axon and O. H. Barron at 6.15 at the Rutherford College of Technology, Northumberland Road.
13th. Brit.I.R.E.—"Masers and parametric amplifiers" by Dr. T. H. Wilmhurst at 6.0 at the Institute of Mining and Mechanical Engineers, Neville Hall, Westgate Road.
18th. I.E.E.—"Heaviside—his life and work" by Prof. R. L. Russell at 6.15 at the Rutherford College of Technology, Northumberland Road.

PORTSMOUTH
13th. I.E.E.—Discussion on "Silicon controlled rectifiers" opened by R. J. Alexander, J. P. Birchenough and R. Thompson at 6.30 at the C.E.G.B. Offices, 111 High Street.

SHEFFIELD
13th. I.E.E.—"Millimetre waves" by Dr. J. Allison at 6.30 at the University.

SOUTHAMPTON
12th. I.E.E.—Discussion on "High speed measuring techniques in the nano-second region" opened by B. H. Venning and D. Grollet at 6.30 at the University.

WEYMOUTH
1st. I.E.E.—"The banana tube" by Dr. P. Schagen at 6.30 at the South Dorset Technical College.

WOLVERHAMPTON
6th. Brit.I.R.E.—Symposium on "New electronic techniques in non-destructive testing" at 10.0 at the Wolverhampton and Staffordshire College of Technology.

UNBIASED

By "FREE GRID"

In Old Bohemia

AMERICANS often claim to be far ahead of us Europeans—and in particular of us Limeys—in the various activities of life, and in many cases they are, of course, quite justified in their claims. For instance, in some of their big cities, their buildings and their crime statistics are much higher than anything we can boast of.

However, it is mostly in matters of applied science that the Americans claim to be so far ahead of us, and here again they are fully justified. What European state, for instance, can boast of having had, since 1890, an electric chair for the administration of what they call "electrocution" but which we old-fashioned grammarians prefer to call "electrocussion"? I believe that American doctors are as out of date as we are when they speak of "concussion," rather than of "concution."

But there is one instance of applied science where the U.S.A. is twenty years behind Europe, as Mr. Kenneth Greenberg, writing to me from the city of sudden and violent death, has made quite clear by sending me a cutting from the October 1957 issue of the American journal *Popular Mechanics*.

This cutting has an illustration of an American ambulance fitted with a radio transmitter which turns all traffic lights red for a few seconds to give it a clear passage as it speeds on its way.

Mr. Greenberg quite rightly sends this cutting to me to refute the statement I made in the September issue of *W.W.* that the idea had never been put into use. But my statement was all wrong, and it is all the more blameworthy in that I had forgotten that in the issue of Dec. 2nd, 1937—nigh on a quarter of a century ago—I myself reported in these columns that I had seen this idea in use in a European city. I can only hang my debowlered head in shame at forgetting my own words, and thus misleading my readers.

"I can only hang my debowlered head in shame."

I did not mention the name of the city but unless my memory has let me down again it was in the city of Good King Wenceslas that I saw this sight.

If any of you are so ignorant that you don't know the name of the land over which Good King Wenceslas ruled, and the name of his capital city—still unchanged today—in which he did his looking out on St. Stephen's Day, I do not consider it my duty to enlighten you. Ask any of the children who sing carols on your doorstep this Christmas.

Diary Data and Dates

I AM very gratified to see in the "*W.W.* Diary" for 1962 that the pages in which we record our daily doings have been kept as free from printed matter as possible. Thus the Editor has kept his hagiographical information to a minimum, only including saints' days and other ecclesiastical information where they coincide with quarter days and half-quarter days.

In the non-diary pages I was a little surprised to see that the terminating sigma (ς) had been omitted from the Greek alphabet, but I suppose the reason is that it has no symbolic significance. I suppose, too, that a similar reason, namely lack of usefulness, causes the omission on the page of abbreviations of r.d.f., to denote what we now call radar. I think it is a pity that this was ever allowed to be superseded by the American name of "radar," but it is too late to alter it now.

I was very pleased to see the page of some historic wireless dates. I notice that the adjective "some" is used in the title, but even so I wonder why some dates were omitted. The omission which dismayed me most was the date when the cavity magnetron was invented.*

It is made quite clear in the Diary that G.M.T. is used throughout but I think it is carrying accuracy a bit too far when the time of the Titanic disaster is reduced to G.M.T. from local meridian time, thus causing what I regard as the wrong date of 15th April, 1912, to be given for the event which I, and all others who personally remember the disaster have always regarded as occurring on 14th April. It occurred at 11.40 p.m. local meridian time on Sunday, 14th April, but as the ship's longitude was 50° 14′ W it would be just after 3 a.m. G.M.T. on 15th April.

* An almost impossible task. It was developed over a period of many months, but on outstanding date was February 21st, 1940, when, to quote Sir Robert Watson-Watt, "the new device was successfully operated."—Ed.

Forty Years On

ALTHOUGH it is only three months since the British National Radio Show closed its doors, preliminary plans for the 1962 show are already being discussed. I think, therefore, I had better remind the organizers that next autumn we shall be celebrating not only the fortieth anniversary of the first radio show, held in the old Horticultural Hall in 1922, but also the fortieth anniversary of the beginning of broadcasting itself; at any rate of regular broadcasting in this country from 2LO.

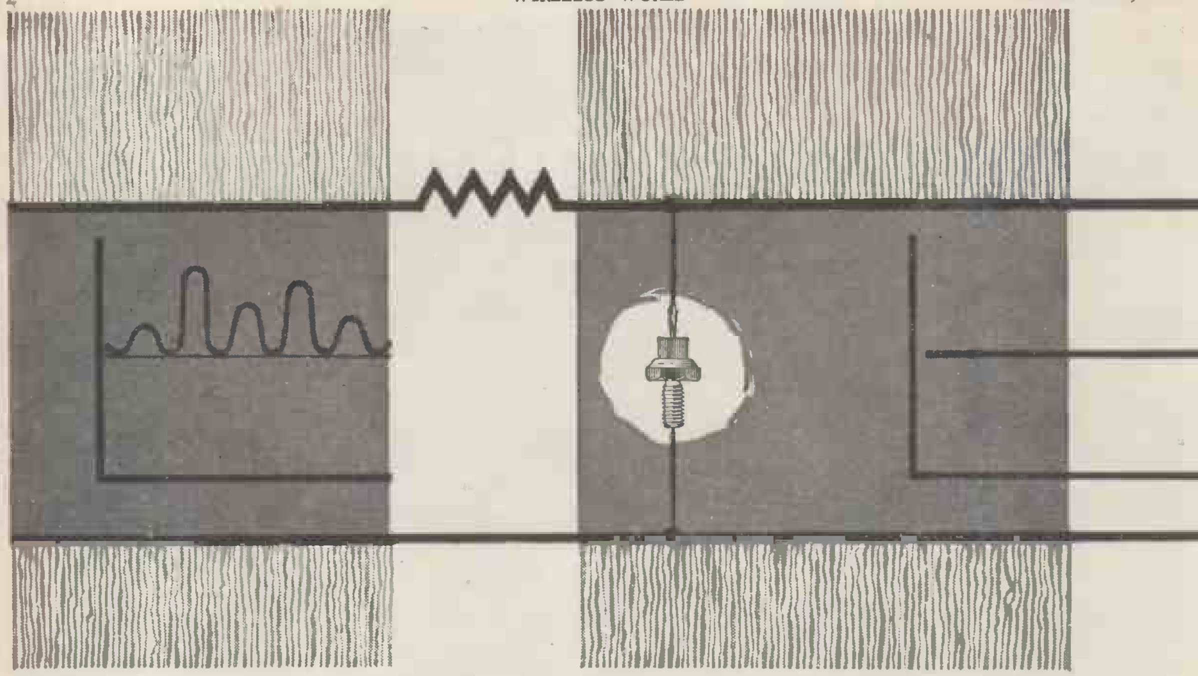
I hope these anniversaries will be celebrated in some way at the show next August but we don't want merely a static museum showing a few sets that were on sale in 1922. Of course a museum section could form a part of the exhibition; there is, at any rate, plenty of room for it in the vast open spaces of which I complained in 1960 and which were again in evidence at the last show.

In order to celebrate these two anniversaries I think it would be a good idea for the B.B.C. to combine with receiver manufacturers to bring home to people how excellent is the quality of 1962 compared with that of 1922, not only on the technical side but on the entertainment side also. I am not trying to decry the pioneers of 1922, but, of necessity, they were venturing into a new field of entertainment altogether, and their efforts were naturally somewhat amateurish compared with today's polished standards.

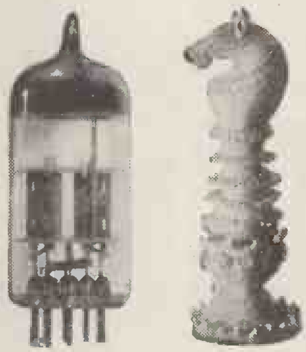
Could not the B.B.C. arrange to give a programme or two of the type we used to get in 1922. I wonder if there are any recordings available. If such programmes were fed through 1922 sets, present day listeners—including youngsters of 40—would know what we had to put up with in those far off days.

Senescent Senescience

I MUST accept with becoming grace the rebuke administered to me by Mr. K. W. Mawson of the Royal Eye & Ear Hospital, Bradford (Nov. issue), concerning remedial measures necessary to combat the hearing defects of the ageing. It is quite clear to me that I have advanced further along the road of senescence than I had supposed, without a corresponding increase in my senescience.



The chesspiece is carved Indian ivory, circa 1740. The valve is from the Mullard Special Quality range.



winning move . . . price and performance !

In one move you can checkmate practically any valve reliability problem by specifying Mullard Special Quality Valves.

Mullard production techniques couple high technological standards with large scale output, giving you the advantage of valves of top quality performance at a surprisingly low price.

Specifically designed to provide combinations of several special qualities—long life, supreme ruggedness, consistent characteristics—these Special Quality valves can increase operational reliability under normal or tough conditions and reduce costly equipment breakdowns and servicing time.

Send us your valve reliability problem and we'll recommend a Special Quality valve type. When writing please quote reference M42212.

Mullard Limited, *Government and Industrial Valve Division*, Mullard House, Torrington Place, London, WC1. Telephone LANgham 5522

Mullard

MVTA 422A


UNIVERSALLY ACCEPTED STANDARD ENCAPSULATION
Our complete range of Switching, R.F., and now A.F. transistors, is produced in the TO-5 International Standard outline. This form of encapsulation is admirably suited to the high quality of Newmarket transistors, which conform to K1007, VASCA, and IEC specifications, for computor, fast switching, and other exacting applications.
STANDARD RATINGS: SWITCHING 20 VOLTS R.F. 15 VOLTS AUDIO 30 VOLTS
For full details of these and other JEDEC outlines contact
NKT NEWMARKET TRANSISTORS LTD, EXNING ROAD, NEWMARKET TEL: NEWMARKET 3381
MEMBER OF THE
PYE
GROUP OF COMPANIES

Easy - to - build kit - sets of **Heathkit** DAYSTROM *highest quality at lower cost*

"GLOUCESTER" STEREO CABINET KIT. Specially designed to meet the varying needs of different homes. Mk. I houses Record Player, F.M. Tuner, Stereo Amplifier, records, etc. Mk. II will house a Tape Deck in addition. 46¼in. long, 30in. high, 21in. deep. "In the white" for finish to personal taste.
Mk. I **£16.13.6.** Mk. II **£17.18.6**

"COTSWOLD" HI-FI SPEAKER SYSTEM KIT. Acoustically designed enclosure "in the white" 26in. x 23in. x 15½in. housing a 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with pressure unit to cover the full frequency range of 30-20,000 c/s. Complete with speakers, cross-over unit, level control, etc. **£21.19.0**

"CHEPSTOW" EQUIPMENT CABINET KIT. Occupies minimum floor space. Will house Record Player, F.M. Tuner, Stereo Amplifier and additional power amplifiers where needed. Dim. 35 x 18 x 33in. high. **£11.5.6**

AG-9U MA-12

"MALVERN" HI-FI EQUIPMENT CABINET KIT. Will house all your Hi-Fi equipment. "Left in the white" for finish to choice. Size 39½ x 32 x 21¾in. **£17.10.0**

HI-FI SINGLE CHANNEL AMPLIFIER KIT. Model MA-12. 12 w. output, wide freq. range, low distortion. **£10.19.6**

STEREO CONTROL UNIT KIT. Model USC-1. Push button selection, accurately matched ganged controls to ± 1 dB. Accepts inputs from most tape heads and any stereo or mono pick-up. **£18.18.6**

HI-FI STEREO AMPLIFIER KIT. Model S-88. 16 w. output, 20 mV. basic sensitivity (4 mV. available, 7/6 extra). Ganged controls, Stereo/Monaural gram., radio and tape recorder inputs, Push-button selection. Two-tone grey metal cabinet. **£26.12.6**

6-W. STEREO AMPLIFIER KIT. Model S-33. 3 watts per channel, 0.3% distortion at 2.5 w/chnl., 20 dB N.F.B. Inputs for Radio (or Tape) and Gram., Stereo or Monaural, ganged controls. Sensitivity 200 mV. **£12.8.6**

HI-FI SPEAKER SYSTEM KIT. Model SSU-1. Ducted-port bass reflex cabinet "in the white." Twin speakers. With legs **£11.18.6.** **£10.17.6**

STEREO-HEAD BOOSTER KIT. Model USP-1. Hi-Fi Stereo pre-amplifier for low output Hi-Fi P.U.'s. Input 2 mV. or 20 mV. Output adjustable from 20 mV. to 2 v. 40-20,000 c/s. Also suitable as low-noise R.C.-coupled amplifier. **£6.17.6**

TAPE AMPLIFIER UNIT KITS. Models TA-1M and TA-1S. This Combined Tape Record/Replay Amplifier is available in both monophonic and Stereophonic models. Model TA-1M can be modified to the stereo version with modification kit TA-1C.
TA-1M **£18.2.6;** TA-1S **£23.6.0;** TA-1C **£6.10.0**

TAPE DECKS are now available as "packaged deals" with other equipment. *Details on request.*

5in. OSCILLOSCOPE KIT. Model O-12U. Has wide-band amplifiers, essential for TV servicing, F.M. alignment etc. Vertical frequency response 3 c/s to over 5 Mc/s, without extra switching T/B covers 10 c/s to 500 kc/s in 5 ranges **£36.10.0**

ELECTRONIC SWITCH KIT. Model S-3U. (Oscilloscope Trace Doubler). Enables a single beam oscilloscope to give simultaneous traces of two separate and independent signals. Switching rates approx. 150, 500, 1,500, 5,000 and 15,000 c/s. Sig. freq. response 0-100 kc/s. ± 1 dB. Separate gain controls and sync. output. Sig. input range 0.1-1.8 v. r.m.s. **£10.15.6**

CAPACITANCE METER KIT. Model CM-1U Direct reading 4½in. scale. Full-scale ranges 0-100μμF, 0-1,000μμF, 0-0.01μF & 0-0.1μF **£14.15.0**

DECADE CAPACITOR KIT. Model DC-1. Capacity values 100μμF to 0.111μF in 100μμF steps. **£6.5.6**

VALVE VOLTMETER KIT. Model V-7A. 7 voltage ranges d.c. volts to 1,500 a.c. to 1,500 r.m.s. and 4,000 peak to peak. Resistance 0.1Ω to 1,000 MΩ with internal battery. D.C. input impedance 11 MΩ dB measurement has centre-zero scale. Complete with test prods, leads and standardising battery. **£13.0.0**

R.F. PROBE KIT. Model 309-CU. Extends the frequency range of our V-7A to 100 Mc/s. and enbles useful voltage indication to be obtained up to 300 Mc/s. **£1.9.6**

HIGH VOLTAGE PROBE. Model HV-336. Measures up to 30,000 V. D.C. with negligible circuit loading. **£2.15.6**

R.F. SIGNAL GENERATOR KIT. Model RF-1U. Provides extended frequency coverage on six bands from 100 kc/s.-100 Mc/s. on fundamentals and up to 200 Mc/s. on calibrated harmonics. **£11.18.0**

GRID-DIP METER KIT. Model GD-1U. Functions as oscillator or absorption wave meter With plug in coils for continuous frequency coverage from 1.8 Mc/s. to 250 Mc/s. **£10.9.6.** Additional Plug-in Coils Model 341-U extend coverage down to 350 kc/s. With dial correlation curves, **15/-.**

TRANSISTORISED VERSION. Model XGD-1. Similar to GD-1U. Fully transistorised with a frequency range of 1.75 to 45 Mc/s. **£10.8.6**

AUDIO WATTMETER KIT. Model AW-1U. Up to 25 w. continuous. 50 w. intermittent. **£14.14.0**

2¾in. SERVICE 'SCOPE KIT. Model OS-1. Light, compact, portable for service engineers. Dim. 5 x 8 x 14½in. long. Wt. 10½lb. **£19.10.0**

POWER SUPPLY UNIT KIT. Model MGP-1. Input 100/120 v. 200/250 v., 40-60 c/s. Output 6.3 V., 2.5A. A.C.; 200, 250, 270 V., 120 mA. max. D.C. **£4.16.6**

AUDIO SINE-SQUARE WAVE GENERATOR KIT. Model AO-1U. Inexpensive generator covering 20 c/s. to 150 kc/s. in four ranges with choice of sine or square waves. Size 9½in. x 6½in. x 5in. **£12.18.6**

STABILISED POWER PACK KIT. Models MSP-1M and MSP-1W. Input 200-250 V., 40-60 c/s. A.C., fully fused. Outputs: H.T. 200-410 V. D.C. at 20-225 mA. in 3 switched ranges. Size: 13in. x 8½in. x 9½in.
MSP-1M (with meters) **£34.12.6**
MSP-1W (without meters) **£27.17.6**

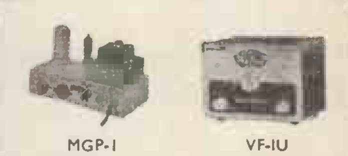
MULTIMETER KIT. Model MM-1U. Ranges 0-1.5 V. to 1,500 V. A.C. and D.C.; 150μA to 15A. D.C.; 0.2Ω to 20 MΩ. 4½in. 50μA meter. **£11.18.6**

AUDIO VALVE MILLIVOLTMETER KIT. model AV-3U. 1 mv. to 300 v. A.C. 10 c/s. to 400 kc/s. **£13.18.6**

AUDIO SIGNAL GENERATOR KIT. Model AG-9U. 10 c/s. to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's. **£19.19.6**

RESISTANCE - CAPACITANCE BRIDGE KIT. Model C-3U. Measures capacity 10 pF to 1,000μF., resistance 100 Ω to 5 MΩ and power factor. 5-450 v. test voltages. With safety switch. **£8.6.6**

DUAL-WAVE TRANSISTOR RADIO KIT. Model UJR-1. This sensitive headphone set is a fine introduction to electronics for any youngster. **£2.16.6**



MGP-1 VF-1U

4-WAVE TRANSISTORISED PORTABLE KIT. Model RSW-1. 7 Transistors and three diodes. For short and Medium wave-bands (200-550, 90-200, 18-50 and 11-18 m.). In solid leather case fitted with retractable whip aerial. **£22.10.0**

TRANSISTOR PORTABLE RADIO KIT. Model UXR-1. Pre-aligned I.F. transformers, printed circuit and a 7 x 4in. high-flux speaker. Real hide case. **£14.18.6**

HI-FI F.M. TUNER. Tuning range 88-108 Mc/s. For your convenience this is available in two units sold separately as follows: Tuner Unit (FMT-4U) with 10.7 Mc/s. I.F. output **£3.5.0** inc. P.T. I.F. Amplifier and Power Supply (FMA-4U). Complete with case and valves **£11.11.0.** Total **£14.16.0**

"MOHICAN" GENERAL COVERAGE RECEIVER KIT. Model GC-1U. Fully transistorised. Continuous frequency coverage 550 kc/s. to 30 Mc/s. in five bands. Electrical band spread on five additional bands covers amateur frequencies from 80-10 m. B.F.O. tuning and Zener diode stabiliser. Size 6¾in. x 12in. x 10in. **£38.15.0**

AMATEUR TRANSMITTER KIT. Model DX-100U. 150 w. D.C. input. Covers all amateur bands from 160-10 metres. Self contained including Power Supply. Modulator and V.F.O. **£81.10.0**

AMATEUR TRANSMITTER KIT. Model DX-40U. From 80-10 m. Crystal controlled. Power input 75 w. CW., 60 w. peak controlled carrier phone. Output 40 w. to aerial. Provision for V.F.O. **£32.10.0**

VARIABLE FREQUENCY OSCILLATOR KIT. Model VF-1U. From 160-10 m. fundamentals on 160 and 40 m. Ideal for our DX-40U and similar transmitters. **£11.2.0**

BALUN COIL UNIT KIT. Model B-1U. Will match unbalanced co-axial lines to balanced lines of either 75 or 300 Ω impedance. **£4.9.6**

Prices include free delivery in the U.K.

● *Deferred Terms available on all orders above £10* ●

DAYSTROM LTD.

DEPT. W.W.12 GLOUCESTER, ENGLAND

A member of the Daystrom Group, Manufacturers of the
WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS

Please send me FREE CATALOGUE (Yes/No)..............................

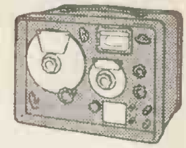
Full details of model(s)..............................

NAME ....
(Block Capitals)

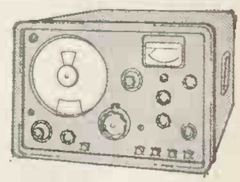
ADDRESS ....

.... W.W.12

SPECTRUM FROM 10 kc/s TO 6,000 Mc/s *



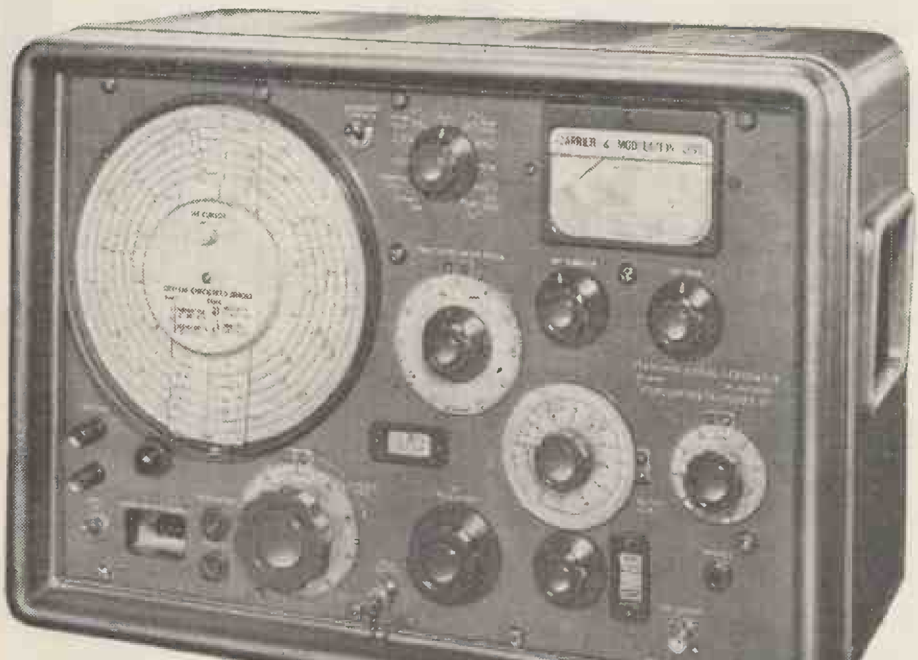
TF 1064B



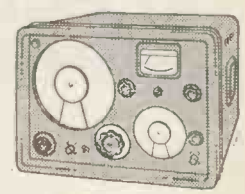
TF 1061

HERE ARE SOME OF THEM

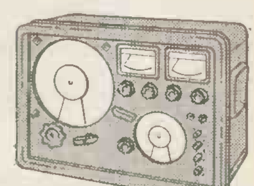
TF 955A/2M



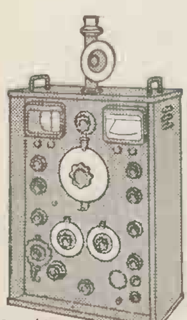
TF 144H



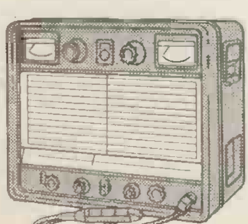
TF 1060



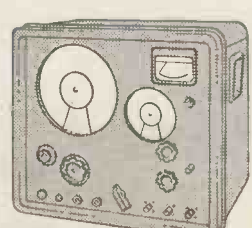
TF 1066B



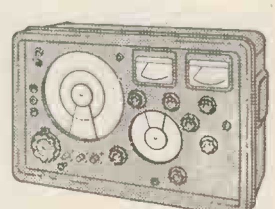
TF 890A/4



TF 867



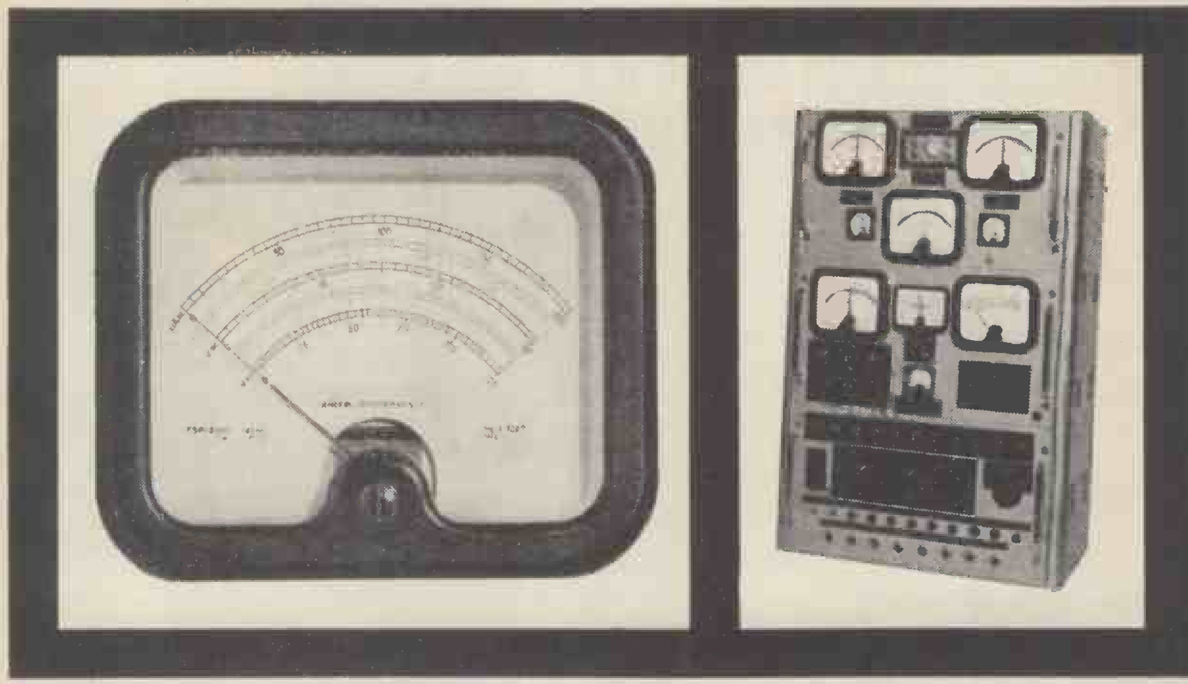
TF 1058



TF 801D/1

TC 200

meters made to measure



seven-range meter, including V, mV, μA, made for Elliott's at short notice

This seven-range meter, using Ernest Turner Model 605 was calibrated with special ranges by Anders at short notice for Elliott Brothers Ltd for the special-purpose test gear shown above. All the meters in this complex installation were supplied by Anders, who have the pleasure of carrying out similar work for a number of famous manufacturers. Anders are indebted to Elliott Brothers for kind permission to illustrate this equipment.

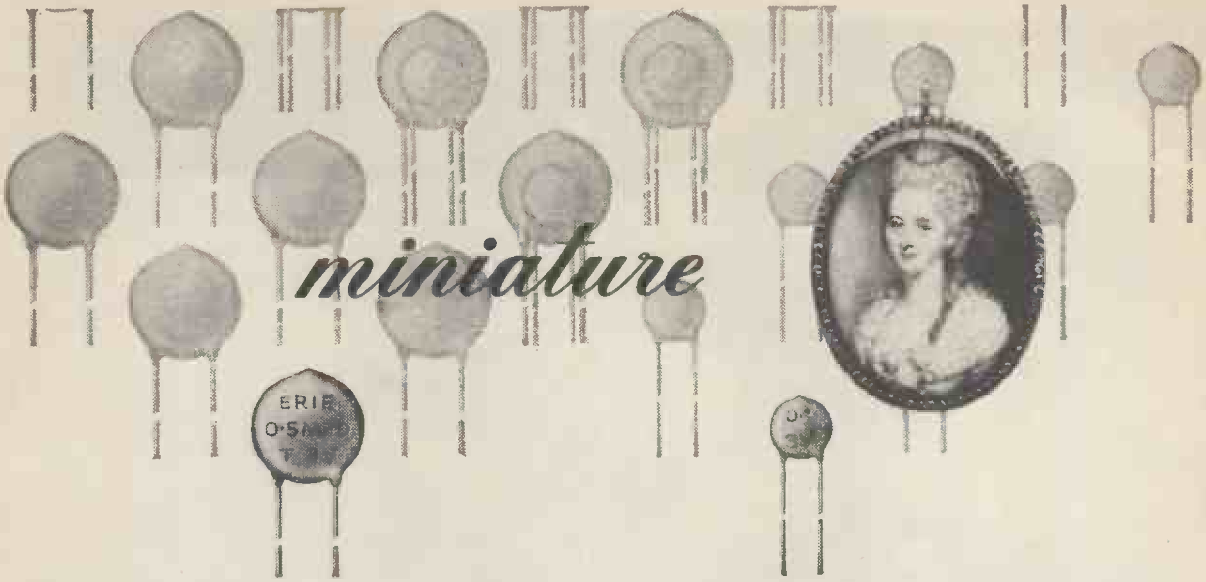
The Anders Instrument Centre commands the largest stocks of meters in the country, unique calibrating facilities, and detailed knowledge of metering problems. Most standard meters are supplied immediately. Non-standard meters of all kinds, shapes and sizes, for special voltage and current ranges, are accurately calibrated, tested and normally ready within 10-14 days. Makes include Avo, Crompton Parkinson, EAC, Elliott, Pullin, Taylor, Turner, Weir, Weston. Types include moving coil, moving iron, thermocouples, electrostatic, dynamometers, from 1½" to large switchboard instruments, and complete range of accessories. Please write or 'phone for details of the Anders meter service.

ANDERS ELECTRONICS LIMITED

103 Hampstead Road, London NW1. Tel: EUSton 1639

Contractors to GPO and Government Departments.
Ministry of Aviation approved.

METERS, ELECTRONIC AND TEST EQUIPMENT TO INDIVIDUAL SPECIFICATIONS



ERIE* Transcaps*

Pat. App. for

for all Transistor Circuits

SPECIFICATION

		811T	831T
CAPACITANCE	:	0.5μF	0.1μF
TOLERANCE	:	−20% +50%	−20% +50%
DIAMETER	:	0.594" max.	0.312" max.
THICKNESS	:	0.156" max.	0,156" max.
WORKING VOLTS	:	3 d.c.	3 d.c.

In line with the Erie policy of anticipating the component requirements of the future, the Erie Transcap capacitor is now added to our ever-increasing range of components for use with transistors.

Designed specifically as a small, reliable, high capacitance, low voltage, coupling, and by-pass capacitor, the Erie developed Transcap is manufactured entirely at our Great Yarmouth factory.

Styles 811T and 831T shown here in their actual physical sizes are only forerunners of the wide range in differing values and voltages which will ultimately emerge.

ERIE*

RESISTOR LIMITED

I, HEDDON STREET, LONDON, W.I

Telephone: REGent 6432

FACTORIES

Great Yarmouth and Tunbridge Wells, England: Trenton, Ont., Canada: Erie, Pa., Holly Springs, Miss., and Hawthorne, Cal., U.S.A.

** Registered Trade Marks*

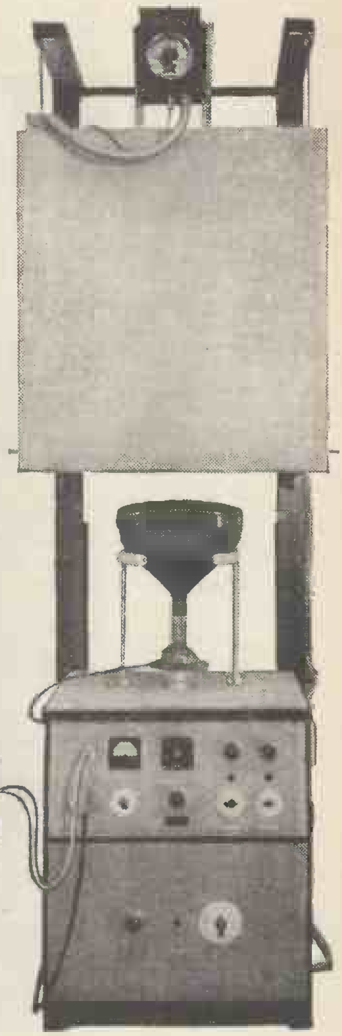
Photograph of miniature by courtesy of Victoria & Albert Museum

Specialists in
THE DESIGN AND MANUFACTURE OF
Vacuum Equipment

VACUUM OVENS · DEPOSITING ·
SPUTTERING · VALVE PUMPING · C.R.T., etc.

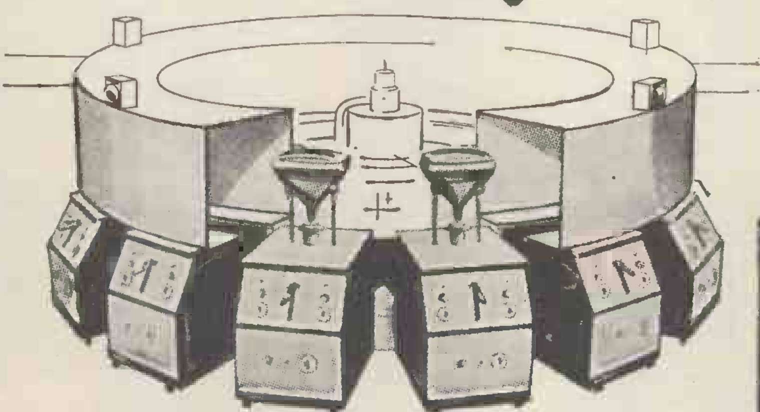
Single position Vacuum Oven. Temp. 0-300°C Vacuum range 10^{-4} double ended for fitting in glove box.

Vacuum Oven with glove box.



Single position C.R.T. Pumping Unit complete with vacuum reading, automatic controls, electric seal-off etc.

Automatic Rotary final exhaust machine for C.R.T. complete with oven, air circulation, automatic temperature controls, etc.



Indicating lights on all switches including fuses all visible on front panel.

VACWELL ENGINEERING CO. LTD.

WILLOW LANE · MITCHAM · SURREY

Tel.: MITcham 8211 (3 lines)

CINTEL DELAYED PULSE

This versatile instrument has four main outputs generating true +ve or −ve going pulses with a rise time of less than 10mµsec at an output of 5V in 75Ω. Variable amplitude, width and delay are provided and the instrument is capable of either single or double pulse modes of operation.

The four main outputs of the generator are (1) a pre-pulse of fixed amplitude and width. (2) A single or double main pulse of variable width and amplitude. (3) A single or double negative going sawtooth (sweep) pulse coinciding with the main pulse. (4) A single or double cable pulse derived from the main pulse.

APPLICATIONS of this instrument can be made in many fields of research and measurement. Its comprehensive specification makes it particularly suitable for use in radio navigation, radar, television, electronics, nucleonics, computors, telemetering and physiological research. Other uses will be apparent and the more common applications are listed in a comprehensive leaflet available on written request.

BRIEF SPECIFICATION

PERIOD: Continuously variable from 0·9µsec to 1·05sec corresponding with a frequency range 0·95c/s to 1·1Mc/s. Accuracy is within ± 5%.

PRE-PULSE: Fixed amplitude 8V peak in 75Ω positive going. Fixed width 60mµsec.

DELAY: The time between the peak of the pre-pulse and the advent of the main pulse is variable from 0·9µsec to 105msec. Accuracy is within ± 5%.

MAIN OUTPUT PULSE: Continuously variable in width from 0·09µsec to 105msec with a calibration accuracy of ± 5%. The amplitude and impedance is controlled by a four position switch and a fine control giving a 4:1 attenuation of each maximum as follows

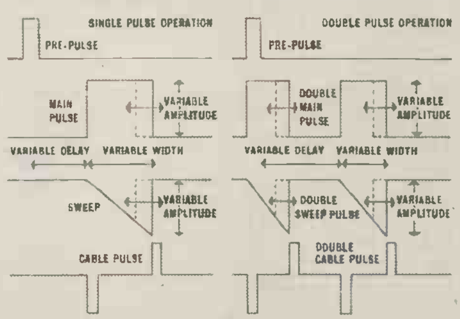
AMPLITUDE	IMPEDANCE	RISE TIME
5V max	75Ω	<10mµsec
10V max	150Ω	≯25mµsec
25V max	600Ω	≯40mµsec
50V max	1000Ω	≯50mµsec

POLARITY of the output pulse can be positive or negative going with respect to earth as required. Accuracy of calibration is within ± 2% on all ranges except the 50V range where it is within ± 5%.

THE SWEEP waveform is a direct coupled negative going sawtooth with the same width and delay as the main pulse. The amplitude of this waveform is 15V peak at maximum width. Linearity is maintained to within ± 2%. Output impedance approximately 300Ω.

CABLE PULSE is obtained from a short circuited pure line. Two narrow output pulses are obtained, one positive and one negative going, coincident with the leading and trailing edges of the main pulse. The width of both pulses is 25mµsec. The maximum amplitude is 3V peak in 75Ω and rise time 8mµsec.

DOUBLE PULSE operation can be obtained by a setting on the front panel. Two pulses are produced, the first coincident with the pre-pulse and the second delayed on it by a selected amount.



SYNC/TRIGGER The generator can be synchronised or triggered by almost any externally applied waveform. The minimum amplitude levels for a sine wave being: SYNC operation 0·5V peak to peak 2Mc/s max., and TRIGGER operation 1·0V peak to peak 2Mc/s max.

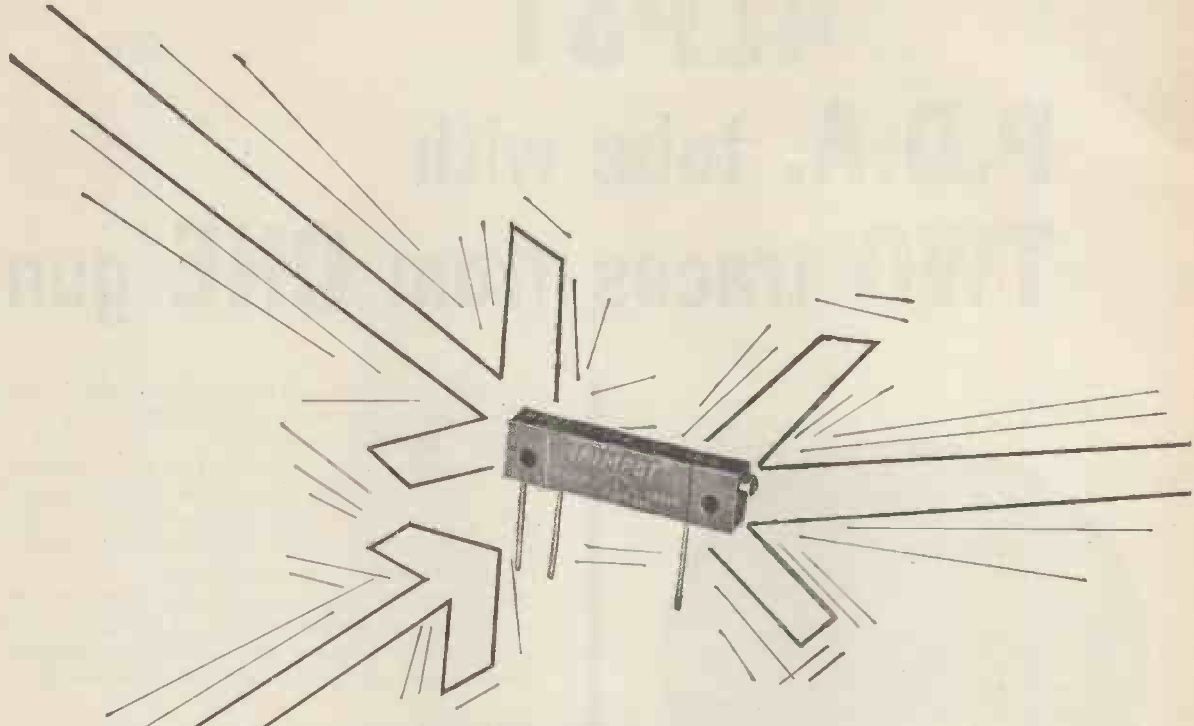
SINGLE SHOT operation obtained by a push-button switch

POWER SUPPLY . .	110-120V and 200-250V a.c.. in 10V steps 40 to 60 c/s
POWER CONSUMPTION	200W
DIMENSIONS	22½" wide x 15" deep x 21" high (57 x 38 x 53 cm.)
WEIGHT	90 lbs. (41 kilos).

CINTEL instruments division

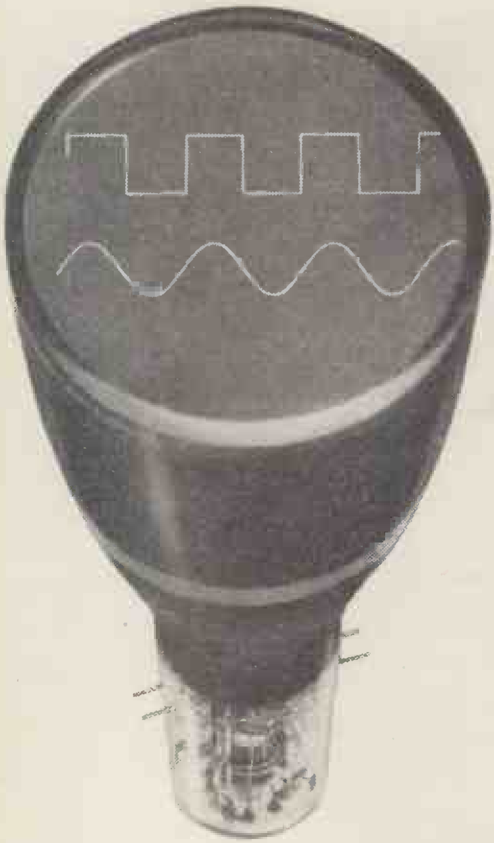
RANK CINTEL LIMITED

Worsley Bridge Road, Lower Sydenham. S.E.26. HITher Green 4600



4LP31

P.D.A. tube with TWO traces from ONE gun



The 'ETEL' four-inch instrument tube 4LP31 is the most economical high performance tube for dual trace oscillography.

Two traces are provided in the simplest and most economical manner—by means of a single gun with a beam-dividing electrode. Sensitivity of 27 V/cm at 3kV is attained by employing a post-deflection accelerator.

The 4LP31 is recommended for high quality general purpose applications. It has a flat face and side connections to the deflector plates. Write for full information to the address below.

ABRIDGED DATA

4LP31 single gun dual trace tube.

SCREEN TYPE	*P31
DEFLECTION	electrostatic
POST-DEFLECTION ACCELERATOR	single stage
SCREEN DIAMETER	4 inches
MAXIMUM OVERALL LENGTH ...	15½ inches

* (The green medium persistence phosphor used by E.T.L. has now been designated P31. It is exactly the same as the E.T.L. phosphor previously called P1.)

Capacitances

cx′—x″	1.4 to 2.0 pF
cx′—all (x″ earthed)	2.7 to 3.8 pF
cx″—all (x′ earthed)	2.7 to 3.8 pF
cy′—all...	2.5 to 3.8 pF
cy″—all	2.5 to 3.8 pF
cy′—y″	<0.1 pF

Typical Operating Conditions

Va1...	1.5 kV
Va2	320 to 420 V
Va3	1.5 kV
Va4	3.0 kV
Vg (for cut-off)	—40 to —95V
Sx	27 V/cm
Sy′	27 V/cm
Sy″	27 V/cm

ETEL CATHODE RAY TUBES

Electronic Tubes Limited · Instrument Cathode Ray Tube Division
80 New Oxford Street · London WC1 · Telephone: Langham 0800

ETL 18a

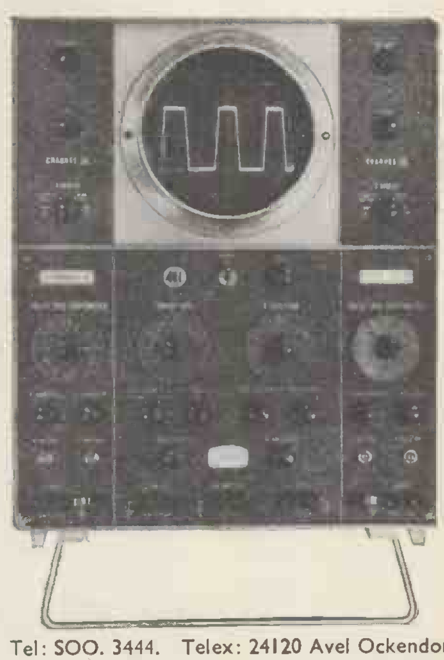
TRACING PHENOMENA

with a DUMONT oscilloscope means swifter and more accurate answers to investigations.

DUMONT TYPE 425 HIGH FREQUENCY OSCILLOSCOPE

The 425 is a modularized, 35 megacycle, highly versatile general-purpose oscilloscope. The READ OUT SWITCH FEATURE and the unique "Two Dot" dialled method of wave-form measurement make this the most accurate instrument available today. Innumerable types of accurately repeatable measurements can be made and the applications are limitless.

DUMONT TYPE 404 PULSE GENERATOR



DUMONT TYPE 411 DUAL-BEAM OSCILLOSCOPE

The 411 is an ultra-high sensitivity instrument of very low frequency and is particularly valuable in the measurement of vibrations in the medical field. It is a true dual-beam oscilloscope employing a multi-gun cathode-ray tube and provides an unusually varied selection of displays.
DUMONT cameras are available for all types of 5in. Tube high grade oscilloscopes. Bezel adaptors used for all makes other than DUMONT. Demonstrations and Full Servicing Facilities available.

AE AVELEY ESSEX

Write for full details:

Aveley Electric Limited

SOUTH OCKENDON, ESSEX. Tel: SOO. 3444. Telex: 24120 Avel Ockendon

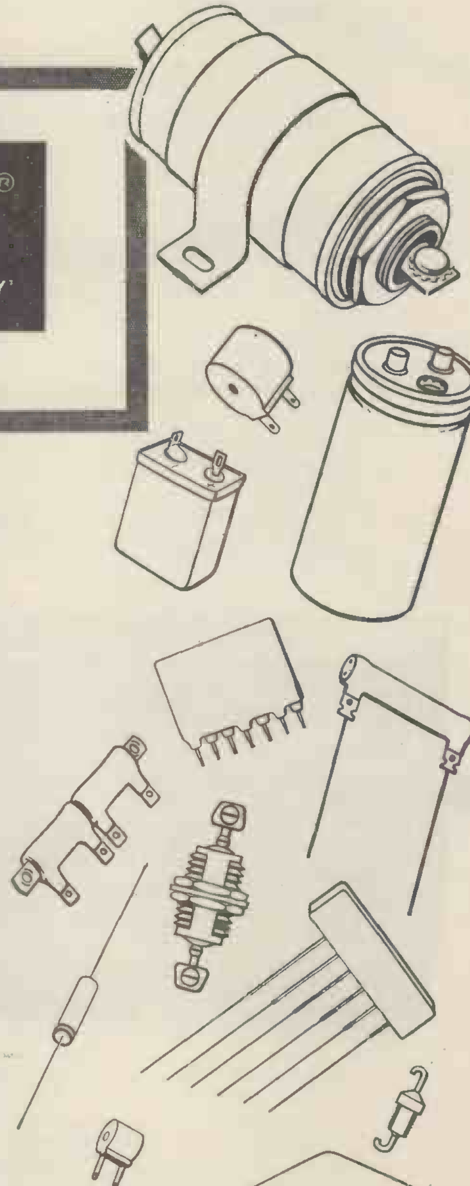
ANGLO-AMERICAN LINK-UP

Interchange of "know-how" of great value to Industry

TCC

SPRAGUE®
THE MARK OF RELIABILITY

GREAT BRITAIN — AMERICA



An agreement of far-reaching importance to all engaged in Radio and Television and in the Electronics and Electrical industries is operating between The Telegraph Condenser Company, Britain's oldest—and Europe's largest—manufacturers of condensers, and the Sprague Electric Company, by far the largest manufacturers of capacitors, electrical components, etc. in America.

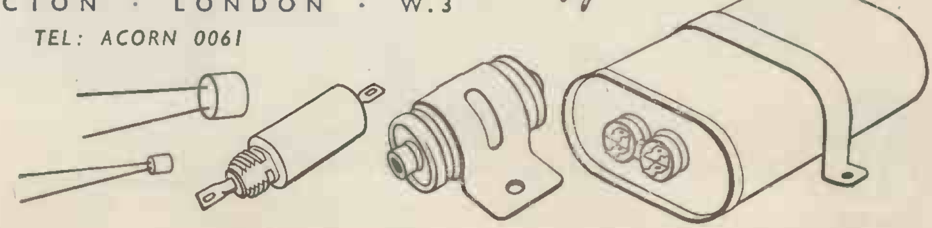
Under this arrangement the two organisations share their vast research and manufacturing experience. Such mutual collaboration cannot fail to be of the utmost value to electronic and electrical engineers.

T.C.C. are proud to be allied with this development, and invite you to make the fullest use of the service available.

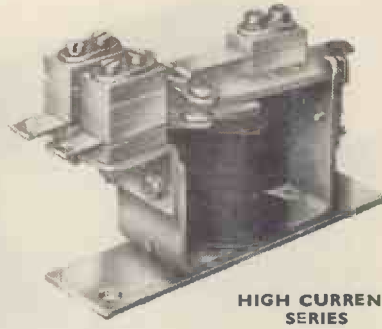
EXCLUSIVE DISTRIBUTORS FOR SPRAGUE PRODUCTS IN THE UNITED KINGDOM

THE TELEGRAPH CONDENSER CO. LTD.

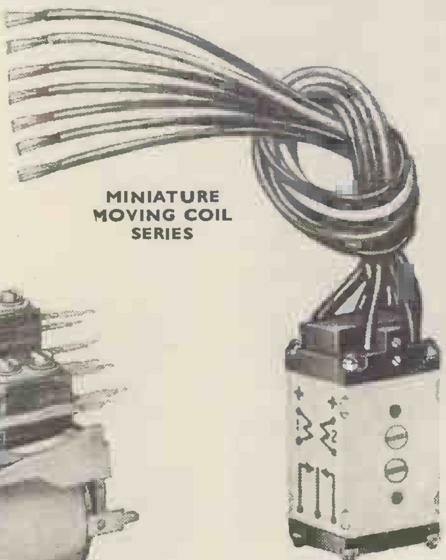
NORTH ACTON · LONDON · W.3
TEL: ACORN 0061



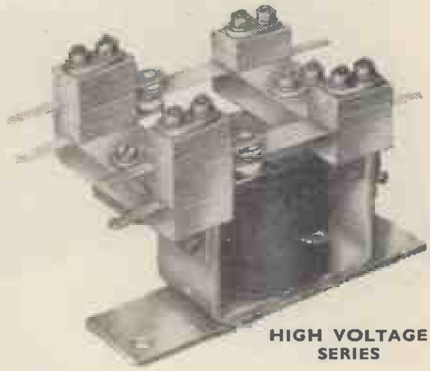
ELECTRO METHODS LTD



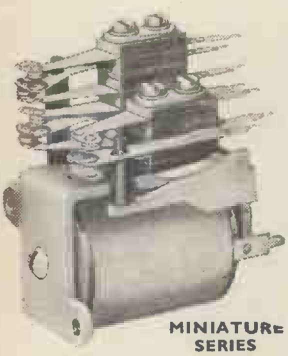
HIGH CURRENT SERIES



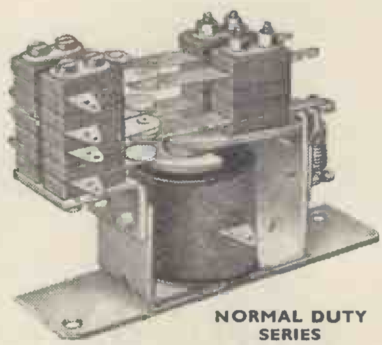
MINIATURE MOVING COIL SERIES



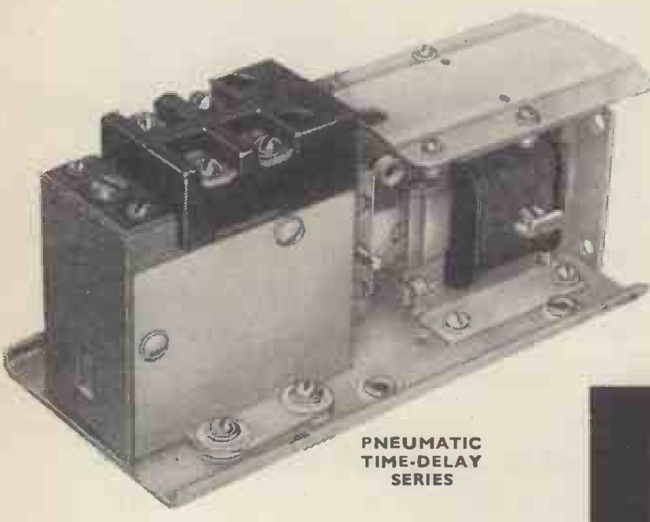
HIGH VOLTAGE SERIES



MINIATURE SERIES



NORMAL DUTY SERIES



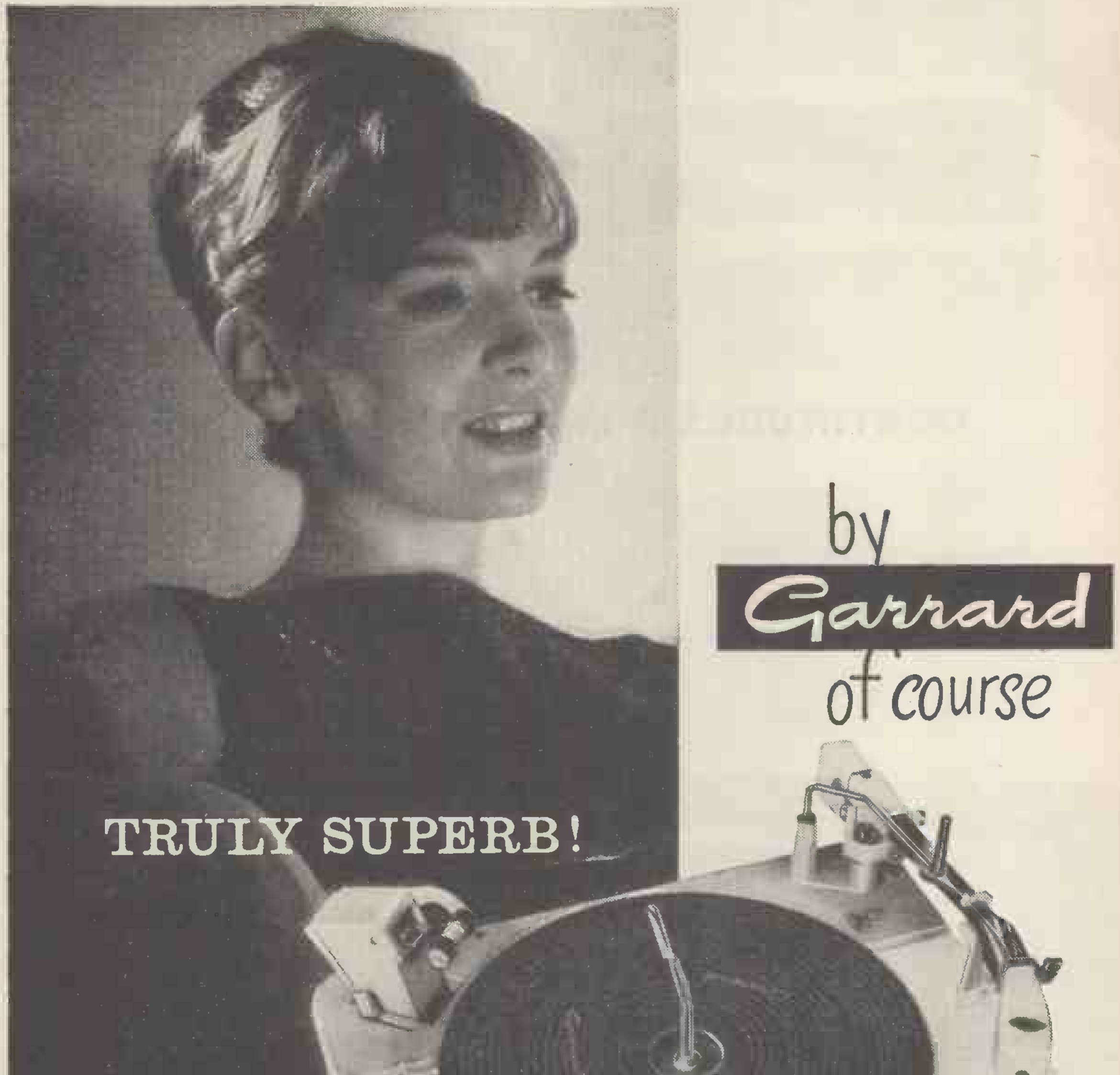
PNEUMATIC TIME-DELAY SERIES

PRECISION RELAYS

Illustrated technical data sent on request :

ELECTRO METHODS LTD., General Products Division, **CAXTON WAY, STEVENAGE, HERTS**

Telephone : Stevenage 2110-7



by **Garrard** of course

Combines for the first time the high performance of a transcription turntable with facility for changing records automatically.

Wow—less than 0.12% R.M.S.
Flutter—less than 0.05% R.M.S.

Fitted with latest type of balanced transcription arm which incorporates a calibrated stylus pressure adjustment. Plug-in pickup head.

Loaded and balanced turntable suitable for use with all types of pick-ups including sensitive magnetic types.

Easily adjustable clip-in spring suspensions from top of unit.

Extremely sensitive automatic trip.

GARRARD
TRADE REG. MARK

LABORATORY SERIES
AUTO-TURNTABLE TYPE A
THE TRANSCRIPTION
UNIT WITH AUTOCHANGE

THE GARRARD ENGINEERING & MANUFACTURING CO. LTD., SWINDON · WILTSHIRE

cut your air fares in half—

fly as a party!

Get the right party together, charter a Cunard Eagle aircraft, and save half the air fare to wherever you wish to fly! What's the right party? Cunard Eagle will explain—just phone or write. Broadly, most firms, clubs, societies qualify. And the tremendous saving can apply to each individual in the party.

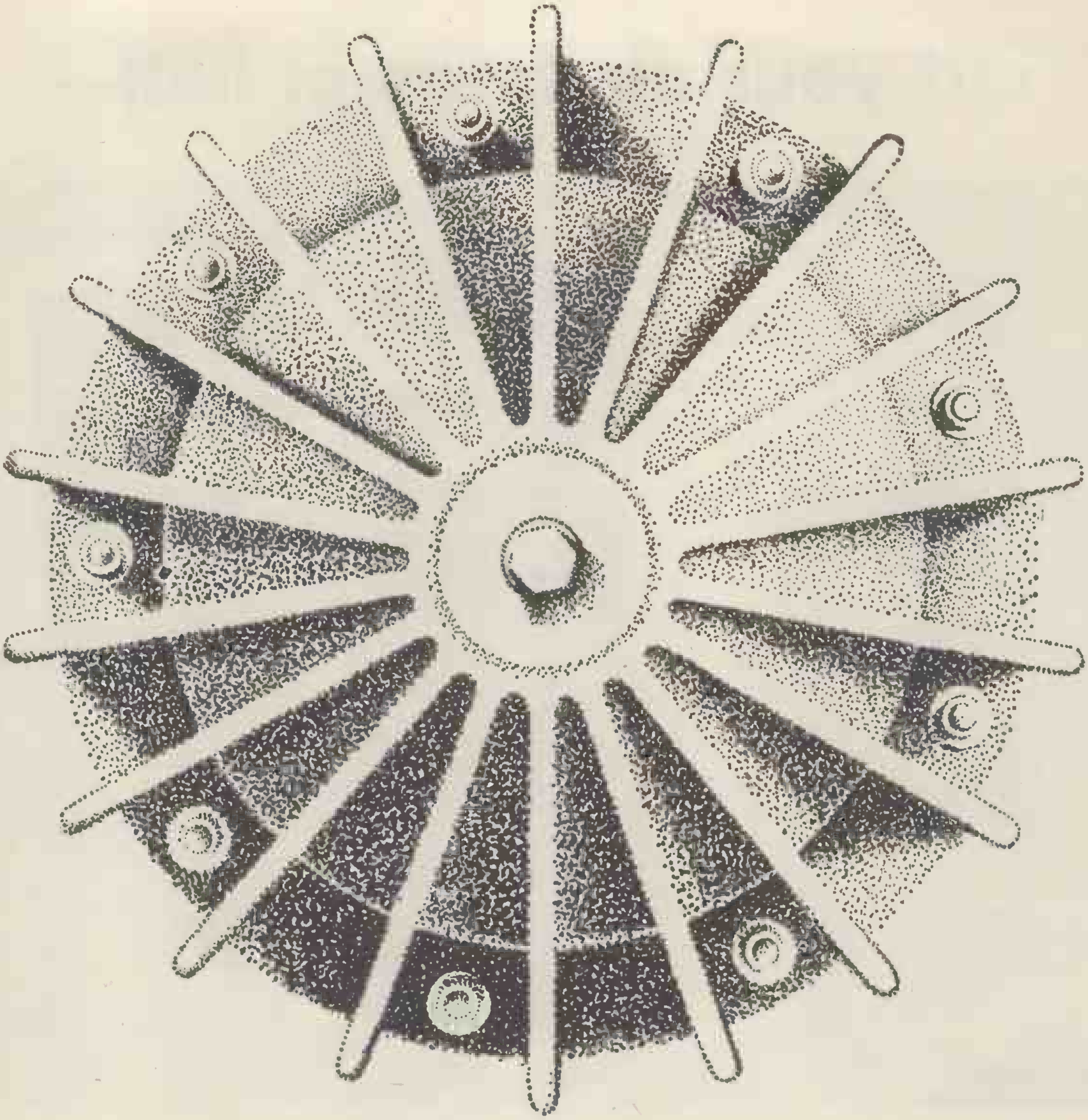
You fly glamorously independent of timetables. Choose your aircraft all the way from vast jet-prop Britannias or giant DC-6C's to swift, luxurious Viscounts or comfortable, bustling Vikings.

Think about it; half the normal air fare! And trust the name Cunard—a great name in travel for 120 years. It's certainly worth your while to enquire.

CONTACT: CHARTER DIVISION,

CUNARD EAGLE AIRWAYS

MARBLE ARCH HOUSE, 40 EDGWARE ROAD, LONDON. W.2. AMBASSADOR 7799



Wide Band Matching Transformers for H.F.

- **Power Capacities 1 kW & 5 kW**
- **Impedance ratios 600 ohms balanced to 75/50/60 ohms unbalanced**

Compact · No tuning · Low loss · Weatherproof

Write for data sheets and further technical details quoting reference M/687/12 to:—

5 kW Type L.382 in cast aluminium. Frequency range 1.5—30 M/cs, with VSWR better than 1.5

MULLARD EQUIPMENT LIMITED

MANOR ROYAL, CRAWLEY, SUSSEX · Telephone Crawley 28787

ME687b

VHF voltmeter,
type GM 6025

Frequency range
0.1 Mc/s - 800 Mc/s flat from 1 Mc/s - 300 Mc/s *(see graph)*
− 1dB at 0.1 Mc/s
+ 1dB at 800 Mc/s

Measuring range
10 mV (f.s.d.) - 10 V divided into 7 ranges in a 1-3-10 sequence.

Accuracy
The overall accuracy is better than 5% with respect to full scale.

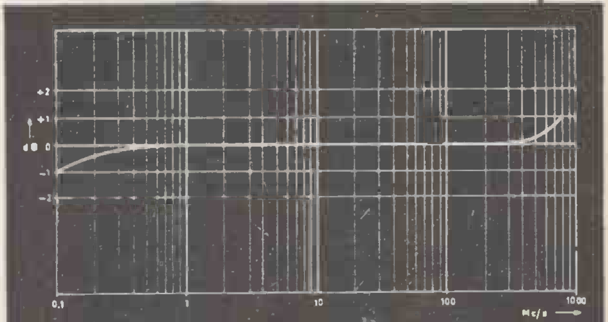
Input Impedance
Input capacitance: 1 µµF
Input resistance at: 1 Mc/s 65 kΩ
100 Mc/s 50 kΩ
200 Mc/s 35 kΩ

Linear scale
Thanks to voltage-dependent feed-back the scale is linear. It is calibrated directly in the r.m.s. value of the VHF voltage and has an effective length of 5".

Calibration voltages
The frontpanel contains a calibration socket which for any setting of the range selector provides the appropriate calibration voltage for that range.

Replacement of the probe crystal
The probe crystal can be easily replaced and the instrument rapidly re-calibrated by the user.

Coaxial T-connector
For measurements on 50Ω-coaxial lines the T-connector, type GM 6050T can be ordered separately.



Response curve with T-connector, type GM 6050T

other voltmeters from our range

µV

type GM 6012
2 c/s - 1 Mc/s
1 mV (f.s.d.) - 300 V

mV

type GM 6014
1 kc/s - 30 Mc/s
1 mV (f.s.d.) - 30 V

V

type GM 6020
D.C.
100 µV (f.s.d.) - 1000 V

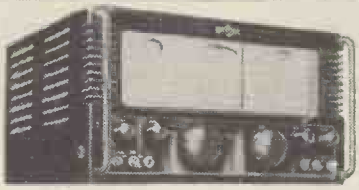
instruments: quality ***tools*** for industry and research

PHILIPS

This advertisement invites YOU to contact H·P RADIO for

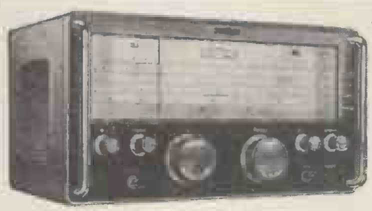
EDDYSTONE

RADIO RECEIVERS



EDDYSTONE 680X

A 15 valve communication receiver with many refinements, including crystal filter, variable selectivity "S" meter, push-pull output and stabilized supply to oscillator stages. 1110 kc/s to 480 kc/s and 2.5 to 30 Mc/s in 5 switched bands. Electrical performance, sensitivity for 50 milliwatts, 15 db signal/noise ratio, 4 microvolts on all ranges.
£140.0.0



EDDYSTONE 840C

Communication receiver at a moderate price. 8 B8A valves in a straightforward superheterodyne circuit. 5 wave bands 30.6-10.5 Mc/s, 10.6-3.7 Mc/s, 30.6-10.5 Mc/s, 10.6-3.7 Mc/s, 3.8 Mc/s, 1.4 Mc/s, 205-620 Metres. Sensitivity better than 10 microvolts. Selectivity 30 db down to 10 kc/s off resonance, AC/DC. Internal speaker. £58.0.0.

EDDYSTONE 880

The Eddystone 880 high stability communications receiver has been designed expressly for use in professional communications systems. Tuning range is from 500 kc/s to 30.5 Mc/s. Please write for technical specification.
£380.0.0

EDDYSTONE 888A

A 12 valve receiver designed for the amateur bands, giving full bandspread. Double superheterodyne with high selectivity and excellent signal to noise characteristics. Crystal calibrator audio filter, separate gain controls, oscillator trimmer. Frequency 1,800-2,000 kc/s, 3.500-4,000 kc/s, 7,000-7,300 kc/s, 14,000-14,350 kc/s, 21,000-21,500 kc/s, 28,000-30,000 kc/s. £110.0.0.

EDDYSTONE 870A

A compact, precision built receiver for the home, giving news and entertainment from the whole world. 5 wavebands, vernier device. AC/DC operation, built-in mains filter and loudspeaker. Two tone metal cabinet
£33.0.0

HP RADIO SERVICES LTD

51, COUNTY ROAD LIVERPOOL, 4

HIRE PURCHASE TERMS OVER 1 YEAR

Model No.	Cash Price	Deposit	12 Monthly of
870A	£33	£6 12 0	£2 6 8
840C	£58	£12 0 0	£4 2 6
888A	£110	£22 0 0	£7 17 8
680X	£140	£28 0 0	£10 0 8

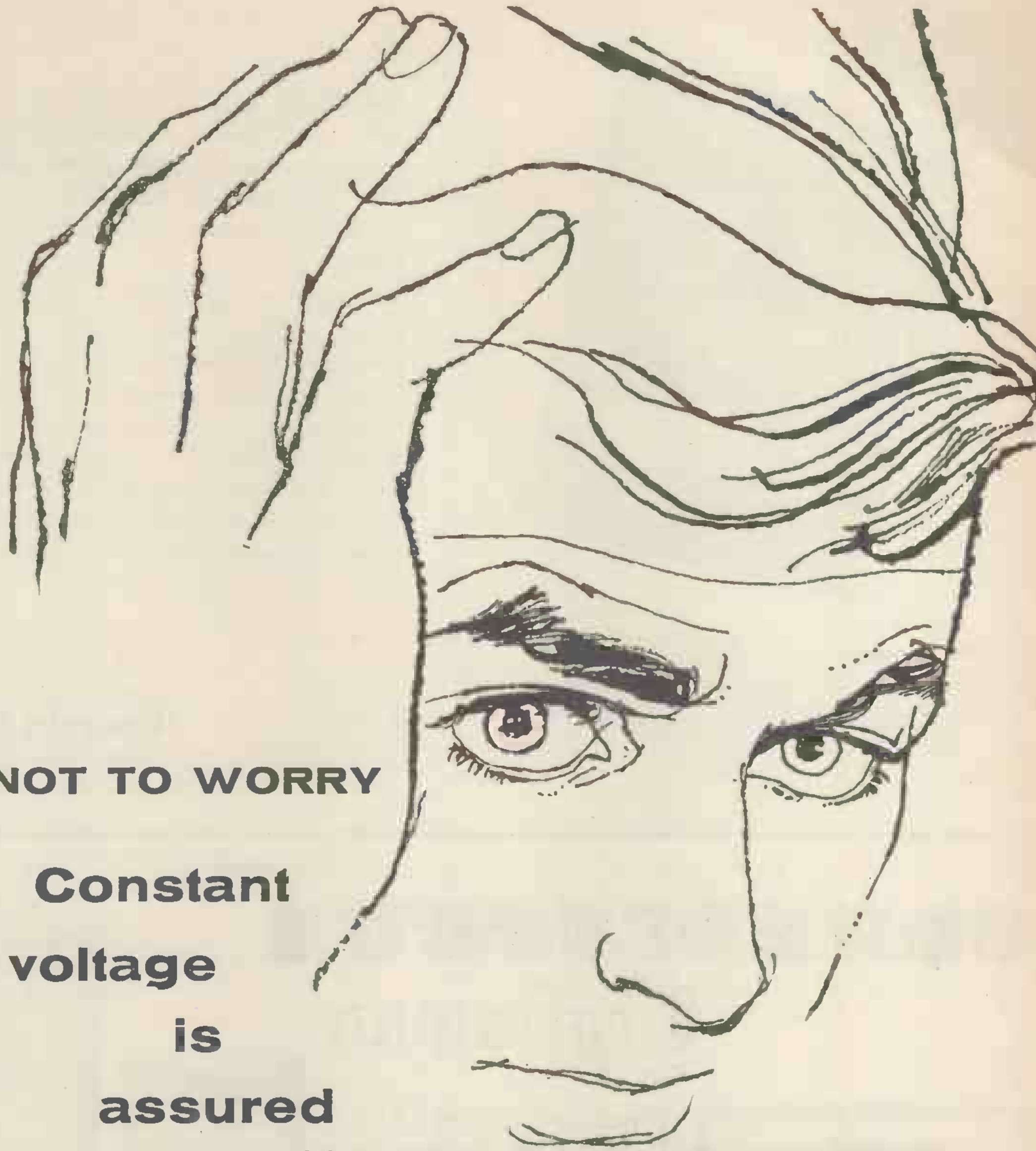
HIRE PURCHASE TERMS OVER 2 YEARS

Model No.	Cash Price	Deposit	24 Monthly of
870A	£33	£6 12 0	£1 5 4
840C	£58	£12 0 0	£2 4 0
888A	£110	£22 0 0	£4 4 4
680X	£140	£28 0 0	£5 7 4
880	£380	Cash Only	

Carriage Paid per Passenger Train.

Most carefully packed to ensure safe delivery.

If payments are completed in 6 months
ONLY CASH PRICE WILL BE CHARGED



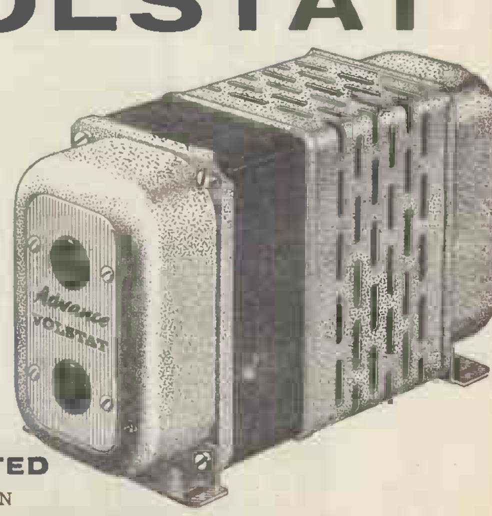
NOT TO WORRY

Constant voltage is assured with a VOLSTAT

A VOLSTAT is the answer to many a.c. voltage fluctuation problems. In most cases, a standard type is all that is required—but there are occasions when a special design may be necessary. Either way an 'Advance' Technical Representative will be pleased to investigate your own particular problems, and recommend a VOLSTAT best suited to your needs.

VOLSTAT stands for a complete range of Constant Voltage Transformers produced by 'Advance'—the leading authority on voltage stabilization.

Full details in Folder D63 available on request.



Advance **COMPONENTS LIMITED**

MAINS STABILIZATION DIVISION

ROEBUCK ROAD · HAINAULT · ILFORD · ESSEX · HAINAULT 4444

SBCV/1

163 Mains transformers for valve and contact-cooled rectifiers, audio output transformers and chokes are fully described in Gardner's new " S/M " Catalogue available on request.

Electrical characteristics, dimensions, weights, fixing centres and prices are fully described in this new publication which includes the latest additions to the Solent range (to BSS 2214 group 10/55) and the high performance but inexpensive " Miniford " range. Typical frequency response characteristics are also given.

Your copy of Gardners " S/M " Catalogue can be obtained now by writing to

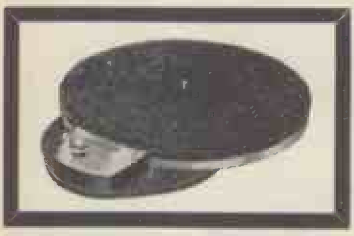
GARDNERS RADIO LTD., SOMERFORD, CHRISTCHURCH, Hants.

Gardners

telephone Christchurch 1734

CONNOISSEUR

Craftsman
SERIES



CRAFTSMAN MOTOR ▲

The Craftsman 2 speed motor finished in matt black and silver. Full 12" turntable. 33⅓ and 45 r.p.m. Synchronous motor, precision ground and lapped shaft, nylon adjustable bearings. Neon on/off light. Price **£19/2/5** inc. tax.

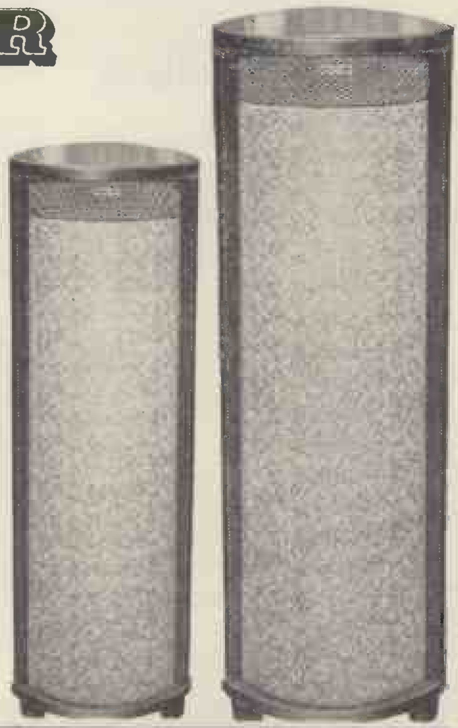
CRAFTSMAN SPEAKER ▶

The new Craftsman Speakers. Maximum performance for monaural or stereo reproduction. New design using vertical space, ideal for small rooms. MAJOR—43" x 14½" dia. complete with 8" and 3" unit, 40-15,000 cycles. Price **£26/8/10** inc. tax. OR—36" x 11½" dia. complete with 8" speaker, 40-12,000 cycles. Price **£16/14/-** inc. tax. Finished Vynair plastic with walnut and black trim.

Please write for LEAFLETS

Also Available

3 Speed Motor
C.S.I. and Mk. III Stereo Pickups
Mk. II Monaural Heads



* **ALL PRICES INCLUDE 10% P.T. SURCHARGE.**

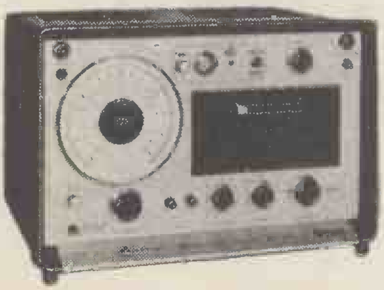
* A R SUGDEN & CO(ENGINEERS) LTD. MARKET STREET, BRIGHOUSE

THE GENERATION OF COMPLEX LOW FREQUENCY WAVEFORMS...

has hitherto been possible only with extensive electronic circuitry—if, in fact, generation was possible at all. Now, with the VLF Function Generator Type SG88, ANY waveshape—mathematical or non-mathematical, no matter how complex or irregular and provided only that it is a single valued function and repetitive—can be generated.

New techniques can be applied to old problems, for the generator can be used in any application necessitating a repetitive cycle of events. Heartbeats, fuel-flow simulation, tidal effects, servo-system tests, load-cycles—

VLF FUNCTION GENERATOR SG88



- 1. Frequency Range: 0.005—50 c/s.
- 2. Output Voltage Range: 200µ V to 22V peak to peak.
- 3. Frequency Calibration Accuracy: ± 1% Full Scale.
- 4. Generation by servo controlled optical mechanical system.
- 5. Automatic frequency sweep facility.
- 6. Direction of rotation and waveform reversible.
- 7. Rapid change of waveform by interchanging glass discs.

Nett price in U.K. £475. 0. 0.

Advance COMPONENTS LIMITED
INSTRUMENTS DIVISION

ROEBUCK ROAD · HAINAULT · ILFORD · ESSEX · TELEPHONE: HAINAULT 4444

SB1/3

TURN YOUR LIVING ROOM into a CONCERT HALL!

The Bird ADD-ON REVERBERATION UNIT

makes music as

LARGE AS LIFE

Added on to your radio, record player or tape recorder, the Bird Reverberation Unit gives concert hall acoustic dimensions to your room. It brings a startling new reality to monaural or stereo reproduction.

19 Gns. Legs 30/- extra

You must have this

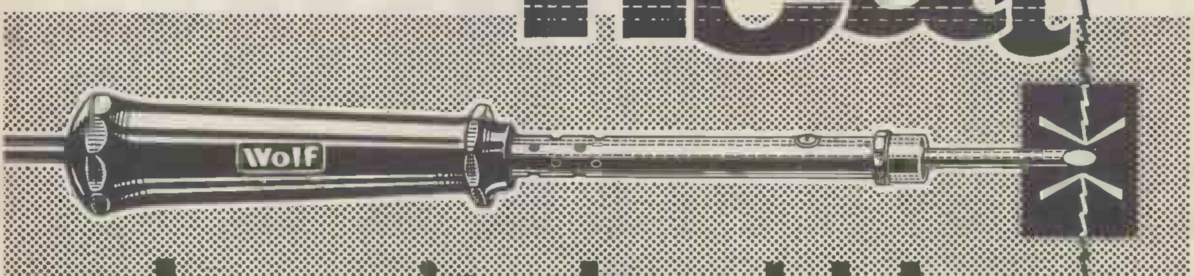
NEW DIMENSION

to your music

ASK YOUR DEALER FOR A DEMONSTRATION

Manufactured by **SYDNEY S. BIRD & SONS LTD., Poole, Dorset**

Heat



where it should be

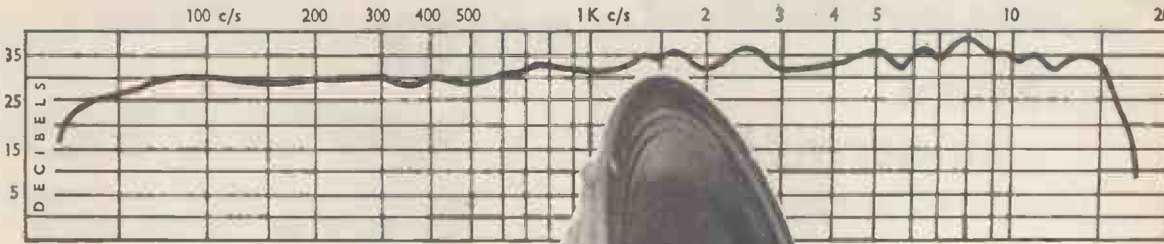
TYPE 92 Take a long, close look at the Wolf 92 Soldering Iron, at the perfect balance, solid construction, quality finish, functional elegance which suggest fast, easy, economical soldering. Try the Wolf 92 on your next job. See how quickly the tip heats up, how the working heat remains constant right through the job. That's because Wolf heating elements put heat where it should be, right at the working tip. You'll do a good job better with the Wolf 92.

SEND FOR FULL DETAILS

Wolf

WOLF ELECTRIC TOOLS LIMITED · PIONEER WORKS HANGER LANE · LONDON · W.5 Tel: PERIVALE 5631 (10 lines)

HEAR AXIOM LEADERSHIP



AXIOM 300 by GOODMANS

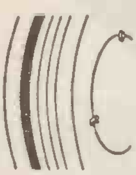
Check the features of the Axiom 300 specification against those of any similar loudspeaker. For final proof — hear the Axiom leadership.

The AXIOM 300 is the most famous 12" Full Range High Fidelity Loudspeaker in the World. Its predecessor, the Axiom 150 Mk II, achieved similar fame in its day. Before that, the Axiom 150. Before that, the Axiom 12...

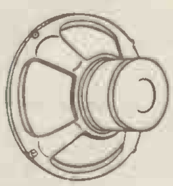
In every case reputation has been built on merit, maintained by consistent production, and enhanced by continuous development. Perhaps the most sincere compliments ever paid to this long line of famous loudspeakers lie in the attempted imitations. There is only one AXIOM series of High Fidelity loudspeakers — with a magnificent tradition and a very long lead in performance and honest value.

SPECIFICATION

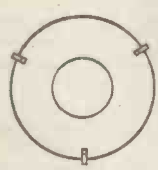
Frequency Range:—30 c/s to 16,000 c/s. See response curve. *Fundamental Resonance:*– 35 c/s. *Power Handling Capacity:*– 15 Watts. *Voice Coil:*—Aluminium, 15 ohms at 400 c/s. $1\frac{3}{4}$" dia. *Magnet System:*– Closed field low leakage. Flux density 14,000 Gauss. Total flux, 158,000 Maxwells. *Construction:*– Entire loudspeaker built into unique Rigidform die-cast chassis. Bass diaphragm vacuum formed controlled edge with plastic termination. Concentrically mounted high frequency radiator, terminated, with automatic mechanical crossover. Dustproof high stability corrugated centering device. Finished in grey hammered enamel. Terminal type connectors.



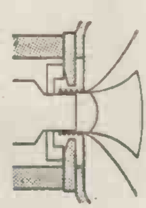
SMOOTH low frequency and mid-range output from vacuum formed controlled edge diaphragm with plastic termination.



STRENGTH of construction is based on a robust cast chassis which ensures permanent alignment of the moving parts.

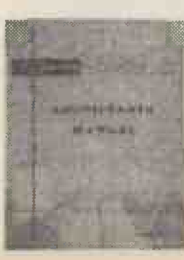


CONTROLLED low distortion output up to 16,000 c/s from specially terminated high frequency radiator, with automatic mechanical crossover.



CLEAN bass and extended H.F. performance from long-throw precision wound aluminium voice coil.

* High efficiency slug type closed field magnet system employing Alcomax III magnet. Precision turned frontplate and pole with heavy protective plating.



GOODMANS INDUSTRIES LIMITED, Axiom Works, Wembley, Middx.

Tel: WEMbley 1200 (8 lines) Grams: Goodaxiom, Wembley, England.

Distributors in most countries including:— *South Africa:* Technical Ind. Services P.O. Box 2652, Cape Town. *Sweden:* A. B. Gösta Bäckström, Ehrensvardsgatan 1-3, Stockholm.

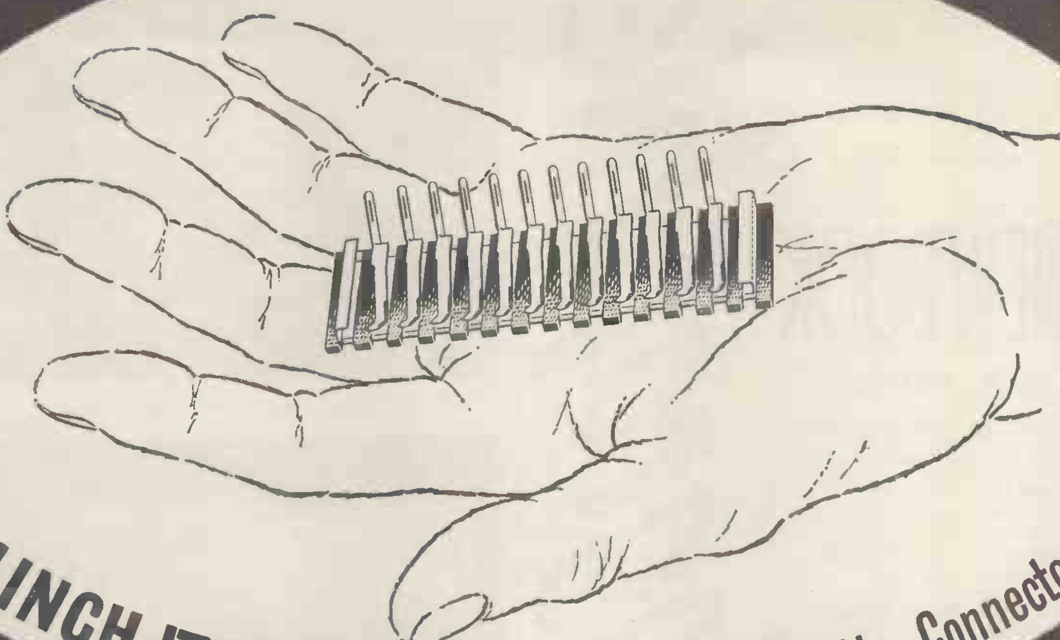
PLEASE SEND HIGH FIDELITY MANUAL

Name ....

Address ....

In every sense the greatest range — in every country the greatest name

G53WW



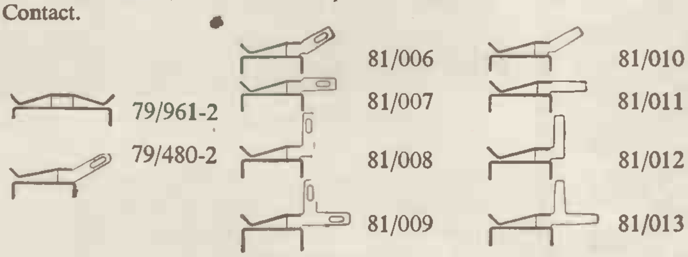
CLINCH IT WITH CINCH Printed Wiring Edge Connectors

FAST, LOW COST ASSEMBLY

SPECIFICATION

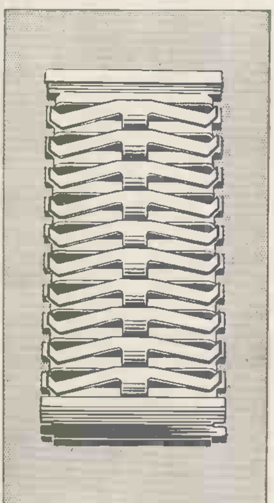
Available in: Any no. of ways up to 40.
Centres: 0.150″ or 0.156″ as specified.
Current rating: 5 Amps per Contact.
Working voltage: 500 V.D.C.
Voltage proof: 2 K.V./D.C.
Contact resistance: $< 5\,m\Omega$ after 1,000 sizings and exposure to DEF.5000 tropical conditions.
Withdrawal force: 4 to 6.5 ozs. per Contact.

Contacts: Phosphor Bronze, finished Gold plate on Silver, Silver or E.T.
Note: 79/480-2 & 79/961-2 Brass only; finish as above.
Laminate: Best quality Commercial Grade, Grade II; Fibreglass to order. (Fibreglass 0.150″ ctrs. only).
End guides: Hard Brass; finish as above.



Tails accept Amp 98 Taper Tab

Tails accept Amp 78 Taper Tab

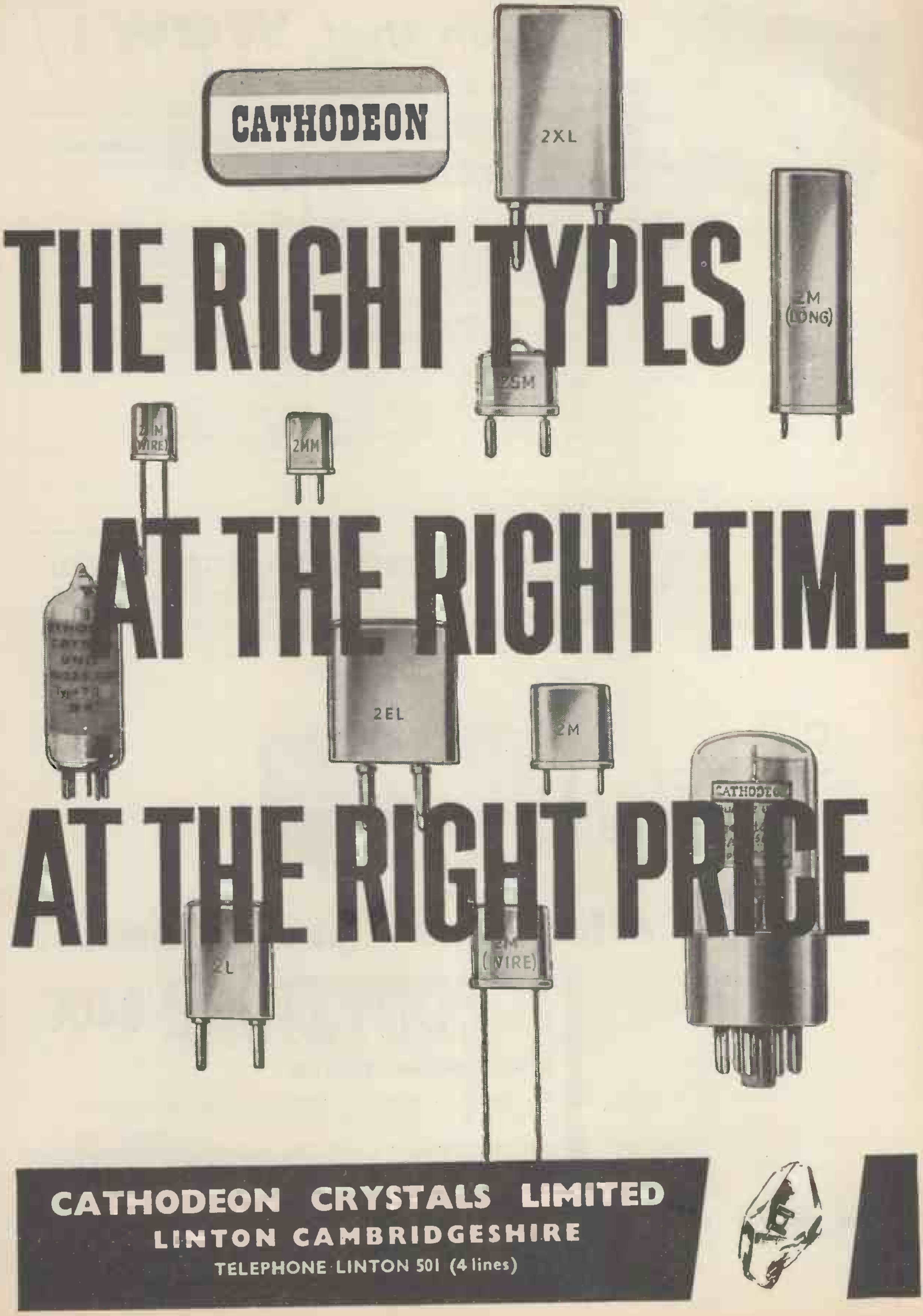


Double Edge Connector using 79/961-2 Contacts

Cinch

Carr Fastener Company Ltd

STAPLEFORD, NOTTINGHAM.
197 GREAT PORTLAND STREET, LONDON, W.1.
(Museum 9361)


CATHODEON
2XL
THE RIGHT TYPES
2M (LONG)
2SM
2MM
AT THE RIGHT TIME
2EL
2M
AT THE RIGHT PRICE
2L
2M (WIRE)
CATHODEON CRYSTALS LIMITED
LINTON CAMBRIDGESHIRE
TELEPHONE LINTON 501 (4 lines)

Watch that WOW!

with the Gaumont-Kalee FLUTTER METER

Accurate measurement of sound equipment speed deviations

Gaumont-Kalee Fluttermeter Type 1740

Brief Technical Data

Operating carrier frequency 3,000 c.p.s. ±5%
Minimum Input Signal 50 mV R.M.S.
Input. Impedance 1 Megohm.
Input amplifier bandwidth —3db at 2,500 and 3,500 c.p.s.
Effective limiter range ± 10dB.
Meter scaling—" Peak wow " 0 to ±1% (centre zero).
" Wow " and " Flutter " 0 to 1% and 0 to 0.2% R.M.S.
Crossover frequency 20 c.p.s.
" Flutter " meter response —3db at crossover. —3dB at 200 c.p.s.
" Wow " meter response —3dB at crossover. —1dB at 0.5 c.p.s.
C.R.O. output frequency response level down to zero frequency—3dB at 200 c.p.s.
3,000 c.p.s. oscillator output level.
5V R.M.S. into 0.5 Megohm 100 mV R.M.S. Into 500 ohms. %
Accuracy: Meter presentations ±2% f.s.d.
Power consumption 35 watts.
Mains 100/150v. and 200/250v.
Single phase 45/60 c.p.s.

The Flutter Meter measures those components which are commonly described as " Wow " and " Flutter " resulting from speed variations in sound recorders and reproducers. This instrument is equally suitable for use with machines employing perforated film, tape, wire or disc records.

Type 1740 is of entirely new design. More compact, lighter in weight and costing considerably less than earlier Gaumont-Kalee Flutter Meters, but with the same high performance and facilities.

Dimensions: Height 10¼in. 26.04 cm. Width 12¼in. 31.12 cm. Depth 14⅜in. 36.47 cm.
Nett Weight: 29lb. 13.15 Kilos.
Write for full details to:

IMPORTANT USERS OF GAUMONT-KALEE FLUTTER METERS INCLUDE:

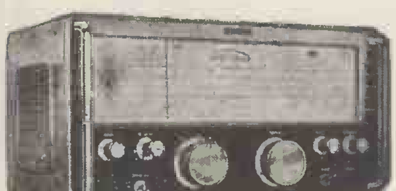
B.B.C. Television and Research.
Birmingham Sound Reproducers Ltd., (England).
Collaro Ltd.
Commission Superieure Technique, Paris.
Commonwealth of Australia, Melbourne.
Compagnia Commerciale di Cinematografia, Milan.
Dept. Posts and Telegraph, Dublin.
Egyptian State Broadcasting.
E.M.I. Research Laboratories.
Garrard Engineering and Manufacturing Co. Ltd.
Magnavox Corporation of U.S.A.
Marconi Wireless.
Ministry of Supply (U.K.).
Ministry of Transport and Civil Aviation (U.K.).
Mullard Ltd.
N.V. Philips' Gloeilampenfabrieken, Holland and Denmark.
N.Z. Broadcasting System.
Post Office Research Department.
R.C.A. Photophone Ltd.
Southern Instruments Ltd.
Truvox Ltd.
Vortexion Ltd.
Westrex Co. Ltd.
Wright & Weaire Ltd., and users in India, Poland and Hong Kong.

RANK PRECISION INDUSTRIES LTD

G.B.-KALEE DIVISION (STUDIO), WOODGER RD., LONDON, W.12, ENGLAND

Tel: SHEpherds Bush 2050. Cables: RANKPRESTU, LONDON

. . . a receiver that tunes with silky effortless precision . . .



THE NEW EDDYSTONE '840C'

COMMUNICATIONS RECEIVER

Five bands cover 480 Kc/s to 30 Mc/s with accurate logging and re-setting by precision type 130-1 ratio drive.

PRICE £58

THE " 840C " IS BUILT LIKE A PIECE OF LABORATORY EQUIPMENT, and handles and performs similarly. Available immediately from stock at WEBB'S.

BROCHURE POST FREE ON REQUEST

WEBB'S RADIO

14 SOHO STREET, OXFORD STREET, LONDON, W.1.

Tel: GERrard 2089/7308 *Shop Hours 9-5.30 (Thursdays 7 p.m.) Saturday 9-1 p.m*

PYE

Portable and Fixed Station Equipment for

MICROWAVE TELEVISION LINKS

For the transmission over long distances of complete television programmes via a number of links, the Pye P.T.C. M1000 equipment provides portable or fixed units for simultaneous radiation in the microwave band of vision and audio signals. Effective communication can be maintained over 50 miles or more per link, with only one watt of power. Frequency ranges are available between 5925 Mc/s and 7500 Mc/s, with excellent frequency stability. In portable form each unit is conveniently carried in luggage type cases and is easily assembled on site. Adaptors for 19-inch rack mounting are available for fixed station applications.

PYE TELECOMMUNICATIONS LTD., CAMBRIDGE, ENGLAND

The Superspeed Soldering Iron

heats up from cold in 6 seconds

Designed on an entirely new principle, this lightweight, versatile iron is eminently suitable for soldering operations in the radio, television, electronic and telecommunication industries. For test bench and maintenance work it is by far the most efficient and economical soldering iron ever designed.

Length, 10"; weight, 3½ ozs.

For best results with this iron use ENTHOVEN SUPERSPEED CORED SOLDER and ALUMINIUM CORED SOLDER

- **Activated by light thumb pressure on the switch ring. When pressure is released, current is automatically switched off—thus greatly reducing electricity consumption, wear on copper bit and carbon element.**
- **Can be used on 2.5 to 6.3 volt supply (4 volt transformer normally supplied) or from a car battery.**
- **More powerful than conventional 150-watt irons; equally suitable for light wiring work or heavy soldering on chassis.**
- **Simple to operate; ideal for precision work.**
- **Requires minimum maintenance—at negligible cost; shows lowest operating costs over a period.**

LIST PRICES	
IRON	39/6
TRANSFORMER	35/6
All prices and trade discounts subject to revision	

ENTHOVEN SOLDERS LTD.
(Industrial Equipment Division)
Sales Office & Works :
Upper Ordnance Wharf, Rotherhithe Street, London, S.E.16. Tel.: BERmondsey 2014.
Head Office :
Dominion Buildings, South Place, London, E.C.2. Tel.: MONarch 0391

TRUVOX SERIES 80

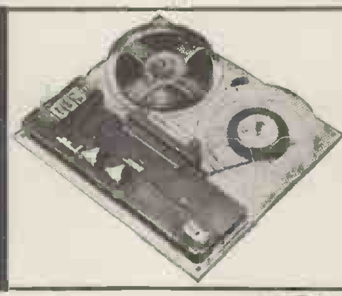
TAPE DECKS and PRE-AMPS

"Technically Luxurious"

Model PD 82. Tape Deck and Pre-amp. Two track mono.

Model PD 84. Tape Deck and Pre-amp. Four track mono-stereo.

Complete in attractive cabinet. Full technical specification freely available.



Model D 82
Twin Track Tape Deck.

Model D 84. 4-track Deck with mono-stereo switch fitted. Two speeds 7½ and 3¾ i.p.s. Pushbutton controls with perfect interlock. Pause control. 7in. spools. Digital counter.

Instant mechanical brakes. Independent speed change wheels automatically disengaged in "off" position. Three motors, heavy balanced flywheel, silent running fast rewind.

Technically luxurious, the precise construction and finish of these new Truvox Decks, Hi-Fi Units,* and complete recorders, ensure an outstanding performance. Note that wow and flutter is better than .15% at 7½ and .2% at 3¾ i.p.s. Brilliantly designed new heads provide a response from 40-20,000 c.p.s. Decks are tropicalised and available in all voltage ranges. Auto stop and "trick" switch available as optional extras.

**Comprises: Deck, Record Amplifier, Play-back pre-amplifier, mounted in attractive plinth for easy connection to your equipment.*

Full technical specification and details from:

TRUVOX LIMITED
Neasden Lane, London, N.W.10.
Telephone: Dollis Hill 8011

LITTLE SHORT OF REVOLUTIONARY

THE

DECCA Deram

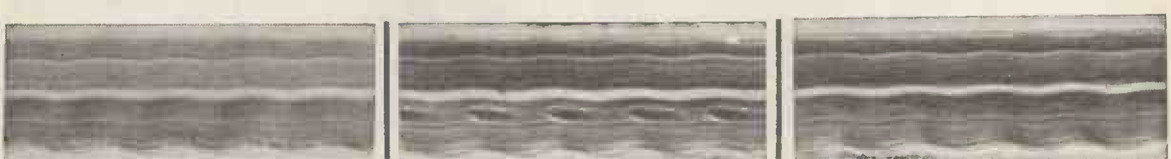
MICROGROOVE 'CERAMIC' CARTRIDGE

fitted with diamond stylus for stereo or mono microgroove records

'I have no doubt that the production of this cartridge will dominate the domestic stereogram market for years to come.'

Percy Wilson, THE GRAMOPHONE

Micrographs of a groove recorded with a 10 Kc signal taken from three copies of the Decca stereo frequency test record SXL 2057



UNPLAYED	AFTER ONLY ONE PLAYING with an average-priced cartridge as fitted to many present-day stereograms of various makes	AFTER 250 PLAYINGS WITH THE DECCA DERAM

THE DECCA DERAM DOES LESS DAMAGE AFTER 250 PLAYINGS THAN THE AVERAGE CARTRIDGE IN CURRENT USE DOES AFTER ONLY ONE

The Decca Deram has a tip mass of 1 milligramme (at 45°); its compliance is 6 x 10^{-6} cms/dyne (lateral) and 3·5 x 10^{-6} cms/dyne (vertical); its output is sufficient for amplifiers of 100 mV sensitivity; crosstalk is better than — 20 db at 1 Kc.

Retail price: **4 GNS.** tax paid

a 78 rpm cartridge is also available at 3 gns. tax paid

TRADE ENQUIRIES WELCOMED

DECCA RADIO AND TELEVISION INGATE PLACE QUEENSTOWN ROAD LONDON SW8

Hewlett-Packard
Oscilloscopes DC-1000 MC

Model 185 A/187 B – DC to 1000 MC
Completely new circuit approach permits viewing – on a bright 5"-cathode-ray tube – of repetitive short pulses requiring a bandwidth up to 1000 MC. Rise time of less than 0.45 millimicroseconds permits direct measurement and observation.
Sensitivity is 10 mV/cm to 200 mV/cm, horizontal sweep times 0.1 to 100 millimicroseconds/cm.
Price 185 A £ 800
187 B £ 400

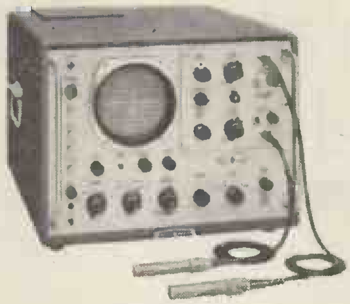


Photo 185 A

Model 150 A – DC to 10 MC
Broadly useful, high quality; has many plug-in amplifiers providing dual trace or differential input, voltage/current dual channel comparison, or high amplification eliminating preamplifiers between the oscilloscope and most transducers.
Sensitivity 200 mV/cm to 15 V/cm, horizontal sweep times 0.1 μsec/cm to 5 sec/cm.
Price 150 A £ 520
(Plus Plug-in Amplifiers)


Photo 150 A

Model 130 B / BR* – DC to 300 KC
Highest quality, low-frequency oscilloscope. Includes universal automatic trigger.
Similar horizontal and vertical amplifiers with sensitivity 1 mV/cm to 125 V/cm.
Horizontal sweep times 1 μsec/cm to 12.5 sec/cm.
Includes times-5 magnifier.
Price £ 260

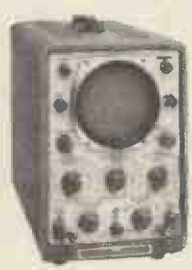


Photo 120 A

* Letter "R" indicates rack-mount instrument available.

Model 160 B / BR* – DC to 15 MC
Militarized instrument meeting U.S.A. military standards for shock, vibration, humidity, temperature.
Maximum vertical sensitivity 20 mV/cm, horizontal sensitivity 0.1 V/cm to 10 V/cm.
Horizontal sweep times 0.1 μsec/cm to 5 sec/cm in 24 ranges. Times 100 magnifier increases fastest sweep to 5 sec/cm.
Dual trace operation.
Price £ 740
(Plus Plug-in Amplifiers)

Model 122 A / AR* – DC to 200 KC
Dual trace, moderately priced instrument presents two separate traces simultaneously, or single trace when desired. Twin vertical amplifiers.
Sensitivity 10 mV/cm to 100 V/cm, sweeps 5 μsec/cm to 200 μsec/cm; expander extends range to 1 μsec/cm.
Universal automatic trigger.
Price £ 270

Model 120 A / AR* – DC to 200 KC
Industrial and production as well as laboratory instrument. Has universal automatic trigger, automatic synchronization on any internal or external voltage.
Sweep speeds 5 μsec/cm to 0.5 sec/cm, times-5 sweep expander, high sensitivity calibrated vertical amplifiers.
Regulated power supplies; steady, drift-free traces, ideal for photography.
Price £ 180

Many world-famous Hewlett-Packard laboratory instruments are now made in the new Hewlett-Packard GmbH plant at Böblingen, near Stuttgart. Here quality engineering and latest manufacturing techniques bring you instruments of exceptional performance at moderate price.

Prices delivered U. K. exclusive of duty where payable. Continuous progress in design may affect the above specifications which are therefore subject to change without notice. For information, technical sales and engineering help, or a demonstration please write or call

Hewlett-Packard S.A.
Geneva (Switzerland) Rue du Vieux-Billard 1, Tel. (022) 26 43 36
Exclusive Distributor for United Kingdom:
LIVINGSTON LABORATORIES LTD.
31, CAMDEN ROAD, LONDON, N.W.1
Telephone: GULliver 8501 (10 lines)
HPSA-3A-412

hp leads the way

NEW LOOK from DULCI

An entirely new range of Stereo/Mono Amplifiers, Pre-amps., AM/FM tuners and an R.G. Chassis that will satisfy the most critical enthusiast from every point of view. Stylish finish, performance, construction and simplicity of installation maintain the rigidly high standards that have always been the hall-mark of all DULCI Equipment.

STEREO FIVE

Twin Channel Pre-amplifier for high fidelity Stereo/Mono reproduction of sound from radio, pick-up or tape.

Input: There are phono sockets for all inputs at rear.

	Sensitivity (*for stated output*)	Impedance
(i) Radio ..	100mV	250 K-ohms
(ii) Pick-up ..	50mV–2V adjustable	1 Megohm
(iii) Tape ..	100mV	250 K-ohms

Independent Bass and Treble controls; separate balance control; distortion factor better than 0.1%; Hum and Noise better than −60db on all channels; Power supply through multi lead cable terminated in Octal Plug; Finish: Front panel, black and matt silver; Case, cadmium plate grey hammer stove enamelled. Front panel size 12¾ × 3⅜in. (aperture 12¼ × 2¾in.). Overall depth 5in. Weight 4lb.

Retail Price **11 gns.**

For low sensitivity pick-ups Model Stereo Five has facilities for the attachment of two type TA6 transistor amplifiers which will give a pick-up sensitivity greater than 5mV. The input impedance with this amplifier is then 75 K/ohms. The radio and tape sensitivities remain at 50mV.

TA6 Amplifiers.

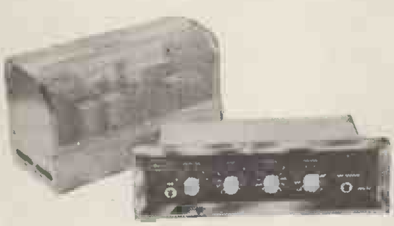
Price each **4 gns.**

MODEL SP55

Twin Power-amplifier

Consisting of two identical power-amplifiers with a common power supply. Designed for stereo application, to operate in conjunction with a "Stereo Five" pre-amplifier control unit. Great care has been taken to match both amplifier sections for identical performance to close limits. Mains: 200-250V A.C. 40-60 c.p.s. Consumption 60 watts; Output: Power, 8-watts peak (4-watts per channel); Loudspeaker matching: 3-5 and 12-16 ohms adjustable; Frequency response: ±1db from 40-25,000 c.p.s.; Feedback: −15db from output transformer secondary; Hum and Noise: −70db; Distortion factor: Better than .5% total harmonic content; Input sensitivity: 200mV for 3-watt output per channel; Connections: Input, two phono sockets. Octal socket for pre-amplifier and remote mains switching. Loudspeaker: screw terminals. Mains: 6ft. 3-core cable. Finish: Cadmium plated steel chassis passivated and silver grey hammer stove enamelled. Dimensions: 11½ × 6 × 5⅜in. high overall.

Retail Price **15 gns.**



MODEL DPA-15 MONO AMPLIFIER

A superb high-fidelity laboratory-designed amplifier for domestic use or in assembly halls holding up to 500 people. The DPA-15 incorporates every facility needed for enjoyment of high quality sound from radio, record, tape or microphone with a range of features and versatility rarely combined in any equipment. A pre-amp. and control unit is required. Mains supply: 200-250V. A.C. Output: 15 watts. Impedance: 3 ohms, 7½ ohms, or 15 ohms. Dimensions: 11½ × 6 × 7½in. Weight: 13 lb. 4oz.

Retail Price **15 gns.**

MODEL DPA-15 MONO PRE-AMPLIFIER

The perfect component for the DPA-15 Amplifier. It possesses all features normally associated with equipment of this very high calibre. Every facility for high quality reproduction of sound from radio, record, tape and microphone. Power supply: Through multi-lead cable terminating in octal plug. L.T. 6.3V. A.C. 0.8 amp. H.T. 250V. D.C. 2.5mA. Dimensions: 12¼ × 3¾ × 4½in. behind front panel. Weight: 2 lb. 14 oz.

Retail Price **9 gns.**

MODEL GA505

Sterephonic Amplifier with built-in pre-amp. for use on 200-250V. 40-60 cycles (A.C. only). Three inputs per channel for p.u., radio and tape; Output 5 watts per channel. Frequency response substantially level between 40-16,000 c.p.s. Output impedance 3 and 15 ohms; Controls: Combined bass, combined treble, twin concentric balance and volume control; Front panel: Black and matt silver (12¾ × 3¾in.). Cut-out required 3 × 12¼in. Depth 7⅝ + 2¼in. for transformer projection.

Retail Price **18 gns.**

MODEL GA5

Similar in appearance to model GA505.

A high quality amplifier with built-in pre-amp., for use on 200-250V. 40-60 cycles (A.C. only). Suitable for shelf standing or building into cabinet (brackets and feet supplied). Three inputs for p.u., tape and radio, 5 watt output. Frequency response substantially level between 40-16,000 c.p.s. Front panel: Black and matt silver (12¾ × 3¾in.). Aperture required 3 × 12¼in., depth 4¾ + 2¼in. for transformer projection. Output impedance 3 and 15 ohms. Retail Price **£13.2.6**

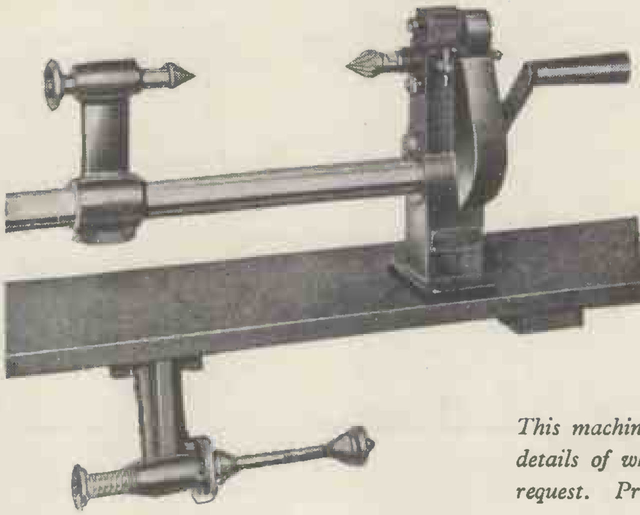
See your local stockist for full details of these models plus Hi-Fi R.G. Chassis and AM/FM Tuners, or direct from

LEE PRODUCTS (Gt. Britain) LTD.

Elpico House, Longford Street, London, N.W.1

Telephone: BIShopsgate 6711 (all lines)

THE KOLECTRIC TYPE RH/1 HAND COIL WINDING MACHINE

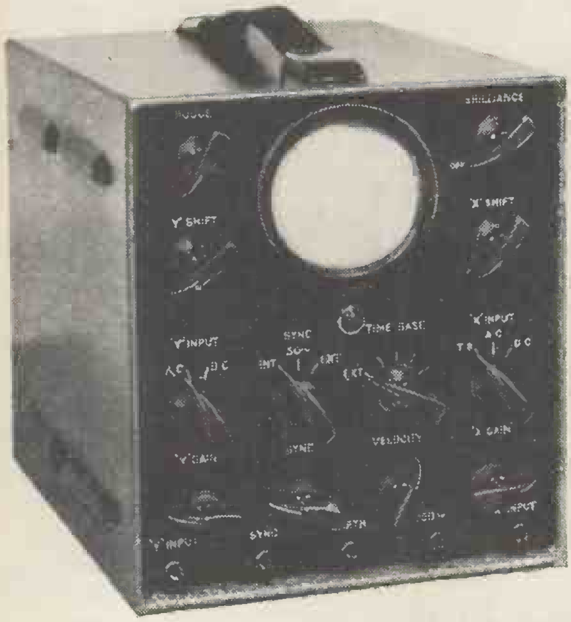


A substantially built Machine suitable for winding wire from 14 S.W.G. (0.080") upwards to the finer wire gauges.

A sturdy detachable winding handle is provided and two winding ratios are provided: 1-1 and 4-1.

This machine possesses many outstanding features, full details of which, together with prices, are available on request. Prompt delivery.

KOLECTRIC LTD 73 UXBRIDGE ROAD, EALING, LONDON, W.5 Ealing 8322



Model 1200B. For A.F. and low R.F. applications. Sensitivity 100mV/cm. B/W D.C. to 100Kc/s. C.R. Tube 2¾in. diam.
£35 10 0

Model 2300. Light-weight Portable. B/W D.C. to 2.5 Mc/s Sensitivity 50mV/cm. C.R. Tube 2¾in. diam. Dims.: 7½x4¾x 7½ins.
£39 10 0

write for full details of

OSCILLOSCOPES

SONTRANIC LIMITED

FORUM WAY · EDGWARE · MIDDLESEX · *TELEPHONE EDGWARE 6020 — 3736*

No. 4 IN THE SERIES

Technical Information for the Transistor Circuit Designer

Thermal Runaway

The maximum temperature at which a circuit will operate is not always determined by the maximum power rating of the transistor but by its thermal stability in the circuit. The thermal stability of the circuit depends partly on the stability factor which was discussed in an earlier note in this series.

What, then, does the circuit designer want to know?

(1) Given the maximum ambient temperature and power dissipation, he will want to know the stability factor.

(2) Given a maximum ambient temperature, he will want to know the power he can dissipate for a given stability factor.

(3) Given the dissipation and stability factor, he will want to know the maximum ambient temperature for safe operation.

For case (1) when the junction temperature (i.e. the ambient temperature and dissipation) and the value of I_{CBO} at that temperature are known, the expression for the stability factor is relatively simple:—

$$S < \frac{1}{V\theta K I_{CBO}} \qquad \text{(1)}$$

where S is the stability factor (defined in No. 3 of this series).

V is the voltage

θ is the thermal resistance of the transistor (in a heat sink if used)

K is a constant$=\dfrac{\log_e 2}{T_D}$

where T_D is the temperature change to double or halve I_{CBO}. (K is typically of the order of 0.07 to 0.09 for germanium)

I_{CBO} is the value of the leakage current at the *appropriate junction temperature* T_j,
and $T_j = T_{amb} + P_D\theta$

where P_D is the total device dissipation.

For case (2) the maximum allowable power dissipation is:

$$P_D < \frac{1}{\theta}\left(T_R - T_{amb} + \frac{2{\cdot}3}{K}\log_{10}\frac{1}{KSV_C\,\theta\,I_{CBO}}\right) \qquad \text{(2)}$$

For case (3) the maximum permissible ambient temperature is:

$$T_{amb} < \left(T_R - P_D\theta + \frac{2{\cdot}3}{K}\log_{10}\frac{1}{KSV_C\,\theta\,I_{CBO}}\right) \qquad \text{(3)}$$

where T_R is some reference temperature (usually 25°C) at which the value of I_{CBO} used in (2) and (3) above is known.

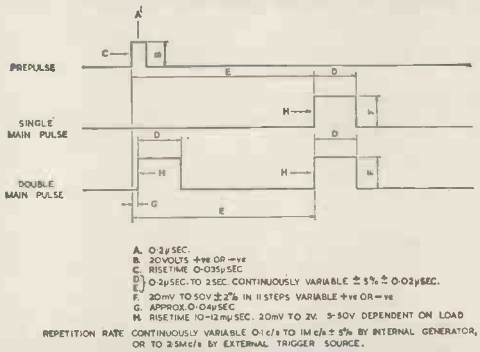
It is clear that the thermal stability can be improved by having a lower value of supply voltage and a more effective heat sink. In estimating the thermal stability, one should always consider the case of those transistors which have the highest values of I_{CBO}.

Of course, the above is subject to individual temperature, power and voltage ratings, given in the data sheet, not being exceeded.

STC TRANSISTOR TYPE	TK 20C	TK 23C	TK 25C	TK 28C	TK 30C	TK 31C	TK 40C	TK 41C	TK 42C
Max. I_{CBO} at 25°C (μA)	5	5	5	5†	5	5	5	6	6
Max. I_{CBO} at 60°C (μA)	30†	50†	30†	30†	30†	30†	50†	50†	50†
K	0·05 *	0·087	0·05 *	0·05 *	0·05 *	0·05 *	0·087	0·087	0·087

*Note that the value of K for a typical transistor is higher than that for a limit transistor and is about 0·077. †95% limit.

Your Laboratory is not complete without it . . . .



The Nagard wide range pulse generator fast rise time, accurate pulse shape, reliable calibration and wide range of pulse dimensions make this an invaluable standard test instrument

Some of the applications are:—
Setting up—Attenuators and Amplifiers, Delay lines, Calibrating oscilloscopes, Analogue and Digital Computers
Measurement of—Response times, Paralysis of amplifiers, Time intervals, Amplitude comparisons.

As an originator of accurate pulses
for modulation, simulation, and testing of various pulse driven devices it is unequalled.

The internal rate generator
provides consistently accurate frequencies over a range of 0.1 c/s to 1 Mc/s or to 2 Mc/s when set to double pulse operation.

The output amplitudes
are accurate within 2% and may be easily calibrated to better accuracies for specific tests.

THERE ARE TWO MODELS:—
TYPE 5002A—Pulse width range 0.1 μsec. to 1 sec now standard.
TYPE 5002 — „ „ „ 0.2 μsec. to 2 sec. to special order.

IMMEDIATE DELIVERY—NOW AVAILABLE EX STOCK
DATA SHEET No. 1060 GIVES FULL DETAILS

NAGARD LTD
18 AVENUE ROAD, BELMONT, SURREY
TEL: VIGILANT 9161-2-3

SPECIAL OFFERS!

BRAND NEW SPEAKERS. Individually boxed. All 3-5 ohms. "Goodmans" 6" x 4", 13/-; 7" x 4", 13/6; 8" x 5", 16/6; 10" x 6", 21/6. "Rola" 7" x 4", 13/6. P. & P. 2/3 each speaker.

DENCO 3-4 WATT AMPLIFIER. For P.U., tape or mike. Complete in hammer gold finish case. ONLY 4 gns. P. & P. 4/-.
BATTERY CHARGERS. 2 amp. 6-12 v. Brand new and boxed, Meter, etc. 49/6. P. & P. 4/-.
HEATER TRANSFORMER. 6.3 v. 3 a. Fully impregnated. 8/6. P. & P. 2/6.
TELESCOPIC AERIALS. For portables. 8/6. P. & P. 1/-.
PARMEKO MAINS TRANSFORMER. Primary 200-250 v. Secondary 350-0-350 v. 70 mA. 6.3 v. 3 A. CT., 6.3 v. 3 A., 6.3 v. 1A. "C" Core, fully impregnated. 50/-. P. & P. 4/-.
GRAM/TAPE DECK MOTORS. By famous maker. 200/250 v. 19/6 each. P. & P. 2/6.
COLLARO "STUDIO" TAPE DECK. Brand new in original maker's carton. 3 speeds, twin track. 7in. spools, press button controls. ONLY £12/10/-. P. & P. 5/6.
B.B.C. T.V. BAND I. PRE-AMPLIFIER. New and boxed with 6F12 valve. ONLY 15/6. P. & P. 2/-.
PNEUMATIC LID STAY with pressure adjuster. Heavy duty, 10/- complete. P. & P. 2/-.

SWITCHES FOR MULLARD

TR2.	2 valve pre-amp.	Selector	12/9
TR3.	3 valve pre-amp.	Selector	12/9
TR4.	3 valve pre-amp.	Low-pass Filter	10/9
TR5.	3 valve pre-amp.	High-pass Filter	8/4
TR6.	3 valve Tape amp.	Record/Playback	16/6
TR7.	3 valve Tape amp.	Equaliser	7/4
TR8.	Tape pre-amp.	Record/Playback	16/6
TR9.	Tape pre-amp.	Equaliser	7/4
TR10.	Stereo pre-amp.	Selector	18/6
TR11.	Stereo pre-amp.	Channel earthing	9/6
TR12.	Stereo pre-amp.	Stereo/Mono	9/6

Please add P. & P. 1/- per switch.

ROTARY WAFER SWITCHES

A.B. Metal and N.S.F. Made to order. Price list free on request.

"BELLING LEE" COMPONENTS

Full range in stock including Unitors, Screenectors, etc. Send us details of your requirements

STEEL METER CASES

	£	s.	d.
4 x 4 x 4in. Sloping Front		10	6
5 x 5 x 8in. Sloping Front		16	0
6 x 6 x 12in. Sloping Front	£1	5	6
4 x 4 x 2½in. Rectangular		8	6
6 x 4 x 3in. Rectangular		10	0
8 x 6 x 3in. Rectangular		12	6
10 x 6 x 2½in. Rectangular		14	6
10 x 7 x 7in. Alum. Panel	£1	7	6
12 x 7 x 7in. with Alum. Panel	£1	14	0
14 x 7 x 7in. with Alum. Panel	£1	17	6
14 x 9 x 8in. with Alum. Panel	£2	7	6
16 x 9 x 8in. with Alum. Panel	£2	12	6
16 x 11 x 8in. with Alum. Panel	£2	17	6
19 x 8 x 11in. with Alum. Panel	£3	4	0
19 x 11 x 10in. with Alum. Panel	£3	6	0

ALSO FULL RANGE OF CHASSIS
Chassis and Case List Free on request.

LARGE STOCKISTS OF COMPONENTS & EQUIPMENT
By well-known Manufacturers including: ● A.B. METAL PRODUCTS ● AVO ● BELLING-LEE ● BULGIN ● COLVERN ● DUBILIER ● ERIE ● MORGANITE ● MULLARD ● PAINTON ● WELWYN ● T.C.C. ● WESTINGHOUSE.

JASON CONSTRUCTIONAL KITS
Complete range in stock

For the Hi-Fi Enthusiast!

OUR NEW DEMONSTRATION ROOM

Incorporates the latest High Fidelity equipment! Sincere advice and courteous service are just two reasons why Tele-Radio (1943) Ltd. is the choice of the High Fidelity enthusiast.

Stockists of ● Acoustical ● Decca ● Ferrograph ● Garrard ● G.E.C. ● Goodmans ● Jason ● Leak ● Rogers ● Tannoy ● Vortexion ● Wharfedale, etc., etc.

- *Immediate dispatch of goods available from stock.*
- *Carriage charged extra at cost.*
- *Goods sent to all parts of the world.*

TELE-RADIO
(1943) LTD.

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

Telegrams: Goahead, London, W.2 ● Our only address
Few mins. from Marble Arch ● Open all day Saturday

an absolute practical minimum of wow and flutter

That has been one of our main objectives since we started making tape decks and recorders and we feel that we have achieved this (along with many other notable features) in our present range of recorders. By the use of high quality components and fastidious precision assembly these "wow and flutter" figures are maintained:—

Below .05% at 15 ips
Below .1% at $7\frac{1}{2}$ ips
Below .15% at $3\frac{3}{4}$ ips
Below .25% at $1\frac{7}{8}$ ips

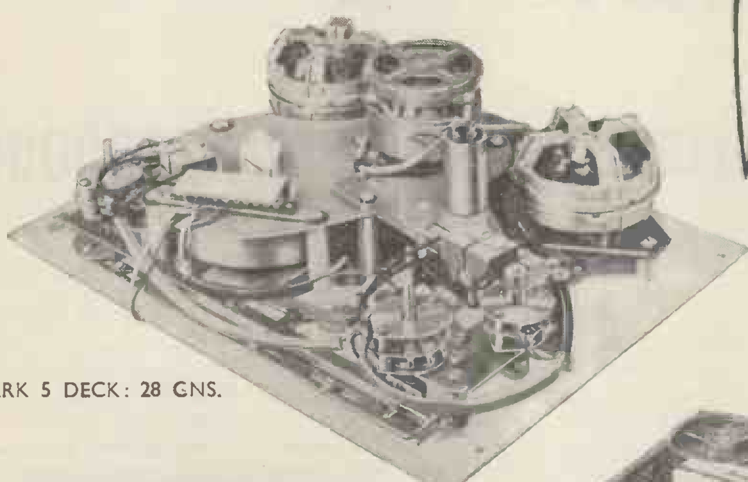
The Brenell Mark 5 deck at 28 gns. has greater precision and dependability than you are ever likely to find elsewhere at anywhere near the price.

IT'S A HEART THAT IS AS SOUND AS SOUND CAN BE.

Abridged Specification:

3 INDEPENDENT MOTORS (Capstan motor-hysteresis synchronous)
4 RECORDING AND PLAYBACK SPEEDS, $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 ips.
FAST REWIND (1,200ft. rewound in either direction in 45 secs)
ACCEPTS $8\frac{1}{4}$in. reels. INTERLOCKED CONTROLS PAUSE CONTROL. DIGITAL REV. COUNTER PROVISION FOR EXTRA HEADS (Mono or Stereo)

TAPE RECORDERS: MARK 5 STEREO: £99.12.0.
3 STAR: 58 GNS.
3 STAR STEREO: 89 GNS.



MARK 5 DECK: 28 GNS.

MARK 5 TYPE M: 88 GNS.

MARK 5: 64 GNS.

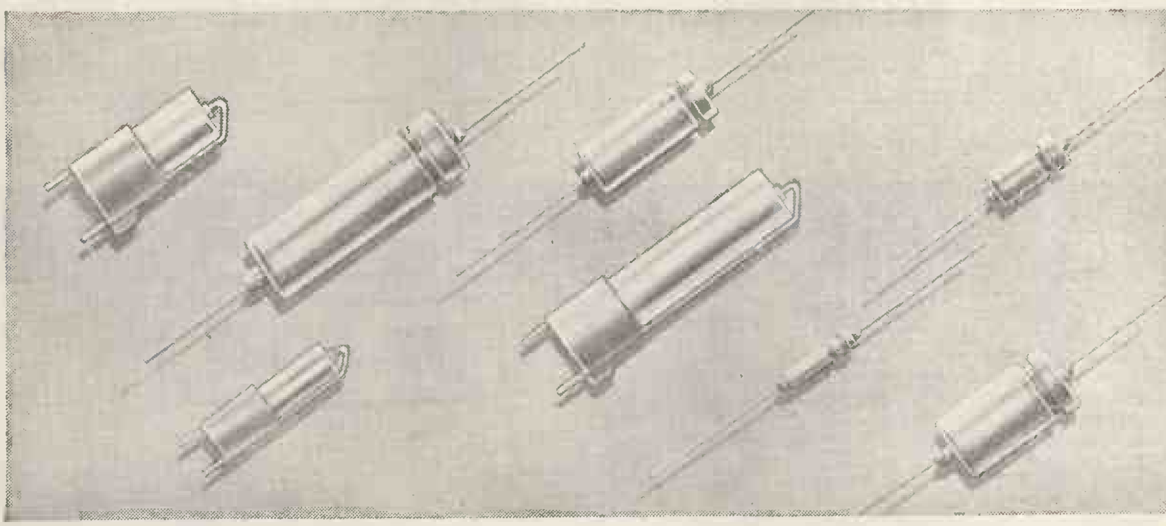
Brenell

Full details and the address of your nearest stockist from the sole manufacturers:— **BRENELL ENGINEERING CO. LTD.**
1A DOUGHTY STREET, LONDON, W.C.1. CHA 5809 and HOL 7358

GD821

Mullard
MINIATURE ELECTROLYTIC CAPACITORS

designed for peak performance and economy....



Literature and full technical details are available on request to Mullard House

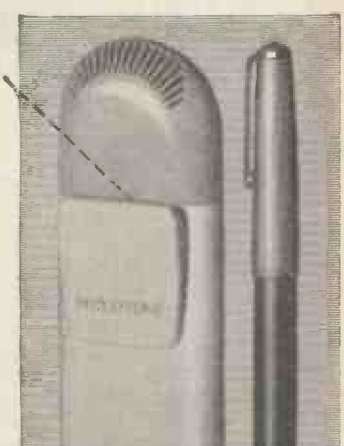
- High quality
- Comprehensive range
- Small physical size
- High capacitance x voltage product
- Low series resistance
- Close production quality control
- Cost saving

MULLARD LIMITED · COMPONENT DIVISION · MULLARD HOUSE · TORRINGTON PLACE · LONDON WC1

MC 4285

Pocket Paging PAYS!

The lightweight receiver, compared here with a fountain pen, clips in any pocket.



***NOW AVAILABLE:* New radio system permits economical 100% coverage of very large areas, e.g. refineries, vast factories, shipyards, etc.**

In an increasing number of progressive firms and institutions, Multitone 'Personal Call' Pocket Paging is saving countless wasted man-hours. It can do the same for your organisation—and your customers.

Multitone 'Personal Call' is a unique paging system which enables any of your key staff to be contacted immediately wherever they happen to be, selectively and without disturbing anyone else—no loudspeakers, bells, flashing lights or any other distraction.

On normal telephone working alone Pocket Paging reduces 'call-backs' and the need for extra lines and operators sufficiently to offset the cost—a few shillings per week per man 'on call' inclusive of all operating costs. On S.T.D. exchanges, using the new G.P.O. Subscriber Trunk Dialling system in which *every* call is charged on a time basis, the saving is obviously much greater.

This all-British equipment, which is installed in hundreds of hospitals and an even larger number of industrial firms in 30 countries, is simple to install and foolproof to operate.

MULTITONE

the original 'Personal Call' Pocket Paging System

MULTITONE ELECTRIC COMPANY LIMITED

12-20 UNDERWOOD STREET LONDON N.1

Telephone: CLErkenwell 8022

Post coupon now for a leaflet which tells you all about one of the greatest time and money savers of this electronic age.

Please send me full details of the Multitone 'Personal Call' Pocket Paging System

Name...

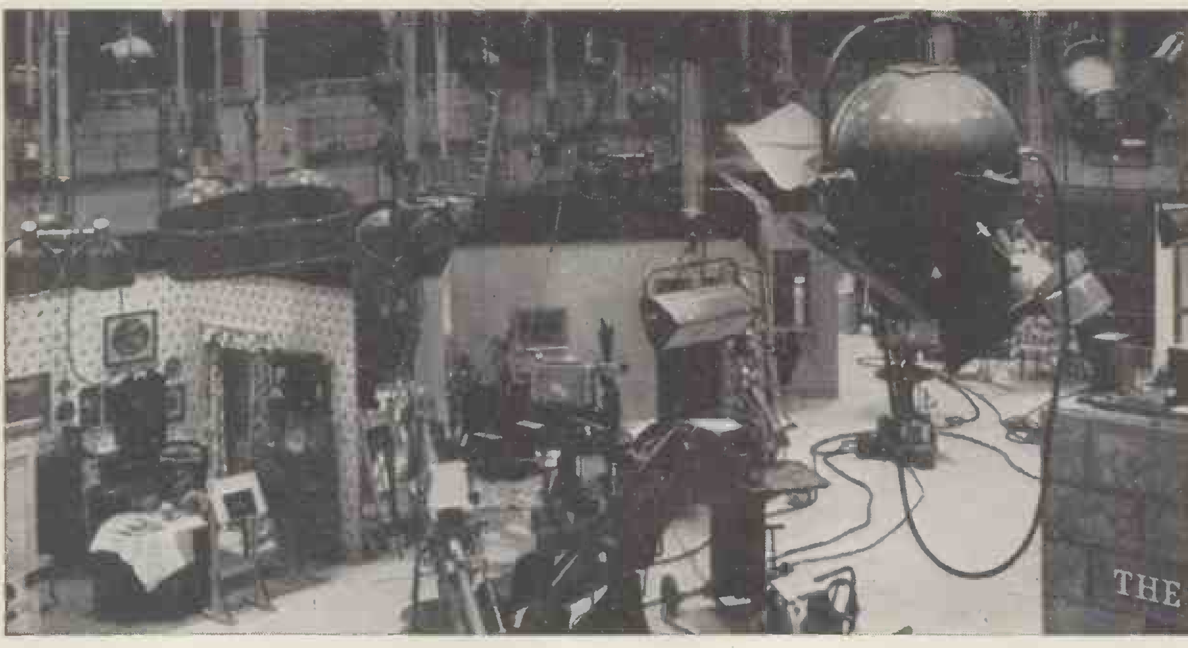
Firm...

Address..

.... WW

CAMERAS FOR ELSTREE

Ten Pye 4½" image Orthicon Camera Chains have been chosen to equip the new ATV studios at Elstree. These cameras, with ancillary Pye equipment, can operate on 405, 525 or 625 line systems. Cameras, picture monitors, switchable pulse and sound equipment have been developed by Pye TVT engineers to help make the new ATV studios among the most modern in the world.



PYE T.V.T. LIMITED · CAMBRIDGE · ENGLAND iia 73

Wireless World

ELECTRONICS, RADIO, TELEVISION

DECEMBER 1961

VOLUME 67 No. 12.
PRICE: 2s. 6d.

FIFTY-FIRST YEAR
OF PUBLICATION

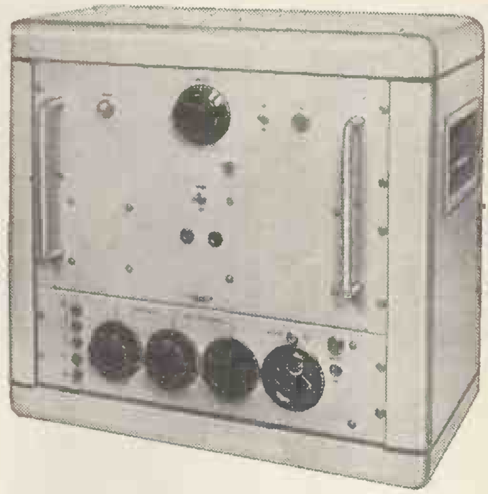
Iliffe Electrical Publications Ltd. *Managing Director:* H. S. Pocock, M.I.E.E.
Dorset House, Stamford Street, London, S.E.1

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

PUBLISHED MONTHLY (4th Monday of preceding month). *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* "Ethaworld, London-SE1." *Annual Subscriptions: Home and Overseas,* £2 0s. 0d. *Canada and U.S.A.*, $5.50. Second-class mail privileges authorized 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:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6. *Telephone:* Digby 9-1197.

Vortexion quality equipment

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.

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.

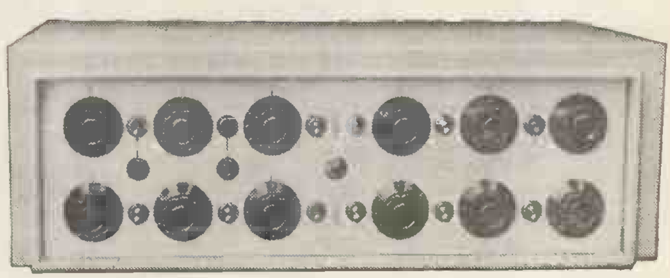
ELECTRONIC MIXER/AMPLIFIER

This high fidelity 10/15 watt Ultra Linear Amplifier has a built-in mixer and Baxendale tone controls. The standard model has 4 inputs, two for balanced 30 ohm microphones, one for pick-up C.C.I.R. compensated and one for tape or radio input. Alternative or additional inputs are available to special order. A feed direct out from the mixer is standard and output impedances of 4-8-16 ohms or 100 volt line are to choice. All inputs and outputs are at the rear and it has been designed for cool continuous operation either on 19 x 7in. rack panel form or in standard ventilated steel case.

Size 18 x 7½ x 9½in. deep.

Price of standard model **£49.**

12-WAY ELECTRONIC MIXER



The 12-way electronic mixer has facilities for mixing 12 balanced line microphones. Each of the 12 lines has its own potted mumetal shielded microphone transformer and input valve, each control is hermetically sealed. Muting switches are normally fitted on each channel and the unit is fed from its own mumetal shielded mains transformer and metal rectifier.

Also 3-way mixers and Peak Programme Meters. 4-way mixers and 2 x 5-way stereo mixers with outputs for echo chambers, etc. Details on request.

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."

DON'T FLUFF THE NOTES

Don't let gravel choke your Ravel. Don't let fluff fur up your Faith. Keep Britten tidy ! Your records are valuable. Dust and grit are attracted to them by 'static'. If you allow impurities to settle, the stylus must grind them into the groove, damaging the sensitive sound track (and the stylus, too). This greatly reduces the life of your records (and of the stylus, too). By the time you can hear loss of quality, irreparable harm has been done. Prevent damage *before* it happens. Slip on an Acos Changer Dust Bug—and let it sweep away dirt *before* the stylus gets there.

USE AN ACOS DUST BUG

The Acos Changer Dust Bug easily clips onto practically every changer arm. Spring action automatically compensates for its weight, and no tracking adjustment is required. A durable Nylon brush cleans the groove, and a plush pad applies anti-static fluid *before* the stylus, collecting the dirt after. The Acos Dust Bug costs only 17/6 plus 6/5 P.T. It pays for itself over and over again by giving very much greater record life, and five times longer stylus life.

acos ARE DOING THINGS IN STYLI

COSMOCORD LTD WALTHAM CROSS HERTS · TEL: WALTHAM CROSS 27331 (London subscribers please dial WS27331)

"BELLING-LEE" NOTES

No. 35 of a Series

Some mechanical aspects of design: Part 8

Standards of sealing are defined in terms of the maximum rate of leakage which will occur in a given time under a stated pressure differential. A typical specification, which applies to Services' Type Approved components (R.C.S. 262) requires that the leakage of gas shall not exceed 1 c.c. per hour under a pressure differential of 20lb. per square inch. Notice that this is the total leakage permissible, irrespective of the area of the seal. Thus the maximum leakage per unit area is lower on a large seal than on a small one, but this does not necessarily mean that a small seal is easier to effect, for tolerances become more critical as sizes are reduced.

In the case of hermetic seals, where the rates of leakage are very small indeed, a unit of measurement called the "lusec" is employed. This word has been coined as an abbreviation of litre, micron per second, the letter "u" sometimes being used for the Greek "m" (μ) which denotes "micro." The lusec is defined as the flow of as much gas into a vessel of 1 litre size as would produce a rate of pressure increase of 1 micron (.001 mm.) of mercury per second at 0°C. The pressure differential responsible for the leakage must be stated, of course. The lusec corresponds to a flow of approximately 5 c.c. per hour, but the leakage of quite an ordinary hermetic seal under a pressure differential of one atmosphere is better than 10^{-6} lusec, while a good seal measures less than 10^{-10} lusec, which is 1 c.c. in approximately 250,000 years!

Seals in the former category, i.e. non-hermetic, find applications in equipment which has to undergo a relatively short period of stress, e.g. equipment taken up to high altitudes (low pressure) in aircraft. The breakdown voltage of a component which measures 3 kV at sea level may fall to as little as 500 V. under the reduced pressure at 68,000ft., which could be disastrous. Also, since the performance of such seals is considerably higher as regards resistance to passage of moisture (owing to the larger size of the water molecules) they form an effective barrier to ingress by capillary action and by "breathing" which occurs in unsealed equipment as the external pressure rises and falls or as the internal pressure varies due to thermal changes.

Such seals are usually demountable, which means that they are assembled on the job, although they may contain built-in elements. Thus, a typical sealed panel fuseholder, such as L.1382, employs a seal at the panel which is assembled in mounting, but the body contact which is moulded in, is permanently sealed in the process. Incidentially, this requires a special technique because the adhesion of a phenolic moulding material to a metal insert cannot be guaranteed to be gas tight. Demountable seals of this type, in which mechanical pressures are relatively low, employ a resilient sealing medium, such as rubber, situated in an accurately dimensioned cavity. In the case of the fuseholder, L.1382, there is an annular groove of rectangular section in the rear face of the front flange, in which a sealing ring is placed. This ring, in the free state, stands proud of the groove, and makes contact with the panel over a circle. As the fuseholder is tightened on the panel, the ring is mainly distorted, since rubber has only a limited degree of compression, and the area of contact is thereby increased considerably. The sealing ring may be of square or circular cross section, but the latter is generally found to be more effective.

Hermetic seals, which are employed where long-term stability is required, e.g. in valves, transistors and other components where the internal environment must be maintained, and impurities excluded, are formed by fusion, or chemical bonding. Hermetic sealing between metals may be achieved by soldering, brazing, welding, etc., and in the case of glass-metal seals, which are used extensively when electrical insulation is required, an oxide layer of carefully controlled thickness is formed on the metal surface and the glass is melted and bonds to it.

The testing of seals to ensure their literal compliance with specification is a tedious business, even in the case of the lower requirements of demountable seals; it is obviously impracticable as a production routine. While it may not be permissible to accelerate the tests by increasing the pressure differential without risk of breaking down the seal, perhaps resulting in permament damage, the time scale may legitimately be shortened if a smaller quantity of gas than 1 c.c. can be accurately measured.

Radiotelephones by ***ATE****—a vital service for isolated communities*

Breaking the cold silence

The outposts of the ever expanding world of today are often to be found in remote, isolated areas. For these communities—lumber camps, trading posts, or even a holiday hotel in a beautiful snow-bound wilderness such as this, modern means of communication are essential. By means of the ATE Type 800 equipment — the latest in the ATE single channel VHF rural radio-telephone range—such remote communities can now be linked direct to the nearest telephone exchange and provided with full telephone facilities; Type 800 is specially equipped with full signalling and control equipment for this purpose.

Exhaustive testing under actual climatic extremes has fully proved its outstanding practicability and efficiency.

Extended frequency coverage over VHF and UHF bands.

New compact cabinet-type construction with slide-in chassis for easy access and maintenance.

Plug-in test meter facilities.

High or low power versions to suit propagation conditions.

Will work in to any type of telephone exchange with improved outband tone signalling facilities.

Modern design conforming to British Post Office, Canadian Department of Transport and Crown Agents' Specifications.

TYPE 800

ATE Radiotelephones are used by industrial, agricultural, civil and military enterprises—and by research and survey teams in 60 countries.

If you would like to know more about this new mains operated equipment or its battery operated counterpart, the Country Set, write for full particulars to your local representative . . . or send for Bulletin REB 4101/1

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD

STROWGER HOUSE, 8 ARUNDEL STREET, LONDON, W.C.2. TELEPHONE: TEMPLE BAR 9262

AT14071

NEW TELEVISION VIDEO OUTPUT BEAM TETRODE

MAZDA 6F28

The 6F28 is a screened high slope frame grid beam tetrode for use in television video output stages. High peak current is available, enabling adequate video drive to be provided for the cathode ray tube with anode loads down to 4700 ohms; this low value of load eases the problem of HF video compensation.

This type has identical characteristics to the tetrode in the 30FL12 triode-tetrode combination.

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3

TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

Anode Dissipation (watts) ..	$p_{a\,(max)}$	2.5
Screen Grid Dissipation (watts) ..	$p_{g2(max)}$	1.3
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Grid Voltage (volts) ..	$V_{g2(max)}$	250
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)\,rms}$	150*

*Measured with respect to the higher potential heater pin.

Inter-Electrode Capacitances†(pF)

Input	c_{in}	8
Output	c_{out}	2.5
Control Grid to Anode	c_{g1-a}	0.03

†Measured in fully shielded socket without can.

CHARACTERISTICS

Anode Voltage (volts)	V_a	180
Screen Grid Voltage (volts) ..	V_{g2}	180
Anode Current (mA)	I_a	10
Mutual Conductance (mA/V) ..	g_m	12.5

TYPICAL OPERATION AS VIDEO AMPLIFIER

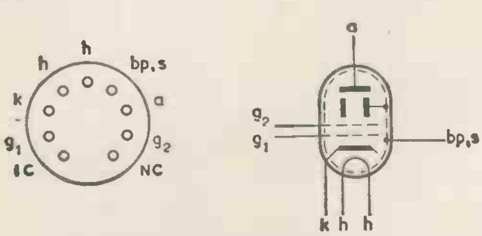
Allowance must be made in circuit design, not only for component variation, but also for valve spread and deterioration during life. Values of peak anode current, for an average valve when new and at the assumed end of life point for any valve, are as follows:—

	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA
Average New Valve	70	180	−1	40
Assumed End of Life Condition..	60	180	−1	25

Mounting Position: Unrestricted

Base: B9A (Noval)

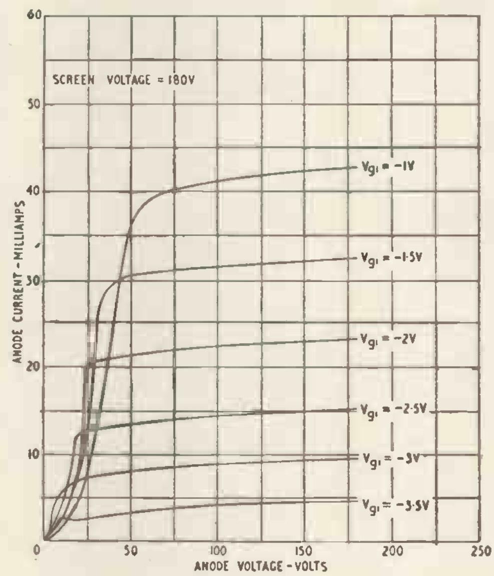
Connections

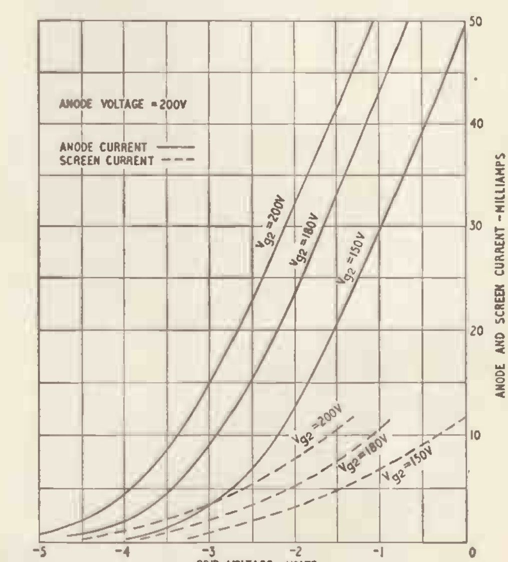


MAXIMUM DIMENSIONS (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

Tentative Characteristic Curves of Mazda Valve Type 6F28





Thorn-AEI Radio Valves & Tubes Ltd.
155 Charing Cross Road, London, W.C.2
Telephone: GERrard 9797

MAZDA

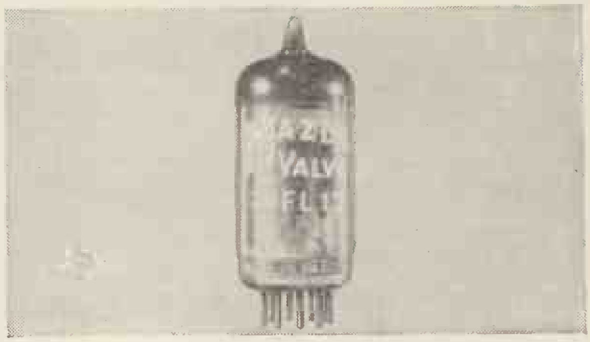
NEW TRIODE TETRODE FOR SYNC SEPARATOR CIRCUITS

MAZDA 30FL13

The 30FL13 consists of a high slope tetrode with frame grid construction and a general purpose triode for use in television sync. separator circuits. The short grid base and high slope of the tetrode enable good pulse limiting to be obtained with the anode load resistance directly connected to the HT line and a fairly high screen voltage.

The triode has identical characteristics to the 6/30L2.

Heater current (amps)	I_h	0.3
Heater voltage (volts)	V_h	10.0



TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

		Triode	Tetrode
Anode Dissipation (watts) ..	$p_{a(max)}$	1.5	1.5
Screen Grid Dissipation (watts)	$p_{g2(max)}$	—	0.5
Anode Voltage (volts) ..	$V_{a(max)}$	250	250
Screen Grid Voltage (volts) ..	$V_{g2(max)}$	—	250
Heater to Cathode Voltage (volts rms) ..	$V_{h-k(max)rms}$	150*	150*

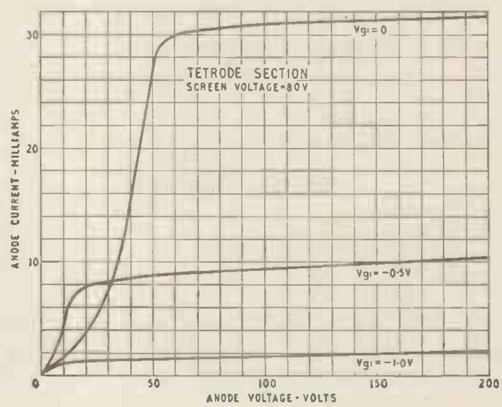
*Measured with respect to the higher potential heater pin.

Inter-Electrode Capacitances†(pF)

		Triode	Tetrode
Input	c_{in}	2.3	10
Output	c_{out}	2.0	2.6
Control Grid to Anode ..	c_{g-a}	2.4	0.04
Grid Triode to Grid 1 Tetrode	c_{gt-g1}	0.003	
Anode Triode to Anode Tetrode	c_{at-aq}	0.012	
Grid Triode to Anode Tetrode	c_{gt-aq}	0.004	
Anode Triode to Grid 1 Tetrode	c_{at-g1}	0.008	

†Measured in fully shielded socket without can.

Tentative Characteristic Curves of Mazda Valve Type 30FL13

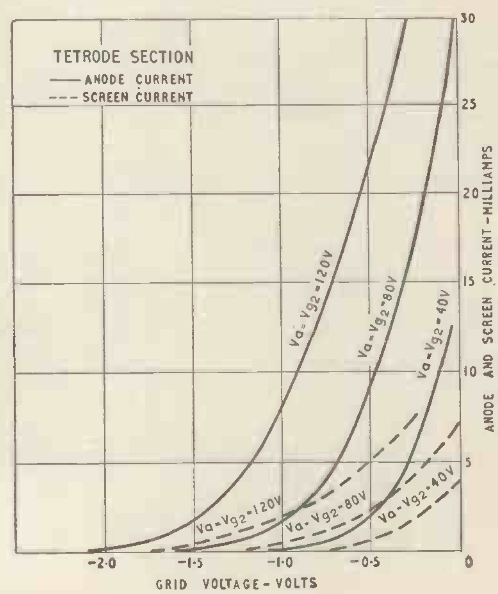


TETRODE CHARACTERISTICS

Supply Voltage (volts) ..	V_b	200	
Anode Load Resistance (kΩ) ..	R_a	4.7	
Screen Grid Voltage (volts) ..	V_{g2}	80	
Control Grid Voltage (volts) ..	V_{g1}	−0.6	−1.5
Anode Current (mA)	I_a	4	0.1

TRIODE CHARACTERISTICS

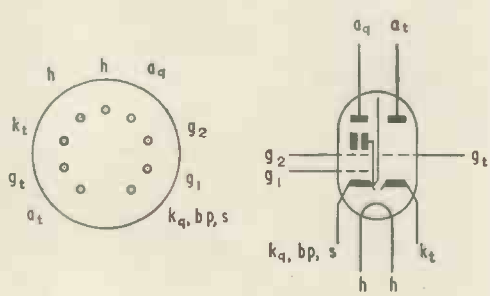
Anode Voltage (volts) ..	V_a	150
Anode Current (mA)	I_a	10
Mutual Conductance (mA/V)	g_m	3.7
Amplification Factor	μ	18



Mounting position: Unrestricted.

Base: B9A (Noval).

Connections:



Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

MAZDA COMMERCIAL DIVISION
Thorn-AEI Radio Valves & Tubes Ltd.

155 Charing Cross Road, London W.C.2
Telephone: GERrard 9797.

MAZDA

Plessey

Aerial Exchange feeds 80 receivers from one aerial

- 2 Mc/s to 30 Mc/s overall coverage; uses four basic units.
- Optional additional units link any receiver to any of several arrays.
- Standard unit range speeds maintenance, simplifies installation.
- Complete system gives ultimate capacity of 80 receivers working to 12 aerial arrays.
- Electronic switching minimises noise, heightens long-term reliability.
- Zero overall insertion loss; high-gain, low-noise wideband amplification.
- Easily arranged for dual-diversity working.

Comprehensive details of this flexible range of equipment are available on request.

Plessey

Telecommunications Division · Electronic and Equipment Group
THE PLESSEY COMPANY LIMITED · Ilford · Essex · Tel: Ilford 3040
Overseas Sales Organisation: Plessey International Limited

the truest sound

For sound reproduction as it should be—as close as possible to the original—make Shure microphones your unvarying choice. They are the finest for every purpose, years ahead of others in the technical excellence of their design and performance, the most comprehensive range obtainable anywhere.

Model 545 'Unidyne III' for public address, tape recording, communications and similar applications requiring compactness with maximum operating efficiency.

Model 420 'Commando' can be used indoors or outdoors, for all general-purpose applications. Quality performance at moderate cost.

Model 540S 'Sonodyne II' This versatile new microphone features *variable frequency response*, allowing the user to tailor the microphone to the application.

Model 55SW 'Unidyne' The most widely used microphone in the world, specified by leading sound engineers and requested by celebrities.

Model 420 'Commando'

The new Shure microphone catalogue is available on application to the address below

SHURE ELECTRONICS LIMITED
84 Blackfriars Road · London SE1
Telephone: WATerloo 6361

SHURE

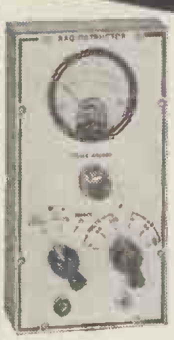
Setting the world's standard in sound

Model 55SW 'Unidyne' **Model 545 'Unidyne III'** **Model 540S 'Sonodyne II'**

NOW YOU can MASTER ELECTRONICS!

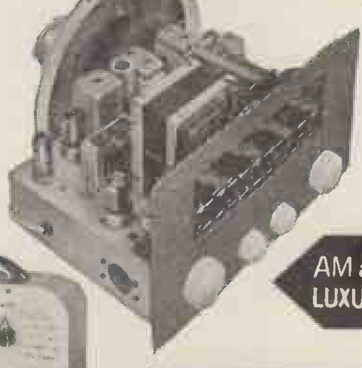
BRITAIN'S MOST COMPREHENSIVE PRACTICAL COURSE in RADIO · ELECTRONICS · TELEVISION!

THESE SPECIAL TRAINING KITS — YOURS TO KEEP



Multi-Range TEST METER

CATHODE RAY OSCILLOSCOPE



AM and VHF/FM LUXURY RECEIVER

SIGNAL GENERATOR

Complete set of Picture Way books and Experimental Manuals

LEARN BY BUILDING NOW for your CAREER • HOBBY • OWN BUSINESS

YOU RECEIVE

- Complete kits of equipment as illustrated.
- Complete set of experimental manuals.
- Complete set of 'picture way' theory books.
- Modern test-yourself examination sheets.
- Study programme.
- Unlimited consultation with Tutors.

FREE BROCHURE

POST NOW

RADIOSTRUCTOR

TO: RADIOSTRUCTOR (DEPT. M.66)
READING, BERKS.

NAME ....

ADDRESS ....

....

(BLOCK CAPITALS, PLEASE)

Date..............

(*We do not employ Representatives.*)

12/61

TRANSMITTING VALVES

The tables below give data relating to some of the Transmitting Valves manufactured by the **English Electric Valve Company.** The full list of these valves, complete specifications and characteristics can be obtained on application to the Company.

'ENGLISH ELECTRIC'

E.E.V. Type	Equivalent Types	Service Type	Filament		Frequency Mc/s §	Anode voltage max. (kV)	Anode dissipation max. (kW)	Type of cooling
			Voltage (V)	Current (A)				
5867	5867, TY3-250	CV1350	5·0	14·0	100/150	3·0	0·25	Natural to 30 Mc/s
833A	TY4-350, 833A	CV635	10·0	10·0	30	3·0 4·0	0·3 0·4	Natural Forced air
‡ 5762	TY6-5000A, ACT30	CV2383	12·6	29·0	30/220	6·2	3·0	Forced air
BR 161	—	CV2322	9·0	175·0	30/50	12·0	15·0	Forced air
BR 189	—	CV5218	9·0	240·0	5/50	15·0	27·0	Forced air
BR 1122	—	—	6·0	115·0	5/110	12·0	10·0	Forced air
BW 161	—	—	9·0	175·0	30/50	12·0	30·0	Water
BW 189	—	—	9·0	240·0	5/50	15·0	35·0	Water
BY 189	—	—	9·0	240·0	5/50	15·0	35·0	Vapour
CR 192	6166	—	5·0	175·0	30/220	6·0	10·0	Forced air
6181	6181, CR1101	—	120·0	1·6	900	2·0	2·0	Forced air

‡ *Previously BR 191 B*

§ *The lower value indicates the operating frequency at full rating. Operation at the higher value is possible with suitable derating.*

ENGLISH ELECTRIC VALVE COMPANY LIMITED

AGENTS THROUGHOUT THE WORLD | *Chelmsford, England. Telephone: Chelmsford 3491*

AN ASTONISHINGLY IMPROVED LOUDSPEAKER SYSTEM

invented by LEAK

the first name in High Fidelity

Leak speakers won the day

"This occasion proved a most stringent test as we were listening to a stereo recording of a very recent orchestral and operatic performance we had enjoyed either as audience or performer. By way of experiment other pairs of speakers were switched in, but the very smooth response of the Leak speakers won the day."

Quoted from the Test Report by Ralph West, B.Sc., M.Brit.I.R.E. The full report appeared in "Hi-Fi News," August, 1961.

Selecting the equipment

"Suggestions? The *Leak* line comes highly recommended on two continents, the pre-amp isn't cursed with superfluous knobs, and it looks good. The mono amp would thus be the *TL/12 Plus* and the stereo version would be the *Point One Stereo 20 Amplifier*. Both run about 10-12 watts per speaker, and frankly I think this is plenty. Even with that you can rattle the windows, and the reason is that this 10W is at *minimum distortion*, 10W sinewave power (which means that it'll put out a lot more on peaks) The price* of the *Leak* is also quite reasonable for uncompromised sound quality."

Quoted from the article "Frankly Speaking," by John Berridge, "Hi-Fi News," August, 1961.

The new LEAK "SANDWICH" LOUDSPEAKER SYSTEM is the product of many years of research and development work

The cabinet is of unique construction which damps panel resonances and permits the loudspeaker motor to reproduce full clean bass without the "boxy" coloration of conventional cabinets. A 3in. and a 13in. moving-coil loudspeaker motor of novel design and a half-section cross-over network complete the system which gives the highest quality of reproduction over the whole frequency range of the input signal from records, radio, tape or microphone THE GREATEST ADVANCE IN THE DESIGN OF MOVING-COIL LOUDSPEAKERS SINCE RICE-KELLOGG INVENTED THE FIRST UNIT IN 1925 HAS NOW BEEN MADE BY LEAK WITH A NEW INVENTION WHICH ELIMINATES BREAK-UP DISTORTION IN THE WORKING RANGE. The 13in. unit employs a new cone whose stiffness to weight ratio is 200 times better than the best cones which are currently available. The low stiffness of conventional cones results in the flexing of the cone at large amplitudes and break-up resonances. The new LEAK cone, which has immense stiffness for no greater weight than a conventional cone, has, for the first time, given us a loudspeaker which behaves as the theoretical ideal of a rigid piston; thus there is no flexing of the cone at large amplitudes and there is no break-up distortion within the frequency range handled by the loudspeaker. It is this freedom from coloration, produced in conventional systems by break-up distortion of the cone and cabinet resonances, which distinguishes the superior quality of reproduction of the LEAK "SANDWICH" LOUDSPEAKER SYSTEM from that of the best currently available loudspeaker systems. The cabinet measures only 26in. × 15in. × 12in.; it can be used in the vertical or horizontal position to suit the convenience of the user

Price £39 : 18s.

The price of Leak studio quality Hi-Fi Equipment is as low as it is because we are kept fully and efficiently employed by the world-wide demand.

See your LEAK dealer or POST THE COUPON now for full details of this superb new EQUIPMENT.

Please tick your requirements below:

☐ **New Loudspeaker System.**

☐ **Hi-Fi Equipment.**

Name ....

Address ....

....

WW/12/61

H. J. LEAK & CO. LTD · BRUNEL ROAD · WESTWAY FACTORY ESTATE

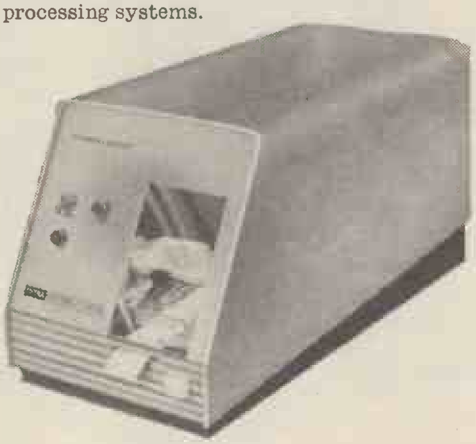
LONDON, W.3

Telephone: SHEpherds Bush 1173 *Telegrams:* SINUSOIDAL, EALUX LONDON.

Data Processing Equipment by **ULTRA** *. . . 7*

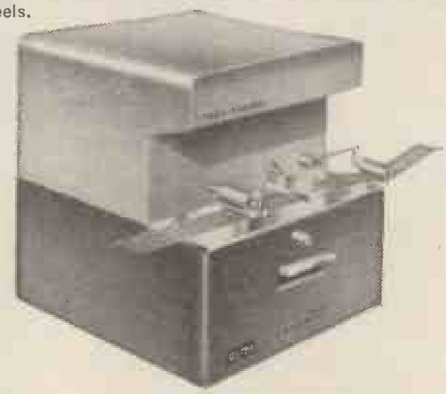
PUNCH AND READER

Our range of Automatic Business Equipment has now been increased by the addition of a paper tape encoder punch and a paper tape reader. These units provide an economic method of encoding and reading when used with other equipment in the Ultra range, or with existing data processing systems.



ENCODER PUNCH

A simple 5-hole paper tape punch with built-in coding facilities. Any desired code can be accommodated on the printed-circuit matrix, which is pre-wired to suit individual requirements. Operates at a maximum speed of 10 characters per second, using standard 1,000 ft. reels.



PAPER TAPE READER

A versatile photoelectric paper tape reader operating at a maximum speed of 150 characters per second. Standard-width 5, 6, 7 or 8 hole tape of varying thickness and colour can be accommodated. Simple loading and unloading of continuous tape loops.

ULTRA

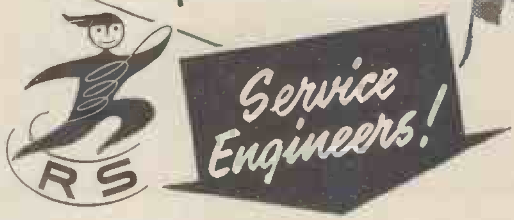
Please write for further information

ULTRA ELECTRONICS LIMITED

WESTERN AVENUE · LONDON W.3 · TEL: ACORN 3434

All good 'labs' use Radiospares

quality components for design development and prototype work

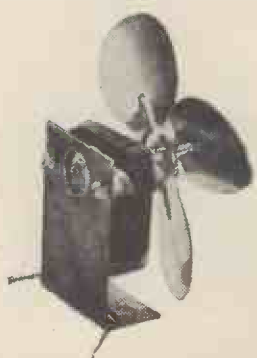


Remember- Radiospares components are delivered absolutely "by return"

AT LAST, FOR ONLY £1.3.0

INCLUDING POST & PACKING

A really efficient Fan for use in Electronic Equipment



This is what the Electronics world has been waiting for! At extremely low cost air-stirring and extraction can be easily achieved.
Also in production we have Low-Speed Motors from 8 r.p.m. to 40 r.p.m. Price £2.8.9 per unit inc. P.P.

KENURE HOLT & CO. LTD.

BOYN VALLEY RD., MAIDENHEAD, BERKSHIRE

Telephone: Maidenhead 5495-6-7-8

WE ALSO HAVE SUB-CONTRACT FACILITIES FOR ELECTRONIC WIRING AND ARE FULLY A.I.D. APPROVED

HEAD FOR THE FUTURE

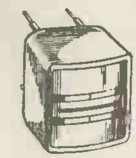
NEW RANGE OF HEADS — TYPE X

QUARTER - TRACK, HALF - TRACK, AND FULL - TRACK—RECORD, PLAYBACK, AND ERASE HEADS FOR HIGH QUALITY AND PROFESSIONAL TAPE RECORDERS.

" Incorporating all the known good points of design and with a life and performance difficult to equal anywhere in the world "—*in those words were our design team set the problem*—and we are proud to present the results: Comparisons with other Heads place " X " range right at the top of the list—the best performance at far from the highest price !

Send for details and free Booklet " Designing Heads for Optimum Performance."

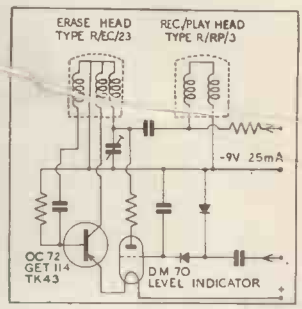
The example shown on the right is a Quarter-Track—Four-Track Stereo Head, for ¼in. tape.



Size: ½in. x ½in. x ½in.

NEW HEADS FOR TRANSISTOR CIRCUITS

TYPES R, DR, X AND L, RECORD/PLAY HEADS CAN ALL BE SUPPLIED IN [illegible] IMPEDANCES FOR TRANSISTOR CIRCUITS. SPECIAL ERASE HEADS AS BELOW.



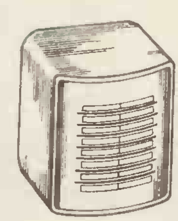
ERASE HEAD COMBINED WITH OSC. COIL (See circuit diagram, right)—Saves cost of component (Osc. Coil) and very much simplifies the Oscillator Circuit. Also supplies bias and H.T. supply for a recording level indicator tube (DM70). Operates from a single OC72 ! No D.C. flux in the erase whatsoever. World patents pending.

ERASE HEAD COMBINED WITH BIAS AND H.T. COIL. This Head is for connecting to a push-pull transistor oscillator circuit of the type where the output stage is converted to an oscillator when recording. A second winding on the erase head acts as a transformer and provides a voltage for the bias supply, and H.T. for an indicator of the DM70 type (70 volts).

LOW LOSS ERASE HEAD. This is a standard form of erase head that requires only a very low input power. Several would work off a single OC72 Oscillator! Patents pending.

NEW RANGE OF MULTITRACK HEADS

TWO—FOUR—EIGHT—AND SIXTEEN TRACKS (AND OTHERS TO SPECIAL ORDER).



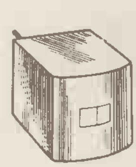
A revolutionary design, giving the finest quality at a comparatively low price. Another great addition to the Marriott range of Heads.

The example shown on the right is for eight tracks on ½in. tape.

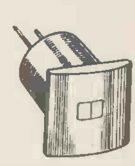
Low Loss Erase Heads for ¼in, ½in. and 1in. Tape are also available. Considerable reductions in erase power made possible. Send for full details of all types.

OLD BUT 3½ MILLION HEADS CAN'T BE WRONG!

Used in Tape Recorders throughout the world and without any doubt whatsoever the finest value obtainable. Well proved—and now **im**proved as the latest production have higher output and improved top response.



Type DR—Size 7/16in. x 7/16in. x ⅝in. long. For ½ track high (½Hy) or medium impedance.



Type R—Exactly as Type DR except body is ⅜in. diameter. Provides a simple fixing arrangement offering ease of azimuth adjustment.

Erase Heads. Available in R or DR cases.

Type L.—For Four-Track Recorders. Offers twice the playing time—or stereo reproduction. Size: Height ⅝in., width ⅜in., depth ¾in. High or medium impedance.

A low impedance Erase Head of similar dimensions is available.

Sets of Brackets are available for fixing heads to B.S.R. and Collaro Tape Decks.

NOTE : ALL ILLUSTRATIONS ACTUAL SIZE.

WE MAKE RECORDING HEADS FOR PRACTICALLY EVERY EQUIPMENT. FULL RANGE OF HEADS FOR CINE.

P. A. MARRIOTT & Co., LTD.

284 WATER ROAD, WEMBLEY, LONDON.
TEL. WEM 7493

QUICK ACCURATE READINGS are possible with the latest timer-counter by Advance which incorporates an easy-to-read in-line display with automatic decimal point and units of measurement indicator. The internal frequency standard is a temperature compensated crystal oscillator which enables accurate measurements to be taken as soon as the instrument is switched on.

NETT PRICE IN U.K. £395

1 Mc/s Timer-Counter
TYPE TC1A FEATURES

IMPROVED SIX FIGURE DISPLAY with in-line presentation.

INTERNAL STANDARD is a temperature compensated crystal oscillator accurate to ± 1 part in 10^6 between +10°C and +30°C.

FREQUENCY MEASUREMENTS from d.c. up to at least 1 Mc/s.

TIME MEASUREMENTS for any time between 3µ sec. and 2777 hours.

PERIOD MEASUREMENTS for 1, 10, 10^2, 10^3, 10^4, or 10^5, cycles of the input.

PULSE WIDTH MEASUREMENTS are possible.

FREQUENCY MEASURING PERIOD 0.1, 1.0, or 10 secs.

TIMING PULSE OUTPUT from 10^{-1} up to 10^6 pulses per second.

SELF-CHECKING FACILITIES are provided.

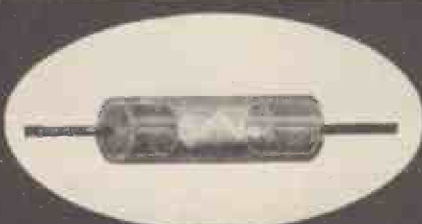
AMBIENT TEMPERATURE RANGE 0°C to + 40°C.

Advance COMPONENTS LIMITED

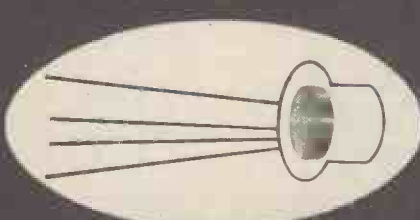
ROEBUCK ROAD, HAINAULT, ILFORD, ESSEX
TEL: HAINAULT 4444
TELEGRAPHIC ADDRESS: ATTENUATE ILFORD

SBI/5

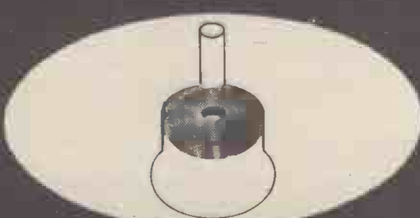

Sing out for
SCOTCH
BRAND
MAGNETIC TAPE
this Christmas
You can always depend upon Scotch Magnetic Tape for all the year round quality recording. So be sure to ask for Scotch Brand this Christmas.
ANOTHER 3M BRAND PRODUCT



DIODES



TRANSISTORS



RECTIFIERS

A complete range of products for the Semi-Conductor Industry :

FOR DIODES :

- Clear Glass precision-cut tubing in the form of beads and cases
- Coloured MULTIFORM sintered-glass beads

FOR TRANSISTORS :

- Coloured MULTIFORM preforms for transistor stems (TO-5, TO-18)
- Clear glass bulbs and beads for all-glass transistors

FOR RECTIFIERS :

- Complete headers with matched or compression glass-to-metal seals...

All products made precisely for you by

SOVIREL

ELECTRONICS-TV DIVISION
27, RUE DE LA MICHODIÈRE
PARIS - Tél. RIC. 52-27 - FRANCE

AGENT IN GREAT BRITAIN : M. CHEVALLIER - NAPIER HOUSE, 24/27 HIGH HOLBORN - LONDON W.C I

Mechanical Relay Latch

FOR P.O. 3000

This latching device enables the P.O. 3000 type relay to be held in the closed position when the coil is de-energised and until manually released.

Does not impair the versatility of the contact arrangements, nor affect the normal mounting position.

WILL TRIP AND HOLD ON A.C. OR D.C. IMPULSE

Ministry of Aviation Approved Inspection

E.I.D.

Illustrations show 3000 Type Relay fitted with "Remote" or "Local" release latch.

EITHER TYPE CAN BE FITTED TO YOUR EXISTING 3000 TYPE RELAYS IN A MATTER OF MINUTES.

Please send for illustrated leaflet.

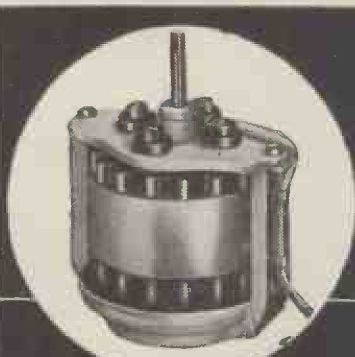
A NEW ADDITION TO THE P.O. 3000 TYPE RANGE

THE "REMANENCE RELAY" *Details on request.*

Jack Davis (Relays) Ltd.

(DEPT. W.) TUDOR PLACE, LONDON, W.1

TELEPHONES: MUSEUM 7960 LANGHAM 4821



PAPST-MOTORS

FOR HI-FI TAPE RECORDERS,
TURNTABLES
AND OTHER QUALITY-PRODUCTS

PAPST-MOTOREN KG

(17b) ST. GEORGEN/SCHWARZWALD

W E S T G E R M A N Y

"SEE THE POINT"

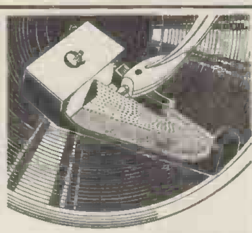
of your Stylus with the "Q-MAX"

"STYLOVUE"

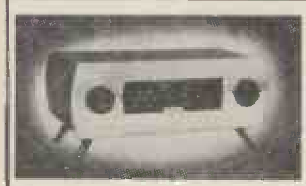
The "Stylovue" is a device for projecting a magnified shadow of your stylus on to a screen, enabling you to see whether your stylus is worn and needs replacing, which cannot be detected by the naked eye.

28/3

Batteries 9d. extra.



Pat. app. for.



CHAPMAN

FM 95 AM/FM TUNER

Provides first-class drift free F.M. reception, and excellent reception of the more powerful continental stations on M. & L. wavebands.

£27.16.7 unpowered
£31.18.8 powered

"Q-MAX"

SHEET METAL PUNCHES

TWO NEW SIZES

$1\frac{1}{16}$" 16/6 | $1\frac{5}{16}$" 18/6

(Keys: 1/6 each.)

List of all sizes and prices on application.

Fully illustrated CATALOGUE of all HI-FI products 6d. Post Free.

BERRY'S RADIO

25 HIGH HOLBORN, LONDON, W.C.1

Tel.: HOLborn 6231/2

CHOOSE FROM THOUSANDS!

SEND ONLY 5/- SELECT £5 WORTH OF LP'S NOW

WORLDS TOP RECORDS
- POPULAR
- SHOW HITS
- TOP JAZZ
- C-WESTERN
- OPERATIC
- CLASSICAL

BY RETURN LEADING LABELS

Why not join the thousands of record lovers who build their L.P. collection the "PH" factory-fresh, by return, postal way? No entrance fee or deposit—choose from thousands. Leading labels: HMV, Decca, Pye, RCA, Philips, etc., plus smaller labels too! Cash or easy credit plan without further obligations. Stereo specialists. Free benefits. New lower priced L.P.s, etc. Advice and trace service. Overseas orders tax free. Hi-Fi, players, radiograms and musical instruments, etc.

GREAT EASY CREDIT CLUB

Send first weekly payment of only 5/-, choose and take delivery of £5 worth of L.P.s, E.P.s. 8/- for £8, 10/- for £10 worth, etc. (repay weekly/monthly to suit).

— — — — CUT HERE — — — —

FREE 'UP TO MINUTE' CATALOGUES. *POST THIS COUPON TO-DAY!*

FOR OUR RETURN SERVICE

Cut coupon and pin to notepaper stating your record interests plus name, full address in capitals, please. Post to address below without any obligations:—

"PH" RECORDING CENTRE

(Dept. GR/DM12) 58, PERSHORE STREET, B'HAM, 5

HETERODYNE FREQUENCY METERS

BRITISH MANUFACTURED

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.
Reconditioned and calibration-checked B.C.221 Frequency Meters range 125 Kc/s to 20 Mc/s still available.

Provisional specifications on a new wide-range, very high accuracy Frequency Meter and also an instrument covering the range 100 Kc/s to 1,000 Mc/s (higher under favourable conditions) available to request.

A

Telemax

INSTRUMENT

Complete Specification 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.8)

TELEMAX WORKS, BROKENFORD LANE, TOTTON, HANTS, ENGLAND

Telephone: Totton, Southampton 3666 Cables: "Teleset," Totton, Southampton

Agents: Some overseas territories still available.

NEW EDITION just out!

The Catalogue for every radio enthusiast

170 pages

Over **600** illustrations

Over **5000** components listed

This is today's most up-to-date, most comprehensive component catalogue for the radio constructor, experimenter, electronic engineer & hi-fi enthusiast. Send for your copy today.

ONLY **2/-** PLUS 1/- POST

POST COUPON TODAY	Please send latest Catalogue. I enclose 3/- for cost and postage.
Please write CATALOGUE on top left corner of envelope.	NAME........
	ADDRESS........
	....
	Home Radio Ltd., Dept. W., 187 London Road, Mitcham, Surrey. MITcham 3282.

Still by far the finest value

STERN'S MULLARD DESIGNS

COMPLETE KIT OF PARTS

Designed by MULLARD—presented by STERNS strictly to specification

MULLARD "5-10" MAIN AMPLIFIER

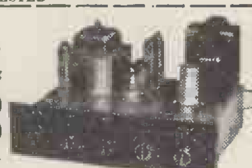
For use with the MULLARD 2-stage pre-amplifier with which an undistorted power output of up to 10 watts is obtained. We supply SPECIFIED COMPONENTS AND NEW MULLARD VALVES including PARMEKO MAINS TRANSFORMER and choice of the latest Ultra-linear PARMEKO or the PARTRIDGE Output Transformer.
Price: COMPLETE KIT (Parmeko O/put Trans.)............ **£10.0.0**
Alternatively we supply ASSEMBLED AND TESTED.... **£11.10.0**
ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

MULLARD'S 2-VALVE PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER but also perfectly suitable for other makes.
Supplied strictly to MULLARD SPECIFICATION and incorporating
- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel. ● Wide range BASS and TREBLE Controls.

Price: COMPLETE KIT OF PARTS **£6.6.0** ASSEMBLED AND TESTED **£8.0.0**

COMPLETE MULLARD 5-10 AMPLIFIER



The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction.
Specified components and new MULLARD VALVES are supplied including PARMEKO MAINS TRANSFORMERS and choice of the latest PARMEKO or PARTRIDGE ULTRA Linear Output Transformers.
Price: COMPLETE KIT. Parmeko Transformer **£11.10.0**
Alternatively we supply ASSEMBLED AND TESTED.... **£13.10.0**
Hire Purchase (Assembled Amp. only). Deposit £2/14/-, 12 months at 19/10.
ABOVE incorporating PARTRIDGE OUTPUT TRANSFORMER £1/6 extra.

COMPLETE MULLARD 3-3

A VERY HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-VALVE 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.
Price for COMPLETE KIT OF PARTS **£7.10.0**
(Plus 6/6 carriage and insurance.)
Alternatively supplied ASSEMBLED AND FULLY TESTED (Plus 6/6 carriage and insurance) **£8.19.6**
H.P. TERMS: Deposit £2 and 8 monthly payments of £1.
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.

COMPLETE STEREO AMPLIFIER

Meets the many requests for a low priced but good quality Stereophonic Amplifier. Output power is 4 watts. Inputs for Crystal Pick-ups and Radio Tuner.
KIT OF PARTS **£8.10.0** or ASSEMBLED **£10.10.0**

Mk. II "Fidelity" FM TUNING UNIT

An attractively presented Unit incorporating MULLARD PERMEABILITY TUNING HEART and corresponding Mullard valve line-up. Very suitable to operate with our Mullard Amplifiers.
FOR THE CONSTRUCTOR **£10.0.0** or ASSEMBLED **£14.5.0**

SPECIAL CASH ONLY OFFER ! !

The 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) 6½in. P.M. SPEAKER 18 9
(Carriage and insurance 4/- extra).

!! A BARGAIN !!

WE ARE ABLE TO OFFER BRAND NEW and FULLY GUARANTEED

TRUVOX Mk. VI TAPE DECKS

List Price £26.5.0 FOR **£18.18.0**
Deposit £3/16/- and 12 months £1/7/8. (Carr. & Ins. 7/6 extra).
A twin track model operating on 3¾ and 7½ in/sec. Speeds and incorporating Pause Control and Rev. Counter.

THE ABOVE INCORPORATING THE LATEST 4-TRACK MINIFLUX HEADS FOR STEREO OPERATION IS AVAILABLE FOR **£21.10.0** (Carr. and Ins. 7/6 extra).
Deposit £4/6/-, 12 months of £1/11/7.

"COMBINED ORDER" PRICE REDUCTIONS

(a) The COMPLETE KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-stage Pre-Amplifier Control Unit **£15.15.0**
(b) The "5-10" and the 2-Stage Pre-Amplifier both Assembled and Tested **£18.18.0**
H. P. TERMS: Deposit £3/16/- and 12 months of £1/7/8.

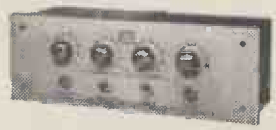
RECORD PLAYERS

Many at REDUCED PRICES ! ! !
Send S.A.E. for ILLUSTRATED LEAFLET

THE COLLARO "JUNIOR" 4-speed single player with separate crystal pick-up..........	£3.15.0
THE NEW GARRARD "AUTOSLIM" 4-speed Autochanger with Crystal Pick-Up	£8.10.0
THE NEW COLLARO "C60" 4-speed autochanger unit with Studio "O" pick-up	£7.19.6
The NEW COLLARO Model RP594 4-speed Single Record Player Studio Cartridge..............	£9.18.6
THE E.M.I. 4-speed Single Record Player, incorporating a high output crystal pick-up....	£6.9.6
B.S.R. MODEL UA14, a 4-speed Mixer Autochanger with crystal pick-up	£7.10.0
Available incorporating the B.S.R. STEREO Pick-up, plays L.P. and 78 records..........	£8.13.10
GARRARD RC210 4-speed Autochanger fitted with latest crystal pick-up	£10.10.0
The latest GARRARD TRANSCRIPTION MOTOR "301"	£22.7.3
The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A. 12 pick-up arm and G.C.S. crystal Cartridge ..	£19.8.7
GARRARD Model TA/Mk. II Single Record Player fitted with high output crystal Pick-up. detachable head..............	£8.10.0

HIRE PURCHASE TERMS available on all units £8/19/6 and over. Carriage and insurance on each above 5/- extra.

MULLARD FOUR CHANNEL MIXING UNIT



Self powered Cathode follower output. Incorporates two inputs for CRYSTAL MICROPHONES, one for CRYSTAL PICK-UPS and a fourth for Radio or Tape.
KIT OF PARTS **£8.8.0**
ASSEMBLED AND TESTED **£10.0.0**
Terms: Deposit £2 and 12 months at 15/-. Model LL one microphone input matched for moving coil or ribbon mike £1/17/- extra.

STEREO "3-3" MAIN AMPLIFIER

Comprise two MULLARD 3-3 Main Amplifiers on one chassis. Operates with above MULLARD STEREO PRE-AMPLIFIER. Output power 6 watts. Inputs for Crystal Pick-up and Radio Tuner
KIT OF PARTS **£10.0.0** or ASSEMBLED **£11.15.0**

STERN'S INTER-COMM or BABY ALARM

A small versatile Unit employing the new MULLARD ECL86 valve and designed to provide two (or three) way conversation up to extreme distances. Operates from A.C. mains 200 to 250 volts and as in all our designs only new high-grade and guaranteed components are incorporated. PRICES—MASTER UNIT and ONE EXTENSION.
KIT OF PARTS **£6.17.6** ASSEMBLED AND TESTED **£8.0.0**
The equipment consists of a MASTER UNIT, size only 8½in. × 5½in. × 6in. and ONE EXTENSION (a second extension may be added at any time).
The Master Unit incorporates switching and power supply and with the chassis completely isolated from the mains is operated in absolute safety. Attractively presented in cases covered in quality leatherette.

! ! 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, Pre-amplifiers, 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 send S.A.E.

"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY
GOODMANS—WHARFEDALE—W.B.
ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

SPECIAL OFFER OF TAPE

P.V.C. base on latest type Plastic Spools, New, boxed and guaranteed.

900ft. on 5 in.	18/6
1,200ft. on 5¾in.	21/-
225ft. on 3 in.	5/9
1,200ft. on 7 in.	21/-
1,800ft. on 7 in.	32/6

H.P. TERMS ARE AVAILABLE ON ALL ASSEMBLED EQUIPMENT OVER £9

STERN RADIO LTD.

DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

TESTMETERS FOR EVERY POCKET AND PURPOSE

1,000 OHMS PER VOLT

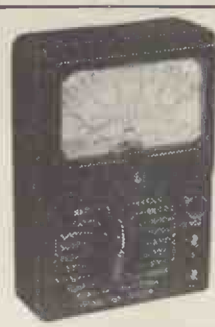
MODEL U.1. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500 mA; Resistance to 200 K. Basic movement 300 μA. Easily read open scale. Size 5¼ × 3⅛ × 2¼in.

£2/19/6

2,000 OHMS PER VOLT

MODEL TP-10. Reads A.C. and D.C. volts up to 1,000; D.C. current to 500 mA. Resistance to 1 Meg.; Capacitance to 1 μF; Decibels from −20 to +36; Output jack for Audio measurements. Size 3½ × 5 × 1½in.

£3/19/6



20,000 OHMS PER VOLT

MODEL TP-5S. Reads voltages up to 1,000, D.C. at 20,000 ohms per volt and A.C. at 10,000 o.p.v.; D.C. current to 500 mA; Resistance to 10 Megs; Capacitance to 0.1 μF; Decibels from −20 to +36. Size 3½ × 5½ × 1¾in.

£5/19/6

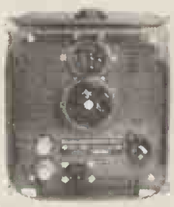
30,000 OHMS PER VOLT

MODEL 500. Reads voltages up to 1,000, D.C. at 30,000 ohms per volt, and A.C. at 15,000 o.p.v.; D.C. current to 12 amps; Resistance to 60 Megs; Decibels from −20 to +56; Incorporates internal buzzer for audible warning of direct shorts and blocking condenser for AF Output measurements. Size 3 $\frac{5}{16}$ × 6 $\frac{5}{16}$ × 2¾in.

£8/19/6

All instruments supplied with test leads and prods, instructions, and internal batteries, and are fully guaranteed. Further details sent on request.

CRYSTAL CALIBRATOR No. 10



A superb Crystal Controlled Wavemeter. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s. but may actually be used from 500 kc/s up to 30 Mc/s. Complete with 500 kc/s. Crystal, 2 valves type IT4, 1 of 1R5 and 1 of CV286 (Neon Stabiliser), and Instruction Book. Size 7in. × 7¼in. × 4in., weight 5 lbs. Used but in first-class condition. ONLY £2/19/6. Carr. 3/6.

PCR COMMUNICATIONS RECEIVERS

Manufactured by Pye & Philips. One of the Army's most versatile and sensitive sets. RF Stage and 2 of I.F., using 6 British I.O. valves. Large 180 Degrees Illuminated and Calibrated Dial, Flywheel Tuning with locking device, Aerial Trimmer, Tone and Volume controls, Band Switch, front panel jacks for speaker or phones. In black metal case. Size 17in. L. × 8in. H. × 10in. D. Model PCR covers 6-18 Mc/s., 200-550 metres and 850-2,000 metres, and has internal 5in. speaker. REME reconditioned AS NEW £6/19/6.

Model PCR 2 has similar Long and Medium Waveband coverage, Short wave 6-18 Mc/s, but no speaker. Used. but excellent condition £5.

Every receiver aerial tested before despatch. Add 10/6 carriage all models.

Designed to operate from bulky EXTERNAL power supply, but any set can be fitted with BRAND NEW COMPONENTS INTERNAL PACK for 200/250 v. A.C. at an extra cost of £2.

W 1191A WAVEMETER. Crystal controlled beterodyne frequency meter covering 100 kc/s. to 20 Mc/s. in 8 switched bands and is virtually the British BC221. Power requirements 2 v. L.T. and 40-60 volts H.T. Complete with Calibration Book, Crystal, Operating Valves and full set of spares. Used but in perfect order. ONLY £5 (carriage 15/-).

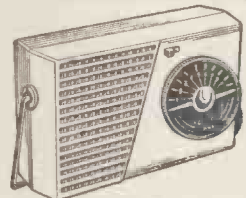
PANEL METERS

F.S.D.	SIZE AND TYPE				PRICE
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/-
200 milliamps	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
300 volts	A.C.	2½in.	Flush	circular	25/-
500 volts	A.C.	2½in.	Flush	circular	25/-

BC 221 FREQUENCY METERS

Coverage 125 kc/s to 20 Mc/s. and known the world over as a first class standard. Complete with original calibration book, crystal, valves, and instruction book. Used, but in very good condition. ONLY **£16.** Illustrated descriptive leaflet available on request.

"P.W." 6 TRANSISTOR PERSONAL RECEIVER



Designed by the technical staff of *Practical Wireless,* easy to build, using printed circuit, and 1st Grade Matched Transistors and Diode. Full Medium and Long Wave coverage to internal speaker. All parts sold separately (new components only) enabling you to buy as required, and full detailed price list will be sent on request. Constructional details 1/6. TOTAL COST INCLUDING BATTERY AND CABINET, £8/19/6.

AMPLIFIER N24. As previously advertised. 4 valves, rack mounting, with internal A.C. mains pack for nominal 110/230 volts. Output to 600 ohms line, provision for 600 ohms or High Impedance Input. A first-class job. ONLY 89/6 (carr. 10/6).

BC 342 RECEIVERS. A few only of these famous American sets covering 1.15-18.0 Mc/s., in six bands. Internal 115 v. A.C. Mains pack. A super receiver in first-class condition and perfect working order. ONLY £20 (carriage 15/-).

UNISELECTOR. 25 way 8 bank 15 ohm coil for 24 volt operation, unused, ex-brand new equipment, only 62/6.

SPRAGUE CONDENSERS. Metal cased wire ends. New, .01 mfd. 1,000 v. and .1 mfd., 500 v. 7/6 per dozen. Special quotes for quantities.

"GOOD COMPANION" 6 TRANSISTOR COMBINED PORTABLE AND CAR RADIO

The finest Transistor Portable ever designed for the constructor.

- ★ 750 mW Output.
- ★ 6 Transistors plus 2 Diodes.
- ★ Covers 540-1,640 Kc/s (180-550 metres) and 160-285 Kc/s (1,050-1,880 metres).
- ★ Latest printed circuit technique.
- ★ Pre-aligned I.F.T.s.
- ★ Very fine tuning with calibrated dial.
- ★ Internal high gain aerial with car aerial socket.
- ★ Brilliantly styled 2 colour cabinet size 11in. x 8in. x 3in.

Technical knowledge is not required to build this set, the easy-to-follow illustrated data which can be purchased for 3/6 making construction simplicity itself.

TOTAL COST INCLUDING CABINET AND DATA (Battery 3/6 extra.)
All parts sold separately, detailed list on request.

£9.19.6

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.

G.W. SMITH & CO (RADIO) LIMITED

Phone: GERRARD 8204/9155
Cables: SMITHEX LESQUARE
3-34 LISLE STREET, LONDON, W.C.2

UNIVERSAL AVOMETERS

All models offered are in first-class condition throughout, fully tested and checked, guaranteed perfect and are supplied with instructions, leads and batteries.

MODEL "D" 34 ranges............£8 : 19 : 6

MODEL "7" 50 ranges............£12

MODEL "8" 20,000Ω/volt.........16 GNS.

Regd. post 5/- extra on all models.

P.C.R. COMMUNICATION RECEIVERS

6 VALVES. Frequency coverage on three bands:—850–2000M. 190–550M. 6–18Mc/s.
Super slow motion drive. Aerial trimmer. Volume and tone controls. Output for 3 ohm speaker or phones.

Available as follows:—
AS NEW WITH BUILT-IN SPEAKER, £7/19/6.
USED BUT IN FIRST-CLASS CONDITION WITH SPEAKER, £6/19/6.
Carriage 10/- extra on all models.

All above models can be supplied with a built-in power unit for operation on 200/250 volt A.C. at an additional cost of 39/6 or alternatively the original plug-in A.C. mains power units are available at 35/- extra.

CONTROL BOX with 0-1 ma. meter (flush mounting 2¼in. scale), 5 microswitches, 2 toggle switches, 2 wafer switches, 2 Leach relays, condensers, etc., in a neat box 10×7×3 inches. New in cartons. 30/-. 2/6 post.
CONVERTORS. 12 or 24 volts D.C. input, 117 volts A.C., 60 cycles, 75, 100 125, 150 or 175 watts output. Mounted in a strong metal case with shock absorbers, 2 vibrators, smoothed, silent operation. New £6/10/-. Carr. 7/6.
AERIALS. Complete dipole sets for the B44 receiver, suitable for FM, television, etc. Simple and very easy to assemble, can be strapped to a pole in a few minutes, etc. Four sets of aerial rods that push into ready-made sockets. No. 1 set 30 inches (each rod). No. 2 33 inches. No. 3 37½ inches. And No. 4 42 inches. All rods ¼ in. dia. Ideal aerial for mobile use. Complete 27/6. Carr. 2/6.
SYNCHROS CONTROL MOTORS (U.S.A.). R112-2D-B. 115 volt 400 cycles, 2 ph., 50/- each.
TELEPHONE SETS. 3 desk telephones, 3 G.P.O. magneto generators, 3 bulls-eye indicators, 75ft. twin lead covered cable and terminal blocks, etc. For use Nos. 2 and 3 C.B. and auto systems or DE.L.'s, P.B.X. £12/10/-. Carr. £1.
BC 611 (WALKIE TALKIE). Complete crystal sets available ft 234. Freq., 4,035 to 5,500 kc/s. 24 xtals, 12 aerial coils and 12 tank coils. £3/10/- set, post 3/-.
USA COMPUTERS. AN-11-70A single parallax, £10 each, £1 carr.
TANNOY power microphones No. 1A. 8/6 each, 2/- post.
MOTOR ASSEMBLY. Servo unit, C-1-11 A G1020. 26 volts D.C. Auto. pilot. New in cartons. Price £3/10/- each. Carriage 7/6. C-1 Auto. pilot flight gyro. unit. Price £3/10/- each. Carriage 5/-.
VARIABLE RESISTORS, 3 ohms 10 amps., 18/6 each. Post 3/-.
TRANSFORMER, (drop thro' type). 110 and 230 volts pri., 275-0-275 at 125 mA., 6.35 v. at 0.9 amps., 6.4 v. at 4 amps. Size 4×4×4¾in., 22/6 each. Post 3/-.
MINE DETECTORS. Type 6A, small lightweight 28lb. packed, complete with spares and carrying case. New £6/10/- each. Carriage 5/-.
ROTAX CONVERTERS, Type 8A. 24 v. D.C. input, 115 v. A.C. at 1.8 amps, 400 cycles, 3-phase, £6/10/- each, carr. 7/6. Other types in stock.

NEW LIST AVAILABLE SEND 6d. IN STAMPS.

PLEASE INCLUDE POSTAGE ON GOODS

TERMS C.W.O. *All goods offered are ex-W.D.* *S.A.E. for enquiries*

W. MILLS

3-B TRULOCK ROAD, TOTTENHAM, N.17

Phone : Tottenham 9213 & 9330

SERVO & ELECTRONIC SALES LTD.

PARISTOR PARALLEL RESISTOR CALCULATORS. Brand new, remarkable time-saving instruments. Quantity discounts for industrial concerns and educational authorities. Apply to our Orpington address for full details. Price 44/6 in plastic wallet (p.p. extra). **S.T.C. BRIDGE RECTIFIERS** B/112/2/1CW 24 V. 10 amp. D.C., brand new, 35/- (2/-). **ELECTROSTATIC VOLT-METERS** 0-15 kv., in oak carrying case, brand new, Everett Edgcumbe, £7/10/- (3/6). **HIGH FREQUENCY ALTERNATOR SETS** O/P 200 v., 1,100 cps, 1 ph., 1½ kVa I/p 415 v. 50 cps, 3 ph. Complete with control panel fitted with voltmeter, ammeter and frequency meter, motor switch gear and stabilizer. Manufactured by E.D.C. and brand new stock. Other alternators available for 400 and 2,000 cps. **COMMUNICATION RECEIVERS** Type R107, 1.2 to 17.5 mc/s. in 3 ranges, 9-valve superhet, 3 Kc/s. or 7.5 Kc/s. bandwidth, 100-250 v. 50 cps or 12 v. D.C. supply. Sensitivity 2-6μV. in ex. cond. £14/10/- (25/-). **R.107 RF** and **POWER UNITS,** brand new, from which superb communication receivers could easily be assembled. Complete R.F. units with drive and 12 v. D.C./230 v. A.C. power unit, supplied with cct. less valves, £4/19/6 the pair (15/-). Set of 4 valves 20/- (1/-). **R.107 L.F. TRANSFORMERS** 9/6 ea. (1/-). **TYPE R.206** 50 Kc/s. to 3 mc/s. cont. in 9 ranges, 15-valve superhet, 0.7, 2.5 or 8 Kc/s. bandwidth, 100-250 v. 50 cps or 12 v. D.C. supply. Sensitivity 2-4μV. Receiver, power unit and range extension unit, 3 units in all for only £30 (35/-). Type PCR2s £9/10/- (15/-). **TRANSMITTER RECEIVERS** 1986 TX RX Xstl controlled, 124-156 mc/s., tip-top cond., with instructions, £8/15/- (12/6). **CIRCUITS** available for R.107 and 1986 at 2/6 ea. (6d.). **E.E. SEALED REFRIGERATOR UNITS,** 110 v. 50 cps, with cooling coils, ice box and thermostat, charged. brand new, £20 (carr. extra). **INDICATOR UNIT** APW 9922A, 1-VCR97, 3-VR91, 2-VR54, 1-CV1285, 1-VT61, mumetal shield, focus and brill. controls, 8 pots, ideal for 'scope conversion or CRT display unit, new with oct., 37/6 (5/-). **COSSOR No. 11 OSCILLOSCOPES.** 3in. C.R.T., mains input, 1-5-40 mS. time base. Superb instrument in brand new condition. £10/10/- (£1). **COMPUTER MAGNETIC RECORDING TAPE.** ¼in. 600ft. lengths on 3in. centres, 15/- (1/6). **MICRO-AMMETERS.** 2½in. F.R. scale 0-500 microamps, 32/6 (1/6). **DRAYTON TYPE RQ MOTORS,** 37 r.p.m., 230 v. A.C., 75/- (4/-). **RHEOSTATS,** 1 ohm 14 amps 10/-, 14 ohm 4 amps 13/6 (1/6). **BATTERY CHARGER D.C. AMMETERS.** 0-20 amps 12/6, 0-50 amps 10/-, 0-50 volts 12/6 (1/-). **MAINS POWER UNITS FOR PCR RECEIVERS** 45/- (7/6). 12 v. **VIBRATOR POWER UNITS** for PCR receivers, 30/- (7/6). **E.E. CAP. START MOTORS.** 230 v. A.C. ¼ h.p., 1,425 r.p.m., £5/19/6 (7/6). **ADVANCE SIGNAL GENERATORS** Type 49, 230 v. A.C. I/P 20 to 110 mc/s., 1 v. to 10 mV. (with 100μA. carrier meter), in 5 ranges with int. mod., exc. cond., £10 (10/-). **TINSLEY GALVANOMETERS.** 885.45, 500 mm. per A., £10/10/- (10/-). **SWITCH BOARD METERS.** 0-200 amps. 400-0-400 amps, 0-500 v., 0-400 amps., 30-0-30 amps., 60-0-60 amps, 30/- ea. (5/-). **BERITEX METEOROLOGICAL BALLOONS.** 500 g. 15/- (1/6). **A.C. AMMETERS.** 2½in., 0-40 amps, 50 cps, moving iron, 12/6 (2/-). **S.T.C. MIN. RELAYS.** 4186 ED and 4186 GE, 17/6 (1/-). **SUNVIC HOT WIRE VACUUM SWITCH RELAY CONTROLLERS.** F102-3, 230 v. 2 kw., 30/- (3/-). F203-8, 230 v. 7 kw., 45/- (3/-). **HRO POWER UNITS.** 12 v. D.C. I/P. 35/-, new and boxed (3/6). **SIZE II SYNCHROS AND SERVO-MOTORS.** Types 26V11CT4A and 11M47A, available ex stock in brand new condition. We stock Magslips. Selsyns, Ipots, and all electrical components for automatic computation and control. Please add carriage in brackets.

Post orders to **1, HOPTON PARADE, STREATHAM HIGH ROAD, S.W.16.** Callers to **43, HIGH STREET, ORPINGTON, KENT.** Tels.: Streatham 6165 and Orpington 31066. **Terms: Nett monthly approved accounts only, otherwise C.W.O.**

MODEL TP5S

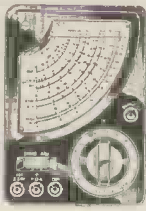
A.C./D.C. voltage up to 1,000 in 5 ranges. D.C. current 4 ranges up to 500 mA. 4 Range resistance to 10 megs. Capacity, dB scales, etc.

20,000 ohms/volt
Size $5\frac{1}{4}$ x $3\frac{1}{2}$ x $1\frac{3}{4}$in.

£5.19.6 P.P. 1/6.

With Test Leads, Battery and Instructions

MODEL 200H



20,000 ohms per volt

£6.19.6 P.P. 1/6.

With Test Leads, Battery and Instructions.

6 Ranges D.C. voltage to $2\frac{1}{2}$ kV.
5 Ranges A.C. voltage to 1 kV.
3 Ranges D.C. current to 250 mA.
Resistance to 6 meg.
Capacity and dB ranges.

★ Model TE10 ★

10,000 ohms/volt version o above

£5.19.6 P.P. 1/6.

SAME SIZE AND RELIABILITY.

AVO-7

Famous Multi-meter. Reconditioned and fully guaranteed.

Full A.C./D.C. voltage and current, resistance, dB, power, etc. etc.

Supplied with Batteries, Leads and Instructions.

£11.10.0 Regd. Post 5/-.

(Normal price £19/10/-.)

BARGAIN OFFER!

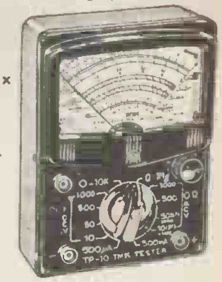
MODEL TP10

A.C./D.C. voltage up to 1 kV. in 4 ranges. D.C. current up to 500 mA. in 2 ranges. 2 Range resistance to 1 meg.
Capacitance, dB ranges, etc.

2,000 ohms/volt.
Size 5 x $3\frac{1}{2}$ x $1\frac{1}{4}$in.

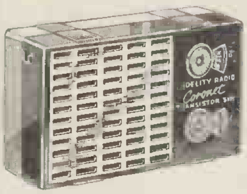
79/6 P.P. 1/6.

With Test Leads, Battery and Instructions.



FIDELITY POCKET RADIO "CORONET"

MEDIUM AND LONG WAVE



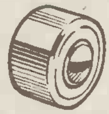
- Attractive 2-tone cabinet.
- Size $4\frac{3}{4}$ x $2\frac{3}{4}$ x $1\frac{1}{2}$in.
- Earphone/Record socket.
- 12 Months' Guarantee

£9.19.6 P.P. 2/-. With Battery and PVC Case.

BRITISH DESIGN AND CONSTRUCTION

PERSONAL EARPHONE FOR CORONET 12/6 EXTRA.

MERCURY BATTERIES

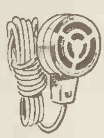


1.3V, 2200 mA/H, $\frac{5}{8}$ x 1in. dia., 2/6; 1.3 V. 5000 mA/H. 2 x $\frac{5}{8}$in. dia., 2/6; 1.3 V. 500 mA./H. $\frac{5}{8}$ x $\frac{3}{8}$in. dia., 1/3; 1.3 V. 14000 mA/H, $2\frac{1}{4}$ x $1\frac{1}{4}$in. dia., 5/-.

★ EXTENSION SPEAKER UNIT ●
Gives "Big Set" performance from any Transistor Portable—just plugs into Earphone Socket. 57/6. P.P. 1/6.
Ideal for "Coronet" or 7 transistor.

★ CRYSTAL LAPEL MICROPHONE

Ideal for Tape Recording Very sensitive.



17/6 P.P. 1/-.

★ LIGHT-WEIGHT 4,000 OHM HEAD-PHONES

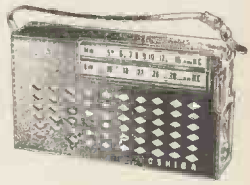
12/6 P.P. 1/-.

● 7-TRANSISTOR ●

MEDIUM AND LONG WAVE LUXURY POCKET RADIO

- Superb Reproduction.
- Exceptional sensitivity.
- Two-tone Cabinet.
- Lever operated MW/LW switch.

Fully guaranteed.



Size 6 x $3\frac{1}{4}$ x $1\frac{1}{4}$ inches.

Supplied in presentation box complete with leather case, carry straps, personal earphone, battery, etc. **16 gns.**

ELECTRONIC DESIGNS VALVE VOLTMETER

TYPE 165-A

FULLY GUARANTEED

D.C. ELECTRONIC VOLTMETER
6 Ranges. 0-3-10-30-100-300 and 1,000 volts. Input res.: 11-meg. constant on all ranges. Sensitivity: 3,666,666 ohms per volt on 3 v. scale.

A.C. VOLTMETER
5 Ranges: 0-10-30-100-300-1,000 volts. Sensitivity: 1,000 ohms per volt.

ELECTRONIC OHMMETER
6 Ranges, from 0.1 ohms to 1,000 megohms. Movement. 200 microamperes.
D.C. accuracy ±2%.

COMPLETE WITH INSTRUCTION BOOK AND TEST PRODS, BRAND NEW.

Input 110-250 volts A.C.

£12.10.0 P.P. 3/6.

PRACTICAL TRANSISTOR CIRCUITS
3/6
Post Free.
Contains easy to follow plans of 40 all transistor units, including light operated switches, amplifiers, transmitters, receivers, test oscillators, signal tracers, hearing aids, radio control, etc. All parts available separately.

★600 ohm PERSONAL EARPHONE with jack plug and socket. 10/6. P.P. 1/-.

STEREO AMPLIFIER

BARGAIN OFFER

- 2 watts per channel.
- Full tone, balance and volume controls.
- Complete with sockets, dials, etc. **97/6** P.P. 2/6.

Suitable Speakers, 10 x 6in., 49/6 pair. UA14 Stereo Deck, £8/19/6. P.P. 3/6.
READY BUILT & TESTED.

PORTABLE LOUD HAILER
★ Pistol grip action. Special shape horn. Built-in batteries and detachable microphone. Made of lightweight materials. Weight 4 lbs. **£14/10/-**

RECORD PLAYER AMPLIFIER

- 2-watt output.
- Ready built with Valves and 8 x 5 Speaker, Tone and Volume controls. Printed circuit.

75/- P.P. 2/-.

Ideal for Portable Record Player.

- UA8 4-speed Record Changer, ideal for above. **£6/19/6.** P.P. 3/6.

TELEPHONE ADAPTOR
★ Ideal for recording telephone conversations. Supplied with screened cable. Fitted rubber sucker. 14/–. P.P. 9d.

CRYSTAL MICROPHONES

ACOS 39-1. Stick Microphone with screened cable and stand (list 5 gns.), 39/6. P.P. 1/6.

ACOS 40. Deck Microphone with screened cable and built-in stand (list 50/-) 19/6. P.P. 1/6.

ACOS 45. Hand Microphone with screened lead, very sensitive, 29/6. P.P. 1/6.

MODEL 100C STICK MICROPHONE
Supplied complete with detachable desk stand, neck cord, 7ft. screened cable, built-in muting switch. 39/6. P.P. 1/6.
★ **BRAND NEW FULLY GUARANTEED.** ★

POCKET IRON
★ Pocket Soldering Iron, 220/250 v. A.C./D.C. 30 watts, complete with mains plug, case, etc. Handle unscrews to cover element, enabling iron to be carried in pocket. 18/6. P.P. 1/–.

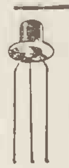
1 Kohm DYNAMIC MICROPHONE
Hand held or desk stand, complete with screened able. Excellent response. 49/6. P.P. 1/–.

CRYSTAL MIC INSERTS
★ ACOS 43-2 $2\frac{1}{4}$in. round, 12/6. P.P. 6d.
★ ACOS $1\frac{1}{2}$in. round, 7/6. P.P. 6d.
★ $\frac{3}{4}$in. square, 3/6. P.P. 6d.

LOUD IMPEDANCE HEADPHONES, 6/–. P.P. 1/3.

MINIATURE PANEL METERS (D.C.)

0/50 microamp.	39/6
0/500 microamp. ...	32/6
0/1 milliamp.	27/6
Vu meter	42/6
"S" meter	35/–



TRANSISTORS

We Stock a Transistor and Components for Every Purpose. FROM **3/6**

ENQUIRIES WELCOMED

1st GRADE—FULLY GUARANTEED

SEND FOR LATEST PRICE LIST

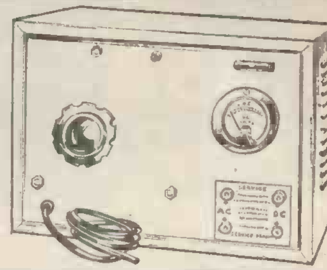
HENRY'S RADIO LTD.

5 HARROW ROAD, EDGWARE ROAD, PADDINGTON, LONDON, W.2.
Opposite Edgware Road Tube Stn. *PADdington* 1008/9. OPEN MON. to SAT. 9-6. THURS. 1 o'clock

SEND 1/- STAMP FOR COMPLETE LISTS AND NEW CATALOGUE

A.C./D.C. OUTPUT UNIT

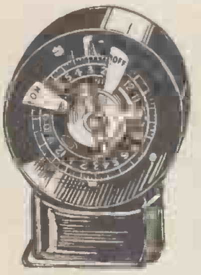
FIRST IN THE FIELD AT A PRICE THAT DEFIES ALL COMPETITION. This unique power unit will give variable outputs of 0-260V. A.C. or 0-230V. D.C. at 8 ampere, from normal 230V. 50 cycles A.C. input. A voltmeter is fitted so that an indication of output voltage A.C. or D.C. is always available. Robustly constructed sheet metal case well ventilated for continuous operation, complete with safety fuse, neon indicator and meter. A modern instrument for up to date development and research. Size 17in. x 12in. x 7in. Weight 36lb. Brand new, freshly manufactured. **Price £34/10/0.** Carriage 20/–.



MAINS POWER SUPPLY UNITS. Potted and sealed transformer and choke by famous maker. Mounted on metal chassis 6½ x 7½in., complete with 5Z4 rectifier valve and full smoothing.

Input tapped 220-230-240 volts.
Output: 300 V. D.C. at 100 mA.
6.3 V. A.C. at 4.5 amp.
6.3 V. A.C. at 2 amp.
Rectifier supply 5 V. A.C. at 3 amp. Very conservatively rated. Price 47/6 plus P. & P. 8/–.

MULLARD TRANSISTORS. OC170, 70 to 100 Mc/s., 13/6 each. OC171, 100 to 200 Mc/s., 14/6.
Set of six 1 x OC44; 2 x OC45; 1 x OC81D; 2 x OC81. Six for 39/6.

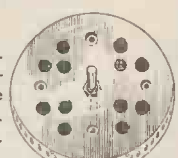


14-day clockwork TIME SWITCH
Contacts 2½ amp., 230 volt, 24 hour phase, ¼ hour divisions, allow setting for one make and one break to be made every 24 hours, complete with key. Used but guaranteed perfect. Price 27/6 each. P. & P. 2/6.

14-day clockwork TIME SWITCH as above but fitted with 5 amp. contacts and enclosed in an aluminium weather proof case. Price 35/-. P. & P. 2/6.

Similar **TIME SWITCH**, 1 amp. contacts, loose not cased. Price 22/6. P. & P. 2/–.

NEW RHEOSTAT.
1,750 ohms 100 watt. Wound on Ceramic former. In metal case with 1in. x ¼in. spindle. New in maker's packing. 32/6 each. P. & P. 3/–.



EX P.O. MAGNETIC COUNTER. 3 ohm type for 6 V. D.C. operation. 4 figures to 9,999. Price 8/6. P. & P. 1/6.

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.

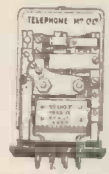
NEW BALANCED ARMATURE HEADPHONES. TYPE DLR5. Guaranteed perfect. Price 12/6 each. P. & P. 2/–.

PHOTO MULTIPLIER, type 931A, for Alfa counting, film scanning, spectography, etc., new, inclusive of 11 pin valve holder. Price £2/7/6. P. & P. 1/-.

NSP2—CV2296 STROBOTRON FLASH-TUBE made by Ferranti, brand new, on I.O. base. Price 15/–. P. & P. 1/–.

MOVING COIL HEADPHONES, 150 ohm impedance. Padded, rubber backed chamois earmuffs. Superb reproduction. Complete with Jack Plug. 21/6. P. & P. 1/6.

CARPENTER'S TYPE POLARISED RELAYS. 2 x 9,500 turns at 1,685 ohms. Price 22/6 each. P. & P. 1/–.



Bases for Carpenter relays ex new equipment. 3/6 each.

HIGH SPEED RELAY. Siemens. Two bobbins 1,000 ohms each. New, 10/6 each. P. & P. 1/–.

HIGH SPEED RELAY. Siemens. Two coils 145 ohms each. New 10/6 each. P. & P. 1/–.

VACUUM SEALED 3,100 OHMS RELAYS. Single pole changeover contacts in platinum. Pull in at 1.25 M.A. (4.25 volt). Price 18/6 each. P. & P. 1/-.

G.E.C. SEALED RELAYS TYPE M1095. 24 volt 670 ohms. 2 make 2 break. Unused. Price 12/– each. P. & P. 1/–.

G.E.C. SEALED RELAYS TYPE M1494. 24 volt 670 ohms coil. 1 pole C.O. Brand new. Price 10/–. P. & P. 1/–.

NEW P.O. RELAYS TYPE 3000. 2,000 ohms coil. 4 make 4 break, 12/6 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 ⅞ x ¾in. Price 22/6 each.

MINIATURE MOVING COIL DIFFERENTIAL RELAY exactly as above but totally sealed in metal case. New Price 27/6 each.

MINIATURE RELAYS 250 ohms. Two makes. For operation on 4.5-9 volt. Ideal for transistor circuits. Weight just over 1 oz. Price 12/6 each.

SIEMENS H.S. RELAY. Very latest type, sealed. H96E. 1,700 ohms plus 1,700 ohms, single C/O contacts. Brand new with fixing clip. In maker's cartons. Price 16/6 each, plus 1/– P. & P.

SOLENOID OPERATED MAGNETIC RELAY. Type 5CW/3945, 4 pole changeover. 10 A contacts 24 v. operation. Brand new 13/6. P. & P. 2/-.

W.W. RHEOSTAT. New. 3.5K or 5K, 25 watts. Price 7/6. P. & P. 1/6.

CONSTANT SPEED, PRECISION MADE, BATTERY DRIVEN D.C. GOVERNED MOTOR (Elliott Bros.). Commutator/brush incorporating loading ballast resistor 2,470 r.p.m. ± 2% at 2¼ volt. Loss on 8.5 volt only 4%. Size 1$\frac{1}{16}$in. dia. x 2$\frac{5}{16}$in. long. Spindle .77in. long x .15575in.dia. Weight 4 oz. New. Price 25/–, plus 1/– P. & P. Ideal for portable tape recorders.

A.C. VARIABLE VOLTAGE TRANSFORMER, brand new, imported, highest quality electrical engineering, fully shrounded with voltage indicating plate. Input 230 volt A.C. Output fully variable from 0-260 volt A.C. at 20 ampere. Size: 16in. x 12in. diameter. Nett Weight 53 lb. **Price £32/10/0.** Carriage Paid.

Similar **A.C. VARIABLE VOLTAGE TRANSFORMER** for 230V. A.C., output fully variable from 0 to 260 volts at 5 amp. Size 8in. x 8in. x 5¼in. Weight 13lb. **Price £9/0/0.** Carriage Paid.

MINIATURE UNISELECTOR SWITCH. Two banks of ten plus home contacts one band continuous of normal. 30 ohm coil for 24 volt operation. Brand new, manufacturer's packing. Price 22/6 each. P. & P. 2/6.

DESK TELEPHONE HANDSETS
Used but perfect. Complete with two-way calling system (buzzer). internal battery. All ready for simple two-wire connection. Price £3/2/6 each or £6 the pair. P. & P. 3/6 each handset.

DESK TELEPHONE SETS, similar to G.P.O. extension telephones. Each complete with automatic dial, internal bell and long connection core and junction box. Used but in perfect working order. Price £2/17/6 each. P. & P. 4/–.

DIALS ONLY FOR AUTOMATIC TELEPHONES. Used but in good condition. Price 12/6. P. & P. 2/–.

CROMPTON PARKINSON BRAND NEW ¼ H.P. MOTORS
230/250 VOLT A.C. 1,440 R.P.M. Complete with 2in. SPINDLE. **Price £3/15/–.** Carriage 8/6.

ROTARY CONVERTER. Ex-W.D. for 12-volt D.C. input, output 230 volt 50 cycles at 100 watts. Housed in wooden carrying case with lid. Voltage control slider resistance, mains switch and 300 volt A.C. voltage output check meter. Perfect working order. Price £9/17/6, carriage 10/–

Postage and Carriage shown above are inland only. For overseas please ask for quotation. We do not issue a catalogue or list.

SERVICE TRADING Co.

PERSONAL CALLERS ONLY: **9 Little Newport Street, London, W.C.2** *Tel: GER 0576.*
(OFF LEICESTER SQUARE)
ALL MAIL ORDERS. ALSO CALLERS AT:
47-49 **High Street, Kingston-on-Thames**
Telephone: KINgston 9450

LASKY'S RADIO

"CLARION" TRANSISTOR BATTERY TAPE RECORDER

Capstan drive, push-button controls. Constant speed $3\frac{3}{4}$ i.p.s., uses 3in. spool. High impact plastic case with transparent upper. Size: $9\frac{1}{2}\times 5\times 3\frac{3}{4}$in. List 25 Gns.

Lasky's Price $16\frac{1}{2}$ Gns. with Mike and Tape, Carr. 7/6.

The LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. 3 motors, 3-speed $1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$ i.p.s., takes 7in. spools. Push-button controls, Digital counter complete with Spool, Carr. & Ins. 12/6. Lasky's Price £10.19.6

TAPE PRE-AMPLIFIER

For use with any Tape Deck including Collaro, Motek, etc. Full recording facilities for $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i.p.s., multi-position switch gives automatic equalisation by negative feed-back to each speed, 4 valves including magic eye level indicator. Overall dim.: $12\times 4\times 5$in. Front panel: $12\frac{1}{2}\times 3\frac{1}{4}$in. Attractive gold hammered finish. LASKY'S PRICE 9 Gns. Post 3/6.

TRANSCRIPTION MOTORS

GARRARD 4HF, stereo or mono, with plug-in head	£19 8 7
GARRARD 301	£23 9 9
GARRARD 301 (Strobe)	£25 2 6
GARRARD A with GC8	£22 9 9
GARRARD A with GSC10	£23 5 6
PHILIPS AG/2009	10 Gns.

Carr. and Ins. 12/6.
Also Lenco, Connoisseur, etc.

FULLY GUARANTEED TAPE AT RECORD LOW PRICES

Famous make, P.V.C. base on latest type plastic spools. New, perfect, boxed, guaranteed.

1,200ft. on 7in. spool	18/-
1,800ft. on 7in. spool	28/6
1,200ft. on $5\frac{3}{4}$in. spool	18/6
850ft. on $5\frac{3}{4}$in. spool	15/6
600ft. on 5in. spool	12/-
225ft. on 3in. spool	6/6
2,400ft. D.P. on 7in. spool	55/-
SCOTCH 1,200ft. P.V.C. on 7in. (Listed 35/-)	21/-

ALL OTHER MAKES, TYPES AND SIZES OF TAPE IN STOCK, INCLUDING E.M.I. AND SCOTCH.

LASKY'S FOR ALL TYPES OF POCKET AND PERSONAL TRANSISTOR RADIOS

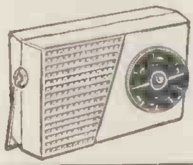
LARGEST SELECTION IN GREAT BRITAIN

An unsurpassed choice at the keenest prices, including the latest med./long and med./short wave models. Call and select or order by post.

FIDELITY 6	$9\frac{1}{2}$ Gns.
LEECO 6	$9\frac{1}{2}$ Gns.
PERDIO 6	$11\frac{1}{2}$ Gns.
CROWN 6	£10 19 6
DANSETTE 6	15 Gns.
PHILIPS 7	15 Gns.
SONYA 8 m/short	22 Gns.
TOSHIMA 7, m/long	16 Gns.
NATIONAL 7, m/short	23 Gns.
N.V.C. 10, 2 short & med.	$29\frac{1}{2}$ Gns.

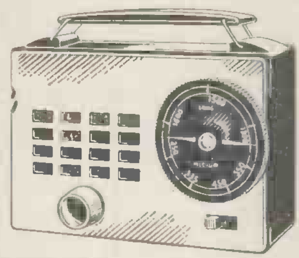
Redg. post and insurance, 5/-.

THE "TORONTO" 3



Employs three transistors plus germanium diode and built-in ferrite rod aerial. Tunable over medium and long waves. Dimensions: $5\frac{1}{4}\times 3$in. $\times 1\frac{1}{2}$in. overall. CAN BE BUILT FOR 32/6. Post 3/6. Circuit diagram and step-by-step instructions, 1/6 (free with parcel).

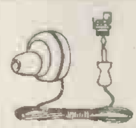
THE NEW "ALBERTA 5" TRANSISTOR POCKET RADIO



Push-pull 200 milliwatts, output, 5 transistors and one diode, $2\frac{1}{2}$in. moving coil speaker, ferrite rod aerial. Med. and long wave. Smart plastic case, $5\frac{3}{4}\times 3\frac{1}{2}\times 1\frac{1}{2}$in. overall. CAN BE BUILT FOR 59/6 Post 3/6

Circuit diagram and data 1/6 (free with parcel). All components available separately.

MINIATURE EARPIECES for Pocket Transistor Radios. Transparent ear-insert with 3ft. cord, sub-min. jack and socket. Fully guaranteed. Post free.



CR.5. Crystal, high imp. 9/-.
MR.4. Magnetic, low imp. 8/-

BUILD THIS 3-SPEED TRANSISTOR RECORD PLAYER FOR ONLY £9.19.6 Post free

6 v. operation for all L.P. and standard records. All components available separately as below.

AMPLIFIER. 300 milliwatts p.p. output using two OC71 and two OC72. Fully assembled, 79/6. Knobs, 3/6 extra. Post 2/6.

SPEAKER. 30 ohms, 7×4 elliptical, matched to amplifier, 25/-. Post 2/-.

3-SPD. TURNTABLE. 6 v. complete with t.o. crystal cartridge and two sapphire styli, 79/6. Post 2/6.

CARRYING CASE. Smart two-tone finish, size $17\times 14\times 5\frac{3}{4}$in. high, 49/6. (Batteries extra). Post 6/6.

"KINEMATIX" STEREO BALANCE METER UNIT

Brand new U.S.A. import. Gives perfect balance in seconds, enabling stereo effect to be re-created in any particular area of room. For use with all hi-fi stereo amplifiers. Complete in smart polished wood Cabinet, $6\frac{1}{4}\times 3\frac{1}{4}\times 4$in., with instructions. Listed at 7 Gns. LASKY'S PRICE 59/6 Post 2/6.

MINIATURE PANEL METERS

New range of meters with clear plastic cases. $1\frac{3}{32}$in. square front. Panel hole $1\frac{1}{2}$in. diameter. Guaranteed brand new, individually boxed. Ranges available: 50 Microamps, 39/6. 500 Microamps, 32/6. 1 Milliamp, 27/6. VU Meter. Range $-20-0\times 3$VU. 0-100% (OVU) at 600 ohms. LASKY'S PRICE 42/6

"S" METER. Range "S" Units 0-9 terminating +10 and +30db 0-5 and 0-10 linear scale. LASKY'S PRICE 35/-

SPECIAL OFFER! "VERDIK QUALITY TEN" HI-FI AMPLIFIER & PRE-AMPLIFIER

LISTED AT £21
LASKY'S PRICE £14.19.6
Post & Pkg. 7/6.

LAST FEW! AVANTIC AMPLIFIERS

SP21. Stereo Pre-amp Control Unit, £16/19/6. Carr. and ins. 7/6.

PL6/21. 20-watt Monaural Amp. and combined control unit. 19 Gns. Carr. and Ins. 7/6.

"LINEAR" AMPLIFIERS

"Diatonic" 10-14 watts	12 Gns.
"Concord" 30-watt	16 Gns.
L.45 4.5-watt	£5 19 6
LT45 Tape Deck Amp.	12 Gns.
L10 10-watt with pre-amp.	15 Gns.
L50 50 watt	22 Gns.
L5/5 Amplifier and Pre-amp.	12 Gns.

ANOTHER TAPE RECORDER SCOOP!! THE VOGUE BERMUDA

Incorporates Collaro studio tape deck, 3 speeds, dual track pause control. rev. counter latest type electronic level indicator, superimposed switch, $4\frac{1}{2}$ watts output. Originally made to retail at 42 gns. Smart carrying case size.
LASKY'S PRICE 25 Gns. Carr. and Ins. 21/-.
Price includes reel of tape, spool and microphone. This is a COMPLETE RECORDER, brand new and ready for use.

NEW TAPE RECORDER KIT

Handsome two-tone blue carrying case, $17\frac{1}{2}\times 6\times 16\frac{1}{4}$in., goldine fitments, removable lid, cut to fit Collaro studio tape deck. Amplifier uses 4 valves, EF86, ECC83, EL84, EM81 level indicator, 2 inputs, mike and radio, low level output jack, separate power pack with contact cooled rectifier. All component parts sold separately.
Amp. complete with valves and power pack. LASKY'S PRICE £8.19.6 P. & P. 3/6.
$7\times 7\frac{1}{2}\times 4\frac{1}{2}$in. loudspeaker 16/6. P. & P. 1/6.
Carrying case 75/-. P. & P. 10/6.
LASKY'S SPECIAL PRICE for above 3 items. Carr. 12/6 £12.19.6
COLLARO Studio Tape Deck, 3 motors, 3 speeds, etc. LASKY'S PRICE £10.19.6 Carr. 12/6

MICROPHONE BARGAINS

ACOS CRYSTAL STICK MIKE. Type M.C.39/1, complete with cable. List £5/5/-, LASKY'S PRICE 39/6 Post free.

Crystal Hand or Table Mike, 15/-. Post free.

MINIATURE moving coil dynamic microphone. Incorporating switch and pocket clip. As used for the "Fi-Cord" 35/-. Post 1/6.

LASKY'S MIDGET T.R.F.

An enormously popular Table Radio for A.C. mains 200/250 v. Med. and long wave. Can be built absolutely complete for only 99/6 Post 5/-
Full data, circuit diagram, etc., 1/6. (Free with parcel).

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

LASKY'S RADIO

★ *Largest and most comprehensive stocks of all components, test gear, etc., and finest values in Great Britain.*

4-SPD. AUTO-CHANGERS

B.S.R. UA12, STEREO	£7 19 6
B.S.R. Type UA8	£6 19 6
B.S.R. UA8, STEREO	£7 19 6
B.S.R. type UA14......	£7 19 6
COLLARO Studio C60 wired for stereo, with monaural p.u.	£7 19 6

Post on all above 5/-.

GARRARD

Model 120	£8 8 0
Model 121	£9 9 0
Model 209	£9 19 6
Mdl. 210 STEREO ...	£11 0 0
Mdl. 210 MONO/STEREO	£12 10 0
RC.88........................	£12 19 6
RC.88 STEREO	£13 10 0
RC.98........................	£14 19 6

SINGLE PLAYERS

Auto start and stop. Complete with pick-up and crystal cartridge.

GARRARD 4SP	£6 19 6
GARRARD TA Mk II, wired for STEREO, plug-in head	£8 9 0
E.M.I. 4-spd., wired for STEREO, fitted mono cartridge...	£5 19 6
As above, STEREO ...	£6 19 6

Post on all above 5/-.

COLLARO JUNIOR 4-speed motor and separate pick-up............ 75/-
B.S.R. TU9, non-auto Turntable and separate pick-up............ 79/6
Post free.

PICK-UP CARTRIDGES

ACOS, G.P.67 turn over crystal cartridge with L.P. and standard styli. List 39/7. **Lasky's Price 18/-.**

ACOS 73-1A STEREO. List 52/6. **Lasky's Price 29/6 post free**

BUILD THE NEW LASKY FM TUNER FOR £4.19.6

P. & P. 8/6.

Non drift permeability lining pack by famous manufacturer, frequency 88/100 mc/s., OA81 balanced diode output 21F stages and discriminator. Smart gold and maroon glass dial 7×3in., self powered, valve line-up: ECC85, 2EF 80's, EZ 80 rectifier. Everything ready for assembly. All components available separately. Dimensions 8 x 6 x 5¼in. Optional extra EM84 magic eye tuning indicator 8/6. Circuit diagram and full data supplied 1/6 post free.

SPECIAL OFFER! World-famous "BOGEN" TAPE RECORDER HEADS. 4 track, high fidelity full frequency range. Type UK.205 RECORD/PLAY BACK. Type BL.216 ERASE. Listed at 16 Gns. per pair. **Lasky's Price £9/19/6.** Post 2/6.

HIGH FIDELITY TAPE RECORDER HEADS. Leading make new and unused, 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. **Lasky's Price** Post free. Per pair **29/6**

LASKY'S CAR RADIO CAN NOW BE BUILT ABSOLUTELY COMPLETE FOR £9.19.6

★ Small size. Will fit any car
★ 12 volt operation
★ New Hybrid circuit
★ Transistor output
★ New type Brimar valves
★ No Vibrator, 12 volt H.T. & L.T.
★ T.C.C. Printed Circuit and Condensers
★ Tuned R.F. stage
★ Medium and long waves
★ Permeability tuning
★ 7in. × 4in. elliptical speaker

Instruction Booklet giving full details illustrations dimensions, circuit diagram and shopping list. 2/6 post free (returned if you order)

CAR RADIO TUNING HEART

Permeability tuned superhet, coil pack covering medium and long waves with tuned R.F. stage. Complete with pointer, needs no gang condenser. Its compact construction, small size 7×5×1½in., make it ideal for use in car radios (valve hybrid or transistor). I.F. 465 Kc/s. **Lasky's Price 49/6.** P. & P. 3/6. With circuit diagram and full data. Dial 2/6 extra.

Better than ever!

OUR NEW 196 /2 COMPONENTS CATALOGUE

Completely new edition of over 100 pages, 8½in. × 5½in., copiously illustrated, packed with money-saving bargains! Invaluable for the "ham" or service man.

Price 2/-, post 6d.

Our latest 12-page "Bargain Bulletin" included free (separately, by post, 6d.).

TRANSISTORS

P.N.P. Junction types.

AUDIO, suitable for high gain and low freq. amplifiers and for output stages up to 250 milliwatts. Double spot—yellow and green 3/6
R.F., suitable for medium and low freq. oscillators, freq. changers and I.F. amplifiers (1.5 to 8 Mc/s.). Double spot—yellow and red... 4/6
Type TSI. Suitable for all audio applications 2/6
Post 6d. One dozen 28/- post free.
Type Z, audio..............each 2/-
One dozen, 23/- post free.
Special prices for larger quantities.

OC44	OC45	OC70	OC71	OC72
8/6	7/6	6/6	6/6	8/-
OC73	OC75	OC76	OC81	OC28
16/-	8/-	8/-	7/6	19/6

OC81 7/6 (Matched Pair, 15/-.)

EDISWAN MAZDA TRANSISTORS

The very latest types:
XB/102 7/6; XB/103 7/6; XC/101 10/6; XA/101 12/6; XA/102 12/6.

SPECIAL OFFER. Set of 7 Ediswan Transistors: XA/101, XA/102, 2 XR/102, XB/103, 2 matched XC/101. Price 49/6.

CRYSTAL DIODES. General Purpose GEX00, each 1/-. Per doz. 9/-. All other types in stock.

"GOLTOP" POWER TRANSISTORS

All types in stock. Example:
V15/10P. Ideal for output stage of car radio, will give approx. 3 watts operating from 12 v. Each 15/- post free.
Suitable Output Transformer for above, correct ratio, matched to 3 ohms, 9/6. Post 1/-.
Driver Transformer, 9/6. Post 1/-.

SUB-MIN COMPONENTS

As used in the smallest Japanese pocket transistor radios. Coils, Loudspeakers, I.F. transformers. Ganged Condensers, etc., in stock at lowest prices. Also all T.S.L. transistorised Miniature Units.

20 000 VALVES IN STOCK

Brand new surplus and imported, also full stocks of B.V.A. valves. List post free.

P.M. SPEAKERS

3½in.	4in.	5in.	6½in.	8in.	10in.	12in.
17/6	19/6	10/6	16/-	16/6	25/-	27/6

ELLIPTICAL:—

7×4	9×6	10×2½	10×6	10×7
12/6	22/6	25/-	25/-	25/-

Post extra.

STEREO AMPLIFIER KIT FOR ONLY 56/-

Twin 4 watt (or 8 w. monaural), using two ECL82 and EZ80 rect. valves, double wound mains transformer, etc. Separate panel with bass, treble and volume controls. Indicator lamp, push button on/off switch. Kit comprises two amplifier units and power unit. Dim. 5×2in. Fully assembled ready to be wired. Priced without speaker so that you can choose type and size required. **Lasky's Price** for kit with 3 new Mullard valves 56/-. Post 6/6.
Full data, circuit diagram, assembly instructions and layout supplied. **Special offer of Speakers for this kit.** Two 5in. for 20/-. Two 6×4in. 25/-. Suitable cabinets at bargain prices.

MARTIN RECORDAKITS TAPE AMPLIFIERS

(as advertised)

KIT A. 4TR AMP for Monardeck. **LASKY'S PRICE 9 gns.**
KIT B (2TR) AMP for Monardeck. **LASKY'S PRICE 8 gns.**
KIT C for Collaro Studio deck. **LASKY'S PRICE 11 gns.**
Post free by return.

C.R. TUBE BARGAINS NEW AND UNUSED

FERRANTI. 12in. types T12/44 or 9in. type T9/3 4 v. heater............ 39/6
FERRANTI 17in. type TR17/10, 6.3 v. .3 amp. heater................ £4/19/6
Carr. and Insur. 12/6.

17in. 90 degrees C.R. TUBES

Seconds but in perfect working order and guaranteed........... 79/6
Carr. and insur. 12/6.

RE-GUNNED C.R. TUBES

GUARANTEED FOR 12 MONTHS

Type	From	Carr. & Ins.
12in. round	£5 10 0	12/6
14in. rect.	£5 10 0	12/6
15in. & 16 round	£5 19 6	12/6
17in. rect.	£5 19 6	12/6
21in. rect.	£7 19 6	21/-

RE-BUILDING CLEARANCE BARGAINS

at 42 Tottenham Court Road. Innumorable oddments and components clearing at silly prices. Callers only. Pay an early visit! This may be your last chance before demolition.

STOP PRESS

STUPENDOUS SURPLUS STEREO SCOOP

Brand new and unused in maker's cartons by a very well-known manufacturer, originally intended for record demonstrations. AC mains 195-250 v. Specification: Garrard 4 speed single record player (TA Mk. 2) complete with pick up, crystal stereo, cartridge and diamond stylus, twin 4 watt (8 watt monaural) amplifier, 3 valves, 2 ECL82 and EZ80 rectifier, vol. control, balance control, on/off switch fitted. Spring mounted on polished wood base 17in. × 14½in. × 8in. with plastic dust cover. Full data and circuit diagram supplied. Two specially matched Acousti-stereo loud speakers in cabinets, corner (floor or wall mounting). Dims.: 5ft. 3in. × 7½in.

LASKY'S PRICE £12.19.6 complete
Carr. & Ins. 25/- extra.

All units available separately, prices on request.

33 TOTTENHAM COURT ROAD, W.1.

2 mins. Oxford Street. Nearest Station, Goodge Street MUSeum 2605

207 EDGWARE ROAD, W.2.

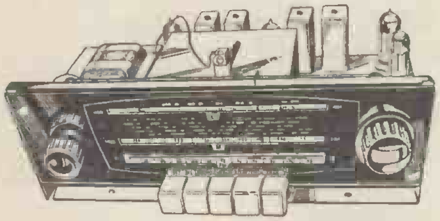
Few yards from Praed Street PADdington 3271/2

Both addresses open all day Saturday. Close 1 p.m. Thursday.

PLEASE ADDRESS ALL MAIL ORDERS TO DEPT. W. AT ABOVE EDGWARE ROAD ADDRESS.

SEE OVERLEAF FOR MORE NEWS FROM LASKY'S RADIO

BRAND NEW AM/FM (V.H.F.) RADIOGRAM CHASSIS AT £14 *(Carriage Paid)*

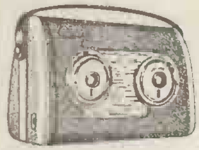


Tapped input 220-225 v. and 226-250 v. A.C. ONLY.
Chassis size 15 x 6½ x 5½in. high. New manufacture, 12 mths. guarantee.
Dial 14½ x 4in. in black and gold.
Pick-up. Extension Speaker. Ae., E., hd Dipole Sockets. Five "piano" push buttons —OFF, L.W., M.W., F.M. and Gram. Aligned and tested.
With all valves and O.P Transformer. Tone Control Fitted.
Covers 1,000—1,900 M.; 200-500 M.; 88-98 Mc/s.
Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85.
Speaker and Cabinet to fit chassis (table model), 47/6 (post 3/6).
10 x 6in. ELLIPTICAL SPEAKER, 20/-, to purchasers of this chassis.

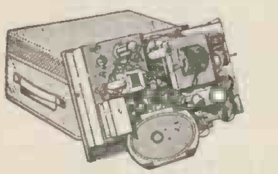
TERMS: (Chassis) £5 down and 5 Monthly Payments of £2, or with Cabinet and Speaker £5/10/- down and 6 Monthly Payments of £2.

This chassis is an ideal partner for the radiogram cabinet appearing on this page.

Fully Built and Guaranteed 6 Transistor Printed Circuit Radio. Originally £16/16/-. OUR PRICE ONLY £10 carr. paid. 12in. x 7½in. high x 4½in. at base, tapering to 2in. at top. 5in. Speaker—L.W. and M.W. Car AER Socket; Ferrite AER; covered in Beautiful Duracour Fabric. BRAND NEW.



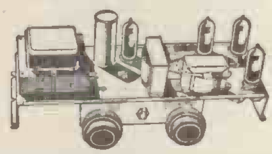
TAPE RECORDER FOR ONLY £17.17.0 (10/- carr.)



A QUALITY ARTICLE. Valves EZ80, ECC83, ECL82, DM70. Acos Crystal "mike," 850ft. Tape and extra spool. 3¾in./sec. Mike and Radio inputs: Vol. on/off tone, Ext. L.S. and Monitor. Fast forward and reverse. Cannot be accidentally erased. Magic Eye Indicator. 6 x 4in. Speaker. Cabinet 14 x 11½ x 7in. Supplied completely built and in cabinet.

STEREO & MONO AMPLIFIERS £4.15.0 (3/- p. & p.)

Brand new. 200-250 A.C. Tone and volume controls each channel. EZ80, ECC83 and 2-EL84, giving 2 x 4W. Size 12 x 3½ x 3½in. O.P. trans. for 2-3Ω speaker. Separate on-off switch to allow balancing to remain set. Monaural push-pull amplifier giving 8W same price.



TRANSISTORS

Packet of matched OC78 (2) Output and 1—OC78D Driver Stage for 20/- (ref. LFG3).
Packet of one each of OC44, (mixer Osc. yellow spot): OC45 (1st I.F. orange spot) and OC45 and I.F. blue spot) for 20/- (ref. RFG3).
The two packets of total of six Transistors will be supplied for 37/6, post paid.

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR

Three motors, three speeds, 1⅞, 3¾ and 7½in. per sec. Takes 7in. spool. Push button controls. £10/17/6 (10/- carr.). Tape and spool 30/- extra the pair.

Latest B.S.R. MONARDECK. Single speed 3¾in. per sec. Takes 5¾in. spools. Only £7/2/6 (plus 5/6 carr.). 850ft. first grade Tape, 5¾ plastic spool, 16/- (post 1/-).

SELF-POWERED V.H.F. TUNER CHASSIS (200-240 V AC)

covering 88-95 Mc/s. Mullard permeability Tuner. Dims. 10½in. x 4½in. x 5in. high. ECC85, EF91, EF91 and 2 Diodes. Metal Rectifier. Mains trans. Fully wired and tested. £7/14/- carr. paid.
Room dipole 10/-. 300 ohm twin feeder 6d. yd.
Without Power Pack £6/14/- carr. paid.

AUTOMATIC RECORD CHANGERS

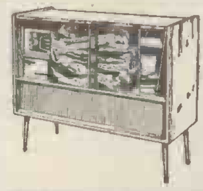
4 sp. turnover crystal cartridge. Wired for stereo, fitted monaural cartridge. B.S.R. UA14 £7/10/-. Motor board to fit 3/6. Collaro C.60 £7/15/-. Carr. 5/- either type.

UNREPEATABLE OFFER OF AM-FM CHASSIS AT ONLY £9.9.0 carr. pd.

A small quantity of Printed Circuit chassis by famous manufacturer. Valves UY85, UCH81, UF89, UABC80, UL84 and UCC85. O.p. trans. for 2-3 ohm speaker. Chassis 14 x 7 x 7in. Front controls concentric, left—Vol. and Tone; right—W/c and Tuning. "Gold" centre knobs provided. 2-dial bulbs. Sockets, AE; E; Ext. sp; P.U. Mains isolating provided free. Coverage: Long, Med., VHF (87-101 Mc/s). Unused, slightly tarnished, but not dirty; New Mullard Valves; not our manufacture, so no guarantee.

NEW LOUDSPEAKER BARGAINS. Good Makes.

2-8 ohms. 13 x 8½in. 35/- (4/-); 7 x 4in. 14/6 (2/-); 6½ x 4½in. 12/6 (2/-); 10 x 6in. 25/- (3/-); 5in. 12/- (2/-); 4in. tweeter 7/6 (2/-); 7 x 5in. 17/6 (2/-); 9 x 6in. 22/- (2/6). Postal charges bracketed.



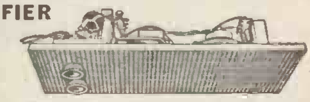
SUPERB CONTEMPORARY CABINET

Fitted with 3 sliding doors providing room for Radio, Autochanger, 4 speakers, and record storage.

PRICE **15 Gns.**

Free delivery in London area.
35/- carriage elsewhere.

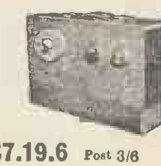
GRAMOPHONE AMPLIFIER



with 5in. SPEAKER. On Fabric-covered Baffle 12½ x 6in. Mains and Output Transformers. EZ40 and EL41 Valves. Tone and Volume Controls. On/Off switch. Plenty of Volume. Fully guaranteed. Two Knobs supplied. Ready to play. Useful for Stereo. ONLY 57/-. Post 3/-.

The "CANTATA" 6-transistor and diode Portable Kit

400 mW. push-pull output; Ferrite rod aerial; M.W. and L.W.; operates on two 4.5 v. cells; full working instructions; booklet of full assembly and alignment instructions; all parts sold separately, write for list; speaker. Price includes every item needed to assemble. Cabinet is supplied completely built. Cabinet size 9½in. x 6in. x 3½in. Car aerial socket provided. 6 Mullard Transistors. Printed circuit 8 X 3 speaker; alignment service 17/6 incl. post.
Fully built & aligned set £10.10.0 carr. pd.
Full guarantee.



£7.19.6 Post 3/6

TAPE RECORDER CASE 55/-; Size 17½ x 13½ x 8in. Hinged lid. Plain Board Inside. Our 57/- Gramophone Amplifier fits this Case. Carr. 5/-.

BATTERY ELIMINATOR

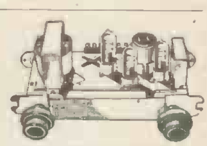
For 4 Low Consumption Valves (96 range), 90 v. 15 mA. and 1.4 v. 125 mA., 42/6 (2/6 post). 200-250 V. A.C. Size 5¼ x 3¾ x 2in. Also for 250 mA. 1.4 v. and 90 v. 15 mA. at same price.

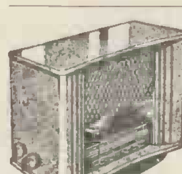
BEREC BATTERY RADIO

25-75 M. and M.W. or 41-120 M. and 16-49 M. Either type £5/4/- (2/6 p. & p.).

3-VALVE AMPLIFIER

4 watts. Valves: EZ80; ECC83; and ECL82. Tone and vol. controls, bass and treble. 13in. x 4in. x 5in. over valves. Mains and O.P. Trans. and 6½in. x 4½in. Celestion speaker. Suitable for mic. and guitar. 200-240 v. A.C. 67/- (P. & P. 4/-).





COMPLETE V.H.F./A.M. RADIO FOR £12/10/-

(carr. paid)
Brand new set, in superb walnut cabinet (size 19 x 8½ x 14½in. high). Covering 80-100 Mc/s. 16-49 M. and 200-500 M. Mains trans. 200-250 v. with 2 tappings. Ferrite rod aerial for A.M. Controls: volume on/off, tone, tuning, w/change. Gram and ext. speaker position provided. Valves 12AT7, 12AH8, 6BJ6, EABC80, 6BW6 and metal rectifier. Fully guaranteed. Today's Value, £20.

Delivery by return. C.O.D. 2/- extra. Terms: Cash with order or one-third down and balance plus 12/6 (up to £7/10/-) in equal four monthly payments. Balance over £7/10/- add 2/- in £1 and pay in not more than 6 monthly payments. See special terms for A.M.-F.M. chassis. All new goods unless stated. Send 6d. for 20-page catalogue. SATISFACTION GUARANTEED. Posted orders to FARNBOROUGH.

GLADSTONE RADIO

56 Stokes Croft, Bristol, 1 Tel. 27809

"SCALA," CAMP ROAD, FARNBOROUGH, HANTS Tel. 3371

247, New Road, Copnor, Portsmouth, Hants.

(Portsmouth and Bristol closed Wednesday.) (Farnborough closed Sat.)

VISIT OUR FULLY EQUIPPED HI-FI SHOWROOM AT TOTTENHAM COURT ROAD FOR DEMONSTRATIONS OF THE LATEST HI-FIDELITY EQUIPMENT BY ALL LEADING MANUFACTURERS

i.e., Leak, Quad, Armstrong, Dulci, Ferrograph, Reflectograph, Tandberg, Vortexion, Tannoy, Linear, Wharfedale, Grundig, Goodmans, W.B., Rogers, Garrard, Lenco, B.T.H., Pamphonic, Simon, Brenell, Collaro, Telefunken, Fi-Cord, etc., etc. A full range of high quality cabinets to suit all purposes is on show. Enquire about our interesting part-exchange scheme for personal callers. H.P. Available

RECORD PLAYERS

Full range at usual competitive prices. Interesting H.P. facilities

E.M.I. MODEL 985 4-SPEED SINGLE RECORD UNIT. Very latest type. Heavy 8¾in. dia. turntable, low flutter performance. 200/250 v. with tap at 80 v. for operating amplifier valve filament if required. Complete with matching pick-up with mount and rest. Brand new and fully guaranteed. **ONLY 89/6**, plus 3/6 P. & P. Pick-up available separately, complete with mount and rest 25/-, plus 1/6 P. & P.

4-SPEED BATTERY OPERATED VERSION OF ABOVE 6 volt operation complete with pick-up £5/9/6 plus P. & P. 3/6.

TRANSISTOR AMPLIFIER now available for use with the above battery player. Compact size, 500 milliwatts output, printed circuit construction, tone and volume controls. Supplied complete with 8in. x 2in. 20 ohms matching quality speaker. Price only 89/6 plus 2/6 P. & P.

LATEST GARRARD MODEL 210. Four-speed manual or automatic. 10in. and 12in. records of same speed can be mixed in any order, wired for stereo, attractive white colour scheme. Price 10½ gns., plus 3/6 P. & P.

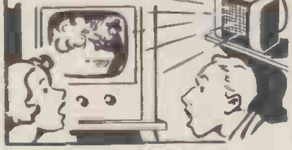
JUST RELEASED! LATEST GARRARD 4-SPEED AUTO SLIM—Monaural, wired for stereo, £9/3/4. Plus 3/6 P. & P.

LATEST B.S.R. UA20. Small compact. 4 speed. For Stereo/Monaural use at £8/19/6. Plus 3/6 P. & P.

LATEST B.S.R. UA14. 4-speed Attractive appearance. Wired for stereo. Fully guaranteed. £7/19/6. plus 3/6 P. & P.

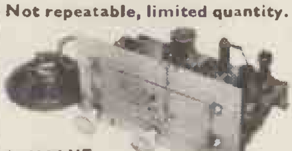
B.S.R. UA14. Stereo/Monaural. Fully guaranteed. £8/19/6, plus 3/6. P. & P.

This highly efficient unit is simple to assemble, extremely sensitive and may be installed in a matter of minutes. Completely SAFE employing a double wound mains transformer. Attractively finished in Red and Grey (washable) "Lionide" with cream plastic escutcheon. Size only 7½in. x 3¾in. x 6¾in. Supplied in kit form complete with mike at ONLY 72/6 plus 2/6 p. & p. or assembled and tested 89/6 p.&p. 2/6. Suitable mike flex available at 3d. a yard. Instruction book and price list separately 1/- post free A.C. 200-250 v.



TWO CHASSIS BARGAINS!

Not repeatable, limited quantity.



4 VALVE AC/DC SUPERHET (as illus.). Medium and long waves. Valve line up UCH42, UAF42, UL41, UY41. Dial size 6½ x 2½in., Overall chassis size 9in. x 6½in. x 5½in. high. Complete with 5in. quality speaker, ready to fit, at only £5/17/6 plus 5/- p. & p. Also, as above, but FOUR STATION PRE-SET SUPERHET chassis. Two controls only, volume on/off, and simple 4 station rotary selection switch. Set to Light, Home and Third programme, also Light programme on long waves. Frame aerial included, also 5in. quality speaker mounted on chassis. Overall measurement 9in. x 6½in. x 5½in. high. Only £4/17/6 plus 5/- p. & p.

FRUSTRATED EXPORT. Not repeatable! **L., M. and S.W. SUPERHET RECEIVER.** Manufactured by McCarthy for export. At present for operation on 6 volts. but conversion details supplied free.

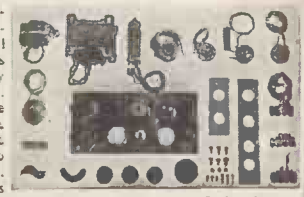
Valve line-up: 6K8G, 6K7G, 6Q7C, 6F6G, 6X5G and 6 volt 4-pin non-synchronous vibrator. 8in. P.M. Speaker, 4 watts output. P.U. socket. Ext. L.S. socket, etc. Tone control. Fitted in polished wood cabinet, size 21½in. x 10½in. x 10½in. These cabinets are slightly soiled owing to storage, but each is guaranteed unused, in serviceable condition, tested prior to despatch. Price £5/19/6 only plus P. & P. 7/6, plus 28/6 for A.C. Mains Conversion Components if required. **OUTSTANDING BUY!**

A.M. RADIOGRAM CHASSIS. Manufacturers' surplus. Brand new and fully guaranteed. Long, Medium and Short Waves. ECH81, EF89, EBC81, EL84, EZ80, slow motion tuning, tone control, ferrite rod aerial. Provision for gram, extension speaker, and tape play-back. Chassis size 11in. deep by 8½in. wide.

Dial engraved on attractive brown and gold front panel size 16½in. x 9in. which forms escutcheon for easy fixing. LIMITED QUANTITY ONLY at £8/19/6 plus 5/- P. & P. H.P. available.

NEW! TAPE RECORDER CONSTRUCTORS

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. Latest type incorporating Record, Interlock, Lever, Button, 3 motors, 3 speeds, 1⅞, 3¾, 7½ i.p.s., takes 7in. spools. Push-button controls. £12/19/6 plus 5/- P. & P. Usual H.P. facilities.



NEW! TAPE RECORDER AMPLIFIER TYPE 8311-V. Sub-assembled — anyone can build! Printed Circuit, all components mounted and dip soldered. Already tested. Each lead cut to length. All that is required to complete the tape recorder is for a few components to be mounted in the cabinet and the free ends of the leads soldered to terminals which are clearly marked. Everything supplied, all you need is solder iron, pliers and screwdriver. Valve line-up, EF86, ECC83, 2 x EL84, EZ81 and EM84 magic eye. Monitoring facilities, output socket for feeding to high quality amplifier, can be used as "straight" amplifier for record reproduction. EQUALISING ON TWO SPEEDS. OUTSTANDING VALUE AT £11/11/- plus 2/6 P. & P. including all necessary instructions

ATTRACTIVE TWO-TONE PORTABLE CARRYING CASE. Suitable for above amplifier and Collaro Studio deck. Fitted with 9in. x 5in. High Flux P.M. speaker for high quality reproduction. Inclusive price £5/5/-. Plus 5/- P. & P.

The above 3 items purchased at one time, SUPPLIED CARRIAGE PAID N.B. Any microphone listed hereunder is suitable for use with this recorder.

CRYSTAL MICROPHONE. Sensitive Miniature Lapel-type. Complete with clip and screened lead. Brand new, 17/6. Plus 6d. P. & P. (as illustrated).

MIC 45-1. Acos latest flat pistol-grip crystal microphone. Attractive black and gold finish. OUR PRICE 29/6 plus 1/- P. & P. **ACOS MIC-39-1.** Crystal stick microphone. List price 6 gns. Our price 39/6 plus 1/6 P. & P. **MIC 40.** General-purpose crystal microphone with desk stand. Our price 22/6 only plus 1/6 P. & P. **100C.** Imported crystal, attractive streamlined polished metal case, incorporates muting switch. OUR PRICE 39/6 plus 1/- P. & P. (stand 8/6 extra).

Large range of microphones in stock—ask for list.

TELEPHONE PICK-UP COIL. Designed to feed into the microphone input of either a tape recorder or any high gain amplifier. Easily attached to telephone by rubber suction attachment. The coil is electrostatically shielded to minimise hum pick-up. When positioned on telephone this model is more than adequate for a fully modulated tape recording. Brand new complete with 5ft. shielded cable. ONLY 14/-. P. & P. 1/6.

SUPER MAGNETIC RECORDING TAPE SPECIAL!!!
Famous American Ferrodynamics **"BRAND FIVE"**

An enthusiast's "must." Brand new (NOT SUB-STANDARD) High grade Acetate Base. 5in. 600ft. 16/-, 5in. 900ft. 18/6, 5¾in. 1,200ft. 23/6 7in. 1,200ft. 25/-, 7in. 1,800ft. 35/-. Extra quality Mylar Dupont, 3in. 300ft. 13/-. 5in. 1,200ft. 37/6, 7in. 1,800ft. 44/-, 7in. 2,400ft. 60/-. Each on plastic spool. All Post free. *Trade enquiries invited*

PLASTIC TAPE SPOOLS. Best quality. 3in. 1/6, 5in. 2/-, 5¾in. 2/3, 7in. 2/6. **PLASTIC SPOOL CONTAINERS** for spool sizes 5in. 1/6, 5¾in. 2/-, 7in. 2/3. Any single item plus 6d. P. & P. Orders over £1, post free.

LANGUAGE COURSES ON TAPE!

Complete Elementary Course in French, Italian, German or Spanish. Phrase book supplied. 5in. long play tape, 55 minutes at 3¾ i.p.s. Price ONLY 29/6 per course. Post Free! Trade Supplied.

EXTRA SPECIAL OFFER !!

A small three-valve **PORTABLE RECORD PLAYER AMPLIFIER** mounted on baffle 12 x 7in., with High Flux 6½in. Loudspeaker. Valve line-up UCC83, EL84, EZ80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high impedance pick-up. Ready for use, £5/12/6. P. & P. 3/6.

NEW STYLE CABINET finished in two-tone Leatherette. Will accommodate above Amplifier and Baffle without modification, also most types of Ancillary Equipment. Overall size 18 x 13½ x 8½in. Fitted with carrying handle, £3/9/6, plus 5/- P. & P.

NOTE. If both items purchased together they will be supplied at a special inclusive price £8/7/6, plus 6/6 P. & P.

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

18 Tottenham Court Road, London, W.1.
162 Holloway Road, London, N.7.
9 Camberwell Church St., S.E.5.

● TURN OVER FOR MORE CLYNE BARGAINS ➜

AN ELECTRONIC ORGAN

TO BUILD YOURSELF!

FULL COMPASS
TWO MANUAL

Fully Polyphonic Great
Monophonic Solo
Complete with
Pedal Board

ONLY (approx.) **£160**
Plus cost of Console.

Also available with both Manuals fully Polyphonic at £190 approx. Plus cost of Console.

Consoles are available in Fibreglass, Oak, etc., from £25.

Large selection of Organ parts available.

ALL REQUIRED COMPONENTS AND FULL CONSTRUCTIONAL DETAILS SUPPLIED. ***H.P. TERMS ARRANGED.***

Already tried and proved throughout the country!

Send stamp for full details or, better still, visit our High Fidelity showroom to see and play a working model of this amazing organ.

INCLUSIVE OFFER!!

STEREO AMPLIFIER fitted in ATTRACTIVE TWO TONE REXINE CARRYING CASE

4 watts per channel. Both speaker units are detachable (as illustrated), volume/on off, bass and treble controls. A.C. mains 200/240 v. Cabinet cut out for B.S.R. Stereo autochanger. Full connection details supplied. Special price 13½ Gns. plus 7/6 P. & P. Limited quantity only.
B.S.R. UA 14 STEREO AUTOCHANGER available at £8/19/6 extra. Plus 3/6 P. & P.
(Both items sent post free if purchased together.)

TELEPHONES!!!

The Best value yet offered!

LIMITED QUANTITY

Attractive appearance.
Operate from 6-volt battery. Ideal for Home, Office, Factory, etc. Simply turn handle and bell rings at other end. Any twin lighting type flex required for connection. Not new but good condition. Tested before despatch.
5 GNS. Per pair complete with batteries, plus C. & P. 7/6.
Suitable twin P.V.C. clear plastic flex 3d. per yard or 20/- per 100 yards.

TRANSISTORISED MINIATURE TAPE RECORDERS

The following Japanese recorders are available for Callers only:—

"SANDY" @ £10.19.6. "APOLEC" @ £12.19.6. "MINY" @ 16½gns. and the fantastic professional model, fully automatic, two speed.

"PT.4K DOKORDER" @ 49GNS.

Wt. under 3lbs. Size: 7¾"×3⅜"×2¼". Complete in leather case with shoulder strap, and every conceivable extra. Mains adaptor available.

Illustrated leaflet on request.

Demonstrations with pleasure!

VALVES

We have perhaps the most up-to-date valve stocks in the trade. New imported valve types fully guaranteed and P.T. paid and all the usual surplus types at special prices. We also carry a comprehensive stock of all B.V.A. types at current list prices. Send stamp for NEW list now available. Note: Certain American special purpose types can be supplied. Enquiries invited.

No. 38 AFV WALKIE-TALKIE. A wonderful offer. This famous trans-receiver unit, with relay operated **SEND/RECEIVE** switch covering 7.4-9 Mc/s band, range approx. 5 miles. Good condition. **ONLY 22/6**, plus 2/6 P. & P. per unit (less accessories). Quantity export inquiries welcomed.

SMALL SOLDERING IRON. With vinyl carrying case, mains lead and 2 pin plug A.C. 230 v. Handle unscrews and becomes protective cover for the bit. Only 18/9. Post free. Spares: Bit 1/3. Element 4/6.

SOLDER. New boxed 1 lb. reels, 16 S.W.G. 50/50 at 8/6 only, plus 1/- P. & P.

RETURN OF A WINNER!!!

(Exclusive)

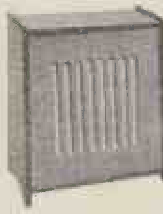
We have been fortunate in obtaining a further limited supply of this fine and popular cabinet. Instantly recognised as being of leading High Quality manufacturer's stock, this trolley-type cabinet is finished in polished dark walnut. Can easily be adapted to accommodate tape recorder, amplifier, radiogram, loudspeaker enclosure, etc., etc. External measurements: 24½in. x 16in. x 29in. The whole is mounted upon "easy run" castors. Subject to being unsold £4/19/6 Plus 15/- C. & P.

ANOTHER PORTABLE CABINET BARGAIN! Ex leading manufacturer's battery portable attache type case. Attractive two-tone grey rexine finish. Size closed 13½in. x 9¼in. x 3¾in. Complete with fittings and handle. Including Medium and Long Wave frame aerial which fits in lid. On/off switch on lid stay. Limited quantity only at bargain price of 19/6 plus 2/- P. & P. Brand new.

STOP PRESS!

The well-known Brayhead
TRANS TRONIC "SUPER 60" RADIO KIT

A complete construction kit to make your own transistorised Transmitter and Receiver. No soldering reqd. 7 different circuits to build. Ideal Xmas Gift—beautifully presented in original manufacturer's coloured box with all necessary instructions. (As nationally advertised at £5/4/8.) Limited quantity only at 49/6. Plus P. & P. 4/-.



EXTENSION SPEAKER CABINETS

As illustrated; new design in light oak.
Two sizes available. For 6½in. or 8in. speaker at 22/6. For 10in. speaker at 25/- only.
Each plus 2/6 P. & P. Suitable reconditioned 8in. P.M. unit at 13/6 only, plus 1/6 P. & P. Ask for speaker list.

OUTSTANDING METER IMPORT!

20,000 OHMS PER VOLT!!

Actual size 4½ x 3¾ x 1in.

MODEL 200H. Volt-ohm-Milliammeter
RANGES:
A.C. VOLTAGE: 10, 50, 100, 500 and 1,000 volts (10,000 ohms per volt).
D.C. VOLTAGE: 5–25, 50, 250, 500 and 2.5k. (20,000 ohms per volt).
D.C. CURRENT: 0–50 micro-amps., 0–2.5 m/a., 0–250 m/a.
RESISTANCE: 0–6k. 0-6 meg. (300 ohm and 30 k. at centre scale).
CAPACITANCE: 10 pf. to .001 mfd., .001 mfd. to .1 mfd.
DECIBELS: −20 to +22 db.
A fully guaranteed pocket size meter, knife edge pointer, top quality, supplied complete with test prods and full operating instructions at **£6.19.6** ONLY Post free.

JUST ARRIVED!! Model TE10. *Identical in appearance and size with rotary type switch but 10,000 ohms per volt.*
Ranges: D.C. Voltages: 0–6–30–120–600–1,200 volts (10,000 ohms per volt). A.C. voltage: 0–6–30–120–600–1,200 volts (10,000 ohms per volt). D.C. current: 0–120 microamp., 0–3–300mA. Resistance: 0–30K, 0–3 Meg. (150 ohms and 15K at centre scale). Capacitance; 50pf to 0.01 mfd., 0.001 mfd. to 0.15 mfd. Decibels: −20 to +63 DB in 5 ranges. **PRICE £5.19.6** Post free.
Bona-fide trade enquiries invited.
Optional extra, attractive carrying case 15/- only. Leaflet available.

TO BUILD YOURSELF!

We have over 40 different circuits to build yourself, including all current JASON KITS. We are specialists in this field. A stamp will bring full list. Our reputation is your guarantee.

CLYNE RADIO LTD.

THE COMPONENT SPECIALISTS

18 Tottenham Court Road, London, W.1.
162 Holloway Road, London, N.7.
9 Camberwell Church St., S.E.5.

ALSO SEE PREVIOUS PAGES

VALVES

Brand new, individually checked and guaranteed

- AC5PENDD 4/-
- AL60 6/-
- AP4 4/-
- AR8 5/-
- ARDD5 2/-
- ARP3 4/-
- ARP4 3/6
- ARP12 2/9
- ARP21 5/6
- ARP24 3/6
- ARP34 4/6
- ARTH2 7/-
- ATP4 2/9
- ATP7 5/6
- AU1 5/-
- AU4 5/-
- AW3 4/-
- AZ31 8/-
- BL63 6/-
- BS4A 5/6
- BT45 25/-
- BT9B 25/-
- BT83 22/6
- CV54 5/-
- CV264 35/-
- CY31 7/6
- D41 3/3
- D77 4/3
- DA30 12/6
- DAF91 6/-
- DAF96 8/-
- DD41 4/-
- DET5 15/-
- DF72 7/6
- DF91 3/3
- DF96 8/-
- DK96 7/3
- DL92 6/-
- DL94 6/-
- DL96 8/-
- DX25 9/-
- EBC21 8/-
- EBC91 3/9
- E1232 5/6
- E1323 25/-
- E1436 3/6
- E1524 6/6
- EA50 1/6
- EABC80 7/3
- EAC91 4/6
- EB34 1/6
- EB91 3/9

- EBC41 7/9
- EBC90 5/-
- EC52 8/-
- EC70 10/-
- EC90 20/-
- ECC81 5/6
- ECC82 6/6
- ECC83 7/-
- ECC84 7/-
- ECC85 8/-
- ECC91 4/-
- ECF82 8/6
- ECH42 7/6
- ECH81 7/9
- ECL80 8/-
- ECL82 9/-
- EF22 7/3
- EF32 5/-
- EF36 3/6
- EF37A 8/-
- EF39 4/3
- EF50 2/6
- EF54 3/3
- EF55 6/-
- EF70 4/-
- EF73 6/-
- EF80 5/6
- EF85 6/10
- EF86 9/-
- EF89 7/9
- EF91 3/6
- EF92 4/6
- EF95 7/6
- EK32 7/-
- EL32 3/9
- EL33 8/-
- EL35 8/3
- EL41 8/3
- EL42 9/-
- EL84 7/6
- EL85 10/-
- EL91 7/6
- EM80 8/-
- EN31 22/6
- EP71 6/6
- EP72 5/-
- ESU208 8/-
- EY51 8/-
- EY86 8/-
- EY91 3/6
- EZ40 7/-
- EZ41 6/9

- EZ80 6/6
- EZ81 6/9
- FW4/500 6/6
- GL450 10/-
- GL464A 10/-
- GZ32 9/-
- HL23 6/-
- HL23DD 8/-
- HVR2 12/6
- KRN2A 19/-
- KT31 8/-
- KT32 8/-
- KT33c 4/9
- KT44 6/3
- KT76 10/-
- KTW62 7/6
- KTW63 6/6
- MH4 3/6
- MH41 5/-
- ML4 4/-
- ML6 6/-
- MS/PEN 6/-
- NT37 (4033A) 10/-
- OB3 7/-
- OC3 5/-
- OD3 5/-
- OZ4 5/-
- PCC84 7/-
- PCC85 8/-
- PCF80 7/-
- PCF82 8/-
- PCL82 8/6
- PEN25 4/6
- PEN46 5/-
- PEN65 6/6
- PEN220A 3/-
- PENDD/1360 9/6
- PL36 10/6
- PL81 9/-
- PL82 8/-
- PL83 7/9
- PT15 10/-
- PT25H 7/6
- PVD7 7/6
- PX4 19/-
- PX25 10/-
- PY80 6/9
- PY81 7/-
- PY82 8/-
- PY83 7/3

- QP21 6/-
- QP25 5/3
- QS75/20 6/9
- QS95/10 6/9
- QS108/45 6/9
- QVO4/7 12/6
- QVO5-25 5/-
- R3 8/-
- R3/10 4/-
- R10 12/6
- REL21 25/-
- RK34 2/6
- RX235 10/-
- SP2 4/-
- SP13C 4/6
- SP41 2/6
- SP61 2/-
- SU2150A 4/9
- T41 7/-
- TP25 15/-
- TT11 3/-
- TZ20 16/-
- U17 5/-
- U18 6/6
- U27 8/-
- U52 5/-
- UBC41 7/6
- UCH42 7/6
- UL11 5/-
- UL12 5/-
- UL41 7/-
- UL84 7/6
- UL85 7/-
- UU9 5/6
- UY41 6/-
- UY85 6/6
- VP23 3/6
- VP41 5/6
- VR78 4/-
- VR99 8/-
- VR105/30 7/6
- VR150/30 7/3
- VT4C 25/-
- VU39 6/-
- VU111 3/3
- VX3138 12/-
- W31 7/-
- Y63 5/-
- Y66 8/-
- Z31 6/-
- 1A3 3/-
- 1A5GT 5/-
- 1C5GT 7/6
- 1D8GT 6/-
- 1E7G 7/6
- 1G6GT 12/-

- 1L4 3/6
- 1LD5 3/6
- 1LN5 4/9
- 1R5 6/-
- 1S5 5/9
- 1T4 4/-
- 1W4 6/-
- 2A3 8/-
- 2A5 8/-
- 2A6 7/-
- 2C34 2/6
- 2D4A 4/-
- 2D21 6/-
- 2X2 4/-
- 3A4 5/-
- 3B7 5/-
- 3B24 8/-
- 3E29 (829B) 60/-
- 3Q5GT 9/-
- 3S4 5/-
- 3V4 6/-
- 5T4 9/-
- 5U4G 5/-
- 5V4G 8/-
- 5Y3GT 6/-
- 5Z4 8/6
- 5Z4G 8/-
- 6AB7 4/-
- 6AC7 3/-
- 6AG5 3/6
- 6AG7 6/-
- 6AJ7 4/3
- 6AK5 5/-
- 6AK7 8/-
- 6AM5 5/-
- 6AM6 6/3
- 6AQ5 7/-
- 6AT6 5/-
- 6B7 5/6
- 6B8G 2/6
- 6C4 3/6
- 6C5 6/-
- 6C6G 4/3
- 6C8G 5/-
- 6D6 4/6
- 6F6G 4/-
- 6F8G 6/6
- 6F12 4/6
- 6F17 7/6
- 6G6G 3/-
- 6H6M 2/-
- 6J5 3/6
- 6J5G 3/-
- 6J6 4/3
- 6J7G 5/-

- 6K6GT 3/6
- 6K7G 2/3
- 6K7GT 4/9
- 6K8G 5/9
- 6K8GT 8/3
- 6K8M 8/6
- 6L5G 6/-
- 6L6 9/-
- 6L6G 6/6
- 6L34 4/6
- 6N7G 5/9
- 6N7GT 6/-
- 6Q7G 6/-
- 6R7 8/-
- 6SA7 6/-
- 6SC7G 5/6
- 6SC7GT 6/-
- 6SG7 5/-
- 6SH7 4/6
- 6SJ7 6/6
- 6SJ7G 5/9
- 6SK7 5/3
- 6SL7GT 6/6
- 6SN7GT 4/6
- 6SQ7 6/-
- 6SS7 6/-
- 6V6G 5/6
- 6V6GT 6/-
- 6X4 5/-
- 6X5GT 6/-
- 6Y6G 8/-
- 6Z4 5/6
- 7B7 7/6
- 7H7 7/3
- 7C6 7/-
- 7C7 6/6
- 7Q7 7/-
- 7V7 5/-
- 7Y4 6/-
- 7Z4 6/-
- 8D2 2/6
- 9D2 3/-
- 12A6 5/-
- 12AH7 7/-
- 12AT7 5/6
- 12AU6 9/-
- 12AU7 6/-
- 12AX7 7/-
- 12C8 3/-
- 12E1 22/6
- 12H6 2/-
- 12K7GT 4/6
- 12K8M 9/-
- 12J5GT 3/6
- 12Q7GT 4/6
- 12SA7 7/6

- 12SC7 4/6
- 12SG7 6/6
- 12SH7 3/-
- 12SJ7 6/-
- 12SK7 4/-
- 12SL7 7/-
- 12SN7 8/-
- 12SR7 6/-
- 15D2 6/-
- 15E 8/-
- 15R 7/6
- 20A2 7/6
- 21B6 9/-
- 30 5/-
- 35L6GT 8/-
- 35T 30/-
- 35Z4GT 7/-
- 37 4/-
- 38 4/-
- 58 6/-
- 59 6/-
- 75 8/-
- 76 5/-
- 77 6/-
- 78 7/-
- 80 6/3
- 82 8/-
- 83V 12/-
- 84 8/-
- 85A1 12/-
- 85A3 15/-
- 89 6/-
- 210LF 3/-
- 210VPT 7-pin 2/6
- 250TH £9
- 274B 3/-
- 350B 8/-
- 393A 15/-
- 705A 17/6
- 715B 97/6
- 717A 8/6
- 801 6/-
- 803 22/6
- 804 55/-
- 805 30/-
- 807 AMER 6/-
- 807BR 6/-
- 808 8/-
- 810 80/-
- 813 67/6
- 815 40/-
- 816 30/-
- 826 10/-
- 829A 30/-
- 832 15/-
- 832A 35/-
- 843 7/4

- 866A 10/-
- 872A 35/-
- 930 8/-
- 954 2/-
- 956 2/-
- 958A 5/-
- 1616 3/-
- 1619 5/-
- 1625 6/-
- 1626 4/6
- 1629 4/6
- 6064 10/-
- 6120 4/-
- 7193 1/9
- 7475 5/-
- 8013A 25/-
- 8020 6/-
- 9001 4/6
- 9002 5/6
- 9003 6/-
- 9004 4/-
- 9006 4/-

Cathode Ray Tubes:
- CV1596 (O9J) 55/-
- 5BP1 35/-
- 5CP1 42/6
- 5FP7 45/-
- 7BP7 40/-
- 12DP7 60/-
- VCRX258 (with scanning coil) 45/-
- VCR138 30/-
- VC139A 35/-

Photo Tubes:
- CMG8 9/-
- GS16 12/6
- 931A 50/-

Special Valves:
- 2J31 45/-
- 3A/1481 45/-
- 3J/170/E £35
- 3J192/E £37/10
- 723A/B 50/-
- 725A 30/-
- 726A 27/6
- ACT6 200/-
- ACT17 75/-
- ACT25 40/-
- CV691 60/-
- KR3 45/-
- LS7B 30/-
- V1924 22/6
- VX7110 15/-
- WL417A 15/-

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves.

All U.K. orders below 10/- P. & P. 2/-; over 10/- 2/6; orders over £3 P. & P. free. C.O.D. 2/6 extra. Overseas Postage extra at cost.

B.P.5 TRANSCEIVERS. Specially built for Parachutists during the war. Receiver Superhet Transmitter crystal controlled. CW. and phone. 2-8 mc/s., 829 valve as output. 60 w. on CW, 15 w. on microphone, together with mains power pack 120/220 v., two rotary converters to work from 12 v. battery, microphone, key and dipole aerial. Price £15. Carriage 30/-.

SPECIALLY BUILT POWER PACK for TCS receivers, 230 volts A.C. mains, including 6X5GT valve, £3/10/-. Carriage 5/-.

SUPPLY UNIT RECTIFIER No. 21. Fully sealed enabling all sets built for 6 v. (R209, R109, etc.) to work from A.C. mains. Input 90 v.-260 v. A.C. (taps at 10 v. intervals); output excellently smoothed up to 10 amps. with meter indicating exact output voltage. Measurements 12 x 9 x 10in. Price £8. Carriage and packing 15/-.

FREQUENCY METER BC221 TECHNICAL MANUAL 22/6.

VIBRATOR UNIT. 12 v./160 v. 35 m/amps. Exceedingly well filtered and smoothed. Excellent for car radios. Including one 6X5G valve and vibrator 17/6. P. & P. 7/-.

U.H.F. SIGNAL GENERATOR TYPE TS14 3,200-3,370 mc/s., power measuring range 20-200 mW., R.F. output power −20 to −100 dbm below 1 mW. Power supply 115 w. A.C. Price £15. Carriage 15/-.

TELEPHONE HANDSET. Standard G.P.O. type new, 12/-. P. & P. 1/6.

R.109 RECEIVER. Covering 2-8 mc/s. 6 v. D.C. with set of spare valves and carrier. Brand new in original packing case. £6/18/- including delivery in U.K.

POWER SUPPLY UNIT. Input 200/250 v. A.C., 50 cycles. Output: 1, HT 280/350 v. 300 mA. smoothed; 2, MT 150/200 v. 40 mA. (positive earthed); 3, LT 18/25 v. 4 amp. D.C. smoothed (negative earthed). 2 relay switching, H.T. and M.T., safety switch fuses on A.C. and all D.C. Two 5Z3 for H.T., one 6X5 for M.T. Selenium rectifier for L.T. Ideal for Ham transmitters. Weight 45 lb. Dimensions 14 x 8½ x 18in. Price £12/10/- including valves. P. & P. 25/-.

BRAND NEW ORIGINAL SPARE PARTS FOR AR88 RECEIVERS.

I.F. TRANSFORMERS. 1st, 2nd, 3rd, 4th (for type D), 12/6 each, or complete set of 6, 60/-.
I.F. Transformers. Crystal Load, 12/6 each.
Plates escutcheons for (D and LF), 15/- each.
Dials (for type D), 10/- each.
Logging dial (for D and LF), 10/- each.
Filter Chokes (for D and LF), 22/6 each.
Output Transformers (for LF), 30/- each.
Antenna Trimmers (LF and D), 2/6 each.
Filter Condenser. 3 x 4μF, £2/10/-.
Condensers, 3 x .25μF (D and LF), 2/6 each; 3x .01μF (D and LF), 2/6 each.
RF Antenna Inductors (D and LF), 7/6 each.
Mains Transformers (LF), £3 each.
Small Mica Condensers, various values, 1/6 each.
Small Trimming Tool, 7/6.
Instruction Manual for AR88D, £1.

FAMOUS RCA TRANSMITTER TYPES ET 4336, K. & L. Frequency 2 mc/s-20 mc/s. Power output: 350 w. telegraph, 250 w. telephone. Type of modulation—Class B high level. Audio input impedance 500 ohms. Power supply 190 to 250 v. Single phase 50-60 c. Tube complement: Crystal oscillators 807. Master oscillators 807, Intermediate amplifier 807, Power amplifier 813(2), Modulator 805(2), Rectifier 866A(4). Complete with Master oscillators, crystal multipliers, speech amplifiers, microphones, keys, instruction manual, etc. We guarantee full supply of all replacement parts for a minimum of 5 years after purchase. Price on application.

P. C. RADIO LTD.
170, GOLDHAWK RD., W.12
SHEpherds Bush 4946

RCA 15 KW TELEGRAPH TRANSMITTER TYPE ET-4750 X. Frequency range 2-22 mc/s. Keying speed up to 250 words per minute. Power supply requirements 230 v. 3 phase 50/60 cycles. Tube complement: Oscillator—807 (1), Doubler (1st) Amplifier—807 (1), Intermediate power (2nd) Amplifier—813 (4), Power (3rd) Amplifier—889-R (2), Plate rectifier—827A (6), Auxiliary Rectifier—872A (3), Bias Rectifier—872A (2), Keyer-807 (2). Price on application.

R209 RECEPTION SET. A 10-valve high-grade Super Heterodyne Receiver with facilities for Receiving R/T (A.M. or F.M.) and C.W. frequency 1 mc/s-20 mc/s. Hermetically sealed. Built on miniature valves and incorporating its own vibrator power supply unit driven by a 6 v. battery (2 point connector included). The set provides for reception from rod, open-wire or dipole aerial with built-in loudspeaker or phone output. Overall measurements: Length 12in., width 8in., depth 9in. Weight 23 lb. In as new, tested and guaranteed condition, £23/10/-, including special headphone and supply leads. Carriage £1.

AR 88's. Completely rebuilt with new PVC wiring. Type "D" £75; Type "LF" £70.

COMPLETE SET OF STRONG AERIAL RODS (American). Screw-in type MP49, 50, 51, 52, 53, total length 15ft. 10in. Top diameter 0.185in. Bottom diameter 0.615in., together with matched aerial base. MP37 with ceramic insulator, ideal for car or roof insulation, £2/10/-, Post free.

VARIOMETERS for W/S No. 9. Fully tested and working, 12/6. P. & P. 2/6.

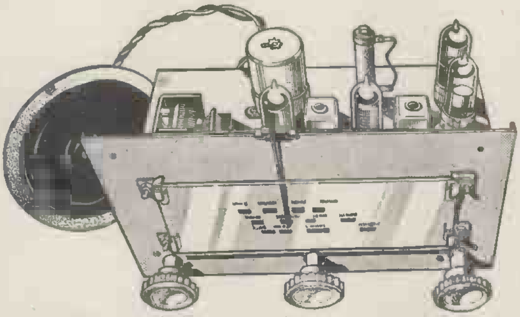
CARBON INSET MICROPHONE, G.P.O. type, 2/6. P. & P. 1/6.

FAMOUS AMERICAN CARBON HAND MICROPHONE. Type T.17 £2/5/-. P. & P. 3/6.

PERSONAL CALLERS WELCOME

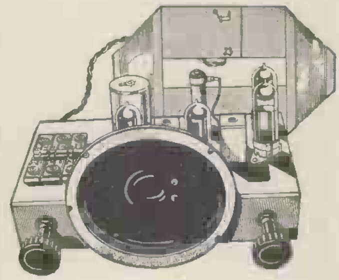
HARVERSON SURPLUS CO. LTD.

2 BAND SUPERHET CHASSIS
with Speaker **ONLY £4.19.6**
Plus 6/6 Post & Packing.



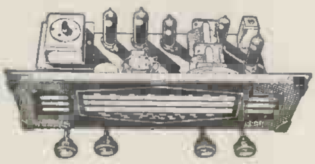
A quality 4 valve AC/DC superhet chassis made by a world famous manufacturer. Long and Medium wave coverage. Fitted with a cord and drum reduction tuning drive and attractive illuminated glass dial (size 6½ x 2½in.). Controls: Volume on/off, tuning and wave change. The receiver is self-powered, employing a mains dropper and a valve rectifier. Chassis dimensions 6¼ x 9 x 5½in. high. Supplied complete with a good quality 5-inch loudspeaker, valves (UCH42, UAF42, UL41, UY41), AC/DC mains input lead, ivory knobs, etc.
DON'T HESITATE, ORDER NOW! This unbeatable bargain is bound to sell out quickly at only £4/19/6 plus 6/6 post and packing.

4 STATION PRESET CHASSIS
with Speaker **ONLY £4.17.6**
Plus 6/6 Post & Packing



A compact, 4 station pre-set mains transportable receiver for operation from AC/DC mains. Two simple controls, volume on/off and 4 position station selector. The latter is set to Light Programme (Long Wave), Third Programme, Home Service and Light Programme (Medium Wave) but may of course be adjusted to alternative selections if required. A frame aerial with throw-out extension is supplied, making this receiver ideal as a general purpose transportable set for the home. A fully smoothed power supply is provided from AC/DC mains input by a mains dropper and a valve rectifier. The good tonal qualities are assisted by the provision of a quality 5in. speaker, which is ready-mounted on the chassis (this is easily detachable if alternative positioning is required). Valve line up: UCH42, UAF42, UL41, UY41. This chassis (size 9 x 6½ x 5½in. high) is supplied complete with valves, knobs, mains lead, aerial, etc. It is beautifully made by a famous maker, and is a first-class buy at the rock bottom price of only **£4/17/6.** plus 6/6 post and packing.

A.M. RADIOGRAM CHASSIS



A chassis of distinction by a famous maker. Covering Long, Med. and Short Waves, plus gram position, this chassis (size 15½ x 7 x 6½in. high), incorporates the latest circuitry, using fully delayed A.V.C. and negative feedback. Controls: Tone, Vol. On/Offi, W/Change (L.M.S. and Gram), Tuning, Tapped input 200–250 v. A.C. only. An attractive brown and gold illuminated dial with matching knobs, make this one of the most handsome, in addition to being one of the best performing chassis yet offered. Complete with valves (ECH81, EF89, EBC81, EL84, EZ81), knobs, output transformer, leads, etc. OUR PRICE ONLY **£9.19.6** plus 4/6 post & packing.

E.M.I. 4-speed Player and P.U.

Heavy 8½in. metal turntable. Low flutter performance. 200/250V. shaded motor with tap at 80V. for amplifier valve filament if required. Turnover LP/78 head. Price 89/6 plus 4/6 P. & P.

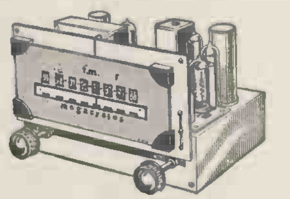
CONDENSER RESISTOR PARCEL
50 mixed P.F. Condensers and 50 mixed Resistors. An assortment of useful values. All popular sizes—all new—a must for the serviceman and constructor.
ONLY **10/-** P. & P. 1/-.

6 TRANSISTOR KIT
Less cabinet & speaker

Special offer. Limited quantity only of new ex-manufacturers parts to make a 6-transistor 2-waveband superhet chassis. Ideal for portable or table radio. All parts including transistors, ferrite aerial, printed circuit, etc., but EXCLUDING speaker and cabinet. Few only £4/19/6 plus 2/6 P. & P. Simple instructions 1/6 (free with kit).

A FEW ONLY £4.19.6 P. & P. 2/6

HARVERSON'S F.M. TUNER KIT



At last a quality F.M. Tuner Kit at a price you can afford. Just look at these fine features, which are usually associated with equipment at twice the price. ★ F.M. Tuning Head by famous maker. ★ Guaranteed Non-drift. ★ Permeability Tuning. ★ Frequency coverage 88–100 Mc/s. ★ OA81 Balanced Diode Output. ★ Two I.F. Stages and Discriminator. ★ Attractive maroon and gold dial (7 x 3in. glass). ★ Self powered, using a good quality mains transformer and valve rectifier. ★ Valves used ECC85, two EF80s and EZ80 (rectifier). ★ Fully drilled chassis. ★ Everything supplied, down to the last nut and bolt. ★ Size of completed tuner 8 x 6 x 5½in. ★ All parts sold separately.

£4.19.6 Plus 8/6 P.P. & Ins.

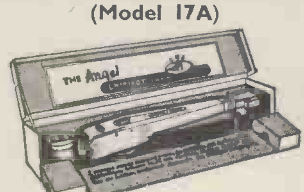
Circuit diagram and illustrations, 1/6, post free.

NOW AVAILABLE

A robust cabinet made from heavy gauge metal which has been specially designed to house the above F.M. tuner. Beautifully finished in a choice of glossy hammer green, or hammer grey enamel, or black crackle. The front panel (illustrated) has holes for control spindles and apertures for tuning dial and magic eye. PRICE 25/-. P. & P.. 1/9. (Front panel only 10/6 P. & P. 9d.)

SUPER STEREO KIT MK. II
A kit of ready-built units only requiring interconnection. Comprising two midget 3W amplifiers push button switch, transformer, control unit (bass, treble and vol.), power pack, two speakers, indicator light, valves (ECL82, EZ80 range), and comprehensive instructions.
Plus 6/6 P. & P. **£3.19.6**

THE WORLD FAMOUS E.M.I. ANGEL TRANSCRIPTION P.U. (Model 17A)



A Pick-up for the connoisseur originally priced at £17/10/-. The last remaining few offered at £5/15/- plus P. & P. 5/-.

TRANSISTOR AMPLIFIER KIT
A complete kit of parts to build a compact 4-transistor amplifier, with volume control and drilled panel. Two GT3 driver transistors, transformer coupled. 1 watt output from matched pair GT15. Supplied with output transformer and 2½in. 3 ohm speaker. Ideal for record player, etc. Plus 4/6 P. & P. **59/6**

SUPERHET CHASSIS —less Valves & Cabinet
Modern AC/DC chassis with printed circuit and ferrite rod aerial. Although not completely built, the main components are mounted. L. & M. wave coverage. 4 valves (UBF89, UCL83, UCH81, UY85). Everything supplied except valves and cabinet. With speaker and simple instructions. Plus 3/6 P. & P. **£3.3.6**

BARGAIN MONTH FOR TRANSISTORS

POWER			
OC44	9/-	GET15	9/-
OC45	8/-	GET15 (matched pr.)	16/6
OC71	5/-	GET102	7/6
OC75	6/6	XA103	8/6
OC76	6/6	PXA101	9/6
OC78	6/6	PXA102	9/6
OC78D	6/6	DIODE	
		OA81	3/-

Please add 6d. postage for each transistor.

SWITCHED ATTENUATOR
Audio to V.H.F. in four steps of 20 dB ± 0.02 dB up to 300 Mc/s. Cost £5/10/-. Plus 1/- P. & P. OUR PRICE **£1.19.6**

83 HIGH ST., MERTON, S.W.19.

CHErrywood 3985/6

ENTHUSIAST'S 14 WATT AMPLIFIER KIT

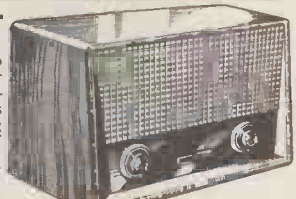
A kit designed to meet the exacting requirements of the audio enthusiast, yet remain within the price range of the average constructor. A stylishly finished monaural amplifier with an output of 14 watts from 2 EL84s in push-pull. Superb reproduction of both music and speech (frequency response ± 3db. c/s.-60 Kc/s. with negligible hum). Separate inputs for mike and gram allow records and announcements to follow each other, and make this amplifier ideal for small halls, youth clubs, etc. Fully shrouded ultra linear output transformer (to match 3-15Ω speaker), and fully shrouded mains transformer (these alone are worth over £3/10/-). Volume control, and separate bass and treble controls are provided, giving good lift and cut. Valve line up: 2 EL84s, ECC83, EF86, and EZ80 rectifier. All parts down to the last nut and bolt, including valves, heavy gauge metal chassis finished in glossy hammer green enamel (mains and output transformers finished to match).

P. & P. 6/6 (simple instruction booklet 1/6. Free with Kit). ONLY **£6.19.6**

PRINTED CIRCUIT AMPLIFIER KIT

A top quality record player amplifier in kit form. This amplifier (which is used in a 29 gn. record player) has a printed circuit, and has an internal fully smoothed power supply (input A.C./D.C. mains) using a mains dropper and contact cooled rectifier. A flying panel is supplied, accommodating BASS, TREBLE, and VOL-ON/OFF controls. 2 valves (UL84 and UF89) and linear output transformer give crisp reproduction from all records at 4 watts.
Our price for the complete kit of parts (including valves) Plus 6/6 P. & P. ONLY **59/6**
Simple instructions 1/6 (free with kit).

SUPERB WALNUT CABINET



A very fortunate purchase allows us to offer this quality table radio cabinet for only 16/6 (these cabinets cost the manufacturers 35/- each to make). The positions of the controls make it ideal for housing our 6 TRANSISTOR SUPERHET KIT described below. Beautifully finished in walnut and tygan. **OUR PRICE ONLY 18/6**
Plus 1/6 P. & P. and ins.

6 TRANSISTOR ★ SUPERHET KIT ★

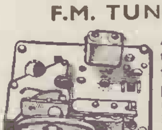
£6.19.6

A first-class 2-waveband transistor superhet in kit form.

- ★ Printed circuit board (size 8¼ x 2¾in.).
- ★ 3 pre-aligned IF transformers.
- ★ Quality 5in. speaker.
- ★ G.E.C. first grade transistors.
- ★ Output transformer.
- ★ High gain ferrite rod aerial.
- ★ Push-pull output.
- ★ Car aerial input socket.

The complete kit of parts ONLY £6/19/6 plus 2/6 P. & P. Simple instruction booklet 1/6 (free with kit). (Suitable cabinet if available 15/-.)

F.M. TUNER HEAD



A permeability tuned tuner head by a famous maker, supplied without valve (ECC85) 18/6 plus 1/9 P. & P. Valve 8/6 extra.

TRANSISTOR SPEAKER

Western Electric. 3Ω or 80Ω. Size 2¼ x 1⅛in. deep. Plus 1/- P. & P. **12/6**

SPECIAL OFFER! One doz. 6K7G £1, plus 2/6 P. & P.

COSSOR CRT SNIP

10in. 108K 18/6
10in. 75K 18/6
EITHER PLUS 6/6 P. & P.

OSCILLATOR COIL

Suitable for any tape deck. ONLY 5/6, plus 6d. P. & P.

REGUNNED T.V. TUBES

Any type, any size supplied.

G.E.C. FIRST GRADE TRANSISTORS

Set comprising one 874 mixer, two 873 I.F.s, one GET114 driver, two GET113 matched output and one diode. Post 1/-. **34/6**

COLLARO STUDIO TAPE DECKS

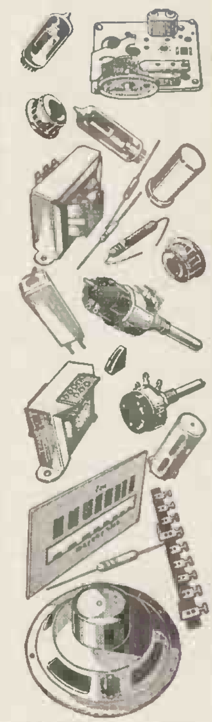
We have a few only of the latest model at the Special price of
ONLY £10 Plus 5/6 post & insurance

CRYSTAL MICROPHONES

Ideal for tape recorders, use with amplifiers, intercom., etc.
T.S.L. stick mike **22/6**
ACOS latest model **18/6**
Postage 1/6 either model

THE HARVERSON COMPLETE F.M./V.H.F. RECEIVER KIT £6.19.6

AT LAST—A COMPLETE F.M. RECEIVER IN KIT FORM!
Specially designed wtih the home constructor in mind, this kit enables the construction of a completely self-contained V.H.F. receiver at fraction of the normal cost of comparable equipment. This is basically a quality self-powered F.M. tuner plus 2 separate audio amplifier stages, with output transformer and speaker.



- ★ F.M. Tuning Head by famous maker.
- ★ Guaranteed Non-drift.
- ★ Permeability Tuning.
- ★ Frequency coverage 88-100 Mc/s.
- ★ OA81 Balanced Diode Output.
- ★ Two I.F. Stages and Discriminator.
- ★ Self powered using a good quality mains transformer and valve rectifier.
- ★ Valves used ECC85, two EF80's, ECL82 and EZ80 (rectifier).
- ★ Fully drilled chassis.
- ★ Good quality speaker.
- ★ Well designed output transformer.
- ★ Attractive maroon and gold glass dial.
- ★ Two output stages (using ECL82).
- ★ Everything supplied, down to the last nut and bolt.
- ★ Compact size.
- ★ All parts sold separately.

OUR PRICE **£6.19.6** Plus 4/6 P. & P.

Introducing HARVERSON'S Monaural Amplifier Kit **39/6**

In response to numerous requests from delighted purchasers of our "SUPER STEREO KIT" we have produced a "MONAURAL AMPLIFIER" on similar lines.

★ A UCL82 valve provides a triode amplifying stage, and a pentode output stage (3 watts), enabling good amplification and sparkling reproduction to be combined with physical compactness (amplifier size, 7 x 3½ x 6½in. high).

★ Modern circuitry design, good quality O.P. transformer (to match 3Ω) keep hum and distortion to a low level.

★ The controls, volume on/off and tone, are complete with attractive cream and gold knobs.

★ The amplifier has a built-in fully smoothed power supply, using a good quality mains transformer (A.C. mains only) and metal rectifier.

★ All you need is supplied including easy to follow instructions which guarantee good results for the beginner and expert. All components, leads, chassis, valve, knobs, etc., are first grade items by prominent manufacturers.

OUR PRICE Plus 4/6 post and packing. **39/6**

5in. LOUDSPEAKER TO SUIT, 14/6 EXTRA
ALL PARTS SOLD SEPARATELY

VALVES

WE HAVE 20,000 IN STOCK AT LOWEST PRICES EVER!
Send for your requirements

R.S.C. (M/c) Ltd. LIVERPOOL MANCHESTER LEEDS BRADFORD

Personal Shoppers welcomed at: 73 Dale Street, 4 mins. from Exchange Station, 8 mins. from Lime St. Station | 8-10 Brown Street (Market Street) | 5-7 County (Mecca) Arcade, Briggate, Leeds, 1 | 56 Morley St. (above Alhambra)

TERMS: C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/9 extra on all orders under £2. 3/3 extra under £5 unless carriage stated. Trade supplied. Post order to: Mail Order Dept., 29-31 Moorfield Road, Leeds, 12.

R.S.C. HI-FI TAPE RECORDER KIT

Build a high quality recorder in the £70 class for only

25½ GNS. Carr. 17/6. OR DEPOSIT £5/7/6 and 12 monthly payments of 42/-. Cash price if settled in 3 months.

Can be assembled in ½ hour.

INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR THE LINEAR LT45X HIGH QUALITY TAPE AMPLIFIER. A HIGH FLUX 7 x 4in. LOUDSPEAKER. Reel of Best Quality TAPE, Spare Tape Spools, a Portable Cabinet, size approx. 16 x 13 x 9in., finished in durable and attractive duo tone Policrome and connection diagram for wiring amplifier to transcriptor.

FEATURES INCLUDE:
★ 3 SPEEDS ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZING FOR EACH SPEED ★ OUTPUT 4 WATTS ★ MAGIC EYE RECORDING LEVEL INDICATOR ★ 3 MOTORS Fast rewind ★ TAPE MEASURING AND CALIBRATING DEVICE ★ TAKES FULL 7in. DIAMETER REELS OF TAPE ★ NEGLIGIBLE HUM ★ ENTIRELY EFFECTIVE AUTOMATIC ERASURE.
Full descriptive leaflet supplied on receipt of S.A.E.

HI-FI 10 WATT AMPLIFIERS

BRAND NEW CARTONED MANUFACTURERS DISCONTINUED MODEL. A REMARKABLE OPPORTUNITY. **£7.19.6** Carr. 7/6.
Push-pull output. Latest high efficiency Mullard valves. Dual separately controlled inputs, for mike and gram. Separate bass and treble controls. High sensitivity. Output for 3 ohm or 15 ohm loudspeaker. Guaranteed, tested and in perfect working order. For 200-250 A.C. mains.

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifiers). A Triode Heptode F/changer is used. Pentode I.F. and double Diode Second Detector delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W. Ch. Sw. incorporates Gram-position. Controls are Tuning, W. Ch. and Vol. Output will load most Amplifiers requiring 500 mV. Input depending on Ae location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost of £4/15/-. Point-to-Point wiring diagrams and instructions 2/6.

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. £4/12/9. Please state whether 3 ohm or 15 ohm required.

BASS REFLEX CABINET. Specially designed for above speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18 x 12 x 10in. Strongly made. Handsome appearance. Ensure superb reproduction for only £3/19/6.

EXTENSION SPEAKERS. Handsome walnut veneered cabinets. All standard 2-8 ohms. 6½in. 29/9. 8in. 35/9.

MULTI-METERS

CABY A10 Basic meter, sensitivity 155 micro-amps. A.C. and D.C. ranges. £4/17/6.

CABY B20. Sensitivity up to 10,000 ohms per volt A.C. and D.C. £6/10/-.

ACOS HI-FI CRYSTAL 'MIKES'

Mic 40 Hand or Desk type **27/9** (Listed 45/-)
39-1 Stick type **39/6** (Listed 3 Gns.)
Limited number.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½ x 4½ x 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 x 5½ x 2½in. Supplies 120 v., 90 v. and 60 v., 40 mA. and 2 v. 0.4 a. to 1 amp., fully smoothed. THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND L.T. 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.

POWER PACK KITS. Only 19/11. Fully smoothed H.T. output of 250 v. 60 mA and L.T. supply of 6.3 v. 1.5 amp. Consisting of Double Wound Mains Transformer 230/250 v. 50 c.p.s. A.C. primary. Selenium Rectifier. Smoothing Choke, Double Electrolytic Condenser, Aluminium Chassis and Circuit.

R.S.C. A12 STEREO AMPLIFIER KIT

4 GNS. Carr. 5/6.

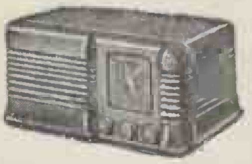
WITH TWIN 6½in. SPEAKERS
A complete kit of parts to construct a good quality 3 + 3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. Suitable for use with all stereo pick-up heads at present available. Ganged volume and tone controls. Preset balance control. Outputs for matched 2-3 ohm speakers. For 200-250 v. A.C. mains.

ACOS HGP 59 Hi-Fi Crystal Cartridges. (Turnover type with sapphire stylus). Standard replacement for Garrard and Collaro. Only 19/9. B.S.R. Ful-Fi 19/9. Acos Stereo/monaural 49/9.

R.S.C. MINIATURE 3 WATT GRAM AMPLIFIER KIT

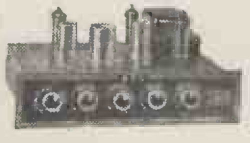
All parts to construct a very compact, highly sensitive amplifier suitable for any type of single or autochange player. Size 12 x 2¾ x 2½in. Chassis is isolated mains transformer. For 200-250 v. A.C. mains. Output for 2-3 ohm speaker. Volume and tone control with mains switch. ONLY **39/9**

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, 6F6 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. STEREO/TEN HIGH QUALITY AMPLIFIER KIT



Valves EZ81, ECC83, ECC83, EL84, EL84. Separate bass and treble controls giving "cut" and "boost." Sensitivity 50 mV. 5 watts high quality output on each channel. Can be used as straight 10 watt amplifier. Controls: Stereo/Monaural switch ganged volume, ganged treble, ganged bass, and balance. Outputs for 3 ohm speakers. Point-to-point wiring diagrams and instructions. Illustration full wiring details and priced parts list, 1/9. Assembled and tested 59/6 extra.

8 GNS. Carr. 7/9.

SELENIUM RECTIFIERS

L.T. Types		H.T. Types H.W.	
2/6 v. ½ a. H.W.	1/9	120 v. 40 mA.	3/9
6/12 v. 1 a. H.W.	2/9	250 v. 50 mA.	3/11
Following F.W. (Bridge)		250 v. 60 mA.	4/11
6/12 v. 1 a.	3/11	250 v. 80 mA.	6/11
6/12 v. 2 a.	6/11	250 v. 250 mA.	12/9
6/12 v. 3 a.	9/9	Contact Cooled	
6/12 v. 4 a.	12/3	250 v. 80 mA.	6/11
6/12 v. 5 a.	14/6	250 v. 50 mA. F.W. (Bridge)	8/11
6/12 v. 6 a.	15/6	250 v. 75 mA. F.W. (Bridge)	10/11
6/12 v. 10 a.	25/9		
6/12 v. 15 a.	35/9		

VARLEY 2 v. 14 A.H. ACCUMULATORS. New ex Govt. 5 x 3 x 1½in. 5/9 each, 3 for 15/-.

JASON F.M. TUNER. Type FMT1. All parts including Dial, Escutcheon, Punched Chassis & Valves. Power supply required 180 v. 25 mA and 6.3 v. 1.5 a. £6/19/6

EX GOVT. SMOOTHING CHOKES

60 mA. 10 h. 400 ohms	3/11
80 mA. 20 h. 900 ohms	5/11
100 mA. 5 h. 100 ohms	3/11
100 mA. 10 h. 100 ohms	6/9
150 mA. 10 h. 100 ohms	10/11
120 mA. 12 h. 100 ohms	9/9
200 mA. 5-10 h. 100 ohms	11/9
250 mA. 5 h. 50 ohms	10/9

Battery Chargers and Kits for 200-230-250 v. 50 c/s. A/C. Mains

HEAVY DUTY KIT

6/12 v. variable charge rate up to 6 amps. Consisting of Mains Trans., F.W. (Bridge), Selenium Rectifier, 0-7 amp. meter. Variable Charge Selector. Fuses, fuse-holders, panels, plugs and circuit. Only 59/6. Post 4/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.

0-9-15 v. 1½ a.	12/9
0-9-15 v. 2½ a.	15/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9
0-9-15 v. 8 a.	28/9

BATTERY CHARGER KITS

Consisting of Mains Transformer, F.W. Bridge, Metal Rectifier, well ventilated steel case. Fuses, fuse-holders, grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp.	24/9
As above, with ammeter	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. (inclusive of ammeter)	42/9
6/12 v. 4 amps.	49/9
6 v. or 12 v. 4 amps., with variable charge rate selector and ammeter	59/9

ASSEMBLED CHARGERS
6 v. 2 a. 29/9. 6/12 v. 2 a. 38/9. 6/12 v. 4 a. 59/9.

ASSEMBLED CHARGER

6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12. v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **49/9** Carr. 3/9.
6/12 v. 3 amp. with variable charge rate selector and ammeter. 59/9.

ASSEMBLED 6 v. or 12 v. 4/5 amps.

Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well-ventilated steel case with blue hammer finish. Ready for use with mains and output leads. **69/9** Carr. 5/-. Or Deposit 13/3 and 5 monthly payments of 13/3.

As above, but for 6 amp. charging. 4 GNS. Carr. 5/-. Or Deposit 16/- and 5 monthly payments of 16/-.

MICRO-AMMETERS

0-50 micro-amp. Diameter 2¾in. approx. Sealed 0-100. Flush mounting, 29/6.

EX GOVT. MAINS TRANSFORMERS

Primary 0-110-200-230-250 v. 275-0-275 v. 100 mA., 6.3 v. 7 a., 5 v. 3 a.	22/9
Input 200-250 v. 50 c.p.s. 250 v. 60 mA. 6.3 v. 2 a.	11/9
Primary 200-250 v. Sec. 12 v. 20 a. (Carr. 7/6.)	49/9
Primary 200-240 v. Sec. 3,500 v. 5 mA. 2 v. 2 a.	39/9
50 watts, 0-110/120-230/250 v.	8/11

D.C. SUPPLY KITS. Suitable for electric trains. Consist of mains trans. 200-250 v. 50 c.p.s. 12 v. 1 amp. selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number, 33/9.

HEAVY DUTY EX GOVT. SELENIUM RECTIFIERS

With large square aluminium cooling fins, 12 v. 15 amp. F.W. (Bridge). Limited number. 19/6.

VALVES: Full range at really competitive prices.

EX GOVT. CASES

Well ventilated, black crackle finished, undrilled cover. Size 14 x 10 x 8½in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE. COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post.

RELAYS. Carpenter Type Polarised, 2 x 9,500 turns at 1,685 ohms. 13/9. Miniature type G.E.C. 670 M1092 sealed wire ends 4 c/overs platinum, 12/9.

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC38, 807, 807, GZ34. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high. Only 12 millivolt minimum input is required for full output. THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP. Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram, etc., can be simultaneously applied for mixing purposes. AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6.3 1. 1.5 A. FOR A RADIO FEEDER UNIT. Price in kit form with easy to follow wiring diagrams.

ONLY Carr. 10/- **11 gns.** Or Factory built using latest EL34 output valves and with 12 months' guarantee. 14 GNS. TERMS ON ASSEMBLED UNITS. DEPOSIT 33/3 and 9 monthly payments of 33/3.

Protective Cover 19/9. Type 807 output valves are used with High Quality Sectionally Wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE. Frequency response ± 3 D.B. 30-20,000 c/s. Tone Controls ± 12 D.B. at 50 c/s. ± 12 D.B. to − 6 D.B. at 12,000 c/s. hum and noise 70 D.B. down. Good quality reliable components used. Chassis finish blue hammer. Overall size 12×9×9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Outputs for 3 and 15 ohm speakers. EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS, SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.

FULL RANGE OF LINEAR HIGH FIDELITY AMPLIFIERS ALWAYS IN STOCK

GL3A MINIATURE 3 WATT GRAM AMPLIFIERS

For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11¾×2¼×2½in. Fitted Vol. and Tone Control with mains switch. Designed for use with any kind of single player or record changer unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 59/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER

A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high fidelity pick-up heads in addition to all other types of pick-ups and practically all makes of microphones. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 26 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish and point-to-point wiring diagrams and Instructions. Exceptional value at only £4/15/- or assembled ready for use 25/- extra, plus 3/6 carriage. Or Deposit 22/- and five monthly payments of 22/- for assembled unit.

P.M. SPEAKERS, 2-3 ohms 2½in. Perdio 21/9. 5in. Goodmans 17/9. 7×4in. R.A. Elliptical 19/9. 6½in. Rola 19/9. 8in. Rola 19/9. 8in. Goodmans 25/9. 8×6in. Elac with high flux magnet 25/9. 10in. R.A. 28/9. 10×6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. R.A. 3 or 15 ohms, 10 watts, 12,000 lines, 59/6.

TWEETERS. 4in. Plessey, 3 ohms 18/9. R.A. 15 ohms 25/9.

R.S.C. TRANSFORMERS Fully Guaranteed. Interleaved & impregnated.

MAINS TRANSFORMERS. Primaries 200-250-250 v. 50 c/s.

FULLY SHROUDED. UPRIGHT MOUNTING.	
250 0 250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a. 2½-3-3in.	17/11
250 0 250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
300 0 300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350 0 350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	27/11
350 0 350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/11
425 0 425 v. 200 mA., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9
450 0 450 v. 250 mA., 6.3 v. 5 a., 5 v. 3 a.	59/9
TOP SHROUDED DROP-THROUGH TYPE	
260 0 260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	17/9
250 0 250 v. 100 mA., 6.3 v. 3.5 a.	19/9
250 0-250 v. 100 mA., 6.3 v. 2 a., 6.3 v. 1 a.	21/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/11
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	26/9
300-0-300 v 130 mA., 6.3 v. 4 a., c.t. 6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9
425-0-425 v. 200 mA., 6.3 v. 4 a., 5 v. 3 a.	47/9
MIDGET CLAMPED TYPE. Primaries 200-250 v.	
250-0-250 v. 60 mA., 6.3 v. 2 a., 2¼×2¼×2½in.	12/9
250 v. 60 mA., 6.3 v. 2 a. Size 2¼×2¼×2¼in.	11/9

FILAMENT TRANSFORMERS

6.3 v. 1.5 a.	5/9	12 v. 1 a.	7/9
6.3 v. 2 a.	7/6	6.3 v. 3 a.	8/11
0.4-6.3 v. 2 a.	7/9	6.3 v. 6 a.	17/9
		12v. 3a. or 24v. 1.5a.	17/9

AUTO (Step Up/Step Down) TRANSFORMERS

50-80 watts 110-120 v./230-250 v.	11/9
150 watts 110-120 v./200-250 v.	27/9

OUTPUT TRANSFORMERS

Midget Battery Pentode 66 : 1 for 3S4, etc.	3/9
Small Pentode 5,000Ω to 3Ω	4/6
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 8,000Ω to 3Ω	5/9
Multi Ratio, Single or P/P 3 or 15Ω	6/9
Push pull 8 watts EL848 to 3Ω	8/9
Push pull 8 watts EL848 to 15Ω	8/9
Push pull 10-12 watts 6V6 to 3Ω or 15Ω	16/9
Push pull 10-12 watts to match 6V6 to 3.5-8 or 15Ω	17/9
Push pull EL84 to 3 or 15Ω 10-12 watts	17/9
Push pull Ultra Linear for Mullard 510	27/9
Push pull 15-18 watts, sectionally wound, 6L6, KT 66, etc for 3 or 15Ω	23/9
Push pull 20 watt high-quality sectionally wound, 6L6, KT 66, etc., or 4 or 15Ω fully shrouded	47/9
MICROPHONE TRANSFORMERS	
120 : 1 High quality, clamped	6/9
120 : 1 High quality Mu metal screened	8/9

SMOOTHING CHOKES

250 mA., 5 H., 100Ω	11/9	80 mA., 10 H., 350Ω	5/6
150mA. 7-10 H., 250Ω	11/9	60 mA., 10 H., 400Ω	4/11
100 mA., 10 H., 200Ω	8/9	1 amp. 0.5Ω L.T. type	6/6

LINEAR PRE-AMP/TREMOLO UNIT

Suitable for use with any Guitar Amplifier. Controls Volume, Frequency, Amplitude and switches. Valves: EF86 and EF80. Inputs for Guitar Pick-up or Mike, and Radio or Gram. Power required only 250/300 v. 20 mA. 6.3 v. 1 a. **5 GNS.**

LINEAR TAPE PRE-AMPLIFIER Type LP/1. Switched negative feedback equalisation. Positions for Record 1⅞in., 3¾in., 7½in. and Playback. EM84. Recording level indicator. Designed primarily as the link between Collaro Tape Transcriptor and high fidelity amplifier but suitable almost any Tape Deck. **9 GNS.** Send S.A.E. for leaflet.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. bass and treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves. Size only 6×5×5½in. high. Chassis fully isolated from mains. Guaranteed 12 months. Only **£5.19.6** Or Deposit 22/- and 5 monthly payments of 22/-. Send S.A.E. for leaflet.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES

Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10 High sensitivity. Includes 5 valves: ECC83, ECC83, EL84, EL84, 5Y3. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx. 12×9×7in. For A.C. mains 200-250 v. 60 c/cs. Output for 3 and 15 ohms speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 51/- extra). ONLY **8 Gns.** Car. 10/-

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/9 and 9 monthly payments of 24/9. Send S.A.E. for illustrated leaflet detailing ready-to-assemble Cabinets, Speakers, Microphones, etc with cash and credit terms.

R.S.C. PORTABLE GUITAR AMPLIFIERS

JUNIOR 5 WATTS. High Quality Output. Separate Bass and Treble "cut" and "boost" controls. Sensitivity 15 mv. High Flux 8in. l/speaker. Input sockets for Radio/Tape or Gram Pick-up and Mike /Instrument Pick-up. Handsome strongly made cabinet (size approx. 14×14×7in.). Finished in attractive and durable polychrome and fitted carrying handle.

£8.19.6 Carr. 7/6. Or Deposit £1 and nine monthly payments £1.

Send S.A.E. for leaflet.

SENIOR 10 WATTS. High-Fidelity Push-Pull output. Separate Bass and Treble "cut" and "boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two Loudspeakers are incorporated: 12in. P.M. for Bass notes and one 7×4in. elliptical for Treble. Cabinet is well made and finished as for Junior model. Size approx. 18×18×8in. 15 gns. Plus 10/- carr. H.P. TERMS DEPOSIT 34/9 and 9 monthly payments 34/9. SUPER-HI FI 15 WATT. All facilities as 10 watt. Cabinet size 20×18×10in. 22 GNS. Carr. 12/6. Terms of Deposit £2/11/6 and 9 monthly payments of 51/6.

COLLARO CONQUEST 4-SPEED AUTO-CHANGERS. With studio pick-up with turnover head. Latest model for 200-250 v. A.C. mains, £6/19/6. Carr. 4/6.

B.S.R. MONARCH AUTO-CHANGERS. Type UA8. 4 speed T/O Pick-up with sapphire stylus £6/19/6. Carr. 4/6.

Any of the above supplied with T/O stereo/monaural head for £1 extra.

COLLARO JUNIOR. 4-speed Single Players with Hi-Fi T/O crystal pick-up head, £3/19/6.

LOUDSPEAKER IN POLISHED WALNUT FINISHED CABINET. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4/19/6. Carr. 5/-. TERMS: DEPOSIT 11/- and 9 monthly payments of 11/-.

12in. 20 WATT 15,000 line l/speakers 15 ohms in Cabinet finished as above. Size 18×18×8in. £7/19/6 Carr. 7/9 or Deposit 17/9 and 9 monthly payments of 17/9.

R.S.C. STANDARD EQUIPMENT CABINET. Designed to house a variety of equipment such as Tape or Record Player Unit, Amplifier and Tuned Unit. Size and appearance as per Reflex Cabinet below. These two cabinets, can be aligned to form a complete high fidelity assembly at a very attractive overall price. Only 6 gns. Set of legs with brass ferrules, 25/-.

R.S.C. STANDARD BASS REFLEX CABINET. for 12in. Loudspeakers, acoustically lined and ported. Size 20in.×14in.×13in. Beautiful walnut veneer finish. Especially recommended for use with Speaker below. £5/19/6. Set of four legs can be supplied with brass ferrules for 25/- per set.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms) consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only £5/19/6. Or Deposit 13/9 and 9 monthly payments of 13/9.

PROOPS Walk-around Store
and MAIL ORDER SERVICE

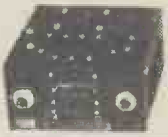
52 Tottenham Court Road, London, W.1 • *Open 9-6, including Sats., Thurs. 9-1* • **LANgham 0141**

ROTARY POWER SUPPLIES

Magnificently engineered, aircraft quality, rotary power equipment originally made by famous British and American manufacturers.

TYPE 102A INVERTOR

Input: 28 volts D.C. Output: 115 volts, 400 c/s, 3-phase A.C. at 625 VA. In excellent unused condition. Size: 11in. × 5½in.



TYPE 34 REGULATOR (5UC/5820)

Self-contained voltage and frequency control unit for use with Type 102A Invertor. Both units complete **£15** Carriage 10/-.

TYPE 300 INVERTOR

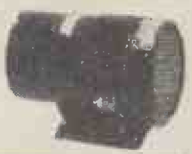
Input: 24/28 volts D.C. Output: 40 volts, 1,600 c/s, 1-phase A.C. at 50 VA. Mounted on pedestal base with built-in filter. Size: 7 × 3½ × 4in. high. **£2** Carriage 5/-.

TYPE 7 INVERTOR

Input: 24/28 volts D.C. Output: 80 volts. 800 c/s, 1-phase A.C. at 240 VA. Power factor of 1.0. Complete with built-in regulator. Size: 10 × 8½ × 5½in. high.

£4.10 Carriage 10/-.

100A INVERTOR



Input: 24/28 volts D.C. Output: 115 v. 400 c/s. 3 ph. Size: 7in. × 3¾in.

£4.10 Carriage 10/-.

100B INVERTOR

Input: 24/28 volts D.C. Output: 115 v. 400 c/s. 3 ph. Size: 7in. × 3¾in. Mounted on pedestal base containing regulator.

£4.10 Carriage 10/-.

TYPE 8A INVERTOR

Input: 24 v. D.C. Output: 115 v., 400 c/s. 3 ph. 1.8A. Size: 9in. × 4¾in.

£5.10 Carriage 10/-.

AMERICAN INVERTOR

Input: 28 volts D.C. Output: 115 volts, 400 c/s, A.C., 1-phase at 50 VA. Housed in black crackle case on anti-vibration mounted pedestal base containing condenser filter. Fan cooled. Size: 7 × 4 × 5in. high.

£4.10 Carriage 5/-.

400 C/S MOTOR/ ALTERNATOR SET

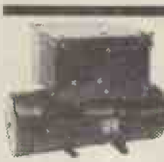
Continuously rated 2.5 kVA 1 phase, 400 c/s Motor/Alternator Set by Lesdix. Input 220/230v. 50 c/s. Two separate, regulated outputs from twin alternators of 200v. 400 c/s at 1.25 kVA each. Complete, free standing unit with Control and Exciter Panel, Exciter Motor and Switched Connector boxes. Size overall: 4ft. × 3ft. high × 2½ft. deep.

£60 Carr. & Ins. £5.

TYPE 200 INVERTOR (5UB/5083)

Self-contained motor-generator unit with complementary carbon pile regulator, contactor, and associated rectifier in separate compartment on same base. Continuously rated for 25/28 volts D.C. input with 360 VA output at 115 volts 1,600 c/s, 1-phase A.C. Power factor of 1.0.

£4.10 Carriage 10/-.

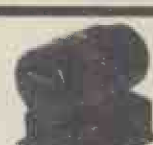


TYPE 201 INVERTOR (5UB/630C)

Input 25/28 volts D.C. Output: 115 volts, 1,600 c/s, 1-phase A.C. at 1,750 VA. Similar in construction to Type 200 and complete with regulator on same base. Power factor of 1.0. Size: 15½ × 8 × 12in. high.

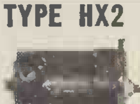
£4.10 Carriage 10/-.

COMPACT 400 c/s INVERTOR



Input: 28 volts D.C. Output: 28 volts, 400 c/s, 1-phase A.C. at 6 VA. Mounted on 1½ inch high pedestal base containing condenser filter. Size: 2½ × 4 inches long. **25/-** Carriage 2/6.

TYPE HX2 GENERATOR (5U/4185)



High-grade, aircraft type, engine-driven generator. Output: 29 volts at 50 Amps. Size overall: 9 × 7in. dia. Fitted with ¾ inch splined drive.

£2 Carriage 10/-

CONSTANT VOLTAGE TRANSFORMER

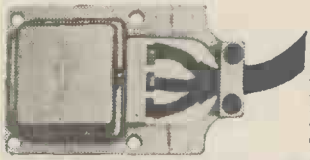
An ingenious and magnificently constructed device by a leading British manufacturer. Consists of specially wound transformer and Visconol condenser which provide a constant output voltage of 7.5 volts R.M.S. at a load of 200 mA with a power factor of 1 from any 50 c/s A.C. input between 5.6 and 9 volts. Unused and fully guaranteed. **15/-** P. & P. 1/6.

TWIN TUBE CRT INDICATOR

Attractive, lightweight, black crackle box 11 × 7 × 13½in. deep with 4 × 2½in. and 3½ × 3in. windows on front panel for twin 5FP7 tubes. Neat arrangement of appropriate (independent) controls and variable scale illumination. Totally enclosed, detachable magnetic focusing coils. All connections to rear sockets. Ideal TV monitoring unit as used by many amateurs. In first class, unused condition.

£1 · 15 Carriage 10/-.

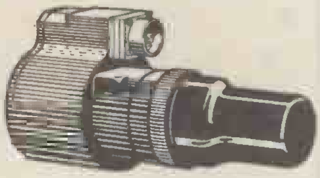
VIBRATION PICK-UPS



£4.10.0

Type 4-260 by Consolidated Electrodynamics Corp. of America. Utilizes variable reluctance to measure acceleration from zero to 100 c.p.s. up to plus or minus 12g. Pick-up consists of spring mounted seismic mass which is the common armature of two variable inductors. Deflection of armature due to gravity, centrifugal or acceleration forces change inductance which is then measured in an a.c. bridge circuit. Range: "G"—plus or minus 12 (stops set at 15). Freq.: d.c. to 100 c.p.s. or more. Linearity 1% or less distortion with amplitude change. Nominal impedance per coil: 400 ohms at 2 kc/s (3 mh, 100 ohms d.c.) 574 ohms at 3 kc/s. Output: 45 mV per g. with 10 volt 2 kc/s carrier, 64.5 mV with 10 volt 3 kc/s carrier. Mounting base 1½ × 2¼in. (1¾ without cable clamp). Height: ⅞in. Weight: 2 oz. Any position mounting. Sensitive axis normal to base.

ELECTRIC ACTUATORS



Special offer of aircraft quality, precision engineered rotary actuators by leading British manufacturers. In new or first-class used condition. For 24/28 V.D.C. operation.

TYPE 2

Split field, series wound, reversible motor fitted with electro-magnetic brake. Max. load 50/60 lb./in. Output 0.02 h.p. at 13,000 r.p.m. Reduction gear ratio 2,857 to 1. Length 7in. Weight 2¼lb. Fitted with adjustable limit switches.

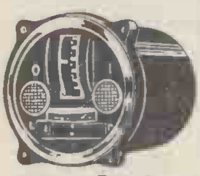
75/- Post paid.

TYPE 3

Similar in appearance to above. Designed for operation of 3-position-type valves in which actuator gives wide variety of angular settings determined by position of limit switches. Max. load 50 lb./in. Output 0.017 h.p. at 17,000 r.p.m. Full range travel: 140 deg. in 2 seconds. Weight 3.25 lb.

75/- Post paid.

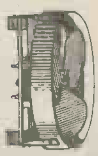
VISUAL INDICATOR Model S.47



One vertical and one horizontal meter, together with two neons in durable black plastic case. Vertical meter: 0-400 microamps. Horizontal meter: 200-0-200 microamps. Neons housed in pull-out, bayonet type lampholders at rear of case. Size: 3¼in. dia. × 4¼in. overall.

10/- Post & packing 2/6

EXTRACTOR FANS



Brand new, 230/250 volts A.C. mains operated, extractor fans, absolutely complete except for external shrouding which can be readily made up from simple sheet metal wrapping to suit any particular installation. Continuously rated, smooth, silent running induction motor. Balanced 3-bladed 6in. fan. Size 7¼in. dia. × 4in. deep.

27/6 P. & P. 2/6.

RECEIVER TYPE 88 (R1475)

Highly stable, specially accurately calibrated, Marconi design, RAF communications receiver covering 2-20 Mc/s in 4 bands with built-in 600 kc/s Xtal reference oscillator for checking dial which can be reset by special panel trimmer control. 11 Valves: 3x6K7, 6K8, 6J5, 3x6Q7, 6H6, Y63 tuning indicator and VR150-30 voltage regulator. Two stage IF with 8 tuned circuits, Xtal controlled B.F.O. Four position selectivity with audio filters for narrow band-width C.W. Fast and slow AVC, high and low noise suppression. A plug-in unit with additional mixer provides a "listening through" guard channel of either 2-4 or 4-7½ Mc/s. Receiver 16½ × 9 × 11in. Power pack 8 × 9 × 11in. Complete with 200-250 volt AC (or 12v. DC) power pack type 360, and operating and alignment instructions. Used, but in very good condition. Guaranteed serviceable. A sound buy indeed at **£13.10.0** carriage paid.

GEIGER COUNTER TUBES

Low voltage, Halogen quenched Geiger Mueller tubes by a famous British manufacturer. Working voltage 400-450. Highly sensitive: effective length 11.8 cm. Background 90 counts/min.—max. response 30,000 counts/min. Plateau 80 volts. Stainless iron electrode. Similar to tubes fitted in high-grade instruments and used in demonstration counters on B.B.C. and I.T.V. programmes. IDEALLY SUITED FOR HOME-BUILT GEIGER COUNTERS, BASIC EXPERIMENTATION, AND INSTRUCTION AS WELL AS SERIOUS WORK. Circuits of simple, all-transistor and conventional valve counters supplied on request. Brand new and guaranteed. **25/-** Postage 2/6

COLD CATHODE TRIGGER TUBES

Sub. miniature cold cathode valve developed by Ericsson primarily for computer work. Anode-cathode running voltage of 95 to 140 at 4.5 mA, and at 290 anode volts require a trigger current of only 250 microamps to cause the anode to take over the discharge. Typical ionization time: 90 microseconds. Will withstand up to 310 volts with zero trigger voltage without self-igniting. Complete with full performance data in original packs of 100 at the special price of **£5.0.0** Post paid.

Minimum quantity supplied: 6 for 10/- Post paid.

TELEVISION OSCILLOSCOPE

£6.10

Carriage 10/-.

Release of a small quantity of the latest version of the well-known APN-4 Indicator Unit from the American Loran Airborne radio navigation system. This provides a golden opportunity to make a serious television servicing and development tool as described in *Wireless World*. Steel, double-deck, chassis with fully screened 5CP1 tube in the centre, all high-grade capacitors and resistors, separate tag boards and layout diagrams for individual sections etc. Modern circuit technique centred around one type of valve (14 of 6SN7 double-triodes and 8 of 6H6, plus three 6SL7 and one 6SJ7), and R.C.A. 100 kc/s Crystal. Not new, but guaranteed and supplied with **W.W. Circuit for conversion.**

THE ERECON PENCIL TESTER

A new, complete multi-testmeter which can be carried in the pocket. Range: 0-50,000 ohms, and 12, 300, and 600 volts D.C. and A.C. Meter sensitivity 300 ohms per volt. Range selection made by rotating integral switch in barrel. Plug-in lead is attached to plastic housing which contains both screw-in test prods when not in use. Size overall: 5½ × ⅝in. dia. (less clip and prod). Post & packing 1/6.

39/6

— BARGAIN OFFERS —

VCR139 (Cossor 23D equivalent) 2¼in. cathode-ray tube 15/-. Postage 2/6.
Mains suppressor in diecast sealed case, 2 for 5/-. Postage 2/-.
Double pole knife changeover switch on porcelain base, 2 for 4/-. Postage 1/-.
Pyrex aerial insulators, four 3in. OR one 7in., 6/-. Postage 1/6.
Neons, ten 115 volts for 19/-. Postage 2/6. Six 80 volts for 6/-. Postage 1/6.
Bulgin type "M" microswitches, 4 for 10/-. Postage 1/6.
Metal rectifiers: selenium 6-12 volt 1½ amp., 9/6. 2½ amp., 9/6. 4 amp., 16/6.
Charging transformers: Pri. 200/250 volts, Sec. 3½, 9 and 17 volts at 4 amps., 18/6. Postage 3/-.
STC Miniature Silicon Diodes, input 50 v. peak inverse; output 15 v. 0.5 amp. D.C., 4 for 10/-. Post paid.
Mains Overload Cutout Switch. Preset at 13 A. but adjustable. Instant reset. 2 for 5/-. Postage 1/-.
APN1 Transducer. 6/-. Postage 1/6.

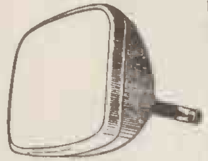
SEND FOR FREE CATALOGUE just published and PROOPS CHRISTMAS SUPPLEMENT of unique Gift Bargains in NEW GOODS!

PROOPS BROTHERS LTD., 52 Tottenham Court Road, London, W.1
Head Office and mail order enquiries, Dept. M. LANgham 0141
Shop hours 9 a.m. to 6 p.m. Thurs. 9 a.m. to 1 p.m. OPEN ALL DAY SATURDAY

TV TUBES

12 MONTHS' GUARANTEE

Insurance and Carriage 15/6



21in. 99/6

17in. . . 90/- 15, 14, 12in. 70/-

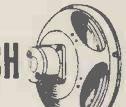
£1 extra without old bowl, refundable if same received within 14 days

14in. TV TUBES 35/-

36-24 and 14KP4

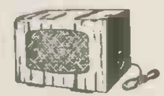
Salvage purchase of Rental replacement stocks. Carriage 5/-

8/9 EACH SPEAKERS



5in.—6in.—8in.—7in. x 4in. Money back guaranteed. Enquire for other sizes. Ex. mfd. salvage. P. & P. 3/-.

EXTENSION SPEAKERS 19/9



8in. P.M. Speakers fitted into polished cabinets. Complete with switch and flex. P. & P. 4/-.

ELLIPTICAL SPEAKERS

15/9 Brand new slot type. 8x3in. and 7x4in. P.&P. 3/-.

MINIATURE SPEAKERS

Brand new 3 inch. P. & P. 1/-. 16/9

VALVES

SALVAGE GUARANTEED

9d. Each — 7/6 Dozen
4D1, 6AL5, 6D1, 6D2, 9D2, 12Y4, 15D2, 78, 210VPT, 7193, C2C, CV66, D1, P61, D152, EA50, EB91, EF50, HL42DD, T41, PM202, SP61, VR35, VR51, VR107.

1/9 Each — 17/6 Dozen
6AM6, 6AT6, 6F1, 6F12, 6F13, 6F14, 6F15, 6K7, 6P25, 6P28, 8D3, D77, DH77, EF91, N142, PEN 46, W148, Z77.

2/9 Each — 30/- Dozen
6L18, 6SN7, 6U4GT, 10D1, 10F1, 874, 10P13, 12AT7, 12AU7, 20D1, 20P3, B36, DH76, ECC31, ECC34, ECC81, ECC82, EF80, EF92, EL32, EY51, KT36, KTW61, L63, N37, PL33, TH233, U22, U31, U35, U151, U281, UCH42, UF41, UF42, W77, Z152.

5/9 Each — 60/- Dozen
6BA8, 6V6, 7AN7, 9BW6, 12AX7, 15A6, 20F2, 20F5, 20L1, 20P1, 21A6, 80C1, 30L1, 30L2, 30PL1, 30PL13, 1625, EBC33, ECC83, ECF80, EL33, EL38, EL41, EL42, EY85, KT33c, KT63, LN152, LZ319, N152, N309, N339, PL81, PL82, PL83, PY80, PY81, PY82, UBF80, U152.

POST ON 1—7d. ON 6—1/6d. ON 12—2/6d.

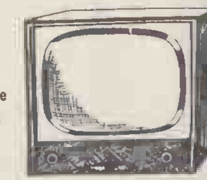
COMPLETE TELEVISIONS

Ex-RENTAL SETS

17in. £11.10.0

Excellent table models. ITA/BBC. Famous manufacturer. Personal collection advised. Ins., carr., 25/-. (Regret some delay).

12 months guarantee on tubes



3 months guarantee on chassis and valves

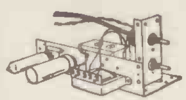
14in. £7.10.0

ITA/BBC. As 17". Ideal for caravans, chalets, weekend bungalows, etc. Personal collection advised. Ins., carr. 20/-.

Various makes and sizes available for inspection.

RECORD PLAYER AMPLIFIER

12 months' guarantee. MK. D.2

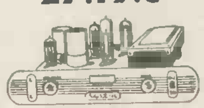


79/6

Latest design incorporating negative feedback, giving 4 watts undistorted output. Valves: ECL82, and metal rectifier. Tone and volume control panel on flying leads. P. & P. 4/6.

TAPE RECORDER AMPLIFIER

£7.19.6



Compact, well designed 5 valve amplifier. Output 3.5W. Input for Microphone, Radio and Gram. Size $8\frac{1}{2}$ x 3 x $4\frac{3}{4}$in. Ins., carr. 5/-. 12 months' guarantee. Terms available. Extras: Dial plate, including sockets, and superimpose switch, 3/6. Knobs 2/6.

TAPE RECORDER AMPLIFIER

£9.15.6

By famous manufacturer. Superb 4-valve amplifier. Two controls and superimpose switch. Sockets for Mike and Gram. Size 11 x 4 x 6in. Ins., Carr. 5/-. Drawings FREE with Order.

DE LUXE RECORDER CABINET

79/6

Beautifully styled rexine covered cabinet in Red or Beige. Size $14\frac{1}{2}$x13x$9\frac{1}{2}$in. Storage comp. In lid for tapes and mike. Easily adapted to Record Player Cabinet. Ins., Carr. 5/-.

SOLO SOLDERING TOOL

12/6

110 v., 6 v. or 12 v. (special adaptor for 200/250 v., 10/- extra). Automatic solder feed including reel solder and spare parts. It is a tool for electronic soldering or car wiring. Revolutionary in design. Cannot burn. In light metal case with full instructions for use. Post 4/-.

"PETITE" RECORD PLAYER

29/9

Portable cabinet in smart two-tone colours. Ideal for Transistor Portable. Size:—12 x $10\frac{1}{4}$ x 6in. Light and easy to carry.

Insurance and carriage 5/-.

DE-LUXE TAPE RECORDER CABINET

only 29/9

Beautifully made Tape Recorder Cabinet. Size: 13 x $10\frac{1}{2}$ x 7in. Covered in two-tone coloured rexine cloth. Stylish design. Easily adapted to Record Player Cabinet. P. & P. 5/-.

"ARGOSY" RECORD PLAYER CABINET 19/6

Exceptional offer. A lightweight portable player Cabinet by famous manufacturer. Size $14\frac{1}{2}$ x $11\frac{1}{2}$ x 6in. Takes single player; 2 control Amplifier; 5in. Speaker. Post, packing and insurance, 5/-.

19/9 "SCOTCH BOY" TAPE

$5\frac{3}{4}$inch. Limited quantity. POST FREE.

DUKE & CO. (LONDON) LTD.,

621/3 Romford Road,
Manor Park, E.12.
ILF 6001/3

Send for a FREE CATALOGUE

Hours— 9a.m.—6p.m. Half day Thursday.

C.R.T. BOOSTER TRANSFORMERS

TYPE A. OPTIONAL 25% and 50% BOOST. 2 V. OR 4 V. OR 6.3 V. OR 10.8 V. OR 13.3 V. MAINS INPUT. 12/6

TYPE A2. HIGH QUALITY, LOW CAPACITY, 10/15 pF. OPTIONAL BOOST 25%, 50%, 75%. MAINS INPUT. 16/6

TYPE B. MAINS INPUT. MULTI OUTPUT 2, 4, 6.3, 7.3, 10 and 13 VOLTS. BOOST 25% AND 50%. LOW CAPACITY, 21/-. Full instructions supplied.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ½ w., 4d.; ¼ w. 4d.; 1 w. 6d.; 1½ w. 8d.; 2 w. 1/-. HIGH STABILITY. ½ w., 1% 2/-. Preferred values 10 ohms to 10 meg. Ditto 5% 9d., 100 Ω to 5 meg.

5 watt, 10 watt, 15 watt WIRE-WOUND RESISTORS 25 ohms—10,000 ohms. 1/3, 1/6, 2/-
12,500 ohms—50,000 ohms. 10 w. 3/-

WIRE-WOUND POTS. 3 w. Pre-set Min. T.V. type, Knurled Slotted knob. All values 10 ohms to 25 K. 3/- ea.; 30 K., 50 K., 4/-. Ditto ½ w. Carbon Track, 30 K. to 2 Meg 3/-.

WIRE-WOUND POTS. 4 w. Standard size Pots. long Spindle High Grade. All values 50 ohms to 50 K. 6/6; 100 K., 7/6. W/W EXT. SPEAKER CONTROL 10 Ω, 3/-.

O/P TRANSFORMERS. Miniature 3V4, etc., 4/6. Heavy duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Ditto Push-Pull 10 watts 15/6. Push-pull 20 w. 6 k. 30/-.
L.F. CHOKES. 10H 50 mA. 4/6. 10H 65 mA. 5/-. 10H 85 mA. 10/6. 10H 120 mA. 12/6. 10H 150 mA. 14/-.

MAINS TRANSFORMERS 200/250 v. A.C. Post 2/-

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. 22/6 .... Ditto 350-0-350	29/6
MINIATURE 220 v. 20 mA., 6.3 v. 1 a.	10/6
MIDGET, 220 v. 45 mA., 6.3 v. 2 a.	15/6
SMALL, 200-0-200 50 mA., 6.3 v. 2 a.	17/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a. ..	17/6
HEATER TRANS., 6.3 v. 1½ a., 7/6 .... 4 amps.	10/6
GENERAL PURPOSE LOW VOLTAGE. Output 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 a.	22/6
AUTO. TRANS. 150 w., 0, 10, 120, 200, 230, 250 v.	22/6
AUTO. TRANS. 500 w., 0, 115, 200, 230, 250 v...	82/6

ALADDIN FORMERS and cores, ¼in. 8d.; ⅜in. 10d. 0.3in. FORMERS 5937 or 8 and Cans TV1 or TV2. 2¼in. sq. × 2¼in. or ⅜in. sq. × 1¼in., 2/- with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
SOLON. Midget Soldering Iron, 200 or 240 v. 25 w., 24/-.
MAINS DROPPERS. 3 × 1¼in. Adj. Sliders .3 amp. 1,000 ohms 4/3. .2 amps. 4/3. .1 amp. 2,000 ohms 5/-.
LINE CORD. .3 amp. 60 ohms per foot, .2 amp. 100 ohms. per foot, 2-way, 1/- per foot, 3-way 1/- per foot.

CRYSTAL MIKE INSERT by Acos 8/6

Precision engineered. Size only 1⅛in. dia. × ⅛in.
ACOS MIKE 40 25/-........TSL. STICK MIKE 35/-

MIKE TRANSF. 50 : 1, 3/9 ea., 100 : 1 Potted 10/6.
LOUDSPEAKERS P.M. 3 OHMS. 2½in., 3in., 4in. 19/6. 5in. 17/6. 8in. × 5in. Goodmans 21/-. 7in. × 4in. Rola 18/6. 10in. × 6in. E.M.I. 27/6. 8in. Plessey 19/6. 6½in. Rola 18/6. 8in. Rola 21/-. 10in. R.A. 30/-. 12in. Plessey 30/-. 12in. Plessey 15 ohms 45/-. Stentorian HF1012 95/-. TWEETERS. 4in. 25/-.

I.F. TRANSFORMERS 7/6 pair

465 kc/s. slug tuning miniature can 1⅜ × ⅞ × ⅞in. High Q and Good bandwidth. Data sheet supplied.

CRYSTAL DIODE G.E.C. 2/-. GEX34 4/-. 40 Circuits 3/-.
H.R. HEADPHONES. 4,000 ohms, brand new, 15/- pair.
SWITCH CLEANER. Fluid, squirt spout, 4/3 tin.
TWIN GANG CONDENSERS. 365 pf. Miniature, 1⅜in. × 1⅜in. × 1⅜in. 10/-. 500 pf. Standard with trimmers, 9/-; Midget 7/6 with trimmers 9/-. Single 50 pf., 80 pf., 100 pf., 160 pf., 5/6. Solid dielectric 100, 300, 500 pf. 3/6.
VALVE HOLDERS. EA50, 6d. Eng. or U.S.A. 4, 5, 6, 7 1/-.
MOULDED Mazda or Int. Oct. 6d.; B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6; B12A, 1/3; B9A with can 1/9.
CERAMIC, EF50, B7G, B9A, Oct., 1/-; B7G ,B9A cans, 1/-.

MONARCH RECORD PLAYER

BUILD IT YOURSELF using 4-SPEED BSR MONARCH AUTOCHANGER
READY BUILT 3W. AMPLIFIER, HANDSOME PORTABLE CASE. HIGH FLUX LOUDSPEAKER.
FULL INSTRUCTIONS SUPPLIED

Total Price Carr and Ins. 5/-. **£12.10.0**

WAVECHANGE SWITCHES

2 p. 2 way, or 3 p. 2 way; short spindle	2/6
8 p. 4 way, 2 wafer, long spindle	6/6
2 p. 6 way, or 4 p. 2 way, or 4 p. 3 way, long spindle	3/6
2 p. 2 way, 3 p. 4 way or 1 p. 12 way, long spindle ..	3/6

Wave change "MAKITS" 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer, 16/-. Additional wafers up to 14, 3/6 each extra.
TOGGLE SWITCHES. S.P. 2/-; D.P. 3/6; D.P.D.T. 4/-.
MORSE KEY, good quality with morse code, 2/6.
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. AMMETERS, 4 a. and 5 a., 13/6.

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. Plans only 6d.
Also Band I version same prices.
(PCC84 Valve if preferred)

"REGENT" 4 VALVE

"96" RANGE VALVES

KIT PRICE £6. 6. 6. Carr. 4/-

PRINTED CIRCUIT BATTERY PORTABLE KIT

Medium and long wave. Powerful 7 x 4in. high Flux Speaker. T.C.C. Printed Circuit and condensers. Components of finest quality clearly identified with assembly instructions. Osmore Ferrite Aerial Coils. Rexine covered attaché case cabinet. Size 12in. x 8in. x 4in. Batteries used B126 (L5512) and AD35 (L5040), 10/- extra. Instructions 9d. (free with kit). Mains Unit ready made for above, 39/6. Sold separately.

BAKERS Quality Loudspeakers

CHOOSE THE BEST AND SAVE POUNDS

12in. Baker 15w. Stalwart, 3 or 15 ohms	90/-
12in. Baker ditto, foam suspension, 15 ohms	£6
12in. Ultra Twelve, 20 c.p.s. to 25 kc/s	£17.10.0
15in. Baker Bass Auditorium, 35 w.	£15

RECORD PLAYER BARGAINS

Post 2/- each

4-Speed Autochangers, BSR, U.A.14	£7 10 0
Collaro Autochanger	£7 19 6
Garrard RC 209	£9 9 0
Garrard RC 210	£10 10 0
4-speed Single Players:	
EMI Monaural. £6/5/- ...... Stereo	£6 19 6
Garrard TA Mk. II	£8 0 0
Garrard 4 HF Transcription	£17 19 6

Garrard Stereo Heads £2 extra.

NEW MULLARD TRANSISTORS
Audio OC71 6/-; OC72 7/6; RF OC44 10/6; OC45 9/6.
"P.W." pocket six transistor kit, all parts, printed circuit and cabinet, £8/15/-.
Weyrad Printed Circuit Components in Stock.
Constructors Book 2/-. 7 x 4in. Speaker 35 Ω 25/-.

465 Kc/s. SIGNAL GENERATOR. Total cost 15/-. Uses B.F.O. Unit ZA 30038 ready made.
POCKET SIZE 2¼ × 4¼ × 1in.
Slight modifications required, full instructions supplied Battery 7/6 extra 69 v. + 1½ v. Details S.A.E.

VOLUME CONTROLS

Midget size:
Long spindle, Guaranteed 1 year. All values.
5 K. ohms up to 2 Meg. No switch 3/-. D.P. Sw. 4/6
Linear or Log Tracks.

80 ohm Cable Coaxial

Semi air-spaced, ¼in. dia. Ideal Band III Losses cut 50% **6d** yd.
40 yds. 17/6. 60 yds. 25/-
FRINGE QUALITY AIR-SPACED .... 1/- yd.

COAXIAL PLUGS....	1/-	LEAD SOCKETS	2/-
PANEL SOCKETS ..	1/-	OUTLET BOXES ..	4/6

BALANCED TWIN FEEDER per yd. 6d., 80 Ω or 300 Ω.
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohms.

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. Panels 10 × 7in. 2/3; 12 × 8in. 3/-; 14 × 9in. 4/-; 12 × 12in. 4/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, coloured, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE, 4d. yd., ½lb. 5/-.
PAXOLIN 1/16in. × 8in. × 10in., 1/6.

AMERICAN MAGNETIC RECORDING TAPE FERRODYNAMICS "BRAND FIVE"

5in. 600 feet	16/-	MYLAR DUPONT	
5in. 900 feet	18/6	Super High Fidelity	
5¾in. 1,200 feet	23/6	Double Play	
7in. 1,200 feet	25/-	5in. 1,200 feet	37/6
7in. 1,800 feet	35/-	7in. 2,400 feet	60/-

Illustrated leaflet S.A.E.
Spare Reels 3in. 1/6; 4in., 5in., 5¾in. 2/-; 7in. 2/6.
"Instant" Bulk Tape Eraser and Head Defluxer. 200/250 v. A.C., 27/6. Leaflet S.A.E.

RECTIFIERS. RM1 5/-; RM2 6/-; RM3 8/-; RM4 16/-; RM5 20/-; FC31 27/6; 14A86 17/6; 14A100 21/-.
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 75 mA. 12/6; 120 mA. 15/-.
COILS. Wearite "P" type 3/- each, Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.
TELETRON. L. and M. T.R.F. with reaction, 3/6.
FERRITE ROD AERIALS. M.W. 8/9; M. & L. 12/6. Ditto for transistor. MW 7/6. M. & L. 10/-.
T.R.F. COILS. A/HF 7/- pair. H.F. CHOKES 2/6.

JASON F.M. TUNER COIL SET 29/-. H.F. coil aerial coil. Oscillator coil two I.F. transformers. 10.7 Mc/s. Detector transformer and heater chokes. Circuit and component book, using four 6AM6 2/6. Complete kit FMT1 with Jason Calibrated dial and 4 valves, £6/5/-. or with New Jason Cabinet FMT2. £2 extra.

CONDENSERS. New Stock. .001 Mfd. 7 kV. T.C.C., 5/6. 20 kV., 9/6; .1 mfd. 7 kV. 9/6; 100 pf. to 500 pf. Micas, 6d. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25, 1/6; 0.5 1/9; 0.1/350 v. 9d.; 0.1/1,000 v. 1/9; 0.1 mfd. 2,500 v., 3/6; 0.001 mfd., 2,000 v., 1/9; 500 pf. 20 kV., 9/6.
CERAMIC CONDS. 500 v. 0.3 pf. to 0.01 mfd., 9d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3.
CLOSE TOLERANCE (1 + pf.) 2 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf., 1/9; 1,000 pf. to 2,000 pf., 2/-.
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.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350 v. ..	2/-	50/350 v. ..	5/6	16/450 v.	5/-
2/350 v. ..	2/3	100/25 v. ..	2/-	32/350 v.	4/-
4/450 v. ..	2/3	250/25 v. ..	2/6	100/270 v.	5/6
8/450 v. ..	2/3	500/12 v. ..	3/-	5,000/6 v.	5/-
8/500 v. ..	2/9	8+8/450 ..	3/6	8+16/450 v. ..	5/-
16/450 v. ..	3/-	8+16/450 v.	3/9	32+32/350 v.	5/-
16/500 v. ..	4/-	8+16/500 v.	5/6	32+32/450 v.	6/-
32/450 v. ..	3/9	16+16/450 v.	4/3	50+50/350 v.	7/-
25/20 v. ..	1/9	16+16/500 v.	6/-	64+120/350v	11/6
50/50 v. ..	2/-	32+32/350 v.	4/6	100+200/275v.	12/6

SUB-MINIATURE ELECTROLYTICS (15 v.).
1, 2, 4, 5, 8, 25, 50 mfd., 100 mfd., 2/6 each.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-; 25in. × 35in., 10/-; Tygan 52in. wide, 10/- ft., 26in. wide 5/- ft. Green or Red. Other colours. Samples S.A.E.

NEW and boxed VALVES 90 day guarantee

1R5 ..	7/6	6L6G	10/6	EA50 ..	1/6	EY51 ..	9/6
1S5 ..	7/6	6N7M	6/6	EABC80	8/6	EY86 ..	10/-
1T4 ..	6/-	6Q7G	7/6	EB91 ..	6/-	HABC80	12/6
2X2 ..	3/6	6SA7M	6/-	EBC33 ..	8/6	HVR2A	6/6
3S4 ..	7/6	6SJ7M	6/6	EBC41 ..	8/6	MU14 ..	9/-
3V4 ..	7/6	6SN7	6/6	EBF80 ..	10/-	P61	3/6
5U4 ..	7/6	6V6G	6/6	ECC84 ..	9/6	PCC84 ..	9/6
5Y3 ..	7/6	6X4 ..	7/6	ECF80 ..	9/6	PCF80 ..	9/6
5Z4 ..	9/6	6X5 ..	6/6	ECH42 ..	10/6	PCL82 ..	11/6
6AM6	5/-	12A6	7/6	ECL80 ..	10/6	PEN25 ..	6/6
6BE6	7/6	12AT7	8/-	ECL82 ..	10/6	PL82 ..	10/6
6BH6	9/6	12AU7	8/-	EF39 ..	5/6	PY80 ..	7/6
6BW6	9/6	12AX7	8/-	EF41 ..	9/6	PY81 ..	9/6
6D6 ..	6/-	12BA6	8/6	EF50 ..	5/6	PY82 ..	7/6
6FG6	7/6	12BE6	8/6	EF80 ..	8/-	SP61	3/6
6H6GT	3/6	12K7	6/6	EF86	12/6	UBC41 ..	9/6
6J5 ..	5/6	12Q7	6/6	EF92	5/6	UCH42	9/6
6J6 ..	5/6	35L6	9/6	EL32 ..	5/-	UF41 ..	9/6
6J7G	6/6	35Z4	7/6	EL41 ..	9/6	UL41 ..	9/6
6K6GT	6/6	80	9/6	EL84 ..	8/6	UY41	8/-
6K7G	5/-	807 ..	5/6	EZ40 ..	7/6	U22	8/-
6K8G	7/6	954 ..	1/6	EZ80 ..	7/6	U52	7/6

DK96, DAF96, DF96, DL98 8/6 ea. 30/- set.

" A MERRY CHRISTMAS TO ALL READERS OF WIRELESS WORLD "

48-HOUR MAIL ORDER

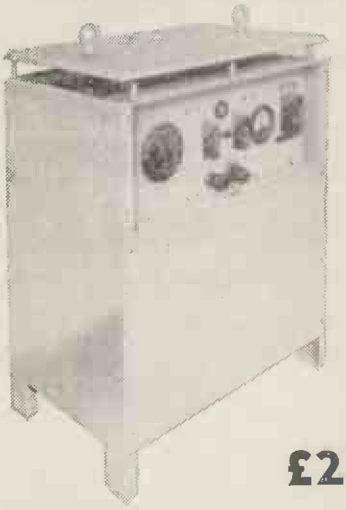
RADIO COMPONENT SPECIALISTS

337 WHITEHORSE RD. WEST CROYDON

POSTAL SERVICE 1/-, OVER £3 FREE. C.O.D. 2/-. (EXPORT C.W.O. POST EXTRA.) Wed. 1 p.m. THO 1665 Buses 133 or 68

Bulk Buying means DELIVERY EX-STOCK LOWEST PRICES

HEAVY DUTY 20 AMP. L.T. SUPPLY UNIT



by S.T.C.

Normal cost over £100

Essential equipment for Electronic Engineering, Research Laboratories, Schools. Ideal for battery charging, etc.

Guaranteed for 20 amps.

Output: D.C. Variable up to 20 amps. and 24 v. or trickle charge 125/350/700 ampere hours.
Input: A.C. 100/260 v. 45/65 cycles.

Size: 16 x 24 x 32in. high.

In attractive Grey Cabinet.

ONLY

£27-10-0

ex Warehouse

VARIABLE TRANSFORMERS

QUANTITIES UP TO 100 DELIVERED BY RETURN. NEW AND BOXED.

Brand New

Output: (1.3 kVA.). Completely Variable 0 to 260 volts 5 amps.
Input: 230 volts, 50/60~.

A SHROUDED FULLY VARIABLE TRANSFORMER FOR BENCH OR PANEL MOUNTING.

Size: approx. 6in. cube.
Weight: approx. 13lb.

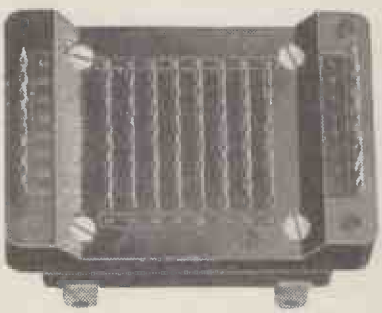
PRICE: RIDICULOUS ONLY

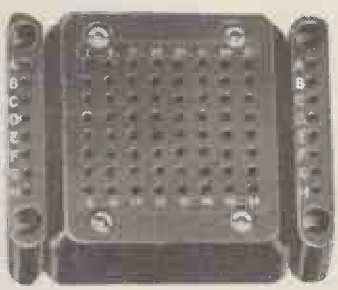
5 amps. **£9-0-0**

10 amps. **£18-5-0**

20 amps. **£32-10-0**

REVOLUTIONARY 80-WAY MINIATURE PLUG and SOCKET





Manufacturers: **G.E.C.**

LIMITED STOCKS— £5 PER PAIR

(a) Precision-made silver plated connectors.
(b) All wiring points numbered.
(c) Revolutionary design in solid bakelite moulding.
(d) Chassis mounting socket and cable mounted plug (metal housing supplied)—ideal for computor programming control equipment on any design requiring up to 80 plug and socket connections where space is restricted.

AERIAL MASTS

IMPROVED TYPE 50 Mk. II
36ft. HIGH

Kits comprise—six 2¼in. dia. Tubular Steel Sections of 6ft. length, top-section and base Pickets, Guys and Fittings. YOU can purchase this normally expensive MAST for a fraction of its cost. Please add £1 for (returnable) wooden carrying case. The MAST is particularly suitable to take aerials for Tx., Rx., F.M. and TV (especially COMMERCIAL) and overseas. Extra 6ft. sections can be supplied at 17/6 per section.

£9.10.0 only Carr. 15/6.

U.S.A. Type 45ft. TELECOM. AERIAL MAST. (7 sections, 6ft. 8in. x 2¼in., guys, etc.). This entirely complete set in carrying case 12½ Gns. Carr. 17/6. Or 2 sets for £25. Carr. extra. British manufacture only.

Limited Quantity 36FT. TELESCOPIC MASTS. Finest quality brass. Non-rusting. Base diameter 2¼in. Complete with hand-winding winch for easy, rapid extension; and cable-wire bracing stays. One of the best masts ever produced. Winds down to 9ft. £35 each. Carr. £1/10/-.

CONSTANT VOLTAGE TRANSFORMERS

★ **FERRANTI 7½-KVA MOVING COIL** stabilised output voltage in the range 200-250 v. Plug-board tappings. The selected output voltage is constant with +½% at all loads 0 to 30/37½ amps. when the supply voltage is varying over the range +8% to —12%.
★ Frequency compensated 45-55 and 54-66 c/s.
★ Excellent output wave-form.
★ Can be used as a variable transformer.
★ Unused. Complete with spares and instruction book at a fraction of the normal cost.

A.C. MAINS STABILISER. ONLY **£65**

LATEST miniature

WALKIE TALKIE

"88" sets—just released by Ministry of Supply. Produced to exacting specifications by leading manufacturers E. K. Cole & Co.

Only **£10** each

SUPPLIED COMPLETE WITH CRYSTALS. Accessories can be supplied to order at extra cost.

This Transmitter/Receiver weighs only 5½lb. (approx.) and measures 3½in. x 5½in. x 9½in. It is a 4 frequency channel set, **crystal controlled**, 38-40/40-42Mc/s., and operates from a Standard Dry Battery—HT/LT. 90v./1.3v. (i.e. Ever Ready/Berec B 1538). 14 of the current series of B7G valves are employed: 1-3A4, 6-1L4, 4-1T4, 1-1S5, 2-1A3.
Special quotations for quantities up to 3,000 sets.

Irongate (M.O.) COMPANY

Dept. (WW24), IRONGATE WHARF ROAD, PRAED STREET, LONDON W.2

PADDINGTON 2231/2/3

RADIO CLEARANCE LTD.

TRADE ENQUIRIES INVITED

27 TOTTENHAM COURT RD., LONDON, W.1.
The oldest Component Specialists in the Trade

Telephone: MUSEUM 9188
EST. 30 YRS.

IN THE HOME, IN THE CAR, BY THE SEA, IN FIELDS AFAR, THE

"CONTESSA"

IS VOTED BEST OF ALL

A really remarkable **2-Band 6-Transistor Superhet Kit—25,000** *satisfied customers and still in huge demand.*

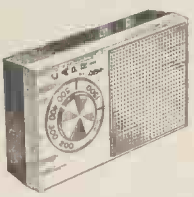
The Contessa is the professional looking set with the professional performance.

Study these brilliant features which cannot be found in any other kit—

- **Waveband coverage of 530 kc/s to 1,620 kc/s and 160 kc/s to 270 kc/s.**
- **Assured reception of at least a dozen stations in daylight!**
- **Large clearly-calibrated station-named dial.**
- **Internal high-gain Ferrox aerial.**
- **5:1 ratio slow motion tuning.**
- **Fitted with the latest 12,000-line high-flux loudspeaker.**
- **Power of 410 milliwatts from the single-ended push-pull final stage.**
- **Specially designed aerial matching coil for use in a CAR.**
- **Only first-grade fully-guaranteed matched transistors and diodes are used.**
- **Double tuned IF transformers for maximum gain and knife-edged selectivity.**
- **Fully drilled printed circuit panel marked with component numbers.**
- **The two-colour case measures 10 x 7½ x 3½in. and weighs approx. 4 lbs. when assembled.**
- **Battery lasts 4 months with normal usage..**
- **Book supplied with detailed assembly instructions, diagrams and circuitry.**
- **Anyone can build this set—everything supplied, just a soldering iron required.**

Inclusive price for all associated components, cabinet and battery. complete in every detail:
Or our BUY AS YOU BUILD SCHEME, **any parts sold separately.**
Send for comprehensive descriptive Manual and Parts List, 3/6 post free.

£10:19:6
plus 3/6 P. Pkg.



AND NOW THIS IS WHAT YOU HAVE BEEN EAGERLY WAITING FOR——————

The "CAPRI"!

A **miniature** pocket transistor kit that **REALLY** works, retaining the most attractive features of the famous "Contessa." Six first grade Mullard transistors plus diode are employed in a highly sensitive superhet MW and pre-set LW circuit embodying the most modern design practices. A special 2¼in. high gauss loudspeaker provides surprising volume and a personal earpiece socket is also available. An attractive two-tone plastic case is supplied in two colours—ivory/red or ivory/blue, the full constructional details being furnished with each set of parts. The **total measurements** of the Çapri are **4½ x 2¾ x 1¼in.**

SEE AND HEAR A WORKING MODEL TODAY

Inclusive price for all associated components, case and constructional data, complete in every detail, or our BUY AS YOU BUILD Scheme, **ANY PARTS SOLD SEPARATELY** (9 volt battery 2/6 extra).

£7:10:0
plus 2/- P. Pkg.

STAMPED AND ADDRESSED ENVELOPE with any enquiry please. But regret no lists or catalogues—our stocks move too quickly!
PLEASE ALLOW FULL POSTAGE AND PACKING CHARGES

TERMS OF BUSINESS: CASH WITH ORDER OR C.O.D. ON ORDERS OVER 10/-

AMPERIAL

BRITAIN'S MOST VERSATILE TOP QUALITY AMPLIFIER

Public Address Engineers' answer to
QUALITY AND RELIABILITY

40 Watts 8 Valve

3 entirely separate inputs (individual EF 86's) for two microphones and gram, tape or tuner

All inputs fully mixing, tone control on gram.

E. K. ELECTRONICS. **Brotherton, Knottingley, Yorks.**

WALTER "METROPOLITAN" MAINS/BATTERY TAPE RECORDER

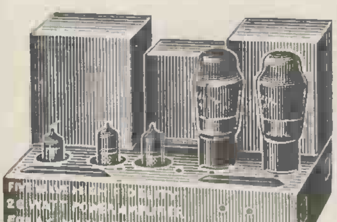
Hi-Fi perfection with enough volume to fill a small hall on mains or battery. OUTPUT: 2 WATTS UNDISTORTED. Just some of the wonderful features: speed 3¾ i.p.s. Rev. counter, record safety button. High flux 7×4in. speaker, magic eye indicator. Mixing and superimposing. Outputs for ex speaker and amp. Complete with 5¾in. tape, spools, radio/gram recording leads and plugs. Hi-Fi microphone and instruction book. BRAND NEW IN MAKER'S SEALED CARTONS. LIST PRICE 55 GNS. OUR PRICE

27 Gns. Carr. & Ins. 15/- ex.

JASON "ARGUS" TRANSISTOR A.M. TUNER for Medium and Long-waves

Superhet printed circuit, designed for use with any tape recorder or amplifier, operates from P.P.3 battery which lasts for weeks. A very efficient Ferrite rod aerial size 8×⅜in. allows for max. sensitivity. Continental stations roll in. Housed in wooden cabinet size L. 9in., W. 4in., D. 2¼in. Supplied in kit form with full instructions. £7/10/- or ready built and tested with battery £9. P. & P. 2/6.

HIGH FIDELITY ULTRA LINEAR 20 WATT POWER AMPLIFIER



With less than 1% total harmonic distortion and a hum level −80 dB. The frequency response is level from 10 cps to 40 K/cps and full power of 20 watts is delivered from 20 cps to 20 K/cps. Printed circuit design, 5 valves ECC82, 2-EF80, 2-EL34 with metal rectifiers. The pre-amplifier is of JASON manufacture and design, using 2-ECC83 valves with a six-position selector switch with the following inputs: (1) Input from a tape recorder, sensitivity 100 mV. (2) Direct connection to tape head with a 5 mV sensitivity and correction provided for a tape speed of 7½ i.p.s. (3) Microphone—ribbon or m/c type—sensitivity 5 mV. (4) Radio input: 100 mV sensitivity, impedance 500 K. (5) Crystal pick-up a high impedance input with 100 mV sensitivity. (6) Magnetic pick-up. Impedance 50 K, sensitivity 5 mV with standard L.P. correction curve. Tone controls give 15 dB cut and lift in base or treble. This 20-watt amplifier complete with pre-amp. giving **TRUE TO LIFE REPRODUCTION £21.** Carr. and ins. 10/-. *Full descriptive leaflets available upon request.*

J. E. SEXTON LTD.,
162 GRAYS INN ROAD, LONDON W.C.1
TELEPHONE TERminus 0228

GEE BROS (RADIO) LTD
15, LITTLE NEWPORT ST., LONDON, W.C.2
Telephone: GERrard 6794/1453
Adjoining Leicester Square Tube Station Open 9-6 Mon.-Fri. 9-1 Sat.

QUALITY TEST EQUIPMENT

EVERSHED & VIGNOLES Series II 500 v. Megger Insulation Tester, complete with leather case. Condition as new. **£21.** *(As illus.)*
EVERSHED & VIGNOLES wee megger 500 v. Complete with leather case. As new. **£16.**
EVERSHED & VIGNOLES wee megger 100 v. 0-20 meg. **£5/5/-.**
EVERSHED AND VIGNOLES MEGGER CIRCUIT TESTER (low reading ohm meter). 2 ranges. 0-3, 0-30 ohms. Complete with test leads. As new. **£5/19/6.** P. & P. 3/-.

WAVEMETER CLASS D. Freq. band 1,900 Kc/s. to 8,000 Kc/s. (158–37.5 metres) in two ranges. 1,900 Kc/s.–4,000 Kc/s., also 4,000 Kc/s.–8,000 Kc/s. Supply 6 v. D.C. input. Complete with twin crystal, spare vibrator, head phones, original instruction manual and transit case. As new **£5/5/-.**
AVO VALVE DATA MANUAL. Contains a host of information on 100s of valves including civilian equivalents of many service types, **21/-** post free.

AVO MODEL 7. Latest Ministry release of this well-known test instrument. Supplying 50 ranges of current, voltage and resistance tests. Complete with leads and batteries. Ready for use. Perfect condition. *(As illus.)*
ONLY £11/10/0 Carr. 5/-.

MARCONI SIGNAL GENERATOR TYPE TF517-F/1. Covering 10–18 Mc/s., 33–58 Mc/s., 150–300 Mc/s. in very good condition. Complete with full technical data and instructions. Unrepeatable at only **£12/10/-.** Carr. 20/-.

BRAND NEW CRYSTAL CALIBRATOR No. 10. (Battery powered 1.4 v. valves). Complete with full working instructions, circuit diagram, carrying haversack, connecting lead and spare valves. Frequency range: 1.5 to 10 Mc/s. (nominal) but can actually be used up to 30 Mc/s. Weight 5lb. Size 7 x 7½ x 4in. As fully described in "Practical Wireless," Dec. issue, pages 691–693. ONLY **£4/17/6.** P. & P. 2/6.

MULLARD BRIDGE. Type GM. 4140/1. Mains operated from 100–250 v. A.C. Will test resistances from 0.1 ohm to 10 megohms and condensers from 10pf to 10mfd. Good condition and complete with instruction booklet. **£6/19/6.** P. & P. 2/6.

HELLERMAN TOOL KIT. Type T.K.3. Contains sleeve expanding tool, wire stripper, 250 sleeves of assorted sizes. A must for every workshop, etc. **32/6.** P. & P. 1/-.

MINIATURE LEAD ACID ACCUMULATORS

2 v. 1.5 A.H. Size 4 x 1½ x 1in. Wt. approx. ¾lb., 6/6.

12 v. 0.75 A.H. Size 4 x 3 x 1½in Wt. approx. 2lb. 22/6.

BRAND NEW AND UNUSED

NEW AND UNUSED ACCUMULATORS

12 v. 75 A.H., 15 x 8 x 11in., **£4/10/-.** Carr. 8/6.
12 v. 25 A.H., 10 x 10 x 4½in., **45/-.** Carr. 7/6.
2 v. 16 A.H., 7½ x 4 x 2in., **5/-** each. P. & P. 2/-. 6 for **24/-.** P. & P. 10/-.
6 v. 75 A.H. Ideal for starting or storage. **59/6.** Carr. 7/6.
6 v. 20 A.H. (as illus.), comprising three 2 v. celluloid-cased cells in wooden case. Overall size 5 x 5 x 7½in., **17/6.** P. & P. 3/6.

POCKET TEST METER MODEL CT.500

20,000 O.P.V.

FOR ONLY **£5.19.6** Post Free

A pocket size individual circuit tester. Complete with test leads. Ranges: D.C., Volts: 0-2.5-10-50-250-500-5,000 v. A.C. Volts 0-10-50-250-500-1,000 v. (10,000 o.p.v.). D.C. Current: 0-0.05-5-50-500 mA. Resistance: 0-12K-120K-1.2M-12M ohms (by 2 1.5 v. internal batteries). Decibels: −20 to +62db. Size: 5½ x 1½ x 3½in.

Also available:

MODEL TK.60. 4,000 o.p.v. Ranges: D.C. volts, 10–1,000 v.; A.C. volts, 10–1,000 v. (2,000 o.p.v.). D.C. current 250 μA/10mA/250mA. Resistance: 0–10 K ohms/1–1 M ohms (by 3 v. internal battery). Decibels: −20 to +22db. £4.

MODEL TK.50 1,000 o.p.v. Ranges: D.C. mA: 1–250 mA., D.C. and A.C. Volts: 10–250–500–1,000 v. Ohms: 0–10 K ohms, 0–100 K ohms. £3/7/6.

Very acceptable Xmas Present! Order early and avoid the Xmas rush!

DON'T MISS THIS SUPER QUALITY HI-FI AMERICAN "CBS" TAPE

BRAND NEW & GUARANTEED

CIP-6	600ft. 5in.	Std. Play	13/-
LP-9	900ft. 5in.	Long Play	17/6
CMXP-12	1,200ft. 5in.	Dble. Play	32/-
CIP-9	900ft. 5¾in.	Std. Play	16/-
LP-12	1,200ft. 5¾in.	Long Play	19/6
CMXP-18	1,800ft. 5¾in.	Dble. Play	37/-
CIP-12	1,200ft. 7in.	Std. Play	21/-
LP-18	1,800ft. 7in.	Long Play	28/6
CMXP-24	2,400ft. 7in.	Dble. Play	47/-

OUTSTANDING VALUE!

1,200ft. P.V.C. Guaranteed first quality, on 5¾" or 7" spools. 17/6 each. P. & P. 1/-. (2 sent for 35/-, post paid).

Many other types available including "Scotch," "EMI," "BASF," "Triton," "Syncrotape," etc. Send s.a.e. for our huge money-saving literature on Tapes and Accessories. *ALL TAPE ORDERS BY RETURN OF POST.*

COLLARO "STUDIO" TAPE TRANSCRIPTORS. Brand new in original cartons. 3 speeds. 1⅞ 3¾. 7½ i.p.s. 3 motors, digital counter, etc. Complete with 7in. spools, instructions and fixings. A.C. 200/250 v. operation. **SPECIAL PRICE 10 GNS.** Carr. paid.

SPEAKER BARGAIN!!

GOODMANS 12", 15 ohm, Axiom 300. Brand new in original packing. Few only! SPECIAL PRICE £10 ONLY. P. & P. 3/6.

SUPER QUALITY TEST LEAD KIT No. 520

Comprises leads and prods. English and Continental type plugs, spade terminals and crocodile clips. Complete in attractive case. Post paid. **10/-**

G.P.O. RACKS

19in. Heavy duty all steel Standard drilling 5ft. 6in. angle uprights £3/10/-. Carr. 15/-. 6ft. Channel uprights £5. Carr. 15/-.

TRANSFORMERS

RCA PLATE TRANSFORMERS 190 to 250 v. primary. 50–60 cycles. Secondary 1,500–0–1,500 or 2,000–0–2,000 at 500 milliamps. Brand new and boxed. £6/10/-.

L.T. TRANSFORMERS for Battery Chargers, etc. All Pri. 200/250 v. Tapped 50 cycles. Type 048B. Sec. 24, 30, 36 v. 6 amps. 4 x 4 x 4in. £2/9/6. Type 066A. Sec. 18, 25, 30, 36 v. 8 amps. 4 x 4 x 5in. £3/19/6. Type 053A. Sec. 12, 25, 30 v. 10 amps. 4 x 5 x 5in., £4/4/-. Carr. 3/6 each.

AUTO TRANSFORMERS 0–110. 205, 225, 245 v. Fully shrd'd. Terminal block connectors. Type 063A 500 w., 4 x 5 x 5in., £3/7/6. Carr. 3/6. Type 064A. 750 w. 4 x 6 x 5in., £3/17/6. Carr. 3/6. Type 065A. 1,000 w. 4 x 7 x 5in., £4/17/6. Carr. 5/-.

20 kV/A AUTO TRANSFORMER. 230/115 v. 50–60 cycles, by Jefferies Trans. Co., U.S.A. Perfect condition. £20. Carr. 20/-.

S.T.C. SELENIUM METAL RECTIFIERS F/B FOR BATTERY CHARGERS, ETC.

6 or 12 v. 1 a. 5/-; 12 v. 2 a. 7/6; 12 v 2½ a. 12/6; 12 v. 4 a. 15/-; 12 v. 6 a. 20/-; 12 v. 10 a. 35/-; 24 v. 1 a. 10/-; 24 v. 2 a. 15/-; 24 v. 3 a. 25/-; 24 v. 4 a 30/-; 24 v. 6 a. 32/6; 24 v. 10 a. 70/-.

SUPER QUALITY HI-FI DYNAMIC (M/C) MICROPHONE with built-in transformer

MODEL MD.180

200 ohm or 50 k. impedance Suitable for hand or stand use. Complete with screened lead. OUTSTANDING VALUE **£4.15.0** POST FREE (State imp. reqd.)

CRYSTAL MICROPHONE

MODEL BM.3

Three-way mike for hand, desk or floor stand use. Response 100–8,000 c/s. Sensitivity −62dB. Length 7in. Head dia. 1¼in. Supplied with neck band, lead and standard jack plug. Terrific performance! OUTSTANDING VALUE AT ONLY **39/6** P. & P. 2/-.

Also available: MD.170. Similar in design to BM.3 but moving coil with built-in transformer. Guaranteed. Outstanding value. £4/7/6, post free.

TELESCOPIC FLOOR STAND. HEAVY 9in. dome chromium base, chromium stand with screw top. Extends to approx. 6ft. Suitable for above mikes, etc., £2/10/-. Carr. 5/-.

BAKERS "SELHURST" SPEAKERS

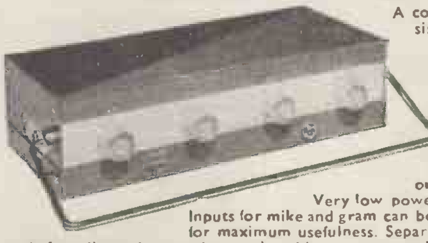
"15in. VISCOUNT AUDITORIUM." 15 ohms at 400 c.p.s., 35 watts. Flux density 18,000. CUR PRICE £15.

"12in. P.M. HEAVY DUTY." 15 ohms, 15 watts, 30–14,000 c.p.s. OUR PRICE £4/10/-.

"SUPER HI-FI 25." 12in., 15 ohms, 25 watts. 25–20,000 c.p.s. Flux density 17,600. OUR PRICE £9/9/-

ALL BRAND NEW. Full descriptive specification available. S.A.E

FULLY TRANSISTORISED PORTABLE HI-FI AMPLIFIER MODEL JTM.12



A completely transistorised Hi-Fi Amplifier powered by 8 1.5 v. dry batteries or any 12 v. D.C. external supply. Power output 12 watts. Very low power consumption. Inputs for mike and gram can be used together for maximum usefulness. Separate volume controls for mike and gram, bass and treble tone controls. Size approx. 5in.x 11¾ in.x 3in. Ideal for outdoor or indoor use for calling, announcing and entertaining. The only portable Hi-Fi amplifier available at this special price of only **£22**

Brand new with full instructions.

ROTARY CONVERTERS. 24 v. D.C. input. 230 v. A.C. output at 250 watts. With starting switch. New and unused £15. Carr. 7/6.

ROTARY CONVERTER. 24 v. D.C. to 230 v. A.C. 50 c/s., 150 watts. New and unused £8/10/-. Carr. 7/6. Ditto 100 watts £6/19/6. 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/-.

GEE BROS (RADIO) LTD

15, LITTLE NEWPORT ST., LONDON, W.C.2

Telephone: GERrard 6794/1453

12 VOLT D.C. AMPLIFIER (Parmeko). As new, 15 watt push-pull output Mike and gram. inputs, tapped output transformer, £9/19/6 Carr. 10/6. (Hand microphone for above 30/- extra.)

50-WATT EX-GOVT. AMPLIFIER. Type III with 4KT66's in paralleled push-pull. Standard 200–250 v. A.C. input. Output imped. 600 ohms line. High imp. gram. and mike input. Bass boost control fitted. Quality amplifier housed in strong metal case ready for use. Terrific performance. £25. Carr £1.

TELEFUNKEN STEREO HI-FI AMPLIFIER

110/250 v. A.C. input. 5 watt undistorted output (10 watts nominal) size 12 x 9 x 2in., weight 9lb., illustrated leaflet available, our price £9/15/-, carr. 5/-.

VERDIK QUALITY TEN AMPLIFIER & PRE-AMP

A truly High Fidelity Ultra-Linear Amplifier with a push-pull output of 10 watts and incorporating negative feedback. Provision for Tuner, also bass and treble control and 5-position selector switch for Microphone. Radio Tape and L.P. and Standard Recordings. Finished in an attractive grey/green stove enamel. Brand new, fully guaranteed. Original cost 23 gns. **£14.19.6** P. & P. 2/6.

SMALL MOBILE RE-ENTRANT LOUD HAILER. 15 watts. 15 ohms. Approx. 7in. dia., 7in. long. As new £5/10/-. Carr. 5/-.

JUST ARRIVED! BEAM PROJECTION EXPONENTIAL HORN. Smaller version of above. 19in. long, 12in. square flare. Complete with mounting bracket. Ideal for mobile use. Brand new. £6/10/-. Carr. 5/-.

TRUVOX/TANNOY LOUD HAILERS

With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope front wooden case. Brand new 27/6. Carr. 4/6.

RE-ENTRANT LOUD HAILERS (Ex-Govt.) Heavy Duty 20 watts all-metal 15 ohms. Dia. 15in., length 15in. (approx.), good cond., £6/10/-. Carr. 10/-. Ditto. Brand new, £8. Carr. 10/-.

Send S.A.E. for comprehensive list of P.A. equipment for outdoor and indoor use.

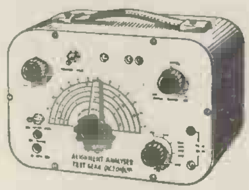
OSCILLOSCOPE

FOR D.C. & A.C. APPLICATIONS

Engineered to precision standards, this high-grade instrument is made available at the lowest possible price, incorporating the essential features usually associated with luxury instruments. This "SCOPE" will appeal particularly to Service Engineers and Amateurs. A high gain, extremely stable differential Y-Amplifier (30 mV/C.M.). Provides ample sensitivity with A.C. or D.C. inputs. Especially suitable for measurement of transistor operating conditions where maintenance of D.C. levels is of paramount importance. Push-Pull X amplifier; Flyback suppression: Internal Time base Scan Waveform available for external use: pulse/output available for checking T.V. Line O/P Transformers, etc.; provision for external X 1/P and CRT. Brightness Modulation. A.C. mains 200/250 v. £15/15/- plus P. & P. 8/- or 30/- deposit, plus P. & P. 8/- and 12 monthly payments of 26/6.
FULL 12 MONTHS' GUARANTEE INCLUDING VALVES AND TUBE.

ALIGNMENT ANALYSER TYPE MC12

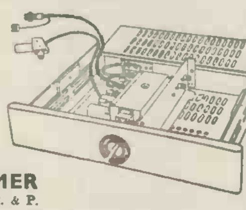
A.C. MAINS 200/250 volts. Provides:—"WOBBULATOR" SWEPT FREQUENCY OPERATION, for FM/TV alignment linear frequency sweep up to 12 Mc/s. From 400 Kc/s—80 Mc/s. CAPACITANCE MEASUREMENT. Two ranges provided 0-60 pf. and 0-120 pf. SPECIAL FACILITY enables true resonant frequency of any tuned circuit I.F. transformer, etc., to be rapidly determined. Cash price £6/19/6 and 5/6 P. & P. H.P. terms 25/- deposit and 5/6 P. & P. and 6 monthly payments of 21/6.



CHANNEL TUNER

Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with P.C.C. 84 and P.C.F. 80 valves (in series). I.F. 16-19 or 33-38. Also can be modified as an aerial converter (instructions supplied).
Complete with knobs.

32/6 Plus 4/- P. & P.



HEATER TRANSFORMER

To suit the above, 200-250 v. 6/- plus 2/- P. & P.

B.S.R. MONARCH UA8 with FUL-FI HEAD

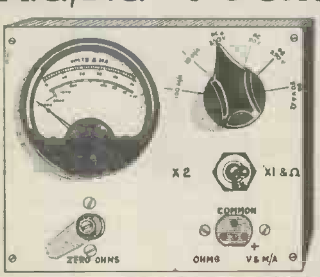
4-speed plays 10 records 12in., 10in. or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12½in. × 10⅜in. Space required above baseboard 4⅝in., below baseboard 2½in. Fitted with Ful-Fi turnover crystal head. £6/19/6. Plus 5/6 P. & P.

STEREO HEAD £7/19/6 Plus 5/6 P. & P.

LINE E.H.T. TRANSFORMER

With built-in line and width control. 14 KV Scan Coil, 90in. deflection, on ferrite yokes. Frame O.P. transformer 500 pf. 18 KV. smoothing condenser. Can be used for 14in., 17in. or 21in. tubes.
Complete with circuit diagram **29/6** Plus 4/6 P. & P.
As above, but for 625 lines **£2.10** Plus 4/6 P. & P.
FOCUS MAGNET suitable for the above (state tube), 10/-, 3/- P. & P.

A.C./D.C. POCKET MULTI-METER KIT



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, wirewound pot (for ohms zero setting), toggle switch, resistor and rectifier. 19/6. P. & P. 2/-. Wiring diagram 1/-, FREE with kit.

BATTERY RECORD PLAYER AND AMPLIFIER

Incorporating 45 r.p.m. "Starr" motor, "Acos" crystal pick up, 3 transistor push-pull, amplifier complete with transistors. Output 500 milliwatts, 49/6 plus 4/- P. & P.

5-TRANSISTOR POCKET RADIO

COMPLETELY PORTABLE. NO AERIAL OR EARTH REQUIRED

Size 4¾ x 3¼ x 1¼in. Output 200 m/W.
5 first quality transistors. Push-pull output.
Fitted 2½in. high-flux moving coil speaker.
Medium and Long wave.
Internal high gain ferrox aerial
Twin-coloured case in red and black.
All parts available separately.
Circuit-diagram 1/6. Free with kit.

Price **£2.19.6** plus 3/6 post & Pkg.

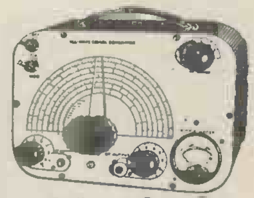
SIGNAL GENERATOR

£6/19/6

Covering 100 Kc/s-100 Mc/s. on fundamentals and 100 Mc/s to 200 Mc/s. on harmonics. Metal case 10in. × 6½in. × 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 or 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%.
Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/6 extra.

SIGNAL GENERATOR

Coverage: 120 Kc/s-230 Kc/s. 300 Kc/s.-900 Kc/s., 900 Kc/s.-2.75 Mc/s., 2.75 Mc/s.-8.5 Mc/s., 8 Mc/s.-28 Mc/s., 16 Mc/s.-56 Mc/s., 24 Mc/s., 84 Mc/s. Metal case 10in. × 6½in. × 4½in. Size of scale 6½in. × 3½in. 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%.

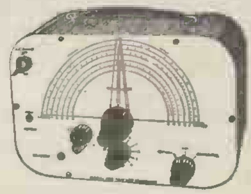


£4 : 19 : 6
P. & P. 5/6 extra.

SIGNAL & PATTERN GENERATOR

£6/19/6 P. & P. 5/6.

Or 25/- deposit. P. & P. 5/6 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.

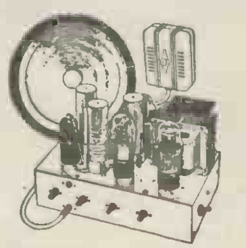


MAINS TRANSFORMER

All with tapped primaries

350-0-350, 70 m/a., 6.3 v. 1 amp., 6.3 v. 2 amp., 10/6, 250-0-250, 70 m/a., 6.3 v., 2 amp., 10/6. Postage and packing on the above 3/6.

280-0-280, 70 m/a., 6.3 v. 2 amp., 6.3 v. 1 amp., 10/6. P. & P. 3/6. 280-0-280, 120 m/a., 6.3 v. 2 amp., 6.3 v. 3 amp., 17/6. P. & P. 3/6.



5-VALVE AMPLIFIER IDEAL FOR SMALL HALLS

High power—high quality. 200/250 v. A.C. 2 inputs, mike and gram, bass and treble lifts. For use with Standard/L.P. Records. Two would be suitable for stereophonic. Ideal P.A. system, £3/19/6. P. & P. 7/-. CRYSTAL MIKE to suit, 15/-. P. & P. 2/-. 8in. P.M. SPEAKER to suit, 12/6. P. & P. 2/-.

PORTABLE AMPLIFIER

On printed circuit for A.C. Mains 200/250 v. Size 4in. x 3in. with tone and volume control. Complete with valves: ECL82 and EZ80. Output 2 watts, 39/6. P. & P. 3/-.

RADIO AND T.V. COMPONENTS (ACTON) LTD.

23A, ACTON HIGH STREET, LONDON, W.3.

GOODS NOT DESPATCHED OUTSIDE U.K. ALL ENQUIRIES S.A.E
TERMS OF BUSINESS C.W.O.

NOW PROVED WITHOUT DOUBT TO BE THE GREATEST MULTI-METER IN THE COUNTRY!

MODEL E.P. 10k. 10,000 o.p.v. on both A.C. & D.C.

A complete wired and tested instrument (not a kit) incorporating extra large 3½in. meter face and unique slide range switch. Can be conveniently carried in the pocket and features unusually sensitive 10,000 ohms per volt A.C.-D.C. meter, 1 per cent precision resistors, and largest meter ever placed on an instrument this size. Single, easy to use range selector switch, can be appreciated by the novice and engineer alike.

Complete with colour coded test leads and battery.

Size: 4½ x 3¼ x 1in. Model EP-10K. ONLY **£5.19.6** Post Free!

Everybody should possess one of these meters!

FULL SCALE RANGES:

D.C. VOLTS: 0–6–30–120–600–1,200 v.
A.C. VOLTS: 0–6–30–120–600–1,200 v.
D.C. CURRENT: 0–120μ A, 0–12–300 mA.
RESISTANCE: 0–20K, 0–2 Meg. (150 ohm, 15K at centre scale).
CAPACITANCE: 0.005 to 0.15 μF (at A.C. 6 v.).
DECIBELS: —20 to +63db (600 ohms, 1mW 0dbm = 0.775 v.
ACCURACY: D.C. voltages and current ±2% f.s. A.C. voltage ±4% f.s. Resistance ±3% of total scale length.

PYE COMMUNICATION RECEIVERS

World coverage on these famous Communication Receivers. They are the simplest type to use yet bring in stations that will amaze you. The ideal domestic receiver for medium wave during the day with Amateur stations at night. **All have been converted to 230 v. A.C. mains and are guaranteed to work immediately.** Incorporate Wave Switch, Audio gain aerial trimmer, high and low tone control, station locking device, aerial and earth inputs, speaker output sockets, etc. Size 17 x 8 x 9½in. Black crackle finish front panel. On demonstration at 87, Tottenham Court Road.

P.C.R.2. Medium and long waves and 6-23 Mc/s. Less speaker. ....
P.C.R. Medium and long waves and 6-18 Mc/s. With speaker ....

ONLY **£8 . 19 . 6** EACH TYPE

All the above have been completely reconditioned.

Carriage 10/6 each.

Order early to avoid disappointment!

TUBULAR BAFFLE EXTENSION SPEAKER

Mounts vertically—mounts horizontally—mounts on wall—sits on desk! Designed for use with transistor radios, valve radios, car radios, amplifiers, auxiliary speakers in Hi-Fi and numerous other applications where quality reproduction of sound is required.

The cabinet is finished in beige leather, with contemporary gold baffles at each end. Complete with 12ft. extension cord fitted with miniature plugs, individually cartoned and guaranteed. Size: 9½in. x 3½in. diameter.

MODEL TS. 30 57/6 P. & P. 2/6

All Transistor 2-STATION INTERCOM Model TI.302

★ Here is an Intercom system for both calling and conversing which uses the highest quality transistors and is operated from a single battery so that it may be used for multi-purpose applications, especially where there is no local electric supply and also where voltage fluctuations are severe.

★ The Master station incorporates individual volume control to ensure perfect speech reproduction.

★ The Sub-station incorporates a unique "buzzing" call system which ensures maximum efficiency.

★ Specially suited for use in offices, manufacturing plants, hotels, restaurants, residences and wherever conversation is required between two or more locations.

SPECIFICATION:

Circuit: 3 Transistors. Output Power: 200 mW. Battery: Standard 9 volt. Speaker: Built-in 2½in. permanent dynamic. Wiring: External 2-way wire. Calling: Internal "buzzer" system. Controls: Volume, Call, Stand-by/listen/talk. Dimensions: Main station: 3¾in. x 1½in. x 3.7/16in. Sub-station: 3½in. x 1¼in. x 3.7/16in. Colours: Black or ivory cabinets.

Model TI.302 12 GNS.

Each Intercom is supplied complete with battery, 60ft. of wire and is individually cartoned in a magnificent fitted gift box.

TI.302

SF.20 RADIO HEADPHONES Hi-impedance—2,000 ohms—general use headset. Black and ivory plastic cased electro-magnetic units with adjustable head-band for comfortable fit. Individual listening for all types of applications. Individually packed, with flexible cord attached. 14/6, post paid.

AMERICAN LIGHTWEIGHT HEAD SET
They're High and Low Impedance!

These H.S.30 phones are the smallest used by U.S. Air Force. 250Ω imp. using soft rubber miniature ear moulds for maximum music and voice reproduction of the finest quality. Supplied free is a small transformer unit with cord and plug which steps impedance up to 4,000Ω. Only 15/-. P. & P. 2/6

No. 7. MOVING COIL MICROPHONE INSERTS. Ultra sensitive. As used in many Govt. Microphones! Size 1¾in. dia., 1¼in. deep. Brand new and guaranteed. 6/6 EACH.

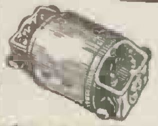
TRANSISTOR SPECIAL! ! 5K EDGEWISE MINIATURE VOLUME CONTROL K2.16 with switch and ivory knob. As used in all miniature transistor radios. 4/6 EACH.

CRYSTAL MICROPHONE INSERTS MODEL MC.1. Precision disc type crystal microphone cartridge. Output 53db. Response 100-6000 c.p.s. **ONLY 6/6.**

Complete HEADPHONE AND MICROPHONE ASSEMBLY. A must for every Constructor and "Ham." consists of moving coil, padded headphones and "press to talk" microphone. 10/-. P. & P. 3/6.

AERIAL VARIOMETERS These magnificent instruments will enable you to receive maximum signal strength on all Short Wave receivers. Precision calibrated control. 12/6. P. & P. 2/6.

LEAD ACID ACCUMULATORS (unspillable), 2 volts 16 A.H. Ideal for 6 volts and 12 volts supply. Brand new, original cartons. Size 4in. x 6in. x 2in., 5/6 each. P. & P. 1/6. 3 for 15/-. P. & P. 3/6. 6 for 27/6. P. & P. 5/-.



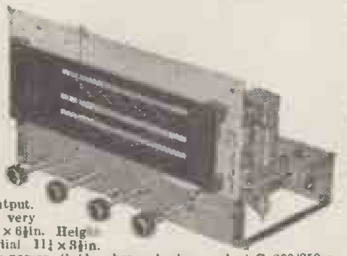
HOOVER ROTARY TRANSFORMERS. 12 v. input, 500 v. output at 65 mA. or 6 v. input, 250 output at 75 mA. ONLY 10/6 each. P. & P. 2/-

Mail Orders
(DEPT. W.) 32a COPTIC STREET, LONDON, W.C.1

Relda Radio Ltd

Callers welcome at:
87 TOTTENHAM COURT ROAD, LONDON, W.1. MUS. 9606

7 VALVE AM/FM RADIOGRAM CHASSIS



Valve Line-up: ECC85, ECH81, EF89, EABC80, EL84, EM81, EZ80.

Three Waveband and Switched Gram positions Med. 200-500 mm., Long 1,000-2,000 m., VHF/FM 88-95 Mc/s. Philips Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers, 460 Kc/s. and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ × 6½in. Height 7½in. Edge Illuminated glass dial 11¼ × 3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250 v. operation. Magic-eye tuning.

Aligned and tested ready for use. **£13 . 10 . 0** *Carr. & Ins. 5/-.*

Complete with 4 Knobs—walnut or ivory to choice. Indoor FM aerial 3/6 extra.

3 ohm P.M. Speaker only required. Recommended Quality Speakers 10" H/DUTY PLESSEY 30/-, 8" H/DUTY ROLA 25/-. P. & p. 2/6.

RECORD PLAYER BARGAINS Latest 4-speed models

NEW RELEASE by E.M.I.—4-speed Single Player Unit fitted with latest stereo and monaural Xtal cartridge and dual sapphire stylii. Auto stop and start. A fidelity unit and bargain buy at only £6/19/6, carr. & ins. 4/6.

SINGLE PLAYERS B.S.R. (TU9), 79/6; COLLARO JUNIOR studio P.U., 75/-. AUTOCHANGERS, B.S.R. (UA8), £6/19/6; UA8 STEREO, £7/10/-; B.S.R. (UA14), latest model, £7/15/-. COLLARO "C60" Latest Model, £7/15/-. Carr. & Ins. 5/-.

RECORD PLAYER CABINETS

Cabinet Price

£3.3.0

Carr. and Ins. 5/-.

Contemporary style, rexine covered cabinet in mottled red and white polka dot. Size 18½ × 13¼ × ht. 8½in., fitted with all accessories including baffle board and anodised metal fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 × 13in. supplied.

2-VALVE 2-WATT AMPLIFIER

Twin stage ECL82 with vol. and neg. feedback Tone control. AC 200/250 v. with knobs, etc., ready wired to fit above cabinet. £2/17/6. P. & P. 1/6.
6in. Spkr. & trans., 22/-. P. & P. 2/-.

TRANSISTOR COMPONENTS

Midget I.F.'s—465 Kc/s $\frac{9}{16}$in. diam. 5/6
Osc. Coil M & L.W. 5/9
Midget Driver Trans. 3.5 : 1 6/9
Midget Push-Pull Trans.—3 ohms 6/9
Elect. Condensers—Midget Type 1 mfd-50mfd. ea. 1/9. 100 mfd. 2/-, 6V/12V wkg.
Condensers 150v. working:
.0mfd., .03mfd. 9d.
.05mfd., .1mfd. 1/-
.25mfd. 1/3; .5mfd. 1/6 etc.
Vol Controls—Midget Type with edge Control Knob. 5K. 47K, 1 M/ohm, ea. 2/6.
Speakers P.M.—2½in. EMI 3 ohms 17/6. 7in. x 4in. Plessey 35 ohms 23/6.
Ear Plug Phones—Min. Continental type, 3ft. lead, jack plug and socket. High Imp. 8/-. Low Imp. 7/6.

VALVEHOLDERS—Paxolin; Int. Oct., EF50, 6d. Moulded: Int. Oct. Mazda Octal, 7d.; B12A (CRT), 1/3; B8G, 9d. each; **Nylon or Moulded, Ceramic:** B7G, B9A unskirted, 9d. each; B7G, B9A skirted, 1/- each; B7G with Can. 1/6 each; B9A with Can, 1/9 each; EF50, B7G, 1/- each; B9A ditto, 1/3 each.

RE-GUNNED TV TUBES

NEW REDUCED PRICES

PRICES REDUCED AGAIN—12 months' guarantee!

All tubes rebuilt with new heater, cathode and gun assembly—and now all tubes are completely rescreened and aluminised at no extra cost. Reconditioned virtually as new.

12in. £5, 14in. £5/5/-, 17in. £5/10, etc.

Exchange Allowance on old tube—12" 5/-, 14"/17" 7/6.

Carr. and ins. 10/-. Comprehensive stocks—quick delivery.

"POCKET 6" TRANSISTOR RADIO KIT—Med & L/W size

5½ × 3½ × 1¾in.

Osmor Ferrite Ae 10/-. Osc. Coil & 3 IF's 22/6. Driver & O/P Trans. 22/-. Tuning Gang 10/6. 2½in. PM Speaker 17/6. Set 6 Transistors & Diode 45/-. Printed Circuit 8/6. Vol. Control 8/-. W/C Sw. 3/6. Cabinet & Dial 8/-. Resistor Set 5/-. Condenser Set 15/-. Handbook, full details 1/6.

Complete Kit *REDUCED PRICE* **£8/10/0** Carr. 2/6

Wavechange SWITCHES, Midget Type—2 pole 2 way, 1 pole 6 way, 2/6 each; 1 pole 12 way, 2 pole 6 way, 3 pole 4 way, 4 pole 2 way, 4 pole 3 way, 3/6 each.

METAL RECTIFIERS, STC Types—RM1, 4/9; RM2, 5/6; RM3, 7/6; RM4, 16/-; RM5, 21/-; RM4B, 17/6.

WESTINGHOUSE—Contact Cooled. FC116, 250V, 60mA, 11/9; FC101, 250V, 200mA, 21/-; FC31, 250V, 300mA, 28/6.

SIEMENS TYPES—Contact Cooled: 250V, 50mA, 7/6; 250V, 85mA, 10/-; 250V. 125mA, 15/-; 250V, 300mA, 26/6.

"6 plus 1" TRANSISTOR RADIO KIT

BEST EVER VALUE! . . . Using 3 latest type Surface Barrier Transistors

MANUFACTURERS SURPLUS BARGAIN OFFER.—Further kit supplies now available. Original purchases of this popular kit were rapidly sold out. This kit is a modern, sensitive quality Receiver Unit with all the latest features. Six BVA transistors and 1 diode, printed circuit med. and long waves. Ferrite aerial, car radio input 500 mW. push-pull output into 3 ohm speaker, calibrated dial and slow-motion tuning, etc. Size approx. 8 × 2½in. Cabinet size 9in. × 6½in. × 3½in.

KIT of Parts including printed circuit **5 gns.** | **BARGAIN OFFER! Complete Kit £6/19/6** less speaker

SET of 6 Transistors and 1 Diode, 45/-.

3 ohm Speaker 7in. × 3½in.—ONLY 15/6, carr. 1/6. Send 3d. stamp for full details. Circuit and Instructions 1/6. Cabinets now available 25/- extra. Carr. 2/6

BARGAINS GARRARD PLAYER UNITS

SINGLE PLAYERS:
Model 4SP £6/17/6. Carr. 4/6.
Model TA Mk. 2 £7/19/6. Carr. 4/6.
Model 4HF. £17/19/6. Carr. 4/6.

AUTOCHANGERS:
Model RC 210 with plug-in GC8 head, 10 gns. Carr. 5/-. Model A Transcription Auto Changer—just released. £18/19/6. Carr. 7/6.

Comprehensive range in stock.

NEW BOXED VALVES ALL GUARANTEED

1T4	6/-	ECL82	10/6	PCF80	9/6
1R5, 1S5	7/6	ECL80	10/6	PCL83	12/6
3S4, 3V4	7/6	EF80	8/-	PCL84	12/6
DAF96	9/-	EF86	12/6	PL81	12/6
DF96	9/-	EL84	8/6	PL82	9/6
DK96	9/-	EY51	9/6	PL83	10/6
DL96	9/-	EY86	10/-	PY32	12/6
ECC81	8/-	EZ81	7/6	PY81	9/6
ECC82	8/-	GZ32	12/6	PY82	7/6
ECC83	8/-	PCC84	9/6	U25	12/6

COAX 80 ohm CABLE

High grade low loss Cellular Air Spaced Polythene—¼in. diam. Stranded Cond.

Now only 6d. a yard

BARGAIN PRICES—SPECIAL LENGTHS 20 yds. 9/-. P & P. 1/6. Coax. Plugs 1/-. 40 yds. 17/6. P. & P. 2/-. Sockets, 1/-. 60 yds. 25/-. P. & P. 3/-. Couplers. 1/3.

JASON FM TUNER UNITS

Designer-approved kits available.
FMT1, 5 gns. 4 valves, 20/-.
FMT2, £7. 5 valves, 37/6.
JTV Mercury, 10 gns. 3 valves 25/-.
JTV2, £13/19/6. 4 valves, 32/6.
NEW JASON F.M. HANDBOOK, 2/6.
48 hr. Alignment Service, 7/6 plus 2/6.

VOLUME CONTROLS—5K—2 Megohms. 3in. SPINDLES. MORGANITE MIDGET TYPE. 1½in. diam. Guar. 1 year. LOG or LIN ratios less Sw., 3/-. D.P. Sw., 4/6. Twin Stereo less Sw., 6/6. D.P. Sw., 8/-.

TRANSISTOR BARGAINS!

Brand New—BVA 1st Grade.

OC44	10/6	874	9/6
OC45	9/6	873	9/-
OC81	7/6	GET114	6/6
2/OC81	15/6	OC72	7/6
XA102	10/-	OC70	5/6
XA101	9/6	OC71	6/-
XB103	7/6	GEX34	2/9
XC101	8/6	OA70	2/9
SB305	9/6	OA81	2/9

CONDENSERS—Silver Mica. All values, 2 pf. to 1,000 pf., 6d. each. Ditto, ceramics 9d. Tub. 450 v. T.C.C., etc., .001 mfd. .01 and .1/350 v., 9d. .02-1/500 v., 1/-. .25 Hunts 1/6. .5 T.C.C. 1/9 etc., etc.
CLOSE TOL. S/MICAS. 10% 5 pf.-500 pf., 8d. 600-5000 pf., 1/-. 1% 2 pf.-100 pf., 9d. 100 pf.-500 pf., 11d. 575 pf.-5000 pf., 1/6.
RESISTORS—FULL RANGE 10 ohms—10 megohms 20% ¼ & ½ w., 3d., ½ w., 5d. (Midget type modern rating), 1 w., 6d., 2 w. 9d.
HI-STAB. 10% ½ w., 5d. ½ w., 7d. 5% ½ w., 9d. 1% ½ w., 1/6. etc.
W/W RESISTORS. 25 ohms to 10K 5W., 1/3, 10 w., 1/6, 15 w., 2/-.
PRE-SET T/V POTS. W/W 25 ohms-50 K., 3/-. 50 K-2 Meg. (Carbon) 3/-.

TURRET TUNER BAND I/BAND 3

Ex-manufacturers current production offer—Standard type 13-channel unit. 35-38 mc/s I.F. complete with PCC84 and PCF80 valves and coils for channels 1-3-9. No knobs or circuit diagram but connection data supplied. Clearance bargain, only 32/6, carr. 2/6. Worth 5 gns.

Electrolytics All Types New Stock

TUBULAR		CAN TYPES	
25/25 v. 50/12 v.	1/9	8+8/450 v.	4/6
50/50 v. 100/25 v.	2/-	32+32/275 v.	4/6
8/450 v. 4/350 v.	2/3	50+50/350 v.	6/6
16+16/450 v.	5/6	60+250/275 v.	12/6
32+32/450 v.	6/6	100+200/275 v.	12/6

Transistor Midget Types—all values 1 mfd. to 50 mfd. 1/9 ea. 100 mfd. 2/-. 6v/12v.

SPEAKERS P.M. 3 ohms. 2½in. Elac 17/6. Goodmans 18/6. 5in. Rola 17/6. 6in. Elac. 18/6. 7in. × 4in. Goodmans, 18/6. 8in. Rola 20/-. 10in. R. x A. 25/-. 9in. x 6in. Goodmans 25/-. E.M.I. Tweeter 29/6.

TYGAN FRET (Contem. pat.), 12 × 12in., 2/-; 12 × 18in., 3/-; 12 × 24in., 4/-; etc.

RECORDING TAPE—Famous American Columbia (CBS) Premier quality tape at NEW REDUCED PRICES. A genuine recommended Quality Tape—TRY IT! Brand new, boxed and fully guaranteed. Fitted with leader and stop foils.

Standard		Long Play	Double Play
5in.	600ft. 15/-	900ft. 19/6	1200ft. 31/6
5¾in.	900ft. 16/6	1200ft. 22/6	1800ft. 39/6
7in.	1200ft. 21/-	1800ft. 32/6	2400ft. 47/6

Post & Pack., per reel, 1/- plus 6d. ea. for additional reels.
SPECIAL OFFER. 3in. mfrs. surplus tape, 225ft. 5/6. P. & P. per reel 6d.
TAPE REELS. Manfrs. surplus. 7in. 3/6, 5¾in. 3/3, 5in. 3/-, 3in. 2/6.

TAPE RECORDER KIT ONLY £16 10s.

Latest 5-valve circuit based on Mullard's design. Magic eye and tone controls. Printed circuit already wired. A sensitive quality recorder. B.S.R. Amp. Kit 95/-. B.S.R. Tape Deck £3/10/-. Collaro Amp. Kit £6/5/-, Collaro Tape Deck £12/10/-. Set of 5 valves 45/-. Special Unit Kit Prices—Send stamp for detailed list. Handbook (full constructional and circuit details) 2/6.

SPECIAL BARGAIN OFFER! *Record Player Kits*

Auto Changer Kit. Comprising three units. Contemp. styled cabinet size 17 × 14½ × 8½in. 2 valve 2 watt amp. and 7 × 4in. quality speaker. Variable tone and volume controls with feedback circuit and B.S.R. 4-speed 10 record mixer auto. changer unit.

BGN. PRICE only £12/10/-. Carr. 7/6.

Single Player Kit. Similar spec. to auto. changer kit except player is 4-speed B.S.R. T.U.9 single record player unit. Attractive contemp. styled cabinet. Size 13¼ × 13 × 6in. with splendid volume and reproduction.

BGN. PRICE only £8/19/6. Carr. 5/-.

All units ready wired, simple screwdriver assembly only
FULL SATISFACTION REFUND GUAR.
SEND FOR DETAILED LEAFLET 3d. STAMP

Terms: C.W.O. or C.O.D., post and packing up to ½lb. 7d. 1lb. 1/1; 3lb. 1/6; 5lb. 2/-; 10lb. 2/9.

TRS **RADIO COMPONENT SPECIALISTS** *Established 1946*

70 BRIGSTOCK RD., THORNTON HEATH, SURREY
Tel. THO 2188; *Hours:* 9 a.m.—6 p.m. 1 p.m. Wednesday.

THE D·T·V GROUP

Instruments for the Radio, TV and Electronic Industries

Have you had your copy of the latest publication from the D.T.V. Group?

If not, and you are an industrial user of electronics, please ask for one NOW. An invaluable desk reference book, it covers a wide range of equipment and materials, all backed by the D.T.V. Guarantee of Service, with a special 16-page feature on instruments alone.

Detailed listings and prices are given for a useful range of components and accessories, transformers, valves, valve-holders, etc.
Everyone connected with electronics will find this new book a valuable and practical guide, saving time, money and trouble.

BEULAH D800

An attractively styled, compact, low-priced Closed Circuit Television Camera

Beulah Electronics' newest development and the focus of interest in the technical press and at every exhibition where it has been shown, the new D.800 Camera makes a dramatic and outstanding contribution to the technique of closed circuit television. Ask for free illustrated brochure giving full details.
Dealers! Dealerships are still available for this unit in certain areas. Write and tell us about the facilities you can offer in your area.

With an external meter, forms equipment equal to an instrument costing in the region of £30 . . .

The D900

a compact, dynamic TRANSISTOR TESTER/POWER SUPPLY

- Makes possible dynamic transistor testing in situ.
- Tests CURRENT GAIN (A.C.), ALPHA GAIN.
- Tests CURRENT GAIN (under D.C. conditions), BETA GAIN.
- Measures leakage currents between Collector/Base and Collector/Emitter at any voltage between 0-25 v.

The D.900 makes possible quick and easy testing of transistors and transistor receivers, in many cases without removing the transistor from the circuit. The unit has its own self-contained power supply, providing smoothed D.C. 0-25 v. Avoids the necessity for drawing batteries from stock . . . saves time and money. Ask for special leaflet. **Retail Price £12.**
Trade and wholesale prices on application.

Model O-12U/F Laboratory 5" OSCILLOSCOPE £45 . 15 . 0

plus carr. Complete with 48-page handbook. Factory made and factory tested.

Heathkit Model O-12U £36 . 10 . 0

Large 5in. flat screen ensures great accuracy and facilitates observation. Patented sweep circuit of exceptional range covers 10 c/s to over 500 kc/s in five steps, many times the sweep, range of other 'scopes. Gold-plated printed circuit. Wide band amplifier for TV and FM servicing. Vertical bandwidth 3 c/s to over 5 Mc/s. Electronically stabilised power supply.

Some of the other top-grade Beulah Electronics Instruments available, factory assembled, wired and tested.

	£	s	d
Capacitance Decade Box DCIU/F	£9	7	6
Model DCIU (In kit form)	£6	5	6
Resistance/Capacitance Bridge C3U/F	£13	9	6
Model C3U (in kit form)	£8	6	6
Audio Valve Millivoltmeter AV-3U/F	£19	19	0
Model AV-3U (in kit form)	£13	18	6
Audio Wattmater AW-IU/F	£20	14	6
Model AW-IU (in kit form)	£14	14	0
Electronic Switch S-3U/F	£15	17	0
Model S-3U (In kit form)	£10	15	9

Deferred terms are available on most items. Please ask for details. See the full range at our London Showrooms: **138, Lewisham Way, New Cross, London, S.E.14.**

PLEASE SEND CASH WITH ORDER NOW OR WRITE FOR ILLUSTRATED LEAFLETS on the instruments in which you are interested.

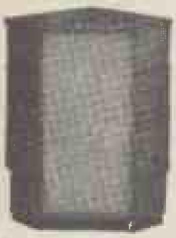
— THE D·T·V GROUP —

DIRECT TV REPLACEMENTS LTD · DIRECT TV WINDINGS LTD · BEULAH ELECTRONICS

TIDeway 6666. **138, Lewisham Way, New Cross, London, S.E.14.** *Day and night automatic service: TIDeway 6668.*

CABINETS, ENCLOSURES AND EQUIPMENT BY STAMFORD

Specialising in Enclosures to Goodmans specifications. Write for new illustrated list.
Speakers supplied.
See "EQUIPMENT" listed below.



S.51. Corner Enclosure in three sizes.
(a) For Axiette. Price £10/10/- or 42/- deposit and 18 payments 10/9 monthly.
(b) For Axiom 110 and 112. Price £11/10/- or 46/- deposit and 18 payments 11/9 monthly.
(c) For Axiom 300 or the 3-Way system including ARU No. 172. Price £18/5/3 or 73/6 deposit and 18 payments 18/7 monthly.

HI-FIDELITY EQUIPMENT
Only 5% interest charged on Credit and H.P. Terms for equipment

	Cash Price £	s	d	H.P. Dep.	18 m/s.
SPEAKERS					
Goodmans 8" Axiette	6	15	4	27/6	6/6
,, 8" Triaxiette	13	16	7	55/4	13/3
,, 110 10"	5	2	5	20/6	4/11
,, 112 10"	8	14	2	34/10	8/4
,, 300 12"	11	5	9	45/2	10/10
,, Trebax 5K/20XL	7	0	0	28/-	6/9
,, Midax 650	9	10	0	38/-	9/1
Wharfedale 8" Column 8/145	7	3	5	28/8	6/11
,, 8" Super 8/FS/AL	7	3	5	28/8	6/11
,, 10" Golden/FSB	8	10	8	34/2	8/2
Whiteleys 1012	5	2	6	20/6	4/11
,, 1016	8	4	0	32/10	7/10
Elac 4 speaker HPP/2	10	16	3	43/3	10/5
LOUDSPEAKERS—COMPLETE SYSTEMS					
Goodmans AL/100	23	10	0	94/-	22/7
,, AL/120	29	10	0	118/-	28/4
,, Sherwood I	32	11	0	130/-	31/2
Wharfedale W2	29	10	0	118/-	28/4
,, W3	39	10	0	158/-	37/11
,, SFB/3	39	10	0	158/-	37/11
GRAM UNITS, ETC.					
Lenco GL 58/580	24	7	2	97/6	23/4
Garrard 301 Strobe	25	14	10	103/-	24/7
,, Auto Type A—Mono	23	1	0	92/3	22/-
,, 4 HF Mono	19	18	2	79/8	19/-
,, TA Mk. II Mono	9	3	8	36/9	8/11
,, 4 HF Stereo	20	17	2	83/6	19/11
,, TA Mk. II Stereo	10	12	10	46/-	10/2
,, 210 Mono	13	7	2	53/6	12/9
Decca FFSS Pickup	21	10	0	86/-	20/7
AMPLIFIERS					
Leak TL 12/Plus/Vari III	34	13	0	138/8	33/5
Rogers HG 88	38	10	0	154/-	36/7
Leak Stereo 20 and Vari Stereo	55	9	0	221/10	53/3
Quad 22 and 2 Amps.	70	0	0	280/-	67/2
Jason J2 10	40	19	0	163/10	39/4
TUNERS					
Leak Troughline Mk. II	34	12	6	138/6	33/1
Acoustical Quad FM	29	13	6	118/9	28/5
Rogers Junior Switched	16	7	3	65/6	15/8
CHASSIS					
Armstrong Jubilee Mk. II	31	15	0	127/-	30/4
,, Stereo 55	33	15	0	135/-	32/3
,, Stereo 12 Mk. II	44	15	0	179/-	42/9
TAPE					
Brenell 3-star Recorder	60	18	0	243/7	58/5
,, Mk. V Deck	29	8	0	117/7	28/3
,, Mk. V Amplifier	24	0	0	96/-	23/-

B2/E 46in. × 16in. DECK
B2/EX 46in. × 18½in. DECK

PRICE £22 or £4/8/- Deposit. 18 payments of 22/3.
PRICE £23/17/6 or £4/15/6 Deposit. 18 payments of 24/5.
Also supplied at same prices with tape or record storage on left and deck 33in. long.

Write for lists of Equipment, Cabinets and Enclosures. We specialise in supplying any equipment currently available. Demonstrations at our Weymouth Terrace Showroom. Our Products are supplied in oak, walnut and mahogany veneers finished in shade required. Delivery 15/-. England and Wales. 25/- Scotland.

Visit our Hi-Fidelity Showrooms at:
84/86/98 Weymouth Terrace, off Hackney Road, LONDON, E.2. Telephone: SHO 5008.
No difficulty in Parking.
Showroom hours: Monday-Saturday 9.30 to 5.30.
Late night Wednesday, 7 p.m.
Directions: No. 6 bus from Liverpool Street Station to the Odeon, Hackney Road, walk back two turnings.
A. L. STAMFORD LTD. (DEPT. P.4)

36/50 SWG ·0076"-.001"
VERY HIGH SPEED
TENSIONING & DE-REELING

FOR COST CUTTING IN COIL WINDING

★ FAST STARTS AND STOPS
★ VERY HIGH SPEEDS
★ CONSTANT REVERSIVE PULL
★ LARGER REEL SIZES
★ SMOOTHER WIRE FEED
★ CUTS BREAKS AND SCRAP
★ VERY LIGHT MOVING PARTS
★ STATIONARY SUPPLY REEL
★ MODELS FOR LARGER WIRES

SHAWNDEL FLYERS LTD.,
DEPT. WW1261, 72 QUEEN STREET
MAIDENHEAD, BERKS, ENGLAND.
Tel. MAIDENHEAD 890

DAMAGED METER?

Have it repaired by Glasers
Reduce overheads by having your damaged Electrical Measuring Instruments repaired by L. Glaser & Co. Ltd.

We specialise in the repair of all types and makes of Voltmeters, Ammeters, Microammeters, Multirange Test Meters, Electrical Thermometers, Recording Instruments, etc.
As contractors to various Government Departments, we are the leading Electrical Instrument Repairers in the Industry. For prompt estimate and speedy delivery send defective instrument by registered post, or write to Dept. W.W.

L. GLASER & CO. LTD.
96-100, Aldersgate Street, London, E.C.1.
Tel.: Monarch 6822

TELEPRINTERS . PERFORATORS
REPERFORATORS . TAPE READERS

Picture Telegraph Equipment; Morse Equipment; Pen Recorders; Switchboards; Rectifiers; Tape Pullers and Rewinders; Motors; Suppressors; Teleprinter and Teletype Tables; Silence Covers; Terminals; V.F. Equipment; Telephone Carriers and Repeaters; Send/Receive Low and High Pass Filters; Teleprinter Testers; Relay Testers; Oscilloscopes; Valve Testers; Electric Meters; Teleprinter and Teledeltos Paper; Plugs; Sockets; Key, Push Miniature and Other Switches; Cords and Cables; Relays and Relay Bases; Counters; Uniselectors; Telegraph and Mains Transformers; Racks and Consols; Miscellaneous Accessories.

BATEY & CO., GAIETY WORKS
AKEMAN STREET, TRING, HERTS.
Ring: TRING 2183 or 2310
CABLES: RAHNO TRING

D. & B. TELEVISION

Phone: Cherrywood 3955

131 & 131a KINGSTON ROAD
SOUTH WIMBLEDON, S.W.19

FOR THE FINEST, FASTEST SERVICE IN THE COUNTRY. We are Open from 10 a.m. Until Midnight. For any information or problems you have Call or Phone, we are always pleased to help.

SEND FOR OUR COMPREHENSIVE L.O.P.T. SCAN COIL L.B.O., F.B.O., F.O.P.T. LIST
Prices of nearly all makes and models, 2/6, post 6d. Invaluable as a service aid. The finest list ever compiled.

TRANSISTORS
Genuine Mullard Transistors in sets of Six: 1, OC44; 2 OC45's; 1, OC81D; 2, OC81's in matched pair. Including OA81, Diode. for ONLY £2/2/6.
Genuine G.E.C. Transistors in Sets of Six: 1, GET874; 2, GET Q873; 1, GET114; 2, GET114's in matched pair; plus 1, GEX34 for ONLY £1/18/6.

SINGLE TRANSISTORS PRICE LIST
Mullard: OC44, 10/-; OC45, 9/-; OC70, 6/-; OC71, 6/-; *OC72, 7/-; OC76, 7/-; OC78, 7/-; *OC81, 7/-; OC81D, 6/-.
G.E.C.: GET874, 9/-; GET873, 8/6; *GET 114, 5/9.
* Available in matched pairs at 1/- extra.
Mullard Diodes: OA70, 2/9; OA79, 2/9; OA81, 2/9; OA91, 3/6.
G.E.C.: GEX34, 3/3.
All above are genuine manufacturers new 1st grade.

SURPLUS TRANSISTORS
Red Spot, A F, OC71 and 72. Equivalent .. 4/3 each
White Spot, R F, OC44 and 45. Equivalent.. 5/- each
Diodes, general purpose .... 1/- each
Various other types in stock. Please ask for prices of types not listed.

TURRET TUNERS. Various Makes: 10. 16, 38 Mc/s, 40/-

EXAMPLE OF TRANSFORMER LIST

	L.O.T.		SCAN COILS	
FERGUSON:	(New)	(Used)	(New)	(Used)
103T, 105T	69/9	35/-	60/-	35/-
992/4/6/8	69/9	35/-	60/-	35/-
PYE:	(New)	(Used)	(New)	(Used)
V4, VT4, V7	52/6	35/-	55/-	35/-
VT7, CTM4	52/6	35/-	55/-	35/-
MURPHY:	(New)	(Used)	(Used only)	
V214, V240, V250	60/6	35/-	45/-	
ECKO:	(New)	(Used)	(New)	(Used)
221, 283	47/3	30/-	40/6	27/6
231, 284, 293	54/-	35/-	40/6	27/6

REGUNNED CATHODE RAY TUBES
all with 12-month Guarantee
ALL MAKES: 12in., £3/15/-; 14in. £4/5/-; 17in., £4/15/-.
ADD: 10/- for 90° tubes; 15/- for 100° tubes; 5/- for Electrostatic types.
SECONDS, with 12-month Guarantee—ALL MAKES: 12in., £2/15/-; 14in., £3/5/- (when available); 17in., £3/15/-.
SECONDS, No Guarantee—ALL MAKES: 12in., £1/5/-; 14in., £1/15/- (when available); 17in., £2/15/-.
NOT APPLICABLE TO NO GUARANTEE SECONDS: 10/- allowance on old tube if in good condition.

THE FABULOUS R.T.D. TRANSISTOR SIX
LATEST ON THE KIT MARKET
Spec.: Six transistor plus diode, printed circuit, superhet, ferrite rod aerial. Automatic gain control to stop overloading. Output 450mW in push pull. All components brand new and guaranteed. Neat, small, two-tone grey cabinet. Two radios in one, portable and car radio. Incorporates car aerial input socket. Everything to build this superb Transistor Radio. Only £8/9/6.

AZ31s	8/6	EY51	7/9	U26	12/-	6AM6	3/-
B36	5/6	EY86	7/6	U31	9/6	6CD6	27/6
D77	3/-	EZ40	6/-	U50	8/6	6D2	3/-
DH77	4/6	KT33C	6/-	U52	7/-	6F1	5/-
DK91	5/9	KT36	8/6	U191	9/-	6F12	3/-
DK92	8/-	KT66	15/-	U281	9/-	6F13	7/-
DK96	7/6	PCC84	7/-	U282	20/-	6F14	9/6
DL92	5/9	PCC89	8/6	U301	20/-	6F15	9/6
DL94	6/9	PCF80	7/-	U801	22/6	6L1	12/6
DL96	7/6	PCL82	10/9	UAF42	8/-	6V6	5/-
EB91	3/-	PCL83	11/3	UBC41	7/9	10F1	4/6
EBC33	5/-	PCL83	9/6	UCH42	7/-	10C1	10/-
EBF80	9/6	PL33	8/6	UF41	8/6	10C2	13/-
ECC81	5/3	PL38	10/9	UF42	3/9	10P13	9/-
ECC82	5/9	LP38	14/6	UL41	7/3	10P14	9/-
ECC84	8/-	PL81	8/6	UL46	7/3	12AT7	5/6
ECF80	8/-	PL82	6/9	UL44	11/6	12AU7	5/9
ECH35	9/-	PL83	7/-	UY41	6/6	20D1	8/6
ECH81	6/-	PY31	7/-	UU8	14/6	20F2	9/-
ECL80	6/9	PY32	10/-	UU9	6/6	20L1	12/6
EF39	5/-	PY80	6/6	SP41	2/3	20P1	10/6
EF50	3/9	PY81	6/-	SP61	2/3	20P3	12/-
EF80	4/6	PY82	6/6	W77	5/-	20P4	16/6
EF91	3/-	PZ30	10/-	Z77	3/-	27SU	14/-
EF92	5/-	U22	9/6	5U4	5/-	30C1	7/-
EL33	8/6	U24	10/-	5V4	9/-	30L1	7/-
EL38	14/6	U25	12/-	5Y3	10/6	30P4	10/9
EL84	7/-			5Z4	10/-	185BT	14/-
EY51SE	6/-			6AL5	3/-		

These are only examples of our valves: if you do not see what you require send stamped addressed envelope for special quotation.

We pride ourselves that we can obtain and supply any TV spare. OUR GIGANTIC STOCKS INCLUDE: *Line Output, Frame Output, Sound Output, Line and Frame Blocking Osc. Trans. and Scan Coils for any make or model Television. Please ask us for ANY components you require—we are almost certain to have them.*

TERMS: S.A.E. all enquiries. C.W.O. or C.O.D. 3/- extra. Postage on Valves 6d. each. C.R.T.s 12/6 inc. insurance
SATISFACTION ASSURED. RETURN POST SERVICE.

CRYSTAL CALIBRATOR No. 10
A crystal controlled heterodyne wavemeter covering 500 Kc/s. to 10 Mc/s. (Harmonics up to 30 Mc/s.). Requires 300 V. 15 mA. and 12 V. 0.3 a. D.C., but can be easily modified for 120 V. and 1.4 V. working. Size 7 x 7½ x 4in. Good condition, complete with valves, crystal, instruction manual and circuit. ONLY 59/6. Post 3/6. This item available complete as above. **BRAND NEW** and with spare set of valves. £4/10/-. Post 3/6.

CANADIAN CRYSTAL CALIBRATOR. Uses double crystal and multi-vibrator circuit to give "pips" at 1 Mc/s., 100 Kc/s. and 10 Kc/s. Incorporates Modulator. With book. 79/6, post 2/6.

MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. 19/6. Post 1/6.
MATCHING TRANSFORMER (for Hi impedance), i.e. for HRO, CR100, etc., with standard jack plug. 4/6.

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RMS, D.C. output 30 v. 10 amps. BRAND NEW. Boxed. 45/-, post 3/6.

CONSTANT VOLTAGE TRANSFORMERS. Input 190 to 260 volts, 50 c.p.s. Output 115 volts at 2 kVA. A pair of these will give a constant output of 230 volts at 4 kVA. Price £17/10/- each plus £1 carriage. Two for £35, carriage paid.

AVO SIGNAL GENERATORS No. 1. Post-war type covering 50 Kc/s to 80 Mc/s. in 6 turret operated wavebands. Operates from standard A.C. mains. In excellent condition and perfect working order, £12/10/-, carr. 7/6.

6-VOLT VIBRATOR PACKS. HRO type, 180 v. D.C., 65 m/amps. BRAND NEW. 29/6, post 3/6. Type PU2. 200 v. D.C. 100 m/amps., with OZ4 rectifier. **BRAND NEW**, 25/- post FREE.

CHOKES. Parmeko 5 H, 200 m/amps., 6/6. AR-88 chokes, 15 H., 90 m/amps., 8/6. Parmeko 8 H., 100 m/amps., 7/6. Postage any type, 1/6.

QQVO6—40 30/-

CO-AXIAL RELAYS (Switch Type 78A). Simultaneously switch two separate inputs to alternative outputs. 24 volt D.C. coils (can be hand operated). Size (approx.) 5 x 3 x 3in. 8/6. Post 1/6.

PRECISION RESISTORS. One Megohm 1% 1 watt wire wound, ex-U.S.A. BRAND NEW. 10/6 per dozen.

SANGAMO-WESTON VOLTMETERS
S61. Dual range 0-5 and 0-100 v. D.C. FSD 1 m/A. 3in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads. **BRAND NEW.** Boxed 27/6. Post 2/6.

PCR COMMUNICATION RECEIVERS
Made by Philips these compact 6-valve receivers incorporate an RF, two IF and a full size output stage for loudspeaker use. There is a phone jack for moving coil phones. All sets are in PERFECT WORKING ORDER and give very fine results on short waves.

Type PCR has a self contained speaker and covers 850 to 2,000, 200 to 550, and 16 to 50 metres.
AS NEW CONDITION £6 19 6

Type PCR 2 requires external speaker and covers 850 to 2,000, 200 to 550, and 50 to 13 metres.
USED (GOOD CONDITION)................. £5 19 6
CARRIAGE (any type) 10/6.

POWER SUPPLIES. The above receivers require 250 volts HT and 12 volts LT. We will supply any of the above receivers fitted with a **BRAND NEW INTERNAL POWER SUPPLY** for £2 extra. Fully guaranteed ready for use on A.C. mains.

RECEIVER R 206 MK 2
A super communication receiver with ALL the right features. 550 Kc/s to 30 Mc/s in 6 ranges. Turret tuning, osc. vernier control super slow motion tuning. Fantastic sensitivity. Complete with power supply and speaker and in first class condition. £25 plus carriage £2. S.A.E. for details.

AR-88D RECEIVERS

One of the finest communications receivers ever made. Those we offer are in superlative condition, thoroughly checked and tested as regards calibration, alignment and sensitivity.
Personal shoppers can see for themselves that we have the finest receivers on the market. Those unable to choose their receiver personally can rely on our integrity to send them a first-class set for ONLY £35.

THE GOOD COMPANION
At last we are satisfied that a first-class transistor receiver with a performance at least equal to the best commercial receivers can be easily constructed. Come and hear one. The printed circuit technique, pre-aligned oscillator and I.F. transformers, American Philco R.F. transistors and Q.P.P. output of 750 mW from Mullard OC 82s ensure success. All the parts including 6 transistors, 2 diodes (all first grade), cabinet, 5in. speaker and comprehensive instructions cost £9/19/6. Uses PP9 battery, 3/6 extra.

THE POCKET FOUR
The new version consists of 4 transistors and 1 diode. Uses printed circuit and ferrite rod aerial. All the parts with comprehensive instructions (DLR 5 speaker) cost 52/6, post 2/6.

L, C & R BRIDGES
AVO Capacity 5 pfd. to 50 mfd. Resistance 5 ohms to 50 Megohms. Inductance can be measured against external standard. Balance is indicated on a meter which can be used as a valve voltmeter from 0.1 to 15 v. Leakage test and Power Factor scale. AC mains operation. Tested and guaranteed and in superlative condition. £9/10/- plus 5/- P. & P.

AVO UNIVERSAL IMPEDANCE BRIDGE No. 2. Resistance 0.5 ohms to 55 Megohm, Capacity 5 pFd to 55 mFd. inductance 50 millihenries to 550 Henry. Leakage at 25, 50, 150, 250, 350 and 450 volts. Power Factor. A.C. mains operation. These are in as new condition. £20 plus 7/6 carr.

WAYNE KERR B101 COMPONENT BRIDGES. 200-250 A.C. mains operation. 1 ohm to 500 megohms in 16 ranges; 1 pFd. to 500 mFd. in 16 ranges, 100 milli-H to 5000 Hen. in 8 ranges; Q factor of 0·5 to 300; power factor ·015 to 1·0; Comparator scale plus/minus 10%; leakage from 1 to 1500 microamps. at test voltages of 6, 12, 25, 50, 150, 250, 350 and 450. Magic-eye null indicator. A first class precision bridge. Size 14 x 9 x 9in. Wt. 24 lb. In perfect working order and first class condition. £17/10/- plus 10/- carr.

MINIATURE RELAYS (ALL BRAND NEW and BOXED)
G.E.C., sealed, wire ends, 670 2M2B H/D M1095 ..... 8/6
G.E.C., sealed, wire ends, 670Ω, 2 H/D makes, M1099 15/-
G.E.C., sealed, wire ends, 5,000Ω 2 c/o., plat., M1052 17/6
Siemens High Speed 1K + 1KΩ, 1 c/over.................. 10/6

GIANT COMPONENT PARCEL
Contains 100 ½ and 1 watt resistors, 50 Hi Stab resistors, wire wound resistors, carbon and W/W pots, 100 capacitors (mica, paper, Sprague, bias, variable, etc.), valveholders, tag strips, metal rectifiers, sleeving, etc. All components are unused. **GUARANTEED VALUE**, 25/- plus 2/6 post.

UNISELECTORS
25 Position, 8 bank double wipers, 24-volt operation. Removed from brand new equipment, 62/6. Post 1/6.

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE
LONDON, W.C.2. *TEMple Bar 0545*
Near Leicester Sq. Station. (Opposite Thorn House)
Shop hours: 9-6 p.m. (9-1 p.m. Thursdays). Open all day Saturday.

AVOMETER MODEL 7
AVO MODEL 7 £11-10-0
AVO MODEL 8 £15-15-0
All meters are in perfect working order and first-class condition. Complete with batteries, leads and instructions. Please add 5/– for registered post and packing.

BC221 **FREQUENCY METER 125 kc/s. to 20 mc/s.**
This crystal controlled heterodyne frequency meter is too well known to need further description. Those we offer are complete with correct individual calibration book and are carefully tested and guaranteed. Condition is very good. **£16/-/-**

RADIATION METERS
Portable close rate meter containing modern type rectangular 50 micro-amp meter CVX 494, electrometer valves, etc. BRAND NEW. In canvas carrying case. £3/19/6. Post 3/6.
PHILIPS RADIATION MONITOR. Type 1092C. A portable self-contained instrument for measuring radio-activity, uses the Mullard MX-115 Geiger counter tube, and is scaled 0-10 milli-Rontgens per hour. Supplied complete with carrying haversack. BRAND NEW. £17/10/-.

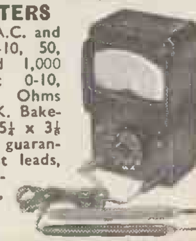
AIRCRAFT CINE CAMERA G.45. Takes 25ft. of 16 mm. film. 16 frames per sec. Complete with 24 v. motor and lens. 29/6. Post 3/6.

GAUSS METERS
American type TS-15/AP. Made by Marion Electric for M.I.T. Radiation Lab. AS NEW. £7/10/-.

D.C./A.C. CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0-300 v. A.C. 2½in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. £9/19/6. Carr. 10/6.
Input 24 v. D.C. Output 230 v. A.C. 50 c/s. 100 watts. In grey metal case. BRAND NEW. 92/6. Carr. 7/6.

MICROAMMETERS
R.C.A. 0-500 microamps. 2½in. circular flush panel mounting. Dials are engraved 0-15, 0-600 volts. As used in the American version of the No. 19 set. BRAND NEW. Boxed. 15/–.
American 0-100 microamps. 2½in. square flush panel mounting. BRAND NEW. Boxed. 42/6.

MULTIMETERS
1,000 Ω/Volt A.C. and D.C. volts 0-10, 50, 250, 500 and 1,000 D.C. current 0-10, 0-100 mA. Ohms 0-2,000, 0-200K. Bakelite case size 5¼ x 3⅛ x 2¼in. Fully guaranteed with test leads, prods and internal battery.



59/6

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

STOCKISTS FOR THE FOLLOWING

AMPLIFIERS, STEREO AND MONAURAL, BY:
VERDIK, QUAD, ARMSTRONG, LEAK, ROGERS, W.B., DULCI, etc.

V.H.F. TUNERS BY:
ARMSTRONG, T.S.L., LEAK, DULCI, QUAD, ROGERS, etc.

HI-FI SPEAKERS BY:
GOODMAN, W.B., PLESSEY, T.S.L., WHARFEDALE, G.E.C., LORENZ, etc.

ANNOUNCING THE NEW VERDIK Mk. III QUALITY TEN AMPLIFIER

10 watt push-pull ultra linear Hi-Fi amplifier with pre-amp. control unit. Amplifier: Valves EF86, ECC83, 2—EL84, EZ81 Sensitivity 40 M/V for 10 watts output impedance. 4, 8 and 16 ohms, spare supply for tuner, 200/250 v., A.C.

NEW PRE-AMP. CONTROL UNIT. ATTRACTIVELY FINISHED GOLD ON BLACK PANEL using 2 EF86 valves, separate inputs for magnetic and crystal p/ups, radio, tape and microphone, 5 position input selector, bass and treble controls continuously variable between—10DB to +12DB bass rumble filter, treble filter for old records ONLY 18 GNS. Post & Packing 7/6.

AMPLIFIER AND PRE-AMPLIFIER

MK II AMPLIFIER, POWER AMP. AS ABOVE
Pre-Amp.: valve EF86. INPUTS Radio: 100 M/V., tape. M/V. GRAM: LP 50 M/V, 78 60 M/V. MIC: 10 M/V., socket for recording direct to tape recorder. Treble: between —10DB and +12DB at 10 kc/s. BASS between —10DB and +12DB at 20c/s. Finished grey, green stove enamel, control panel in gold lettering, fully guaranteed. OUR PRICE £14/19/6. Post & Packing 7/6.

THE NEW VERDIK TAPE RECORDER. The S22, fitted with Collaro studio deck, twin track, 3 speed 7½in., 3¾in. and 1⅞in. p.s. Fast rewind frequency response 60 c/s to 10 kc/s., microphone and radio inputs, record level indicator, ex. speaker socket, 2 watt output, attractively styled portable cabinet 18in. front to back, 15½in. wide, 6½in. deep. Weight 26 lb.

Usual price 39 gns. **OUR PRICE 33 GNS.** Packing and insurance 15/-. 4 track model at **39 GNS.** S.A.E. for details.

THE NEW JASON RANGE FOR CONSTRUCTORS

FMT2. In kit form with free standing case, power pack. Including valves, £8/19/6.

FMT3. Variable tuner 88-108 Mc/s. Variable AFC control dual limiters. approx. 80 miles range. Including valves, £10/19/6.

JTV2 Tuner, self powered switched tuner for FM and TV sound. Both BBC and ITA, as required. Including valves. £13/19/6.

MERCURY II switched FM/TV sound tuner in kit form for building into cabinet. Including valves. £10/10/-. Power pack kit, £2/14/9.

JTV2 Tuner completely assembled ready for use, £25/19/6.

2/6 post and pkg. on all the above. S.A.E. for details. Stockists of all other Jason Kits.

The FLEET 6 PORTABLE TRANSISTOR RECEIVER

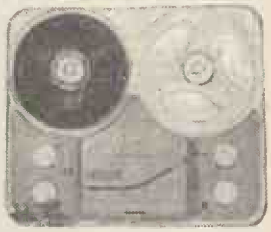
Using 6 guaranteed first-grade transistors, sensitive diode, p/pull output, medium and long wave bands, printed circuit, high Q ferrite rod aerial, 6 x 4 high flux speaker. Provision for car aerial. Attractive 2-tone cabinet, overall size 9 x 7 x 3in. Easy to follow

instructions, all components including 2-tone cabinet, transistors, speaker circuit etc. £9/19/6, complete, P. & P. 3/6. Battery extra. All components guaranteed and sold separately. Send S.A.E. for details. Circuit and instructions 2/- post free.

SPECIAL OFFER!
THE "FLEET SIX" TRANSISTOR

The "Fleet 6," a wow of a transistor set that really gets the stations. New design 6-transistor superhet pocket receiver, using 6 guaranteed first grade transistors plus sensitive diode, push-pull output medium and long wave bands, new type printed circuit high Q internal ferrite rod aerial, 2½in. high flux speaker, provision for car aerial, overall size 7½ x 4½ x 2½in. Simple to follow instructions. All components guaranteed, service after sales. This is equal to many manufactured sets at double the price. All components including cabinet, transistors, speaker, circuit, etc., only £8/19/6, complete. Post and pkg. 3/6. PP4 Battery 2/- extra. All components sold separately. Send S.A.E. for details. Circuit and instructions 2/6 post free.

ASTOUNDING OFFER! THE NEW VERDIK
PRECISION TAPE DECK



SPECIFICATION: Three Hi-grade motors driving from left to right, 2 knobs controlling record, replay and fast rewind, interlocked mechanically and electrically; solenoid operated brakes, giving even braking. 3¾ and 7½ IPS, separate erase, record and p/back heads. P/back head gap length 0.0002". Simple drop in tape loading. Wow and flutter better than .2% at 7½ sec. Quality stove enamel finish in white and grey. AC 210-250V. 70W. consumption, bias and erase approx. 65 kc/s. Bias voltage approx. 30V. erase voltage 25-30V., frequency response 40CPS-12 KC/S. Built-in Rev. counter. Fully guaranteed.

OUR PRICE £18/19/6. Post & Packing 12/6.

BUY NOW!

Definitely the last of the remaining stocks of the **AVANTIC BEAM-ECHO HI-FI EQUIPMENT**

SP21 STEREO PRE-AMP CONTROL UNIT
A twin channel pre-amp. control unit, has 6 inputs for each channel. INPUT SENSITIVITY for 250 M/V or 1.5 V. output. TUNER 100 and 250 M/V. Tape 100 M/V. flats 250 M/V. PICK-UP 5 and 50 M/V. Frequency response: 40 c/s. to 15 kc/s. TAPE OUTPUT 50 M/V continuously variable bass and treble control, loudness control and stereo balance control. Power required 6.3 V. at 1.3 amp. A.C. 350 V. at 6 M/A D.C. Will match any hi-fi amplifier. Manufacturer's price £28/10/-. OUR PRICE now £16/19/6. Carr. and packing 10/-.

AVANTIC PL6-21
High quality monaural power amplifier and pre-amp. compactly housed and suitable for shelf mounting or cabinet. Two EL84, three EF86, one ECC83, one EZ81, 20 watts peak; speaker impedance, 4, 8 or 16 ohms. Sensitivity; 4 M/V on pick-up. 3 M/V on tape. 100 M/V on tuner, intermod. distortion 1% at 10 W. equivalent. Sinewave output. Maker's price £28/10/-. OUR PRICE 19 gns. Post and Packing 10/-.

AVANTIC
STEP II Stereo pick up pre-amp. unit, 84/-. P. & P. 2/6.
STEP 21 tape pre-amp. unit, also 84/-. P. & P. 2/6.

STOP PRESS REPEAT OFFER
HI-FIDELITY TAPE HEADS
Made by famous manufacturer. Brand new. Upper track, record/play-back, high impedance giving up to 12,000 c.p.s. at 7½ I.P.S. Output 5 m/volts at 1 kc. at 7½ I.P.S. Erase heads low impedance. Only 29/6 per pair. Post 1/-.
PORTABLE BATTERY ELIMINATOR MADE BY COSSOR
Housed in two containers which are to replace AD35 and B126 Batteries, 39/6 plus 2/- P. & P. Only suitable for use with Dk96 Series valves.

IMPERIAL CHEMICAL INDUSTRIES LTD.

PLASTICS DIVISION

has vacancies at its headquarters at Welwyn Garden City for the following appointments:

(a) Designers (Electrical) for power and lighting installations in industrial plant. (Experience with British Standards, Flameproof and intrinsically safe practice would be an advantage.)

(b) Designers and Draughtsmen (Instruments) for application of instrumentation, including automatic control of industrial plant.

(c) Experimental Officers for

(i) work on instrument evaluation and automatic control systems (knowledge of machine tools and workshop practice would be an advantage);

(ii) work on development of electronic equipment for use in the measurement and control field. (A knowledge of transistorized circuits and pulse techniques would be an advantage).

Candidates should have an appropriate Higher National Certificate or Ordinary National Certificate and experience in the field offered.

Excellent conditions of service include a 37½ hour, five-day week, a Pension Fund and a Profit Sharing scheme. For married men assistance is given towards removal expenses and a lodging allowance.

Apply briefly, quoting reference No. 5147, to the Personnel Officer, Imperial Chemical Industries, Plastics Division, Bessemer Road, Welwyn Garden City, Herts.

Due to further expansion, ABC Television invites applications from

ENGINEERS OF ALL GRADES

for vacancies in the Maintenance Department, Central Apparatus Area —including Videotape or Telecine.

A thorough basic knowledge of electronics and the ability to maintain equipment is essential. Industrial experience in an allied industry would be an advantage.

Salaries are in the range of £691-£1560 p.a.

Applications must be made in writing to: **The Personnel Manager ABC Television Ltd. Broom Road, Teddington, Middlesex.**

Vacancies in Government Service

A number of vacancies, offering good career prospects, exist for male

RADIO OPERATORS

Write giving details of education, qualifications and experience to:—

Personnel Officer, G.C.H.Q. (RO/3), 53, Clarence Street, Cheltenham, Glos.

LEO DATA PROCESSING

TRAINING TO BE ELECTRONIC COMPUTER ENGINEERS AND TECHNICIANS

Outstanding opportunities are offered by this young and rapidly expanding Company to men interested in the maintenance of large scale computers. Men with initiative and a logical and decisive approach to problems are invited to apply for entry to our next training courses.

There are openings for people with any of the following backgrounds:—

(i) Experienced electronic engineers with or without qualifications.

(ii) Men with experience of electro-mechanical equipment and preferably a knowledge of electronics.

(iii) Qualified men with a degree or H.N.C.

(iv) Men with "A" level in maths and physics and an active interest in electronics.

The positions are pensionable and there are excellent prospects for rapid increase in salary. If you are seeking a progressive career in an invigorating atmosphere, write to:

The Personnel Manager, LEO Computers Limited, Hartree House, Queensway, London, W.2.

STERN RADIO LIMITED

109 & 115, FLEET ST., E.C.4

have vacancies for

TWO RADIO ENGINEERS

Applicants must be experienced and possess sound technical knowledge. Good wages are offered plus Bonus and Staff Pension Scheme. Half-day on Saturday.

Phone **FLEET STREET 5812** or call at 109, Fleet Street (at Ludgate Circus, close to Blackfriars Station).

QUEEN MARY COLLEGE
(University of London) Mile End Rd., E.1
Nuclear Engineering Laboratory
Chief Technician

A Chief Technician is required to help in developing equipment and to supervise newly-erected laboratories. Experience in a laboratory, adaptability and enthusiasm are more important than paper qualifications or specialised experience. The work of the department includes electronics, vacuum circuits and precision mechanical engineering. A well equipped electronics workshop and machine shop are available. Pension scheme; five day week; four weeks annual leave.

Appointment, according to ability etc. on scale £940 × 30 to £1,060 and in special cases to £1,195 per annum.

Letters only to the Registrar (NC) Queen Mary College, stating age and giving full details of experience and present work.

Electronic Instrument

ENGINEERS

Senior, Intermediate and Junior Engineers with sound theoretical knowledge and wide practical experience, are required in a department handling the Design, Development, Inspection and Maintenance of production test equipment for the Plessey Company Limited.

★ *An exceptional range of equipment is dealt with.*

★ *The work, whilst difficult, is constantly interesting.*

★ *We welcome applications from men who enjoy meeting a challenge with clear thought and precise action.*

The following categories are required:

DESIGN ENGINEERS

These posts are for engineers who are able to design measuring instruments and associated equipment to an electrical specification. Senior Engineers must have the experience and personal qualities necessary to provide acceptable guidance to junior engineers.

INSPECTING ENGINEERS

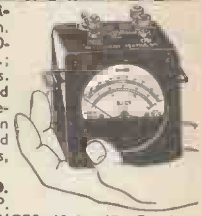
These engineers carry out a detailed inspection of the electrical measuring equipment purchased by the Company, and of the products of the department's Design and Development sections. An ability to understand specifications and a detailed knowledge of the use of electronic measuring instruments is essential for those applicants qualifying for the grade of Senior Engineer.

● ***Attractive salaries; Immediate entry into the Company's Life Assurance Scheme.***

Please reply, giving full details to The Personnel Manager, The Plessey Company Limited, Vicarage Lane, Ilford, Essex.

Plessey

SOUTHERN RADIO'S WIRELESS BARGAINS



TEST METERS, PORTABLE. 3¾ x 3¾ x 2½in. D/C. M/C. Ranges: 0-5,000 ohms; 0-60 mA.; 0-3 volts; 0-1.5 volts. Range can be extended to suit individual requirements by addition of resistances. (Featured in Practical Wireless, March issue.)
NEW AND TESTED. 12/6 each plus 2/- P. & P.
SPECIAL QUANTITY PRICES: 12 for £7. Carriage paid U.K. (ex sea routes).

METERS. 30-0-30 and 3-0-3 volts combined ranges with prods, 15/-.

TRANSMITTER RECEIVERS TYPE "38" with 5 valves. New but untested. No guarantee. 25/- each. Post Paid.

ATTACHMENTS for "38" TRANSMITTER-RECEIVERS Mark II.
HEADPHONES 15/6 per pair; THROAT MICROPHONES 4/6; JUNCTION BOXES 2/6; AERIALS, No. 1 2/9, No. 2 5/3; WEBBING 4/-; HAVERSACKS 5/6; VALVES. A.R.P.12 4/6, A.T.P.4 3/6; SET OF FIVE VALVES 19/-. Postage on each item except valves 1/6 extra.

RECORDING BLANKS. Brand new. Ready for cutting. 13in 6/- each or 15 complete in metal case, £4.

RESISTANCES. 100 assorted useful values; New wire end 12/6. NEW.

CONDENSERS. 100 assorted Mica: Tubular, etc., 15/-. NEW.

INSULATORS. Porcelain egg type 7/6 per doz.

CONTACTOR TIME SWITCHES. 2 impulses per sec., in case, 11/6.

REMOTE CONTACTOR. For use with above, 7/6.

LUFBRA HOLE CUTTERS. Adjustable ¾in. to 3½in. For Metal, Plastics, etc., 7/-.

MAGNETS. Strong Bar type 2 x ¼in., 1/6 each.

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.

PACKARD-BELL AMPLIFIERS. Complete BRAND NEW, with valves, relay, etc., etc., 17/6 each.

ATTACHMENTS for "18" TRANSMITTER-RECEIVERS Mark III.
HEADPHONES 15/6 per pair. HAND MICROPHONES 4 a., 12/6. AERIALS 5/9; MORSE KEY 6/6; VALVES: A.R.P.12 4/6, A.R.8 7/6, A.T.P.4 3/6; SET OF SIX VALVES 25/-. Official booklet "18" T/R circuits, etc., 6/6 post paid. Postage on each item except valves 1/6 extra.

BOMBSIGHT COMPUTERS. Recent purchase, ex-R.A.F. Ideal for experimenters. A wealth of gears, motors, blowers, etc., etc., £3/12/6, carriage paid.

QUARTZ CRYSTALS. TYPES F.T.241/F.T.243. 2-pin, ½in. space. Frequencies (F.T.243) 5,700 kc/s. to 8,650 kc/s. (F.T.241) 20 Mc/s. to 38.9 Mc/s. (54ft. and 72nd harmonics). 4/6 each. List of available frequencies on request.

BRAND NEW. CRYSTAL BASES. F.T.241, F.T.243 1/3 each.

CRYSTAL CASES. F.T. 241/243 types, 10/6 per dozen.

STAR IDENTIFIERS. Type I.A.-N. covers both hemispheres. 5/6.

COMMAND RECEIVERS. B.C. 454 3-6 Mc/s. B.C. 455 6-9 Mc/s. Complete with 6 valves. 47/6 each.

DYNAMOTORS FOR ABOVE. 28 volts. 15/-.

VISUAL INDICATORS (10Q/4). Type 3. With 2 meter movements and two neons. New in cover. 12/- each.

TRANSPARENT MAP CASES. Plastic 14in. x 10¾in. Ideal for Maps, Display, etc., 5/6.

Post or carr. extra. Full list Radio Books, etc. 3d.

SOUTHERN RADIO SUPPLY LTD.
11, LITTLE NEWPORT STREET,
LONDON, W.C.2. GERrard 6653

SOUND MARKETING LTD.

Applications are invited for the post of Development Engineer. Experience of Electronic and/or Audio Tape equipment design essential. Apply in writing to the Chief Engineer, Sound Marketing Ltd., 40 Osnaburgh Street, London, W.1.

SERVICE ENGINEERS

required in the London area for interesting work on X-ray and electronic equipment. Training will be given in this specialised field, but a sound knowledge of electrical and electronic principles is essential.

Apply in writing to: Service Manager, General Radiological Ltd., County Building, Honeypot Lane, Stanmore, Middlesex. Nr. Queensbury (Bakerloo) Station.

Z. & I. AERO SERVICES LTD.

Head Office: 14 South Wharf Road, London, W.2

Tel.: AMBassador 0151/2 Cables: ZAERO, LONDON

A.R.B. Approved Stockists

RETAIL BRANCH (personal callers only): 85 TOTTENHAM COURT ROAD, W.2 Tel.: LANgham 8403

Please send all enquiries, correspondence and Mail orders to Head Office

OVERHAULED, TESTED AND GUARANTEED TEST EQUIPMENT FOR DELIVERY EX STOCK

SIGNAL GENERATORS: MARCONI TF144G, 85 kc/s.-25 mc/s.; Type106, 5.5-52 mc/s.; MARCONI TF-390G, 16-150 mc/s.; MARCONI TF-517F, 18-58 and 150-300 mc/s.; GENERAL RADIO 804, 7.5-330 mc/s.; WAYNE KERR CT-53, 8.9-300 mc/s.; TYPE 101, 400-650 mc/s.; R.C.A. 710A, 370-560 mc/s.; MEASUREMENTS CORPORATION TYPE 84. 300-1,000 mc/s.; HEWLETT PACKARD TYPE LAE, 520-1,300 mc/s.; BC-1277, 2,700-3.400 mc/s.; TS-14, 3,200-3,370 mc/s; TS-45/APM-3, 8,700-9,525 mc/s.; TS-35/AP, 8,700-9,500 mc/s.; TS-13/AP, 9,305-9,445 mc/s.

WAVEMETERS: BC-221 125 kc/s-20 mc/s.; LM, 125 kc/s-20 mc/s.; LR-2 (Combined Heterodyne Frequency Meter and Calibrator Equipment with direct indication of difference frequency): 160 kc/s 60 mc/s.; MARCONI TF-783, 3-60 mc/s.; TS-173, 90-450 mc/s.; TS-175, 80-1,000 mc/s.

AUDIO-VIDEO OSCILLATORS: FURZEHILL No. 1, 0-10,000 kc/s.; B.S.R. LO-50 B.F.O., 0-16,000 c/s., MARCONI TF-195L, 0-40,000 c/s; GENERAL RADIO WIDE RANGE B.F.O. TYPE 700A, 50 c/s.-5 mc/s.; MARCONI TF-885A VIDEO OSCILLATOR, 25 c/s. to 5 mc/s.

OSCILLOSCOPES: DUMONT SINGLE BEAM TYPE 208; COSSOR DOUBLE BEAM TYPE 339; COSSOR DOUBLE BEAM TYPE 1035; MULLARD-TYPE L101 DOUBLE BEAM (Switched): AIRMEC TYPE 723 SINGLE BEAM: AIRMEC TYPE 830 SINGLE BEAM; E.M.I. TYPE 3794TA SINGLE, BEAM ON TROLLEY; TS-34 SINGLE-BEAM PORTABLE OSCILLOSCOPE.

R.F. OUTPUT POWER METERS: TS-118, 25 mc/s. to 750 mc/s., 5-500 watts; TS-36, 8,700-9,500 mc/s., 1-1,000 mW.; TS-3/AP, 2,750-3,400mc/s. .5-250 mW.; TS-226, 405-425 mc/s., 0-1,000 watts.

A.F. OUTPUT POWER METERS: MARCONI TF-340, 0-5 watts; TAYLOR 150A, 0-5 watts; TAYLOR 160A, 0-2.5 watts.

FIELD STRENGTH METERS: CT10, frequency 20-30 and 40-650 mc/s., measurements up to 140 db. above 1μV/m.; RCA type 301B, frequency 18-125 mc/s., measurements range 5μV/m. to 1V/m.

VALVE VOLTMETERS, INSULATION FLASH-OVER TESTERS, IMPEDANCE BRIDGES, etc. 3cm. and 10 cm. ECHO BOXES. Please write for new edition of Test Equipment Catalogue.

HETERODYNE WAVEMETERS

TS-173 Heterodyne Crystal Controlled Frequency Meters range 90 to 450 Mc/s. Individual Calibration Books with numerous crystal check points. Accuracy .005% nominal and .01% interpolation. Power required: dry batteries 6 V. and 135 V. PRICE, fully overhauled and guaranteed £120 0 0

TS-175 Heterodyne Crystal Controlled Frequency Meters, range 80 to 1.000 Mc/s., otherwise as above. PRICE fully overhauled and guaranteed £150 0 0

GENERAL RADIO LR.2 COMBINED HETERODYNE FREQUENCY METER AND CALIBRATOR EQUIPMENT

Frequency range 160 kc.-60 mc. and 0-5,500 c/s. In the latter range, the instrument will also work as audio oscillator with an output of 3V into 600 ohms Precision 100 kcs. crystal accurate to ±1 cycle drives a multivibrator providing checkpoints at 100, 20 and 10 kcs. Direct reading interpolator indicating the difference frequency between the measured signal and the wavemeter setting. Power supplies 120 V. A.C. Price .... £150 Packing and Carr. £6

MARCONI TYPE TF-783 PRECISION HETERODYNE WAVEMETER. Range 3 to 15 Mc/s. on fundamentals, extendible to at least 30 Mc/s. by using harmonics. Accuracy better than .005%. Crystal Reference Oscillator giving check points every 20 and 200 kc/s. Direct calibration with linear interpolation. Power supplies 230 V. mains. PRICE £75 0 0

ALSO BC-221 and LM-14 FREQUENCY METERS. Prices and details on application.

POWER UNITS

WESTINGHOUSE SELENIUM RECTIFIER POWER UNIT

Input 115-230 V. Fully smoothed and fused. Output adjustable from 80-140 V. D.C. by means of tap switches in the transformer secondary winding. Maximum continuous current 400 mA. Dimensions 17¾in. × 10½in. × 3½in. Price .... 40/- P.P. 7/6.

RECEIVER POWER UNIT DRAWER

Input 115-230 V. A.C. Output 6.3 V at 6 A. A.C., and 250 V. H.T. at 200 mA. Fully smoothed and fused. Built-in cooling blower. Dimensions 6¾in. high × 13½in. wide × 17¾in. deep. Weight 32 lbs. Price, complete with connectors and fully guaranteed .... £5 P.P. 20/-.

TRANSMITTER POWER UNIT DRAWER

Input 115-230 V. A.C. Output 6.3 V. A.C. at 10 A.; 24 V. D.C. at 60 mA. smoothed to peak ripple of .1%; 24 V. D.C. at 240 mA. for control circuits etc.; fixed bias of minus 8 V.; adjustable bias from zero to minus 30 V.; two independent outputs of 300 V. at 135 mA. with peak ripple of 1% and 300 V. H.T. at 215 mA. with peak ripple of 5%. Built-in cooling blower. Dimensions 8½in. high × 13½in. wide × 19¾in. deep. Weight 60 lbs. Price .... £10/10/- P.P. 25/-

SPECIAL RECEIVERS

R-1359; frequency range 130-520 Mc/s. In two bands. Tuned coaxial line input circuit, crystal mixer, CV-52 local oscillator, four IF stages at 13.5 Mc/s. and bandwidth of 3.5 Mc/s. and 420 kc/s., detector, Video Amplifier and Cathode Follower Stage, Beat Frequency Oscillator. Video or Audio output. Sensitivity approx. 10μV. for 6db S/N ratio. External mains power supply unit. Fully overhauled and guaranteed, complete with power supply unit for 230 V. mains operation £95 0 0

R-1294: frequency range 500 to 3,000 Mc/s. Tuned coaxial line input circuit, crystal mixer, CV-52 local oscillator. Four IF stages at 13.5 Mc/s. and bandwidth of 3.5 Mc/s. Detector and two LF stages. Separate power supply unit is required. Fully overhauled and guaranteed, without power supply unit .... £85 0 0 External power supply unit can be supplied at extra charge.

HALLICRAFTER S-27C; AM/FM reception in the range of 130 to 210 Mc/s. in one band. 117 V. A.C. operation. Fully overhauled and guaranteed £90 0 0

TELEFUNKEN RS1/20/AM/FM Receiver. 400-800 Mc/s. I.F. 2.25 Mc/s.: R.F. sensitivity at 450 Mc/s-10μV for S/N of 10 db; Mixer-Oscillator-Four I.F. stages and two A.F. stages. Power supplies 230 V. A.C... £110 0 0

AN/APR-4. The receiver unit is essentially an I.F. Amplifier with the associated audio and video stages and mains (115 V. A.C.) power supply unit. I.F. 30 Mc/s.; bandwidth 4 Mc/s. and .6 Mc/s. I.F. sensitivity from; 35 to 56μF. Different frequency ranges are obtained by means of interchangeable plug-in tuning units containing mixer and local oscillator stages. These units are available for the following ranges: 38-95 Mc/s.: 74-230 Mc/s.: 300-1.000 Mc/s. and 1,000-2.000 Mc/s. Prices on application—please specify the ranges required.

PANORAMIC ADAPTORS TYPE RDO, for use with AN/APR4 Equipment. 30 Mc/s. input frequency with sweep width of 10 Mc/s. Sensitivity at least 25μV for beam deflection of ½in. Mains operation. Price on application.

COMMUNICATIONS RECEIVERS

Fully overhauled to original specification and suitable for use in laboratories.

MARCONI CR-100. 60 kc/s to 30 Mc/s. .. £42 0 0

Ditto with Noise Limiter £48 0 0

MARCONI CR-150: 2-60 Mc/s.; Dual Superheterodyne with Signal Strength Meter and Electrical Bandspread. Complete with separate Mains Power Supply Unit £75 0 0

R.C.A. TYPE AR-88D, 540 kc/s. to 32 Mc/s. £85 0 0

The above receivers are also available on Hire Purchase Terms. Please write for details and charges.

MARCONI TYPE TF-866A CIRCUIT MAGNIFICATION METER. Frequency Range 15 to 170 Mc/s. in four ranges ±2%. Magnification Range 60 to 1,200 in three ranges. Tuning Capacitor 12 to 85$\mu\mu$F with Vernier Tuning Dial. P.P. 20/-. £130 0 0

MARCONI TYPE TF948 FM/AM SIGNAL GENERATOR

Frequency range 20 to 80 Mc/s in two ranges. Built-in Crystal Calibrator with audible beat indicator. Output 1μV to 1mV into 75Ω and fixed high output of 1 V. Internal pulse. AM and FM modulation at 300, 1000, 1600 and 3000 c/s. Max FM deviation 600 kc/s. Provision for external modulation. Power supplies 100/150 V. and 200/250 V. Fully overhauled and guaranteed £200 0 0

METERS

50μA D.C. MC 2½in. Rd. Proj. Mtd. 45/-

200μA D.C. MC 2½in. Rd. Fl. Mtd.:
- Calibrated 0-200μA 35/-
- Calibrated 0-30%, sealed 35/-

500μA D.C. MC 2in. Rd. Fl. Mtd., Ferranti or Elliott, with Ring Nut fixing, FGX4 .... 30/-

500μA D.C. MC 2in. Rd. Fl. Mtd. Victoria 20/-

500-0-500μA D.C. MC 3½in. Rd. Fl. Mtd., Calibrated 50-0-50 yds./sec. 30/-

750-0-750μA D.C. MC 2in. Rd. Plug-in, uncalibrated, with Centre zero and FSD marks 25/-

1 mA. D.C. MC 2½in. Rd. Fl. Mtd., calibrated 0-30/0-100 sealed 30/-

1-0-1 mA D.C. MC 2½in. Rd. Fl. Mtd., calibrated 100-200-400 with centre zero, sealed 22/6

15-0-15/30-0-30 mA. D.C. MC 2½in. Rd. Fl. Mtd. Dual range with three terminals. Turner model 505, FGX4 25/-

75mA. D.C. MC 2½in. Rd. Plug-in, FGX4 .... 15/-

150mA. D.C. MC 2in. Rd. Panel Mtd., FGX4 ..... 15/-

200mA. D.C. MC 2in. Rd. Fl. Mtd. 20/-

1 Amp. D.C. MC 2½in. Rd. Fl. Mtd. 25/-

1 amp. R.F. Thermocouple. 2in. Rd. Panel Mtd. 15/-

2 amps. D.C. MC 2½in. Rd. Fl. Mtd. 25/-

5 amps. D.C. MC 2½in. Rd. Fl. Mtd. 25/-

5 amps. A.C. MI 2½in. Rd. Fl. Mtd., calibrated 0-80 amps. or 0-200 amps. 15/-

10 amps. D.C. MC 2½in. Rd. Fl. Mtd. 25/-

40 amps. D.C. MC 2in. Rd. Proj. Mtd. 10/-

100 amps. A.C. MI 2½in. Rd. Fl. Mtd. 17/-

30-0-30 volts D.C. MC 2½in. Rd. Fl. Mtd. 17/6

36 v. D.C. MC 2in. Rd. Fl. Mtd., suppressed zero; zero deflection reads 18 v.; sealed 20/-

150 v. A.C. MI 2in. Rd. Fl. Mtd. 25/-

150 v. A.C. MI 2½in. Rd. Fl. Mtd. 20/-

300 v. A.C. MI 2½in. Rd. Fl. Mtd. 25/-

300 v. A.C. MI 6in. Rd. Fl. Mtd., Turner 32 .... 80/-

500 v. A.C. MI 2½in. Rd. Panel Mtd., Ferranti, Waterproof. FSD—250Ω/V; complete with external resistance; movement, 200Ω/V 20/-

Signal strength meters, 2in. Rd. Panel Mtd. Basic movement 1 mA. D.C. Translucent scale with provision for internal lumination, calibrated from 0-20 "S" units at half scale, and from 0-40 db above 20 "S" units 35/-

1½in. Rd P.M. miniature meters made by G.E.C., complete with fixing clips. These are available at the following ranges: 1 mA. at 25/-; and 25, 75, 100 and 150 mA. at 20/-

When ordering please add 2/6 in £ for packing and post.

PEN RECORDERS

ELLIOTT SINGLE PEN SWITCHBOARD PATTERN RECORDING MILLIAMMETER OR VOLTMETER. 4in. Strip chart: Clockwork chart drive (8-day) at 1in. per hour. This recorder is available for range of 15V. D.C. or higher or 5 mA. or higher. Fully overhauled and guaranteed £35 0 0

ELLIOTT OR EVERSHED SINGLE PEN SWITCHBOARD PATTERN RECORDING MILLIAMMETERS. Range 5 mA. D.C. or 2.5-0-2.5 mA. D.C.; 230 v. Chart drive at 3in. per minute. 6in. Strip Chart. Fully overhauled and guaranteed £50 0 0

Ditto with range of 1 mA. D.C. £53 15 0

EVERSHED TWIN PEN SWITCHBOARD PATTERN RECORDING MILLIAMMETERS. Electric Chart Drive at ¼in. per minute Strip Chart 6in. wide. Fully overhauled and guaranteed. complete with two charts, two gravity pens, two siphon pens with trough, bottle of ink and dashpot oil.

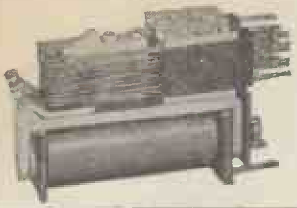
Range 5 mA. D.C. £65 0 0

Range 1 mA. D.C. £72 10 0

Packing and carriage £1 per recorder.

DEPENDABLE RADIO SUPPLIES LTD.

12 TOTTENHAM ST., LONDON, W.1. Tel. LANGHAM 7391



POST OFFICE RELAYS TYPE 3,000 TYPE 600

LARGE STOCKS AND QUICK DELIVERIES

SIEMENS HIGH SPEED RELAYS

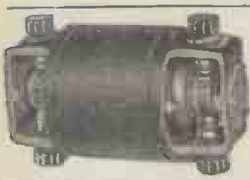
250+250 ohms Twin Coils C/O 8/6	1,000+1,000 ohms Twin Coils C/O 10/6
500+500 ohms Twin Coils C/O 8/6	1,700+1,700 ohms Twin Coils C/O 17/6
850+850 ohms Twin Coils C/O 9/6	

G.E.C. MINIATURE SEALED RELAYS—MOST VALUES FROM STOCK

S.T.C. MINIATURE SEALED RELAYS

4184GD	700 ohms	2 C/O	24 v.	19/6
4190HC	170 ohms	2 C/O	12 v.	17/6

1/6 Post & Packing on all relays. Send for lists.

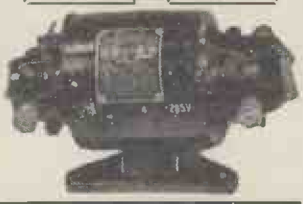


ROTARY TRANSFORMERS

Delivery ex stock. Quotation on application.

H.T. 31	H.T. 32
Input 11.5 v. Output 250 v. at 125 mA.	Input 11.5 v. Output 490 v. at 65 mA.

ROTARY TRANSFORMERS
Made by DELCO
TYPE 1. 37/6. P. & P. 5/-.
TYPE 2. 37/6. P. & P. 5/-.
Type 1. Dual voltage 12 or 24 v., input 265 v., 120 mA. output; 500 v., 26 mA. output.
Type 2. 12 v., input 275 v., 110 mA. output; 500 v., 50 mA. output. Both types dual output.



OTHER LINES AS DESCRIBED IN PREVIOUS ADVERTISEMENTS STILL AVAILABLE. SEND FOR LIST.

---

new edition

of a popular standard photographic reference book

DICTIONARY of PHOTOGRAPHY 19th Ed.

edited by A. L. M. Sowerby, B.A., M.SC., F.R.P.S.

Extensively revised to include recent advances, particularly in the fields of development, colour photography and zoom lenses. The alphabetical arrangement and comprehensive system of cross references enables information on any topic to be found without difficulty, and the various sections are both instructive and readable, giving concise yet detailed information on every aspect of photography.

25s net by post 26s 5d 715 pages

from booksellers and photographic dealers

Published for "Amateur Photographer"

by **ILIFFE BOOKS Ltd.**

DORSET HOUSE · STAMFORD ST. · LONDON S.E.1

ASSISTANT ENGINEERS, GRADE II (RADIO)

Required by the GOVERNMENT OF TANGANYIKA, Ministry of Home Affairs, on contract for one tour of 21-27 months in the first instance. The commencing salary of the post (including Overseas Allowance) is £1,056 a year in scale rising to £1,479 a year. GRATUITY 25% of total salary drawn. OUTFIT ALLOWANCE £45. Children's Education Allowances. Free Passages. Liberal leave on full salary.

Candidates, under 30 years, with a good general education, should be capable of installing and maintaining fixed and mobile H/F and V.H.F. equipment.

Apply to CROWN AGENTS, 4 Millbank, London, S.W.1. for application form and further particulars, stating age, name, brief details of qualifications and exeprience and quoting reference M2A/51373/WF.

LANGUAGE COURSES with your tape recorder

FULL ELEMENTARY COURSE 3 gns
(including book)

COMPREHENSIVE COURSE 6 gns
(including handbook)

New French and Italian Advance Courses available.

CONVERSION PULLEYS
for Collaro Mark 4 deck to run at $1\frac{7}{8}$", $3\frac{3}{4}$", $7\frac{1}{2}$" per sec. Cost complete 21/-

(Please Note Change of Address)

TUTOR TAPE COMPANY LTD.

66 Sloane Street, London, S.W.1. Bel 1405

Locate Hard to Get Tubes at Big Savings!

DIRECTORY and BUYERS' GUIDE for American Electron Tubes

GET YOUR COPY ABSOLUTELY FREE!

This brand new "Directory" covers almost every tube made by American manufacturers. Top name brands as well as specialized brands are included. Receiving, Television, and Special purpose tubes are listed by type numbers and low, low prices.

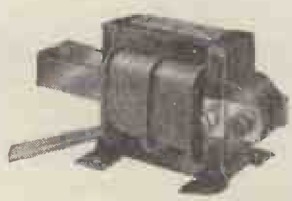
Send for your copy now, it's FREE and will **Save You Money on Tubes.**

METROPOLITAN OVERSEAS SUPPLY CORPORATION

1133 Broadway, New York 10, N.Y., U.S.A.
Cable address: LECIMEX New York.

A.C. SOLENOID TYPE SBM/T

NOW FITTED WITH STAINLESS STEEL GUIDES—SIX TIMES THE LIFE



Continuous $3\frac{3}{4}$lbs. at 1".
Instantaneous at 16 lbs.
Smaller sizes available.
Also — transformers to 7kVA 3 phase.

R. A. WEBBER LTD.

KNAPPS LANE, CLAYHILL, BRISTOL 5. PHONE 65-7228/9

Wireless World Classified Advertisements

Rate 9/- for 2 lines or less and 4/6 for every additional one or part thereof, average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World," Dorset House, Stamford St., London, S.E.1.) Trade discount details available on application. Press Day January 1962 issue, Tuesday, November 28th. No responsibility accepted for errors.

NEW RECEIVERS & AMPLIFIERS

THE new Mark II Symphony Stereophonic Amplifier is now in full production. In addition to the sound qualities which made this amplifier a favourite in the past, it now has a newly designed and more attractively styled front panel and set of de luxe knobs; price unchanged at 22gns. Dr. Scherchen's Stereophoner, a patent Swiss invention for greatly enhancing the musical content of all mono equipment—radio, gram and tape; only £4/19/6. STD Switched F.M. Tuner, very high-grade instrument for the connoisseur; our price only 19gns (list 26gns). Percy Wilson Column Enclosure, kits of cut timber including solid wood, cone and speaker fabric available; also built cabinets. Standard Equipment Cabinet, the most compact cabinet on the market to take amplifier, tuner plus gram unit or tape deck, attractive walnut finish, fitted legs; £10/19. Bass Reflex Cabinets get absolutely maximum performance from whatever speaker fitted, models for 8in, 10in and 12in units, in kit form or built. Infinite Baffle Cabinets, the most compact 8in speaker cabinets available today, consistent with Hi-Fi results, ideal for stereo; only £5/10. Heathkits; all radio, gram and tape kits available; also offered ready built by us. Send for latest catalogue, giving further details of above and many other lines. Credit terms available. All above goods in stock now.—Northern Radio Services (Dept. DWW), 16, King's College Rd., London, N.W.3. Tel. Primrose 3314. [9780

RECEIVERS AND AMPLIFIERS SURPLUS AND SECONDHAND

CR 100 for sale, working order; £12/10.—114, Gales Drive, Three Bridges, Sussex. [9803

80/- Star regun tubes, guaranteed; £5 21in, c.w.o.—33, Brief St., Bolton. [9772

HRO-60, little used, magnificent receiver; 50% below list, £175; any trial.—17, Knottsall Lane, Oldbury, B'ham. [9798

HRO Rx's, etc. AR88, CR100, BRT400, G209, S640, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London E.11. Ley. 4986. [0053

51—J—3 Collins, Hallicrafter's, S-27CA, S-36A, S-37, 388/URR, R.D.O., 13/URR, 35/URR, AR-88, RT-67/RT-70A, R-109/GRC, .5mc/s-4,000mc/s, frequency meters, BC-221, TS-174, TS-175A, TS-323, USM-45, 125kc/s-11,000mc/s.
WRIGHT, 4a, Nepal Ave., Atherton, Manchester. Tel. 991. [0023

"WIRELESS World" 7-valve F.M. tuner, unused, with cathode follower, magic eye and power supply for use on 200-250 volts, A.C., fitted with latest type F.M. components of the highest grade including specified temperature, compensating capacitors, price £12/15 including 7 valves, accurately aligned and tested, ready for use, approx. half original price, exceptionally good reproduction, ideal for use with all high fidelity amplifiers and recorders, limited number bargain, above are sent in boxes lined with foam rubber to ensure safety in transit.—Box 5063. [9755

NEW LOUDSPEAKERS

DUODE sound units give most natural results from tape, disc or radio—because their famous, unique dual drive, built-in crossover and feedback, linen cone with graded compliance, produce 20-15,000 cps with smooth non-resonant, dead-beat crystal clarity; buy Duode for your lasting pleasure and finest long-term good sound investment.
DUODE, Ltd., 16, Brunswick Rd., Sutton, Surrey. [9678

NEW TEST EQUIPMENT

HEATHKITS can now be seen in London and purchased on easy terms; free brochure.—Direct TV Replacements, Ltd., Dept. W.W. 27/12, 138, Lewisham Way, S.E.14. Tideway 6666. [9240

BRAND new 5,000 volt insulation testers, output 0-5,000 volts A.C. or D.C., max. output current 5 m/a D.C., 10 m/a A.C.; voltage indicator meter magic eye leakage indicator, variac voltage regulator; input 200/250 volts A.C.; complete leads and prods; one prod has microswitch for absolute safety; dimensions 18in×18in×13in, weight 30lb; cost Government nearly £100; in original transit cases, £27/10 each, cash with order, carriage forward; 14-day refund guarantee.—R. Sankey, Regal Cinema, Atherstone, Warwicks. Tel. Atherstone 2220. [9619

TEST EQUIPMENT—SURPLUS AND SECONDHAND

SIGNAL generators, oscilloscopes, output meters, wave 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

NEW!

Partridge

P.4160

WIDE FREQUENCY RANGE

U.L. TRANSFORMER

Ten years' development and research are behind this newest Partridge Push-Pull Output Transformer.

PRICE : 210/-

The Partridge P4160 transformer is a wide frequency range U.L. transformer. We regard this new transformer as the biggest step forward in Audio output transformer development in the last decade, i.e. since we produced the famous CFB range in 1950. We would stress that we consider this to be the finest transformer it is possible to manufacture with present known techniques.

- Primary resonance greater than 100 kc/s.
- Primary resonance impedance: 1,200Ω at 100 kc/s. 900Ω at 80 kc/s.
- Specially balanced leakage inductance between various sections.
- Very low D.C. resistance on primary and secondary windings.
- Power rating: 20 watt, 20 c/s-50 kc/s. 35 watt, 25 c/s-30 kc/s.
- Enclosed in robust steel shielding case, resin filled, suitable for H2 operation.
- Weight: 10¾lb.

Post the coupon now for latest release details on this new type.

To Partridge Transformers Ltd.
Roebuck Road, Chessington, Surrey
Latest Release on the P.4160 please

NAME ....
ADDRESS..
.... WW/12/61

TEST EQUIPMENT—SURPLUS AND SECONDHAND

OSCILLOGRAPH, Cossor double beam, type 1035, list £139; one available surplus to requirements; £60.
ALSO available, Cossor double-beam type 339, needs slight attention; £12/10.
BURGESS LANE & Co., Thornton Ave., Chiswick, W.4. [9803

NEW COMPONENTS

LINE output transformers and scan coils for most makes, exact replacements, from 25/- used, and 45/- new; send s.a.e. for imm. quote; just a few examples from our extensive range in stock; add 2/6 for p. & p.; telephone orders sent same day c.o.d.
NEW L.O.P.T.s for Pye V4/V7, VT4/VT7, 52/6; scan coils for above, 62/6. Ferranti L.O.P.T. 14T3/4, 17T3/4, 45/-; Ferguson 992/6/8 L.O.P.T., 69/6; Murphy 240/250 L.O.P.T., 62/6; Bush TV24, 67/6; TV43 67/6 L.O.P.T.s.
T.C.S. Ltd., 28, Brockley Cross, S.E.4. Tid. 5394, and 112, Camberwell Rd., S.E.5. [0334

COMPONENTS—SURPLUS AND SECONDHAND

SEND for catalogue No. 14—500 illustrated items; 2/6 post free.—Arthur Salls Radio Control Ltd., 93 (c) North Rd., Brighton. [0193

3000 type P.O. relays, 1,000ohm 4M 4B operate on 10v-50v, in maker's boxes, unused surplus, 8/6 each, p.p. 6d, or 100 for £30.—W.B.A., 54, Primrose Gdns., N.W.3. Swi. 3805. [9793

MANUFACTURER'S stocks of radio cores, components and measuring instruments for disposal; send for free lists, enclosing s.a.e., to S.E.I., Stock Disposals, Gee St., Heywood, Lancs. [9758

NEW GRAMOPHONE AND SOUND EQUIPMENT

SAVE on tapes, ask for Sound News imported tape; list; see trade. [0131

TAPE decks and recorders by Ferrograph, Vortexion, Brenell, Telefunken, Reflectograph, Bradmatic, amplifiers and tuners by Quad, Leak, Dulci, Chapman, Rogers.
MICROPHONES by Reslo, Lustraphone, S.T.C., Grampian, A.K.G. All tapes and accessories.
GOOD quality equipment welcome in part exchange.
CLOSED circuit television for schools and industry from 119 gns.
SPECIALIST audio service and sound recording.
Hire purchase facilities available.
LAMBDA RECORD COMPANY LIMITED, 95, Liverpool Road, Liverpool, 23. Telephone Great Crosby 4012. [9014

GLASGOW.—Recorders bought, sold, exchanged; cameras, etc., exchanged for recorders or vice-versa.—Victor Morris, 343, Argyle St., Glasgow, C.2. [0201

LOWTHER Acousta twin stereo speaker enclosure, supero instrument, as new condition; £90 o.n.o.—Mather, Pine Hill House, Easebourne, near Midhurst, Sussex. Tel. Fernhurst 328. [9786

"EROICA" RECORDING STUDIOS (Est. 1949).—For the better class tape recorders for industry, research, music and private use; Ferrograph, Brenell, etc.; complete recording service; music for industry, tape/disc.—31, Peel St., Eccles, Manchester. Eccles 1624. Studio. Director Thurlow Smith, A.R.M.C.M. [0122

GRAMOPHONE AND SOUND EQUIPMENT—SURPLUS AND SECONDHAND

RECORDING tape; save up to 30%; send for list; also 50 second-hand recorders in-stock.—E. C. Kingsley & Co., 132, Tottenham Court Rd., London, W.1. Eus. 6500. [0035

EXPERT GRAMOPHONES, Ltd., have for disposal from time to time used items of mono/stereo equipment including preamplifiers, main amplifiers, loud speaker columns and complete units; all equipment offered has been thoroughly tested in our workshops and is fully guaranteed; send us your requirements; quotations without obligation.—235a, Bensham Lane, Thornton Heath, Surrey. Tel. Thornton Heath 4139. [9783

TAPE RECORDING, ETC.

TAPE to disc, Adanac recordings.

SEND a personal Xmas message this year; records from 12/6.—E. H. Jackson, 36, Bannatyne St., Lanark, Scotland. [9721

FERROGRAPH 4/AN, year old, mint condition; (London); price £65.—Box 5067. [0138

ASK your dealer for American Ferrodynamics "Brand Five" recording tapes; the best tape value! [0270

RENDEZVOUS RECORDS offer comprehensive 78/45/33 tape to disc recording facilities.—Leaflet from 19, Blackfriars St., Manchester, 3. [9386

TAPE-TO-DISC Service, E.P.s, L.P.s, editing and dubbing, standard, comprehensive leaflet from—Toucan Sound Productions, 122, Fernlea Rd., Balham, London, S.W.12. [9682

TAPE to disc recording—finest professional quality, 10in L.P. 30/- (32 mins.), 12in L.P., 35/- (45 mins.), 7in E.P. 17/6; 48-hour postal service; s.a.e. for leaflet to:—Deroy Sound Service, 52, Hest Bank Lane, Hest Bank, Lancaster. [9735

EXCLUSIVE OFFERS

★ E.M.I. WM5A Oscilloscopes	£195	0
★ EMI WM-3 Oscilloscopes	£75	0
★ M. Vickers 500 H.S. Waveform Monitors	£225	0
★ Roband 101 Power Units	£25	0
★ R.C.A. Type 715 Laboratory 5in. Oscilloscopes on trolley	£75	0
★ GR 804B V.H.F Signal Generators, 8/330 Mc/s.	£35	0
★ Cambridge Temperature Controllers, 0/1,200 deg. C., 230 v. A.C	£35	0
★ Philips PW 4031 G.M. Counters, 230 v. A.C.	£22	10
★ Crypton Cabinet Rectifiers, 50 v. 1 amp.	£2	10
★ Heyer Low Voltage Testers, zero to 18 v. and 60 amp.	£8	10
★ Portable Operating Theatre Lamps, universal voltage	£8	10
★ Portable Airport Runway Floodlights, 1 kW.	£10	0
★ Avo Geiger Counters, new	£9	10
★ 5ft. P.O. Racks, 19in. wide	£3	10
★ Type 56 Monitors (Indicator and P/S)	£8	10
★ Teleprinter Motor Rectifiers, 200/250 v. A.C to 110 v. 0.7 amp.	£2	18
★ Ferranti 7 kVA Auto Voltage Regulators	£35	0
★ Murphy 1074 Pulse Amplitude Analysers	£175	0
★ Edwards Speedivac Pumps, 230 v. A.C.	£18	10
★ Metro-Vickers Metrovac Pumps, 230 v. A.C.	£22	10
★ Muirhead Ipots	£3	10
★ E.M.I. Waveform 3794 Monitors on trolley	£125	0
★ Precision Mains Filters, 2 amps.	£10	0
★ R.201 Triple Diversity Receivers	£95	0
★ T.1131 Transmitters, complete	£35	0
★ T.1190 Transmitters, complete	£55	0
★ 75ft. Hollow Plywood Masts	£35	0
★ 85ft. 2½in. dia. Steel Tubular Masts	£50	0
★ 15 kVA Constant Current Transformers	£85	0
★ 1000 watt 230/115 v. Double-wound Transformers	£6	0
★ Turner 6in. dia. 0/1 Milliammeters	£4	0
★ Dowty High Speed Registers, 4in. dia.	£6	0
★ American Stabilised Power Supplies, 230 c. A.C. to 115 v. ½ amp. D.C.	£12	10

40-page List of over 1,000 items in stock available —keep one by you.

★ R.C.A. 10-way Aerial Exchanges	£20	0
★ DFG-20 Marconi D.F. Receivers, 75/1,500 Kc/s.	£35	0
★ 6 volt Rotary Converters with smoothing, 250 v. 80 mA.	£1	15
★ 12 volt Rotary Converters with smoothing, 300 v. 250 mA.	£1	15
★ R.C.A. Projector Speakers, 25 watts, range 1 mile	£14	10
★ Fountain pen Type Pocket Dosemeters	£1	5
★ BC-603 F.M. Receivers, 20/30 Mc/s.	£12	10
★ BC-604 F.M. Transmitters	£17	10
★ R.C.A. Twin Channel Studio Monitor and Pre-amp. Bay	£175	0
★ E.M.I. Radio-active Hand Monitor	£75	0
★ Murphy 30-Channel Kicksorter	£475	0
★ Western Electric Transmission Measuring Equipment and Oscillator	£75	0
★ 50 kV working 2.25 mfd. Condensers	£17	10
★ T.P.7 Telephone Repeaters	£7	10
★ TCJ-400 watt Transmitters	£35	0
★ Dynatron Radio Active Dust Samplers	£70	0
★ 11ft., 4ins. dia. Hollow Wood Mast Sections	15/-	
★ 20 Henry 400 m/a Chokes	£1	0
★ 212E Western Electric 250 Watt Triodes	£4	0

CARRIAGE EXTRA ON ALL ABOVE

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements as we can probably help—all enquiries answered.

P. HARRIS
ORGANFORD - DORSET
WESTBOURNE 65051

TAPE RECORDING, ETC.

TAPE/DISC/TAPE transfer editing; duplicating; if quality and durability matter (especially with L.P.s from your precious tapes), consult Britain's oldest transfer service; new tape recorders supplied with a free service guarantee; latest American tapes. 1,800ft 29/-, now available.—Sound News Productions, 10, Clifford St., London, W.1. Reg. 2745 [0192

EXCITING news from N.R.S. Revolutionary new automatic tape recorder makes its debut this month! Symphony automatic tape recorder, unique in the whole world. Opens up new vistas of enjoyment from tape recording. Stuzzi Radio Tuner adds radio to above for only £5/9/6.—Details from Northern Radio Services (Dept. DWW), 16, King's College Rd., London, N.W.3. Tel. Primrose 3314. [9779

PRE-RECORDED TAPES

PRE-RECORDED tapes.—Unique 40-page catalogue listing all makes, mono, stereo, 7½ and 3¾ i.p.s.; send 2/6, refundable on first tape record purchased.—Dept. TR5, Teletape, Ltd., 33, Edgware Rd., W.2. Pad. 1942. [0020

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A., Boxmakers, 75a, Godwin St., Bradford, 1. [0172

NEW and surplus valves, fully guaranteed, huge stocks, genuine valve bargains; s.a.e. for list; also reclaimed valves, perfect, 5/- maximum, plus 6d p. & p. each.—Lewis, 46, Woodford Avenue, Ilford, Essex. [9744

GUARANTEED valves at real bargain prices, boxed and post-free.
OA2, OB2, 6AG7, 6AH6, 6AQ5/EL90, 6AU6/EF94, 6Y6, 807, 12AT7/ECC81, 12AU7/ECC82, 5/- each, 6 for 25/-. 5R4G, 6AS7, 8/- each, 6 for 42/-. 6AL5, 6SN7, 3/- each, 6 for 15/-. RAWSON & PANTON, Ltd., 107a, Lion Rd., Bexleyheath, Kent. [9797

VALVES WANTED

NEW valves wanted any quantity, best cash price by return.—Stan Willetts, 43, Spon Lane, West Bromwich, Staffs. Tel. Wes 2392 [9632

WE purchase new valves, old or modern type, for cash; full details, please, including price required, in your first letter.—Waltons Wireless Stores, 15, Church St., Wolverhampton. [0102

ALL types of valves British or American, transmitting and receiving; keenest cash prices paid. What have you to offer?—Write or call Lowe Bros., 95/97, Redchurch St., London, E.2. Tel. Shoreditch 4415-6. [9567

WANTED, EXCHANGE, ETC.

WANTED, new valves, speakers, components, etc., for cash.—A.D.A. Mfg. Co., 172, Alfreton Rd., Nottingham. [9676

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0163

A PROMPT cash offer for your surplus brand new valves, speakers, components, test instruments, etc.—R.H.S., Beverley House, Mannville Tce., Bradford 7. [0190

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Gerrard 2504. [9623

WANTED for cash, good quality test gear, amplifiers, Ham RXS, freq. meters, com. RXS, microwave equipt., etc., etc.—Call, write or send Tel. Miller's Radio, 38a, Newport Court, Leicester Sq., W.C.2. Ger. 4638. Est. 18 years. [9629

REPAIRS AND SERVICE

BOULTON'S OF BRADFORD.

LOUDSPEAKER pressure unit, and microphone repairs, D.C.B., cone assemblies and field coils in cartons, service and satisfaction guaranteed —D. C. Boulton, 134, Thornton Rd., Bradford, 1. Tel. 22838. [0171

MAINS transformers wound to any specification.
MOTOR rewinds and complete overhauls; first-class workmanship, fully guaranteed.
F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 54898. [0113

WE undertake the manufacture of transformers singly or in quantities to any specification; all work guaranteed for 12 months.
LADBROKE Transformer Co., Ltd., 820a, Harrow Rd., London, N.W.10. Tel. Ladbroke 0914. [0222

SPEAKER repairs, cones fitted, fields and clock coils wound, guaranteed satisfaction, prompt service.—L. S. Repair Services, Pluckley, Ashford, Kent. [0223

ALL transformers manufactured to specification, estimates. Auto. transformers 50 to 600 watts. Bulk demagnetizers for tapes and tools 27/6.—Osmabet, Ltd., 46, Kenilworth Rd., Edgware, Middx. Tel. Stonegrove 9314. [0070

TRANSFORMERS to any specification, singles, small or large batches, quick and efficient service, competitive prices, estimates.—Messrs. Newman & Son, 10, Fullers Ave., Woodford Green, Essex. [0330

ERSIN Multicore

MULTICORE PRODUCTS FOR ENTHUSIASTS

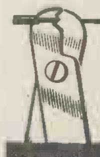
Savbit for the small user

The solder with a small percentage of copper that gives ten times longer life to your soldering iron bits is available in the popular size one carton. It is supplied in three specifications: 45 ft. of 18 s.w.g., 25 ft. of 16 s.w.g., or 17 ft. of 14 s.w.g.: 5/- each (subject).

Home Constructors Pack

Contains 16 ft. of 18 s.w.g. 60/40 alloy wound on a reel or, for soldering printed circuits, 35 ft. of 22 s.w.g. 60/40 alloy also wound on a reel. 2/6 each (subject).

Bib Wire Stripper and Cutter

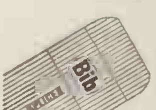


This efficient tool strips insulation, cuts wires cleanly and splits plastic twin flex. It is adjustable to most wire thicknesses. 3/6 each (subject).

Tape Solder Card

A real tin/lead solder containing cores of Ersin Flux. Needs no soldering iron or extra flux. Sufficient solder for 100 average joints. 1/-.

And don't miss this outstanding Bib FREE OFFER



Send us this flap from any Bib Tape Splicer carton for FREE packet of Bib Tape Reel Labels and a Data Card! (Details below).*

* Tear off the end flap from any Bib Tape Splicer carton and send it, together with a stamped addressed envelope, to the address below. By return, we will send you a FREE 2/6d packet of Bib Tape Reel Labels —plus an information-packed Data Card worth 2/-. This offer is limited —write today!

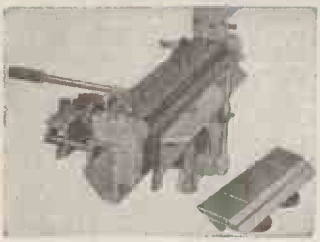
See also MULTICORE advertisement on back cover

If you have difficulty in obtaining any of these items, they will be sent post free.

MULTICORE SOLDERS LIMITED HEMEL HEMPSTEAD, HERTS

TA6140

DON'T CRY CRISIS BUY A BENDER AND BEAT IT



RX-20

This UNIQUE BENDER

Quickly and Accurately Forms

Angles, Channels, Sections, Boxes, Lids, Trays, Chassis Brackets, Clamps, Clips, Shrouds, etc.

The RO-20 and RXX-26 are becoming "essential equipment" for Electronics, Radio, T.V. and General Research work. Many now prefer the RZ-26.

The RO-20 is similar in general design and finish to the RX-20 shown above, but is lighter and less expensive. Obtainable only direct or through leading tool merchants.

For 6-page Folder write to:—

A. A. TOOLS (w)

197a Whiteacre Rd., Ashton-u-Lyne

Audix

SOUND SYSTEMS

THE MOST UP-TO-DATE **RANGE** OF **SOUND EQUIPMENT** INCLUDING

Pre and Power Amplifiers, Mixer Units, Microphones, and Loudspeakers.

LET **AUDIX LTD.** of STANSTED (Phone: STANSTED 3132) ESSEX

Plan, Install & Commission YOUR SOUND SYSTEM

MISCELLANEOUS

ROTARY wafer switches.

IMMEDIATE dispatch of goods from stocks; no carriage goods sent to all parts of the world; A.B. metal and N.S.F. made to order switches; reduced price list free on request.—Overseas Eximport Co., 172, Bishopsgate, London, E.C.2. [9799

METALWORK, all types cabinets, chassis, racks, etc., to your own specification, capacity available for small milling and capstan work up to 1in bar. PHILPOTT'S METAL WORKS, Ltd., Chapman St., Loughborough. [0208

SMALL plastic mouldings, undertaken ½oz injection, polystyrene, p.v.c., polythene, low mould charge, quick delivery.—E. R. Nicholls, 33/35, Carrington Field St., Higher Hillgate, Stockport. [9782

MINE detectors, types ANPRS-1 and Mark IV, complete in original boxes, fully reconditioned and released to specification in "as new" condition.—W.S. Electronics, Ltd., Brunel Rd., East Acton, London, W.3. [9792

NOTICES

THE ASSOCIATION OF PROFESSIONAL RECORDING STUDIOS, Ltd. To protect and encourage the interests of member studios engaged in electrical sound recording.—Write to the General Secretary, A.P.R.S., Flat 4, 34A, Arterbery Rd., London, S.W.20. [0173

CAPACITY AVAILABLE

GERALD FISHER ENGINEERING, Ltd., Lancs.—All types of electronic and electrical assembly work undertaken to your requirements; chassis wiring, cableforms, groupboards.—Hampden Rd., Shaw, Lancs. Shaw 7509. [9621

SITUATIONS VACANT

AN Overseas Career

WITH

INTERNATIONAL AERADIO LIMITED

IN order to meet the requirements of constant growth and expansion we have opened a new Radio School at Southall, Middlesex, to train technicians and engineers for a permanent overseas career in North, West and East Africa, the Mediterranean area, the Caribbean and the Arabian Gulf. If you have recently completed service in a trade such as Ground Wireless Fitter in the R.A.F. or Radio Electrical Artificer in the Royal Navy or if you hold Intermediate City and Guilds in telecommunications, or its equivalent or have experience in the maintenance of HF and VHF communications, RTT and navigational aids, we should be interested to hear from you.

CANDIDATES who are accepted for training spend either 6 or 14 weeks at the School before proceeding overseas but in some cases staff with suitable qualifications and experience are offered immediate posting. Overseas staff receive a tax-free salary with married and child allowances if appropriate and accommodation, bachelor or married, is provided free; other benefits include generous U.K. leave and membership of an excellent Pension and Life Assurance scheme.

WRITTEN applications please to Personnel Manager, 40, Park Street, W.1. [0263

ELECTRONIC Engineer.

A rapidly expanding Company wishes to appoint an Electronic Engineer to handle development and production problems in specialised coil winding and miniature components. Applicants should preferably have H.N.C. or equivalent, but prime consideration will be given to experience in coil design and in versatile approach to electronic engineering problems.

THE successful applicant will be aged 25-35 and will be required to live in or near Buckingham. Salary will not be less than £1,250 p.a. according to age and experience, and other emoluments by negotiation.

APPLY in writing for interview to Managing Director, Amos (Electronics), Ltd., Castle Mills, Buckingham. [9774

EASTERN ELECTRICITY.

TELECOMMUNICATION engineer required by Eastern Electricity to install, test and maintain communications equipment.

THE post provides an opportunity for a keen practical engineer to work on a compact system comprising automatic telephony, carrier and V.H.F. radio transmission and supervisory systems.

EXPERIENCE in multi-channel carrier and V.F. signalling systems is desirable; salary £940-£1,065 per annum, superannuable.

APPLY within 14 days by letter to The Manager, Eastern Electricity, Northmet Sub-Area, Northmet House, Cannon Hill, Southgate, N.14, stating age, education, experience present position and technical qualifications. [9802

RADIO engineer (A1); £1,000 p.a.; only experienced senior man need apply.—Box 5068. [9801

ENGINEERS required with sound knowledge of audio techniques and relay circuitry, also V.H.F. test engineer.

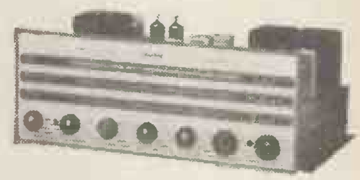
APPLY in Writing to: Clarke & Smith Mfg. Co., Ltd., Hanworth Air Park, Feltham, Middlesex. [9787

TESTERS, E. K. Cole, Ltd., Southend-on-Sea, have vacancies for radio and television testers and fault finders.—Apply Personnel Manager. [9731

Armstrong

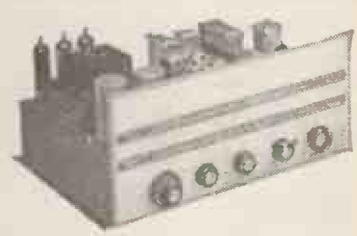
HIGH QUALITY RADIOGRAM CHASSIS

STEREO 12 Mk. 2 £44.15.0



The most complete chassis ever produced, combines AM and FM Tuners, a Stereo Control Unit and two High Fidelity Amplifiers in one compact unit. Eight watts push-pull output from each amplifier provide a total of 16 watts for both mono and stereo. Other features include automatic frequency control on VHF; ferrite aerial, two IF stages and miniature tuning indicator for medium and long waves; inputs for tape recording, playback, pick-ups and stereo radio (should this come about); separate wide range bass and treble controls and balance control; booster units available for low output pick-ups; alternative matching for any loudspeakers.

STEREO 55 £33.15.0



A junior version of the Stereo 12 Mk. 2 providing ten watts output, five watts from each amplifier and covering the VHF and medium wavebands. Ideal for a complete hi-fi system where the higher power output of the Stereo 12 Mk. 2 is not required. Like the Stereo 12 Mk. 2 it can be used for mono only and a second loudspeaker added at a later date.

JUBILEE Mk. 2 £31.15.0

A hi-fi mono chassis giving eight watts push-pull output and covering VHF, medium and long bands. Tape recording and play back inputs.

AF 208 £23.15.0

An AM/FM chassis providing 5 watts output and covering the full VHF and medium wavebands. Tape recording and playback inputs

Post this coupon or write for descriptive literature or call at our Holloway showroom for full demonstraton. Open 9-5 including Saturdays.

NAME ....

ADDRESS ....

.... W.D.C

ARMSTRONG WIRELESS & TELEVISION CO. LTD.

Warlters Road, London, N.7

Telephone: NORth 3213

SITUATIONS VACANT

HERTFORDSHIRE County Council.

MID-HERTS College of Further Education.
THE Campus, Welwyn Garden City, Herts.
PRINCIPAL: W. V. Lloyd, Ph.D., M.Sc., Dip Ed., A.R.I.C., F.R.S.A., Department of Engineering.
WANTED 1st January, 1962.
ASSISTANT, Grade B, to **teach** Radio Service Work and Telecommunications, technicians work to intermediate and final standards.
MINIMUM qualifications: H.N.C. (Electrical).
SALARY: Burnham Technical Scale, minimum £700×£27/10 to £1,150, with additions for qualifications, training and experience.
GOOD housing prospects for married teachers.
APPLICATION should be made to the Principal at the College. [9757

UNICAM INSTRUMENTS LIMITED.

THIS Company specialises in the production of high-quality optical instruments for use in spectrum analysis and has an international reputation as a leader in this field; at all stages of manufacture the best standards of workmanship are needed We have vacancies for men with electronic experience for testing. Radar and radio technicians with fault-finding experience would be suitable. If you have the kind of background which you think would fit you for this interesting work in a pleasant University City, please let us have full details of your qualifications and experience.—Apply to the Personnel Manager, Unicam Instruments, Ltd., York St. Cambridge. [9736

THE UNIVERSITY OF MANCHESTER.

OPTICS and Spectrometry Group.
AN opportunity exists in the Group for an assistant electronic engineer to participate in the development of a space-borne infra-red spectrometer, which is intended to be part of the pay load of a U.S. spacecraft to be flown near to the planet Mars. Applicants should be of H.N.C. or B.Sc standard in electronic engineering, should have several years experience and a knowledge of data processing and transistor techniques. Salary in the range £900-£1,200.
APPLICATIONS should be sent to Dr. J. Ring, Reader in Spectrometry, The University of Manchester, Oxford Rd., Manchester 13. [9778

BRADFORD INSTITUTE OF TECHNOLOGY.

DEPARTMENT of Electrical Engineering.
APPLICATIONS are invited for the post of: SENIOR lecturer and lecturer in electrical engineering.
THESE vacancies are created by the rapid expansion of the department which is mainly concerned with Diploma in Technology courses, and the posts offer exceptional opportunities for teaching, consulting and research work.
CANDIDATES should be suitably qualified to teach to final Diploma in Technology standard in electrical power or machines or electronics or telecommunications. Industrial and research experience will be a recommendation.
THE successful candidate will be encouraged to develop industrial contacts and undertake research for which adequate facilities are available.
SALARY scales (which are subject to revision at an early date) are as follows:
SENIOR lecturer £1,550 to £1,750 per annum.
LECTURER £1,370 to £1,550 per annum.
PREVIOUS industrial and research experience at a suitable level will be taken into account in fixing the commencing salary.
FURTHER particulars and forms of application may be obtained from the Registrar (Department O), Bradford Institute of Technology, Bradford 7.
HENRY PATTEN, Clerk to the Governors. [9789

KINGSTON UPON HULL EDUCATION COMMITTEE.
COLLEGE of Technology.
PRINCIPAL. Emlyn Jones, M.Sc., F.R.I.C.
REQUIRED, for 1st January, 1962, Assistant (Grade B) in the Electrical Engineering Department to teach in Marine Radar (maintenance) courses. Applicants should hold the Ministry of Transport Radar Maintenance Certificate with, preferably, seagoing radar and radio experience.
SALARY: Burnham Technical Scale—£700×£27/10—£1,112/10×£37/10—£1,150 with additions for training and graduate qualifications and increments for suitable teaching and industrial experience.
THE Education Committee will consider the payment in approved cases of the whole or part of the removal expenses of married teachers moving into Hull.
FURTHER particulars and application forms, to be returned within 14 days of the date of this issue, may be obtained from the Chief Education Officer, Guildhall, Kingston upon Hull. [9776

SALESMAN required, with experience of marine radio telephone equipment.—Box 5058. [9717

ARE you interested in joining a team of Design and Development Engineers engaged in producing auto-pilots for new helicopters now under development?
LOUIS NEWMARK, Ltd., of Croydon, are desirous of appointing Design Engineers and Assistant Engineers to these posts, senior and junior appointments are available.
PLEASE send details of qualifications and experience to Personnel Manager, Louis Newmark, Ltd., Gloucester Road, Croydon. [0337

BOOKS ON FREE TRIAL!

No. 8
Pin-Point
TV troubles in 10 minutes

Find the exact sound or picture trouble in ANY TV set from 700 possibilities/ 300 pages; 300 diagrams; check charts/ 31/6.

No. 9
Pin-Point
Transistor troubles in 12 minutes

Trouble-shoot every type of circuit in ALL transistorized equipment! 525 pages; hundreds of illustrations; 120 check charts. 47/6.

TRY ANY THREE BOOKS ON NO RISK FREE TRIAL

No. 4. Latest Instruments for Servicing Radio and Television. Coyne. 26/-.
No. 7. Transistor Circuit Handbook. Louis E. Garner. Coyne. 39/6.
No. 12. Radio Designer's Handbook. F. Langford-Smith. Iliffe. 55/-.
No. 16. Principles of Frequency Modulation. B. S. Camies. Iliffe. 21/-.
No. 11. Principles of Transistor Circuits. S. W. Amos. Iliffe. 21/-.
No. 20. Principles of Semiconductors. M. G. Scroggie. Iliffe. 21/-.
No. 10. Television Receiver Servicing, Vol. 1. Spreadbury. Iliffe. 25/-.
No. 17. Electronic Computers. Principles and Applications. Iliffe. T. E. Ivall, 2nd. Edition. 25/-.
No. 15. Wireless Servicing Manual. W. T. Cocking. Iliffe. 17/6.
No. 14. Radio Circuits. Miller & Spreadbury. Iliffe. 15/-.
No. 5. Practical Television and Trouble Shooting Manual. Coyne. 34/-.
No. 6. Television Servicing Cyclopaedia. Coyne. 47/6.
No. 33. Colour Television. NTSC System, Principles and Practice. P. S. Carnt, G. B. Townsend. Iliffe. 85/-.
No. 22. Pin-Point Colour Television Troubles in 15 Minutes. Coyne. 47/6.
No. 21. Basic Mathematics for Radio and Electronics. Iliffe. 17/6.
No. 23. Introduction to Laplace Transforms. For radio and electronic engineers. W. D. Day. Iliffe. 32/6.
No. 24. Radio Valve Data. Compiled by Wireless World. Iliffe. 6/-.
No. 25. The Oscilloscope at Work. A. Haas and R. W Hallows. Iliffe. 18/-.
No. 26. Numerical Methods for High Speed Computers. G. N. Lance. Iliffe. 42/-.
No. 27. Second Thoughts on Radio Theory, Cathode Ray of Wireless World. Iliffe. 25/-.
No. 28. Foundations of Wireless. M. G. Scroggie. Iliffe. 15/-.
No. 1. Coyne Elementary Practical Radio-Television. Set of three volumes, total 1,038 pages, sturdy vinyl, washable covers. Special offer £3/12/6 the set.
No. 18. Mullard Reference Manual of Transistor Circuits. 12/6.
No. 19. Refrigeration Service Manual. H. P. Manly. Drake. 24/-.

Just mail coupon for free trial. After 7 days send only low price or return book and pay nothing!

Postage: £3 or less 1/6, £3 or more 2/-

FREE TRIAL OFFER! Mail coupon NOW!

Mail Order Division, SIM-TECH BOOK COMPANY, Dept. WW16, Gater's Mill, West End, Southampton, Hants.

☐ RUSH BOOKS No.............................. for 7 days' FREE TRIAL as per offer.

☐ Tick here if enclosing full price. We pay postage (Coyne Books only) Same 7-day money-back guarantee.

NAME ....

ADDRESS ....

City.................... County....................

SITUATIONS VACANT

CENTRAL ELECTRICITY GENERATING BOARD.
SOUTH-EASTERN Region, North Thames Division.
APPLICATIONS are invited for the following appointment at West Thurrock Generating Station (Grays, Essex):—
ASSISTANT Maintenance Engineer (Instruments) (S.V. No. 1558).
SALARY, N.J.B., Class M, Grade 12, Scale 9, £1,115-£1,245 plus London Weighting £50 per annum, rising eventually to Class N, Grade 12, Scale 10, £1,190-£1,325 per annum plus London Weighting £50 per annum.
SUITABLE candidates must have a thorough knowledge of general electronics, with an emphasis on pulse circuit technique. An understanding or experience of instrumentation and/or transistors will be an advantage. His practical training should be preferably either an apprenticeship with a major radio firm, or ex-Royal Air Force Radar Mechanic. Technical qualifications would be an advantage. The post is intended for a technician whose duties will include the maintenance of a Ferranti Argus Digital Computer and its peripheral equipment.
APPLICATIONS, quoting Reference S.V. No. 1558, stating age, qualifications, experience and present position should be sent to the Assistant Regional Personnel Officer, Central Electricity Generating Board, South-Eastern Region, North Thames Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts, to arrive not later than 23rd December, 1961.
F. W. SKELCHER.
Assistant Regional Director. [9805

INDUSTRIAL HANDBOOKS, LIMITED, have further openings for fully experienced technical authors (electronics) in London and Birmingham.
ALSO, there are occasional opportunities for engineers with adequate technical background wishing to become professional writers.
WRITE fully to the Director-in-Charge, Rapier House, Eagle Street, London, W.C.1. [9784

BERRY'S RADIO requires a Service Engineer with good experience of Stenorettes and Hi-Fi equipment. Send full details for interview to 25, High Holborn, W.C.1. [0039

SENIOR Technician required for the maintenance of two 6 MeV. Linear Accelerators and one 2MeV Van de Graaff X-Ray Generator.
GOOD general electronic and micro-wave background essential; experience on linear accelerators desirable, some knowledge of radiation precautions and safety procedure would be helpful. Salary rising up to £905 plus £30 London Weighting.
APPLICATIONS should be addressed to the House Governor, Royal Marsden Hospital, Fulham Rd., London, S.W.3. [9773

TESTERS, Ekco Electronics, Ltd., Rochford, Essex, have vacancies for experienced electronics testers.—Write giving details of qualifications and experience to Personnel Manager. [9732

EXPERIENCED H.F. T.V. relay planning and installation engineer required to take charge of installation at Newquay.—Apply Newquay Dealers Aerial Relay, Ltd., c/o E. F. Radford, 5a, Bank St., Newquay, Cornwall. [9791

ENGINEEER, mainly field service television and radio, clean licence; minimum five years' experience; congenial situation.—Sherbourne, 50 Topsfield Parade, Hornsey, N.8. Mou. 1987. [9751

CINE camera and projector mechanics required; we are looking for both experienced men and trainees.—Please contact Burgess Lane & Company, Thornton Works, Thornton Avenue, Chiswick. [9781

WILLIAMS Cine and Public Address Services require an electronic/mechanical engineer, also continuous projection film cabinet and public address operators; £100 per year over standard rates.—44, Shipman Rd., S.E.23. Tel. Forest Hill 7575. [9790

DEPUTY Chief Inspector (M.O.A. approved) required for company engaged in the manufacture of electro-mechanical details, used in connection with telecommunication equipments. Write stating age, experience, and salary required to Box 5066. [9769

SERVICE Engineers required for service department. E. K. Cole, Ltd., Southend-on-Sea. Applicants must be experienced and capable of diagnosing and repairing faults in radio and television receivers. Apply Personnel Manager. [9770

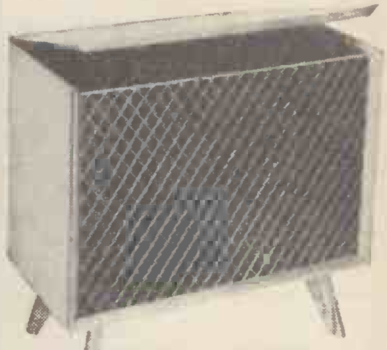
TELEVISION test engineers required for television factory; television experience essential but not necessarily factory production experience; superannuation scheme.—Apply Rediffusion Vision Service, Ltd., Fullers Way South, Chessington, Surrey. [9748

X-RAY Technician required to maintain and service a wide variety of equipment between 45-250 K.V. The successful applicant will be based at the new Surrey Branch of the Hospital at Sutton, but will be required to work both there and at Fulham Rd.
REPLIES, giving age, experience and names of two referees to the House Governor, Royal Marsden Hospital, Fulham Rd., London, S.W.3. [9775

VACANCY in medical electronics for technician to maintain respiratory mass spectrometer and to develop associated apparatus; applicant must have experience in electronic servicing and preferably National Certificate or City and Guilds qualifications; age 23-30.
SALARY on scale £625-£750 including London Allowance. [9788

LEWIS have the CABINET for YOU

FROM THE MOST EXTENSIVE RANGE IN THE COUNTRY



THE CONTEMPORARY
Price £13.13.0

This beautifully designed Contemporary Cabinet can be supplied in Oak, Walnut or Mahogany veneer and has a waxed semi-matt finish.
This cabinet can be fitted with any of the latest Hi-Fi units.

THE GROSVENOR
Price £22.1.0

This elegant cabinet is available in veneered figured walnut and polished to a high gloss in a medium shade. Gold embellishments are an attractive feature of the design. A unique three sliding door system reveals ample storage room and space for equipment.

TWO NEW LEWIS CATALOGUES—

FREE!

The Cabinet Catalogue
The Equipment Comparator Catalogue

(Designed to assist your choice of cabinet and equipment).
Please send me details of your two new catalogues.

Name ....

Address ....

BLOCK CAPITALS, PLEASE W121

LEWIS radio

100 CHASE SIDE, SOUTHGATE, LONDON, N.14
Telephone: Palmers Green 3733/9666

SITUATIONS VACANT

ELECTRONIC engineers (junior) to assist in projects involving the design and development of electronic instruments; candidates will be expected to work with the minimum supervision and be of O.N.C. to H.N.C. standard or above.—Write The Chief Designer, British Physical Laboratories, Radlett, Herts. [9785

TECHNICAL Writer required for compiling Radio and Television Service Manuals; must have good theoretical and practical knowledge of radio and television receivers, and the ability to write good English; apply with details of age, experience, etc., to—Personnel Officer (Ref. P.C. 555), Murphy Radio, Ltd., Welwyn Garden City, Herts. [9752

SERVICE engineers.—Hilger & Watts have vacancies for service engineers for installation and testing of optical and electronic instruments; driving licence essential; applicants must be prepared to travel.—Please write, quoting ref. No. N8, to the Personnel Officer, Hilger & Watts, Ltd., 98, St. Pancras Way, London, N.W.1. [9796

SERVICE engineers.—Have you ever considered the possibility of a career in the transmission side of television engineering? There are unlimited opportunities for capable engineers in this field, and you are invited to read **Pye T.V.T., Ltd.'s** display advertisement for test engineers on page 151 of this journal. [9800

TECHNICAL assistants wanted for wide range of interesting work on "Specials" assembly and wiring, testing, prototypes, service (inside and outside). Non-contributory pension scheme available; country area within easy reach of London; some experience of wiring or radio essential but keenness and ability to learn quickly most important.
APPLY, stating age and wage required to The Managing Director, Elcontrol, Ltd., Wilbury Way, Hitchin, Herts. [9737

SERVICE Engineers required by Selfridges for their Radio and Television Dept. Applicants must be fully experienced in the servicing of television and radio equipment, and hold a current driving licence. An excellent salary will be offered and the positions are permanent and pensionable for men under 45 years of age. Apply Men's Staff Controller, 5th Floor, Selfridges, Ltd., 400, Oxford St., W.1. [9771

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the company's permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18 [0252

ELECTRONICS engineers, Ekco Electronics, Ltd., have vacancies for electronics engineers based at Rochford, Essex, for installation and service laboratory duties. Work is in connection with industrial nucleonic systems, nucleonic counting equipment and general nucleonic instrumentation. Permanent progressive posts in expanding organisation. Requirements, good theoretical electronic fault-finding experience. Salary commensurate with ability.—Please write stating age, qualifications and experience to Personnel Manager, E. K. Cole, Ltd., Southend-on-Sea, Essex. [9733

MECHANICAL, electrical, and heating and ventilating engineering draughtsmen. Pensionable posts for men and women aged at least 20 on 1.6.61 with at least 3 years' training, including adequate practical experience with appropriate technical study. Appropriate O.N.C. is essential, and at least one year must have been spent in full-time drawing office work. Salary (Inner London) £617 (at 20) to £950 (at 28 or over). Scale maximum £1,043. Promotion prospects.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application form, quoting S/68-69/61. Closing date 29th December, 1961. [9777

THE NATIONAL INSTITUTE FOR THE DEAF requires an assistant for its Technical Department. The post involves work on hearing aids and audio frequency electronic equipment. Applicants should have good general knowledge of electronics and be able to construct prototype equipment with the minimum of supervision. The ability to deal with the general public would be an advantage. Salary £600 to £700, according to qualifications and experience; pension scheme. Applications in writing should be made to the Secretary, National Institute for the Deaf, 105 Gower Street, London, W.C.1, within ten days of the appearance of this advertisement. [9794

ELECTRONICISTS required by Ministry of Aviation at National Gas Turbine Establishment, Pyestock, Farnborough, Hants, to assist in the design and development of unique electronic and electrical apparatus for instrumentation associated with gas turbines and allied research. Appts. in grade of (a) Experimental Officer (min. age 27) or (b) Assistant Experimental Officer. Quals: G.C.E. "A" Level, pass degree, H.N.C. (Elec. Eng. or Physics) or equiv. qual. Experience of modern electronic apparatus and instrumentation techniques desirable. Salary: (a) £1,087-£1,336; (b) £458 (age 18)-£810 (age 26)—£983. Opportunities (normally for candidates under 31) to compete for established (non-contributory pensionable) posts.—Forms from Ministry of Labour, Technical and Scientific Register (K), 28, King St., London, S.W.1, quoting D 546/1A. [9795

TECHNICAL TRAINING

LEARN Radio and Electronics the New Practical Way! Very latest system of experimenting with and building radio apparatus—"as you learn"—Free brochure from Dept. W.W.10 Radiostructor, Reading. [0241

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 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

FIND TV set troubles in minutes from that great book, The Principles of TV Receiver Servicing, 10/6, all book houses and radio wholesalers.—If not in stock from Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8. [0089

THE Incorporated Practitioners in Radio & Electronics (I.P.R.E.), Ltd., Membership Conditions booklet, 1/-; sample copy of I.P.R.E. Official Journal, 2/-, post free.—Secretary, 20, Fairfield Rd., London, N.8. [0088

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

TV 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, TV and electronics, write for 148-page Handbook—free—B.I.E.T. (Dept. 397A), 29, Wright's Lane, London, W.8. [0016

RADIO and TV Servicing, all aspects from basic principles, guaranteed coaching for City & Guilds, R.T.E.B. Cert., Brit.I.R.E., etc.; study at home under highly qualified tutors; no books to buy.—Write for free prospectus, stating subjects, to I.C.S., Intertext House, Parkgate Rd. (Dept. 442), London, S.W.11. [0034

"HOW and Why" of Radio and Electronics made easy by a new, no-maths. Practical Way. Postal Instructions based on hosts of experiments and equipment buildings carried out at home New Courses bring enjoyment as well as knowledge of this fascinating subject.—Free brochure from Dept W.W.12, Radiostructor, Reading. [0240

A.M.I.Mech.E., A.M.Brit.I.R.E., City & Guilds, G.C.E., etc., bring high play 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

BOOKS, INSTRUCTIONS, ETC.

WEBB'S log-book for recording signals heard and worked, 112 pages 9¾×8in, approved format, semi-stiff covers, excellent value, 6/1 post free, or callers, 5/4.—Webb's, Radio, 14, Soho St., London, W.1. [0021

"RADIO Interference Suppression as applied to Radio and Television Reception." By G. L. Stephens, A.M.I.E.E. 2nd. Ed. An up-to-date guide to the various methods of suppressing electrical interference with radio and television reception. Many practical applications are given particular attention being paid to the problem of interference at television frequencies. Other chapters deal with the design and choice of suppressor components, methods of locating the source of interference, and suppression at the receiver itself. 10/6 net from all booksellers. By post 11 2 from Iliffe Books Ltd., Dorset House, Stamford St., London, S.E.1.

LYONS RADIO LTD.

RADIO RECEIVERS TYPE RAY-5. An 11-valve special purpose fixed frequency (26.5 mc/s) American receiver unit. Housed in black crackle aluminium case, size 12 × 9 × 8in., weight 18 lbs. Fitted 24 v. D.C. input rotary converter giving supply of 250 v. D.C. at 120 mA. output, octal based, 7.8 mc. plug-in crystal, output level meter scaled 0/2 v. A.C. Valves: 2-12SN7, 3-6AB7 and 1 each 6H6, 12J5, 12SR7, 6AC7, 12SJ7, 12A8. Brand new condition (no data available). "Give away" PRICE only 37/6. Carriage 5/-.

ROTARY TRANSFORMERS. Size of both 6in. long × 3in. dia.

Type 31. Input 12 v. D.C. Output 250 v. at 125 mA. **PRICE ONLY 12/6.**

Type 32. Input 12 v. D.C. Output 500 v. D.C. at 65 mA. **PRICE ONLY 7/6.** Post either type 3/-.

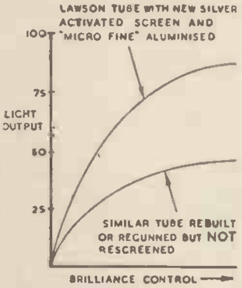
SUPPLY UNITS W/S.19 Mk. 3. Rotary transformer units in metal case 10 × 8 × 6in. Input 12 v. D.C. Output approx. 220 v. D.C. at 125 mA. and 450 v. D.C. at 65 mA. **PRICE ONLY 21/-**, carriage 5/6.

MODULATION INDICATORS. These are battery operated ex-Govt. Test Sets in neat metal cases 11¼ × 7¼ × 6¼in. Fitted with 2¼in. dia. 0/500 microammeter, 1 mA. meter rectifier, triode valve, etc. These units should also serve as an excellent basis for a first-class valve voltmeter. **PRICE ONLY 35/-.** Post 4/-.

COMPONENTS FOR BATTERY CHARGERS AND MODEL RAILWAY SUPPLY.
A good range available, see our advert. in W/W, October issue, page 146.

3 GOLDHAWK ROAD, SHEPHERDS BUSH, LONDON, W.12
Telephone: SHEpherd's Bush 1729

LAWSON

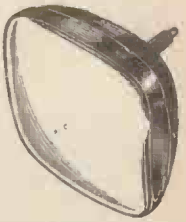


EXPRESS SERVICE
Orders received by 3 p.m. are dispatched same day. Special direct services to Ireland and Scotland, including Eire.

YOU HAVE A CRT PROBLEM? OUR ENGINEERS ARE SPECIALISTS—MAY WE HELP.

LAWSON TUBES
156, PICKERSLEIGH ROAD, MALVERN, WORCS. TEL.: 3798

DIRECT REPLACEMENT
Reprocessed **TV TUBES**



12 MONTHS *FULL REPLACEMENT* GUARANTEE

ENGINEERS WITH EXPERIENCE

Know that as a television tube gets old not only does it become low emission but the light efficiency of the phosphor screen has also seriously deteriorated (up to 10% per year). This deterioration of the screen obviously continues if the tube is only rebuilt or regunned. Don't risk a **"dead screen"**. Enjoy the brilliant, crisp, high definition of a **Lawson Tube**. Tubes which are absolutely **BRAND NEW** throughout (excepting the glass) and which incorporate the very latest CRT developments. New silver activated screens, "micro fine" aluminising, high efficiency gettering, brand new **direct replacement** electron guns by Britain's premier manufacturers, Mullard, Mazda, Emiscope, Brimar, Emitron, E.E., Cossor, etc.

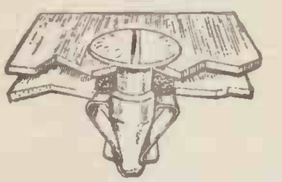
ALL MAKES AND TYPES FROM STOCK

LAWSON. The ONLY replacement tubes for which all types are guaranteed, correct and direct plug in replacements.

12" – £4 : 10 : 0
14" – £5 : 5 : 0
15"-17" – £5 : 15 : 0
CARR. & INS. 7/6

C.O.D. or C.W.O
10/-
Gladly refunded if you wish to return your old tube (excepting 12")

ODDIE FASTENERS



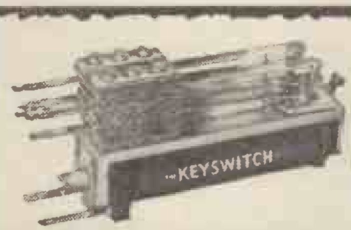
THE FASTENER WITH ENDLESS APPLICATIONS - SIMPLE - POSITIVE SELF-LOCKING. MADE IN A VARIETY OF TYPES AND SIZES. SPECIAL FASTENERS TO SUIT CUSTOMERS' REQUIREMENTS. WIDELY USED IN THE RADIO INDUSTRY.

Illustrated brochure and other information will be gladly sent on request

DEPT. "W.W."

Oddie, Bradbury & Cull Ltd., Southampton

Tel. 55683 Cables: Fasteners, Southampton



RELAYS
PO 3000 & 600 TYPES...

QUICK!
DELIVERY

KEYSWITCH RELAYS

SALES MANAGER:
IRONGATE WHARF RD., PRAED ST., LONDON, W.2
Telephone: PADdington 2231 (6 lines)

'PHONES OR INSERTS WANTED

IBA5, IBAT5, DLR5, or any sound powered Earphones wanted Urgently. Either pairs, single, or inserts. Any quantity.

Please state price and quantity.

CONCORD ELECTRONICS
210 Church Road, Hove, Sussex, England.
Tel: HOVE 35296

TUBES

Guaranteed 12 months.
Carriage Free.
Passenger Train despatch.

Completely Rebuilt Rescreened, Aluminised		NEW	
14in.	£5 5 0	MW 31-74	£5 5 0
15-17in.	£5 10 0	MW 36-24/44	£6 6 0
21in.	£8 0 0	MW 43-69, CRM 171-2	£7 7 0

ASTOUNDING BARGAIN! The "CLARION" Transistor Battery Tape Recorder. Push-button controls, 3¾ i.p.s. Portable. Durable plastic case. List price 25 Gns. Complete with Mike and Tape. Our Price ONLY **16 gns.** Carr. 7/6.

WESTWAY RADIO
S.A.E. with enquiries please
5 Westward Way, Preston Road, Harrow, Middx.

LINE OUTPUT TRANSFORMERS

Direct Replacements for 500 sets.

Bush. TV 11A, B; 12A, B; TVF 12A, TUG12A, B; TRG 12A, B	45/-
TV12AM; TV22, 24; TRG24, TUG24	60/-
Cossor. 930, 931, 933, 934, 948, etc.	58/-
Ekco. T8146; T8113-114	47/6
T221, 231; TSC311, etc.	55/-
Ferguson. 841, 2, 3; 941 to 945	55/-
990T-998T; 103-145T; 203-246T	66/6
Ferranti. 14T3, 14T4, 17K3, 17T3	45/-
14T2, T1205, T1215, T1225, T1325, T1405, T1415, T1425, T1505, T1825	65/-
Murphy. V114C, V116C, V118C	45/-
V120C, V180, V178, V200, V202C	57/6
V240, 250......62/6; V214, 216	69/-
Philips. 1114 UF/UM, 1115 U, 1437 U, 1446 U, 1726 U, 1746 U, 1747 U	65/-
383A, 463A, 563A, 663A	60/-
Pye. LV30, 16T, C817, VT17	60/-
CTM4, V4, VT4, V7, VT7	52/6
Ultra. 814, 815, 817, 915, 917, VW80, Y/YA730, YVW84, VWY720, V710 (complete assembly with U25)	85/-
14/53, 15/60, 17/50, 17/53, 17/60, 17/63-4, 17/70-1-2, 21/50, 21/60, 21/70-1-2	60/-

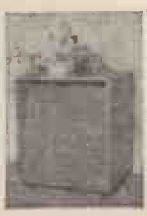
Add 2/6 Postage.

MINICOIL PRODUCTS

Manufacturers of:—

Miniature Precision Coils to specification. Chokes, Delay Lines, Pulse Transformers etc. Also Stockists of Ferrite Material, Coil Formers, Copper Wire, Insulating Tape, etc.

2A MAXWELL ROAD, PORTSMOUTH
Phone: Portsmouth 33330



A.D LOUDSPEAKER ENCLOSURES

SHERWOOD TYPE for Goodmans 12" Speakers
£15-10-0

A. DAVIES & CO.
(CABINET MAKERS)
3 Parkhill Place (off Parkhill Road) London, N.W.3
GULliver 5775

MALVYN ENGINEERING WORKS

Engineer to the Radio and Electronic Industries

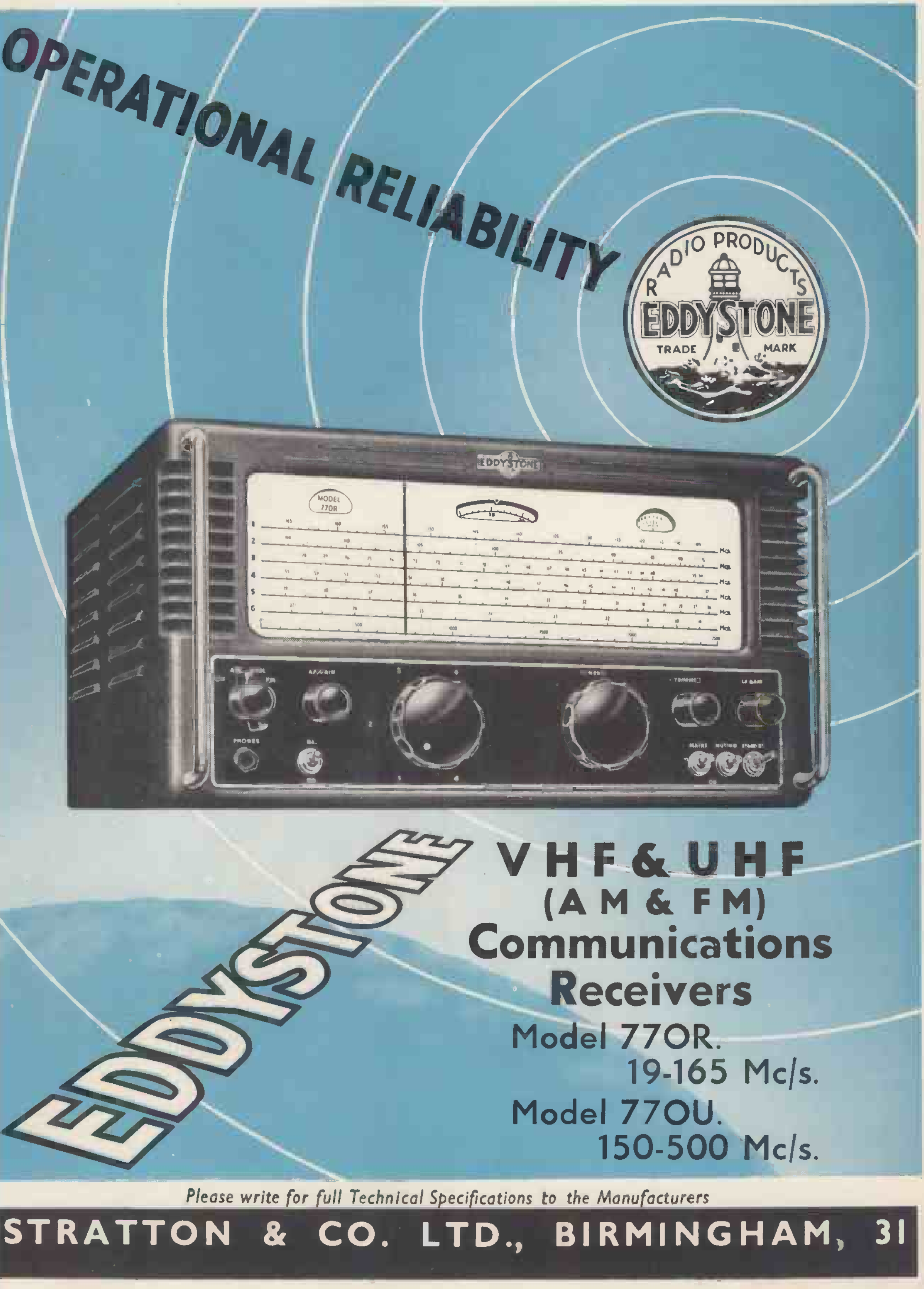
Manufacturers of: Chassis, Small Pressings, Machined Components, Wiring and Mechanical Assemblies, to specification.

Single and Production Quantities

7 CURRIE STREET, HERTFORD, HERTS.
Telephone: Hertford 2264

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE ELECTRICAL PUBLICATIONS 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.


OPERATIONAL RELIABILITY
RADIO PRODUCTS
EDDYSTONE
TRADE MARK
EDDYSTONE
MODEL 770R
EDDYSTONE
VHF & UHF
(AM & FM)
Communications
Receivers
Model 770R.
19-165 Mc/s.
Model 770U.
150-500 Mc/s.
Please write for full Technical Specifications to the Manufacturers
STRATTON & CO. LTD., BIRMINGHAM, 31


all the best for the coming season
—with the best of all possible solders—Ersin Multicore, the most widely used solder in the U.K.
ERSIN Multicore SOLDER
SAVBIT FOR INDUSTRY
The best present for factory operatives is to know that adequate supplies of Ersin Multicore Savbit Alloy are available for 1962. Savbit Alloy reduces bit wear and soldering iron maintenance to a minimum.
PUBLICATIONS
Laboratory engineers and technicians are invited to write on their company's letter-heading for the following publications:
"Modern Solders"—a comprehensive booklet on Multicore solders.
"P.C.L. 101"—an illustrated leaflet giving full details of the Multicore complete printed circuits soldering process.
"Ersin Multicore 5-core Solder"—Data on melting points, gauges, alloys etc. of Multicore solders.
"Ersin Multicore Savbit Alloy"—Explains the special advantages of Savbit Alloy with operating data.
Multicore are now able to supply virtually any diameter of solder rings in any gauge and in most of the standard alloys. They simplify automatic processes and the soldering of enclosed joints. A first-class joint is assured every time because of the even flow of solder and flux.
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)
Savbit is made under sole British Licence of Patent No. 721881
Ersin Multicore Solders are covered by Patents Nos. 433194; 675954; 704763.
See advertisement on inside page for details of further Multicore products and gift suggestions.
MULTICORE SOLDERS LIMITED · MULTICORE WORKS · HEMEL HEMPSTEAD · HERTS · Telephone: BOXMOOR 3636