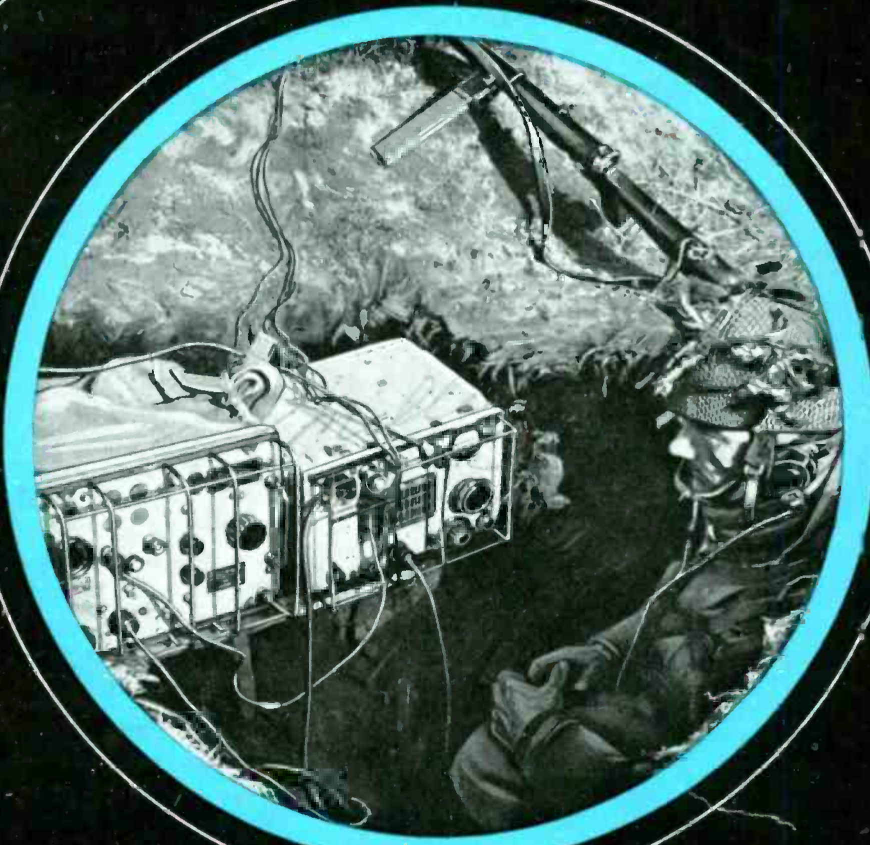
Wireless World

RADIO and ELECTRONICS



MAY 1945

1/6

Vol. LI. No. 5

IN THIS ISSUE: FREQUENCY ALLOCATION PROBLEMS

Orders bearing Government Contract Numbers and Priority Rating can now be accepted for quick delivery of the following two "AVO" instruments:—

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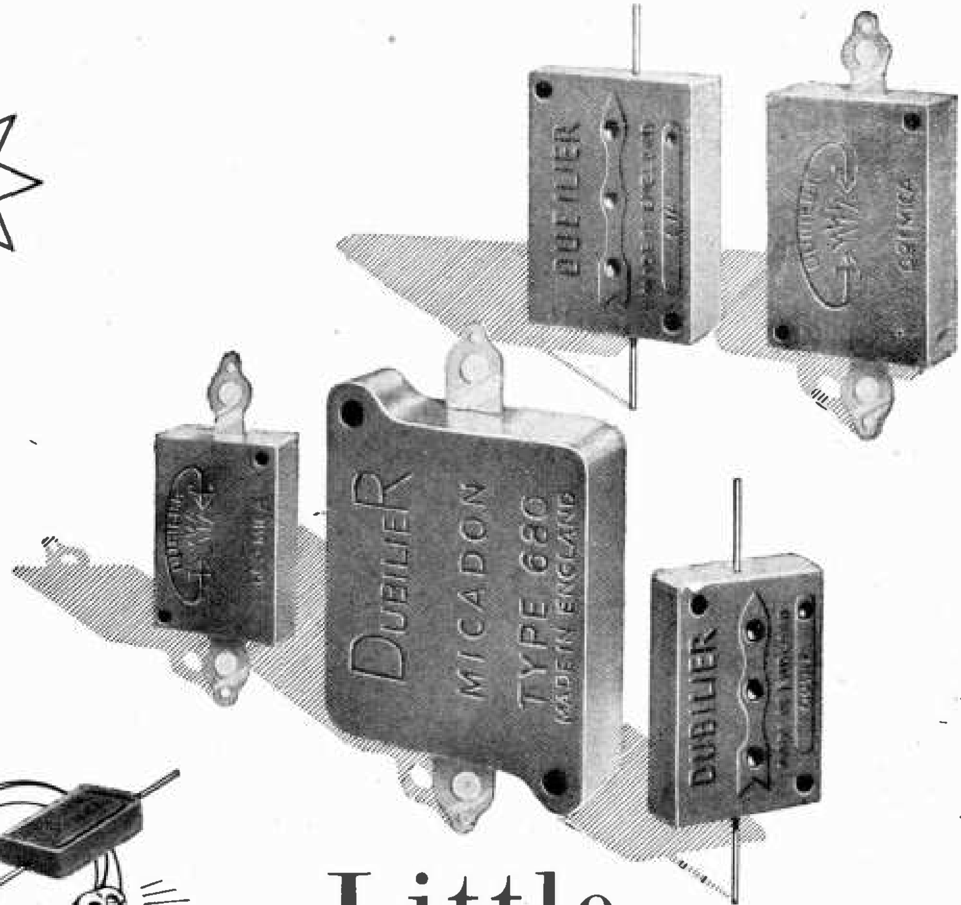

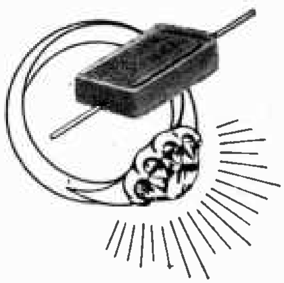

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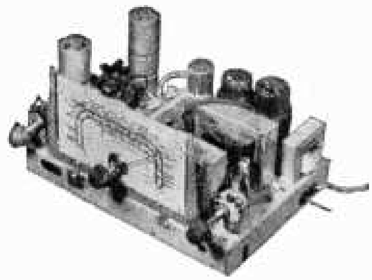

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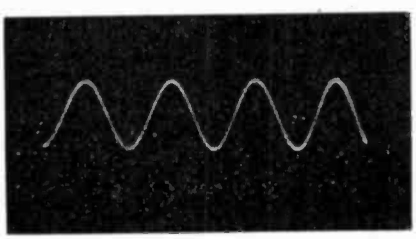

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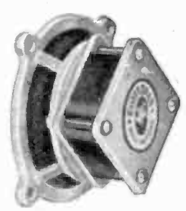

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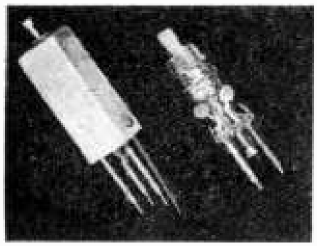

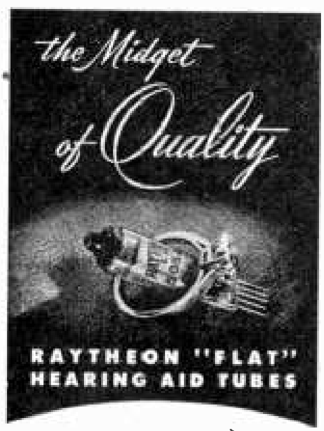
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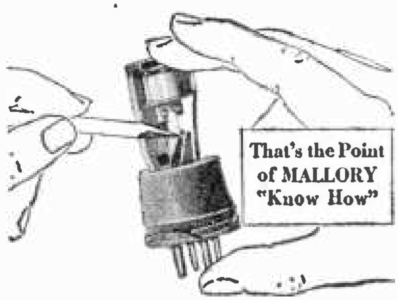
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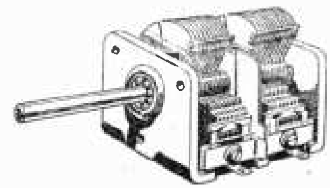


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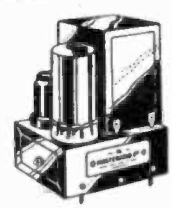

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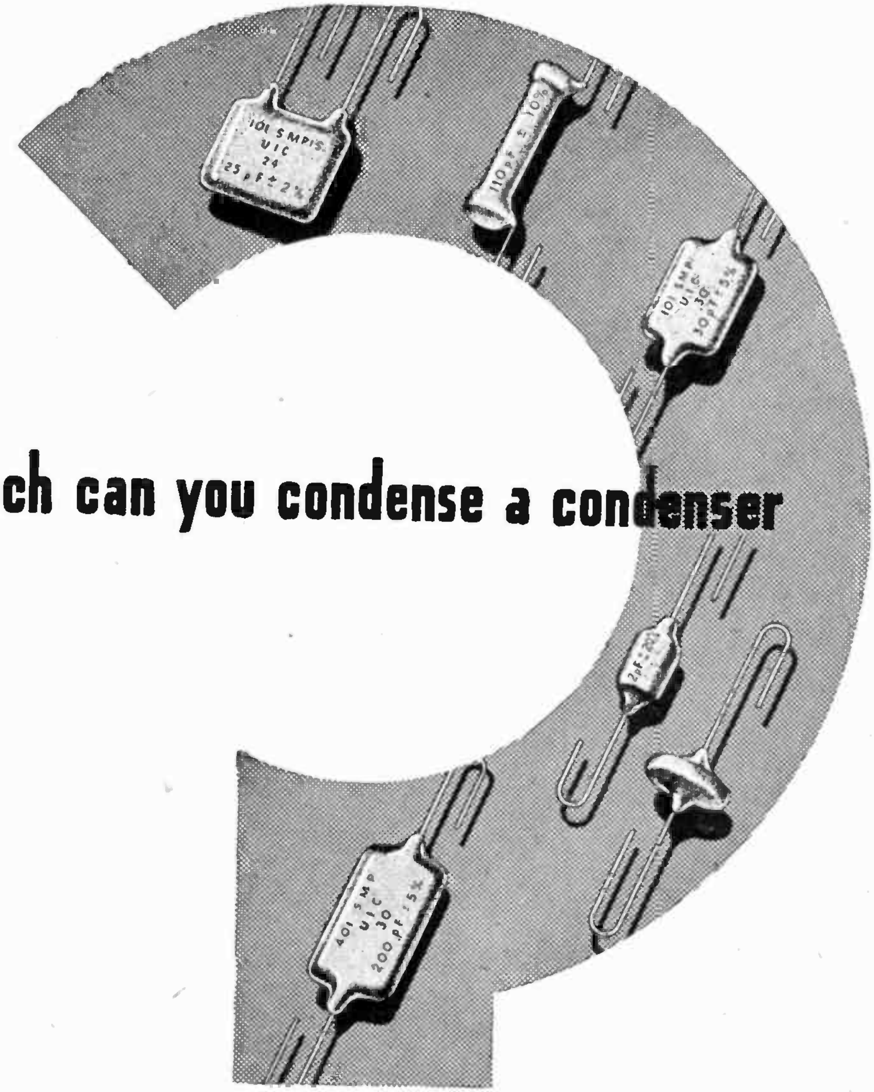


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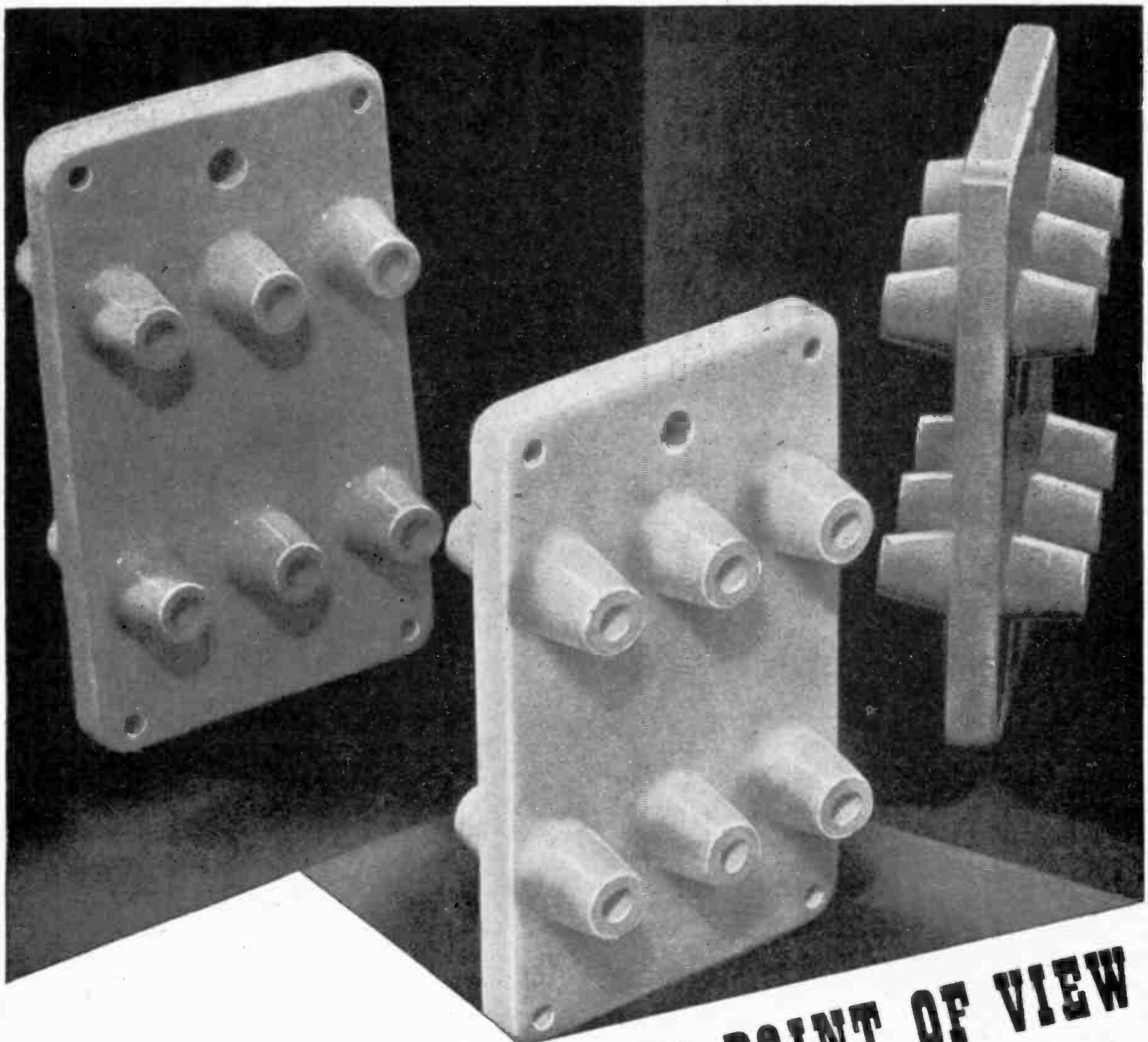

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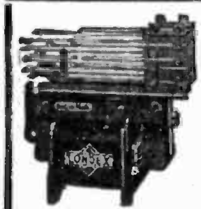

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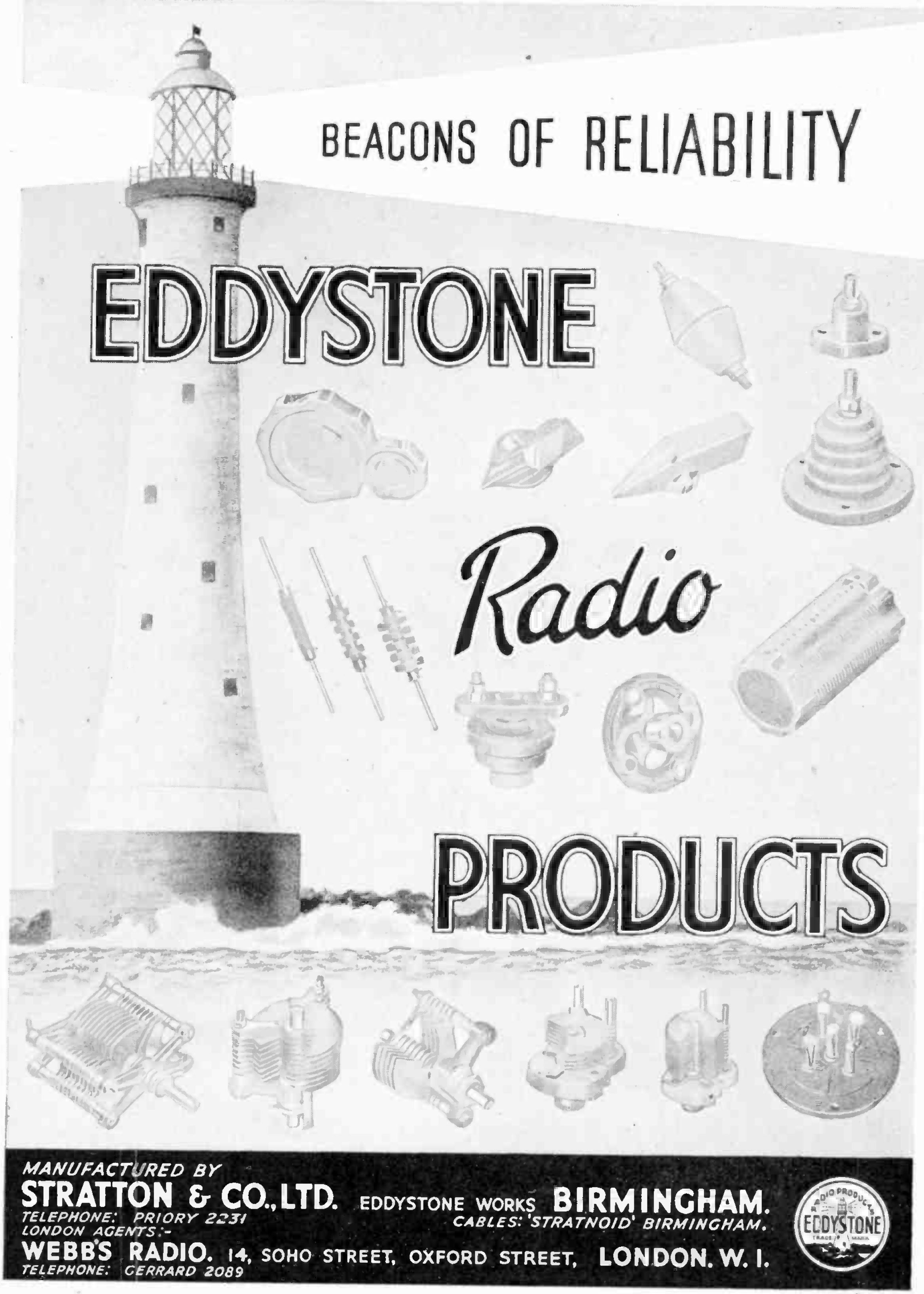
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Radio and Electronics

35th YEAR OF PUBLICATION

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Wireless World

Radio and Electronics

Vol. LI. No. 5 MAY 1945 Price 1s. 6d.

Monthly Commentary

Television Psychology

So far, there have been few adverse criticisms of the Television Committee's Report, summarised in this journal last month. Indeed, it has been the subject of surprisingly little serious discussion, though several well-deserved tributes have been paid to the painstaking and thorough manner in which the members have carried out their difficult task. There is much that is admirable in the Report, but we think it fails to take into account the psychological reactions of the average potential viewer, on whose attitude will ultimately depend the success or failure of British television. In particular, he has heard so much of wartime developments that he is unlikely to be more than lukewarm towards the restarted pre-war system, especially when there is a promise of "better television round the corner." There will be every temptation to delay the installing of a receiver. Promises that the 405-line service will be retained for a period of years, in parallel with transmissions of higher definition, will do little to allay feelings of uncertainty and fears of obsolescence. A secondary matter, also largely psychological, is the size of the television viewing screen, which was often compared, perhaps subconsciously and certainly unjustifiably, with the larger screen of the cinema.

These and similar questions must be studied most intensively by all concerned with the future well-being of television. Most emphatically, the set-up of our post-war service, which will depend for its success on the number of patrons it can attract, cannot be decided on a severely rational basis of technical standards or programme composition. Less tangible factors are of at least equal importance. For instance, we should try to learn why so few receivers were sold between 1936 and 1939. (The generally accepted figure is only 18,500). Many reasons have been given; at present one guess seems almost as good as another. Fear of obsolescence was undoubtedly one cause. "Television is still in its infancy; it is certain to become better and cheaper before long." Again, it is doubtful if television was publicised to the best advantage; did all those millions to whom the service was in fact available fully realise that it was a practical possibility for them?

Wireless World has always urged the need for re-establishing television with the least possible delay, and inclines more strongly than ever to the view that a new start should be made with a standard of definition involving no radical departure from well-tried technique, either in transmission or receiver design. But, within that limitation, definition should be the highest that can be achieved. Let us concentrate on that, without too many problematical "1,000-line" distractions.

Elsewhere in this issue a contributor examines the Report in detail, and rejects the re-establishment of the 405-line pre-war service as anything but a temporary measure. We hope that readers will give us their view on this important matter.

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The Technical Press

During the war all specialised journals have suffered under severe restrictions, particularly in the way of paper rationing. Supplies of paper have been cut to one-fifth of pre-war consumption, and quality has deteriorated seriously. Believing that the time has now come when we can perform an essential social function in paving the way for post-war reconstruction, the Council of the Trade and Technical Press, representing more than 200 journals, has presented a joint case to the authorities. This is in the form of a Memorandum, drawn up by the Council under the chairmanship of Roland E. Dangerfield, pleading for immediate relaxation of the main handicaps under which we have laboured. It is pointed out that the specialised Press serves as a forum for discussion of post-war problems by industrialists and technicians, many of whom have lost touch, during the war years, with their normal peacetime activities. In order that the diverse interests of readers can be treated adequately, and the case of British industry can be worthily presented both at home and abroad, we need more and better paper and printing facilities. In addition, the authorities are urged to release information on wartime technical developments at the earliest possible moment that security will allow.

TELEVISION COMMITTEE'S REPORT

Are They Flogging a Dead Horse ?

By R. W. HALLOWS, M.A., A.M.I.E.E.

NO one can read the Report of the Television Committee* without being impressed by two things. The first of these is the amount of hard work done by Lord Hankey and his fellow members, both in the examination of witnesses and in coming to the conclusions which the Report embodies. The second is the complete sincerity of the Report: it represents the reasoned beliefs of a body of men who have devoted themselves unselfishly and untiringly to the task which was assigned to them. But no committee, whatever the subject of its enquiry and whatever its terms of reference, can expect that its findings and recommendations will meet with a hundred per cent. agreement when they are published. As one who has the future of British television very much at heart, I confess that I am uneasy about the present Report, and I find that my misgivings are shared by a good many of those with whom I have discussed it.

The Witnesses

To begin with, I cannot help feeling that Lord Hankey's committee made one cardinal error in selecting the witnesses whom they examined. These witnesses consisted (Report, Appendix 1, p. 22) of representatives of the following organisations: the General Electric Company, the Marconi-E.M.I. Television Company, Scophony Limited, Standard Telephones and Cables, the Board of Trade, the B.B.C., the British Film Producers' Association, the Ministry of Education, the Radio Industry Council, and the Cinema Renters', Exhibitors' and Producers' Joint Committee. The only other witness was J. L. Baird. In a word, the witnesses consisted entirely of "transmitters" rather than "receivers," if I may so put it. All were interested in the manufacture of televisors, in the marketing of televisors, or in what could be put over by television. No one appears to have been called by the Committee to give them the view of the buyer—the owner or would-be owner of the television receiver—the experiences of those who had such apparatus in their homes before the war or the feelings of the amateur enthusiast who is interested in both the technical and the entertainment aspects of television. And by not examining witnesses of these kinds the Committee were, I believe, led to form certain decisions which might have the effect of retarding very seriously the development of television in this country when the war is over.

Fortunately, however, the conclusions and recommendations contained in the Report are not final: the Committee is emphatic that a new advisory committee should be appointed by the Government and that this body should have a very large say in all matters affecting television in post-war days. The advisory committee, one gathers, will not be bound hand and foot by the Hankey Committee's recommendations. There is, therefore, still time for the adoption of a policy which will lead to rapid progress and to Britain's retention of the lead in the television field. I am convinced that the reverse of both these things would be inevitable were the recommendations of the Report carried out as they stand.

A Poor Start

Let us see first of all what reasons the Committee accepts for television's failure to become a popular hobby in the years before the war. If those reasons are the right ones, well and good: once you really know why a promising thing does not achieve success at first you are well on the way to making a success of it eventually, for you understand what to do and what to avoid in the future. But *are* the reasons given in the Report the real reasons why in its first 2½ years television crawled into popular favour instead of advancing at the expected gallop? Here they are:

> "By 1939 the service had reached a high standard, the programme technique had made great progress, and the result was a service of considerable entertainment value. The number of television receivers in use by the public did not, however, rise appreciably above 20,000. This was ascribed *inter alia* to the cost of the sets (£20 to £75), the belief that the price would soon fall and the fear of obsolescence. The restriction of the service to the London area no doubt gave rise to the impression that the service was still in the experimental stage. Nevertheless the demand for the extension of the television service to the provinces became insistent. It was urged in Parliament, in the Press, and by the Radio Industry."[1]

There is also a mention of the fact that "a considerable number of complaints were made of electrical interference with the reception of pre-war television programmes."[2]

Fear of Obsolescence

I accept without question that 20,000 television receivers had left the factories, but I fancy that the number actually in private ownership was a good deal below that figure when the war broke out. And emphatically I do not believe that the price of £20-£75 had much to do with it. The area covered by the Alexandra Palace transmissions contains, one understands, between a quarter and a third of the entire population of England and Wales; no one would suggest that less than 20,000 radio receiving sets and radiograms at prices of £20 upwards were sold there in 1937, 1938 and 1939. And many of the quite moderately priced television receivers were also "all-wave" radio receivers or even radiograms as well. If people believed before the war that the prices of televisors would

* "Report of the Television Committee, 1943": H.M. Stationery Office, 1945. 6d.

soon fall, they still have that belief, for it has been fostered (if I may say so without offence to my many good friends in the wireless industry) by the pronouncements of prominent members of the industry itself, and so far as one can see there is nothing to prevent them from holding it indefinitely! Nor can I accept fear of obsolescence or any feeling that transmissions were still experimental as root causes of the public's slowness to invest in television receivers. There certainly was a very definite demand for the extension of the Alexandra Palace service to the provinces, and that could hardly have been so strong had there been widespread apprehension of this kind.

This much I can say: I have talked television certainty with scores and probably with hundreds of people of all kinds and very few indeed of those who did not possess television receivers gave any of the reasons accepted by the Committee. What they did tell me was that they were not satisfied that the pre-war service was providing adequate entertainment, save on occasions when there was some big sporting or news event to broadcast; that the viewing screen was too small for their liking; that they were apprehensive of the possibly staggering cost of CRT and valve replacements and that, on the whole, they did not feel that they were missing much by sticking to ordinary radio sets and radiograms.

With the programme side of television I dealt at some length in the columns of *Wireless World* last year.[3] The point I made then was that we knew now *how* to televise, but had not yet discovered *what* to televise in order to provide good entertainment day in, day out. Some suggestions were made which the powers that be may or may not regard as being of value. The means of allaying the not unnatural fear of the cost of "retubing" a television receiver or of revalving apparatus containing a large number of valves rests with the industry. May I emphasise the fact that people are not nearly so frightened of a fairly high initial outlay as of the possibility of having to spend on replacements at a later date more than the instrument is then worth?

Size of Screen

A very important reason that has deterred listeners from becoming viewers is their dislike of the small screen. Many who have discussed the matter with me have drawn comparisons between the televisor and the home cinematograph. The latter, they say, is fine. A whole roomful of people can watch the moving pictures in comfort; you don't have to peer; there is no need to sit or stand tightly packed right opposite the middle of the screen. In fact, given a television viewing screen, say, 30 inches by 20, and definition approaching that of the home movie projector, there would be enthusiasm where there is now lukewarmness or even antipathy.

"A very important reason that has deterred listeners from becoming viewers is their dislike of the small screen."

Now, 405-line television may be reproduced on big screens, as it was before the war by the Scophony process, but, the bigger the screen, the more obvious are the shortcomings due to poor definition. That fact was recognised by the Committee, who regarded 405-line transmission as suitable for a picture no bigger than 8in. x 10in.[4] Yet this same Committee recommends the extension of the 405-line system to six provincial centres after the war[5] at a capital cost of $1\frac{1}{2}$ million pounds.[6] It recommends that an improved system, of possibly 1,000 lines, be introduced as soon as possible, and that for some considerable time the new and the old systems should run side by side.[7]

Second Best

What is the point of extending the 405-line system to the provinces if something better is to be introduced at no distant date? Is not the spending of a million and a half of good money on such a scheme something very like sheer waste? Why should people in the provinces rush to buy 405-line television receivers when the millions in the London service area would not do so? Even though they have the assurance that the 405-line transmissions will be continued for years after the arrival of the improved system, will there be any real inducement to people to buy such sets? I think not, for very few are content to have something that is notoriously a poor second-best. My own belief is that, were the money spent and the six extensions made, the result would be a ghastly flop; would-be purchasers would wait for the new and better system, particularly if their dreams of ever-falling prices led them to believe that the 1,000-line television receiver of the not-far-distant future would cost no more (perhaps even less!) than the 405-line instrument then offered.

And there is something else to be considered. Again and again in the Report the Committee stresses the importance of Britain retaining the world lead in the

Television Committee's Report —

field of television. What will the rest of the world think of us if, after the war, we expend money, materials and technical ability in making nation-wide an admittedly inferior television system? By the time that the projected six provincial centres were erected we should almost certainly have in being not the best but the worst television system of the great countries. The Committee is fully alive to the importance of our building up a great export trade in television gear;[8] how can we hope to do anything of the kind if other countries believe—as believe they will, no matter what we say about the future—that we have pinned our faith to 405 lines?

"Television and the cinema are likely to be closely bound together in the future." This illustration is reproduced from a photograph taken on Feb. 23, 1939, when two cinemas at Marble Arch, London, showed B.B.C.'s television broadcast of the Boon - Danahar boxing match.

Surely, by far the sounder course would be to regard our pre-war 405-line system as obsolescent, if not, indeed, obsolete, and to decide firmly to spend no more money in developing it. The Alexandra Palace station must certainly be brought back into action at the earliest possible moment after the end of the war. By so doing we shall keep faith with those who now own television receivers, and we shall give the entertainments departments of the B.B.C. full opportunities of developing the new lines of vision broadcasting that are essential to ultimate success. Meantime, let all the money and all the technical brain power that can be made available be devoted to research and to the rapid development of high-definition television. As soon as a system has been approved, let the first high-definition station (to work on the standard to be finally adopted) be erected at Birmingham or some other chosen provincial centre. London had the first television service; it is the turn of the provinces to be first with high definition. The new London station must be one of the earliest erected after this on account of the vast population of the area served by it. The moment this station is working satisfactorily, the 405-line system should be scrapped, lock, stock and barrel.

If we devote our money and energy to a first-rate system and do not squander either on what is already out of date, the new television service might well come into being far sooner than the compilers of the Report envisage. There would then be no doubt about our retaining our lead and export prospects should be good.

Lastly, the Report recognises that television and the cinema are likely to be closely bound together in the future.[9] I have long held this view, and first put it forward some years ago in *Wireless World*.[10] That partnership can never come properly into being with a 405-line system. When it does come its consequences are likely to be so important that we should do all that we can to hasten the day.

From almost every point of view, then, it behoves us to cease as soon as may be from flogging the almost dead horse of 405-line television and to put our money on an altogether better and very much alive animal, which will prove a winner, surely.

REFERENCES

(1) Report §5, p.4. (2) Report §39, p.11. (3) "Television Survey," *Wireless World*, June 1944. (4) Report §14, p. 6. (5) Report §28, p. 9. (6) Report §65, p. 16. (7) Report §29, p. 9. (8) Report §52 *et seq.*, p. 18. (9) Report §31 *et seq.*, p. 10. (10) "A Partnership with the Cinema," *Wireless World*, 9th March, 1939.

HEADS OR HANDS?

AT a recent discussion meeting of the Radio Section of the Institution of Electrical Engineers on apprenticeship and training, the opinion was expressed that the "incoherent growth and newness" of radio precluded attempts to establish as yet any rigidly defined methods of training or grading of technical workers. Many speakers stressed the point that the industry has depended largely on ex-amateurs, and the present tendency of the industry to discourage the amateur was criticised as unwise.

It was widely thought that far too much stress has been laid in the past on the need for specialised training in "craftsmanship"; that term, as generally understood, tended to emphasise the need for a degree of manual dexterity that did not in fact exist in the radio industry, except in rather exceptional cases. In most radio production work there was little scope for craftsmen with a specifically radio training. In general, "heads were more important than hands." One speaker contended that a purely radio training might even be inimical to the interests of the manual worker, as it would narrow his field of employment.

Much sympathetic consideration was shown for the difficulties of recruits to radio, which was thought to attract an extremely good type of entrant. Most speakers urged that young entrants should have every opportunity to change from one grade to another, according to their abilities. It was emphatically stated that the student-apprentice should not be expected to undergo vocational training outside normal working hours.

FREQUENCY ALLOCATION

Needs of Long-distance Communication Services

By R. L. SMITH-ROSE,
D.Sc., Ph.D., D.I.C., A.R.C.S., M.I.E.E., F.I.R.E.
(*National Physical Laboratory*)

THE present allocation of radio-frequency channels for various communication purposes, excluding any effects brought about by the war, was settled by the International Conference at Cairo in 1938. The revised regulations there drawn up and agreed to by the representatives of sixty-five nations, provided for the allocation of radio frequencies over the whole spectrum from 10 kc/s to 200 Mc/s. This range of frequencies covered not only the needs of radio communication but also other applications, such as navigational aids and radio meteorological soundings, that had already attained a certain stage of practical development. The present article is limited to a discussion of the needs of radio communication over distances of 500 miles and upwards, as they would appear to be in the immediate post-war period.

For communication over these distances the appropriate frequency bands would appear to be broadly 10 to 300 kc/s and 3 to 30 Mc/s. While it is known that signals on frequencies outside these bands are on occasions received at distances in excess of 1,000 miles at specially favourable times or seasons, these conditions cannot be considered as suitable for the operation of a communication service at a usefully high load factor. In particular, the intermediate region from 300 to 3,000 kc/s is uneconomical for ranges exceeding 1,000 miles, since the attenuation of the ground waves and the absorption of the ionospheric waves are both detrimental to reliable communication over such distances.

The justification for selecting the above frequency bands is based upon the present state of our knowledge of the propagation of radio waves around the surface of the earth and through the ionosphere. This knowledge is now considerably in advance of that available when the current distribution of frequencies was drawn up by the Conference at Cairo in 1938, and it is to be expected that any revision of the allocations will have due regard to the known suitability of the various frequencies from a wave propagation standpoint.

Frequencies between 10 and 300kc/s.—At the low frequency end of the first band (10-300 kc/s), the experience gained with the operation of a station such as Rugby on a frequency of 16 kc/s has shown that only by using a low frequency of this order can a virtually continuous telegraphic service, necessarily of a broadcast nature, be maintained with ships and other receiving stations in all parts of the world. The opinion expressed at a meeting* of the Institution of Electrical Engineers in 1926, that no more super-high-power stations would be built for long-distance communication has proved wrong. Thus there is justification for continuing the use of the band 10 to 100 kc/s for fixed stations erected for the purpose of maintaining communication in various directions at ranges from 500 miles and upwards. The upper end of this band and continuing up to about 300 kc/s is usefully confined to those services operating entirely over sea, such as from coastal stations to ships and aircraft, since in this way the maximum use can be made of the reliable ground-wave range. While at least one radio-telephone service has been operated successfully on a carrier frequency near 60 kc/s, it is perhaps relevant to enquire whether the frequency band, about 3 kc/s wide, required for such a service could not be more usefully and economically employed for high-speed telegraphic purposes.

* *Journal of the I.E.E.* 1926. Vol. 64, p. 710.

Frequencies between 3 and 30 Mc/s: Ionospheric Conditions.—When we turn to the second frequency band of 3 to 30 Mc/s it is by no means such a simple matter to suggest allocations; but it is suggested that it will be useful to take note of the conditions imposed by the ionosphere on the possibility or otherwise of maintaining virtually continuous communication conditions over the assigned path, and then compare the results of such a study with the experience obtained in the operation of long-distance radio traffic routes during the last decade or so. The results obtained from measurements of the reflection of waves from the ionosphere reveal several facts of which it is essential to take account in planning the frequencies necessary for communication over various distances and at various times and seasons.

The highest frequency at which waves are reflected from the ionosphere over a particular path varies in a ratio of between two and three to one from day to night in the winter, and in a somewhat smaller ratio in the summer. The change in frequency from maximum to minimum of the sunspot cycle, some five to six years, is also about two to one, all other conditions remaining the same.

Apart from the fact that waves in this high frequency band are transmitted efficiently through the ionosphere, a feature which is of great practical importance in radio communication is that the wavelengths involved (10 to 100 metres) are very suitable for the use of highly directive antenna array systems, which both reduce the signal interference conditions and improve the overall efficiency of the communication circuits.

For a given distance, geographical location and time of transmission, there is a maximum frequency above which it is in general not possible to sustain communication, however much power is available at the sending end. As the frequency is reduced below

Frequency Allocation—
telegraphy and telephony, and it is perhaps not entirely a technical matter to decide the order of priority of these types of radio communication. Thus, in considering communication between this country and one of the Dominions, a certain range of frequencies will be available in practice; some of which are more favourable than others. It is a conceivable decision that the national interests would be best served by giving broadcasting pride of place, and so allocating to this particular service the highest, and therefore most efficient, frequency channel available. There may, however, be other views which demand that high-speed telegraphic communication is the most important service to safeguard. Alternatively, there may be a case, in the future, for giving special consideration to the needs of facsimile transmission as one of the most effective means of communicating special printed material and pictures. These are all matters involving questions of policy as well as technique; and it is to be noted that they are under active discussion at the present time in America by the Federal Communications Commission, the body responsible for frequency allocation in U.S.A.

Conclusions.—In conclusion, it may be said that the foregoing remarks amount briefly to a proposal that careful and adequate use should be made of our present scientific knowledge of radio wave propagation as part of the foundation upon which to base a revised scheme of frequency allocation for long-distance radio communication of all types. This knowledge should naturally be used in a complementary manner to the results of the experience of all those who are, and have been, responsible for the practical design and operation of such communication circuits, and who will undoubtedly have already formed certain opinions as to the efficacy and limitations of the present distribution of radio frequencies on the basis agreed to over six years ago. That much practical material of the requisite type is already available was illustrated by the article published in *Wireless World* for August, 1944, by J. A. Smale, in which a few excellent examples were given of some of the existing possibilities of world-wide communication, and of the steps that are taken to counteract the vagaries of the ionosphere.

RADIO AND REHOUSING

IN the report of the Committee convened by the I.E.E. to study electrical installations in relation to post-war building, wiring for telecommunication services of all kinds is dealt with. It is proposed that each house should be provided with a duct through the foundations for telephone, wire broadcasting or "wired television" if the latter is introduced at some future date. It is also recommended that a fixture for an outdoor aerial be provided, normally at the back of the dwelling and that an internally glazed porcelain lead-in tube should be cemented into the wall with a slope downwards towards the outside.

The provision of continuous wall ducts in the skirting or a deeply grooved picture rail is suggested to house internal telecommunication wiring, including extension loudspeaker leads.

Telecommunication problems in larger buildings such as blocks of flats and hospitals are also dealt with. The report is published by H.M. Stationery Office and the title is Post-War Building Studies No. 11, Electrical Installations.

MAN POWER. The American Signal Corps transmitter-receiver, the SCR 694, which is used in forward areas, being transported as a three-man pack. On the move it draws its power from batteries, but under static conditions from a hand generator as shown in the lower photograph

ARMY SET—Type 76

Crystal Control of Operation between 2 and 12 Mc/s on Pre-selected Spot Frequencies

THIS transmitter is intended primarily for use by Commando formations working in advance of the main forces, sometimes in semi-isolation and nearly always under very difficult campaigning conditions. Stark simplicity and ruggedness are, therefore, the key-notes of its design, there being no place for unnecessary frills and elaborations.

From the circuit diagram it will be seen that two valves only are employed; one is a crystal oscillator whilst the main function of the other is that of a power-amplifier. Both valves are tetrodes with characteristics somewhat similar to the well-known American 807.

The crystal oscillator, V1, is a modified form of the Pierce circuit, which, having the advantage that no tuning controls are required, admirably suits the purpose of this set. Change in frequency is effected simply by changing the crystal, six of which are included, the desired one being selected by the switch S1.

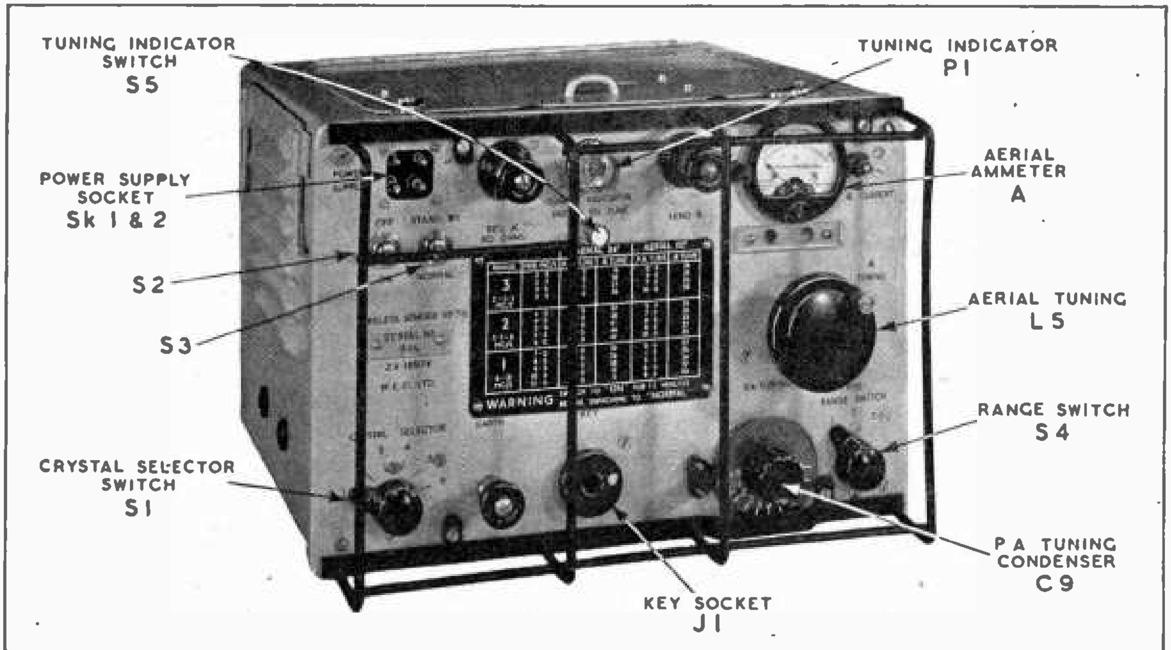
Grid bias for V1 is provided partly by the cathode resistor R2, and partly by the grid leak R1. As the voltage produced by the latter is dependent upon the amplitude of the oscillations, which are in turn governed by the activity of the particular crystal in use a reasonably constant output is obtained at all frequencies.

PA Circuit

As the transmitter is intended for operation on predetermined spot frequencies within a band of 2 to 12 Mc/s it seems almost certain that the second stage, V2, will sometimes be operating as a straightforward power amplifier and sometimes as a combined frequency doubler and output stage. This is based on the assumption that it is most unlikely crystals having a fundamental oscillation frequency higher than about 6 Mc/s would be used in a set of this kind.

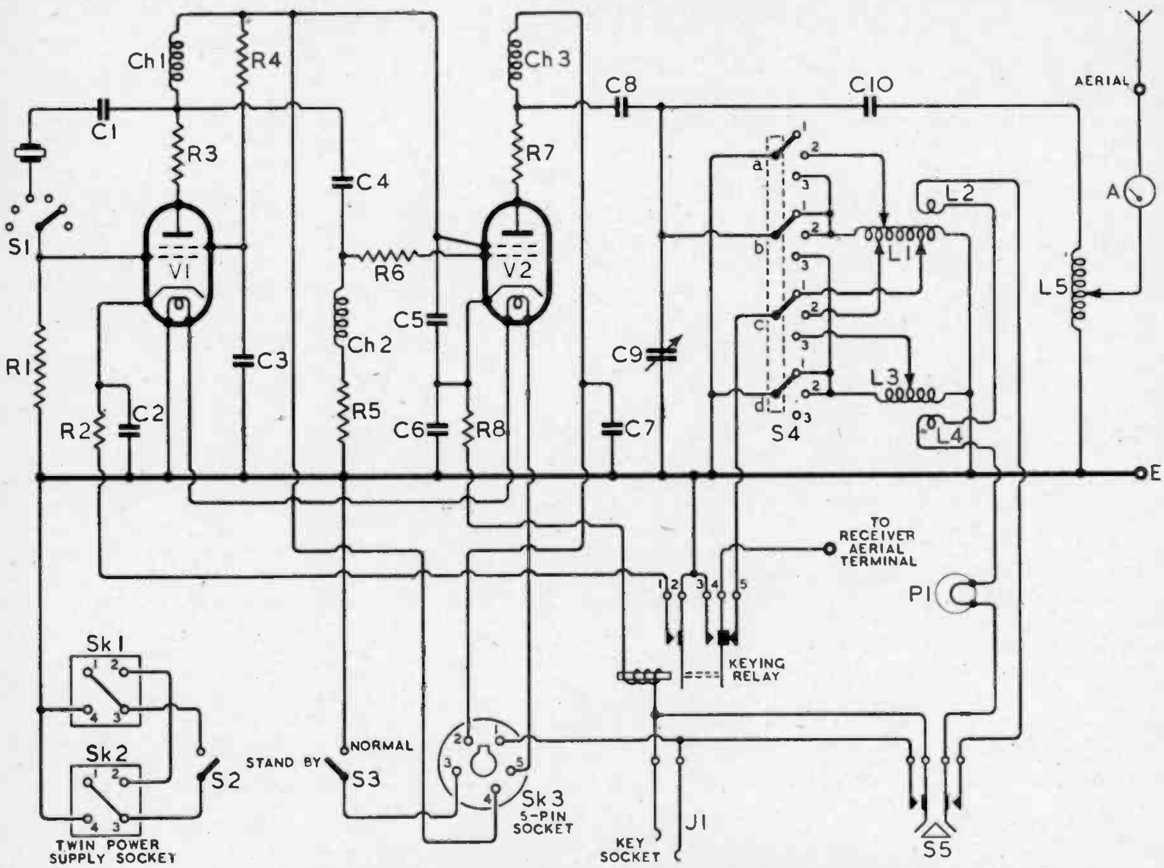
There being no tuned circuits in either the oscillator stage or the input to V2, the mode of operation must be governed solely by the frequency to which the anode circuit of V2 is tuned. This comprises the variable condenser C9 and either the inductance L1 or L3. It is thus possible to obtain at least two transmission frequencies from any one crystal having a fundamental frequency between 2 and 6 Mc/s, merely by tuning the PA circuit either to the fundamental frequency of the crystal or to its second harmonic. As the RF output from the Pierce oscillator is generally rather small it is very doubtful if third-harmonic operation would be worth-while. Some twelve transmission frequencies will therefore

The various switches and tuning controls on the Army set Type 76 can be located by the lettering, which is the same as that used in the theoretical circuit diagram.



be available with the six crystals for which provision is made.

Biasing arrangements for the PA stage are similar to those of V1: R8 provides the minimum grid bias and R5 the additional



Complete theoretical circuit diagram of the CW transmitter—Army Set Type 76. For the sake of clearness, only one of the six crystals connected to switch S1 is included. Relay contacts are shown in the key "up" position.

bias needed for Class "C" amplification or for harmonic generation, as the case may be. Resistors R3, R6 and R7 are anti-parasitic resistances.

As already stated the tuned anode circuit for V2 consists of the variable condenser C9 and the inductance L1 or L3. Actually either a portion only or the whole of L1 is used, depending on the setting of the range switch S4. This is a four-pole three-way switch and its three positions enables C9 to cover the following frequency bands:—

2—3.5, 3.5—6, 6—12 Mc/s.

The PA circuit is shunt-fed through the choke Ch3 and condenser C8.

Sections (*a*), (*b*) and (*d*) of the range switch S4 make the aforementioned inductance changes, at the same time short-circuiting and earthing the idle part of L1 or L3 as required. Section (*c*) performs the somewhat unusual function of joining the lead from the aerial terminal on the receiver, which comes in through the relay contacts 3, 4 and 5, to tappings on L1 or L3.

"Break-in" Operation

This serves a two-fold purpose. In the first case, it ensures that the input circuit of the receiver is always correctly matched to an aerial tuned to the particular band of frequencies in use and, secondly, it enables the receiver to be operated continuously, so permitting reception of any incoming signals during the keying intervals. This system is known as "break-in" operation, as the distant station can immediately ask for a repeat of any part of the message without having to wait until the transmission is terminated. Obviously, the receiver has to be disconnected from the aerial during actual transmission periods and this is effected by the keying relay. With the key "down" contacts 3 and 4 are made and the receiver aerial is earthed. In the key "up" position relay contact 4 makes with contact 5 and the receiver is then connected to the aerial via the PA anode circuit, the condenser C10 and matching coil L5.

Coils L2 and L4, in conjunction with the lamp P1 and a spring-loaded press switch S5, together form a visual tuning indicator for use when adjusting the PA circuit. Switch S5 not only completes the indicator circuit when required but it also short-circuits the key contacts, thus starting up the transmitter. Correct tuning of the PA circuit is indicated by maximum brilliance of the lamp P1. Having tuned this circuit the aerial circuit is then adjusted for maximum current in the aerial as indicated by the aerial ammeter A.

Simplicity of Operation

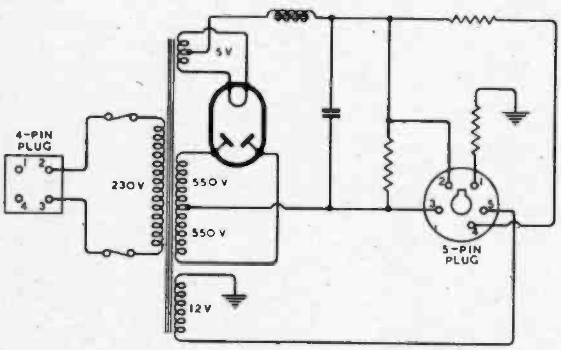
From the foregoing it will be seen that there are two main tuning controls only, namely C9 and L5. Subsidiary adjustments, such as changing crystals and selecting the required frequency band, are made by switches S1 and S4.

There are two other switches shown on the circuit diagram the functions of which may appear a little obscure. Switch S3, a single-pole make-and-break type and marked "stand-by" in the open position and "normal" in the closed position, is used to start up the rotary transformer in the power supply unit as a preliminary to actual transmission. While receiving, this switch would be put to "stand-by," thereby conserving the LT current; the HT generator consumes only about 2½ amps at 12 volts when running light.

The switch S2 is the main on-off switch and merely makes or breaks the LT supply from the battery.

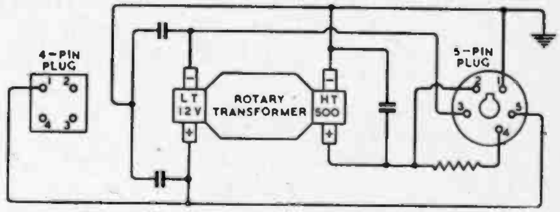
With S3 at "stand-by" and S2 "on" LT current is supplied to the valve filaments only, the two valves together consuming 0.9 ampere at 12 volts. The total consumption of the set when transmitting is about 8 amps, but this load is applied only during the actual periods when the key is down.

Interconnection between transmitter and power unit is made



Circuit diagram of the rectifier supply unit No. 14 for use where AC mains are available.

by means of two cables, one a five-way and the other a single conductor. This may appear unnecessarily complicated in an otherwise strictly austere set, but there is a very good reason for it. Whilst being normally a battery-operated transmitter this type of power supply is not the most convenient for fixed



Theoretical circuit of the battery-operated power unit type No. 18.

station operation, so that if an AC supply is available advantage can be taken of it for operating the set. All that is necessary is to replace the rotary transformer power supply unit by one incorporating a suitable transformer and rectifier.

Switches S1 and S2 still serve the same function as formerly, but they do so in a different manner. The same applies to the power supply socket. This incidentally consists of two similar sockets assembled in tandem, one facing outwards from the front panel and the other facing inwards. Interconnection is made as shown with S2 incorporated in the lead connecting the No. 3 sockets on each unit. Now when battery operation is desired the LT accumulator is connected to sockets 1 and 4, the latter being the negative. With an AC supply power is fed into sockets 2 and 3, so whichever form of supply is used S2 always breaks the circuit when "open." The AC supply unit would have a twin cable for power instead of the single conductor which suffices for the battery unit. Thus no damage will be done if the supply is changed without first fitting the appropriate power unit.

Circuit diagrams of the alternative power units are reproduced here in order that the various leads connected to the 4- and 5-pin sockets on the transmitter can be traced through to their several destinations. The power unit, whether battery or mains operated, is housed with the transmitter in a stout metal case measuring 12¼in. x 12in. x 8¼in. and weighs 30 lb. with the former, and 33 lb. with the latter, supply unit in situ. The RF power output is given as 20 watts.

As the full load consumption of the transmitter is about 90 watts at 12 volts fairly frequent recharging of the battery is necessary and in the field this is catered for by a very compact self-contained petrol-electric charging set, the hollow bedplate of which forms a fuel tank.

The receiver generally used with this transmitter is the type R109A, an eight-valve superhet with waveband switching, a built-in loudspeaker, provision for using telephones, and powered by a vibrator supply unit. AVC is not included, as the set is intended for CW reception only. Coverage is 2 to 12 Mc/s in two ranges.

OUR COVER

THE illustration on this month's cover is of the Army's Type 76 transmitter, described above, and its companion receiver R109A, photographed under battle conditions on the Western Front. It is interesting to recall that the 76 set was the Arnhem men's last link with this country.

"CLASSIFICATION OF COPPER AND COPPER ALLOYS"

THIS recent publication, issued by the Copper Development Association, 9, Bilton Road, Rugby, contains in tabular form a vast amount of information on the chemical and physical properties of the commoner copper-base materials in commercial use, including electrical conductors.

VALVE VECTORS

Relationship Between Input and Output AC Voltages and Currents and the DC Supply

By K. R. STURLEY, Ph.D., B.Sc., A.M.I.E.E.

MANY students have no clear mental picture of the vector relationship between the input and output voltages and currents of a valve. Attempts, made by various writers* to remedy this have not, in the author's opinion, proved entirely successful because they appear either to violate Ohm's law or to ignore the DC conditions in the output circuit. It is possible to represent the actual as well as the equivalent generated AC voltages and currents on the vector diagram, and this short article is offered as a solution to the impasse in which many students, and some teachers, find themselves when dealing with the problem.

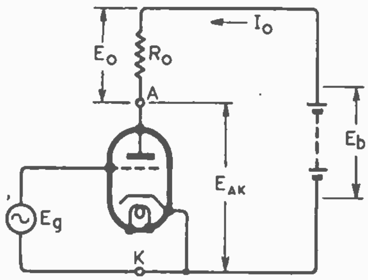


Fig. 1. Valve amplifier with resistive anode load.

The most important fact to grasp is that the grid input AC voltage and the voltage generated by the generator imagined to exist inside the valve are 180° out of phase; this is true whether the anode load is resistive or reactive. Many writers create difficulties for themselves and their readers by stating that the grid input AC voltage and the anode current are in phase with each other, whereas in actual fact the phase of the two vectors is determined by the anode output load conditions.

Let us consider the simplest valve amplifier having a resistance anode load and a grid input AC voltage E_g, as shown in Fig. 1. Assuming the valve to be represented by a constant voltage AC generator of μE_g volts and internal resistance R_a, where μ is the amplification factor of the valve and R_a its slope resistance, the equivalent AC circuit is that of Fig. 2(a). The voltage and current vectors are as shown in Fig. 2(b). The current I'_a is the AC anode current produced by the generated voltage μE_g and must not be confused with the actual AC change, I_a, superimposed upon the DC current I_o taken from the HT source, E_b, by the valve. Neither Fig. 2(a) nor Fig. 2(b) take into account the fact that the valve is actually controlling power derived from the DC voltage source, and Fig. 3 is drawn to include this feature. Arrows indicate the directions in which the voltages and currents are acting. Points A and K correspond to the anode and cathode respectively and should be considered in relation to Fig. 1. The generated AC output voltage and current vectors are unaffected by the inclusion of the DC voltage E_b and the DC anode current I_o. The actual voltage at the anode of the valve

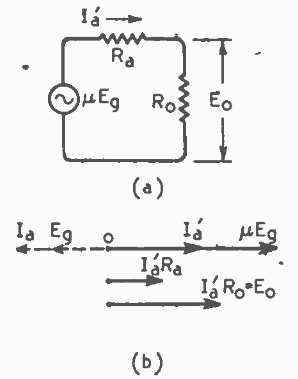


Fig. 2. (a) Equivalent circuit of Fig. 1 with the valve as a constant voltage AC generator. (b) Vector relationships of voltage and current for the equivalent circuit (a).

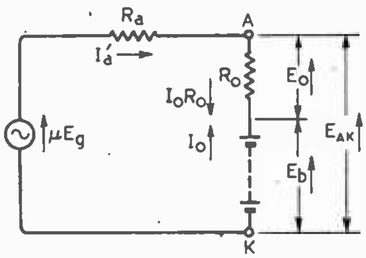


Fig. 3. Equivalent circuit for the valve amplifier of Fig. 1 including the DC voltages and currents.

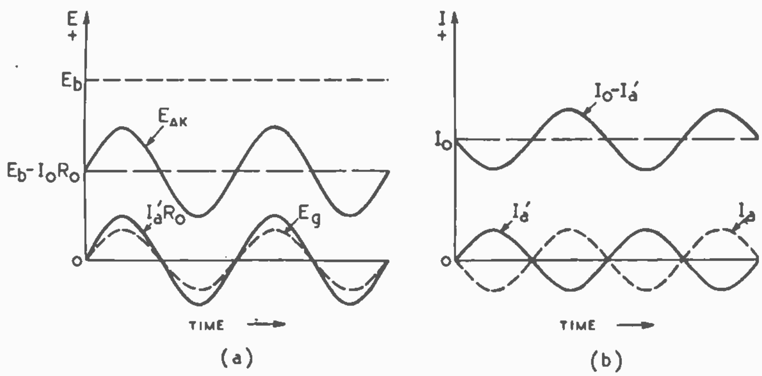


Fig. 4. (a) Voltage/time relationships; (b) current/time relationships for the valve amplifier.

* "The Phase Convention of Currents and Voltages in Valve Circuits," Editorial, *Wireless Engineer*, March 1940, p. 95. Correspondence D. A. Bell, ibid, April 1940, p. 165.

consists of the sum of the DC and AC voltage components, since the voltage E_o developed across R_o by the generated current I'_a during its positive cycle is in the same

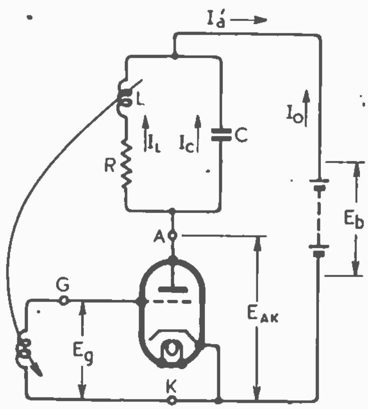


Fig. 5. Tuned anode oscillator.

direction as the DC voltage E_b. The DC anode voltage is $E_b - I_oR_o$ so that the actual anode voltage is

$$E_{AK} = (E_b - I_oR_o) + E_o = (E_b - I_oR_o) + I'_aR_o$$

The voltage time relationships are therefore as shown in Fig. 4(a)

The total current in the valve is the difference between the DC and AC currents, i.e., $I_o - I'_a$, because I'_a during its positive half cycle is in the reverse direction to I_o. The time relationship of the currents is as shown in Fig. 4(b). The actual AC current variation I_a superimposed upon the DC current I_o is therefore seen to be 180° out of phase with the generated AC current due to the voltage μE_g, and is represented by the vector I_a in phase with E_g as shown in Fig. 2(b). In this instance E_g and I_a are in phase, but this is simply because the anode load is a resistance; when it is reactive I_a will lag (inductive anode load) or lead (capacitive) upon E_g.

Two important points arise from this analysis regarding the valve as a generator of μE_g volts, (1) the generated voltage is 180° out of phase with the input voltage E_g and (2) the AC current produced in the anode load by the generated voltage μE_g is 180° out of phase with the actual AC current variation superimposed upon the DC anode current. The second point is entirely due to the fact that the valve is deriving its power from E_b. Once these points have been appreciated there need be no confusion as to the vector representation of a valve circuit.

As a second illustration let us analyse vectorially the tuned anode oscillator of Fig. 5. We shall assume ideal conditions, viz., zero grid current and Class "A" operation. Grid current complicates the vector diagram by introducing an extra vector, and the more usual Class "C" operation has no material effect on the vector positions of the fundamental frequency components. Fig. 6 gives the equivalent circuit and Fig. 7 shows the vector representation. The oscillator frequency is greater than the natural frequency of the tuned circuit so that the AC current I'_a produced by the generated voltage μE_g is capacitive and leads upon E_o

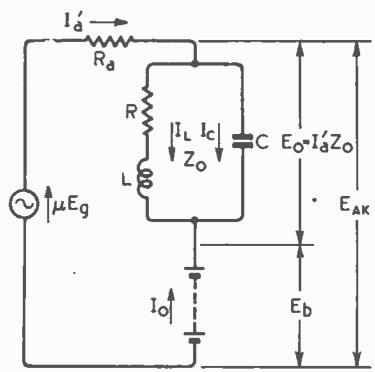


Fig. 6. Equivalent circuit of the tuned anode oscillator.

and to a less extent upon μE_g i.e., E_o lags behind μE_g. This is an essential condition if the coil L contains resistance because I_L must lag 90° behind μE_g in order that E_g, which equals $-j\omega MI_L$, may be 180° out of phase with μE_g. The vector representation of the actual AC current component superimposed on the DC anode current I_o is a vector of the same length as I'_a but 180° out of phase with it as shown by I_a. It leads upon E_g by the same angle as I'_a leads upon μE_g. The time relationships of the voltage and current waves are illustrated in Fig. 8 and we see that the voltage wave at the anode of the valve is $E_{AK} = E_b + E_o = E_b + I'_a Z_o$ if the DC resistance of the coil L is negligible. The generated AC current wave (I'_a) leads slightly upon the anode voltage thus making the actual AC current variation superimposed upon the DC feed current I_o lead by the same angle upon the 180° out-of-phase position with respect to the generated voltage μE_g.

The grid coil is wound in a direction such that the mutual

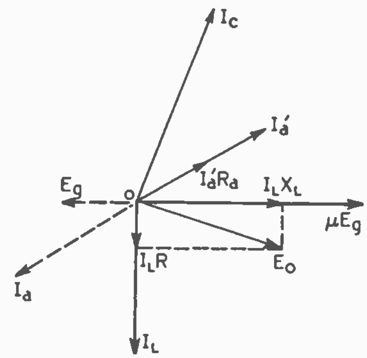


Fig. 7. Vector diagram for the tuned anode oscillator.

inductance between the anode and grid coils increases the inductance, measured across the points A to G, above a value equal to the sum of the separate inductances of the two coils. The voltage generated in the grid coil by an AC current, I_L, in the anode coil L therefore lags 90° behind the current I_L producing it, and equals $-j\omega MI_L$ where M is the value of the mutual inductance between the coils. If either the anode or grid coil is reversed the generated grid voltage becomes

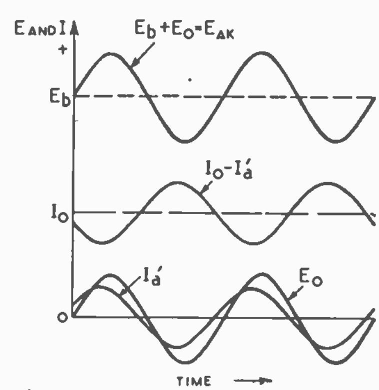


Fig. 8. Voltage and current/time relationships for the tuned anode oscillator.

$+j\omega MI_L$ and leads upon I_L by 90° thus preventing any possibility of oscillation.

U.S. FREQUENCY PROPOSALS

American and International Allocations Above 25 Mc/s

CONSIDERABLE interest has been centred around the post-war re-allocation of frequencies, which has often been stressed in these pages as an urgent necessity. It is felt, therefore, that readers will be interested to have the tabulated proposals for international and American allocations put forward by the U.S. Federal Communications Commission after lengthy discussions with Government and industry officials. It should be pointed out that the allocations for American services have yet to be agreed upon by the U.S. Government, whilst those for international use are simply proposals. So far as Great Britain is concerned, it is learned on enquiry at the General Post Office that the question of the post-war allocation of radio frequencies has been under the consideration of His Majesty's Government for some time in preparation for the resumption of international discussions. The Government is well aware of the proposals published in the United States and careful study is being given to them.

The proposals which cover that portion of the spectrum from 25 to 30,000 Mc/s, have brought forth strong comments in American circles, especially among advocates of frequency modulation. Proposals for frequencies below 25 Mc/s will be made later.

The plan introduces allocations for a number of new services, the most novel being that styled the Citizens' Radio Communications Service, which would occupy the 460-470 Mc/s band. A simplified licensing procedure is proposed by the F.C.C. for this service, in which no technical knowledge will be required, nor will the licensee be subject to an examination.

Because it has been concluded that the carrier-current system is not a practical solution for all the needs of the railways, by reason of its dependence on wires running beside the track, the 156-162 Mc/s band will be allocated to railway radio. In addition, six bands above 1,900 Mc/s are proposed for experimental use.

Provisions are also made for a new service for "highway safety."

So far as amateur allocations are concerned there seems to be general agreement. The Board of Directors of the American Radio Relay League has agreed to accept the proposals, feeling that they have received an allocation "that will well take care of our needs."

Ten bands have been allocated to amateurs. The only previously assigned band retained in this portion of the spectrum is that from 28-30 Mc/s. Instead of the four bands from 56-60, 112-116, 224-230 and 400-401 Mc/s previously allocated, provision is made for amateurs to use the following:—50-54, 144-148, 220-225, and 420-450 Mc/s. In addition they have been granted five new channels above 1000 Mc/s: These are:—1125-1225, 2500-2700, 5200-5750, 10,000-10,500, and 21,000-22,000 Mc/s.

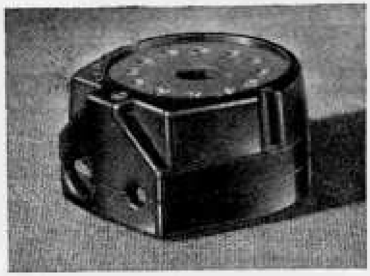
Although the Commission considers international broadcasting "a service of great significance," it has cancelled the only frequency above 25 Mc/s previously allocated for this service. It is, however, stated that it will endeavour to allocate adequate frequencies below 25 Mc/s when the lower frequencies are dealt with.

There has been some shuffling of television and FM allocations which seems to have caused considerable heartburn in the industry, especially among advocates of FM. It is understood that the re-allocation of FM frequencies has been largely influenced by propagation data supplied in secret session by the U.S. War Department. The allocation of 84-102 Mc/s in place of 40-50 Mc/s proposed by the industry is adversely criticised because of the 500,000 FM receivers said to have been purchased by the public. The F.C.C. report, however, stresses that "The cost to the public as the result of moving FM from its present band will not be great. . . . The present receivers are, of course, several years old. Even if the present FM band were retained these receivers would become partially obsolete since an expansion of the existing 42-52 Mc/s band would place a number of stations out of range."

It is contended by the advocates of this frequency change that F2 layer transmissions on 44 Mc/s created interference from a station working in the same channel over 2,000 miles away for more than 700 hours during one sunspot cycle. The F.C.C. states that "this interference would be concentrated principally during two or three years of the sunspot maximum and necessarily would be greater from stations farther apart. . . . These computations were based on ionospheric measurements at Washington, D.C."

Television services have been granted the same number of channels as previously occupied below 225 Mc/s although in different bands. The proposals allow for six channels in each of the 44-84 and 180-216 Mc/s bands. In addition, the 480-920 Mc/s band has been proposed for the development of high-definition and colour television, and the 1225-1325 Mc/s band for television relay purposes.

"CLIX" SHROUDED CR TUBE SOCKET



This component is designed to give protection for all live leads, without adding to the complication of wiring. The socket plate can be removed from the shroud for wiring and the spigot keyway can be mounted in various positions relative to the double cable grip, which permits segregation of high and low potential leads. Socket plates with 9, 10 or 12 connections are available.

F.C.C. PROPOSALS FOR FREQUENCY ALLOCATIONS

Freq. Band Mc/s	Proposed International Allocation	Proposed United States Allocation
25.015–27.305	Fixed and mobile, except aeronautical and maritime (max. power 500 w.)	Gov. and non-Gov., fixed and mobile (1)
27.305–27.335	Scientific, industrial and medical	Scientific, industrial and medical
27.335–28	Fixed and mobile, except aeronautical and maritime (max. 500w).	Gov. and non-Gov., fixed and mobile (1)
28–30	Amateur	Amateur
30–30.5	Fixed and mobile, except aeronautical	Government (2)
30.5–32	,, ,, ,,	Non-Gov., fixed & mobile
32–33	,, ,, ,,	Government
33–34	,, ,, ,,	Non-Gov., fixed & mobile
34–35	,, ,, ,,	Government
35–36	,, ,, ,,	Non-Gov., fixed & mobile
36–37	,, ,, ,,	Government
37–38	,, ,, ,,	Non-Gov., fixed & mobile
38–39	,, ,, ,,	Government
39–40	,, ,, ,,	Non-Gov., fixed & mobile
40–40.96	,, ,, ,,	Government
40.96–41	Scientific, industrial and medical	Scientific, industrial and medical
41–42	Fixed and mobile, except aeronautical	Government
42–44	,, ,, ,,	Non-Gov., fixed and mobile (3)
44–50	Broadcasting, fixed and mobile	Television
50–54	Amateur	Amateur
54–60	Broadcasting, fixed and mobile	Television, fixed and mobile
60–66	,, ,, ,,	,, ,, ,,
66–72	,, ,, ,,	,, ,, ,,
72–78	,, ,, ,,	,, ,, ,,
78–84	,, ,, ,,	Television
84–88	Broadcasting	Educational FM
88–102	,,	Commercial FM
102–108	Fixed, mobile and broadcasting	(Later allocation to FM, Non-Gov., emergency services, facsimile or television)
108–112	Air Navigation (Localisers)	Government
112–118	Air Navigation (Ranges)	,,
118–122	Aeronautical mobile (Airport Control)	Airport Control
122–132	Aeronautical mobile	Aeronautical mobile
132–144	Fixed and aeronautical mobile	Government
144–148	Amateur	Amateur
148–152	Fixed and aeronautical mobile	Government
152–156	Fixed and mobile, except aeronautical	Police
156–162	,, ,, ,,	Non-Gov., fixed and mobile (4)
162–170	Fixed and mobile	Government
170–180	Navigation aids	Navigation aids
180–186	Broadcasting, fixed and mobile	Television and Government
186–192	,, ,, ,,	,, ,, ,,
192–198	,, ,, ,,	Telev'n, fixed & mobile
198–204	,, ,, ,,	,, ,, ,,
204–210	,, ,, ,,	,, ,, ,,
210–216	,, ,, ,,	,, ,, ,,
216–220	Fixed and mobile	Government
220–225	Amateur	Amateur
225–400	Fixed and mobile	Government, 75 aeronautical channels for non-Gov.
400–420	,, ,,	Government
420–450	Air navigation and amateur	Amateur and air navigation (5)
450–460	Air navigation	Non-Gov., fixed and mobile (6)
460–470	Fixed and mobile	,, ,, ,,
470–480	Broadcasting	Facsimile
480–508	Broadcasting	Television
508–524	Air navigation aids	Television (7)

Freq. Band Mc/s	Proposed International Allocation	Proposed United States Allocation
524–920	Broadcasting	Television
920–940	Broadcasting	Exp. broadcast services
940–960	Fixed and broadcasting	Fixed and exp. b'casting
960–1125	Navigation aids	Navigation aids
1125–1225	Amateur	Amateur
1225–1325	Fixed and mobile, except aeronautical	Television relay
1325–1450	Fixed and mobile	Government
1450–1500	Air navigation aids	Air navigation aids
1500–1550	Meteorological	Meteorological
1550–1650	Aeronautical mobile	Aeronautical mobile
1650–1900	Fixed and mobile	Government
1900–2300	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
2300–2500	Air navigation	Air navigation
2500–2700	Amateur	Amateur
2700–2800	Meteorological	Meteorological
2800–3900	Navigation aids	Navigation aids
3900–4550	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
4550–5200	Fixed and mobile	Government
5200–5750	Amateur	Amateur
5750–7050	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
7050–10000	Fixed and mobile	Government
10000–10500	Amateur	Amateur
10500–13000	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
13000–16000	Fixed and mobile	Government
16000–18000	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
18000–21000	Fixed and mobile	Government
21000–22000	Amateur	Amateur
22000–26000	Fixed and mobile	Government
26000–30000	Fixed and mobile, except aeronautical	Non-Gov., fixed and mobile
Above 30000	Experimental	Experimental

(1) Distribution of channels in the 25–28 Mc/s band. Exact channels to be determined later.

22 channels.	Motion picture, relay press, relay broadcast and geophysical.
5	,,	Power and petroleum.
10	,,	General experimental.

(2) On the basis of an assumed average channel width of 40 kc/s minimum provisions will be made for the following services in the 30–42 Mc/s band :—

35 channels.		Police.
15	,,	Fire.
10	,,	Urban, transit, forestry and conservation.
10	,,	Power and petroleum.
4	,,	Special emergency
33	,,	Forestry and conservation.
9	,,	Maritime mobile, geophysical.
12	,,	General highway, mobile (exp. and marine.
8	,,	General experimental.

(3) Provisions will be made for the following services in the 42–44 Mc/s band (40 kc/s channels) :—

21 channels.		Police.
12	,,	General highway, mobile (exp.) and marine.
11	,,	General experimental.

Provisions will be made for the temporary operation of existing commercial, educational and experimental FM stations now operating between 42 and 50 Mc/s.

(4) Provisions will be made for the following services in the 156–162 Mc/s band (60 kc/s channels) :—

20 channels.		Fire.
7	,,	Forestry, marine, urban and mobile (exp).
6	,,	Special emergency.
5	,,	Power and petroleum.
4	,,	Motion picture, relay press, relay broadcast and geophysical.
33	,,	Railways (end-to-end, train-to-train, station-to-train).
5	,,	General experimental.

(5) To be used temporarily for "special" air navigation aids. Band to be exclusively "amateur" when no longer required for "special" air navigation aids; meanwhile, amateur power to be limited to 50 watts.

(6) To be used temporarily for "special" air navigation aids.

(7) To be used temporarily for air navigation aids.

UNBIASED

By

FREE GRID

Post-war Planning

A MAN who ought to know better was complaining to me the other day about the way in which the war, immediately it broke out, rendered completely useless the station names on the dial of his broadcast set. In actual fact, I think that a large part of his disgruntlement was due to the fact that his receiver had a particularly elaborate dial, complete with coloured lights and all the other red-herrings which some manufacturers used to employ in order to distract attention from the more vital parts of the set (after the manner of some females who are a bit too heavy-handed with the lipstick and rouge). In order to save a lot of unnecessary correspondence I had better say at once that I don't mean that every manufacturer and every female who does this sort of thing has nothing else in the cupboard to offer. On the contrary, some of the soundest designs I know are, in my opinion, a bit too overloaded with non-essential trimmings.

"Non-essential Trimmings."

Station names on dials are, I think, a relic of the adolescent days of the radio industry when it tried to please two classes of set user and succeeded in satisfying neither. Technical men like myself, to whom programmes are merely a form of carrier-wave modulation useful for testing purposes, were not much interested in them and would have preferred kilocycles per second or even geometrical or purely arbitrary "degrees," plus a calibration chart. The ordinary listener didn't care whether the programme originated in Timbuktoo or Wigan, so long as it was the sort of thing he wanted to listen to.

As an example of what I mean, I make bold to say that in pre-war days fully 50 per cent. of the people who listened to Luxembourg were completely ignorant of the name or geographical position of the country in which the station was situated. Only the other day, in fact, I heard a bright young thing in the train look up from her copy of the *Daily Scream* and remark to her companion that she supposed that this Luxembourg where the American troops had been fighting had been named after that "divine pre-war wireless programme."

Nowadays, of course, when B.B.C. transmitting stations have to be strictly "incog," as they have been for the past five years, people have no idea to what station they are tuned when receiving any of the B.B.C.'s programmes; nor indeed do they care any more than they care which particular generating station is providing the juice to light their house. It is the light they want, and it is all the same to them whether it comes from Battersea or Little Bugsby.

It is to be hoped, therefore, that manufacturers will not be so foolish as to try to give us station names in our post-war sets, and that the B.B.C. will not be so misguided as to encourage them by printing station names in the *Radio Times*. For the ordinary listener, dials need to be calibrated with the type of programme which will always be found on that setting, and I look forward to seeing sets with their dials labelled with such things as "Moral Uplift," "Sentimental Slush," and so on.

It will, however, be little use for manufacturers to give us this sort of dial until they have extracted a promise from the B.B.C. that any particular class of programme will always be found on the same wavelength. I don't, for instance, want to find Mrs. Mopp making an unexpected appearance on the Bach Cantata wavelength or *vice versa*.

Origins of Radar

INTERESTED as I was in the remarks concerning the origins of radiolocation made by the Editor in his March commentary, I cannot agree with the suggestion or conclusion, implicit in his musings, that the earliest record of the use of "reflected" electro-magnetic waves for the purpose of locating distant objects was the ionospheric research initiated some twenty years ago.

It is painfully obvious that the Editor is floundering in a morass of ignorance almost as abysmal in its depth as that in which certain members of the Brains Trust disported themselves recently when discussing the question of whether or not plants possessed intelligence. It was quite clear that none of them was acquainted with the researches of Sir Jagadar Bhose and other Indian savants into this very question.

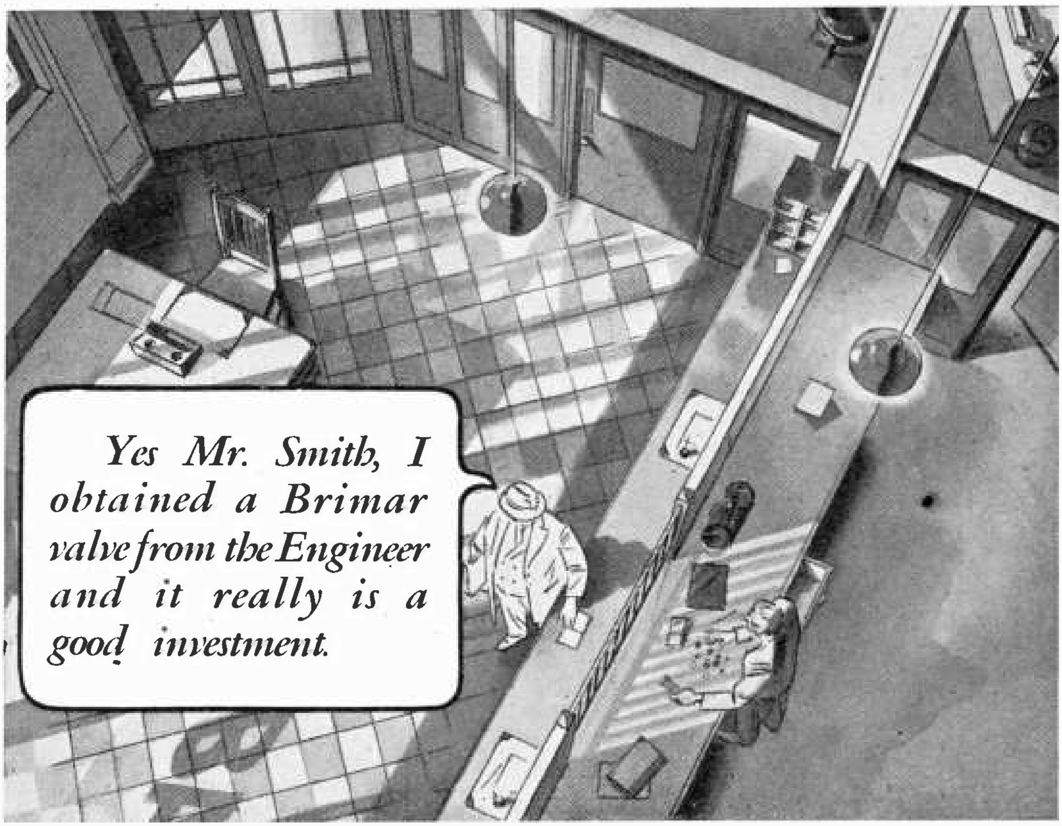
I take it that the Editor is equally ignorant of these matters, otherwise he would have been acquainted with the fact that it has been experimentally verified that certain sensitive plants have been found to possess the power of locating approaching objects and even of distinguishing friend from foe. Thus, the succulent strawberry is easily able to distinguish the approach of the friendly cat from that of the predatory *homo sapiens*. The plants are able to do this by sending out certain "etheric emanations" which are "characteristically modulated" and reflected by the approaching object. If this is not radiolocation I should like to know what is. Since it is generally agreed that plant life preceded human or, indeed, any form of animal life on the earth, it looks as though RDF is a lot older than the Editor thinks.

True Radar.

Of course, to come to more modern times, anybody like myself who habitually struggles with a box of matches to locate an errant collar stud underneath a wardrobe is employing reflected electro-magnetic waves generated by the match. If I could have daylight for my daily search I should still be employing reflected electro-magnetic waves, but it could not then be labelled true RDF as I should not be responsible for generating the waves, as in the case when I use a match. I purposely avoid using daylight as I like to be up-to-date.

Incidentally, the earliest known instance of ordinary DF in which the object to be located is actually radiating is, I believe, the seed germinating in the ground and struggling upwards towards the sun.

Angles on BRIMAR PRESTIGE



The use of the correct Brimar Valves in a radio set is as good as a guarantee of peak performance. Valves are still in short supply, but you may be fortunate to get the Brimar Valve you need.

BRIMAR

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VALVES

STANDARD TELEPHONES AND CABLES LIMITED, FOOTSCRAY, SIDCUP, KENT.

RADIO SPECTROSCOPY

What It Is, and How It Works

By THOMAS RODDAM

THE radio spectroscope seems to have made its first public appearance in 1938, but very little has been heard of it since then, and it is likely that many readers will not have seen any of the few articles describing the device. It is a remarkably interesting instrument, however, and appears to have a wide range of application; it is, moreover, an instrument which can easily be constructed by anyone who already has a communications receiver and a cathode-oscilloscope. With these two pieces of basic equipment available, a simple two-valve adaptor can be constructed which will form a basis for the study of the properties of the radio spectroscope, and I know of no field in which so much fresh ground can be explored for so little constructional effort.

Essentially, the function of the radio spectroscope is to display on the screen of a cathode-ray tube, "or other indicating means," as they say in Chancery Lane, an analysis of the radio-frequency energy reaching a receiving aerial. In simpler language, if the instrument is set up to cover, say, the medium frequency broadcasting band, you can see which stations are actually being picked up by your aerial. In addition, a rough estimate of field strength can be made, and some idea of the sort of modulation can be obtained. During the day, for example, some 5 or 6 marks show the usual B.B.C. channels; at night there is a thick forest of indications as the whole mob of European stations come in. To watch the tube through the twilight period separating day conditions from night affords a very striking picture of the change in propagation conditions which takes place; the dependence on frequency is very clearly shown. This is only one application. The amateur transmitter can monitor his own transmission and its sidebands; if he is transmitting W/T he can check that his key-clicks are not occupying an excessive bandwidth. The sideband structure of a frequency-modulated transmission can be studied, and any frequency modulation of a transmitter which is meant to be amplitude modulated can be observed. Other applications will spring to mind as soon as the instrument is in use.

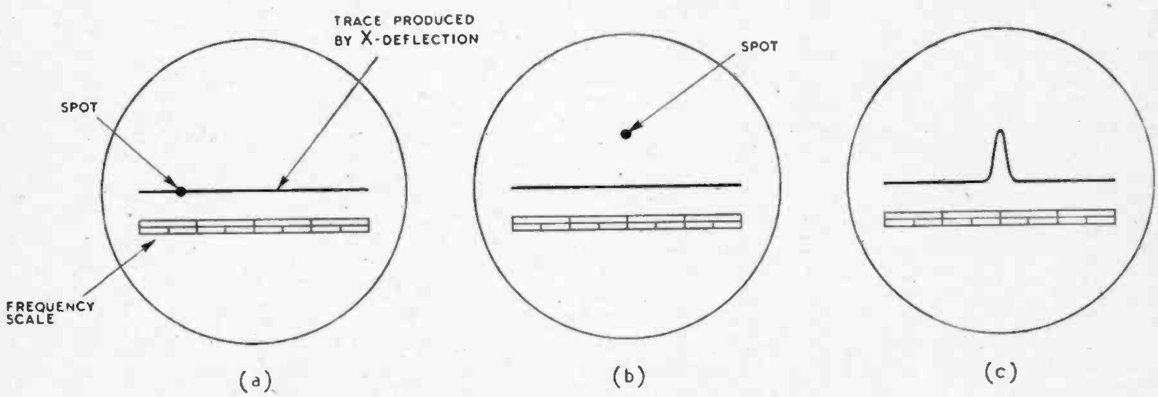


Fig. 1. Illustrating the principle of the radio spectroscope (see text).

Like a mule, the radio spectroscope has two parents of very different kinds; unlike the mule, however, it has more hope in the future. The conjunction of a normal receiver and a visual alignment generator begat the radio spectroscope. In its simplest form it is, indeed, nothing more than an ordinary receiver with frills. Imagine any one-knob receiver, with a variable resistor ganged to the tuning knob. Across this resistor is applied a convenient DC voltage—say, 200 volts. One end and the tapping point are taken to the X-plates of a cathode-ray tube. Then, as the tuning knob is turned, the voltage tapped off varies, and the X-deflection of the spot on the tube is varied in sympathy. The position of the spot is directly related to the frequency to which the receiver is tuned, and a scale can be stuck on the tube relating frequency and spot position. The receiver output is now connected to the Y-plates actually; unless the receiver uses an infinite impedance detector, it is most convenient to use the detector output, for then we shall get some output even when an unmodulated carrier is received. With this set-up, as the receiver is tuned up and down the band, the spot on the cathode-ray tube moves across in the X-direction, and whenever a station is in tune moves also in the Y-direction. In Fig. 1 (a) we see first the after-glow trace produced by the spot being swept across the tube in the X-direction only. In Fig. 1 (b) a station is in tune, and the spot has been deflected vertically by the rectified carrier; if the receiver

Radio Spectroscopy—

tuning is swept quickly to and fro, the picture of Fig. 1 (c) is obtained, persistence of vision and afterglow combining to give a trace with a bump in it at the point where the signal is being received. There is no point in turning the tuning knob by hand; the addition of a tuning motor which reverses its direction of travel at each end of the band is an obvious step. This gives the basic radio spectroscope. Let us recapitulate. An ordinary receiver is tuned up and down its

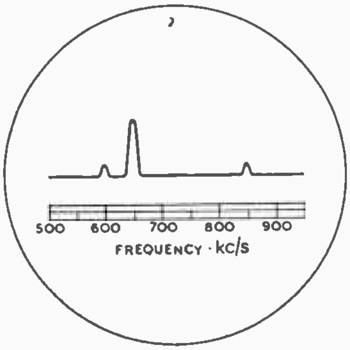


Fig. 2. Typical spectrogram of the medium-wave band showing one strong and two weak stations.

working band by a motor; the detector output from the receiver is applied to the Y-plates of a cathode-ray tube, and a voltage dependent on the position of the tuning knob is applied to the X-plates. The result is a picture on the tube like that of Fig. 2, which shows a strong station on 650 kc/s and two weak ones on 600 kc/s and 850 kc/s.

The arrangement described above is practically the Piltdown man of radio spectroscopes. A forward step is made by designing a tuning condenser system which can be continuously rotated in the same direction: this avoids the awkward speed variations and accelerating forces which the simple reversing system involves. Consequently, the rate at which the band is swept can be increased, and a motor running at 1,500 r.p.m. can be used. This gives 25 sweeps per second, and the picture is easy to watch. At this speed the potentiometer method of producing an X-shift is impossible: other means must be adopted. There are two simple solutions. If the motor is truly synchronous, that is if it runs at 1,500 r.p.m. on 50 c/s mains, a time-base locked to the mains, or even, if linearity of frequency scale is not wanted, the mains voltage itself, can be used. If the motor is an ordinary induction type with some slip, running at 1,425 to 1,450 r.p.m. on 50 c/s mains this cannot be done. An ordinary time-base circuit is used, however, and this is locked to the motor speed. One simple way of providing a locking symbol is to mount a thin strip of Mumetal (or any other ferromagnetic material) on the end of the condenser shaft, and fix near this a moving armature pickup. The arrangement is such that once every revolution the gap is almost closed by the strip: this generates a short triggering impulse which always occurs at the same angular position of the condenser shaft. A diagram illustrating the method is shown in Fig. 3. This shows the end of the condenser shaft, an edge-on view of the Mumetal strip, and the pickup coil. Obviously, either pickup system or armature must be polarised. If Mumetal strip is used, there remains a choice between a permanent magnet system, and one passing direct current through the coil. The usual basis for such a choice is an examination of the junk-box to find either an old headphone or gramophone pickup to serve as a permanent magnet system, or some old transformer stampings which can be cut up for use in a DC excited system. Convenience is the only criterion of choice.

Condenser Design

In the description above I have skated lightly over the fact that the tuning condenser is being spun continuously at 1,500 r.p.m. Obviously such a condenser must be accurately balanced. As we shall see later, it is only at VHF that we need use a rotating condenser; there is therefore no need to discuss expedients like rotating each plate of the rotor a small amount so that the total assembly is spread out over 360 deg. A simpler solution is available. Without going into too much detail, a rotating condenser for VHF can be made to be dynamically balanced by the use of composite plates. The rotor system consists of a shaft, which will be made earthy, on which is mounted a number of discs of bakelised linen. These are thick enough to be rigid. Shaped copper foil is stuck to the surface of these discs and soldered to the shaft. These foils form the actual rotor plates, but as their mass is small, they do not disturb the balance of the rotor. An insulating frame carrying stator plates and bearings completes the condenser. One interesting trick avoids the use of the bearings as current-carrying elements. A number of the rotor discs are completely covered with foil, and provide low-impedance connections to the motor shaft at radio frequency. These earthing discs are used as screens between signal frequency and oscillator sections of the condenser if a superheterodyne circuit is in use.

The derivation above of a practical radio spectroscope from its primitive ancestor has been parthenogenetic. For a more advanced form we must introduce a second parent. The visual alignment generator, or ganging oscillator, provides a starting point for a purely electronic radio spectroscope. As is well known, the ganging oscillator, which is used for lining up IF circuits on production lines, consists of an oscillator frequency modulated with a saw tooth or pyramid wave. The saw tooth or pyramid provides the X-deflection on a cathode ray tube, and the output of the circuit under test when the FM input is applied forms the Y-deflection. A trace of the frequency response of the circuit under test is thus presented on the tube, and effects of adjustment are seen

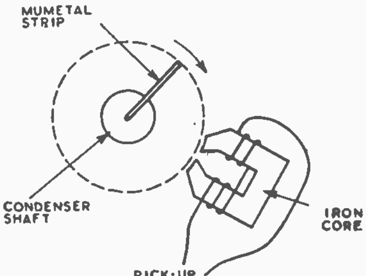


Fig. 3. Suggested synchronising pulse generator for the horizontal time base.

immediately. In practical setups, the circuit output is usually rectified and then amplified in a logarithmic amplifier so that a decibel scale of Y-deflection can be used. It will be appreciated that the ganging oscillator behaves in just the same way as the frequency-changing oscillator of the radio spectroscope described above, except that the frequency modulation is produced by the use of a reactance valve instead of by a rotating condenser. The ganging oscillator commonly swings over about 50 kc/s: this is not enough for our purpose here, and circuits providing a swing of perhaps 500 kc/s are desirable for use on the MF and HF bands. This amount of frequency modulation can be achieved at frequencies of about 10 Mc/s without much difficulty: at lower frequencies it is not easy to maintain a linear relationship between the controlling voltage and the frequency. With a wide-range ganging oscillator the system becomes quite simple.

The Complete Circuit

The circuit is shown in Fig. 4. A wide-band RF amplifier accepts signals over the whole band under examination, and amplifies them for application to the signal grid of the mixer valve. This amplifier, like the RF amplifier in a normal receiver, is only required if a really sensitive instrument is needed: in simple forms of the device a wide bandpass coupling may be used between aerial and signal grid. The voltage applied to the oscillator grid of the mixer is provided from the arrangement in the lower chain in Fig. 4. The swinging oscillator is designed to work at, say, 10 ± 0.25 Mc/s and is driven over this range by the sawtooth generator. If the signal band to be covered extends from 500 kc/s to 1 Mc/s, an IF of 10.75 Mc/s could be used. This arrangement is rather inflexible, however. By the addition of a second oscillator of frequency f_2 and mixer, any convenient frequency, $|f_2 \pm 10| \pm 0.25$ Mc/s can be applied to the signal mixer, and there is greater freedom of choice for the intermediate frequency. Furthermore, the range of the instrument can be extended, for the input filters and second oscillator can be ganged together and the band under examination can be varied without disturbing the swinging oscillator. In practice it is often convenient to use an ordinary receiver as the IF amplifier, the whole system being then a double superhet.

By combining rotating condenser systems with electronic systems a wide variety of effects can be produced. This survey of the general properties of radio spectroscopes is no place for further discussion of these circuits for special applications.

The discussion of the principles of radio spectroscopy given above is not meant to be exhaustive: all that has been attempted is an explanation of what a radio spectroscope is, and a general description of how it can be designed. There are some general points of interest which are not usually appreciated at first. Although a radio spectroscope gives more information about what is going on over the whole band than does a normal receiver, the usual law of nature that you can't get something for nothing is applicable. With an ordinary receiver you can tell that the B.B.C. Home Service is on, and that a programme called "Pansies in Portland Place" is being broadcast. The radio spectroscope will tell you that on six different carrier frequencies something is being transmitted, but it will not enable you to find out what the actual "message" part of the signal is; it may be a talk on "How to avoid dried eggs" or it may be Noel Coward; the radio spectroscope wouldn't know and, rather wisely, couldn't care less. If the transmission is slow CW morse, then it will play, and if you can read morse, the message can be read straight from the tube face. It is quite easy to see why the apparatus behaves in this way. The bandwidth of the IF amplifier is assumed to be the normal value for a receiver. This is barely enough to cope with the intelligence radiated on one carrier. If we put in a number of carriers, we must expect less intelligence about any one of them.

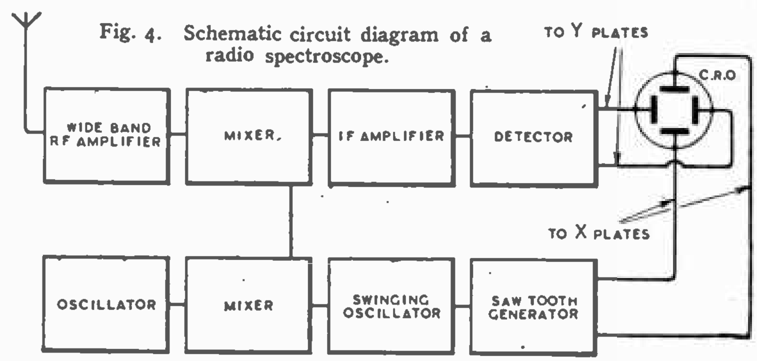


Fig. 4. Schematic circuit diagram of a radio spectroscope.

Sweep Rate

The limitation described above has other aspects. Those who have attempted to line up a filter with a very sharp cut-off, a crystal filter, for example, on a ganging oscillator circuit, will know that as the sweep rate is increased curious things happen, and the true filter response is not obtained. In the same way, if the sweep rate of a radio spectroscope is made too high, or the IF bandwidth too narrow, the marks produced by stations begin to broaden out. It is very easy to observe this effect when a communications receiver is used as the IF amplifier in an electronic spectroscope, as both sweep rate and bandwidth can be varied. The solution of the problem of the response of a filter to a frequency-modulated wave sweeping through the pass band is astonishingly difficult. Fortunately a good approximation to the answer can be obtained by quite simple reasoning. Two approaches are possible. Either we may say that the signal must be in tune for long enough for oscillations to build up in filter circuits of known Q, or we can adopt a more analytic approach.

Suppose that we are sweeping over a band of width n c/s, p times every second. The IF bandwidth is taken to be m c/s. If the IF amplifier and filter system is considered as split up into two halves, we can see more clearly what happens when we sweep through a station. The first stages of the IF amplifier, having a bandwidth of m_1 c/s, will be swept through in m_1/np

Radio Spectroscopy—

seconds. For this length of time, then, a signal is applied usefully to the input of the first IF amplifier, and an impulse of this duration appears at the output. Experience with television amplifiers suggests that a signal lasting for t seconds requires an IF bandwidth of $3/t$ c/s, or a vision frequency cut-off of $3/2t$ c/s if the distortion is not to be excessive. If this experience is applied to the design of the second IF amplifier, we can see that the bandwidth of this amplifier, m_2 c/s, must be such that a signal lasting for m_1/np seconds is transmitted with little distortion. The required bandwidth is $3np/m_1$ c/s, which must therefore equal m_2. This leads to the equation $m_1 m_2 = 3np$, or, if $m_1 = m_2 = m$, $m^2 = 3np$. The artificial separation into two IF amplifiers is only necessary in order to give the separation of function. We could have said in the first place something like this: when the carrier is swept through the IF amplifier, an impulse appears at the output, and this impulse lasts for m/np seconds. If the rectified shape of this impulse is good and square, anyone looking at it, without knowing how it was produced, will think that it was an ordinary impulse of duration m/np which has passed through an IF amplifier of bandwidth $3np/m$ c/s. We know, however, that the bandwidth was actually m c/s, and as the two views must be reconciled, we must have $3np/m = m$. The reasoning adopted here is not rigorous, for it overlooks the frequency modulated character of the actual signal in the IF amplifier. It does, however, give a fairly good approximation.

50 c/s Satisfactory

If the bandwidth is m c/s, we can just about resolve stations spaced m c/s apart, provided that the impulse is not artificially broadened by sweeping too fast. The conditions discussed above give satisfactory results, and if we wish to sweep a band n c/s wide and use an IF bandwidth of m c/s, we must have $p = m^2/3n$ sweeps per second.

In the MF band we can take $n = 500$ kc/s (from 1 Mc/s—300 metres to 500 kc/s—600 metres), and $m = 10$ kc/s. This gives $p = 67$ c/s. To provide a small safety margin a 50 c/s time-base would be used. Experiments show that this rough formula gives quite good agreement with practice.

RADIO IN GREECE

FROM the publishers of the Greek journal *Radio-Television* we have received the following brief summary of the radio situation.

In October, 1940, at the outbreak of war in Greece, there were only about 70,000 broadcast receivers in the country for a total population of 7,000,000. When the country was invaded the Germans seized all sets in the provinces. In the Athens-Piræus areas comparatively few sets were seized, but the remainder were sealed in such a way that only the Athens broadcasting station could be received.

Apart from the fact that most of these sets are sadly in need of repair, there is a great demánd for receivers, which must be imported.

The 15-kW Athens station, damaged by the retreating Germans, was almost completely restored within a month, and steps are now being taken to increase its power to 70 kW.

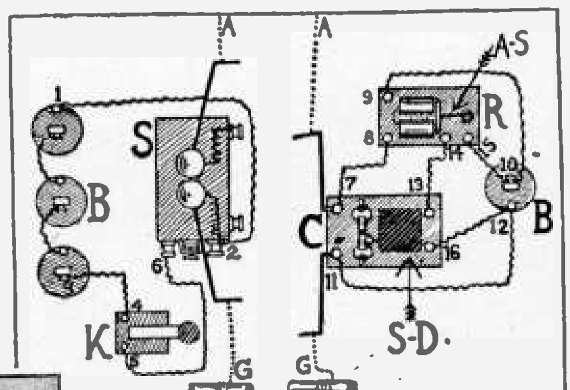
In addition to the demand for broadcast receivers, the younger generation of Greeks is taking a keen interest in technical radio matters; this interest is focused on British methods and ideas. Bearing these facts in mind, the Greek market should offer opportunities to the British radio industry.

Further information can be obtained from Radio-Karayanni (Radio Publications), Karitsi Sq., Athens, Greece.

AMATEUR RADIO : 1905 MODEL

A REPLICA of a wireless transmitter and receiver sold for home use forty years ago was recently demonstrated in operation in New York by Hugo Gernsback, publisher of our American contemporary *Radio-craft*. As spark transmission is now forbidden, a special dispensation from the Federal Communications Commission was necessary for the occasion. In the authorisation, frequency is given rather vaguely as "above 30 Mc/s." Ultra-short waves are not so new!

The outfit, shown in the accompanying illustration, was sold at $7.50. The transmitter, which comprised a 1in. induction coil, spark gap, morse key and aerial, was powered by three dry cells. The corresponding receiver employed a coherer, de-coherer, relay and a single dry cell. Signals were read from the buzzing of the de-coherer.



In the accompanying diagram, taken from the Electro Importing Company's catalogue of 1905, the reference letters have the following significance: A, aerial; G, ground; S, induction coil; B, batteries; K. morse key; R, relay; AS, adjusting spring for relay armature; SD, de-coherer; C, coherer; 8 and 9, relay magnet terminals; 7 and 11, coherer terminals; 13 and 16, de-coherer terminals; 14 and 15, relay contact terminals.

Letters to the Editor

Specialised Broadcast Receivers • Frequency-Changer Calculations • Hearing Aids

Sets for Export

I HAVE just received my December *Wireless World*, and hasten to support R. W. Hallows' and "Dialist's" views on post-war broadcast receivers. I hope that their timely advice will not fall on deaf ears; also that the industry will pay greater attention to the export market.

Need I say that British radio manufacturers blundered before the war, and that India was virtually a lost market to them? Have they found out their mistakes? Here are some of them:—

1. Non-standardised usage of valves.
2. Ugly cabinets without "eye appeal."
3. Non-tropic-proof components.

Indian servicemen are not highly trained, and they like and recommend American sets for their simple and standardised arrangement of valves.

India is a poor country, and cheap receivers will be welcomed. But high-quality sets will be needed as well.

H. K. L. ARORA.
New Delhi, India.

Pubradio

FROM time to time, in order to study the advance in the science of chemistry and the degradation of my fellow man, I visit one of the establishments where alcohol in a diluted form is purveyed for immediate consumption. In these places, often termed, by their habitués, "public houses," there is sometimes a broadcast receiver. The manufacturers of these devices, while no doubt aware of the civilising mission they can perform, have, in my view, omitted certain considerations from their design. These, sir, I crave your hospitality to make known.

First I would urge that the serviceability of these machines should be increased. They have a very hard life in a warm atmosphere. Many hands assault their controls with that lack of care which is common when handling another's possession. Yet the sets are usually only the ordinary domestic model. Small wonder that the accelerated life-test in these places causes frequent breakdowns. The effect of these breakdowns is to suggest to the regular habitué that the particular set is not very good, and that when he buys a new set to comfort his deserted wife he should avoid a "————." It would, I think, be wise if a special "pub" model were introduced. The controls should be really robust, so that they would not fail under the strenuous conditions of public life.

If the idea of such a receiver is accepted, there is an extension worth considering. In the places where people congregate there are, on crowded nights, two problems. The broadcast programme interferes with conversation, and conversation interferes with the broadcast programme. It would be useful to have a two-position tone control. In one position a harsh strident tone would force everyone to listen to the news summary. In the other, the elimination of all high notes would produce a gentle booming background. A considerable amount of volume compression could usefully be included to maintain a constant level. Refinements and extensions of this are possible, but the basic idea is that it should be accepted that realism is not needed, nor even desirable in such circumstances. The quality should be modified to suit the environment.

Here is a new and interesting problem for the student of quality. How rarely are his studies carried out in so congenial an atmosphere! T. BUVANT.

"Sandwich" Training

WITH reference to suggestions recently made in *Wireless World* on the alternation of technical study with periods of practical work in industry it may be possible to learn something from current practice in Canada. In the Dominion it has long been possible for civil engineering students to take their courses from October 1st to April 30th, when outdoor construction work is stopped by the severity of the winter. During the rest of the year construction goes ahead at full blast, and students stand a good chance of obtaining a paid job.

In good times many students do this, and earn enough in the summer to pay for the following winter's tuition fees and board. The other faculties—Electrical, Mechanical and Chemical—have followed suit, so far as timing goes.

This plan is admittedly brought about by the climatic conditions prevailing in Canada, but it seems to have had three important results. First, it marries up theory and practice, and it is preferable for a student to alternate his studies and work every six months rather than, say, every few years. Secondly, it enables students to pay their way through university, thus putting the recruitment of engineers on a much broader basis than if the students were forced to rely on their parents' finances. Lastly the university authorities are enabled to insist that the student does practical engineering before he is granted a degree.

L. A. SHERWOOD.
London, S.W.1.

Oscillator Circuit Calculations

I HAVE been very interested in some of the articles giving methods of calculating the values of padding condensers and oscillator circuit inductances which have, during the past few years, been published both in *Wireless World* and *Wireless Engineer*. They all have the disadvantage that they cannot easily be evaluated on a slide-rule, and I feel that some readers may be interested in two simple empirical formulæ which give results accurate

Letters to the Editor—

to within 10 per cent. Some may feel that a 10 per cent. error is somewhat large, but I should like to point out that, even if accurate calculations are made, it will in practice be necessary to adjust the values during the lining-up of the receiver. Further, condensers and inductances cannot easily be obtained having tolerances of the order of 1 per cent.

The formulæ referred to are:—

$$\frac{C_p}{C_1} = \frac{\alpha^2}{A^2 - \alpha^2} \quad \ldots \quad \ldots \quad (1)$$

$$\frac{L_o}{L_s} = \left(\frac{f_1}{f_1 + IF}\right)^2 \left(\frac{C_1}{C_p} + 1\right) \quad (2)$$

where C_1 is maximum capacity of tuning condenser.
C_p is padding condenser.
α is oscillator frequency ratio over entire tuning range.
A is signal frequency ratio over entire tuning range.
L_o is oscillator inductance.
L_s is signal circuit inductance.
f_1 is lowest frequency of band.
IF is intermediate frequency.

The value of the oscillator trimming condenser is not given by these formulæ as they are based on the assumption that its value is equal to that of the signal frequency circuits. This is no great disadvantage as it must always be adjusted on a signal. On the assumption quoted, the formula obtained for C_p is $\frac{C_p}{C_1} = \frac{\alpha^2 - 1}{A^2 - \alpha^2}$ The omission of the constant gives more accurate results, particularly on the lower frequency bands, and is therefore recommended.

H. P. STAUNTON.
Ashford, Kent.

Hearing Aids

RECENTLY questions have been asked in the House of Lords about hearing aids in general and plans for the manufacture of a utility aid in particular.* These questions and subsequent reports and correspondence in the Press have given many people interested in the subject a wrong impression of the situation as a whole, especially where the different committees and their functions are concerned. May I, therefore, be allowed to give your readers a few facts?

* See opposite page.

The following technical committees are in existence: 1. National Institute for the Deaf Medical Committee (Protection of the deaf public against inefficient aids, and unethical suppliers). 2. Medical Research Council—Electro-acoustics Research Committee (fundamental research into electro-acoustic problems). 3. British Standards Institution Committee (calibration and standardisation of audiometers). (This is quiescent at the moment.) 4. The Hearing Aid Manufacturers' Association—Technical Committee (this is in three sections: (a) Utility aid and general standardisation; (b) audiometers and hearing tests (c) technical education for the staff).

The President of the H.A.M.A. attends meetings of the N.I.D. Medical Committee. The Secretary of the N.I.D. attends most meetings of the H.A.M.A. The latter is now represented on the B.S.I. Committee. There is as yet no official contact between the M.R.C. Committee and the H.A.M.A. Technical Committee. The former Committee, however, is fully informed of the work of the latter, and closer co-operation may result.

In these days of fear of trade associations becoming cartels, it is desirable to explain about membership of the H.A.M.A. This is open to all hearing aid suppliers on the N.I.D. approved list. Any hearing aid supplier whose instruments meet with the approval of the N.I.D. Medical Committee, and who agrees to give home trials of at least one week before selling an instrument, to avoid door-to-door touting and other undignified practices, is put on the N.I.D. approved list. It is a great pity that the general Press has not given more publicity to the work of the N.I.D., for many deaf people are quite unaware of the existence of the approved list and of its significance.

From 1934 to the outbreak of the war, the hearing aid manufacturers here, with the help of British valve makers, led the world in the design and production of pocket valve amplifiers. British valve aids were exported to most foreign countries, including the U.S.A. They were much smaller and more efficient than anything available elsewhere.

Since the war, members of our Association have had a tremendous struggle to keep their instruments in operation, and to supply the users with adequate battery and other replacements. With the help of the Board of Trade we have managed reasonably well, and produced sufficient new instruments to make importation of valve aids unnecessary. Encouraged by the N.I.D. we produced the specification of a "pooled" utility three-valve pocket aid, which we were hoping to produce during the war to sell at a price around £10. We were unable, however, to obtain supplies of valves, components and batteries over and above our existing very small allocation, to make the manufacture of these utility aids possible. The situation remains unchanged.

The number of valve aids in use in Great Britain is now definitely known to be under 50,000. The total figure of deaf people who could be helped by a valve aid is undoubtedly higher, but it includes many who obstinately refuse to wear an aid. It is certain that among these potential users there are very few indeed who remain deaf because they cannot afford an aid. Before the war our members supplied robust and reliable valve aids from 8 gns. upwards. They used standard batteries and the upkeep amounted to only sixpence a week. Hospital clinics help patients to obtain aids at substantially reduced prices, and many societies give grants towards purchase.

Deafened ex-Service men are given aids free of charge by the Ministry of Pensions, with whom a number of our members have contracts. Happily, this business is negligible. The number of men recommended for hearing aids last year was officially given as 60.

ALEXANDER POLIAKOFF,
Chairman, Technical Committee,
H.A.M.A.
223-7, St. John Street,
London, E.C.1.

ELECTRICAL INSTALLATIONS

THE "B.I. Pocket Book for Wiremen" (M.111/1), issued by British Insulated Cables, Ltd., Prescot, Lancs, gives useful information for electrical contractors on the rating of conductors, fuses and motors, extracts from the I.E.E. recommendations and notes on the testing of installations.

WORLD OF WIRELESS

RADAR PATENTS

ESTIMATING that for several years after the war there will be sales of radar equipment amounting to $75,000,000 a year, the Director of the Electronics Division of the U.S. Navy has advocated the setting up of a radar patent pool.

When addressing a joint meeting of the American Institute of Electrical Engineers and Institute of Radio Engineers, the Director stated that there is very little information available about the number and scope of radar patent applications filed. He stressed the need for the industry to take such steps as were necessary to avoid clashes when the U.S. Patent Office released the estimated 2,000-3,000 radar specifications from the secrets list.

The proposal is for a non-profit corporation to be formed for licensing pooled radar patents.

EMPIRE BROADCASTING

CONCURRENTLY with the Commonwealth Broadcasting Conference attended by representatives of the broadcasting organisations of the Dominions and India, a Technical Sub-Committee met to discuss the engineering and scientific aspects of commonwealth broadcasting.

Although details of the findings of the Committee are not available it is learned from a statement issued by the Chairman of the Conference, W. J. Haley, B.B.C. Director-General, that "the Technical Sub-Committee has done valuable work in studying problems of improving coverage and transmission, particularly on short wavelengths; sound recording and reproduction; the collection, dissemination, and practical use of ionosphere data; studio acoustics and frequency modulated transmission."

SECRET PACIFIC RADIO

THE George Medal has been awarded to two officers, who in 1942, on the Pacific Island of Tarawa, held by the Japs, succeeded in getting information of the enemy's movements back to Allied Naval authorities, when the main transmitting station had been put out of action.

2nd Lt. R. G. Morgan, an Australian, who was in charge of a training school for native wireless operators, concealed a portable transmitter and, in spite of Japanese threats, relayed information sent to him by a system of runners by Capt. F. G. L. Holland, 60-year-old Director of Education, Gilbert Islands. Lt. Morgan, who voluntarily remained on the island, after arranging the escape of most of the civilians, was notified of the award by radio. He was later killed by the Japanese with 21 European prisoners.

STANDARD FREQUENCIES

THE transmissions from the U.S. National Bureau of Standards' radio station, WWV, near Washington, D.C., have been extended to include a continuous radiation on 15 Mc/s throughout the 24 hours.

Standard audio frequencies of 440 c/s and 4,000 c/s are now broadcast continuously on this carrier.

Details of the transmissions on 2.5, 5 and 10 Mc/s, which remain unaltered, were given in the September, 1944, *Wireless World.*

OLIVER LODGE SCHOLARSHIP

A RESEARCH scholarship, which is to be known as the "Oliver Lodge Scholarship," has been founded by the Institution of Electrical Engineers to commemorate the 25th Jubilee of the Radio Section.

The scholarship will have a basic annual value of £250 and will be tenable for one year. The scholar will have to carry out research in a subject closely allied to radio engineering.

Further particulars and nomination forms are obtainable from the Secretary, I.E.E., Savoy Place, London, W.C.2. Nominations must be received by May 15th.

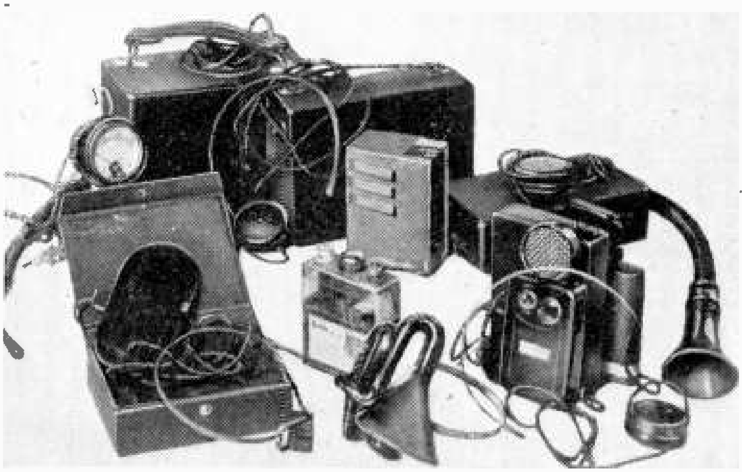
WHAT THEY SAY

SPOKEN WORD *versus* LAZY MAN. Broadcasting has one great advantage over other methods of distributing information: it can push things at people in such a way as to overcome the barrier of inherent human laziness.—*Lord Vansittart, speaking at the Radio Industries Club on "Radio's Part in Keeping the Peace."*

APPLIED SCIENCE.—In this country, the advance and efficient application of science requires democratic planning largely by scientists themselves. For this we propose a Central Research and Development Council, under the authority of the Lord President of the Council.—*Clause from the resolution drafted during the recent conference on "Science in Peace" organised by the Association of Scientific Workers.*

HEARING AIDS

HAVING asked in the House of Lords what progress had been made by the Medical Research Council towards the supply of standard national acoustic aids for deafened ex-Servicemen, the Duke of Montrose, President of the National Institute for the Deaf, moved that provision should be made in all large cities for setting up approved otological clinics as part of any national social rehabilitation scheme for ex-Servicemen. He said that after the last war 34,000 men were discharged because



ELECTRONIC AND ACOUSTIC hearing aids of varying types are available, and have been supplied to British prisoners of war through the Red Cross and St. John War Organisation. Literature on the choice of a hearing aid has also been supplied to P.o.Ws.

World of Wireless—

of deafness, but after this war the country ought to be ready to train and treat at least 200,000 deaf cases.

There were, he said, about 20 kinds of aid for the deaf, but their prices were exorbitant. He had an offer from one firm to make 10,000 sets at £10 each, but he was sure a national standard set could be provided by mass production at £5, and distributed on a national basis.

PERSONALITIES

Leslie McMichael has been elected an honorary member of the Radio Society of Great Britain. He was a co-founder of the Society and was, at one period, Hon. Secretary.

O. S. PUCKLE, M.I.E.E., who has left Cossor's Research Dept., which he joined in 1932, to become Chief Engineer and a director of R. F. Equipment Ltd., of Amersham, Bucks. He has worked on radiolocation practically from its inception and has collaborated with L. H. Bedford in work on the velocity modulation television system. He is probably best known for his work on time bases.

Dr. E. F. W. Alexanderson was recently awarded the Edison Medal for 1944 "for outstanding inventions and developments in the radio, transportation, marine and power fields." He has also recently received the award of the Swedish Cedergren Gold Medal. Dr. Alexanderson, who is now Consulting Engineer with the G.E.C. at Schenectady, built the original HF alternator for Prof. R. A. Fessenden, which resulted in the first broadcast of radio telephony on Christmas Eve, 1906.

G. L. Marshall, Northern Ireland Director of the B.B.C., has just completed 21 years' service with the Corporation. He has been in Belfast 13 years, during which time the new headquarters in Belfast and the transmitting station at Lisnagarvey have been erected.

Dr. F. E. Terman, well-known author of "Radio Engineering," has been appointed Dean of the Stanford University School of Engineering, Palo Alto, California. He is at present head of the U.S. Government Radio Research Laboratory at Cambridge, Mass.

R. J. F. Boyer has been appointed Chairman of the Australian Broadcasting Commission in succession to J. W. Cleary.

W. S. Verrells has resigned from his position as Chairman and Joint Managing Director of E. K. Cole, Ltd. With a capital of only £50, he and E. K. Cole formed the Company in 1925 to manufacture mains power units. E. K. Cole continues as managing director.

A. G. Allen, D.S.O., M.C., a director, has been appointed Chairman of E. K. Cole, Ltd. He was Chairman, for a year, of the Associated British Pictures Corporation.

OBITUARY

It is with regret we record the following death:—

Percy W. Paget, the last survivor of the group of pioneers associated with the first transatlantic wireless transmission in December, 1901, who died at the age of 72. He joined the Marconi Company in 1898, a year after its incorporation, and went to Newfoundland in 1901 with Marconi and G. S. Kemp to set up a receiving station for the experiments which proved the practicability of transatlantic wireless communication. Mr. Paget retired from the Marconi Company in 1938 after 40 years' service.

IN BRIEF

N. Rhodesian Radio.—A new broadcasting station was opened on March 25th at Lusaka, Northern Rhodesia. It operates daily from 5.30 to 8 p.m. on a wavelength of 76 metres. Technical and experimental work is being carried out and will be expanded when the delivery of transmitters ordered from this country is completed. One transmitter arrived in a badly damaged condition, and another is in transit.

Sudan Broadcasting.—To overcome poor reception in the Khartoum area it is planned to install a new short-wave 5-kW transmitter. A 20-kW medium-wave transmitter to cover the middle area of the Sudan is included in later plans.

R.C.A. has established a new international division and plans to build manufacturing plants in several countries.

Wavemeters.—A limited number of Type 605A absorption wavemeters can now be supplied from stock by Rediffusion, Ltd., Broomhill Road, London, S.W.18. Eight interchangeable coils give a wide range of 7 to 3,000 metres.

Four Officials from the Canadian Marconi Company and Cable and Wireless have come to this country to discuss with C. and W. Head Office the development of means of communication, especially Press traffic, between Britain and Canada.

Sign of the Times.—175 students, all technical employees of Columbia Broadcasting System, have commenced a 60-week training course in the operation of television studio and transmitter equipment. The course, which has been developed jointly by representatives of New York University, the Columbia network and the International Brotherhood of Electrical Workers, is in three parts, as follows:—(I) "Electrical Circuit Theory for Television," (II) "Vacuum Tube and Communications Network Theory," (III) "Television Theory and Practice."

School Broadcasting.—Among the provisions made by the Minister of Education under the 1944 Education Act, which came into operation on April 1st, is the equipment of all schools for broadcast reception.

Leicester Radio Society has been successfully restarted and the following meetings are planned:—On May 1st, a talk on "Output Valves, Curves and Load Lines" by J. C. Easther will be followed by a discussion. "Resistance/Capacity Oscillators" is the subject of a lecture to be given on May 15th by S. May. Both meetings will commence at 7.15 at the Charles Street United Baptist Chapel (side entrance), Leicester.

MEETINGS

Institution of Electrical Engineers

Radio Section.—"Notes on the Stabilities of LC Oscillators," by N. Lea, B.Sc., May 2nd.

"The Characteristics of Luminescent Materials for Cathode-Ray Tubes," discussion to be opened by C. G. A. Hill, B.Sc., May 15th.

"Non-Ferrous Contact Springs," discussion to be opened by H. G. Taylor, D.Sc.(Eng.), and L. B. Hunt, Ph.D., M.Sc. May 22nd.

All the above meetings will be held at 5.30 at the I.E.E., Savoy Place, Victoria Embankment, London, W.C.2.

Cambridge Radio Group.—"Carrier Protection on Overhead Transmission

ALFRED CLARK, Chairman of E.M.I., who has been elected first President of the Radio Industry Council. This photograph is of part of a painting by Professor Artur Pan recently presented to Mr. Clark by his co-directors. He began his career in Edison's Laboratories fifty years ago and was responsible for the building of H.M.V.

Lines," by D. H. Towns, B.Sc., at 6.0 at the Technical School, Collier Road, Cambridge, May 8th.

South Midland Radio Group.—" High Frequency Dielectric Materials," by Prof. Willis Jackson, D.Sc., D.Phil., at 6.0 at the James Watt Institute, Great Charles Street, Birmingham, April 30th.

London Students' Section.—" Education and Training for Engineers " and " Part-Time Further Education," discussion on these reports (prepared by Post-War Planning Committee) at 7.0 at the I.E.E., Savoy Place, London, W.C.2, on May 1st.

Television Society

" Beam Tetrodes," by S. Rodda, B.Sc., at 6.0 at the I.E.E., London, W.C.2, April 27th.

Inst. of Musical Instrument Technology

Electronic Music Group.—" A Homophonic or Single-Note Electronic Musical Instrument with a Photo Electric Cell as Playing Manual," demonstration and lecture by Dr. W. Saraga, at 3.0 at the Northern Polytechnic, Holloway, London, N.7, on May 12th.

Royal Society of Arts

" Wire Broadcasting," by Paul Adorjan, at 1.45 at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, on May 23rd.

NEWS IN ENGLISH FROM ABROAD

Country : Station	Mc/s	Metres	Daily Bulletins (BDST)
America			
WOOW (Wayne) ..	7.820	38.36	0000
WRUW (Boston) ..	9.570	31.34	2300
WLWO (Cincinnati)	9.590	31.28	2300
WLWR1 (Cincinnati)	9.750	30.77	0000, 1600*, 1730, 2300
WNRA (New York) ..	9.855	30.43	0000
WLWK (Cincinnati)..	11.710	25.62	1600*, 1730, 2300
WRUW (Boston) ..	11.730	25.57	1730, 2300
WRUS (Boston) ..	11.790	25.44	1600
WCRC (Brentwood) ..	11.830	25.36	1545, 1600*, 2300
WGEA (Schenectady)	11.847	25.32	1500, 1730
WOOW (Wayne) ..	11.870	25.27	0000, 1600*, 1730, 2300
WNRI (New York) ..	13.050	22.99	1500, 1730, 2300
WNRX (New York)..	14.560	20.60	1500, 1730
WNBI (New York) ..	15.150	19.80	1500
WOOC (Wayne) ..	15.190	19.75	1600*, 1730, 2300
WBOS (Boston) ..	15.210	19.72	1500
WLWO (Cincinnati) ..	15.250	19.67	1600*, 1730
WCBX (Brentwood)..	15.270	19.65	1545, 1600*, 1730
WGEO (Schenectady)	15.330	19.57	1730, 2300
WRUA (Boston) ..	15.350	19.54	1415, 1545, 1600*
WLWL1 (Cincinnati)	17.955	16.70	1500
WRUW (Boston) ..	17.750	16.90	1730
WRCA (New York) ..	17.780	16.87	1500, 1730
WCBN (Brentwood)..	17.830	16.83	1545, 1600*, 1730
WNRA (New York) ..	18.160	16.52	1500, 1730
Australia			
VLG (Melbourne) ..	9.580	31.32	1635
VLC6 (Shepperton) ..	9.610	31.22	1600, 1635, 1700
VLC2 (Shepperton) ..	9.680	30.99	1815
VLG3 (Melbourne) ..	11.710	25.62	1700
VLG5 (Melbourne) ..	11.880	25.25	1815
Belgian Congo			
Leopoldville	15.167	19.78	1300
Brazil			
PRL8 (Rio de Janeiro)	11.715	25.61	2130†
Canada			
CHTA (Sackville) ..	15.220	19.71	1345, 1545*, 1745, 1945
China			
XGOY (Chungking) ..	9.635	31.14	1500, 1600, 1700
Ecuador			
HCJB (Quito) ..	12.455	24.09	0100, 2130
Egypt			
Cairo	7.510	39.94	1945, 2200
Forces Broadcasting Service	7.22	41.55	1030, 1330, 1930, 2200
French Equatorial Africa			
FZI (Brazzaville) ..	11.970	25.06	2045, 2245
India			
Delhi	6.190	48.47	0900, 1650
	7.240	41.44	1650
	7.290	41.15	0900, 1400, 1650
India (contd.)	9.630	31.15	1400, 1650
	11.760	25.51	0900
	11.830	25.36	0900
Iran			
EQB (Teheran) ..	6.155	48.74	2325
Mozambique			
CR7BE (Lourenco Marques)	9.830	30.52	2150
Newfoundland			
VONH (St. John's) ..	5.970	50.25	2415
Palestine			
Jerusalem	11.750	25.53	1715
Portugal			
CSW6 (Lisbon) ..	11.040	27.17	2100
Spain			
EAQ (Aranjuez) ..	9.860	30.43	2150†
Sweden			
SBU (Motala) ..	9.535	31.46	2320
SBP	11.705	25.63	1800
Switzerland			
HER3 (Schwarzenburg)	6.345	47.28	2150
HER4	11.775	25.48	2150
Berne	10.340	29.00	0300, 2150
Syria			
FXE (Beirut) ..	8.035	37.34	1735
Turkey			
TAP (Ankara) ..	9.465	31.70	1845
U.S.S.R.			
Moscow	6.230	48.15	0115, 1900, 2000, 2100, 2300
	6.770	44.30	0047, 0115
	6.980	42.98	0115
	7.300	41.10	0000, 0047, 0115, 0200, 0300, 1900, 2000 2100, 2200, 2300
	9.480	31.65	0200, 0300
	10.445	28.72	0830, 1340
	11.634	25.79	1340
	11.830	25.36	0115, 1300, 1340, 1420, 1800
	11.950	25.11	0115, 0200, 0300
	12.260	24.47	1320†, 1700
	15.530	19.32	0115, 1300, 1340, 1420
Vatican City			
HVJ	6.190	48.47	2115
	9.550	31.41	2115
	kc/s	**Metres**	
Athlone	565	531	1440, 1945, 2300*, 2310†

It should be noted that the times are BDST—**two hours** ahead of GMT. * Sundays only. † Sundays excepted.

COLOUR TELEVISION

Discussion on Ways and Means

IN opening an informal discussion on colour television before the Radio Section of the I.E.E., L. C. Jesty introduced the subject by saying that it seemed inevitable that a colour television service would ultimately be established. Development should be directed towards (a) the agreement of the technical methods to be employed, particularly with regard to the colour analysis and synthesis of the picture, and (b) the standard of definition to be achieved before colour is introduced.

With regard to (a), the literature shows that the methods proposed for colour television have followed logically the same steps as already trodden in colour photography and cinematography, but have not yet reached an equivalent of the elegant solution to the photographic problem known as the "subtractive integral tri-pack" technique. Television, however, being electronic and therefore practically inertialess and instantaneous, enables the older "additive" principles to be used more advantageously than in cinematography.

All the demonstrations of colour television so far given, by Baird in this country, and Bell Telephone and C.B.S. in America, have employed scanning processes embodying various colour sequences for analysis and synthesis. It is now taken for granted that the science of colour has established the necessity for a minimum of three primary colours for acceptable reproduction.

Scanning sequences can be classified under three heads: (1) Scanning each picture point; (2) scanning each picture line; and (3) scanning each picture frame, in the three primary colours. Of these (1) is the most attractive but the most difficult. It gives the minimum of difficulty in colour registration and fringing; allows the retention of the same basic scanning frequencies (line and frame) as the equivalent definition black-and-white picture; and allows the possibility of adding colour to an existing black-and-white system, the existing receivers continuing to receive the picture in black and white. The difficulties with this system lie in changing the colour of the scanning spot at about three times the maximum video frequency of the black-and-white picture and in maintaining colour synchronism. At the other extreme (3) offers the simplification of changing the colours at only about three times the equivalent black-and-white frame frequency, but at the expense of three times the frame and line frequencies; it also suffers from the inability to add colour to an existing black-and-white system.

Additive Systems

Various methods from "reseau" screens to moving filters have been proposed for producing the necessary primary colours. All additive colour systems result in a loss of sensitivity in the transmitter camera and loss of brightness in the received picture. These must be restored by improvements in cameras and cathode-ray tubes. Additive systems fall into two main classes: those employing optical or electron-optical superposition of the colour images, and those employing sequential projection or scanning of the colours. The former suffer from errors of superposition of the images, giving colour fringes where the registration is inaccurate, but offer the possibility of using separate channels for each colour with corresponding advantage. The latter suffer from colour fringes on moving objects, owing to the time lapse between the presentation of the successive colours, but these lags can be made imperceptible provided the colour sequence is fast enough.

Electronic scanners give high relative accuracy in the location of picture points, but absolute accuracy is of a low order. Their use for the former method is therefore ruled out unless some auxiliary device is used for ensuring registration. The same argument applies to the use of a fixed "reseau" with either scanning sequences (1) and (2) above.

It would appear, therefore, that the only immediately practicable system is the "sequential-colour frame-scanning" system (3) (above), unless some unpublished device has been perfected, such as a method of altering the colour of a fluorescent screen at will, or receiver picture storage, or the simultaneous transmission of all picture points instead of scanning.

With regard to the standard of definition, the additional information to be conveyed in a colour picture results in an increase in the video band-width of about three times compared with the equivalent definition black-and-white picture. In going from a black-and-white to a colour picture with the same available band-width, it follows that the black-and-white picture will have about three times the number of lines of the colour picture. At low definition this would be very noticeable, but in the region of 400 lines or over the comparison in definition would become less obvious. A 405-line colour picture would require about three times the video band-width, and with vestigial sideband transmission about twice the ether space of the pre-war 405-line transmission. On this basis, a 500-600-line colour picture is not inconceivable as a long-term development. Should it be demonstrated, however, that higher definition, say, 800-1,000 lines, is necessary on purely visual grounds, then it would seem that colour television is only a remote possibility until much greater experience of the higher transmission-frequency bands has been obtained.

During the course of his remarks, Mr. Jesty gave demonstrations of the synthesis of white light from three primary colours. Sequential illumination of a set of snooker balls through a rotating three-colour filter served to show brilliant colour fringes when the balls were set in motion. Finally, the meeting was given the opportunity of comparing monochromatic and colour cine films of the same subjects projected simultaneously side by side.

In the discussion which followed, several speakers commented on the apparent improvement in contrast in the colour pictures, and it was agreed that less range of tone was required in colour than in a black-and-white system. On the other hand, the brightness level of an additive colour television picture would be less than that of monochrome, and there was need for further development to increase the efficiency of screen fluorescence. One speaker thought that a mechanical system of scanning might provide a solution; small high-speed motors were now available with a useful life of the order of 4,000 hours.

Colour Fringing

Colour fringing on moving objects was a serious defect of present frame-by-frame scanning methods. It could also be caused by hum in the receiver if the vertical scanning rate were not an integral multiple of the mains frequency and by fading in a propagation system depending on a network of radio links. Point-by-point scanning must be the ultimate goal, and one method by which this might be reached was to introduce transverse velocity modulation in the time base so that the wanted colour in each point would receive a longer period of illumination.

In a written communication, J. L. Baird expressed the opinion that point-by-point scanning did not offer sufficient advantages over line-by-line scanning to counterbalance the increased difficulties involved. With present frame-by-frame scanning methods a considerable reduction in colour flicker was obtained by increasing the number of interlacings (and consequently the frame frequency) for the same number of lines. He thought it rather misleading to state that frame-by-frame scanning could not be added to existing black-and-white systems. A two-colour 600-line system (200-line frames at a frame frequency of 50 per sec., interlaced three times) could be used in the pre-war B.B.C. 405-line system, and would be received as a 200-line black-and-white picture on existing receivers. A three-colour system was necessary for *accurate* colour reproduction, but, in his view, a two-colour system gave a pleasing and *acceptable* picture.

Other speakers held that colour reproduction should not be attempted until adequate definition was assured, and that the problem of colour should be set as a separate objective, not as an adjunct to existing systems.

In his concluding remarks, the chairman (H. L. Kirke) said colour television was not likely to become an established service for some years, but when it did it would be of great value, as there were many subjects which could not be adequately portrayed in monochrome. From the æsthetic point of view he thought the subtle improvement over black-and-white of pictures with ordinary sober colours was of greater value than the more striking effects of vivid colours.

BETRO

WITH the primary object of studying overseas markets, the British Export Trade Research Organisation has recently been formed. Among those industrial concerns which have taken part in the formation of "Betro" are several wireless and allied companies; these include the General Electric Company, the Automatic Telephone and Electric Company, British Insulated Cables, Marconi's Wireless Telegraph Company, and Cable and Wireless. Our publishers, the Iliffe group of companies, have applied for founder membership.

Betro's staffs will investigate on the spot such matters as overseas consumers' tastes and requirements, the special characteristics of each market, methods of marketing, transport and distribution, trade customs and local government regulations affecting trade.

Betro is to be registered as a company limited by guarantee and operating under Board of Trade licence. It will be non-profit-making, and revenue will be derived from membership subscriptions and payments for special investigations carried out for individual members. Full particulars can be obtained from the organiser, Philip Scott, Betro, Georgian House, Bury Street, St. James's, London, S.W.1.

RANDOM RADIATIONS

By "DIALLIST"

Back in the News

HOW good it is to read in one's daily paper of the capture or liberation of place after place that we used to know so well in the days before the war when we twiddled our tuning knobs in search of entertainment from abroad—or just for the pleasure of logging stations. Poznan, Eindhoven, Kaiserslautern, Cologne, Danzig, Moravska-Ostrava, Karlsruhe, Graz, Cassel, Stettin, are just a few that have come to mind in the few days before this is written; doubtless there will be many more before it appears in print. I fear, though, that it may be some time before we have the actual transmissions of stations in Poland, Czechoslovakia, Holland and Northern Italy. Some have been badly damaged by Allied bombardment, whilst many more were badly smashed up by the routed Germans before they left. And there *are* stations that I hope we shall never hear again. In the bad old days Europe had far too many. No doubt with an eye to coming events the aggressor nations grabbed much more than their fair share of the long-, medium- and short-wave channels in the years before the war, and not a few of their stations were used mainly for propaganda purposes.

Dx and Geography

To follow this world-wide war intelligently a considerable knowledge of geography is needed. Day by day the news tells of doings in the far corners of the earth and ordinary mortals must reach for the atlas to discover the whereabouts of Bandoeng or Luzon or Tandjong-priok or Suva. Not so the pre-war short-wave enthusiast. To him they are familiar names and he knows where they are without having to refer to maps. Medium-wave long-distance wireless experience came in equally useful during the North African and Italian campaigns, during the Russian advance and during the stirring doings in Western Europe that have continued since the Normandy landing. To adopt long-distance wireless as a hobby means automatically the subsequent acquiring of a useful knowledge of world geography without tears—a sound reason for encouraging any of the young hopefuls who show signs of taking it up! Apart, too, from giving them a knowledge of where towns and countries are, it is an incentive to regard spherical trigonometry not as a mere dry-as-dust subject, but as a ready aid to the solution of a variety of interesting practical problems.

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Sorting Out the Channels

HOW long, I wonder, will it be after the end of the war before a European broadcasting conference assembles to evolve the new wavelength plan? The sooner the better, for the quicker they get to work the better will be their chance of producing a scheme acceptable to all. If nations are allowed to take their own course for some time before a conference is convened many difficulties will arise. New and powerful stations will be built in large numbers and each will claim to have established its right to a channel. But if this thing is tackled right soon each country can receive its allotment of channels before new stations have been erected or old ones repaired. I very much hope that whatever conference there may be will resolve right away that a 10-kilocycle separation between channels is the only thing that will answer. A system on that basis has worked and worked well for years in the United States. It makes for much less interference between stations and it has another great advantage: your channels can be known (and indicated on receiver tuning dials) by consecutive numbers corresponding to tens of kilocycles. Thus 550 kc/s is channel 55, 540 kc/s is channel 54 and so on.

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Should Television Pay Its Way?

THE Television Committee has recommended that television should stand as soon as possible on its own financial feet. In other words, they urge that those who derive entertainment in their homes from the television programmes should provide the money for them by paying an extra licence fee—£1 a year is suggested. At first sight that seems very right and proper—but is it really? Personally, I dislike the sharp distinction drawn between sound-only and sound-and-vision broadcasting; I should like to see the two included under the one heading of broadcast entertainment. Be that as it may, your 10s. licence does *not* automatically entitle you to have entertainment laid on any more than a gun or game licence provides you with the right to shoot over land. Read its conditions if you don't believe me. The Government does, in fact, maintain a broadcasting service, but you'd have to pay the same ten bob if you used your set only for receiving (in peacetime) the Air Ministry weather reports or the signals of the radio beacons. Every ciné goer will have the benefit of some, at any rate, of the television programmes when the high-definition service is in being, and why should the owner of a televisor pay for his fun? In any event, the cost of the post-war television programmes is estimated at an annual £1,500,000, and the best way of bringing the number of television set owners up to 1½ millions in quick time is emphatically not to impose a £1 tax on them.

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Fine Work

TO me one of the most amazing things about radiolocation gear is the way in which it enables semi-skilled operators to make minute measurements of almost incredible accuracy. Still more astonishing perhaps is the fact that they make such measurements without realising that they are doing anything of the kind. Here's an example. I'm not going to say to what degree of accuracy a range can be obtained, but let's suppose that it is required to measure a particular range with a maximum error of *plus* or *minus* 200 yards. The round figure speed of radio waves is 300,000,000 metres a second: more accurately it is 2.9982×10^8 m/sec. or 3.2772×10^8 yards per second. As Dr. Smith-Rose explained recently in *Wireless World*, ranges are measured by timing the out-and-home journey of pulses, so that 1,000 yards of range equals 2,000 yards of pulse travel, if I may so put it. A moment's work on the back of an old envelope will show that a pulse returns from a "target" 1,000 yards away in 6.1 microseconds. As 6.1 μ-sec. represents 1,000 yards of range, 1.22 μ-sec. corresponds to 200 yards. And being accurate within such limits is, I think you'll agree, pretty fine work! Not very wonderful in the laboratory, perhaps with a skilled physicist at work; but something of an achievement on the battlefield, especially when the work is done by an operator who, in civil life, may never have made measurements more accurate than the pint of beer, the pound of butter or the yard of cloth of everyday life.

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High-fidelity Sound

IT was not, perhaps, surprising that the Television Committee made scant reference in its report to the sound transmissions from television broadcasting stations. The members no doubt felt that the vision side of the business was their particular affair and stuck to that. I can't help wishing at the same time that they had recommended that high-fidelity sound transmissions should take place throughout ordinary programme hours, whether or not vision was being sent out. As they didn't do so, I hope that the Television Advisory Committee will. The "pros" are many and important; the "cons," so far as I can see, nil. First, it would give all who invested in good televisors every opportunity of making full use of them. People may be rather chary about buying apparatus that can be used for only an hour or two a day, but many would be anything but reluctant if they knew that their television set's sound department could be used at any time to bring in, say, the national programme far better than any ordinary domestic wireless receiver could. Then there's the amateur experimenter, keen on the quality aspect of wireless reception. A splendid field would be opened to him and he could be relied upon to make full use of it. And apart from the amateur, there is the professional radio engineer specialising in the matter of fine reproduction. We owe a great deal to him already for the wonders that he has worked in the reproduction of ordinary sound broadcasting; our debt would be greater still if high-fidelity broadcasts of the complete programmes gave him a chance of showing what he could do with them. There was, so far as I recall, no mention of FM in the report. I want to see us going ahead with FM, largely because I feel that it offers one of the best hopes of palliating interference. I'm afraid that the Television Committee's recommendation that the Postmaster-General should be given powers to enforce the suppression of radiated interference won't get us anywhere—at any rate for a very long time. There will be far too much opposition from vested interests.

GOODS FOR EXPORT
The fact that goods made of raw materials in short supply owing to war conditions are advertised in this journal should not be taken as an indication that they are necessarily available for export.

THE "SONIGAGE"

Supersonic Sound Measurement of Metal Thickness

IN many instances in aircraft construction, for example, hollow metal propeller blades, a surface finishing operation has to be carried out on a totally enclosed hollow structure which may reduce the thickness of the material beyond the safety point. The inaccessibility of the inner surface precludes the use of normal gauges and a method must be devised by which the thickness can be measured from the outer surface without drilling or cutting.

In the "Sonigage," an instrument designed by the Research Laboratories Division of the General Motors Corporation and described by W. S. Erwin in a paper before the Society of Automobile Engineers (October, 1944), supersonic sound waves are excited in the material by a thin quartz plate silvered on one side and using the work as the other electrode. Piezoelectric vibration is induced by an oscillator and resonance conditions are indicated by the power absorbed from the oscillator circuit. Standing waves are established between the front and back surfaces of the metal, and, for the fundamental mode, the thickness t in thousandths of an inch is given by the relation $t = c/2f$ where c = velocity of sound in the material in inches per second, and f = resonant frequency in kilocycles.

Good contact with the work is essential and this is achieved by brushing the surface with oil before applying the crystal unit. The natural frequency of the latter must be above the range of the oscillator.

The "Sonigage" has two frequency ranges covering thicknesses in steel, from 0.002 to 0.4 inch and the maximum error does not exceed 2 per cent.

CATALOGUES RECEIVED

INTERIM catalogue No. 256 (Jan., 1945) describing standard capacitor types made by A. H. Hunt, Ltd., Bendon Valley, Garratt Lane, London, S.W.18. Circulation limited to set designers and manufacturers.

Descriptive List N.S.C.12—"B.I. Radio Frequency Cables," from British Insulated Cables, Ltd., Prescot, Lancs.

Leaflet No. 18 describing metallised ceramic bushes for hermetic seals, issued by Steatite and Porcelain Products, Ltd., Stourport-on-Severn, Worcs.

Illustrated brochure describing the applications of the "Clayflex Flexible Bearing" from Clayflex, Ltd., Tiddington Road, Stratford-on-Avon.

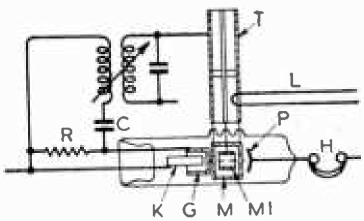
RECENT INVENTIONS

A Selection of the More Interesting Radio Developments

SUPER-REGENERATIVE RECEIVER

An electron tube is arranged to develop two frequencies, one by velocity modulation and the other by back-coupling two of the electrodes. The second frequency is then used to "quench" the first, as in a super-regenerative receiver.

The velocity-modulating electrode comprises two concentric cylinders M, M_1 situated between the control grid G of the cathode K and the anode or plate P of the tube. Incoming signals are fed by a loop L to a coaxial-line resonator T, which is branched across the two concentric cylinders of the modulator, so that the RF fields "bunch" or velocity-modulate the electron stream as it passes through.



Super-regenerative receiver for high frequencies.

Meanwhile the outer conductor of the resonator feeds back energy to the control grid through a coupling circuit, which includes a blocking condenser C and a leak resistance R, to generate a quenching frequency. The resulting signals are heard in a pair of headphones H.

Marconi's Wireless Telegraph Co., Ltd., and G. B. Banks. Application date May 9th, 1941. No. 564731.

INDICATING FIELD STRENGTH

A relay responding automatically to waves of a given amplitude is used for plotting the polar diagram of a short-wave transmitting aerial. The device includes a reactance winding, having a core of high permeability, and connected across an AC source. The magnetisation of the core is controlled by two coils arranged in opposition. One coil takes the anode current from a pentode valve coupled to a stationary receiving dipole, whilst the other coil is fed with a steady direct current. For a given value of the latter, it follows that the core will be de-saturated when the grid of the pentode reaches a certain potential due to the energy fed to it from the dipole, that is, for a given strength of the prevailing field. The resulting sudden change of potential across the reactance then operates the relay.

A number of such relays, graded to respond to different field-strengths, are arranged at selected points around the transmitter, the orientation of which is then varied, step by step. By linking the relays with a flashlamp at the transmitter, a photographic record can be taken of the corresponding field-strength contours.

The British Thomson-Houston Co., Ltd., and J. Dyson. Application date April 30th, 1943. No. 563698.

COLOUR TELEVISION

A composite fluorescent screen for producing, say, a two-colour picture in a cathode-ray receiver consists of a stack of mutually insulated conducting strips, laid face to face, the exposed edges of the long sides forming the active surface. Before assembly, the edges are coated with different fluorescent material, and the stack is arranged so that lines of blue-responsive zinc sulphide alternate with lines of orange-responsive zinc cadmium sulphide. Each set of similarly coated strips is electrically bonded to a separate bus-bar arranged at opposite ends of the stack, the bus-bars being fed with a square-shaped voltage which is synchronised with the frame-scanning frequency.

The incidence of the scanning beam is determined by the relative potential of the two intermeshed network of strips, so that the lines of one colour are first completely scanned, and then those of the second colour, and so on.

A. C. Cossor, Ltd.; D. A. Bell; and H. Moss. Application date May 4th, 1943. No. 565547.

TELEVISION SCREENS

It is usual to mask the fluorescent screen of a CR tube in order to hide the ragged edges of the scanning raster. This practice, however, has certain drawbacks. An external mask, for instance, limits the size of the picture when viewed at an angle, whilst any mask is liable to produce undesirable reflection.

The invention discloses a method of laying a fluorescent screen of the required size and shape, with clear-cut edges, on the inside of the bulb, in such a way that the borders consist only of transparent glass, against which any irregularity in the raster cannot be seen. A disc of filter paper, with a centre aperture of the required size, is first laid over the inside of the glass bulb, and is moistened so that it adheres closely. A binding material is next applied to the exposed glass surface, on which the fluorescent coating is laid, say, by the "air-settling" method. When dried by an air jet, the filter paper will fall away, leaving the screen *in situ.*

Philco Radio and Television Corporation. (Assignees of J. S. Vansant.) Convention date (U.S.A.) March 30th, 1942. No. 564425.

TELEVISION AND SOUND SIGNALS

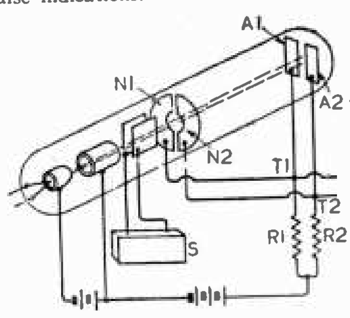
Relates to systems of the kind in which the sound accompanying a television programme is transmitted in the form of a series of pulses of constant width but varying amplitude, which are superposed on the common carrier wave, together with the synchronising impulses, during the line-blanking periods when the picture signals are suppressed.

According to the invention, the system is modified by varying the width of the sound-carrying pulses in such a way that changes in width represent the depth of modulation, whilst the rate-of-change of width carries the tonal frequencies. The amplitude of each pulse can thus be kept constant. One advantage of the modified system is that the peak level of the sound pulses can be used to control the gain of the set, instead of having to introduce auxiliary pulses for this purpose. Another is that the amplitude of the sound pulses can be made substantially greater than either the picture or synchronising signals, whereby all three are more easily separated in the receiver. If desired, the usual synchronising impulses can be width-modulated to carry sound, thus making the one set of pulses serve both purposes.

S. R. R. Kharbanda and Pye, Ltd. Application date January 7th, 1943. No. 564511.

ELECTRONIC RELAYS

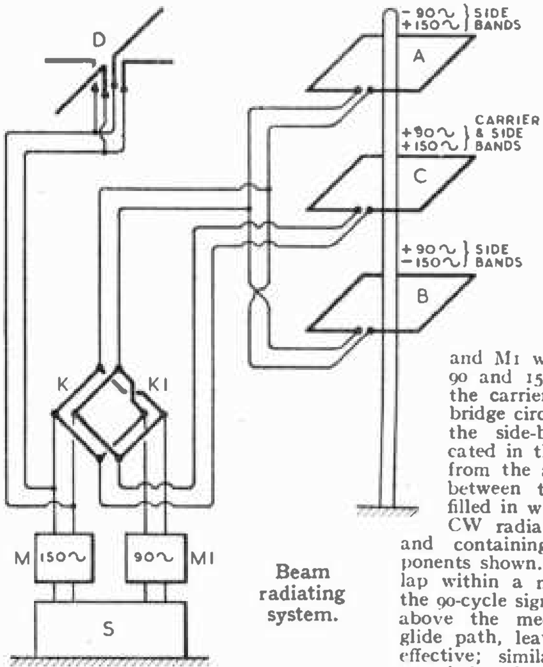
The drawing shows a relay of the kind in which an electron stream is deflected by impulses from a source S so as to fall on one or other of two targets A_1, A_2, these being connected to output loads R_1, R_2 respectively. A strong signal, however, is liable to swing the beam too much to one side of the centre line, so that some or all of the electrons fail to strike against the proper target, thus giving weak or false indications.



Beam deflection relay.

To prevent this, two intercepting electrodes N_1, N_2 are placed close behind the usual deflecting plates in order to catch any electrons that are over-deflected. They are connected at T_1, T_2 to the load resistances, so that their pick-up is added to that of the main target. The interceptors are cut away at the centre to allow a normally deflected beam to pass freely. One advantage of the arrangement is that the main targets can be made smaller than usual, thus reducing the overall size of the tube.

H. Ziebolz. Convention date (U.S.A.) April 22nd, 1942. *No.* 564382.



Beam radiating system.

VOLTAGE STABILISERS

CASUAL fluctuations in a DC supply are offset by a regulating circuit which includes two local oscillators, one being a piezo-crystal of constant frequency, and the other a valve generating a frequency which varies with the supply voltage.

A reactance coil, shunted across the supply terminals, responds to any voltage variation by a change of inductance, which in turn alters the frequency of the valve generator, and so affects the difference frequency obtained by mixing the valve output with that from the crystal oscillator. The output from the mixer is fed to a discriminator circuit, which develops a control voltage that is of the same polarity whether the supply voltage rises or falls. This is applied as a correcting bias to the control grid of a low-impedance valve, which is inserted between the positive supply terminal and the load to make the system self-regulating.

G. S. P. Scantlebury. Application date March 27th, 1943. *No.* 566031.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

BLIND LANDING SYSTEMS

A NUMBER of overlapping beams are arranged to give a clear-cut gliding path which is as free as possible from false or ambiguous indications. This is secured by first radiating two relatively fixed beams, separated by a narrow gap which contains no energy, and then filling this gap with a third beam suitably modulated with course-indicating signals.

The distance between the two aerials A and B is adjusted so that the radiation field from the pair includes two closely adjacent major lobes, in opposite phase. Radio-frequency from the source S is modulated at M and M1 with two-signal notes of 90 and 150 c/s respectively, and the carrier-wave is suppressed in bridge circuits K, K1 so that only the side-band components indicated in the drawing are radiated from the aerials A, B. The gap between the two lobes is then filled in with a lobe of modulated CW radiated from the aerial C, and containing the side-band components shown. All three beams overlap within a narrow region in which the 90-cycle signal note is cancelled out above the median line forming the glide path, leaving the 150-cycle note effective; similarly, only the 90-cycle note is heard below this line.

False indications are eliminated by radiating the side-bands of only one of the signal notes from a separate vertically directive aerial D, which covers the region above the glide path.

Standard Telephones and Cables, Ltd. (assignees of A. G. Kandoian). Convention date (U.S.A.) May 11th, 1942. *No.* 565379.

CATHODE-RAY TUBES

A CONDUCTIVE disc of sheet metal, or of colloidal graphite, is laid on the outer surface of the glass bulb, close to the fluorescent screen, and serves to apply radial deflections to the spot when making records against a circular time base. The deflecting voltages can be applied between this outer disc and the internal conductive coating usually found near the top end of the bulb; or the final anode may serve as the second electrode for the purpose. To generate the circular time base, voltages are applied in quadrature across the familiar two pairs of plates.

Although the radial deflections of the spot are not linear over a wide range of voltage, they are sufficiently so to give sensitive and accurate indications of short time intervals or of frequencies comparable with that of the time base. It is claimed that a radial deflection sensitivity of the order of 20/V mm. per volt can be obtained, where V is the voltage of the final anode of the gun relative to the cathode.

A. C. Cossor Ltd., and L. A. Woodbridge. Application date February 26th, 1943. *No.* 563817.

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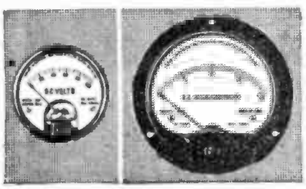

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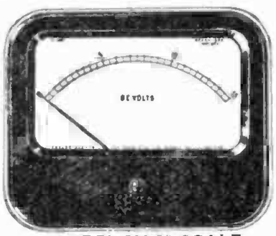
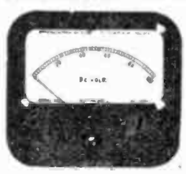


MODEL 500 5" SCALE



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H.P. RADIO SERVICES, Ltd., 55, County Rd., Walton, Liverpool, 4. Tel. Aintree 1445. Estab. 1935. [3732

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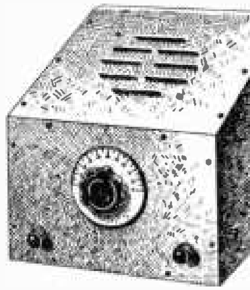

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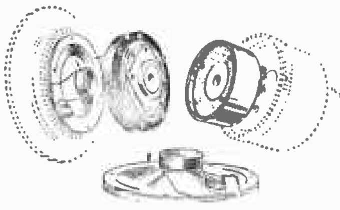

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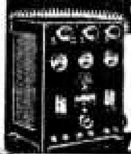

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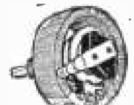

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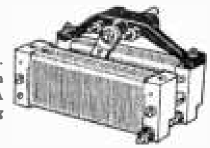

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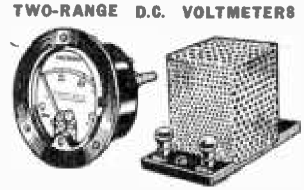

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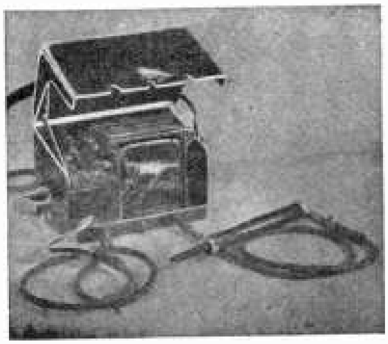

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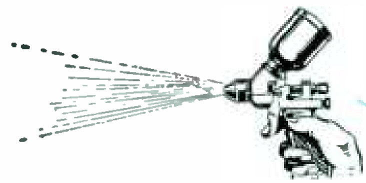

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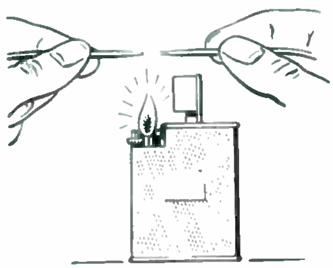

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