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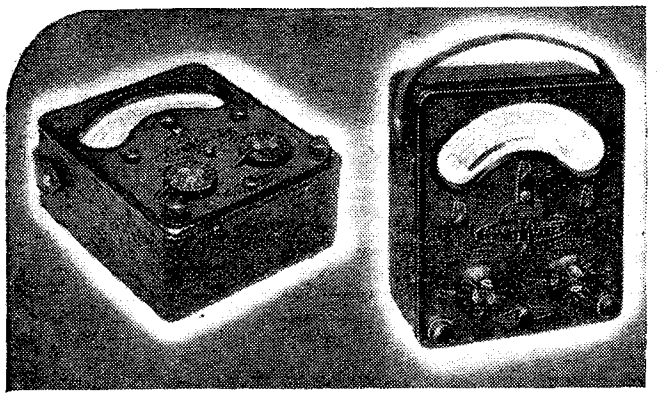
AUGUST, 1940

WIRELESS FOR ARTILLERY CO-OPERATION: Canadians under training in England

No. 1058 Vol. XLVI No. 10



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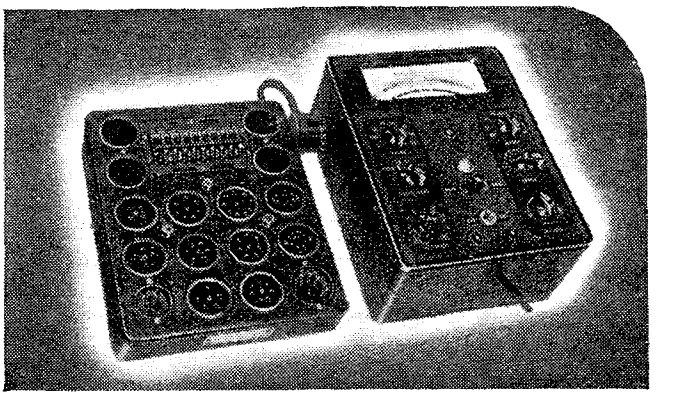

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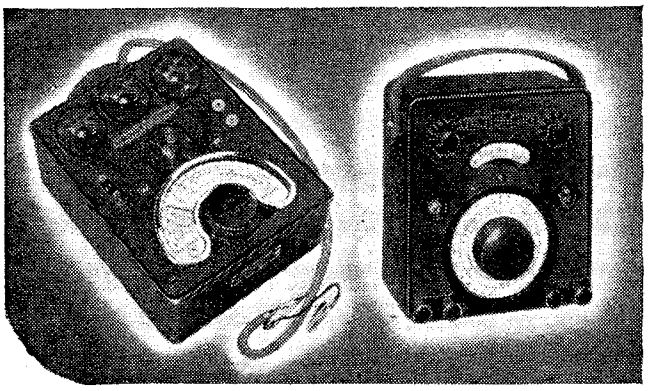

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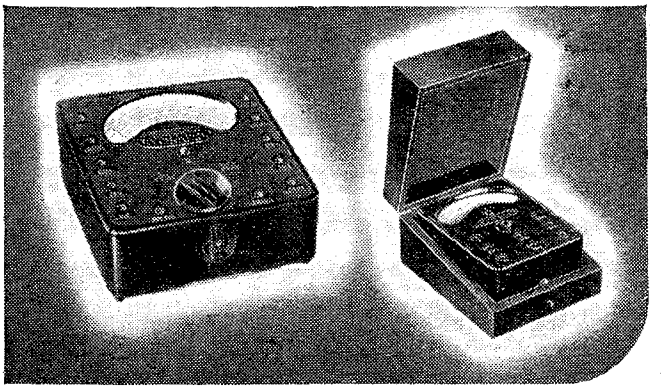

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Premier Morse Practice Key on Bakelite Base and Brass Movement	3/3
General Purpose Morse Key	5/10
Heavy Duty TX Key on Cast Base ...	10/-
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Complete Kit of Parts for Valve Oscillator as described in W.W. "Learning Morse"	25/-

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Short-Wave Coils, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 2/- each, with circuit. Premier 3-Band S.W. Coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, 2/11.

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- Beat Frequency Oscillator
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L.T. Transformers, all C.T.

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Wire-ends. All L.T. Windings Centre-Tapped

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Will match any output valves to any speaker impedance.

11 ratios from 13 : 1 to 80 : 1. 5-7 watts, 15/9. 10-15 watts, 20/6. 20-30 watts, 35/-.

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U.S.A. Types, 24, 30, 35/51, 55, 56, 57, 71, 85, 2A5, 2A6, 2A7, 2B7, 6A7, 210, 250, all 2 for 3/-.

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Will fit any tone-arm 5/3

ANOTHER SPECIAL OFFER.

Rothermel Brush Piezo Crystal Pick-ups.

New Junior P.U. with arm, 19/6. Standard, S.8. Model with arm, 29/6. P.U. head only, De Luxe Model, 19/6.

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Transverse Current Mike. High grade large output unit. Response 45-7,500 cycles. Low hiss level. 23/-.

Microphone Transformers. Suitable for all mikes. Tapped secondaries. A, 20 and 40 : 1; B, 30 and 60 : 1. 6/6 each.

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Moving Coil Mike. Permanent magnet model requiring no energising. Response 90-5,200 cycles. Output .25 volt average. Excellent reproduction of speech and music. 48/-.

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The
Wireless World

COVERING EVERY WIRELESS INTEREST

30th Year of Publication

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No. 1058 **Vol. XLVI. No. 10**

AUGUST 1940

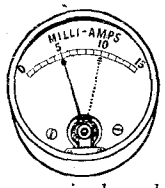
Contents

THIS SET
works overtime without pay!

We're most of us working overtime these days, and our radio sets are no exception. They too are working hard—using energy and costing us more for H.T. replacements. That's why the Marconiphone 892 is gaining such widespread popularity among battery set users.

THE BATTERY ECONOMISER
halves upkeep costs

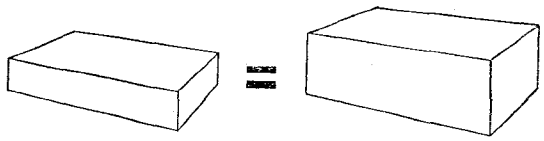
Here's a receiver which *more than doubles* the life of your batteries for all normal listening without impairing volume or quality. This outstanding combination of performance and economy is the result of carefully co-ordinated design from aerial terminal to speaker fret. The Battery Economiser, important though it is, is only one of this receiver's many unique features. The high gain aerial circuit; the duplex action A.V.C.; the very high electric-to-acoustic conversion efficiency of the output stage, and the extreme sensitivity of the new type speaker—all these contribute powerfully to the achievement of "big set" performance for 5 MA.



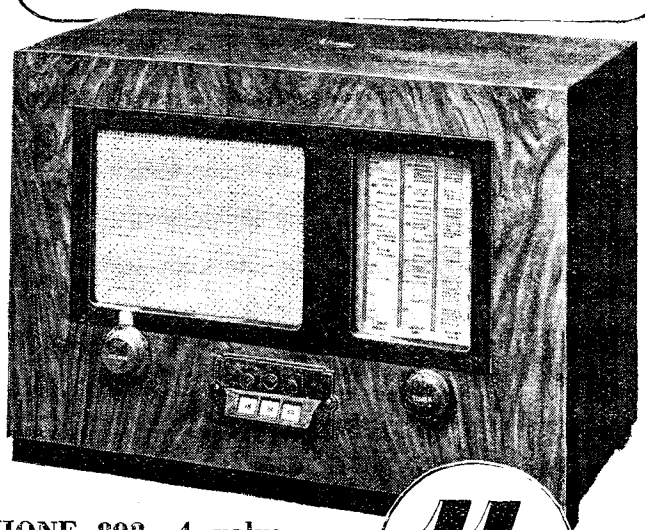
THE BATTERY ECONOMISER

This device halves the usual H.T. consumption when switched into circuit; yet volume and sensitivity are ample for all ordinary listening requirements. Only when maximum sensitivity and even greater output are required need the Battery Economiser be switched out of circuit. H.T. consumption then goes back to 10 MA.

BATTERY LIFE MORE THAN DOUBLED



Reducing the consumption by half means *more than doubling* the battery life, owing to the well-known fact that the electro-chemical efficiency of the battery is not in strictly inverse ratio to the discharge rate, but becomes progressively greater as the discharge rate is reduced.



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MARCONIPHONE 892—4 valve, 7 stage, All-Wave Battery Superhet

11 Gns.

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THE MARCONIPHONE COMPANY LIMITED, HAYES, MIDDLESEX

The
Wireless World

COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

No. 1058. Vol. XLVI. No. 10. AUGUST 1940 Price One Shilling

Editorial Comment

Morse Operating Technique

SINCE the outbreak of war we have devoted much more space than formerly to wireless telegraphy, and in particular to matters relating to the training of wireless operators. For that no apology need be offered, as many readers who hope to join the wireless branches of the Services are eager for information on what is to them a new subject. Moreover, the tempo of modern warfare calls for speed in all forms of communication, and anything that makes for smart and efficient operating should be encouraged in every possible way.

Contributors who have written in our pages on these subjects are by no means in complete agreement on all points, and it will perhaps be helpful if we sum up with regard to those matters on which differences of opinion exist.

Everyone is agreed that the beginner in morse telegraphy should concentrate on memorising the sounds corresponding to each letter rather than the combination of dots and dashes that constitute the morse symbol. This object is defeated if, in anything but the earliest stages of instruction, individual letters are transmitted with a spacing ratio strictly appropriate to any speed the beginner can be expected to follow. In other words, if letters are sent with extremely long dots and dashes they lose their distinctive rhythmic character, and wrong methods of memorising them are thus encouraged. It has been suggested that, to avoid this, the letters themselves should be sent at very high speed—as high as 40 words per minute has been mentioned—with greatly exaggerated spaces between the letters. That seems to be carrying a good idea too far, and we are in agreement with those who prefer a compromise. The practice of sending letters at the rate of 15 to 20 w.p.m. seems more appropriate to the capabilities of the average learner in the early stages; as he gains experience, exaggerated spacing may be progressively reduced until it comes down to the correct ratio.

Gramophone records are already quite widely used for morse instruction, and we feel that it would be an advantage if a series of records with exaggerated inter-letter spacing, as discussed in the preceding paragraph, were freely available, both to those who are studying the code in schools and in their own homes.

As the human hand is not of standardised proportions it is clearly impossible to lay down a hard-and-fast rule as to the method of holding the knob of a morse key. The general principles were, we think, best summarised in our June and July issues, where it was shown that the knob should be held lightly with the first and second fingers resting on the top and the thumb underneath it. The need for avoiding a "tapping" style was stressed, as was the fact that the actual operation of opening and closing the key contacts should be effected entirely by up-and-down movements of the wrist.

Insufficient attention seems to be paid to the position of the operator with relation to his key. The upper arm should hang loosely at the side, and the forearm should make a straight line with the bar of the key. A chair adjustable as to height is a real help towards attaining the correct position.

When the learner passes on to the real thing, and has to work his key in the cramped quarters of an aeroplane or in the reeling cabin on a small patrol boat in a seaway, he may have to forget some of the things he has learned. But, if he has been trained to avoid slovenly methods, he will adapt himself to circumstances, and form an efficient link in one of our most vital communications.

Review of American Radio

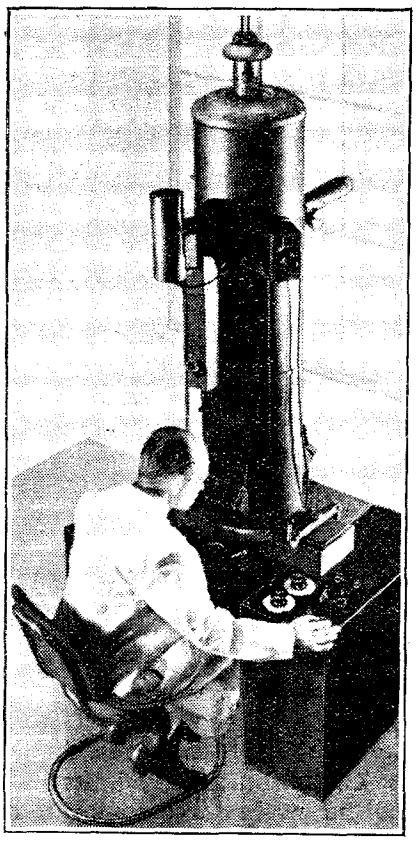
FREQUENCY MODULATION — TELEVISION — AMATEURS — DEFENCE

By A. DINSDALE

After placidly proceeding along its commercial way for ten years or so, American radio is now in a state of flux, influenced by several powerful revolutionary factors which bid fair to bring about some far-reaching changes: present tendencies are here explained for the benefit of British readers.

ONE of the most important factors in American radio at the present time is frequency modulation, or FM. On June 1st of this year about fifteen FM stations were in more or less regular experimental operation, and the Federal Communications Commission had before it 170 applications for construction permits for new FM stations. Further applications are coming in at the rate of fifteen to thirty a week.

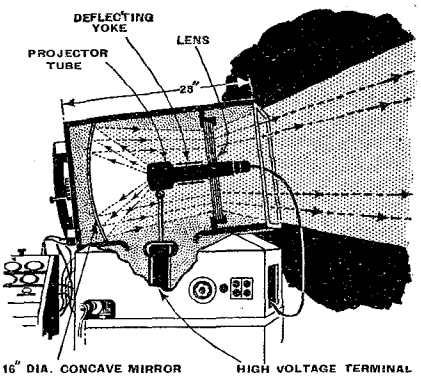
A recent FCC ruling took away from television its No. 1 channel and assigned it to FM. This band lies between 42 and 50 megacycles, and provides forty FM channels, each 200 kc/s wide. FM stations now operating, or about to operate, are licensed to do so only on an experimental basis. Between now and January 1st, 1941, it is expected that certain Government services now operating in the new FM band will have been reallocated out of it, and when that has been accomplished it is expected that the FCC will authorise FM stations to operate commercially, i.e., to sell time.



25,000 TIMES MAGNIFICATION. Designed under the supervision of Dr. Vladimir Zworykin, the Iconoscope pioneer, this new electron microscope has recently been produced by the Research Laboratories of the Radio Corporation of America.

Major Armstrong, the inventor of FM, estimates that within five years there will be few, if any, amplitude modulation (AM) stations left in the United States. Other authorities think it will take ten years. The transition, however it comes, will undoubtedly be gradual, controlled by a number of important factors.

Taking first things first, it is obvious that the problem of receivers must be solved, and it is being solved very promptly. The new 1941 models now about to make their appearance include several combination receivers which, in addition to the standard all-wave feature, will include a switch-over device to enable the instrument to pick up signals from FM stations. Some of these combination receivers will be priced as low as $125-150, which is very little more than one has to pay already for a really first-class all-wave AM receiver.



LARGE-SCREEN TELEVISION IN AMERICA. Simplified sketch showing the operation of the new RCA projection system.

The next problem is that of transmitters. It has already been decided that the standard FM transmitter shall have a power of 50 kW. The range of such transmitters will be about 50 miles, depending upon the elevation of the aerial. This means that in metropolitan areas more transmitters can operate without mutual interference than at present, using AM. In a large centre like New York, there may be a demand for the maximum permissible number, forty. And FM will undoubtedly prove far more satisfactory for covering densely populated areas, partly because of the increased number of stations permissible, and because of the range limitation factor.

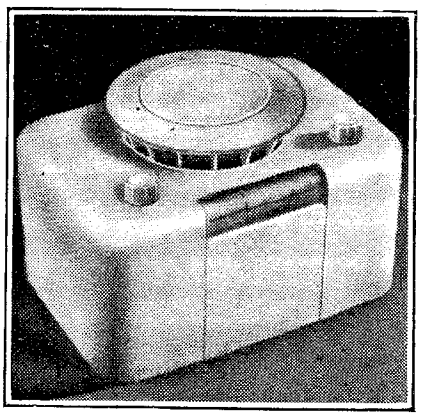
No Mutual Interference

In cases where cities are located close together, no interference is expected, even if two adjacent cities employ the same frequency assignments. This is because Major Armstrong has developed a special limiter valve and associated circuit which causes the receiver to reject automatically a weaker signal on the same frequency. Listeners in the dead centre between two stations on the same frequency are the only ones who will be inconvenienced, and it is claimed that this interference area does not extend over a mile.

Thus, in densely populated areas it is to be expected that all present AM stations will disappear within a relatively short space of time. Out in the sparsely populated rural areas, however, it is to be expected that present AM stations, operating on cleared channels (i.e., not sharing

Review of American Radio—

their assigned frequency with any other station in another part of the country), will continue to operate indefinitely, because they provide the only practical means (at present) of covering such vast areas. In fact, as channels are released by metropolitan AM stations, it would not be surprising if more AM stations were built to cover the vast rural areas more thoroughly than can be done at present.



By courtesy of "Plastics"

Originality in design is the keynote of this cabinet moulded by the Firestone Rubber Company for the American "Kadette" receiver. There is a tendency in the U.S.A. to eliminate the speaker grille in the front of the cabinet, and in the model shown it has been replaced by a diffuser cowl on the top.

There remains the problem of the networks. FM cannot at present be relayed over telephone lines because of the wide-frequency swing —75 kc/s on either side of the median line. If the networks are to preserve their structure, therefore, two alternatives face them: (1) They must either face the enormous expense of building FM relay stations at fifty-mile intervals clear across the continent, with side branches to important centres, or (2) relay their voice currents by telephone line as at present to feed FM stations in various parts of the country. In the first case, noise-free, high-fidelity reception would be assured. In the second case, quality would remain as at present, and only the noise-free characteristic would accrue to listeners. It is probable that some compromise combination of the two methods will be worked out gradually over a long period of time.

One thing is certain. So long as American broadcasting remains on its present commercial, competitive basis, the contemplated changes will result in better service to the listener from the standpoint of better radio coverage of the nation, better quality, and less interference.

After a period of acrimonious discussion, television in America is in a state of suspended animation. A rather amazing *volte-face* on the part of the Federal Communications Commission is responsible for this, and it must appear so bewildering to British readers that a transatlantic interpreter is perhaps necessary to permit an understanding of the issues involved. The recent history is as follows:—

For years several American companies have been transmitting television experimentally, led by the Radio Corporation of America, operating in conjunction with its affiliate, the National Broadcasting Company. Millions of dollars have been spent, with no return. At last television became good enough to allow of a demand being made for permission to operate commercially, i.e., sell time to advertisers. The FCC spent some time examining the latest achievements of all the interested companies all over the United States. The question of standards was a grave issue. Finally, the FCC "countenanced" the RMA standards of 441 lines, 30 pictures per second, and authorised the commencement of limited commercial operation on September 1st next. RCA immediately embarked on an extensive advertising campaign to market more sets, incidentally reducing prices by one-third. Instantly the FCC cancelled its order permitting limited commercialisation, and rapped RCA severely over the knuckles "for commercial exploitation." Further hearings were held by the FCC, marked by much acrimonious discussion and name-calling, but the FCC refused to budge. What's behind it?

To begin with, RCA has spent more, done more and gone farther in television research than any other manufacturer. This applies to transmitting equipment, receivers and programmes. When the go-ahead signal was given by the FCC, they were naturally in a position to proceed immediately to cash in on their investment; others were not. So the deadly cry of monopoly was heard. From there on the causes of subsequent developments were partly political and partly commercial.

Bogy of Monopoly

In American politics the Democratic party is traditionally a trust-busting party, the deadly enemy of monopoly. The present administration is no exception. Charges were made that the RMA standards were adopted because they were RCA standards, and RCA saw to it that some of its engineers were elected to the RMA standards committee for the purpose of getting their standards adopted.

Engineers of rival companies, busy along their own lines of research, disagree with the RMA standards. They testified at FCC hearings that if commercial operation by RMA standards were permitted, and if RCA were permitted to sell receivers exclusively geared to RMA standards, then further research would be useless, and the art would be "frozen" at its present level of development. To no avail; RCA offered to make receivers adjustable to any standards.

In particular, Allen B. DuMont testified that he wanted an experimental licence to transmit 661 lines and 15 pictures per second. He said his receivers could receive any number of lines from 400 to 900, and either 15, 20 or 30 pictures per second. He wanted to transmit only 15 pictures per second because he said he had developed a screen material of greater retentive power.

AUTOMATIC DIRECTION FINDER. This instrument, seen installed in a Douglas aeroplane of American Air Lines, indicates continuously, by means of an arrow, the bearing of the station to which it is tuned.

Review of American Radio—

David Sarnoff, president of RCA, tore DuMont's testimony to ribbons, and stated that his plans would result in a picture inferior to that obtainable by RMA standards. He also testified that a 51 per cent. control of the DuMont interests is held by Paramount Pictures, to whose interest it was to make sure that television never became so good that it could compete with motion pictures.

The FCC digested all the latest testimony, and recently handed down its final decision that commercial operation is not to be permitted. Meanwhile, television linguishes, and the Press of the nation almost universally criticises the Government decision in no uncertain terms.

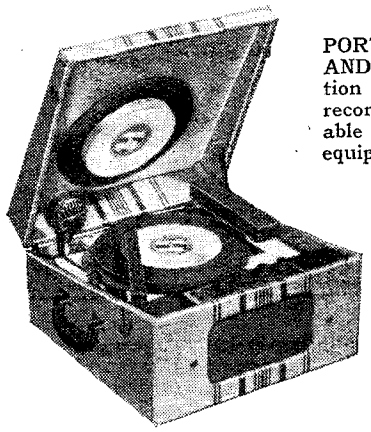
Result: Public Apathy

John Q. Public is rather apathetic about it all, and no wonder. He has heard so many conflicting arguments pro and con; there are so few programmes available, and those of dubious quality; and, finally, in these days of unemployment and depression, who can afford to invest several hundred dollars in a television receiver which, by all accounts, may be out of date and useless in a year or two?

In the New York metropolitan area, where NBC broadcasts television five days a week, a total of 16 hours, there are no more than 3,000 television receivers. In Los Angeles the Don Lee Network broadcasts television a total of nine hours a week to about 500 receivers. In Chicago the Zenith Radio Corporation broadcasts experimentally about three hours a week to a few receivers lent by the company to selected observers. In Schenectady, N.Y., the General Electric Company relays New York transmissions experimentally over week-ends to an unknown number of receivers. In Philadelphia Philco Radio and Television Corporation transmits experimentally on an irregular schedule.

The FCC recently took television's No. 1 channel away from it and awarded it to FM. This means that all present television transmitters will have to shut down until they have been readjusted to operate on one of the following channels: No. 1, 50-56 Mc/s; No. 2, 60-66 Mc/s; No. 3, 66-72 Mc/s; No. 4, 78-84 Mc/s. Additional channels have been assigned between 162 and 294 Mc/s.

Since music is the backbone of radio entertainment, American broadcasters now find themselves being held up for exorbitant charges by both union musicians and copyright owners. Over a period of years the demands of the musicians' union have resulted in the replacement of many musical programmes by dramatic sketches, and further to cut down expense, an electric organ requiring but one musician is frequently used for interlude and mood music instead of an orchestra.



PORTABLE GRAMOPHONE AND RECORDER. In addition to playing ordinary records, this American portable electric gramophone is equipped with an automatic cutting head and microphone for the making of sound records at small cost (12½ cents each). Immediate play-back is possible. The 6½ inch diameter blanks have a 2¾ minute recording time per face, and are made on a flexible paper base.

In addition to these limitations on musical programmes, American listeners may soon be deprived of many of their favourite tunes. The performing rights to all popular and some classical music are controlled by the American Society of Composers, Authors and Publishers, known as ASCAP. American broadcasters play ASCAP music under a licence which expires on December 31st next, and when ASCAP announced this spring the terms for renewal, the broadcasters got fighting mad.

Under the existing licence, broadcasters estimate they will pay ASCAP $5,000,000 during 1940. This sum represents two-thirds of ASCAP's total revenue from all sources, and is a 900 per cent. increase over what they paid in 1931. Under the terms of the proposed new licence, it is estimated that broadcasters will have to pay ASCAP $8,500,000 during 1941.

Music Publishers' Reward

ASCAP defends its demands as follows: In pre-radio days a song like *Three o'Clock in the Morning* sold 2,500,000 copies of sheet music. From such sales composers, authors and publishers were able to reap a fair return. In those days a large publisher of popular music published four or five songs a week. Nowadays the same publisher has to publish 20 to 25 songs a week to keep up with radio's voracious demands—at a cost of $1,000 to $2,500 per song.

To-day a hit tune is plugged unmercifully over the air (at the publisher's instigation, by the way), and is dead within a few weeks. Successes like *The Last Round-up* and *The Old Spinning Wheel* do not sell more than 200,000 copies of sheet music.

Therefore, since fair returns are no longer to be had from sheet music sales, ASCAP must look for its revenue to performing rights; and since radio created this situation and is the biggest user of music, radio should pay the lion's share. Radio business in the U.S. amounts to $900,000,000

Review of American Radio—

annually, of which $171,000,000 represents sales of time on the air—ASCAP's target. The rest is in radio receivers and other equipment. ASCAP contends that without music this enormous volume of business would not be possible.

On their side, the broadcasters contend that they can no longer tolerate a situation whereby they are at the mercy of a monopoly for the supply of one of their most important raw materials. They point to other major industries which have purchased or created their own sources of supply. So, through the National Association of Broadcasters, they have contributed a pool now totalling $1,500,000 and formed Broadcast Music, Inc., to publish and supply them with music under their own control. BMI is already in operation and expects by December 31st to have accumulated a library of popular music sufficient to enable the broadcasters to start off 1941 without resort to ASCAP music. The two major networks have announced that after December 31st they will use no more ASCAP music.

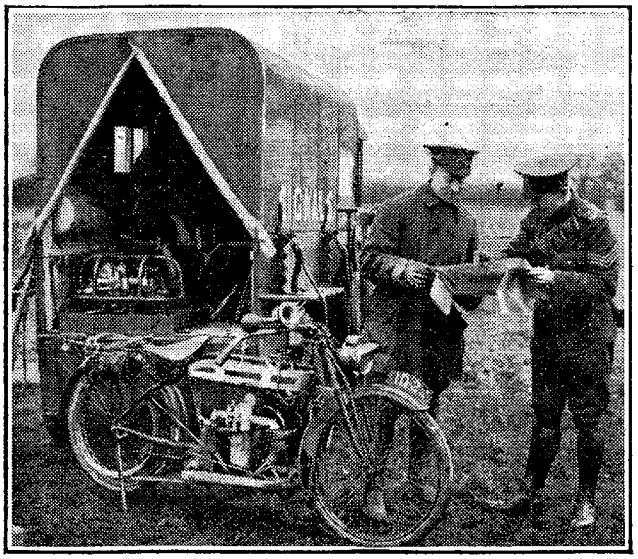
From the American listener's standpoint this means that he or she will no longer be able to hear the works of many favourite composers, such as Irving Berlin, Cole Porter, Victor Herbert (who founded ASCAP), Rudolf Friml, Sigmund Romberg, Ferde Grofe, George Gershwin, Jerome Kern, Walter Damrosch, Ethelbert Nevin, Olie Speaks and Vincent Youmans, whose compositions are controlled by ASCAP.

It remains to be seen what the listener will have to say when this situation is suddenly sprung on him.

America's 55,000 amateurs are still merrily chewing the rag, but only amongst themselves. When the war started the FCC ruled that they must not communicate with amateur or other stations in belligerent countries. Just recently another ruling has gone forth prohibiting American amateurs from communicating with any stations outside the boundaries of the United States or its territorial possessions. The object is to prevent "fifth column" activity.

If the United States should become involved in war, all amateur stations will be closed down and sealed with the exception of a comparative few on different frequency bands who are organised to co-operate with the U.S. Army in maintaining a communication network for the conduct of certain essential services.

So far as broadcasting stations are concerned, the advent of war involving the United States is not expected to disturb the existing set-up too drastically. In other words, commercial broadcasting as now known will continue; otherwise, all entertainment programmes would disappear, and the Government is not geared to provide a substitute service. It is expected that the Government will have first call on all non-commercial time and retain the right to interrupt any commercial or other programme to air important Government bulletins or news items. It is expected also that uniformed censors will move in on every station and be on hand at all times to scrutinise every word before it is broadcast—and pounce on anybody who extemporaneously departs from his approved script.



This photograph, sent by a reader, shows that externally there is little difference between this transmitting van of the signals section attached to the Westmorland and Cumberland Yeomanry in the early days of the Great War and its modern counterpart. The part then played by wireless was, however, relatively small compared with the important role it has assumed both with the forces and on the home front in the present struggle.

Henry Farrad's Problem Corner

No. 49.—A Disappointing Pick-up

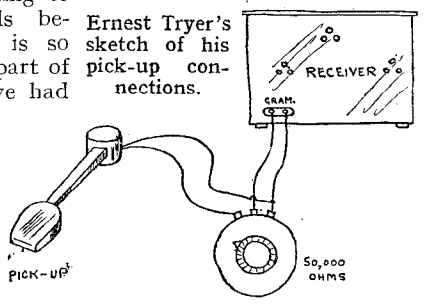
An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:—

67, Muddlecombe Buildings,
Nether Backwash.

Dear Mr. Farrad,

Reading *The Wireless World* I have several times seen that people are taking to gramophone records because broadcasting is so bad. Now in this part of the country we have had very bad reception since the War, what with fading and bellowing out and all that. So I have fixed up a gramophone motor and pick-up to the receiving set. I have made the connections exactly as they should be (see the enclosed drawing). The pick-up is a very common sort, and, although results are not bad, as I am very particular, I thought I'd go in for something really good and get a "piezo-electric" crystal pick-up. I have fitted it in place of the other, and now the results are worse; there is hardly any bass.

Ernest Tryer's sketch of his pick-up connections.



I don't want to trouble you a lot, but the new pick-up is expensive and I reckon I ought to get good bass, like it is supposed to give. So if you would let me know if I should send it back I would be very grateful.

Yours very truly,
ERNEST TRYER.

Is there good reason to suppose that the new pick-up is faulty, and if so why? Think it over, and then turn to p. 368 for Henry Farrad's explanation.

Cross Modulation

ITS EFFECTS IN DIFFERENT STAGES OF A RECEIVER

By "CODON"

HAVE you ever realised that it is only the linearity of the transmitting medium which enables a sufficiently selective receiver to pick out any one of the large number of broadcasting stations which are transmitting simultaneously on different frequencies? Since many of our man-made instruments, such as valves, iron-cored coils, and loud speakers, are so often more or less non-linear that linearity seems almost an exceptional property, does it not seem remarkable that the medium through which signals are propagated from transmitter to receiver is so perfect that there is negligible distortion or mutual interference?

A knowledge of the nature of cross modulation is still useful in detecting its effects, although, thanks largely to improvements in valve technique, the trouble is not so prevalent as formerly.

It is true that such an effect does occur sometimes when a powerful long-wave station is involved, namely, the "Luxembourg Effect"; but this is regarded as a rare exception to the general rule. But, you may say, the transmission is taking place through free space, and there is plenty of room for all the signals in "space."

Then consider a more concrete example: television receivers use the same aerial for reception of both sound and vision signals, and many of them even use the same RF amplifying valve and frequency-changing valve for both, yet the two sets of signals are completely separated later in the receiver. How can the circuits carry two different signals, requiring the electrons which carry the currents to move in two different ways at once, without the signals getting mixed up?

As a matter of fact, everyone seems to have taken it for granted in the first place that there would be no mutual interference; and it was only when the combination of some of the early screened-grid valves and the first high-power broadcasting stations occurred that the ordinary listener was forcibly reminded that two signals might mutually interfere in the receiver in such a way that no amount of selectivity applied afterwards could separate them.

This phenomenon was called "cross-modulation," because it appeared that the modulation of the two signals was crossed over. What is it, then, that decides whether cross-modulation will or will not occur in any given piece of apparatus? The key to the problem is contained in the example above, where the combination of a strong signal with a valve that was designed for weak signals caused trouble; mutual interference is likely to occur whenever there is "overloading," or more exactly, non-linearity.

It is easiest to see the case in which the signal-handling capacity of a system is limited by an abrupt cut-off. As a mechanical example, consider a tuning fork which is maintained in vibration at its natural frequency of, say 1,000 c/s and at the same time swung bodily from side to side 50 times per second. If there is plenty of room for the tuning fork to move, the 50 c/s oscillation need not interfere with the 1,000 c/s vibration. But suppose there is a stop on one side of the fork so placed that it could perform either the 50 or 1,000 c/s motion, but has not room for the two at once; if initially the fork is moving in either one of the two modes, the addition of the other will cause it to hit the stop and so modify or distort both of them. This mechanical system may be regarded as the analogue of an AF amplifying valve, the abrupt stop representing the flow of grid current which prevents the valve grid from being driven positive. The 1,000 and 50 c/s vibrations of the tuning fork correspond to a 1,000 c/s and a 50 c/s voltage applied to the grid of the valve, and if the combined voltage is sufficient to run into grid current, there will be mutual interference between the two signals.

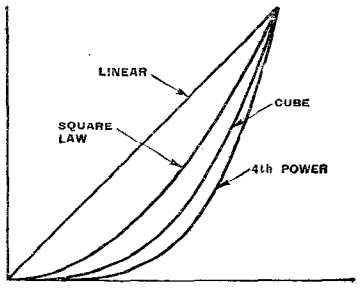


Fig. 1.—Characteristic curves following various non-linear laws are here compared with a linear curve

Suppose now that in order to avoid grid current the negative bias on the overloaded valve is increased; assuming that the signal is really too big for the valve to handle, the result will merely be to change from grid-current to anode-bend distortion. The latter appears more complicated, since in place of an abrupt limitation of the signal we have a more or less gradual tailing away of the amplification of the stage. It is fairly easy to see that when the strong 50 c/s signal brings the grid potential of the valve down to the bottom-bend region of the characteristic, where the slope of the valve is less than in the proper working region, the amplification of the 1,000 c/s signal will be momentarily reduced, though not completely extinguished, 50 times per second. (This has been explained at length in previous articles in *The Wireless World* on the subject of cross-modulation versus harmonics as the chief source of audible dis-

Cross Modulation—

tortion.) But in order to understand the different effects which can be produced by cross-modulation in AF and RF amplifying valves, we

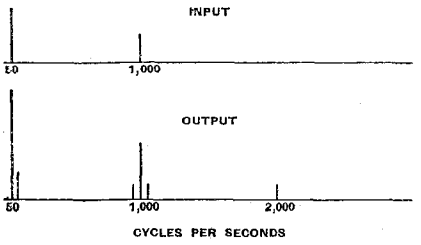


Fig. 2.—Production of spurious frequencies in the output of an AF amplifying valve with a square law characteristic

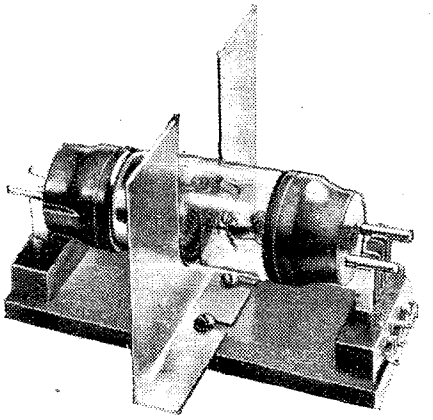
must venture a little nearer the mathematics of the problem.

A linear device is one whose output is simply proportional to the input, while a square-law device has its output proportional to the square of the input; a valve working over its anode bend approximates to a square-law device, a property which is useful for certain types of valve voltmeter. But one can also have characteristics which follow a law of higher power, such as cube, 4th power, and so on, and a selection of these are illustrated in Fig. 1 drawn to scales such that they all reach the same value of output at the highest value of input considered. One can see immediately that the higher the power of the output/input law, the greater the curvature of the characteristic; and one has only to add that a practical characteristic is likely to contain the sum of several different powers to give a fair idea of the way in which a sharply curved characteristic needs a number of terms, running to high orders, to represent it mathematically.

Sum and Difference Frequencies

We have now to borrow one more bit of information from the mathematicians. It may come as a surprise to the non-mathematical wireless man to hear that the sines and cosines of our sine waves are closely related to logarithms. (The link between them involves *e*, the "base" of natural logarithms, and the square root of minus one whose "imaginary" nature is no difficulty to the mathematician.) Anyway, when two sine functions of different frequency are *multiplied*, the result contains components at the *sum* and *difference* frequencies, just as when two numbers are multiplied together the logarithm of the result is the sum of the logarithms of the two numbers.

Let us apply this information first to a square-law characteristic. For the square-law rectifier, a suitable input would consist of a carrier plus a single side-band; the output will then contain the difference frequency between the carrier and side-band, i.e., the modulation frequency. Thus the square-law rectifier is a satisfactory one to use on a single-side-band signal, for apart from the wanted modulation the out-



The early screen grid valves were especially prone to cross modulation troubles

put will only contain twice the carrier and side-band radio-frequencies and their sum, which are of no significance. But if a square-law rectifier is used on an ordinary double-side-band signal, the output will contain first the difference between each side-band and the carrier, namely, the modulation frequency, and secondly the difference between the two side-bands independently of the carrier, which is twice the modulation frequency, so that with a normal signal the square-law rectifier produces harmonic distortion.

Next consider the over-biased and overloaded output valve, whose anode bend characteristic we will assume to follow a square law. When the input consists of a number of different frequencies, the mathematical operation of squaring the input (in order to find the output) means that we must square each term separately, obtaining harmonics, and also multiply them together in pairs in every possible combination, obtaining all possible sum and difference frequencies. We then have the well-known effect that on applying the two signals of 50 c/s and 1,000 c/s, which were considered earlier, the output from the valve will include components at 50, 100, 950, 1,000, 1,050 and 2,000 c/s. A square-law characteristic is a fairly simple case, yet the application of two frequencies to the input produces no less than six different output frequencies; clearly the possibilities of distortion are very great for characteristics of higher order. Taking a cube law, for example, in addition to third harmonics the signals are to be combined in all possible groups of three, or if only two signals are present the square of one is to be combined with the first power of the other and vice versa. These two examples are shown diagrammatically in Figs. 2 and 3. (The amplitudes of the various components are not to scale.)

In RF Stages

So far we have only considered distortion in AF signals, but now that we have examined the cube law characteristic we are ready to investigate cross-modulation in an RF amplifier. Suppose the signal applied to a cube law RF amplifier consists of a wanted carrier of frequency W kc/s, and an unwanted modulated signal having carrier U kc/s, and side-bands U+S and U−S kc/s. The output will contain all possible frequencies obtained by adding or subtracting the original

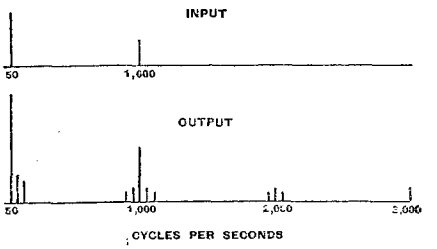


Fig. 3.—Another example of the ill-effects of non-linearity. In this case the valve is assumed to have a cube law characteristic.

Cross Modulation—

frequencies in groups of three; in particular it will include

$$W+(U+S)=U-W+S$$

and $$W+(U-S)-U=W-S.$$

The side-bands S which originally belonged to the unwanted signal U have thus been transferred to W, and cannot be eliminated by selective circuits which separate U from W; hence the name "cross-modulation."

The Cure

Now the obvious solution to RF cross-modulation would appear to be to make the amplifier linear; but unfortunately this would prevent one from obtaining volume-control, either manual or automatic, by variation of grid bias. (It is true that it has been proposed to use hexode valves, so that a separate grid would be available for AVC, the signal grid retaining a linear characteristic, but the idea of adding yet another grid to the already intricate screened valve, if it can be avoided by other methods, is not likely to be popular with manufacturers.) There is, however, one way of avoiding the difficulty, and this is used as nearly as possible in variable-mu valves. The mathematical proof of the method cannot be given here, but it was mentioned earlier in this article that sine waves are related to logarithms; the result is that if the valve curve is logarithmic, the distortion frequencies which appear in the output are only *sums* of groups of input frequencies, and contain no differences. The result is that combining wanted and unwanted signals can only produce frequencies of the order of double the original frequencies and higher, which are easily eliminated by the following tuned circuit; so there is no cross-modulation, although the valve has a curved characteristic which makes it possible to obtain AVC.

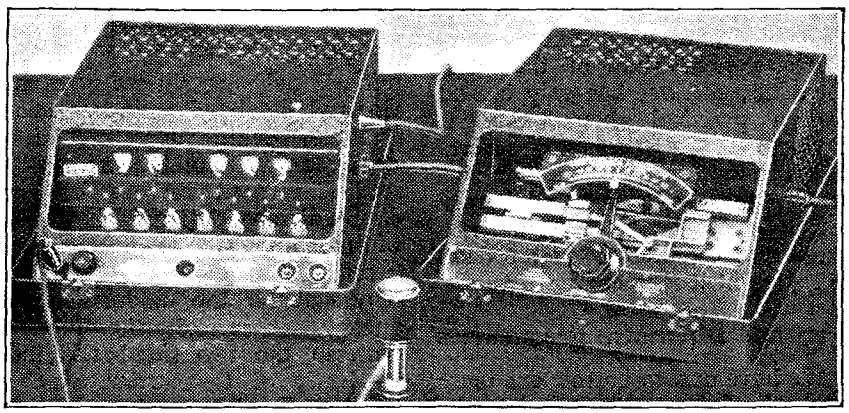
A less familiar problem is the possibility of cross-modulation in the mixer valve of a superhet. receiver. Since there would be three signals concerned in such a process, wanted, unwanted and local oscillator, the characteristic must have curvature of at least the fourth power before modulation on the unwanted signal can be transferred to the intermediate frequency corresponding to the wanted signal. In general, the higher the power of curvature required to produce an effect, the less pronounced it is, so that mixer cross-modulation would be expected to be less troublesome than RF amplifier cross-modulation, but this is partly off-set by the fact that superhetorodyne receivers are usually more sensitive than small "straight" sets. It is therefore desirable to use adequate selectivity before the mixer to keep down the strength of the local station when listening to others, and, of course, if the second channel is not fully suppressed the possibilities of interference are automatically doubled.

The old-fashioned anode-bend rectifier type of first detector was inherently a non-linear device, and therefore exposed to the risk of cross-modulation. The modern "multiplicative" mixers, on the other hand, such as heptodes, hexodes, etc., do not depend upon curvature of the (anode current)/(signal-grid voltage) characteristic to produce the difference frequency, but use the fact that the output is the product of the signals applied to two successive grids; this does not involve any combination with each other of various signals present on the signal grid, but only the combination of every one of them with the signal on the injector grid, so that the result is a number of IF signals corresponding separately to the different input signals and free from cross-modulation. It is then the business of the valve manufacturer to keep the conversion characteristic of the valve free from third and higher power curvature as far as possible. In practice the problem may be complicated by the need for applying AVC to the frequency-changing valve.

If this article has succeeded in its purpose, the reader should now realise that while any non-linearity involves some distortion of the signal passing through the device in question, the amount of harm done depends upon the particular shape of the non-linear characteristic and on the stage of the receiver in which it occurs.

IS IT IN TUNE?

Instantaneous Visual Observation of Pitch



Designed for giving visual indication of the accuracy of pitch, this instrument may be used not only for tuning musical instruments, but also as an aid to vocalists in achieving good intonation.

A microphone picks up the sound, which is amplified and made to modulate the illumination of a series of stroboscopic discs with different graduations in the unit on the left. Each disc corresponds to a semitone, and there are graduations for 7 octaves of each note. When a note is sounded one of the discs will appear stationary and its frequency may be read off. If the pitch does not exactly coincide with any of the semitone discs the speed of rotation may be varied by an operator and the amount by which the pitch is in error will be indicated on the scale on the right-hand unit. The accuracy of adjustment is equivalent to one-hundredth of a semitone. The maker is C. G. Conn, Elkhart, Indiana, U.S.A.

Collecting Short-wave Data

LONG-PERIOD OBSERVATIONS OF PROPAGATION CONDITIONS

By D. W. HEIGHTMAN

CONDITIONS of propagation on all short wavebands are, fundamentally, dependent chiefly on the degree of ionisation in the various layers of the ionosphere, which is, in turn, dependent on the sun's radiation. The greater the degree of ionisation in a layer the higher the frequency it will reflect to earth.

A simple and comprehensive record of short-wave conditions is, therefore, given by observing the highest frequency which is returned by the various layers of the ionosphere on any particular day. If the signal is transmitted vertically upward, the highest frequency reflected will be much less than that of a signal which leaves the earth at a low angle and just skims the layer. The latter frequency, in the case of the F-layers, is generally about three times higher

MONTHLY AVERAGE OF DAILY UPPER FREQUENCY LIMITS FOR F-LAYERS (ALL DIRECTIONS). FREQUENCIES IN MC/S.

	1937	1938	1939	1940
January ...	38.6	34	37.25	28
February ...	43.25	39.1	31.6	28.4
March ...	39.1	36	29.3	30.6
April... ...	34.5	30.6	28.5	
May	29.6	29.6	26.6	
June... ...	28.0	27.3	29.2	
July	27.1	27.4	26.5	
August ...	29	30	25	
September ...	33.8	32.6	29.8	
October ...	40.25	33.8	32.1	
November ...	42.6	42.5	32.8	
December ...	38.5	37.25	30.0	

Peak days, up to 15 per cent. higher frequency than average.

than the former. Research stations of the National Bureau of Standards in America and the National Physical Laboratory in England, among others, make daily measurements with complicated apparatus in the former manner, i.e., transmission of the signal vertically upward and measurement of the highest frequency reflected (in addition to other observations).

It is, however, not beyond the average listener, with a frequency-calibrated receiver, to make a similar record of signals transmitted at low angles. Nowadays, there are so many transmitters, in various parts of the world, operating on high and ultra-high frequencies, that one can be practically certain of receiving either fundamental or harmonic signals up to the frequency limit for any particular day. The system, then, is just to listen for brief periods at various times during the day, tuning the receiver gradually higher in frequency until no further signals are heard, making a note of the highest frequency signal received.

Generally speaking, the signals higher than 20 Mc/s will be those reflected by the F-layers, but occasionally, particularly during the summer months, some E-layer signals will be heard as high as 60 Mc/s or more. The two types may be distinguished by the fact that E-layer signals are seldom heard from distances in excess of 1,000 miles, while F-layer signals generally come from distances well over 1,000 miles.

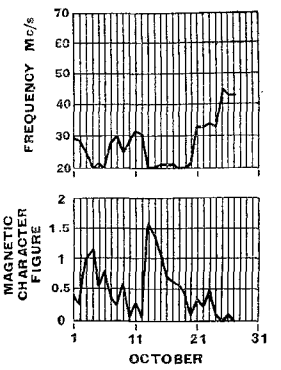


Fig. 1. F-layer upper frequency limit from U.S.A., October, 1939, showing drop occurring with periods of high magnetic disturbance.

The results of the observations above mentioned can most simply be recorded in graphical form. Signal routes covering directions north of east or west (particularly the latter) are subject to considerably more variation in day-to-day frequency limits than those from southerly directions, and it is generally preferable to note the limiting frequencies for the two directions separately.

During the past several years the writer has carried out daily observations of the above nature. The results have been tabulated in the accompanying table, which gives the monthly average of the daily frequency limits for all directions, since 1937. This table shows that undoubtedly the peak period was that of winter 1936-37, and conditions have gradually been falling off since. The 11-year average between sunspot maxima gave 1939 as the peak year, but in this instance only nine years elapsed since the previous maximum. There is, of course, always a drop in the F-layer limit during the summer months as the table shows. Early and late winter months provide best conditions, with a slight drop in mid-winter.

At times of abnormal sun spot activity, what are known as ionospheric and magnetic storms take place. Under such conditions there is a considerable reduction of the upper frequency limit. Fig. 1 indicates the effect on the upper frequency limit from U.S.A. during October, 1939. The amount of magnetic disturbance is measured at many observatories in various parts of the world, and a character figure assessed according to the intensity of the disturbance. The lower graph of Fig. 1 gives the day-to-day variation in the "magnetic character figure." The latter may be likened to the figure which meteorologists use to represent the state of the sea, or the wind on the Beaufort scale. A magnetic character figure of 2 represents a disturbed day, 0 a quiet day, and 1 a day of intermediate activity.

The E-layer limit increases during the summer months and spasmodically reaches very high values. Fig. 2 shows the graph of such signals for the summer of 1939. Here again the graph is compared with that of the magnetic activity for the same period.

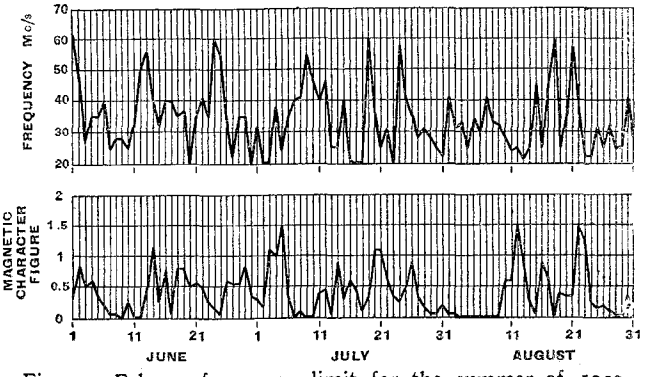


Fig. 2. E-layer frequency limit for the summer of 1939 compared with magnetic activity.

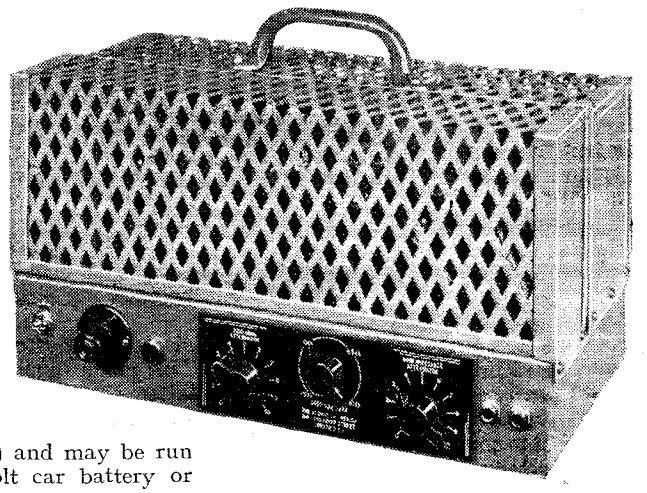
Collection of Short-wave Data—

It will be observed that peak conditions are generally followed in a day or two by magnetic storms. This is due to the fact that sunspots generally have two opposed effects on the ionosphere, the first being an increase in the ionising radiation to provide better conditions, while the second, which generally occurs suddenly a day or two afterwards, causes very disturbed conditions, reduced ionisation, magnetic storms, etc. The latter radiation is thought to be of corpuscular nature and slower moving than the ultra-violet radiation.

The C25 Acoustical Amplifier

A COMPACT UNIT SUITABLE FOR MOBILE EQUIPMENT

IN most PA work compactness and portability are considerations which play an important part in the choice of equipment. There must be few amplifiers of comparable specification which occupy as little space as the Type C25 made by the Acoustical Manufacturing Co., 201-205, Lever Street, London, E.C.1. Weighing only 18 lb., its dimensions are 14 × 7 × 7in., yet it has a power output of 30 watts, is provided with separate channels for high and low impedance inputs (the latter polarised for carbon microphones) and may be run from either a 12-volt car battery or AC mains.

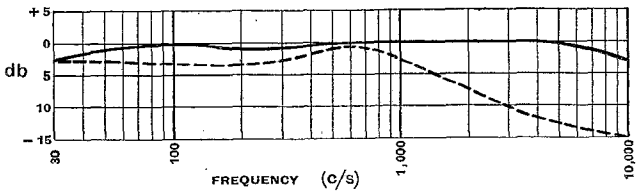


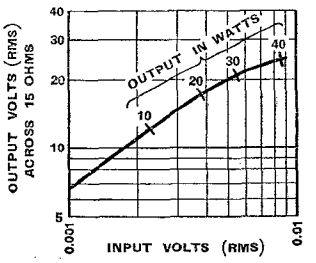
Acoustical Manufacturing Co.'s Type C25 amplifier.

Three double-triode valves precede the push-pull output stage and the circuit is briefly as follows. The two halves of the first valve function as separate first-stage amplifiers for the high- and low-impedance inputs. A polarising potential for the latter circuit, which is matched to 200 ohms, is derived from the cathode bias resistance of the output stage.

Independent volume controls in the RC couplings following these stages lead to the grids of the second valve, in which the anodes have a common load resistance. This arrangement gives mixing of the two channels without mutual interaction.

The first half of the third double-triode valve functions as a further stage of straight AF amplification, with a resistance-capacity tone control across its grid circuit. The second half effects phase reversal for the input to the KT66 push-pull output valves. When worked under class AB1 conditions with 400 volts in the plate these have a rated output of over 30 watts. The output transformer is tapped to match loads of 4 or 15 ohms, the required impedance being selected by a switch. Other load impedances can be catered for if ordered specially.





(Above) Frequency response curves of Acoustical Type C25 amplifier. The dotted curve shows effect of full use of the tone control. (Right) Input-output curve of Acoustical Type C25 amplifier. With direct connection to the grid cap of the first stage 30 watts is obtained for an input of 0.0055 volt.

Separate primary windings are provided in the mains transformer for AC mains or the vibrator input. The vibrator is not of the synchronous type and its output is rectified and smoothed by the mains equipment. The circuit connections for mains or battery operation are changed by means of a six-pin plug fitting into either of two sockets. No damage will result if the plug position does not happen to accord with the type of supply when the amplifier is switched on.

On test the amplifier gave 20 watts without any trace of distortion being revealed either by the input-output curve or the cathode-ray oscilloscope. Subsequently it was discovered that the mains and consequently the HT voltage were down, and there is no doubt that if this point is given the attention it requires the full rating of 30 watts will be obtained. Full power is given for an input of 0.0055 volt RMS in the grid of the first valve. In the amplifier tested, the high-impedance input was connected to the grid of the second stage for gramophone reproduction with normal pick-ups, and in this case the input required for full power was 0.072 volt RMS.

The measured frequency characteristic showed a loss of less than 3 db at 30 and 10,000 c/s with the tone control turned fully clockwise. The curve obtained at the other extremity, and with the maximum top cut, showed a steady fall of about 15 db between 600 and 10,000 c/s.

On a 12-volt car battery the amplifier took 8.6 amp. and its performance was in every way comparable with that in AC mains. The vibrator unit was quiet both electrically and mechanically. A switch is provided to break the HT circuit and economise current during intervals between announcements, while keeping the valve heaters ready for instant use.

From every point of view this amplifier shows refreshing originality in design, but at the same time is kept within the bounds of practical PA requirements.

The price is £28 and a high-grade transverse current microphone to work with it is available at £4.

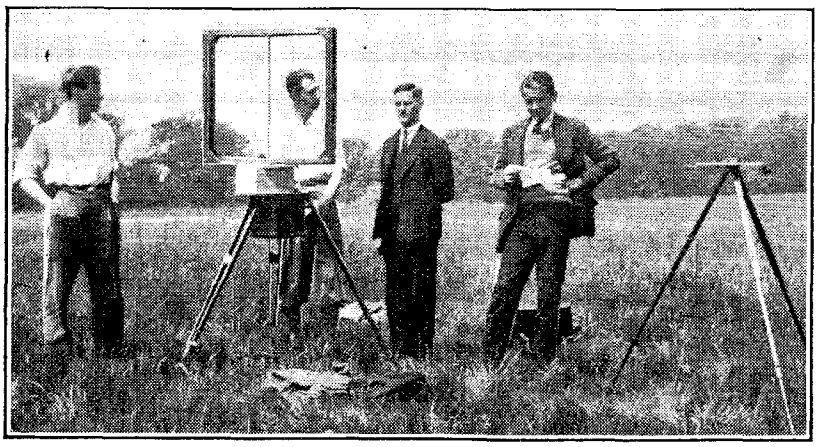
Taking Bearings

OPERATING AN AMATEUR DIRECTION-FINDER

By ALEXANDER BLACK

In last month's issue the design and construction of a simple direction-finder for amateur use was described. The procedure in taking and laying off bearings is now explained.

WE will assume that a set on the lines of that described last month has been constructed and given a preliminary test on the workbench and that signals are received satisfactorily, particular attention being given to the reaction control as it is essential that the set should go into oscillation gently and without plopping. The frame aerial should turn smoothly but not too easily. It is very disconcerting if the frame is moved by a gust of wind while it is being sighted with a compass. Do not worry if you find it impossible to get a satisfactory minimum when taking bearings indoors; on 40 metres the wave of any station over 40 miles distant is almost entirely vertical and so it is impossible to DF under any circumstances. If you have a lead roof or other metal work anywhere above the set, the effect of this completely upsets DF working on almost any wavelength.



Here is a list of the apparatus required: Set complete with batteries; headphones; vertical aerial; earth rod and wire; table for set; map on board, ruler, protractor, set square and pencils; compass and stand or tripod. A suitable table on which to stand the set out of doors can be a small folding card-table which has the advantage of being light and easy to carry.

The map should be pinned to a plywood board. Any of the 1in. Ordnance Survey maps can be obtained on paper and unfolded, and are cheaper than those mounted on cloth. The ruler or straight edge should be 15in. to 24in. long. As regards the protractor, the author uses a circular transparent one 5in. in diameter engraved 0-360 deg. A $\frac{1}{32}$in. hole is drilled in the centre, and countersunk on the reverse side. A cotton thread about 24in. long, knotted at one end, is then drawn through until the knot comes to rest in the countersunk hole. All that is necessary to read off a bearing quickly on the map is to put the centre hole of the protractor on your position and, by stretching the thread taut, any particular bearing may be easily traced to the edge of the map.

Regarding a suitable compass, it will be realised that this is one of the most important items of equipment; it must be accurate to within $\frac{1}{2}$ deg. and easily readable. The author uses an ex-Army type of prismatic compass. A good test for a compass is to place it on a firm stand and sight some object a few hundred yards away, take a careful note of the bearing; the needle should then be made to swing again and with the compass in the same position the bearing again taken; this should be repeated about half a dozen times. With a good compass the variation will not exceed about $\frac{1}{4}$ deg. When taking bearings, keys and other steel objects such as pliers and screwdrivers and in some cases even a wrist watch should be removed, as they may cause errors. Similarly, headphones should never be brought within 6ft. of a compass when taking bearings. It is advisable to have some kind of stand for the compass when taking readings; a wooden or brass tripod is suitable.

Having set up your receiver in a suitable field, fitted the vertical aerial (if you are using one) and connected your earth, you should then carefully tune in a station you wish to DF. Whether it is CW or phone, make the set just oscillate with the reaction control and then slightly detune until the beat note produced is at a suitable pitch and easy to listen to; the frame should then be swung round until the two positions of weakest signal are found; choosing one of them, the frame should be swung backwards and forwards across the minimum, at the same time adjusting the differential condenser on the vertical aerial until an adjustment is reached when the signal completely disappears over a degree or so as the frame is rotated. The operator should stand square with the frame when in the approximately minimum position with a hand on each side of the aerial; in this way body effects are almost negligible.

Having found one minimum it is a good plan, with a new set especially, to check the reciprocal bearing

Taking Bearings—

which should be, of course, exactly 180 deg. different. Until the differential condenser is adjusted again the second minimum should be very

A receiving site clear of all obstructions minimises the risk of inaccurate bearings.

flat and indefinite; by readjusting the differential it should be possible to get the second minimum equally as good as the first. If the two minima do not come 180 deg. apart a careful check should be made of all the mechanical details; if you are using a 0-360 deg. scale mounted on the frame as suggested assure yourself that it is fitted accurately. Make certain that the frame aerial winding is parallel with the aerial screening and spaced evenly.

Compass Bearings

It will facilitate taking the compass reading if a sight can be fitted at each end of the top of the frame aerial case. Having found the minimum with the frame, the compass and stand are taken about 12 feet away from the set and in line with the frame. The compass is then placed on the stand (a platform about 12in. × 3in. is useful as it allows the compass to be moved until it is accurately in line with the frame), a reading is taken, but it must be remembered that as a minimum signal was taken, the frame is at right angles to the direction of the transmitting station, therefore the correct bearing is obtained by adding or subtracting 90 from the compass reading.

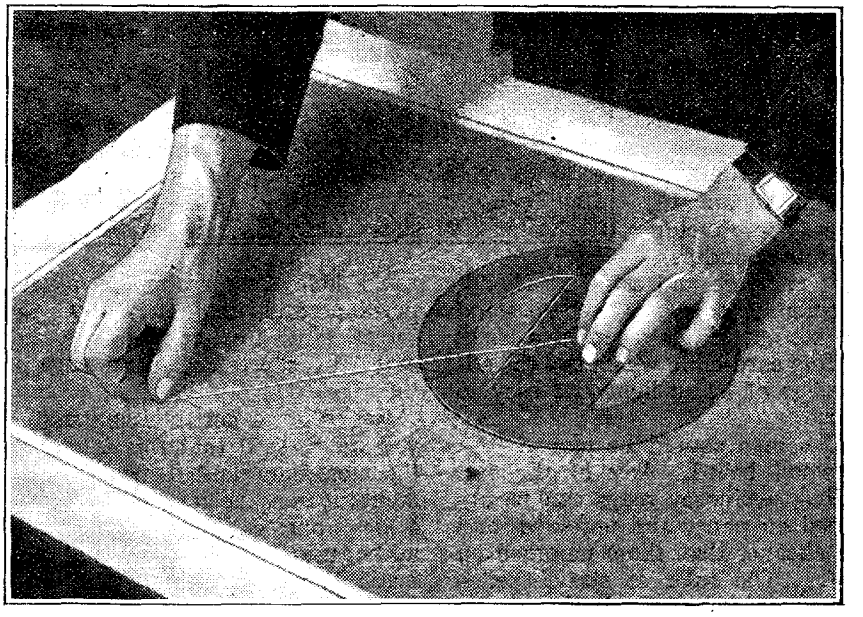
A point to be remembered is that as the differential condenser acts as a sense finder, it is possible to mark an arrow on top of the frame case at right angles to the plane of the aerial; this will show the direction of the transmitter with the frame at its minimum when the differential condenser is, say, turned to the right of zero. Whether the condenser should be turned to the left or right can be ascertained on a transmitter whose position is known.

Let us now consider the question of maps. Undoubtedly the best ones to use for distances up to about 20 miles are the Ordnance Survey 1in. to the mile; they are reasonable in price, easily obtainable and give sufficient detail to enable one to plot one's position accurately. On the latest edition it will be found that the map is divided up into approximately $2\frac{3}{4}$in. square by fine lines, known as "grid lines." The vertical lines do not run due North and South, but are approximately 1 deg. east of north in the case of Hertfordshire.[1] The correction is given in top right-hand corner of the newer maps together with the magnetic variation; it must not be forgotten that the compass gives a magnetic bearing and not a true one; in order to avoid mistakes it is as well to note down each bearing taken as follows: Compass reading, say, 263 deg. – 90 for minimum position of frame = 173 deg. – 11 deg. for magnetic variation plus 1 deg. for correction on grid lines = 163 deg., which is the bearing to be plotted on the map.

Plotting Bearings

The receiver's position is marked on the map by a pencil point; a line about 6in. long parallel to the vertical grid lines is then drawn through

[1] A method of estimating the divergence between the grid lines and true North was described in *The Wireless World* of May 12th, 1938.



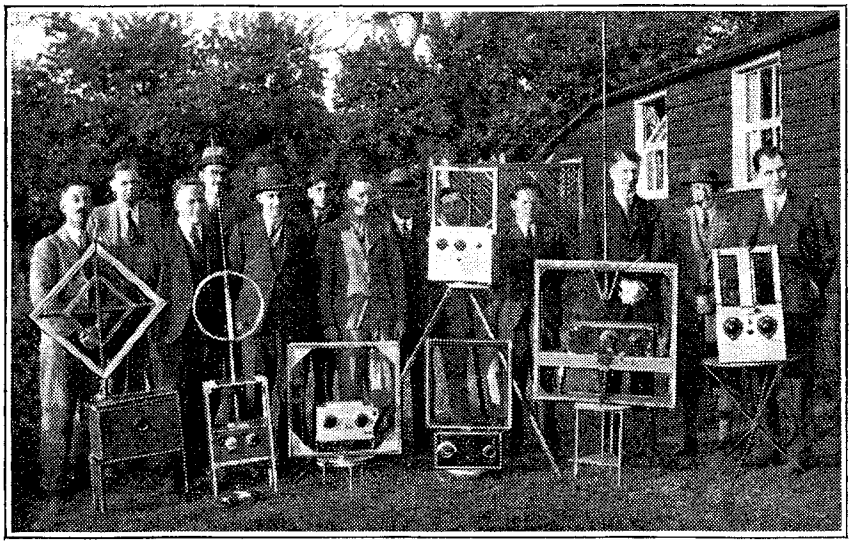
In some circumstances bearings may conveniently be laid off by means of a stretched thread, secured to the centre of the protractor in the manner described in the text.

Taking Bearings—

it. The centre hole of the protractor is placed over the point; when the 0 deg. and 180 deg. marks are over the vertical line, the bearing can then be plotted. If it is proposed to work at greater distances the ½in. or ¼in. to the mile maps may be used, but the same care must be taken that true north and south lines are drawn over the receiving point before using the protractor, and that the correct amount is subtracted for magnetic variation.

Experiments show that hedges, trees and buildings within about 50 yards (in the case of 40-metre transmissions) act as reflectors and create an error of anything up to 10 deg. in direction; the maximum error appears to be caused when the objects are at right-angles to the direction of the transmitter. Reasonably flat country is best for these experiments, as it has also been found that hills influence bearings.

It will be found that at some good receiving sites it is possible to get accurate bearings in some directions, while errors are recorded from transmitters in other directions. Some investigators consider that the surroundings by the transmitter's aerial and the type of country between it and the receiver, such as hills, woods, lakes or reservoirs, have an influence on the accuracy or otherwise of the bearings obtained. The author, however, is strongly of the opinion that it is the surroundings of the receiving site that cause the errors. In going through the individual logs of the competitors for the last few years of the Golders Green and Hendon Radio Society's pre-war field days, on almost every transmission one competitor at least got a 1 deg. error or less. If, on the other hand, the surroundings of the transmitter did have an influence, one would not expect to get accurate results from any of the receiving groups on that particular transmission.



The different types of frame-aerials used for amateur direction-finding are well shown in this photograph, taken at a peace-time field day of the Golders Green and Hendon Radio Society.

MAINTAINING A SERVICE

IN the current issue of *The Wireless Engineer*, which was published on July 1st, over 350 articles on wireless and allied subjects recently published in some forty technical journals of ten different countries are abstracted or referred to in the Abstracts and References section, which is a regular feature of our sister journal. Compiled by the Radio Research Board, this section is becoming increasingly valuable in view of the present difficulty experienced in obtaining publications from abroad.

In the July issue, which is obtainable through newsagents or direct from the Publishers, Dorset House, Stamford Street, London, S.E.1, at 2s. 8d. post free, a short description of a battery-operated power unit for a cathode-ray oscillograph is given. In another article in the same issue the stability of regenerative circuits is discussed.

Anti-Interference Data

E.R.A. REPORTS

IT is not generally realised that a vast amount of information on the nature of electrical interference with radio reception, and more especially on methods of suppressing it, is available in various reports published during the past few years by the British Electrical and Allied Industries Research Association—generally known as the E.R.A. A list of publications on these subjects follows:—

M/T27: "Simple Apparatus for Comparative Observations of Radio Interference Produced by Electrical Appliances."
M/T28: "The Suppression of Short-wave Radiations from Automobile Ignition Systems." 4s., post 2d.
M/T29: "The Suppression of Broadcast Interference from Trolley Buses." 3s., post 2d.
M/T30: "Some Considerations in the Measurement and Suppression of Radio Interference." 1s. 6d., post 3d.
M/T39: "The Magnitude of the Radio Frequency Disturbance from Trolley Buses and the Use of Condensers and Other Devices in its Suppression."
M/T42: "The Suppression of Broadcast Interference from Electric Lifts."
M/T44: "The Properties and Performance of the E.R.A. Short-wave Receiver for Field Strength Measurements."
M/T45: "Methods of Measurement of Radio Interference." 2s., post 3d.
M/T46: "A Note on the Representation of Rectification by a Fourier Series." 1s., post 2d.
M/T47: "Short-wave Interference from Ignition Systems." 2s., post 2d.
M/T48: "The Radio-frequency Disturbance from Mercury Arc Rectifiers and its Suppression." 3s., post 4d.
M/T50: "Short-wave Radio Interference Produced by Electro-Therapy Apparatus." 1s. 6d., post 2d.
M/T52: "The Suppression of Radio Interference, with Particular Reference to Portable Appliances." 2s. 6d., post 3d.
M/T53: "The Relation Between the Sparking Plug Current and the Short-wave Radiation Produced by Ignition Systems." 3s., post 3d.
M/T58: "The Development of High-frequency Choke Suppressors." 3s., post 3d.
M/T59: "Type Testing for the Interfering Voltages of Small Electric Appliances." 4s., post 3d.
M/T60: "Experimental Ultra-high-frequency Receiver for the Measurement of Radiated Interference." 2s., post 3d.
M/T61: "The Design of High-frequency Choke Suppressors." 2s., post 3d.
M/T62: "The Study of the Capacity Spark in Automobile Ignition Systems, with Special Reference to Short-wave Radio Interference" 2s., post 3d.
M/T63: "The Radiated Short-wave Disturbance from Automobile Ignition Systems." 2s., post 3d.
M/T64: "Apparatus for the Measurement of Interference at Ultra-high Frequencies." 6s. 6d., post 4d.

Copies of reports for which prices are shown are still in print, and obtainable from the E.R.A., 15, Savoy Street, London, W.C.2. The others may be consulted at the Association's offices by arrangement.

The British Journal Photographic Almanac, 1940. Published by Henry Greenwood and Co., Ltd., 24, Wellington Street, London. 2s. 6d. net.—Although some features of this well-known annual have suffered as a result of the war, the same standard of quality is maintained as in normal years. Illustrated technical articles, a well-produced photogravure supplement and reviews of photographic apparatus are among the leading features of the almanac, which is now in its 81st year of publication.

Test Report

Murphy A92 "Stationmaster"

SHORT-WAVE "SPECIAL" WITH STATION CALIBRATION ON ALL WAVEBANDS (FIVE VALVES + RECTIFIER). PRICE £15 . 15s.

BRED from a long line of successful short-wave receivers, this latest Murphy "special" exhibits all the characteristic features of its predecessors in the matter of range, signal-to-noise ratio and image rejection. The ease of tuning resulting from the employment of electrical band spreading on short waves and the stability consequent upon the careful choice of RF components and materials have now been fully exploited, and the arbitrary sub-division of the tuning scale in earlier models gives way to precise marking of the tuning positions of all the principal short-wave stations.

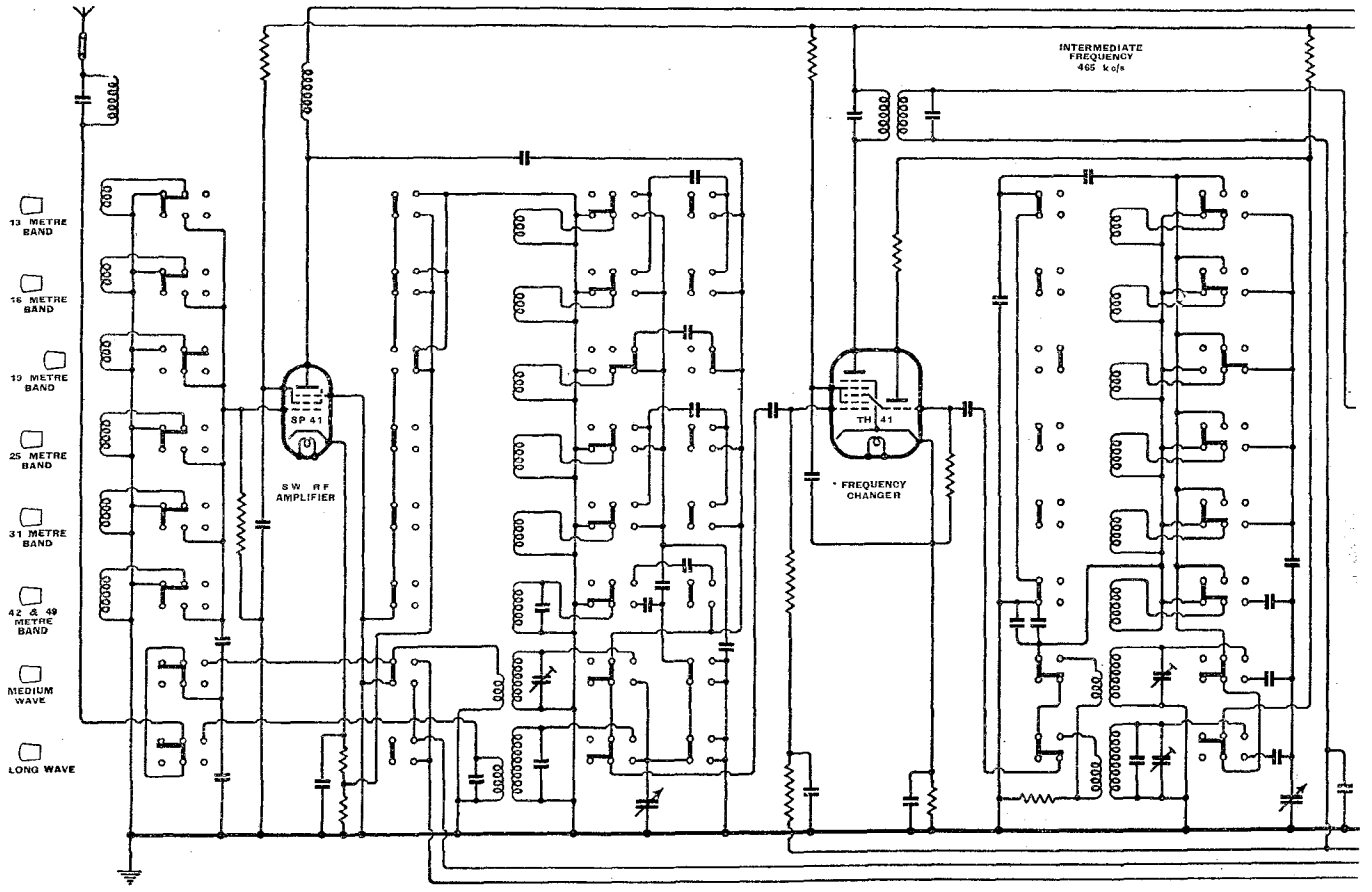
Circuit.—The aerial lead includes an IF filter and there is provision for inserting a local station filter for medium waves which will be supplied free in districts where it is required.

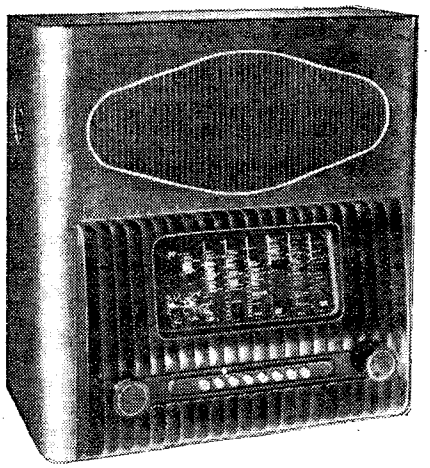
Separate coils with permeability trimming are used for each waveband, and in the aerial circuit they are tuned to the middle of the band on the short-wave ranges, the damping of the aerial being sufficient at high frequencies to ensure the requisite broadness of tuning.

Instead of the band-pass filters used in the A76 to couple the RF stage to the frequency changer, a single tuned grid circuit is employed in the A92. The image suppression circuit is also found in this coupling. It consists of a capacity potentiometer so arranged that the impedance of the coupling to second channel signals falls much lower than it would normally by virtue of the resonance curve of the tuned circuit alone. The action is analogous in some respects to that of an AF tone control circuit.

Band spreading on the short-wave ranges is affected by small fixed capacities in series with the main tuning condenser. The oscillator

Circuit diagram of the Murphy A92. The RF stage functions only on the short-wave ranges, for each of which separate sets of coils are provided. A heterodyne whistle filter is included in the output stage.

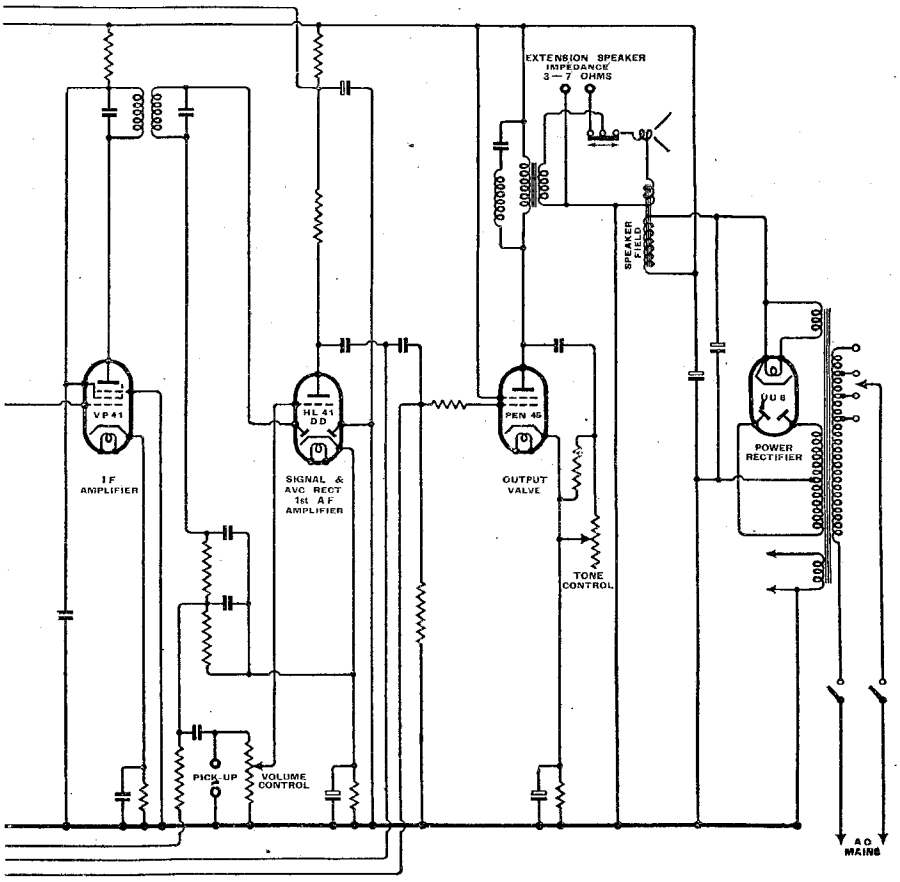




section of the frequency changer uses the Colpitts circuit and warming up drift is reduced to a minimum by large fixed capacities across the coils, which swamp variations in the valve capacities. A part of the tank capacity is provided by a condenser with negative temperature coefficient.

A Mazda SP41 television valve is used in the RF stage, which functions on short waves only, and in order to ensure uniformity of gain between different wavebands the value of the cathode bias resistance is changed where necessary by the press-button contacts. One drawback of the A76 receiver was that it went down to only 16 metres. An extension of the range down to 13 metres in the A92 has been made possible by omitting the 21-metre amateur band. The 42- and 49-metre bands have also been coalesced in a single waverange, in which the 49-metre performance has been given first attention.

The remainder of the circuit follows standard practice except that the AVC is undelayed. The AF coupling is altered on short waves to give somewhat less bass response relative to that available on medium and long waves. There is provision for a gramophone pick-up, and, in addition to the usual tone control, there is a heterodyne whistle filter in the anode circuit of the output valve. The latter is a Pen45 for which no permit is required.



Performance. — A preliminary run through each of the eight waveranges of the receiver sufficed to confirm the maker's claims regarding signal-to-noise ratio, image rejection and general liveliness of performance. The performance in the first two respects is at least equal to that of the Model A76 review in our issue of September 21st last, and the sensitivity is quite definitely better than that of the earlier model. Although the A76 was by no means lacking in range, it did not show the avidity for weak signals or the obvious zest with which they are dealt with by the A92.

Tuning with the new dial is a real pleasure to the experienced short-wave listener, and will place the novice on an equal footing with the expert. There is no turning up of wavelength lists or log book settings. With every important station spread out before him on the illuminated dial he can quickly locate and turn the pointer directly to an alternative programme when conditions deteriorate on any one band. To facilitate speed in locating names, selective illumination of wavebands by the waverange control has been abandoned in favour of general illumination, the push buttons showing at a glance which waverange is in operation.

WAVERANGES

Short	*13.2*	*14*	*metres*
	16.7	*16.9*	,,
	19.5	*19.9*	,,
	24.6	*25.7*	,,
	30.4	*31.7*	,,
	41	*50*	,,
Medium ..	*190*	*550*	,,
Long	*970*	*2,000*	,,

Accuracy of calibration was in every case within the thickness of the marking corresponding to each station name, and is, in our opinion, far better than the maker's own cautious claim that the markings must be regarded as "signposts rather than as positive indications."

Stability of tuning was so good in the A76 that it is difficult without taking measurements to appreciate

Murphy A92 "Stationmaster"—the improvement which the makers claim for the A92. Certainly it fulfils in this respect the elementary requirements of exact repetition of station settings whether the set is just switched on or has been running for an hour or more.

A careful search for second-channel interference failed to reveal any trace either on the short waves, where special precautions have been taken against it, or on the medium and long-wave ranges.

Although no special claims are made for the A92 as a quality receiver, the reproduction is far better than that of the ordinary broadcast receiver. It has the clear-cut response characteristic of triode output valves and there is nothing to suggest that the last stage in fact uses a tetrode. The 8-inch loud speaker gives enough bass for good balance without coloration from any obvious resonance, and the excellent transient response gives very realistic reproduction of instruments such as the guitar and piano.

Constructional Details. — The chassis design follows the practice adopted in the Model A90 reviewed in the May issue. All RF components, push-button switches and wiring are assembled on a rigid front plate, but in this case the larger tuning scale and the main tuning condenser are mounted on the chassis proper.

The large fluted bakelite escutcheon plate can be withdrawn after removing the two main control knobs, thus giving access to all the essential trimmers. From many other points of view, also, this set is very easy to service—an important consideration in these times. Connection between set and loud speaker is made through a readily detachable plug and socket and the leads to the combined tone control and on-off switch on the side of the cabinet are long enough to permit the withdrawal of the chassis for testing. A spring clip has been provided to take the slack in the leads when the set is returned.

Concentration on essentials and the omission of such luxuries as a cathode-ray tuning indicator have enabled the price to be brought down below that of its predecessor in spite of rising costs of production.

Short-wave Receiving Conditions : Prospects for August

(COMMUNICATED BY THE ENGINEERING DEPARTMENT OF CABLE AND WIRELESS, LTD.)

IN general, short-wave receiving conditions were less favourable during June than in May. Atmospherics were above normal on the following dates:—June 7th to 12th (inclusive); 14th; 16th; 20th to 22nd (inclusive); and 24th to 26th (inclusive). Reception was impaired on some of the above dates, notably during the afternoon and evening.

Ionosphere storms were experienced as follows:—June 5th to 9th (inclusive); 14th to 16th (inclusive); 18th; 22nd; 23rd; 25th to 27th (inclusive) and 30th.

With the number of consecutive "quiet" days thus limited to four, short-wave propagation conditions were more erratic in June than in May; in the latter month there were as many as seventeen consecutive days which were free from ionosphere storms with the result that conditions then were far more stable.

Sudden ionosphere disturbances of the "Dellinger" type were experienced on June 7th, at 1250; June 8th, at 1050, and June 13th, at 0850 and 0925. These and other times given in this report are G.M.T. on the 24-hour clock notation. The effects of all four disturbances were of short duration and were confined mainly to routes eastward and southward of this country; at times such as those quoted above the intensity of the disturbance would normally have to be very great to affect transatlantic working. During the last twelve months there has been a definite reduction in the frequency of occurrence of this type of disturbance.

Particulars of the broadcast bands which, it is considered, should prove most reliable under normal conditions of propagation during August on five selected routes are given below; these may serve as a guide when considering reception from places other than those mentioned.

Considerations of transmitter power and efficiency of aerials at both the transmitting and receiving end may often result in better reception being obtained on wavelengths other than those quoted, as may also be the case during disturbed conditions.

Tokio: 0800/1200, 16 m; 1200/1530, 16 or 19 m; 1530/1800, 19 or 25 m; 1800/midt, 25 or 31 m.

With sunrise at Tokio occurring at about 2000 and sunset at London at about 1930, a progressive weakening of signals is to be expected for the two or three hours immediately prior to midnight, as a result of increasing daylight at Tokio and increasing darkness at London.

Melbourne: 0800/1000, 16 m Eastward (via Calcutta) or 25 m Westward (via Pacific); 1400/2000, 25 m Eastward 2000/midt, 25 m Eastward initially, but subsequently 19 m Westward.

From 1000 to 1400 conditions are likely to be very difficult; there are possibilities, however, of fair reception for limited periods on the Eastward route, particularly on 19 metres. A general weakening of signals is to be anticipated towards midnight. The best periods for reception should be from 0800 to 1000 and from 1700 to 1900.

Bombay: 0800/1630, 16 m; 1630/1930, 16 or 19 m; 1930/2230, 19 or 25 m; 2230/midt, 31 m.

Buenos Aires: 0800/1000, 25 or 31 m; 1000/1100, 19 or 25 m; 1100/1200, 16 or 19 m; 1200/1930, 16 m; 1930/2200, 19 or 25 m 2200/midt, 25 or 31 m.

The forenoon period presents the greatest difficulty, but conditions should rapidly improve after 1000. The field strength of South American stations may exhibit a minimum around 1400.

Montreal: 0800/0930, 25 or 31 m; 0930/1100, 19 or 25 m; 1100/2000, 16 or 19 m; 2000/midt, 19 or 25 m.

Skip distances, in respect of propagation via the F_2 layer, are expected to decrease somewhat in the afternoon in this country, and to attain a minimum value towards sunset.

Atmospherics, while usually less troublesome in August than in July, may still impair reception, particularly during the two or three hours prior to sunset on the shorter wavelengths, and between sunset and midnight on the longer wavelengths. Magnetic activity, however, will probably exhibit an increase; its present trend suggests that during the second week of August it may be somewhat above average for the present season.

Echo signals may still be prevalent around 2000 from the Tokio and Buenos Aires zones, though the tendency should be less marked in the case of the latter.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

RESERVED OCCUPATIONS

The Radio Industry

SINCE the publication of our July issue, a revised schedule of reserved occupations has been issued. At first sight it would appear that the lowering of the age reservation from general service for wireless engineers, mechanics and servicemen from 30 to 18 years implies that greater importance is now attached to the maintenance of civilian broadcast receivers. However, it should be noted that servicemen between 18 and 30 are still liable to be called up (or be accepted as volunteers) for duties in their trade capacity. The availability of servicemen for civil work, therefore, still depends on the requirements of the Forces.

Sea-going wireless operators and radio officers, civil air-crew wireless operators, operators in Government departments and students of recognised wireless technical schools are now all reserved from the age of 18.

Valve makers, loud speaker cone makers and wireless mast riggers are still reserved from general service from the ages of 21, 30 and 30 respectively.

Under the heading "Electrical Communication and Signalling Systems," maintenance hands on wireless transmitting and receiving equipment (including interference detection apparatus) over the age of 18 are reserved from general service, but those up to the age of 23 may be called up or accepted for service in their trade capacity.

Administrative and executive grades of the B.B.C. staff will, from August 1st, be reserved from general service from 30 instead of 25 as at present.

NEW C.B.S. TRANSMITTERS

THE Columbia Broadcasting System has applied to the Federal Communications Commission for permission to construct two new 50-kW international short-wave broadcasting stations, each of which would operate on each of the six bands between 6 and 22 Mc/s now allocated for this type of service.

C.B.S. also seeks to increase the power of the present 10-kW short-wave station, WCBX, and remove it from Wayne, New Jersey, to the site chosen for the new transmitters on Long Island, New York.

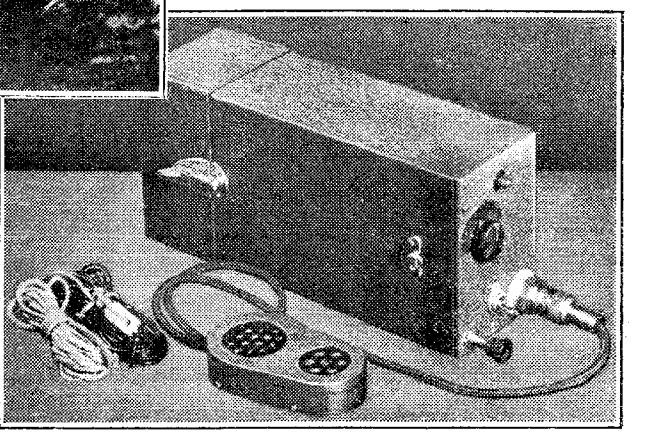
AMERICAN AMATEURS

Foreign Communication Banned

THE Federal Communications Commission issued an order on June 5th banning radio communication between American amateurs and those in foreign countries. The ruling does not apply to amateur communication between stations in the continental United States and operators in its territories and possessions.

The American Radio Relay League had previously asked its members to voluntarily pledge themselves not to work European amateurs until after the war.

Commenting on the ban our American contemporary *Radio* states that the F.C.C. explanation that the order is to guard against "Fifth Column" activities should not be taken to indicate the likelihood of a total ban on amateur activities in the U.S.



WIRELESS FOR PARACHUTE JUMPERS. The Forest Service of the United States is developing new methods of fighting fires, and has produced this light-weight phone transmitter-receiver for use by forest guards who are landed by parachute at the scene of the fire.

POSSESSING HF APPARATUS

Police to be Notified

UNDER a defence regulation (S.R. & O., 1940, No. 1079), issued on June 26th, those who possessed on June 28th or acquired after that date, apparatus having a maximum power output exceeding 10 watts, capable of generating or using a frequency exceeding 10,000 c/s must notify the police of its existence.

The main types of apparatus covered by this Order are: diathermy and electro-therapy apparatus using either valves or spark coils; high-frequency furnaces; eddy-current heating apparatus such as is used by valve and electric lamp manufacturers; and test oscillators with a high-frequency output exceeding 10 watts.

The regulation does not apply to wireless transmitting or receiving apparatus, the normal type of violet-ray equipment, X-ray apparatus, infra-red and ultra-violet-ray apparatus, medical shocking coils, wave meters, and low-powered test oscillators as used by radio engineers.

The Home Secretary has also made an Order prohibiting enemy aliens from possessing any such apparatus without a permit.

FRENCH STATIONS

ONE of the terms of the armistice between Germany and the Pétain Government of France was that all wireless transmitting stations in French territory should stop. This means that the stations Grenoble, Lyons P.T.T., Marseilles, Toulouse P.T.T., Limoges, Radio-Toulouse,

Current Topics—

Radio-Montpellier, Nice, Radio-Méditerranée, Montpellier P.T.T., and Radio-Lyons have all been silenced.

The territory occupied by Germany includes many well-known transmitters, among them the short-wave Paris Mondial and the recently completed 450-kW Radio-Paris stations at Allouis, Paris P.T.T., Radio-37 (Paris), Strasbourg P.T.T., Poste Parisien, Rennes-Bretagne, Radio-Cité (Paris), Bordeaux-Lafayette, Radio-Normandie, Lille P.T.T., L'Ile de France (Paris), Bordeaux Sud-Ouest and Eiffel Tower.

MUSIC IN FACTORIES

Alleviating Tedium

THE first emergency report of the Medical Research Council on industrial health in war recommends the use of music to alleviate boredom in factories where work is repetitive. As the B.B.C. recently introduced a new half-hour feature, "Music While You Work," which is broadcast twice a day, it appears that the Corporation also agrees on the value of music for this purpose.

The G.E.C. has equipped one of its own factories with a complete system which provides not only music for relieving the monotony of tedious tasks, but also serves for an air-raid warning and control system throughout the factory and its shelters. The 220 loud speakers used in the installation are fed from the main amplifier rack, which has three 100-watt channels taking the microphone, gramophone and radio inputs through a relay panel which can be remotely controlled from both the private telephone exchange and the underground A.R.P. control room.

RECORD MATERIAL IMPROVEMENT

IN recent *Wireless World* articles particular mention has been made of surface-noise as one of the remaining major defects of solid-stock gramophone records. It is interesting, therefore, to note that the research department of R.C.A. has discovered that the incorporation into the resin moulding composition of one or more compounds of titanium produces a record with extremely low surface-noise and with exceptionally long-wearing properties. Very fine titanium dioxide or lead titanate (particle size between 0.1 and 0.5 micron) replaces the usual fillers of slate, metal oxides or silicates in the moulding compound, which latter may be shellac, vinyl resins or phenolic resins.

A BOON OR A BANE ?

Marconi's Undelivered Address

"HAVE I done the world good, or have I added a menace?" It was recently revealed by Sir James Irvine, principal of St. Andrews University, Glasgow, that Marchese Marconi included this question in the draft of his speech which, but for his untimely death, he would have delivered on the occasion of his installation as rector of the university.

In the draft of his address, the title of which was "The Path of the Inventor," Marconi referred to the fact that it was his desire to add to the safety of navigation at sea by ship-to-ship and ship-to-shore communication that first inspired him to investigate the possibilities of wireless telegraphy. He had at that time no thought whatever of the spoken word being transmitted all over the world.

CRYSTAL PALACE AND BAIRD

A LONDON landmark and link with the development of television will disappear when the two 284-ft. towers of the Crystal Palace, which withstood the fire of 1936, are demolished. The 1,600 tons of metal are to be used for war purposes. It will be recalled that the south tower was used by the Baird organisation for its 30-line television transmissions demonstrated in 1935, and has since been used for experimental work.

Owing to the termination of the commercial production of television receivers, due to the cessation of television transmissions, it has been decided to reconstruct Baird Television, Ltd., and to merge it with Cinema Television, a subsidiary company. With the approval of the Board of Trade it is proposed to retain the name Baird Television.

NEWS IN MORSE

British Foreign Office Bulletins

THE following table gives the present times (B.S.T.) at which British official news bulletins are transmitted in morse from stations GIA, 15.27 metres; GAI2, 16.03 metres; GIM, 23.13 metres; GAY, 33.67 metres, and GBR, 18,750 metres.

00.30	GBR, GAY, GIM.
13.00	GBR, GAI2, GIA, GIM.
17.02	GBR, GAI2, GIM.
20.48	GBR, GAY, GIA, GIM.

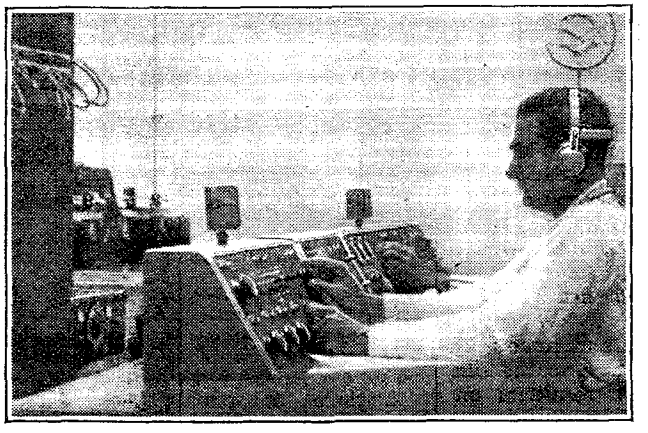
For the benefit of those who are learning the morse code it may be pointed out that these bulletins, though transmitted automatically, are sent at "hand" speed, and so the transmissions are suitable for practice.

LICENCE FIGURES

IT was, perhaps, not surprising, in view of the number of homes which have been broken up on account of the war, that the figures recently given by the Assistant P.M.G. showing the increase in the number of receiving licences issued during the first nine months of the war was not greater. It is, however, interesting to compare the increase of nearly 21,000 during the period from September 1st, 1939, to May 31st, 1940, with that of 135,000 recorded during the eight months preceding the war. The approximate number of licences in force on May 31st was 9,065,000.

CANADIAN SOLDIERS' LICENCES

A RECENT amendment to the Canadian Radio Regulations permits the issue of free receiving licences to any person or organisation owning or operating a private receiving station installed in barracks, mess-halls, canteens or recreational rooms for the gratuitous entertainment of



BOMBAY'S CONTROL ROOM where the outputs from all the studios, the O.B.s, and the diversity receiving station located outside the city are handled before being fed to the medium- and short-wave transmitters VUB1 and 2 in the suburbs.

His Majesty's naval, military or air forces on active service.

Only one licence will be issued to cover the operation of all radio sets in a military camp, but in cities and towns where various buildings are occupied, one licence will be issued to each building to cover the operation of all radio sets installed therein.

This free licence will not apply to receivers operated in private homes, or to radio sets installed and operated by married personnel living in Government married quarters.

It will be remembered that the British P.M.G. stated in the House of Commons earlier this year that it was necessary for soldiers in camp in England to obtain an ordinary 10s. receiving licence. This licence covers the use of any number of receivers in barrack rooms contained in a single block of buildings.

FROM ALL QUARTERS

B.B.C. European News

A NUMBER of additional wavelengths are now being used by the B.B.C. for the transmissions of news in English in the European short-wave service. The call signs and frequencies at present used are: GSA, 6.050 Mc/s (49.59 m); GSL, 6.110 Mc/s (49.10 m); GSW, 7.230 Mc/s (41.49 m); GSB, 9.510 Mc/s (31.55 m); GRX, 9.690 Mc/s (30.96 m); GSN, 11.820 Mc/s (25.38 m); and GSE, 11.860 Mc/s (25.29 m).

The times (B.S.T.) of the transmissions and the calls used are:—

00.30, 07.15, 09.00 } GSA, GSW, GRX.
12.45, 14.15 } GSA, GSL, GSW, GSN, GSE.
17.00—GSA, GSW, GSE.
19.00—GSA, GSL, GSW, GSB, GRX.
23.00—GSA, GSW, GRX.

Receivers in Caravans

THE recent defence regulation banning receivers in all road vehicles has been relaxed and does not now apply to caravans which are habitually used as residences, that have no motive power and have the wheels removed. Horse-drawn caravans are also exempt.

Schwarzenburg Inaugurated

SWITZERLAND'S short-wave transmitter at Schwarzenburg, which had to be rebuilt after the fire which, in July, 1939, destroyed it prior to its inauguration, is now complete and is being used for the new direct wireless telephone service with the U.S.A.

India's Voice

WITH a view to reaching listeners at considerable distances from Delhi, All-India Radio has brought into use a fourth Delhi short-wave transmitter, VUD4. It is operating experimentally in the 25-metre band with a power of 10 kW.

Receiver Cabinets

COMMENTING on the new Timber Control Orders which became operative on July 1st, Major A. I. Harris, the Timber Controller, intimated that whilst economies in the consumption of timber would have to be made in many directions, a supply of wood for simple wireless cabinets would be maintained.

Private Radio Communication Banned

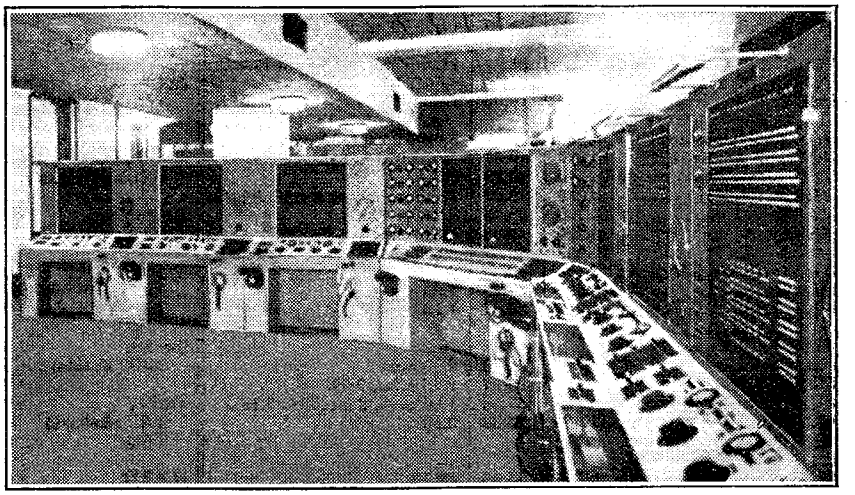
THE F.C.C. having received a number of requests from private concerns for licences permitting the use of radio communication between head offices and cars has decided that it would not be in the public interest to grant such facilities owing to the limitations on the number of frequencies available for essential services in the U.S.A.

Indian Listeners

A MILESTONE in the history of Indian broadcasting has been reached. The number of licensed listeners passed the six-figure mark at the end of April, the actual total being 1,000,388. The 26,690 licences issued during the preceding year is a record.

Export Drive

As a special effort to help in the wartime drive being made by the Radio Manufacturers' War Export Group to develop the radio export market, *The Wireless and Electrical Trader* for June 15th contained a 16-page export section which was printed in English, French or Spanish for distribution in markets where those languages are used commercially.



THE NERVE CENTRE of Japan's broadcasting organisation. Situated in the heart of the capital, the six-storey headquarters of the Broadcasting Corporation of Japan includes this modern control room which handles the short-wave international transmissions as well as those intended for the country's five million, or more, licence-holders, who pay a fee of 50 sen a month.

British Radio-Therapeutic Apparatus

DURING Dr. P. P. Dalton's lecture on the application of short waves to medical science before the British Institution of Radio Engineers on June 21st he expressed regret at the high cost of radio-therapeutic apparatus. He said, however, that he wished to pay tribute to British manufacturers who, in his opinion, were definitely ahead of the Americans and Germans in this field.

KDKA Pioneer Honoured

DR. FRANK CONRAD, assistant chief engineer of the Westinghouse Electric and Manufacturing Co., of America, received the medal of merit of the American Institute of the City of New York, for his pioneering work in short-wave radio communication and for developing the first broadcasting system. Dr. Conrad was responsible for the inauguration of America's first broadcasting station, KDKA.

Kolster-Brandes

MR. A. MCVIE has been appointed general manager of Kolster-Brandes, Ltd., succeeding Mr. F. A. Cobb, who has resigned from the company.

The Candler System

WE regret to record the death of Mr. Walter H. Candler, the originator of the Candler Systems of morse instruction. We are informed that the London office of The Candler System Company, of Asheville, North Carolina, U.S.A., is continuing as heretofore under the direction of Mr. H. Freeman.

Straits Settlements

SINCE the Straits Settlement Government took over the British Malaya Broadcasting Corporation, which owned and operated the Singapore short-wave transmitter, early this year, a number of changes have taken place. The latest

Current Topics—

is that the annual receiving licence has been reduced from $12 to $5. An increasing number of programmes in various Asiatic languages, designed to counteract those from Berlin and Rome, are radiated by the 2.5-kW transmitter. It is understood that the Government is acquiring a site on the west coast of Singapore for the purpose of erecting a new station.

American Ambulance

AT the suggestion of Mr. R. A. Rothermel, who is so well known in the radio industry in this country, an American ambulance unit has been organised to operate in Great Britain to deal with air-raid casualties. Subscriptions, which have been made entirely by Americans, are approaching the £100,000 mark. The first unit will consist of 100 vehicles, and will be provided and maintained in service by the new organisation which is to be known as American Ambulance, Great Britain.

Greece Honours Sir Edward Wilshaw

HIS MAJESTY the King of Greece has honoured Sir Edward Wilshaw, chairman of Cable and Wireless, by awarding him the Cross of Grand Officer of the Royal Order of George I for his work in developing Greek communications.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
America			
WNBI (Bound Brook)	17.780	16.87	5.0, 6.0.
WCAB (Philadelphia)	6.060	49.50	11.45 (Tu., Wed. and Fri.), 12.0 midnight†.
WCAB	9.590	31.28	11.45 (Mon., Th. and Sat.).
WCBX (Wayne)	15.270	19.65	8.30‡, 10.50§‡.
WCBX	17.830	16.83	1.0, 2.0†, 3.0†, 3.15§‡, 4.0*†, 4.30§‡, 6.0, 6.30§‡, 7.55†.
WGEO (Schenectady)	9.530	31.48	8.30†, 9.55§‡, 11.25‡.
WGEA (Schenectady)	15.330	19.57	1.0, 2.0‡, 9.55§‡.
WPIT (Pittsburgh)	15.210	19.72	6.0.
WRUL (Boston)	6.040	49.67	12.15 a.m.‡, 12.0 midnight*.
WRUL	11.790	25.45	8.30§‡, 9.30§‡.
WRUL	15.130	19.83	12.15 a.m.‡.
WRUL	15.250	19.67	8.30§‡, 9.30§‡, 12.0 midnight*.
WLWO (Cincinnati)	6.060	49.50	7.25 a.m.†.
WLWO	9.590	31.28	7.25 a.m.‡.
WLWO	11.870	25.27	1.15.‡.
Australia			
VLQ (Sydney)	9.615	31.20	9.15 a.m.
VLQ2	11.870	25.27	9.15 a.m., 9.50.
VLR (Melbourne)	9.580	31.32	10.0 a.m., 2.50 (Sun. 2.15).
VLR3	11.850	25.32	9.50.
China			
XGOY (Chungking)	9.500	31.58	10.30.
XGOY	11.900	25.21	11.30 a.m., 12.10, 10.30.
Finland			
OFD (Lahti)	6.120	49.02	12.15 a.m., 8.55 a.m., 7.15, 10.15.
OFD	9.500	31.58	
French Indo-China			
FZR (Saigon)	11.780	25.47	12.0 noon, 4.45.
Hungary			
HAT4 (Budapest)	9.125	32.88	1.30 a.m.§.
HAT5	9.625	31.17	12.15 a.m.‡, 12.30 a.m.†.
HAS3	15.370	19.52	3.55†.
India			
VUC2 (Calcutta)	9.530	31.49	4.20 a.m.
VUB2 (Bombay)	9.550	31.41	4.20 a.m., 9.0 a.m.
VUM2 (Madras)	9.570	31.35	4.20 a.m.
India (contd.)			
VUD2/3 (Delhi)	9.590	31.28	4.20 a.m., 9.0 a.m., 1.30, 4.50, 6.30.
VUD3 (Delhi)	15.290	19.62	4.20 a.m., 9.0 a.m.
Japan			
JZJ (Tokio)	11.800	25.42	9.5.
JZK	15.160	19.79	9.5.
Manchukuo			
MTCY (Hsinking)	11.775	25.48	7.30, 10.0.
Rumania			
Bucharest	9.280	32.33	11.0.
Spain			
FET1 (Valladolid)	7.070	42.43	8.50.
EAJ7 (Madrid)	9.860	30.43	12.30 a.m.
Sweden			
SBO (Motala)	6.065	49.46	10.45.
Turkey			
TAP (Ankara)	9.465	31.70	7.15.
TAQ	15.195	19.74	12.15.
U.S.S.R.			
—— (Moscow)	7.545	39.76	10.30, 11.30.
RW96	9.520	31.51	7.30, 9.0, 10.30, 11.30.
RAL	9.600	31.25	1.0 a.m.
——	11.710	25.62	9.0, 10.30.
RNE	12.000	25.00	1.0 a.m., 10.30.
——	12.145	24.70	12.0 noon.
RKI	15.040	19.95	1.0 a.m.
RW96	15.180	19.76	1.0 a.m., 9.0 a.m., 7.30, 9.0, 10.30, 11.30.
——	15.735	19.07	5.0.
——	17.910	16.75	12.0 noon.
Vatican City			
HVJ	6.190	48.47	8.0 (Fri.).
Yugoslavia			
YUA (Belgrade)	6.100	49.18	8.30, 10.30.

The times of the transmission of news in English for Europe from the B.B.C. short-wave station are given on page 365.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

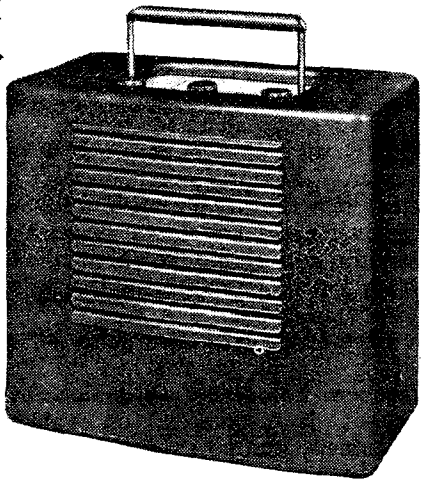
Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Finland			
Lahti I	166	1,807	12.15 a.m., 8.55 a.m., 7.15, 10.15.
Hungary			
Budapest I	546	549.5	11.10.
Ireland			
Radio-Eireann	565	531	6.45‡, 10.10 (10.5 Sun.).
Latvia			
Madona	583	514.6	10.0 (Tu. and Fri.).
Kuldiga	1,104	271.7	10.0 (Tu. and Fri.).
Russia			
Moscow 1	172	1,744	11.30.
Sweden			
Falun	1,086	276.2	10.45.

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Test Report

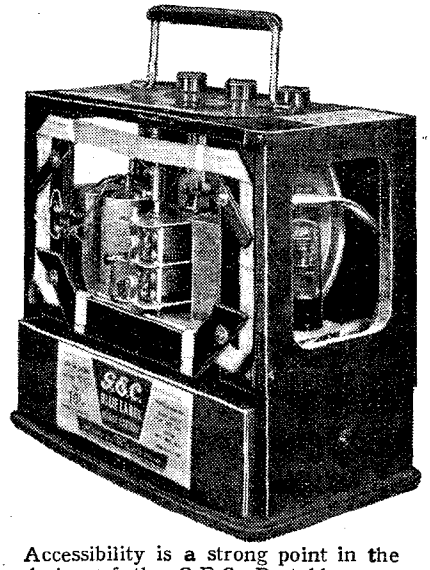
G.E.C. Portable BC4141

AN EFFICIENT SUPERHET (4 VALVES) OPERATING FROM COMBINED HT AND LT DRY BATTERY. PRICE £8 18s. 6d.



WAVERANGES			
Medium ...	*192-550 metres*	*Long* ...	*1,000-2,000 metres*

THE attraction of the "all-dry" battery portable is its complete independence. Its range of travel is not limited by consideration of the distance from the nearest charging station, for with ordinary care a life of 200-250 working hours can be expected from the batteries. Consequently it invites hard usage and should be designed accordingly.



Accessibility is a strong point in the design of the G.E.C. Portable, seen here with the cover removed. The chassis is rubber-sprung and valves are readily removed through the sides of the framework.

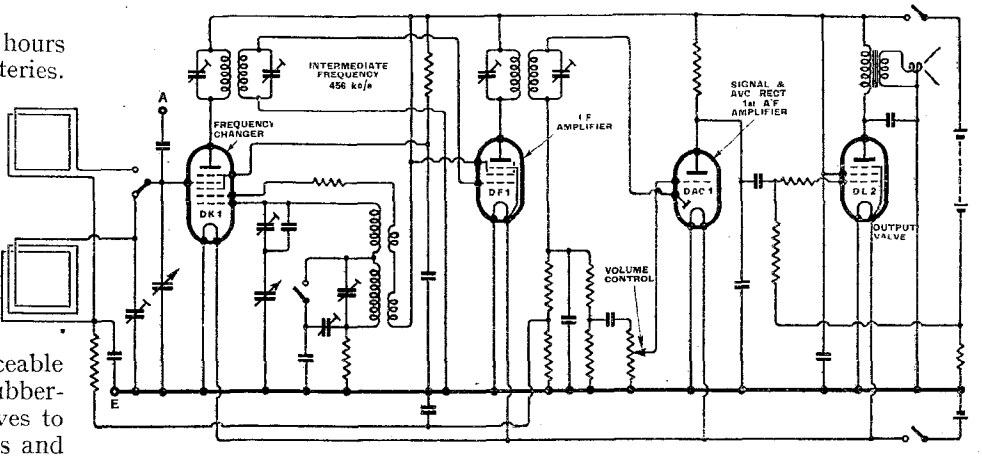
Those responsible for the G.E.C. Model BC4141 have shown a full appreciation of the situation. No attempt has been made to catch the eye by useless decoration, and the tough plywood case is finished in a matt serviceable paint. The chassis itself is rubber-sprung, and this not only serves to protect the valves, components and wiring from injury, but also reduces any tendency which the low-temperature filaments may show towards microphony.

Circuit.—Separate frame aerials are used for medium and long waves which feed direct to the grid of the heptode frequency changer. The IF stage operates at 456 kc/s and has iron-cored band-pass couplings. It is followed by a single-diode triode in which the diode is arranged to supply undelayed AVC to the two preceding stages as well as serving the function of signal rectifier.

The output valve is a tetrode giving a power output of between 200 and 250 milliwatts.

Performance.—The moving-coil loud speaker used in this set has a permanent magnet much above the average in size for the diaphragm diameter (5½in.). To this fact may be attributed the clear-cut quality of reproduction and exceptionally good volume obtained. There is no doubt that the performance in this respect is appreciably better than the standard usually regarded as acceptable from receivers of this class, and for all classes of solo and light orchestral music where a powerful bass response is not required the results are satisfying to the musical ear. It need hardly be added that the type of response implied is particularly well suited to the reproduction of speech.

On the radio-frequency side we found a performance which could only be achieved with valves and circuits working at their maximum efficiency. A number of foreign stations were received inside a steel-framed building in addition to the B.B.C. Home Service transmitters. Knowing the extent to which field strength is reduced in these circumstances, an ample reserve of sensitivity is to be expected under normal conditions, and there is little likeli-



Circuit diagram of the G.E.C. Model BC4141

G.E.C. Portable BC4141

hood that the external aerial and earth, for which provision is made, will be called for. Incidentally, the addition of an aerial and earth does not seriously reduce the high selectivity of the set, and in this respect the superhet circuit undoubtedly scores over the straight TRF. As regards self-generated whistles, this G.E.C. set is as quiet as any TRF receiver. There is, in fact, no fault to find with the performance, and the receiver earns bonus marks for the volume and quality made available from a nominal output of the order of 200 milliwatts.

Constructional Features.—The lifting handle is attached to the wooden framework in which the chassis is suspended on rubber grommets, and no strain is imposed on the screws which hold the plywood case in position. All the valves are easily reached through the open sides of the wooden sub-frame, and the combined HT-LT battery with four-pin connector fits neatly into a compartment in the base.

The medium and long wave frame aerial windings, which are mounted on opposite sides of the set, are self-supporting and are first wound in the form of single-layer solenoids which are then folded to form flat edge-on rectangles. Adjacent turns are held together with a special wax having low dielectric loss.

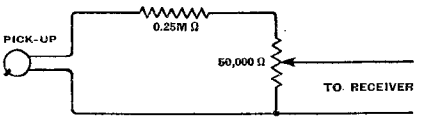
The tuning scales are legible and the knobs are well shaped for finger-tip control. The on-off switch is combined with the waverange control, and those who have acquired the "mains-set" habit of switching off with the volume control should be on their guard as no "on-off" indicator is provided.

The HT consumption in the set tested was 10.2 mA.

Henry Farrad's Solution

(See page 351)

THE complaint about the crystal pick-up can easily be explained without assuming it is faulty. Looking at Mr. Tryer's sketch, one sees that the volume control, although correctly connected, is 50,000 ohms, which is too low for most types of pick-up, and certainly for a crystal type. The crystal pick-up is of the nature of a capacity, and its impedance is very high and increases at the low frequencies. Consequently, if it is shunted by a resistance that is not a much higher impedance still, there is a reduction of low notes as compared with high. This effect is likely to be all the more noticeable because the old pick-up, being "a very common type," was most likely a moving-iron, which is inductive and therefore rises in impedance at the high frequency end. The tendency would



therefore have been to weaken the high notes, so that the bass would be relatively strong.

The resistance across a crystal pick-up should be 250,000 or even 500,000 ohms. If there is plenty of output in hand, this can be arranged, without scrapping the 50,000-ohm volume control, by connecting a quarter-megohm resistor between it and the pick-up, as shown.

The Wireless Industry

A NEW H.M.V. battery superhet portable is announced by the Gramophone Co., Ltd., Hayes. This model, the "1406," is fitted with an efficient frame aerial of new design, and has mechanical push-button tuning for four stations on medium or long waves. LT current is supplied by an accumulator, and push-pull output valves deliver 800 mW to the moving-coil loud speaker. The price is 11 guineas.

◈ ◈ ◈ ◈

A. C. Cossor, Ltd., Highbury Grove, London, N.5, have introduced a comprehensive service kit (Model 3426) for use with their double-beam oscillograph and ganging oscillator. The kit consists of all the necessary screened and low-capacity leads, test prods and coupling units for signal tracing and circuit alignment. A wallet container is included, and the price is £1 17s. 6d.

◈ ◈ ◈ ◈

A comprehensive wall-chart of Cossor receiving valves has just been produced. The valves are classified according to function, and base connection diagrams for all types are included.

◈ ◈ ◈ ◈

Lockwood and Co., of Lowlands Road, Harrow, Mdx., well known as makers of broadcast receiver cabinets, are also laid out for the production of cases for instruments, portable transmitters, and other classes of wireless apparatus.

◈ ◈ ◈ ◈

Important price reductions in the case of certain Mullard valves are announced. The EB4 double-diode with separate cathodes is reduced from 10s. 6d. to 5s. 6d., the EBL1 triple-diode from 7s. 6d. to 5s. 6d., and the EL50 output pentode from 25s. to 20s.

Westinghouse Brake and Signal Co., Ltd., are now producing a selenium-compound rectifier under the name of "Westalite." This is intended primarily for power rectification and will replace copper oxide rectifiers in a few applications. In future both types will be included under the general description "Westinghouse Metal Rectifiers."

◈ ◈ ◈ ◈

Mr. E. R. Rogers has been appointed to give any assistance required in Scotland regarding Westinghouse metal rectifiers. Enquiries should be addressed to him, c/o J. E. Robson and Co., 11, Bothwell Street, Glasgow, C.2.

◈ ◈ ◈ ◈

Mr. G. H. Nisbett has relinquished his duties as managing director of British Insulated Cables, Ltd., but will continue to act as deputy chairman. Mr. T. H. Martin-Harvey and Mr. W. Travis have been appointed joint managing directors of the company.

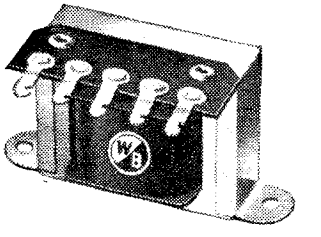
◈ ◈ ◈ ◈

The G.E.C. report a considerable expansion in the overseas market for wireless receivers, and draw attention to the facilities provided by their organisation for meeting the increased demand. A wide range of receivers specially designed for use in all parts of the world is available, and these include six sets operating from AC mains, five for AC or DC mains, and two models for battery operation. Full particulars may be obtained from the Overseas Section of the Publicity Organisation, Magnet House, Kingsway, London, W.C.2.

Export Enquiry

A Portuguese firm wishes to get into touch with British makers of broadcast receivers suitable for the local market. Letters sent to this office will be forwarded.

WB Miniature Output Transformer



Designed for service replacements in midget mains receivers, all-dry portables, etc., this universal transformer measures approximately 1" × 1" × 1¾", and will fit most standard makes of set. It has five ratios, 30 : 1, 40 : 1, 60 : 1, 70 : 1 and 80 : 1, and is centre tapped for push-pull stages. The price is 3/- and the makers are Whiteley Electrical Radio Co., Ltd., Victoria Street, Mansfield.

New Books Reviewed

CATHODE-RAY GEAR — OSCILLATORS — RECORDING

Cathode-ray Oscillographs. By J. H. Reyner. Pp. 177, with 128 illustrations. Sir Isaac Pitman and Sons, Ltd., Parker Street, London, W.C.2. Price: 8s. 6d. net.

THE well-known author of this book has been devoting special attention during recent years to the design and use of cathode-ray tube apparatus, as a result of which he has accumulated not only a sound and thorough knowledge of its principles, but also much practical acquaintance. Add to this his long experience as a teacher of radio technique, and all the conditions are present for a helpful treatment of the subject.

Such expectations are admirably fulfilled. It is obvious on every page that the author knows what he is talking about. Only enough of general principles and theory are included as are really necessary to the practical worker, who is also assumed to be familiar with valve-circuit practice; so that although the book is not very large it contains a surprising amount of directly useful information. Undoubtedly the most praiseworthy feature is the nearly seventy actual photographic oscillograms, demonstrating and interpreting the many effects seen on the screen.

It is pleasing to note that Mr. Reyner, unlike many others dealing with the subject, is not a slave to the linear time base, but shows how distortion can often be better and more simply traced by input/output curves. In fact, his treatment of time-base circuits, especially of the hard-valve varieties, is the least satisfactory part of the book, and is brief to the point of obscurity. Figs. 52-56 seem to be insufficiently explained. The use of shading to distinguish gas relay tubes would be a help.

There are one or two minor confusions (e.g., p. 78, where it is stated that if the resistance of a grid leak is high the capacity of the condenser must also be high to transfer the same proportion of signal), but nothing seriously modifies the general high standard of accuracy, or the heartiness with which the volume can be recommended to radio servicemen, laboratory workers, and practical oscillograph users in general. M. G. S.

The Oscillator at Work. By John F. Rider. Pp. 243+xi. 157 illustrations. John F. Rider, Publisher, Inc., 404, Fourth Avenue, New York City, U.S.A. Price: $1.50.

ALTHOUGH the valve oscillator is ubiquitous in radio apparatus of all kinds, books on it are scarce to the point of rarity; so the above title attracts special interest. The author's reputation is as a writer for servicemen, and if this were not enough he explains in his foreword that the book is aimed at that particular branch of the radio industry. Theory and design are therefore very largely excluded, and the various types of oscillators (triode, negative resistance, electro-mechanical, etc.) are dealt with descriptively. Then follow chapters on modulation, AF oscillators, and RF signal sources. Lastly, and, according to the author, chiefly, about one-third of the book is devoted to testing, servicing, and use of test oscillators, including a chapter on the oscillator stage in superhet receivers. A bibliography refers the reader to literature mainly on other aspects of the subject.

It would have been well if the author had confined himself even more strictly to guidance in the use and care of service equipment, for the earlier chapters are diffuse and ill-balanced in style and at many points misleading. Judicious elimination of about half the words would clarify the matter considerably. Several pages are devoted to what every reader could be assumed to know—the meaning of alternating current and frequency—while really difficult points are dodged. Incidentally, the ratio of RMS to peak value of AC is given with no hint that it applies only to certain waveforms. The definition of a relaxation oscillator as "one in which the ratio of inductance to capacitance is abnormally low or high" does not appear to be consistent either with general acceptation or with the remainder of the author's own treatment. And many such examples could be quoted.

In the second part of the book, however, the author seems to reach home after wanderings on a foreign strand; and servicing in which oscillators take part (there is little in which they do not) is treated in a practical and experienced manner. Complete circuit diagrams, with component values, of many American signal generators and beat-frequency oscillators are a valuable feature. An appendix on laboratory methods packs much useful information into a small space.

Criticism of the earlier chapters notwithstanding, the book is worth every keen service engineer's attention.

M. G. S.

Techniques of Recording. By F. H. Goldsmith and V. G. Geisel. Pp. 43. Published by The Gamble Hinged Music Co., 228, S. Wabash Avenue, Chicago, Illinois, U.S.A. Price (in U.S.A.): $1.25.

THIS well-printed new publication is intended to be a practical handbook surveying all aspects of direct sound recording on discs. The best of the 16 chapters included are those dealing with Recording Heads, Recording Styli, Reproducing Needles, Records and Record Materials, and Making Good Records. Many explanatory diagrams and 20 excellent photomicrographs of grooves and styli tips enliven the text. D. W. A.

Applied Acoustics. By H. F. Olson and F. Massa.

THE second edition of this book, which was reviewed in the June 18th, 1939, issue of this journal, is now published in this country by Constable and Co., Ltd., 10, Orange Street, London, W.C.2. The price is 25s.

Books Received

How to Write for Broadcasting. By Howard Thomas. A handbook for authors and would-be authors, with particular reference to the requirements of the B.B.C. The preparation of scripts for a wide variety of programmes is discussed; much space is devoted to explaining how the technique of writing for broadcasting differs from that appropriate to other methods of presentation. An appendix contains a number of scripts written by the author of the book. Pp. 160; 5 illustrations. George Allen and Unwin, Ltd., Ruskin House, 40, Museum Street, London, W.C.1. Price 5s. net.

Motor Driving Made Easy. Sixth Edition. By R. F. Broad and the Technical Staff of *The Autocar*. The new edition of this well-known book, which constitutes a complete guide for the beginner, contains a special wartime supplement with information on new regulations and advice on black-out driving and getting the utmost mileage from rationed fuel. An important aim, maintained throughout the book, is the inculcation of "road sense" in the new motorist's mind. Pp. 130+20; 92 illustrations. Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1. 2s. 6d. net; by post 2s. 10d.

Principles of Fault-tracing

PART III.—SIMPLE VALVE VOLTMETER : CAUSES OF NOISE

In this closing instalment the design of an inexpensive valve voltmeter for fault-finding is dealt with, and the author concludes his description of the tracing of specific defects in receivers.

By W. H. CAZALY

THE valve voltmeter mentioned in last month's instalment will measure (*a*) high resistances; (*b*) capacities between 0.001 and 1 mfd.; (*c*) AC voltage of the order of 1 to 5 volts; (*d*) inductances of the order of 1 to 10 henrys, if not with precision, at least with enough accuracy for quick fault-finding. Calibration must be carried out by using known inductances, capacities, resistances and AC voltages. Thus, the constructor of this instrument must beg, borrow or steal components having known values, for long enough to put them across the appropriate terminals of the instrument and mark off the readings on the 5-mA meter.

The inductance range will be calibrated by obtaining the loan of, say, half a dozen chokes or transformers whose inductances are known to be 1, 2, 4, 6, 8 and 10 henrys respectively. First, with the mains plug of the instrument inserted into a power socket, terminals F and B are connected by a short length of wire, and the slider on the resistance across the secondary of the transformer moved until just 5 mA is registered on the meter of the instrument. Next, the 10-H choke is connected between F and B in place of the shorting wire. The reading will be considerably less. Either the deflection can be marked on the milliammeter dial or a graph constructed, plotting henrys against mA. Next, the 8-H choke is connected in place of the 10-H choke and the new reading noted. And so on throughout the range. The capacity range is calibrated in exactly the same way. For the high-resistance range, using terminals A and B, it is sufficient to calibrate with ordinary commercial resistors of good make up to 5 megohms. The AC voltage range, using terminals D and E, is calibrated against an AC voltmeter of the usual testing type with 50 c/s AC.

Great accuracy is obviously not to be expected of this simple instrument, but as the tolerances are considerable in the usual commercial receiver components, it will provide a fairly reliable check. For example, the leakage resistance of a condenser is tested by connecting the condenser across terminals A and B. Then its capacity can be roughly checked by plugging the instrument's mains lead in to the mains and connecting the condenser across B and F. Let us suppose, for the sake of illustration, that the leakage resistance is found to be 100,000 ohms; this might not matter greatly if the condenser were C17 in Fig. 1 (see Part I), since it would be in parallel with R16, which would probably be of the order of a few hundred ohms. But if the condenser were C12, this leakage would seriously upset the action of the AVC network. If it happened to be a coupling condenser in an RCC AF stage, such a leakage resistance might enable quite high positive potentials to reach the grid of the succeeding valve, with disastrous results.

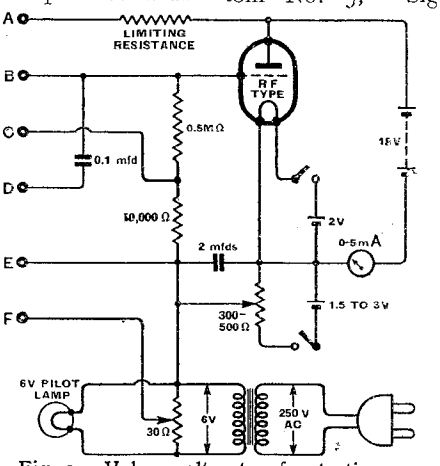


Fig. 3.—Valve voltmeter for testing. Especial care must be taken about insulation. The limiting resistance should be of such a value that the 5 mA meter reads just full scale when A is joined directly to B; plainly, when a high resistance is inserted between A and B, the reading will be something less than full scale. The tests possible are :—A to B, high resistance measurements; B to E, AC voltage ***without*** DC in circuit; D to E, AC voltage ***with*** DC in circuit; B to E, DC voltage in AVC circuits; E to C, higher DC voltages, or higher AC voltages without DC in circuit. B to F inductance and capacity measurements, with 6V, 50-c/s supply from transformer.

Many uses and variations of this simple instrument will suggest themselves to a fault-finder of ingenious mind. Simply as a DC valve voltmeter, using terminals E and B or C, it will, for instance, reveal the presence of AVC voltages; as an AC voltmeter across terminals E and D, it can be used as an output meter to register the voltage developed across the speech coil of a loud speaker.

Before leaving the subject of component tests, mention must be made of the substitution method. A man dealing with many receivers will probably have a boxful of small spares, and if he suspects the condition of a resistor or a tubular condenser, he may whip it out and put a "spare" in its place, connected temporarily; obviously, if the receiver then works properly, it may be assumed that the original resistor was at fault. But, of course, the condition of the "spares" themselves must be absolutely above suspicion.

Signal + Noise

Returning to the subject of tracing specific faults, let us consider Symptom No. 5, "Signal plus Noise," which presents a problem that may be solved in rather the same way as No. 2, of "No Signal." That is to say, the stage at which noise is introduced is isolated by the simple process of silencing each stage in turn. Here, it is not the signal which concerns the fault-finder, but the noise, and in his testing he disregards the signal. For the sake of illustration, it will be assumed that, in Fig. 1, L13 has developed a spot of corrosion, and that this gives rise to a resistance too small to be clearly shown up by direct continuity test, but, as soon as current passes through the primary coil of the IF transformer, crackling, frying and hissing noises are heard in the loud speaker.

Now it will be plain that if the cir-

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cuit presents a short-circuit to chassis for all audio-frequencies, at some signal-sensitive point between L13 and the aerial terminal, the noise will continue to be heard in the speaker, even though no signal can be transferred from the aerial past the short-circuited point. If the S/C exists between L13 and the speaker, not only the signal but the noise also well be by-passed to chassis. To trace a fault of this kind it is therefore only necessary to short-circuit the signal-sensitive points each in turn to chassis by a fairly large capacity (say 4 mfd.) paper condenser with rating adequate to withstand any voltage likely to be found in the circuit. Thus, in the case of a "green spot" in L13, one terminal of the condenser would be connected to chassis by a reasonably short lead, the other terminal being extended by a flexible test lead and prod. This prod would be touched to the following points: (*a*) grid of V1; (*b*) anode of V1; (*c*) oscillator anode of V1 (in case R12, for example, or C13 were breaking down) in order to stop the local oscillator operating; (*d*) grid of V2; (*e*) anode of V2; (*f*) diode-anode of V3. At this point (*f*), both signal and noise would cease. This would indicate that the fault lay in the coupling between V2 and the signal diode-anode of V3, and the components involved in this coupling would then be individually examined.

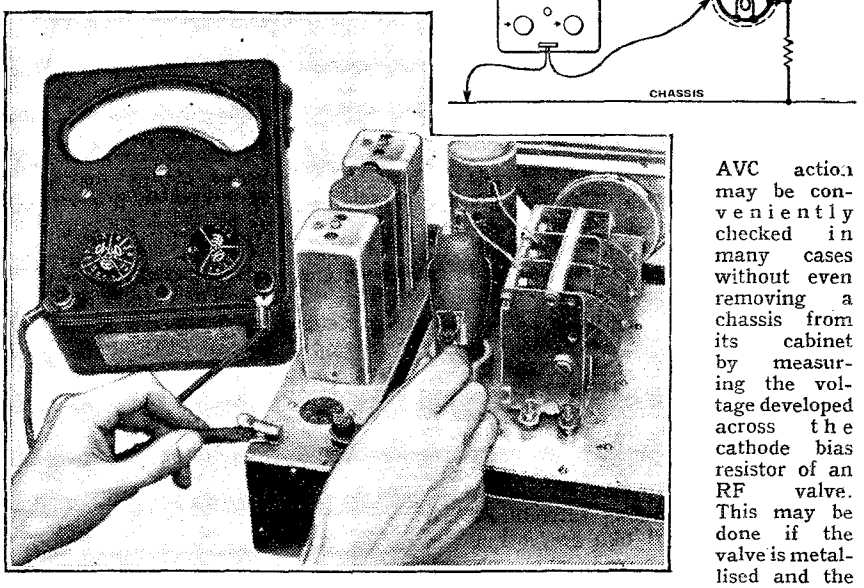
The term "noise," however, is not as simple as this. It includes not only irregular noises, but also hum and whistles, valve hiss and "splash." These sub-divisions are important, because they initiate test sequences peculiar to each. They also demand another important mental process in fault-finding. This is the translation of sounds into electrical terms. It has not been strictly necessary to emphasise this so far in this exposition, but now it becomes prominent. What the layman calls a "nasty buzzing sound" must be translated by the fault-finder in the privacy of his workshop (however sympathetic and non-technical he may have been in the set-owner's home) as "unwanted audio-frequencies," and his first task is to determine their origin in general terms, and his second to formulate theories about the way in which they are introduced into the operation of the set. Hum means alternating frequency from mains supplies at 50 c/s or harmonics of it; whistles mean beat-notes formed by the heterodyning of two or more high frequencies; valve-hiss means high-audio-frequency currents and voltages set up by inherent molecular or electronic action in circuits of high gain; splash, monkey-chatter, and such euphonic terminology means cross-modulation or assymmetrical side-band response; steady howling means oscillation in AF stages or microphonic feed-back. And so on. This sort of translation might have been done when considering previously mentioned symptoms—"weak signal" *was* translated into "loss of sensitivity"—but would hardly have been necessary. Now it *is* necessary.

Conduction or Induction

The 50 c/s alternating voltage of AC mains, or the ripple component of DC mains, may be introduced to signal-sensitive points of a receiver in two ways—by conduction and by induction. There is only one way it can be conducted, and that is by the closing of some path that normally acts as a barrier; i.e., by some kind of S/C. There are two inductive ways, capacitive and magnetic. The conductive path can only be set up actually in the receiver itself, through a breakdown; the inductive paths, however, can exist without actual breakdown, and be set up by some peculiarity of conditions external to and independent of the receiver itself. All of which means that before ripping the chassis to pieces to try to find a breakdown, the fault-finder must make quite certain that the mains supply itself and its position relative to the receiver and its accessory apparatus are not responsible for conveying hum voltages to the set in a manner that it was never designed to guard against. This is essentially a problem of installation and as such outside the scope of this article.

Inside the set things are different. The source of alternating voltage is, obviously, in the case of an AC set the mains input transformer secondaries. Ordinarily, the power supplied by these secondaries is converted into forms devoid of alternating components by the action of choke and condenser filters and resistances in anode feed circuits, and by the action of heaters in the cathode circuit. The only other way in which power could be conveyed from the mains transformer secondaries to the rest of the circuit is by direct magnetic or electrostatic influence, and in the ordinary way the amount of energy so conveyed is too small to have much effect on signal-sensitive points in their normal conditions of sensitivity.

All this is the concern of the set designer, and he has usually concerned himself with it to such good purpose that it is not worth while trying to improve on his arrangements. But if this is borne in mind, the kind of faults that would lead to the occurrence of hum are not very difficult to imagine. The barrier offered to hum



AVC action may be conveniently checked in many cases without even removing a chassis from its cabinet by measuring the voltage developed across the cathode bias resistor of an RF valve. This may be done if the valve is metallised and the metallising is connected to the cathode. The leads of a good voltmeter are applied to chassis and metallising; with a strong signal, AVC reduces the anode current of the valve and hence the voltage across the cathode resistor, and a weak signal has the opposite effect. If AVC is not operating, no change will be registered on the voltmeter for signals of different strength.

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voltage in the anode feed circuits may be lifted in three ways: either by the actual S/C of the main smoothing choke—L4 in Fig. 1; or by loss of capacity—e.g., O/C to AC—of the smoothing condensers, especially C2; or by the loss of inductance in the choke, which would occur if excessively heavy DC were passing through its windings so as to saturate the core. This last might well occur through a breakdown elsewhere in the circuit causing anode current to be extremely heavy. This would almost certainly be revealed by abnormalities found during the early stages of preliminary tests. The only way, short of an actual metallic contact between the heater supply and other wiring, by which alternating voltage could be introduced, via the cathode circuit, is through leakage between the heater and cathode of a valve. This is quite common. Valve cathodes are subjected to considerable strains whenever they are warming up or cooling—that is, at the times of switching on and switching off of the set, when expansion and contraction tend to crack the rigid, heat-resisting material by which the cathode is insulated from the heater inside it. It is sometimes baffling to detect, because when the valve is tested cold, the leakage does not show up by ordinary tests. In cases of doubt, of course, the substitution of another valve known to be in good order is the quickest and surest check.

Mains Transformer Induction

There is always a small field set up by the mains transformer windings and in the ordinary way this has practically no effect on signal-sensitive points. But if these points become abnormally sensitive, they may pick up hum voltages. Anything like a "free" grid will be revealed by abnormalities found during preliminary checks, but sometimes by-pass condensers lose capacity or load resistances go high and raise sensitivity in the H.F. stages to alternating voltage influence from the mains field. In such cases, hum is being introduced along with the signal like any other noise voltage, and the stage at which this is happening can be isolated by means of a large condenser just as was described earlier. It must be remembered, however, that the reactance of even a 4-mfd. condenser to 50 c/s is about 800 ohms., so that it will by no means form a dead S/C to hum at all signal-sensitive points; it will, however, much reduce it, and, to make certain, the capacity of the testing condenser can be increased to 10 or 12 mfds. Hum is very liable to occur with an AC/DC receiver through bad cathode-heater insulation, because the p.d. between the cathode and heater is much higher than it is with AC valves and even small leakage paths pass correspondingly higher current.

Whole volumes have been written on "whistles" under their various technical names. Their elimination is essentially a design problem, and as design changes with the times, it will probably be found that well-designed modern sets suffer from few if any whistles save those due to the heterodyning of two transmissions on closely

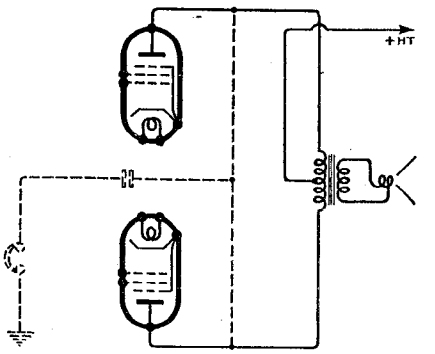

Fig. 4.—Checking balance of push-pull stages: distortion may sometimes be due to uneven amplification of the two halves of the signal owing to some defect in the components of the system. To test, join the anodes of the two valves, and connect a pair of phones from them to chassis through a condenser (0.5 to 1 mfd.) of amply adequate voltage rating: under properly balanced conditions, the signal voltages at the anodes cancel each other and little sound should be heard.

adjacent frequencies. Older sets, designed in the days when the scramble for frequencies on which to advertise policies and commodities had not reached its present frenzy, may suffer from whistles largely owing to inherently insufficient selectivity. There is nothing the fault-finder can do with such whistles, other than to line up the tuned circuits very carefully. The subject is treated with much clarity and detail in Mr. Cocking's "Wireless Servicing Manual." A warning is necessary in this connection: the business of a fault-finder is to find faults—not to redesign or reconstruct receivers. Unless the set he is working on happens to be his own, he will be well advised not to add to or alter circuits in any way, or he may find himself having to pay for a new receiver!

Certain whistles, however, are unmistakably due to self-oscillation in RF or IF amplifying stages, which gives rise to loss of sensitivity and a number of whistles ranging from sheer howls to innumerable chirps. Now self-oscillation is due to the transference of energy from anode circuits to grid circuits preceding them in the amplifying chain, and to nothing else. This energy may be transferred in the form of either voltages developed across impedances common to the grid and anode circuits involved, or by inductive coupling between them, either capacitive or magnetic. Once this is clearly realised, the list of possibilities that, in accordance with the principles already established for fault-finding, has to be made out, does not become inordinately long. For instance, referring to Fig. 1, loss of capacity in C8, C16, C14, C10, C12, or C18, might give rise to coupling voltages developed across various resistances associated with them. Substitution is evidently the quickest way of eliminating these possibilities.

Unwanted Couplings

Most difficulties in tracing the causes of feed-back arise from the sheer unexpectedness of the defects. Resistance can be set up at a junction that looks as if it is perfectly sound—a "dry" soldered joint, for example, or a dirty spindle bearing in a ganged condenser. The author remembers a receiver of some years ago that had its oscillator coil enclosed in a screening can secured by a central rod and nut to the top of the can of another coil; so long as the top can made good contact all round its bottom edge, which rested on the lower can, all was well; but the slightest displacement of the top can was sufficient to leave a narrow gap between its bottom edge and the top of the lower can, and appalling squeals were set up. The fault was almost imperceptible to the eye and was not revealed by continuity tests with the meter, because electrical continuity was firmly established for DC by the holding-down nut. Dry joints, loose nuts, poorly fitting screens—the list is apt to be rather long when dealing with a stubborn case of self-oscillation.

Valve-hiss and circuit-noise becomes troublesome only when the overall gain is high. Now the gain is controlled in a modern receiver by the AVC circuits, which in their turn depend on the strength of the signal at the AVC diode for correct functioning. So, evidently, two conditions will raise the noise-signal ratio; mistuning of RF and IF circuits, which lessens stage gain, and breakdown in the AVC net-

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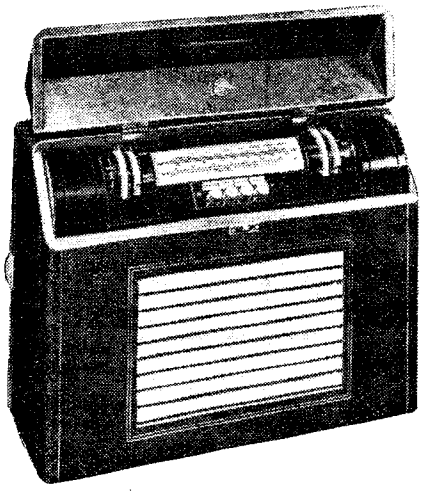
work. The former is an example of maladjustment—in this case of tuned circuit constants, and the latter of either a S/C or an O/C, in this case amongst the components of the AVC network. Closely bound up with these factors is the production of side-band splash and monkey-chatter or cross-modulation, so that lining up tuned circuits accurately and effecting repairs in the AVC network are remedies that will probably apply to both forms of noise. Older receivers not fitted with AVC are often very bad in these respects, owing to their having been designed before the large increases in transmitting power that have taken place in recent years—one might say they are of pre-Dictator vintage!

In the light of all the foregoing, the two remaining symptoms, Nos. 6 and 7, should present no difficulties. No. 6, "Noise only, No Signal," points to some fairly gross defect that can be fairly easily traced, probably during the preliminary tests of valves, voltages, etc. If it is not at once found, the methods adopted for Nos. 2 and 5 will provide clues. No. 7, again, suggests fairly obvious avenues of investigation. Loss of manual volume control indicates checking of the potentiometer and coupling network between the signal diode and the grid of the AF amplifier. Fading and high noise level, suggesting that the AVC is not performing its functions correctly, indicates that that part of the circuit should be tested—a process much facilitated by the use of the simple valve voltmeter that has been described earlier.

In conclusion, it may be said that no pretence has been made to give a complete and comprehensive outline in these articles of all fault-tracing methods. That would require at least one whole book, and, indeed, a number of quite good books have been written on that subject. But it is hoped that the basic principles underlying all these methods have been sketched with sufficient clarity to enable the intelligent person to apply those methods logically. As the art and science of radio communication advance, the two factors, of trained reasoning and theoretical knowledge, are bound to become of more and more importance in radio servicing, and the specialised tuition they demand will, it is certain, help to raise the hitherto all too humble radio service engineer to a truly professional status.



The new Marconiphone Model 895 portable is housed in a serviceable cabinet covered in black waterproof cloth. The controls and ornamental fittings are in red.

Marconiphone Model 895

A NEW BATTERY PORTABLE WITH PUSH-BUTTON TUNING

IN the advanced specification of this portable, due for release at the end of this month, there are indications that it will prove an efficient as well as a compact receiver. The LT current is supplied from a 2-volt accumulator which permits the use of push-pull tetrodes in the output stage. Working under QPP conditions, these give an output of 800 milliwatts.

A battery economy switch effects a reduction of HT consumption from the normal of 9 mA to 6 mA. Unlike most economising circuits, this does not reduce the available undistorted output, but cuts down the sensitivity of the earlier stages; on the local station no difference should be heard whether the economiser switch is on or off.

Push-button tuning of the mechanical type is provided for four stations, which may be set up either on medium or long waves. The other controls are of the edge-wise disc type and are mounted at the ends of the convex tuning scale.

The circuit consists of a triode-hexode frequency changer, tetrode IF amplifier, double-diode-triode signal and AVC rectifier and first AF stage, and a pair of KT2 tetrode output valves. Incidentally, accurate matching of these valves is not called for to maintain the rated output.

Special claims are made for the medium-wave frame aerial, which is wound in the form of a helix and treated with low-loss insulating material. This is said to have a high Q factor and a pick-up efficiency of over twice the normal. On long waves it is loaded by an iron-cored inductance.

The price of the new set is 11 guineas, and the makers are The Marconiphone Co., Ltd., Hayes, Middlesex.

On Learning Morse

A PSYCHOLOGICAL PROCESS IN TWO DISTINCT STAGES

By MAJOR R. RAVEN-HART

LEARNING morse is a psychological process, very much like learning to skate or to ride a bicycle; and, just as in those cases, there are two stages. The first is the conscious stage, when one is learning facts with the conscious mind—for instance, that if the cycle tends to fall to the right you must steer to the right. The second is the driving of that conscious knowledge into the subconscious, until when the machine thus tends to fall it is impossible not to steer in that direction.

The difference is that in learning to cycle the first stage may last for a few minutes only: in learning morse it may last for weeks, or may even last for so long that the learner gives it up in despair and never reaches the second stage at all.

Now, these two stages demand entirely different methods of teaching: unfortunately they often do not get them. But before going further, let me say that "in my opinion" or "I think" or "my experience indicates" is to be read into every sentence that follows; teachers of morse, as of philosophy, can disagree more acrimoniously than most people.

Personally then, in teaching morse I use at first a statement of the letters in dots and dashes, together with buzzer transmission at a slow speed, with exaggeratedly long dashes and dots. Then, as soon as the conscious learning is nearing completion, this is replaced by transmission at about 12-16 words a minute, with pauses between letter and letter for the learner to "think it out." Once the class is really getting into the second, subconscious, stage, only this "high-speed" transmission is allowed, and no further reference is made to dots and dashes. It is better that a learner shall miss a letter completely rather than relapse (even momentarily) into the first stage.

The vital point in this system is that no attempt be made to work up the speed gradually; dead slow for as short a time as possible and then "full speed" is the rule.

Technique of Sending

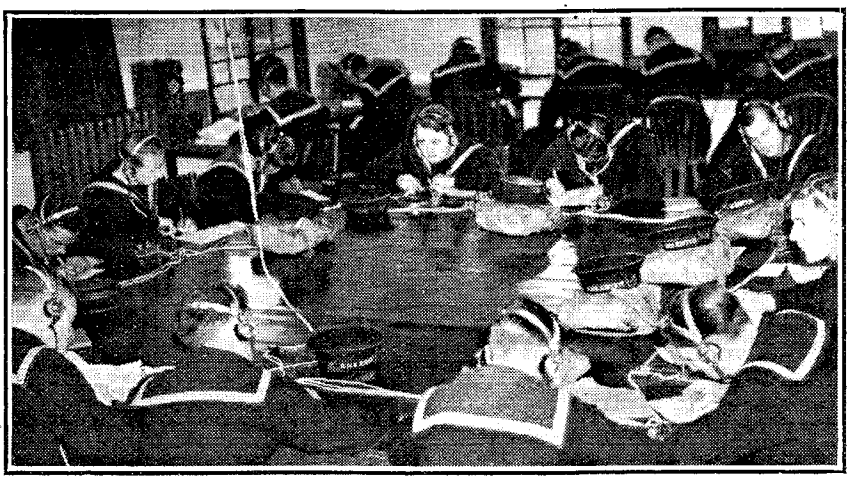
As regards learning to send, this should not be started until well on in the course, and then it should be insisted that the letters are sent at a speed of at least 8-10 words a minute—faster if possible, but at any rate never dead slow. On the actual technique of sending I doubt if anything can usefully be added to the article in the July *Wireless World*.

Receiving instruction should, of course, start with the easy letters E, I, S, H, T, M, O. No attempt should, however, be made to get these into the subconscious stage before going on to the next group: A, B, D, F, G, L, N, U, V and W. For some of these I can recommend a visual memory help which is so old that I cannot now remember where I found it. It may, however, still be copyright, so that it must suffice here to say that it is based on the shape of the capital letters. Thus, for example, the three dots of B and the two of D correspond to the three and two points respectively where the curves touch the "backbones" of the capital. V has three sharp points, and so three dots, whereas U has two. There are similar dodges for F and L, and (based on the italic capitals) for W and G. It should, however, be noted that on no account should the learner be taught F *with* L or W *with* G, as opposites, or he will confuse them for weeks—or for life.

The next batch is J, K, P, R, X and Z; no particular dodges seem to help much here.

Finally, there are the "terrors," C, Q and Y. In the case of these I would suggest that they be ***never*** sent slowly, so that from the first they come as rhythmic units. In fact, I go further, and teach "CQ" (with its meaning) as one unit, and "BY" as another. This applies also to sending practice; it will be found that most learners are so worried about the coming Q that they forget their fears of C and send it rhythmically (instead of as NN or TR), and Y seems to "flow" from the fingers after B, for some reason.

In parenthesis, it is often stated that musicians learn morse readily. Perhaps it would be safer to say that those who have a strong sense of rhythm, whether musicians or not, do learn easily; trained musicians, on the contrary, often tend to attempt to reduce letters to standard rhythmic



In the Morse Practice Room of a Naval training establishment: recruits for wireless duties with the Fleet Air Arm.

On Learning Morse—

force of Western music—and unfortunately this is impossible in the very cases (Q and Y, for example) where it would be most useful. Other letters do fit into musical "bars"—V is the Beethoven "Fate" motif, for instance—but even here musicians often have to be watched: I recall one persistently clipped dash in an F which was finally traced to a faulty link with the "Get your hair cut" rhythm in the Franck "Symphonic Variations," where, however, the "dash" is only twice the length of the "dots."

Royal Marines operating a field transmitter-receiver.

The real difficulty comes at the shift from one stage to the other. There are days of utter despair, usually at about 6-8 words per minute: one sticks there until there seems no hope—and then suddenly, often from one day to the next, the speed jumps to about 12 words a minute.

The Subconscious Stage

The chief help at this shift of stage seems to be a saturation of the learner with morse. Experiments have even been tried of putting automatically fed telephone earpieces under his pillow while he sleeps. I have personally had considerable success by deliberately allowing morse practice in one room to be audible in another where men were doing mechanical work on instrument repair, or even listening to a lecture. (Brutal to the lecturer, but he was myself.) A less drastic dodge which occasionally works marvels is to tell the despairing learner to write down *something* for each letter he hears, even if he is sure it is wrong; it is surprising to him, and encouraging, how often it turns out that the supposedly "wrong" letters prove to be the right ones after all.

Again in parenthesis, I believe buzzers to be the best instructional instruments in all cases, even if the learner needs only sounder or lamp or even cable-slip. Once his buzzer speed is up to about 15 words, the desired system can be continued with it, so that he hears both sounder and buzzer, or sees lamp or slip and hears buzzer simultaneously. Then, little by little, the buzzer can be weakened until he relies more and more on the other source of signals without realising that he is doing so.

And a word of consolation to the learner in closing: once morse is really subconsciously known it can never be forgotten, any more than skating or cycling.

Club News

Christ's Hospital Wireless Society

Hon. Sec.: Mr. R. L. Denyer, Lamb B, Christ's Hospital, Horsham, Sussex.

This society was formed on the 11th February last, and has now about fifty members.

Members are being encouraged to give lectures, and, so far, one has been given almost every week. Lectures this term have been given by G. S. Tucker on "The Electronic Theory," T. R. Munro on "SW Battery Sets," and P. A. Shears on "The Principles of the Superhet." Mr. Waller gave a lecture giving general hints to beginners and R. L. Denyer, the secretary, gave one on "Television," illustrating the principles of the selenium cell by using it as the resistance in a neon-lamp capacity tester.

Various members are constructing testing equipment such as capacity bridges, and one member is designing and constructing a coil winder. Many testing instruments are available to the members of the society as the weekly set-constructors' meetings are held in the science laboratories.

The secretary would be pleased to correspond with other School Radio Clubs, in order to exchange information and ideas.

British Short-wave League

Headquarters: Ridgewell, Halstead, Essex.
Hon. Sec.: Mr. F. A. Beane, Ridgewell, Halstead, Essex.

Due to increases in the cost of production the League has suspended publication of its journal, *The Short-Wave Review*. It is hoped to issue a semi-official news bulletin during the war and to publish reports in *The Wireless World*. The hon. sec. will make an endeavour to reply to letters if a stamped addressed envelope is enclosed. Those corresponding with foreign countries are advised to use plain English and to avoid ham jargon.

Random Radiations

By "DIALLIST"

Misleading and Misled

IN my last month's notes, I'm afraid I must have misled a good many readers by giving a wrong address for the National Wireless Register. Let me put it right now; letters concerning the Register should be addressed to the Secretary, Wireless Telegraphy Board, c/o Admiralty, Whitehall, London, S.W.1. The mistake was one of those sickening things that just *will* happen, no matter how hard you try to prevent them. Here's how it came about. Not knowing the address myself, I asked a fellow who ought to have been able to supply the information. He gave me an address without the slightest hesitation, and in so downright a manner that I never thought of doubting its correctness. I'm so sorry if anyone was put to unnecessary trouble. Will he please realise how the mistake occurred—remembering that in the out-of-the-way spot where I've been stationed so long no books of reference are available—and forgive me.

Good Training

THERE used to be those who scoffed at the long-distance enthusiast's doings in general, and at his passion for burning the midnight oil in search of elusive far-away stations in particular. Well, there's one good thing, at any rate, about having made a peacetime habit of sitting up late once or twice a week. It has proved splendid training for anti-aircraft work, as I'm sure any of those who are gunning or searchlighting will agree. Lesser men groan if stand-to comes when they are just thinking of going to bed. They yawn mighty yawns as the small hours become less and less small, and have difficulty in preventing themselves from falling asleep on their feet. Not so your hardened radio long-distance man. Bedtime deferred means little to him so long as there is interesting and exciting work in hand. If he yawns at all, it is only from boredom, when a promising stand-to results in nothing but a long and uneventful vigil, with never a sight or a sound of a hostile plane.

Peacetime Possibilities

Those who were not brought up in the Spartan school of D-X grow gradually used to keeping uncanny hours as time goes on, of course. By now many of them are hardened to watching darkness give way to the dim light of approaching day as they gaze at the sky. Will their newfound ability to keep wide awake through the small hours result in an increase after the war in the number of long-distance wireless men? I shouldn't be a bit surprised. Many of them have been bitten by the short-wave bug already. You'll find them, whenever they get the chance, putting the wave-change switch of the receiver in the mess to "S" and trying over the various short-wave bands with increasing skill and patience. You can do a vast amount of short-wave work, of course, in the day-time, and the comparatively early part of the night. But there are so many interesting stations that you can't hear without sitting up for them, that late nights every now and then are a necessity unless you're content to leave much of the short-wave field unexplored.

The VC Nuisance

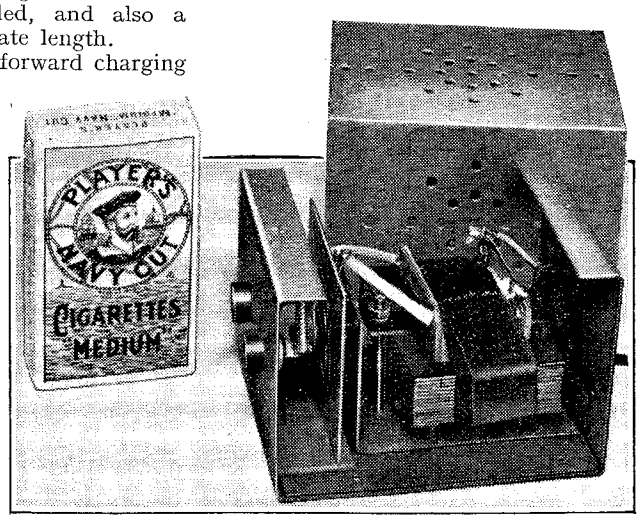
VC in the heading has, naturally, its radio and not its Army meaning! It is of volume-controls that I write with a pen steeped in vitriol. Why *are* the darned things so prone even at this time of day to let you down. I know that there are good and reliable makes; but, taking them by and large, volume-controls are still amongst the major worries of wireless. Sometimes they merely become "gritty." That you can put up with for a time, for the unpleasant effects occur only when you move the knob and you can always avoid them by leaving it alone. Sometimes they peter out altogether and then you simply have to fit a new one if you want to be able to use the set. Per-

Heayberd "Tom Thumb" Charger

THIS neat unit will charge a 2-volt accumulator at 0.5 amp. from 50-cycle AC mains of any voltage from 200 to 250. It consists of a small double-wound transformer and a single element metal oxide rectifier. The all-metal case is well ventilated and its size is $3\frac{1}{2} \times 2\frac{3}{4} \times 2\frac{3}{8}$in. Shrouded output sockets and plugs, coloured for polarity, are provided, and also a mains lead of adequate length.

On test the mean forward charging current started at 0.58 amp. and settled down to exactly 0.5 amp. when the battery was taking its normal charging rate. After allowing an hour for the unit to attain temperature equilibrium, the rectifier element was found to be quite cool and the transformer only comfortably warm from the electrical engineering standpoint. Some lamination noise was present on load as the core is clamped only at the centre, but this is a minor detail, and there can be no hesitation in stating that the charger is well up to its work.

The price is 14s. 4d., and the makers are F. C. Heayberd & Co., Ltd., 10, Finsbury Street, London, E.C.2.



Heayberd "Tom Thumb" charger for portable set and other small 2-volt accumulators.

DISTRIBUTION OF "THE WIRELESS WORLD"

Provided that an order is given to the newsagent in advance, no difficulty should be experienced in obtaining *The Wireless World*. Readers are reminded that this journal appears on the 20th of the month preceding that for which the issue is dated: they are asked to report to our publishers any case of difficulty in obtaining copies.

haps the worst of all their goings on is to become defective intermittently. Then, because you can often make it work in some kind of way for a bit by pushing and pulling at its knob, or by twiddling it to and fro half a dozen times, you put off the job of changing the volume-control or having it changed. And every time you use the set you cuss that VC heartily.

The Worst Kind

I've got one of these worst of volume-controls in my set at the moment. I haven't time to change the hateful thing, and there isn't a radio service man within miles. And here's what it does to me. When I *can* manage to hear one of the news bulletins I switch on expectantly—and forget about that volume-control. It soon forces me to remember. "In an encounter over the North Sea," says the announcer, "five of our fighters attacked a formation of . . . crackle, pop, fizzzzz, mumble, mumble, mumble." I seize the knob and apply treatment ranging from the gentle at first to the vigorous later. Incomprehensible whisperings intermingled with frequent spluttering noises issue from the loud speaker. Suddenly, at a moment when I have the VC in the full "on" position, the set returns to life with an ear-splitting bellow. I tone it down; but by this time the announcer is talking about fat stock or giving hints on the storage of apples, and with a sigh I switch off. Later on, when there is something that I don't particularly want to hear, I switch on and the set works perfectly by the hour. Assuring myself that the fault has cleared itself, though knowing quite well that it hasn't, I hope for the best when the next thing I want to hear comes along, and invariably get the worst.

The Service Problem

Just now I mentioned that there was not a radio service man within miles of me. Till recently there was one—and a good one, too—but he has been called up and is with us no more. The servicing of wireless sets is becoming a big problem, for the wireless shops have sent so many of their younger men to the Navy, the Army or the Air Force. The older men and those unfit for fighting forces are carrying on nobly; but in many places they are simply overwhelmed with work. I know one man who had in peacetime five assistants, all kept busy. Now he is alone. He does his best to help his customers in their difficulties by working like a nigger. But there are limits to human endurance, and obviously one man, however willing, cannot do the work that used to keep six fully occupied. Remember the service man's plight and do all you can to help him to help you. Most readers of *The Wireless World* probably do the bulk of their own minor repairs and adjustments and maybe the major ones as well. Such can do the service man many a good turn just now by seeing that friends with little knowledge of the "innards" of the wireless set don't call him in unnecessarily. How often does the harassed service man answer a call for aid, only to find that poor reception or complete silence on the part of the receiver is due to some footling little thing that his customer could have attended to himself if he had had a knowledgeable friend to point it out and show him what to do.

Carrying On

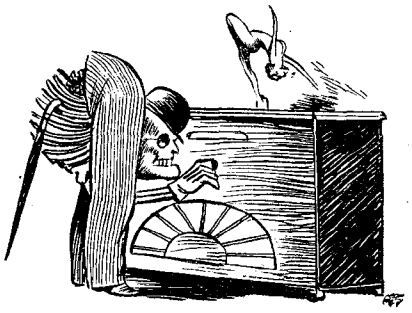
IT'S good to see how well the wireless industry is carrying on in difficult times. The supply of sets has been kept up and new models to suit the requirements of the man in uniform and the man in "civvies" keep on appearing. Price restrictions and the difficulty of obtaining some material (urgently needed for other purposes) have imposed handicaps. But the industry has done its job well. It has kept us going and it has been able to help on the export trade that we need so much by making models for distant countries and selling them there. That's the stuff! And don't forget the grand work that the industry has done in turning out vital supplies for the Forces. You'd be surprised if you knew what kind of things some of them have adapted themselves to make.

Unbiased

By FREE GRID

Tuner's Tiredness

I WAS deeply interested by the article published in last month's issue of *The Wireless World,* in which we were shown some rather indelicate illustrations of our internal economy, in order to assist us in learning to handle a morse key correctly. Frankly speaking, I was astounded, as I was quite unaware that I had got such components as



Help from Harley Street.

an ulna and a humerus inside me, and even now I have my doubts of this ball and socket arrangement of the shoulder joint. Probably the author of the article has this rather crude makeshift, but I can hardly think that we can be all built alike in this respect, as it seems unthinkable that Paderewski and myself, for instance, depend on the same mechanism as the local plumber for our efforts.

The article *did* set me thinking, however, about the shocking state of ignorance we are in concerning our internal economy, and I can see now why we all find the turning of a tuning dial so fatiguing that we need a push-button. It is all a question of holding the tuning knob correctly, and I have been in consultation with a well-known Harley Street doctor concerning the particular muscles we employ to tune a set.

He has rather startled me by telling me that it is not the fault of listeners at all that they suffer from tuner's tiredness at the end of an evening's listening. It is solely due, he said, to the fact that set manufacturers when they are designing their receivers do not call in a competent physiologist to guide them in placing the tuning knobs correctly.

As the medico rightly pointed out to me, it is quite impossible for manufacturers to remedy this state of affairs now, as all their energies are required to be devoted to far more vital work. Fortunately, according to my adviser, matters are not entirely hopeless, however, and he has been at some pains to draw me a sketch of a posture suitable for tuning a console receiver of a type which is representative of a large number of commercial products. The posture, as will be seen from the sketch, is somewhat unconventional, but it does avoid the fatiguing strain on the muscles of the back, which the more ordinary bending position causes.

In order to make matters still more clear, my Harley Street friend has shown the set user in skeleton form in order to illustrate the bones that are used in tuning a receiver. I have taken the liberty of amending the sketch slightly, by putting trousers on the skeleton, as I am not unmindful of the fact that many of my readers belong to the Victorian age when even piano legs were encased in pantaloons.

Radiotel

I WAS recently compelled to visit a certain northern city, which censorship regulations forbid me to name, in order to fulfil an urgent business engagement, and all my efforts to cancel it having proved unavailing, I reluctantly packed my grip and wended my way to Euston. I have, however, always been a believer in looking on the bright side of things, and while in the train I consoled myself with the thought that at least I was unlikely to suffer from sunstroke in the particular city to which I was bound, and by the time I arrived I was feeling sufficiently fortified to face the morgue-like atmosphere of the average provincial hotel bedroom.

I stood for a moment outside the station in earnest conversation with one of the natives before proceeding to seek an hotel, and I am well pleased that I did so as he was able to recommend me to an hotel where real home comforts are now available. To my astonishment I found that not only were there such home comforts as an electric blanket and an electric razor, but that, in addition, headphones were provided, via which I could receive either of the B.B.C. programmes as desired.

There was, moreover, a third switch position which apparently connected me to the microphone system installed in the hotel restaurant, whereby I was enabled to listen to the cabaret, a thing which I must confess that I never thought went on at all in provincial cities, as I have always been led to believe that the citizens retire dutifully to rest at the sound of the curfew. I was so absorbed that daylight had begun to filter through the mirky gloom out-

A certain northern city.

side the windows before I finally took off the headphones.

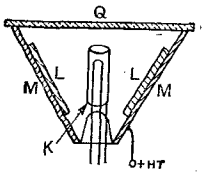
There was, however, one thing lacking, and that was the provision of a good short-wave set in the bedroom to enable me to garner in a few foreign programmes, and I said so rather forcibly to the chambermaid when she brought me my tea in the morning. To my surprise, she proved to be an enthusiastic radio fan, and we were soon engrossed in discussing the relative merits of various types of frequency changer, with a result that I missed my appointment.

Recent Inventions

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns.

GENERATING INFRA-RED RAYS

IT is known that electromagnetic waves, so short that they come within the visible spectrum, can be generated by subjecting a fluorescent material to electronic bombardment. A familiar instance is the viewing screen of a cathode-ray television receiver. The present invention is based on the discovery that it is possible to produce longer waves—extending into and beyond the infra-red region—by similarly subjecting suitable substances to the action of a stream of electrons. The materials mentioned are the selenides



CR tube technique for generating infra-red rays.

or tellurides of zinc, cadmium, or mercury, with or without the aid of activating metals, such as copper, silver, and platinum.

As shown in the figure, an evacuated tube with metal sides M and a quartz top Q contains an indirectly heated cathode K. The metal part serves as an anode and is coated with a continuous layer L of infra-red-sensitive material. The electrons liberated from the cathode are attracted by the high anode voltage, towards the sensitive material, and liberate infra-red waves which pass out through the quartz plate at the end of the tube.

Telefunken Ges. für drahtlose. Telegraphie m.b.h. Convention date (Germany) July 23rd, 1937. No. 517526.

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BRIGHTER TELEVISION PICTURES

IT is known that a more intense fluorescence can be produced by using ultra-violet light as the energising agent. The object of the invention is to utilise this effect in a television receiver in order to secure a brighter picture.

The incoming signals are first reproduced on the fluorescent screen of a cathode-ray tube in the ordinary way, and an image of the picture so obtained is focussed on to the photo-sensitive cathode of an auxiliary tube. The electrons liberated from this cathode are then projected at speed against a second screen in the same tube so that its temperature is varied locally in accordance with the light-and-shade values of the picture image.

The other side of the second screen is coated with a fluorescent material which is activated from outside the tube by a source of ultra-violet light, the general illumination so produced being modified by the local differences in temperature so as to give a final image of the picture in brighter contrast than the first image. Since the ultra-violet fluorescence is diminished by a rise in temperature, the image is originally projected as a negative, so as to show as a positive in the final stage.

Baird Television, Ltd., and V. A. Jones. Application date, July 29th, 1938. No. 517483.

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ACCURATE TUNING CALIBRATION

THE figure shows a slow-motion indicator dial suitable for tuning to short-wave stations. An outer disc D is rotated by knob N, and is marked with five equally spaced divisions A, A1, A2, etc., which pass across the fixed scale marked 1 . . . 10, shown on the upper edge of the frame, so as to give a 50-division range. The knob N is linked by a 40 to 1 reduction gearing to the tuning condenser, so that 20 full revolutions of the knob correspond to a 180 deg. movement of the condenser. Any one of the lines A, A1 then moves over a distance one thousand times greater than the movement of the condenser.

Behind the disc D is a second plate mounted on ball bearings and carrying five cylinders C, each marked with 20 sets of numerals. A toothed wheel at the end of each cylinder gears with a screw thread T formed around the edge of the fixed casing, so that the cylinder rotates on its own axis as it moves round the dial.

Arrangement for extreme accuracy of tuning-dial calibration.

The setting of the tuning condenser is found by combining the reading on the fixed scale with the figure on the cylinder showing through the slot K immediately beneath. For instance, if the line A on the dial D points to 5 on the fixed scale, and the cylinder reading is 470, then the condenser has been rotated 475 thousandths of 180 deg. from zero.

The General Electric Co., Ltd., W. R. Rose, F. Clark, and A. D. Forbes. Application dates September 10th, 1938, and January 5th, 1939. No. 518979.

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HT SUPPLY

THE DC potentials required to operate a television receiver vary from, say, 400 volts and less, for the valves, to 3,000 volts or more for the cathode-ray tube. These voltages could, of course, be tapped off from a potentiometer shunted across a single rectifier supplying the highest voltage, though this would waste a good deal of power.

According to the invention an AC mains eliminator includes what is, in effect, a double rectifier unit, which has only one common cathode. The single cathode feeds a stream of electrons to two anodes, placed one behind the other, the anode nearer the cathode being perforated so that it collects only a part of the total electron stream. This provides a range of DC potentials up to 400 volts. The second anode collects the remainder of the stream and builds it up to, say, 3,000 volts, in order to supply the anode and accelerating electrodes of the cathode ray tube.

The General Electric Co., Ltd., W. H. Aldous, and D. C. Espley. Application date July 7th, 1938. No. 516782.

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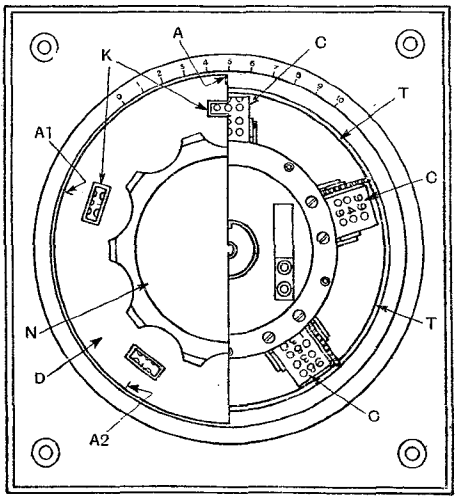
DF AERIALS

IN the Adcock type of aerial two pairs of dipoles are connected in phase opposition by horizontal leads to a radiogoniometer, the object being to remove any horizontally polarised waves, and to take the critical minimum reading on a vertically polarised field only. It is found, however, that a certain degree of unbalance is caused by the fact that the lower limb of each of the dipole aerials has a larger capacity to earth than the corresponding upper limb. This allows the presence of horizontally polarised components to blur the sharpness of the directive response of the system.



Such lack of symmetry is compensated, according to the invention, by connecting variable elements of in-

Recent Inventions—

ductance and capacity across the poles of each dipole, at the point where the horizontal connecting leads are taken to the radiogoniometer or receiver. In this way a clear-cut indication is given of the direction of the incoming wave, free from so-called night error.

W. W. Triggs (communicated by Pan-American Airways). Application date April 21st, 1938. No. 516563.

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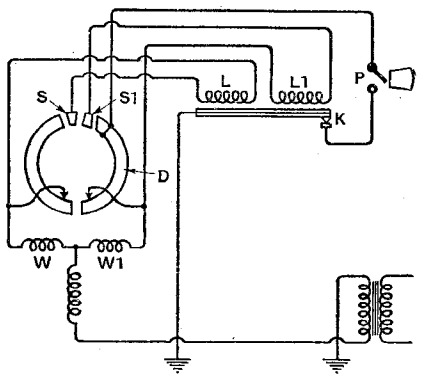
PUSH-BUTTON TUNING

THE driving motor of a push-button receiver is stopped exactly at the selected tuning point by an arrangement which slows down the speed of the motor just before this critical point is reached. Usually, the closure of one of the push buttons P drives a motor in one direction or the other, through the forward or reverse windings W, W1, and rotates a commutator disc D until the contact maker (not shown) for the particular



Thermal contact breaker in motor-driven push-button circuit.

circuit selected reaches the main gap in the disc.

According to the invention, the main gap is fitted with two auxiliary segments S, S1, which are respectively connected to the two heater coils L, L1 of a bi-metallic switch K; the coils are also in series with the forward and reverse windings W, W1 of the driving motor. Each contact maker is sufficiently wide to bridge the space between the main gap and one of the segments S, S1, whereupon the coil L or L1 heats the switch K and so, momentarily, breaks the energising circuit of the motor, say once a second. This slows it up, and ensures that it stops without overshooting the mark, as soon as the preselected contact maker reaches the centre gap between the segments S, S1, and finally breaks the motor circuit.

E. K. Cole, Ltd., and G. Bradfield. Application date August 17th, 1938. No. 518229.

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AIRCRAFT LANDING BEAMS

THE field radiated from a horizontal dipole elevated above the ground is determined at a given point, partly by the direct or space-wave component, and partly by the wave which reaches the same point after reflection from the ground near the dipole. The resulting radiation provides a gliding path to earth, which the pilot finds by flying his machine so as to keep along a line of constant field-strength, as shown by his indicator.

The invention relates to means for varying the slope of the line of constant field-strength so as to allow the pilot to make a steeper or flatter landing, according to the weight or speed of his machine, or in order to avoid local obstacles. For this purpose, the conductivity of the earth near the transmitting aerial is modified, in order to vary the strength of the reflected component of the radiated field. For instance, a layer of sand is found to reduce reflection and give a flatter line of descent, whilst a conducting surface, say of sheet iron, will give a steeper gliding angle.

G. L. Davies. Application date February 20th, 1939. No. 517306.

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ELECTRON MULTIPLIER

RELATES to an electron multiplier of the type in which a resonant circuit is coupled across a pair of electrodes, between which the electron stream is made to oscillate and build itself up by secondary emission. In order to secure linear amplification, it is desirable that each electron should be subjected to the same number of impacts; this tends to present the so-called "shot" effect.

According to the invention, the external resonant circuit is energised or "driven" from a separate source which generates a non-sinusoidal voltage wave of such form that the rate of change of voltage increases after a preliminary interval. The electrons are therefore subjected to a low rate of multiplication during the first part of each cycle, and then to a more rapid rate of multiplication, which gives a more equal amplification, with less "shot" noise, than if a sinusoidal driving voltage were used.

Farnsworth Television, Inc. Convention date (U.S.A.) March 22nd, 1937. No. 515297.

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TELEVISION IMPROVEMENTS

THE picture signals are transmitted on one sideband only of the carrier wave. The receiver, in effect, is tuned to the outer edge of the band, and has an acceptance band of, say, 5 megacycles, with a response characteristic which falls off sharply on the opposite side of the carrier.

The synchronising impulses are transmitted on a separate carrier wave, which is located 5 megacycles lower down the frequency scale than the picture carrier, but inside the normal range of the picture signals. The necessary frequency shift is effected automatically by means of a suitably biased diode or pentode valve working under saturated conditions.

The arrangement allows less-powerful synchronising signals to be radiated, and enables a positive discrimination to be made between the line and frame impulses. It is applicable to three-colour television, and to transmissions which are intended to give stereoscopic effects.

W. A. Beatty. Application date May 4th, 1938. No. 515474.

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AIRCRAFT WIRELESS

TO reduce aerodynamic resistance, the "crossed" frame-aerials used for the radio-compass equipment on a high-speed aeroplane are housed inside a streamlined casing, which is either made of some non-conducting subtance, or of two symmetrical halves of metal separated by a layer of insulating material so as to avoid complete screening.

Provision is made to allow each of the frame aerials to be adjusted slightly, relatively to the other, in order to correct for the effect of the surrounding metal on the incoming wave front.

Standard Telephones and Cables, Ltd., and C. W. Earp. Application date, August 12th, 1938. No. 517982.

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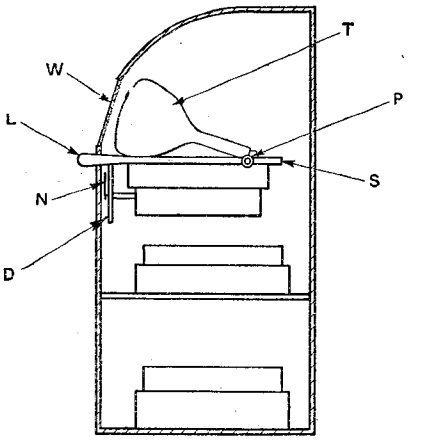
TELEVISION RECEIVER REFINEMENT

IN a set which is designed to receive either television or ordinary sound broadcast programmes provision is made to mask the fluorescent screen of the cathode-ray tube, when the set is switched over to receive sound broadcast programmes, and to present in its place a station indicator.

As shown in the figure, the cathode-ray tube T is mounted on a shelf S which is pivoted at P. Normally the tube is located as shown, so that the fluorescent



Arrangement for interchanging positions of CR tube and tuning dial.

screen is visible through the glass window W. The set is switched over to receive ordinary broadcasting by lifting a lever L. This makes the necessary circuit alterations, and simultaneously tilts the shelf S so that the dial D and pointer N come into view through the window W.

Kolster-Brandes, Ltd., and C. E. Lock. Application date July 1st, 1938. No. 516631.

Wireless World

CLASSIFIED ADVERTISEMENTS

THE CHARGE FOR ADVERTISEMENTS in these columns is
12 words or less, 3/- and 3d. for every additional word.
Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 3 consecutive insertions, 5 per cent.; 6 consecutive, 10 per cent.; 12 consecutive, 15 per cent.

ADVERTISEMENTS for the September issue are accepted up to First Post on Thursday, August 8th, at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, or one day earlier at the Branch Offices, 8-10, Corporation Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26B, Renfield Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section are subject to prepayment.

Cheques and Postal Orders sent in payment for advertisements or deposits should be made payable to ILIFFE & SONS Ltd., and crossed. Notes cannot be traced if lost in transit. They must therefore be regarded as being despatched at sender's risk. Alternatively, they may be sent per registered post.

All letters relating to advertisements should quote the number printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes. They also retain the right to refuse or withdraw advertisements at their discretion.

NEW RECEIVERS AND AMPLIFIERS

BANKRUPT Bargains.—Brand new 1939-40 models, well-known best makes, makers' sealed cartons, with guarantees, at less 30%-40% below listed prices; also Midgets, portables; send 2½d. stamp for lists.—Radio Bargains, Dept. W.W., 261-3, Lichfield Road, Aston, Birmingham. [9150

£11 Only.—Usual price £22; *Wireless World* 2 R.F. Receiver with push pull quality amplifier, 10 valves, including tone control stage, 8 watts triode output, ideal for quality reproduction from radio and gramophone; limited number.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [9142

COMMUNICATION RECEIVERS

Wanted

COMMUNICATION Receiver, Hallicrafters SX-25, SX-17; full particulars.—Charlesworth, 30, Ainsworth Rd., Radcliffe, Lancs. [9147

PUBLIC ADDRESS

VORTEXION P.A. Equipment

IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4, 7.5, and 15 ohms speakers, or to specification, inaudible hum level, ready for use; 8½ gns. complete.

C.P. 20 12-volt Battery and A.C. Mains Model, as used by R.A.F., output as above; 12 gns.

A.C.-20, in portable case, with Collard motor, Piezo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver

(This advertisement continued in third column.)

ARMSTRONG

WE THANK YOU

for the immediate interest shown in our new Export Model EXP 48. We shall welcome further enquiries and do our level best to meet the varying requirements of our overseas friends.

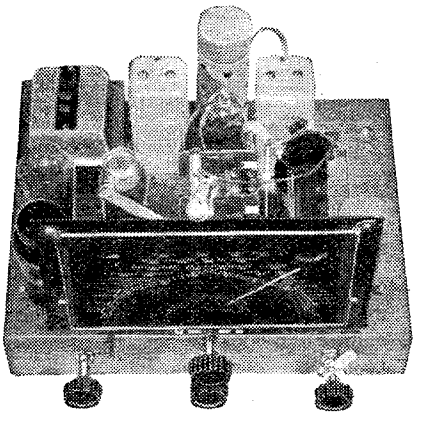
We are fully alive to the difficulty in obtaining good radio reception in many parts of the world and as our engineers have had already a wide experience in this connection they will gladly co-operate with you in overcoming as far as is practicable, your particular problems.

Many such difficulties have been solved by us and we are confident we can help you. Please drop us a line!

SPECIAL OVERSEAS MODEL EXP48

8-v. 4-BAND ALL-WAVE SUPERHET CHASSIS

(13-160m. continuous & normal Broadcast bands)



This chassis has been developed on the lines of our Model AW38 which has proved an outstanding success since its introduction at 1939 Radiolympia. Overseas requirements, however, have been given primary consideration. Firstly, an additional short-wave band has been incorporated and the chassis now gives an efficient continuous short-wave coverage from 13 to 160 metres. All coils and I.F. transformers have been specially treated to render them impervious to humidity. Switching is of extra robust construction and contacts heavily plated. The mains transformer is interleaved and has a generous iron content to avoid excessive temperature rise and the steel chassis itself is heavily cadmium plated for tropical use.

International standard base valve-holders are used throughout ..... **8 gns.** Plus 5%

With 8" P.P. Speaker ..... **£9.9.0** Plus 5%

With 10" P.P. Speaker ..... **£10.3.0** war increase

OVERSEAS TRADE BUYERS
are invited to get into touch with us.

For our friends at Home

OUR ILLUSTRATED ART CATALOGUE
fully describes the above new model, our well-known AW125 PP (reviewed so favourably by "The Wireless World"), the SS10 and all other chassis in the Armstrong range. Write for your copy to-day—6d. p.f.

ARMSTRONG MANUFACTURING CO.
WARLTERS RD., HOLLOWAY, LONDON, N.7, ENGLAND.
'Phone: NORth 3213.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 1/- to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Readers who reply to Box No. advertisements are warned against sending remittances through the post except in registered envelopes: in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. Details of any arrangement made between parties which does not concur with any of the above conditions must be advised to us when the deposit is made. For all transactions whether a sale is effected or not a commission of 1 per cent. is charged on and deducted from the amount deposited (minimum charge 2/-). All correspondence must be sent to Dorset House, Stamford Street, London, S.E.1.

PUBLIC ADDRESS

(This advertisement continued from first column.)

transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up, with tone control, complete with valve and plugs; £17/10.

COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer; £22/10.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model, with negative feed back; £40, complete.

250-VOLT 250 m.a. Full Wave Speaker, field supply unit; 25/-, with valve.

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

ALL P.A. Accessories in Stock; trade supplied.

SEE Our Display Advertisement on page 377 (Edit.).

VORTEXION, Ltd., 257, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [9127

USED SETS FOR SALE

FULTOGRAPH

LABORATORY-BUILT "Fultograph" Still-picture Receiver, complete, as new, cost £45; what offers?—Stewart and Roberts, Amersham. [9118

Wanted

MULTI-VALVE or Communications Receiver, 6-26 M.C.—10, Howitt Close, Howitt Rd., N.W.3. [9134

NEW MAINS EQUIPMENT

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not you?

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

VORTEXION, Ltd., 257, The Broadway, Wimbledon, London, S.W.19. 'Phone: Lib. 2814. [9128

ALL-POWER TRANSFORMERS, Ltd.—Transformers and chokes to specification, rewinds; write for quotation.—8a, Gladstone Rd., Wimbledon, S.W.19. Liberty 3303. [9122

NEW LOUD-SPEAKERS

BAKERS Brand New Surplus Speaker Bargains.

EVERY Music Lover Interested in Realistic Reproduction should write for free descriptive leaflet now.

£3/10; usual price £9.—Brand new Baker Super Power Electro Magnet Speakers, as solely specified for the *Wireless World* Quality Four Receiver.

£4/10; usual price £10.—Brand new permanent magnet infinite baffle speaker, complete with beautifully finished cabinet in polished walnut.

£2/7/6; usual price £5.—Brand new super quality triple cone speaker, permanent magnet model; exceptional bargain; limited number.

SECURE One of These Exceptional Bargains Now.

BAKERS SELHURST RADIO, 75, Sussex Rd., S. Croydon. [9143

SECOND-HAND LOUD-SPEAKERS

VOIGT Twin Diaphragm Unit and Rectifier, recently reconditioned; £10.—Blanks, 48, Brantwood Ave., Monkseaton. [9141

EPOCH Portable Cinema Speaker, 14in. lightweight model, perfect condition; £2/10; D.C. field.—B. Marsden, 60, Leigh Rd., Highbury, N.5. [9152

TRIPLE CONE CONVERSIONS

BAKERS Triple Cone Conversions Will Immensely Improve Reproduction of Your Present Speaker. ("For a few shillings you have converted a speaker scheduled for the scrap heap into one worth pounds.—W. E. Darby. Grad. I.E.E.")

SPECIAL Offer.—We will loan you a speaker free of charge whilst we fit a triple cone to your present unit; write for details.

BAKERS SELHURST RADIO, 75, Sussex Rd., Sth. Croydon. [9145

EXTENSION SPEAKERS

27/6 usual price £3/5.—Brand new Infinite Baffle Extension speaker in cabinet, limited number.—Bakers Selhurst Radio, 75, Sussex Rd., Croydon. [9144

SHORT-WAVE EQUIPMENT

G5NI for Short Wave Equipment; largest stocks in the country; communication receivers; National agents; American and British Valves, etc. See advertisement on page 2—44, Holloway Head, Birmingham. [9531

"H.A.C." One-valve Short-wave Receiver, famous for over 5 years, now available in kit form; complete kit of precision components, accessories, full instructions, 12/6, post 6d., no soldering necessary; descriptive folder free on request.—A. L. Bacchus, 109, Hartington Rd., S.W.8. [9126

CABINETS

A CABINET for Every Radio Purpose.

SURPLUS Cabinets (Undrilled) from Noted Make.

WE Have Hundreds in Stock (no Catalogues); send measurements of chassis, etc., and say what kind of cabinet required; stamp for reply.

INSPECTION Invited.

H. C. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 5891. [0485

DYNAMOS, MOTORS, ETC.

ALL Types of Rotary Converters, electric motors, battery chargers, petrol-electric generator sets, etc., in stock, new and second-hand.

A.C. D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

RECORDING EQUIPMENT

PARMEKO Recording Amplifier, new model, cost pre-war £70, accept £35.—Full particulars from Educational Exhibitors, Ltd., 117, George St., W.1. [9136

Wanted

WANTED, "Parmeko" recording machine; must be in good condition.—Write, E. S. Farrow, 117, George St., W.1. [9137

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods, post free.

ELLIPTICAL Speakers, Celestion, suitable Ekco replacements, 750 ohms, less transformers, speech 25 ohms, new, handle 8 watts, carry up to 120 m.a.; 3/9 each, to clear.

FERRANTI Air Core Type Tuning Coils, transformer wound, can be used as band pass, tuned grid with reaction, chassis type; three for 2/6, with coil connections.

T.M.C. 0.5 mf. Paper Tubular Condensers, N.I., 400v., D.C. working, 3 for 1/3; Erie 60 ohm ½-watt resistances, 1/3 dozen; Erie 1,500 2-watt resistances, 4 for 1/3; 600 ohm wire wound, 3 watt, 4 for 1/3.

VOLUME Controls.—Morganite Stackpole ½ meg., with switch, 1/9; Murphy ½ meg. type with D.P. switch, 1/9; Sator broad base type without switch, 10,000 and 250,000 ohm, 1/3 each; Centralab 11,000 short spindle, less switch, two for 1/3; Sator midget, less switch, 1 meg. and 0.4 meg., 1/2 each, or two for 1/9.

THIMBLE Top Caps, 30 for 1/3; 9-pin plugs with cap and socket, two for 1/6; Epicyclic (reduction) drives, two for 1/3; Erie 3-watt resistances, 0.25-270-300-350-400-15,000-60,000 2 meg., two for 1/3.

4-WAY Lead in Single Cover, brown or white, single strand, 4 yards 1/3; push back connecting wire, stranded, 12 yards 1/3; Polar dials, less escutcheon, 2-band, 1/6, V.P. type, spindle offset to right-hand.

SPEAKERS.—Celestion, energised types, 7,500 and 2,000 ohms, less transformer, 8in., 5/6 each; 600 ohm ditto, 6in., 5/-; Magnavox 2,000 ohm, with pentode transformer, 8/6.

SPECIAL Offer 2v. British Base Type Valves, triodes only, H.F. det., G.P. power, super power, similar to Triotron, all types, 2/- each; American 6C5 tuning eyes, 2/9.

ELECTROLYTICS.—T.C.C. 8 mf. wet type 802 upright cans, 440v. working, 460v. surge, 1/9 each, 15/9 dozen; T.C.C. midget block electrolytics, 25×25v. and 10 mf. at 150v., 1/3 each, three for 2/9.

SPEAKERS.—Pairs elliptical cone M.C. speakers, Plessey and R. & A., ex Philco, push-pull pentode transformer, fields 325 ohm for smoother, 8,600 ohm as bleeder, handle 10-15 watt, 10/9 pair.

GOLDTONE Mains H.F. Chokes, 120 watt, 2 for 1/6; Plessey midget semi screened twin gangs, 2/9; Plessey twin gangs, screened, with trimmers, 2/6.

AMERICAN Type 2v. Valves (1A4, 1B4 2101), in sets three, VM/HF/Pen., HF/Pen., and ½ watt output pentode, with valve base circuit and details, 4- and 5-pin, with top grids, 5/9 set three; valve holders, chassis, to suit, three for ninepence.

AMPLIFIER Kit Parts for 12-watt output, single 6L6 output, V.H., etc., mounted on chassis, 10×7, complete with four valves, pair Celestion elliptical speakers, resistances, condensers, tone and volume controls, and comprehensive circuit, 3 stage high gain, fully tested, for A.C. 200-250 volts; 45/-, carriage 2/6 extra.

BEST Known Make, 1 watt, colour coded carbon resistances, 20 sizes, as ordered; 2/6 dozen; ½ watt type, 2/- dozen.

ASSORTED Resistances, 50 for 2/6; 1 watt carbon, U.S.A. make, reasonable assortment given, sizes approx. 450-12,000-17-60-70 90-120 thousand ohms.

PAXOLIN Strip for Group Boards, etc., 2½in. wide, 3ft. for 1/3; Centralab ¼meg. and 50,000 ohm pots, with switch, long spindles, 2/6.

ULTRA Type Brown Knobs, octangle, plain arrow, L.S., 1/9 dozen, 8/6 gross assorted, 10/6 gross plain or arrow.

SMALL Iron Core Coils, made by Varley, aerial and oscillator, 465 k/c, 2/6 pair, with coil connections for straight type gang.

FERRANTI Wire Wound 2½ watt Resistances, with metal end caps, tubular, sizes 3,000, 4,000, 6,000, 8,000, 35,000; four for 1/3.

CLIX Valve Holders 4- and 5- and 7-pin square and oblong, 1/3 dozen; chassis types 4- and 5- and 7-pin, round type, with cover, 2/6 dozen.

REX Type Switches, 4B, 2P, 4w., with shorting plates on 5 switches, 2/6; 4B, 2P, 3w., 1/6; 3B, 4P, 3w., 1/3; screens 3¾×3⅜, 5 for 1/3.

PLESSEY 3-gang Fully Screened Straight Type Condensers, with top trimmers, 2/9; Plessey 3-gang straight type, all wave, ceramic insulators with SM cord drive, antimicro feet, 2/9.

T.C.C. Tubular 8 mf. Dry Type 450v. Electrolytics, wire ends; 1/6 each, 12/9 dozen. [9149

GALPINS

ELECTRICAL STORES

75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13

Telephone: LEE GREEN 5240

Terms: Cash with Order

MAINS TRANSFORMERS, 220/240 volts input, 100 volts 40 m/a. and 4 v. 1 amp. output, **4/6** each. P.F.

D.C. MOTOR BLOWERS, 2in. inlet and outlet. Aluminium body, laminated field, ideal for dug-out ventilation. 100-volt, **25/-**; 220-volt, **30/-**. C/Paid.

E.C.C. DYNAMO, 50/75 volts, 40 amp., 1,500 r.p.m. Ball-bearing. In good condition, **£7/10/-**, c/forward.

EX-G.P.O. SMALL RELAYS, 1,000 × 1,000 ohms with multi contacts, new, **5/-**. Ditto, 7,000 ohms two-leave type, **3/6** each. Useful for remote control, etc.

DYNAMOS, for charging or lighting, etc., all shunt wound and fully guaranteed. 100-volt 10 amp., 4-pole, 1,500 r.p.m., **90/-**; 50/75-volt 15 amp., 1,750 r.p.m., 4-pole, **90/-**; 30-volt 10 amp., ball bearings, 1,500 r.p.m., 4-pole, **70/-**; 25-volt 8 amp., 1,750 r.p.m., 2-pole, ball-bearing, **37/6**; 50/75-volt 25 amp., 4-pole, 1,500 r.p.m., **110/-**.

ELECTRIC LIGHT CHECK METERS, for sub-lettings, garages, etc. 200/250 volts, 50 cy. 1 ph., supply 5, 10 or 20 amps., **6/-** each, post 1/-.

TRUVOX PUBLIC ADDRESS HORN SPEAKER UNITS, 15-ohm speech coil, 6-volt field, **15/-** each, post 1/6.

X-RAY TUBES 4 to 7in. bulbs, tungsten targets, **15/-** each; platinum targets, **25/-** each. 2/6 extra for packing. C/F.

PHILIPS PRE-STAGE AMPLIFIERS. Consisting of 4 × 4 mf. 750-volt condenser, 400-volt transformer, L.F. choke, less valves. **10/-** each, C/F.

WESTON MOVING COIL MILLIAMP METERS, 0 to 50 m/A., 2in. dial model (506), as new, **20/-** each. Ditto, 301 model, 0 to 3 m/A., **30/-**; 0 to 50 m/A., **25/-**.

PORTABLE LIGHTING ENGINES. 2¾-twin Douglas special air cooling, complete with all fittings, including petrol tanks, etc., fully protected, condition as new, **£10**, C/F.

SMALL ELECTRIC ROTARY CONVERTOR, 110 volts D.C. input, 10 volts at 30 amps. output. Useful for garage charging. **55/-**, C/F.

ROTARY CONVERTORS, all in good condition. 100-volt D.C. input, 120-volt 1 amp. 333 cycle output, **35/-**. Another 24-volt D.C. input, 100-volt 3 amps. 500 cycles output, **45/-**.

X-RAY TRANSFORMERS, input 120 volts 50 cy., 1 phase, 40,000 volt 800 va output, **£7/10/-**. Another, same input, 64,000 volts 2 kva output, **£11/10/-**. Carriage forward.

50-VOLT D.C. MOTORS, ⅛ h.p., 1,500 r.p.m., **6/6** each. Ditto, 100 volt D.C., **7/6** each.

ZENITH VARIABLE RESISTANCES single-bar type, 5,000 ohms, carry 300 m.a., **25/-**. Ditto, twin-bar type, 180 ohms, carry 3.3 amps., **30/-** each.

EPOCH P.M. MOVING-COIL SPEAKERS, 10in. cone, 10 ohm speech coil, handle 10/12 watts, **32/6** each. Carriage, 2/6.

MAGNAVOX P.M. PUBLIC ADDRESS HORN SPEAKERS, handle 15/20 watts. Size of horn, 40in. by 20in. flare, **55/-** each. Carriage forward. Packing, 2/6 extra.

MOVING-COIL METER MOVEMENTS for recalibrating into multi-range meters. Low milliamp deflection. 2½in. dial. Makers: Everett Edgcumbe and other good makers. Price, **6/-** each.

EX-G.P.O. PEDESTAL TELEPHONES, complete with automatic dials, **8/6** each; without dials, **6/-** each. Bell Boxes, complete with A.C. bell, microphone, transformer, condenser, etc., **3/6** each. Hand Combined Telephones with finger press switch, **4/6** each.

ELECTROSTATIC (EVERETT EDGCUMBE) VOLT-METER, 0 to 6,000 volts, 8in. dial, in new condition, **62/6**, C/F.

PUBLIC ADDRESS 8-10 WATT AMPLIFIERS, 200/240-volt A.C. mains using 2PX4's in parallel, less valves, **32/6** each, carriage 2/-.

HIGH-VOLTAGE TRANSFORMERS, useful for all test work, or television. Input 200/240 volts, output 5,000 and 7,000 volts, **6/6** each, post 1/-.

MAINS TRANSFORMERS, 200/250 volts input, 12 and 24 volts at 4/6 amps. output suitable for model trains, etc., **15/-** each, post 1/-.

MAINS TRANSFORMERS, 200/240 volts input, 50 volts 8 amp. output, useful for small arcs, etc., **15/-** each, post 1/-.

ELECTRO DYNAMIC D.C. TO A.C. ROTARY CONVERTORS, 240 volts D.C. input, 230 volts 50 cy. 1 ph. 100 watts output. Complete in silence-proof cabinet with all smoothing. Condition as new, **95/-** each, C/F.

VOLTAGE CHANGING TRANSFORMERS (Auto Wound), 100/110 to 200/240 volts or vice versa. Guaranteed 12 months. 250 watts, **25/-**; 500 watts, **32/6**; 1,000 watts, **50/-**; 1,500 watts, **62/6**. Delivery 7 days from date of order.

REGULATORS, STARTERS and **LARGE DIMMER RESISTANCES,** Stud Switcharm type. Please state requirements.

SWITCHBOARD VOLT AND AMPMETERS. Moving coil and M.I. All first class makers. Please state requirements.

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

COULPHONE RADIO.—Change of address to Station Rd., New Longton, Preston. Cosmocord crystal pickups, 18/6; Rola G12 speakers, energised, 52/6; G12 P.M., 65/-; American valves, 4/6; Octal, 5/6; 40% discount on British types; stamp for lists. [9140

FINAL Clearance Sale. Large quantities of valves, transformers, chokes, condensers, loud-speakers, amplifiers, feeder units, etc. Offers wanted for G12, Goodman 20-watt, Magnavox 66, Celestion Junior Auditorium, and others.—Write, W. T. Rickards, 17, Heathfield Rd., Kings Heath, Birmingham, 14. [9116

Wanted

DOUBLE List Price Paid for Varley 465 k.c. Airtune I.F. Transformer, B.P.95, used in "W.W." Imperial S.W. Six.—Moss, 25, Highbury Hill, Highbury, N.5. [9130

MISCELLANEOUS

WALLBOARDS.

MANUFACTURER has for Disposal about 400 Crates ¼in. Imported Hardboard.—Enquiries to Box 2530, c/o *The Wireless World*. [9123

CARDS, memos., billheads; 1,000, 6/9; samples. Rubber stamps.—"B," Tices, 11, Oaklands Grove, London, W.12. [9139

HOOVER, £4/10, accessories included; also Electrolux, £4/4; Goblin, 49/6; Vactric-Airflo, £6/6; Airway (twin motor), £7/7; Mary Ann, £3/3; all rebuilt, guaranteed perfect; spares, repairs, rewinding.—R.E.C.S., Crown St., Reading. 'Phone: 2796. [9157

EVERY Radio Dealer Who is Not a Regular Reader of "The Wireless and Electrical Trader" should send his trade card at once for a specimen copy and full details of the "Trader" Services. "The Wireless and Electrical Trader" has the widest influence, and is read by all the leading manufacturers and traders. Trade only, 17/6 per annum, post free. Published at Dorset House, Stamford St., London, S.E.1. [0615

REPAIRS AND SERVICE

GUARANTEED Repairs, any transformers, choke, or motor armature, converter, dynamo, etc.; keenest prices, immediate quotation, prompt, dependable service.—See below.

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6486 (3 lines). [6892

EPOCH Diaphragms, 66, Domino, etc., transformers. —"R.E.C.S.," Crown St., Reading. 'Phone: 2796. [9156

MAINS Transformer Service, repairs, rewinds, or construction to specification of any type, competitive prices and prompt service.—Sturdy Electric Co., Dipton, Newcastle-on-Tyne. [0516

"SERVICE with a Smile."—Repairers of all types of British and American receivers; coil rewinds; American valves, spares, line cords.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [8934

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, service parts and rewinds; trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0435

REPAIRS to Moving Coil Speakers; cones/coils fitted or rewound; fields altered or wound; prices quoted, including eliminators; pick-ups and speaker transformers rewound, 4/6; trade invited; guaranteed satisfaction; prompt service.—L. S. Repair Works, 5, Balham Grove, London, S.W.12. Battersea 1321. [0394

SITUATIONS VACANT

AIR MINISTRY.

DIRECTORATE of Signals.

APPLICATIONS are invited for appointments as Civilian W/T. Operators at Air Ministry W/T Stations. These appointments are of a temporary nature in the first instance, but it may be possible to absorb a proportion of temporary post into the permanent establishment after the conclusion of hostilities.

APPLICANTS, who should not be above 45 years of age at the date of making the application, should preferably possess the 1st Class Postmaster-General's Certificate or the Air Operator's Certificate in Wireless Telegraphy and have had experience in radiotelephony, direction-finding and maintenance work. Operators will be required to serve at any Air Ministry W/T station, as the needs of the service may require.

SALARY is at the Rate of 75/- a Week for the First Two Years, thereafter rising by annual increments for approved service to a maximum of 125/- a week. The normal hours of duty are 45 a week exclusive of meal times, day or night, or 180 in periods of four weeks. Arrangements will be made for suitable candidates to be interviewed at Renfrew, Manchester, London or Bristol.

REQUESTS by Postcard for Forms of Application should be Addressed to the Under-Secretary of State, Air Ministry (S.I.e.), Julian Rd., Bristol, 9, and should state the town at which an interview is desired. [9153

SITUATIONS VACANT

AIR MINISTRY.

DIRECTORATE OF SIGNALS (CIVIL AVIATION).

APPLICATIONS are Invited for Appointments as Civilian W/T Operators at Air Ministry Civil Aviation W/T Stations. These appointments are of a temporary nature in the first instance, but it may be possible to absorb a proportion of temporary posts into the permanent establishment after the conclusion of hostilities.

APPLICANTS, who should not be above 45 years of age at the date of making the application, should preferably possess the 1st Class Postmaster-General's Certificate or the Air Operator's Certificate in Wireless Telegraphy, and have had experience in radio-telephony, direction-finding and maintenance work. Operators will be required to serve at any Air Ministry Civil Aviation station, as the needs of the service may require.

SALARY is at the rate of 75/- a week for the first two years, thereafter rising by annual increments for approved service to a maximum of 125/- a week.

THE Normal Hours of Duty are 45 a Week, exclusive of meal times, day or night, or 180 on periods of four weeks.

ARRANGEMENTS will be Made for Suitable Candidates to be interviewed at Renfrew, Manchester, London or Bristol.

REQUESTS by Postcard for Forms of Application should be addressed to the Under-Secretary of State, Air Ministry (E.1.e), Julian Rd., Bristol, 9, and should state the town at which an interview is desired. [9063

VACANCIES Exist for Civilian Wireless Instructors at the Electrical and Wireless Schools, Royal Air Force, at a rate of pay of £5/2/6 a week, rising by annual increments of 2/6 a week to a maximum of £5/10 a week.

CANDIDATES Must be Capable of Lecturing and Must Have a Sound Knowledge of Electrical principles and Their Application to Radio and Low-power Electrical Engineering.

APPLICATIONS Should be Addressed to the Under Secretary of State, Air Ministry (S.5.D.), London, W.C.2, giving full particulars as to previous experience, age, etc.

CANDIDATES Will be Required to Appear Before a Selection Board at the Schools for Interview and Test, but may be reimbursed the cost of third-class locomotion expenses for this purpose. The test will include the giving of a lecture on any subject which may be chosen by the candidate involving the principles of modern radio. Lecturing sequence and style are most important. [9155

RADIO-ELECTRICAL Service Engineer Required by West London Dealer Specialising Murphy, H.M.V., Pye; undertake aerial installations; familiar all makes; able drive car; exempt military service.—Full particulars, wage required, references, to Box 2532, c/o *The Wireless World*. [9133

REQUIRED for Branches in Provinces, Men over 40 who are fully experienced as radio engineers; also experienced radio salesmen; some technical knowledge an asset.—Address, by letter only, stating age, qualifications, and salary expected, M. W., c/o J. W. Vickers and Co., Ltd., 24, Austin Friars, E.C.2. [9138

MAN Required, with technical and production experience, to take charge of Test Department of well-known radio receiver manufacturers, employed on commercial and Government work; state age, experience, salary required, and present position; applications not giving this information will be ignored.—Box 2531, c/o *The Wireless World*. [9124

VACANCIES Exist for Civilian Morse and Procedure Instructors at the Electrical and Wireless Schools, Royal Air Force, at an initial rate of pay of £4/12/6 per week, rising by annual increments of 2/6 a week to a maximum of £5/2/6 per week. Candidates must be able to send and receive morse at not less than 25 w.p.m. and should have had experience of lecturing and teaching, but consideration will be given to others who consider themselves capable.

APPLICATIONS Should be Addressed to the Under Secretary of State, Air Ministry (S.5.D.), London, W.C.2, giving full particulars as to previous experience, age, etc.

CANDIDATES Will be Required to Appear Before a Selection Board at the Schools for Interview and Test, but may be reimbursed the cost of third-class locomotion expenses for this purpose. [9154

SITUATIONS WANTED

SERVICE Engineer, first class certificate City and Guilds radio service work, seeks trade connections Bromley, Lewisham and districts.—Write, D. Ellis, 121, Kingsway, Petts Wood, Kent. [9135

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