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JULY 1946

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EDITORIAL

Two Electromagnetic Problems

A LONG solenoid of small cross-section is wound on a non-magnetic core and supplied with a steady current I from a constant-current source. It is free to move in a magnetic field—say that of the earth—and takes up its normal position with its axis along the lines of force. If now we forcibly turn it round so that its north pole points to the south, we do work. To calculate the work done, consider one turn and assume that it is a square of side s; the force on each side is $sH_xI/10$ dynes where H_x is the strength of the field in which the solenoid is placed. The work done is turning the one turn through 180° will be $2s^2H_xI/10 = 2AH_xI/10$ ergs where A is the cross-sectional area of the coil. For T turns the work will be $2AH_xIT/10$ which, since $H = 4\pi IT/10l$ is equal to $HH_xAl/2\pi$ ergs, where H is the magnetic field produced within the solenoid by the current I. On turning the solenoid round the flux through it will be decreased by an amount $2AH_x$ and, since the current is maintained constant during the change, the energy supplied to the circuit will be $I\int edt = IT2AH_x/10 = HH_xAl/2\pi$ ergs.

Hence the mechanical work done in turning the coil is exactly equal to the electrical energy supplied by the coil to the circuit, but the resultant value of H within the solenoid has been reduced from $H + H_x$ to $H - H_x$ and the energy of the magnetic field within the solenoid has therefore been reduced and this appears at first sight to be unaccounted for. The amount of this reduction of energy is $[(H + H_x)^2 - (H - H_x)^2]Al/8\pi = 4HH_xAl/8\pi = HH_xAl/2\pi$ ergs, neglecting the small end-effects. Thus all the three amounts of energy concerned are equal. There is, however, a fourth amount of energy involved, since, when the solenoid is reversed, there is a strengthening of the external field, and the reduction of the magnetic energy within the coil is exactly balanced by the increase of magnetic energy outside the coil. At a great distance from the solenoid the field H_x is quite unaffected by the reversal and the total magnetic flux over a large cross-section is therefore unchanged; it is merely redistributed on reversing the coil.

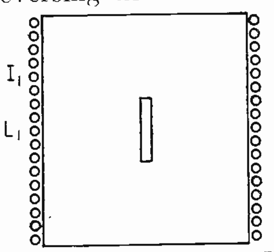

Fig. 1. *A small solenoid is located at the centre of a large cylindrical coil,* L_1 *carrying a current* I_1.

Imagine the field H_x to be produced by a large cylindrical coil, Fig. 1, with the small solenoid at its centre as shown and let the self-inductance of the large coil be L_1 and that of the solenoid L and let M be the mutual inductance. Let I_1 be the current in the large coil producing the field H_x. With the solenoid in its normal position the magnetic energy will be $0.5\ L_1I_1^2 + 0.5\ LI^2 + MI_1I$. On reversing the solenoid, any tendency of the total magnetic flux linking the large coil to decrease can be counteracted by increasing I_1 to I_2 so that $I_1L_1 + IM = I_2L_1 - IM$ and therefore $I_2 = I_1 + 2IM/L_1$. The total magnetic energy will now be $0.5\ L_1I_2^2 + 0.5\ LI^2 - MI_2I$ which on substituting the above value for I_2 gives $0.5\ L_1I_1^2 + 2I^2M^2/L_1 + 2MI_1I + 0.5\ LI^2 - MI_1I - 2I^2M^2/L_1 = 0.5\ L_1I_1^2 + 0.5\ LI^2 + MI_1I$ which is the same as before.

It will be seen that the necessary increase of current $I_2 - I_1$ in the outer coil is proportional to M, and hence, as the coil is made larger in diameter and M correspondingly decreased, the necessity of changing the current ceases. If then the magnetic field is produced by something so far removed from the solenoid that it is unaffected by its reversal, there is no change in the energy of the magnetic field on reversing the solenoid, the decreased energy inside being balanced by the increased energy outside it. Hence, although one appears to be doing work against the forces of the magnetic field, the magnetic energy is merely redistributed and all the work done appears as energy in the electric circuit. Since, at distances large compared with the length of the solenoid, H falls off as the cube of the distance, the modifications of the magnetic field due to the reversal are very local.

Torque on a Solenoid

When the solenoid is held at right-angles to the direction of the field it is interesting to consider the nature of the torque exerted upon it. One's permanent magnet upbringing makes it natural to picture poles at each end upon which the magnetic field exerts forces in the direction of the field, but closer examination suggests that this is very far removed from the facts of the case.

Fig. 2 shows a current-carrying solenoid in a magnetic field H_x. In the absence of H_x the magnetic field of the solenoid itself causes forces on the turns, but these merely tend to make the turns expand and come closer together, without any tendency to make the solenoid rotate. When H_x is applied we need, therefore, only consider the forces on the turns due to their current flowing in the presence of the magnetic field H_x. These forces will be the same on each turn whether at the ends or at the middle of the coil and they will be parallel to the axis of the coil as indicated by the arrows. Hence the torque is not due to forces parallel to H_x acting on the ends of the solenoid but to forces at right-angles to H_x acting equally all along the solenoid. Assuming the turns to be square the force on each side is $sH_xI/10$ dynes, giving a torque of $s^2H_xI/10$ per turn and a total torque of $s^2H_xIT/10$. If m is the pole strength $4\pi m = 4\pi s^2IT/10l$ = total magnetic flux through the solenoid; hence torque $= mH_xl$.

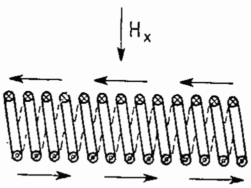

Fig. 2. *Current-carrying solenoid in magnetic field H_x. The arrow shows the direction of the forces on the turns.*

This shows that, although about half the flux never reaches the end of the solenoid but escapes sideways near the end, and although the poles are often said to be somewhere near the ends, the whole length must be taken in calculating the torque, that is, the poles must be assumed to be actually at the ends. The above discussion and Fig. 2 indicate, however, that the whole conception of the field acting on the poles, however convenient as a method of calculating the torque, bears little relation to the actual interaction between field and solenoid.

G. W. O. H.

PORTABLE PRECISION AMPLIFIER-DETECTOR*

By F. A. Peachey, A.M.I.E.E., S. D. Berry, and C. Gunn-Russell, B.A.

(Lines Department, British Broadcasting Corporation)

SUMMARY.—This paper is a description of a Portable Precision Amplifier-Detector, calibrated in decibels, for the measurement of the level of tone of 50 to 10,000 c/s from + 20 db to − 50 db to the nearest 0.1 db. Facilities for the measurement of programme volume and also for noise measurement down to − 110 db are incorporated.

THE amplifier-detector described in this article was designed primarily for precision testing of broadcast circuits and associated apparatus in the field. Routine measurements can be covered for most purposes by apparatus of less precision, but as this design has materialized it has become apparent that as so much extra may be accomplished for the addition of so little, precision gear may economically supplant the less precise type. This point is further emphasized by features in this detector which permit its separate use for normal or precision working. There are three uses, to any one of which it may be adapted by the operation of a single switch on the front panel. The same switch gives choice of high or low impedance input and its positions provide the following facilities :—

(1) Peak programme meter of 30,000 ohms input impedance.

(2) Peak programme meter of 600 ohms input impedance.

(3) Noise (peak value), 600 ohms input impedance.

(4) Level (calibrated R.M.S.), 600 ohms input impedance.

(5) Level (calibrated R.M.S.), 30,000 ohms input impedance.

The instrument (Figs. 1 and 7) is contained in a duralumin box 19in × 8¾in × 9in deep overall and weighs approximately 30 lb. It requires D.C. power supplies of 6 volts, 2 A and 200 volts, 12 mA. It has not been designed for supply direct from the mains, as it may frequently be used at places where such facilities are not immediately available. No doubt it would operate satisfactorily from a mains supply, although special steps would probably have to be taken to guard against hum induction from the valve filaments when it is used as a sensitive noise measuring device.

Level Measurements

The circuit for level measurements will first be described as it covers the main part of the apparatus. Broadly, the circuit functions as follows (Fig. 2). A calibrated attenuator S_1R_2 followed by an amplifier A_1A_2 of known gain feeds a rectifier R, which supplies current to a D.C. meter M. The whole is calibrated so that a sinusoidal tone of given level across the input, deflects

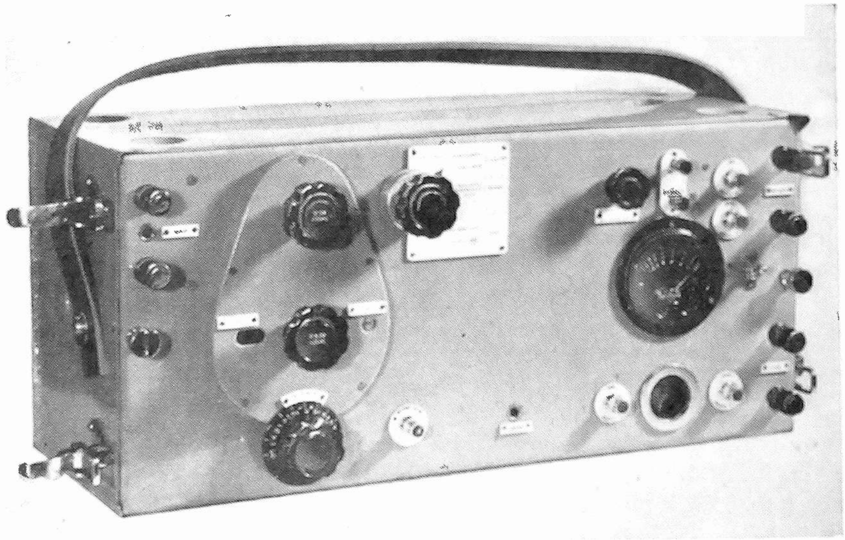

Fig. 1. *The complete amplifier-detector.*

* MS. accepted by the Editor, January 1946.

the meter to a marked point when the attenuator switches are set to indicate that given level. This provides for measurements demanding an accuracy of ± 0.25 db. For greater accuracy an auxiliary gain control R_5 is provided whereby the output of the amplifier (simultaneously with the above function) is used to balance a thermal bridge B_1. The output of the thermal bridge is amplified by A_3, so that a small signal, representing lack of balance, is readily indicated, and the bridge may be brought into balance by adjustment of the auxiliary gain control R_5. Indication of the state of balance is given by a cathode-ray tuning indicator operating on the rectified output of the bridge amplifier A_3. The auxiliary gain control is such that a considerable angular movement produces relatively little change in the thermal-bridge currents and so may be calibrated quite widely to show small adjustments in level.

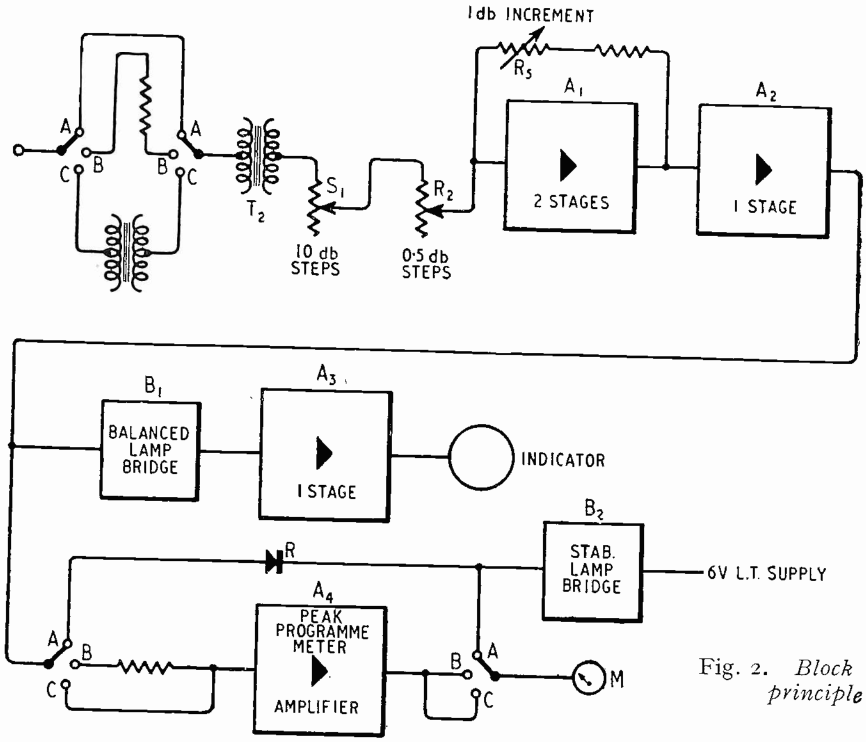

Fig. 2. *Block diagram illustrating the principle of the apparatus.*

In more detail the circuit may be described as follows. The circuit selector switch S_2 (Fig. 3) is set to position (4) or (5) according to the input impedance required and connects the input terminals via the input transformer T_2 to the cascaded variable potential dividers S_1 and R_2. S_1 is calibrated in 10 db steps to cover a level range of + 20 to − 40 db, while R_2 is calibrated in 0.5 db steps with a range of 0 to − 9.5 db.* The output of these cascaded potential dividers supplies the input of a three-valve resistance-capacitance coupled amplifier. The overall negative feedback of the first two stages is controllable by R_5. This resistance operated over its full travel varies the gain of the amplifier by just over 1 db and is actually calibrated from + 0.5 to − 0.5 db. A further gain control, R_7, provides a gain adjustment for precision calibration purposes. The third and final stage to the amplifier supplies two output transformers, T_3 and T_6. The former provides negative feedback to V_3 and output for the thermal bridge. A 6-volt metal-filament lamp in one arm of the bridge reaches a resistance of 50 ohms at about 10 mA. At this value the bridge balances and no output is passed through V_4 and its output rectifier to the tuning indicator V_5. If the bridge is not balanced, the output of V_4 is rectified and operates the indicator. Critical balancing of the bridge is achieved by adjustment of, first, the coarse volume controls S_1, R_2 at the amplifier input and, secondly, the fine control, R_5. The gain of V_4 is such that a very clear indication is obtained if the bridge input current is changed 0.1 db from its balance value.

Transformer T_6 provides, via the bridge metal rectifier, sufficient direct current to bring the meter to its calibrated point. The D.C. circuit is complicated by the fact that a special meter with a right-hand zero is used as this is necessary for the Peak Programme-measuring circuit described below. Most operators are used to a meter pointer moving in a clockwise direction, or left to right, as the

* Reference level 1 milliwatt in 600 ohms.

current is increased. To establish this feature a "backing-off" current is supplied to the meter in the reverse direction from that of the detector output and of a value such as to deflect the pointer to zero on the left-hand side of the scale with no signal from the rectifier. It is important that when this current has once been adjusted (by R_{13}) it should remain constant despite any normal

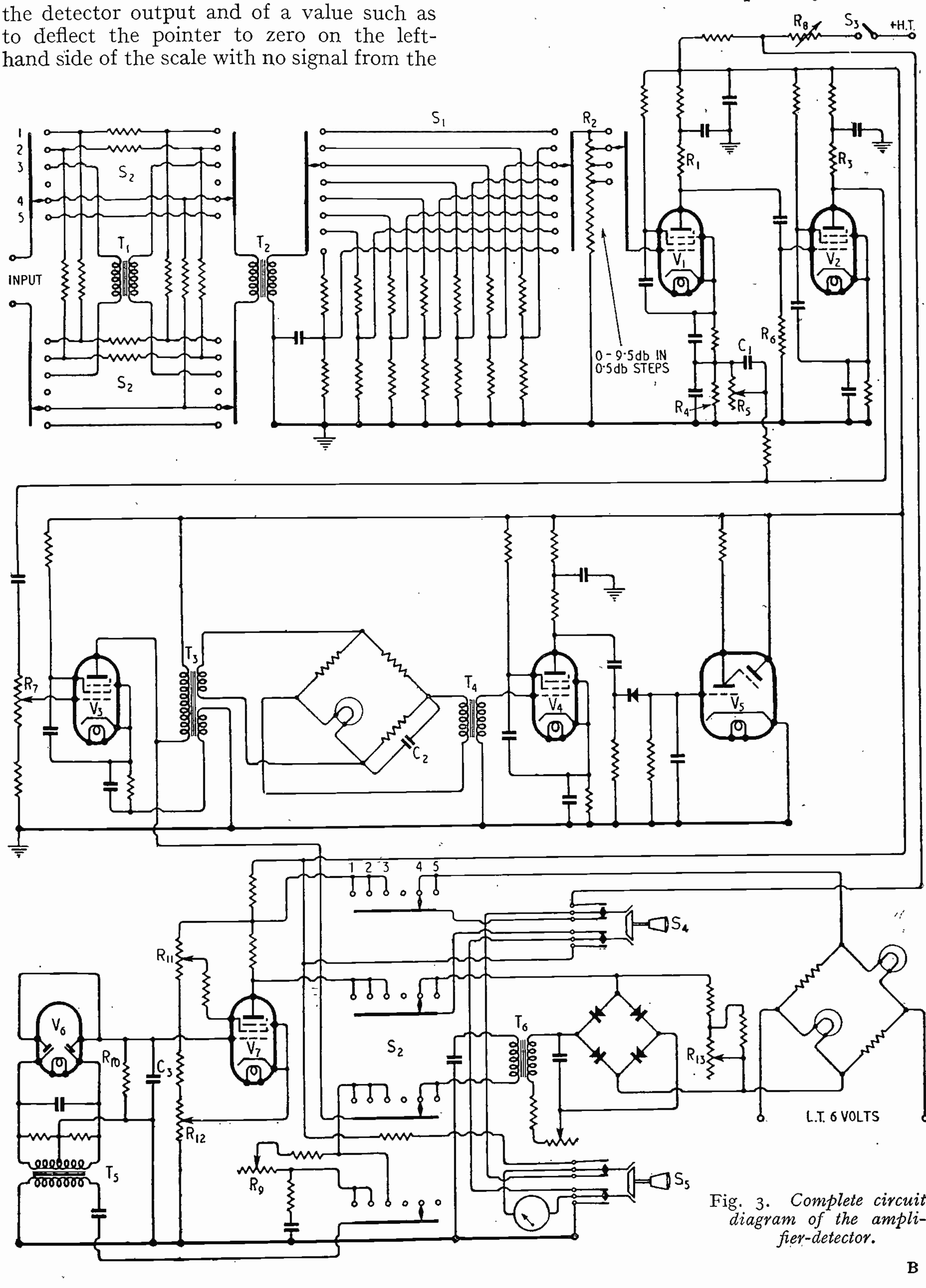

Fig. 3. *Complete circuit diagram of the amplifier-detector.*

variation in the L.T. supply. The thermal-stabilizing circuit shown ensures this. (See Appendix.) In using the gear, therefore, the procedure is to adjust the potential dividers S_1 and R_2 until the meter pointer is on (or nearly on) the calibrated mark, and read the level indicated by the switches. This gives the level to the nearest 0.5 db and it can actually be assessed rather more closely than this by interpolation. However, such assessment is not really necessary, as if greater accuracy is required, R_5 may be adjusted to show balance by means of the cathode-ray indicator. This gives the level reading to the nearest 0.1 db quite easily.

Attenuator Scales

Frequent use of such apparatus has drawn attention to an inaccuracy which may often occur, due to the incorrect addition of two switch readings, such as + 10 and − 5.5. Such errors are excusable when it is remembered that the user often has some more complex problem on his mind when he has reason to use the gear. As also in this particular case a third control (the 0.1 db control) is added with its positive and negative settings, it was felt that some assistance to avoid such errors was well justified. The two main controls, S_1 and R_2, therefore, have their dials so geared together that only the algebraic sum of the two dial settings can be seen. Furthermore, to emphasize the sign of the level, positive readings appear in a window on the left and negative readings appear on the right, the windows being clearly labelled " + " and " −." The arrangement of this dial is shown in Fig. 4, whilst Fig. 5 shows the manner in which it is assembled.*

There are two main controls, the one providing 10 db steps S_1 and the other 0.5 db steps R_2. The range of the latter switch is 0 to 9.5 db. For clarity these will be called the tens and units switches respectively.

The unit switch drives dial " C " (Fig. 4). There are three concentric sets of figures on this dial. The inner figures 0 — 9.5 may be viewed successively through a slot in a fixed cover over this dial. This slot is on the right-hand side of the cover in a horizontal position. On the left-hand side of the cover is a similar slot, positioned so that both ranges of figures 0.5 — 10.0, and 10.5 — 20.0 may be seen (successively).

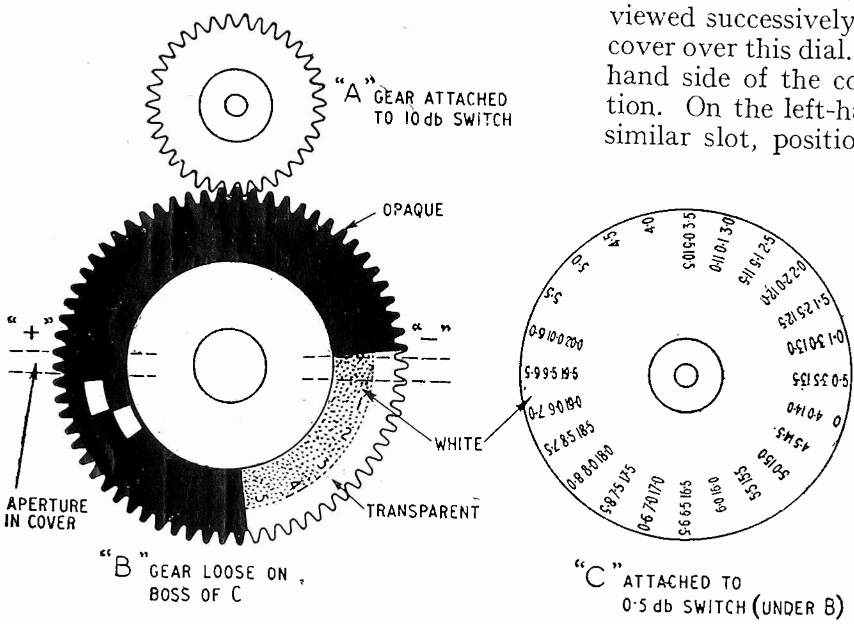

Fig. 4. *The main attenuator controls S_1 and R_2 have a combined indicator. " A " is attached to S_1 and " C " to R_2. " B " is the cover for " C " and has windows through which the " C " scale can be read. It is geared to " A " so that the operation of S_1 alters the position of the window and, therefore, the reading of the " C " dial.*

Fitted freely between dial " C " and the cover is a mask " B." This is driven by gear " A " which is attached to the " tens " switch. If the tens switch is set in the +20 position then the range of figures 10.5 — 20.0 is exposed in the left-hand slot ; the actual figure exposed being determined by the units switch setting (dial " C "). In a like manner if the tens switch is set to the " + 10 " position the mask " B " moves round covering all groups of figures except those 0.5 — 10.0 and the reading (determined by " C " setting) is displayed in the left-hand window. This left-hand window is labelled " Total + " and has figures exposed in it only when the tens switch is in its " + 20 " or " + 10 " position. With the " tens " switch in any other position the mask is moved round so that only the right-hand window displays figures. The right-hand window is labelled

* Details of the dial are the subject of a British patent application.

" Total —ve " and displays the outer set of units on dial " C " for all settings of the tens switch from 0 to —50. This is arranged by leaving the outer part of mask " B " transparent over an arc corresponding to this range (see Fig. 5). The appropriate

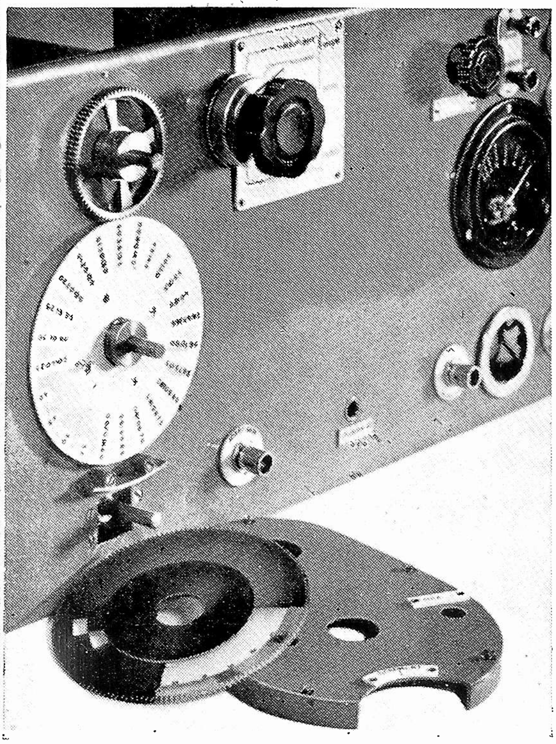

Fig. 5. *Details of the attenuator dial.*

" tens " digit is also carried by the mask and placed on the left-hand side of the units figure on " C " (Fig. 4). Actually, the whole arrangement is very simple and can be seen clearly from Fig. 5 which shows the " units " dial on the " units " switch shaft, the gear attached to the " tens " shaft and, lying in the foreground, the mask (normally driven by the tens switch) and the cover to expose one reading only on the left- or right-hand side. The units dial is constructed of white ivorine and marked with black figures. The mask is of perspex painted black for masking purposes, left clear where exposure of the units dial is required, and painted white to provide masking behind the tens digits and to match the ivorine dial underneath.

It should be observed that sundry small capacitances such as C_1 in the feedback path, C_2 in the bridge circuit, etc., have been employed in order to compensate for stray reactance effects and so provide for a flat response, or good degree of balance, at all frequencies. Table 1 shows that in spite of this it was impossible to arrange for a flat response at all levels. It was considered desirable to arrange for the best performance from + 5 to — 15 db in level, although it will be seen that even with an input level of — 55 db, the error is less than 0.1 db at 10,000 c/s.

The amount of negative feedback it was possible to provide in the amplifier is not as great as would be necessary for the degree of stabilization considered desirable. This may be seen from the following. It has been shown[1], employing the notation of the article referred to, where

A = highest gain of an amplifier without negative feedback.

TABLE I

FREQUENCY RESPONSE

Voltage input to bridge balance.
Relative gain referred to zero at 1,000 c/s at various input levels.
Source approximately 600 ohms into " 600-ohm level " input.
Probable error of method 0.02 db.

The first three columns show the effect of varying the 0.5 db input potential divider—the other columns the effect of the 10 db potential dividers. A significant error appears in the last few of the latter only.

Freq. c/s	Input level db.								
	0	— 5	— 9.5	+ 5	— 15	— 25	— 35	— 45	— 55
50	+ 0.02	+ 0.04	+ 0.02	0	0	+ 0.06	+ 0.04	+ 0.03	+ 0.04
100	+ 0.02								
250	+ 0.02								
500	0								
3,000	0								
5,000	+ 0.02	0	0	0	0	— 0.02	0	— 0.07	— 0.04
8,000	0								
10,000	0	0	— 0.02	0	0	— 0.06	— 0.04	— 0.15	— 0.07

A^1 = highest gain of the amplifier with negative feedback.

β = feedback ratio.

X = the fraction of its maximum value which the gain of the amplifier assumes when circuit constants are varied.

SF = stability factor.

$$= \frac{\text{percentage change of } A}{\text{percentage change of } A^1}$$

that $SF = 1 + A\beta X$.

In this case, the first stage A.C. load is R_1 in parallel with R_6 and equals 32,000 ohms, and that of the 2nd stage is R_3, the following grid resistance, and the resistance of the negative feedback path, all in parallel and equals 67,000 ohms. So that, assuming a g_m of 3 mA/V for each valve under working conditions, and with R_7 at maximum, for the first two stages.

$$A = 3 \times 0.032 \times 3 \times 0.067 \times 10^6$$
$$= 19{,}300 \text{ times}$$
$$= 85.7 \text{ db}$$

and, with the fine control, R_5 in its mid-position, since R_4 is 230 Ω and the remainder of the feed-back path 552,000 Ω.

$$\beta = \frac{230}{0.552 \times 10^6}$$
$$= 0.416 \times 10^{-3}$$

if the small effect of current feedback in the first stage from R_4 is ignored.

$$\text{Then } A^1 = \frac{19{,}300}{1 + (0.416 \times 10^{-3} \times 19{,}300)}$$
$$= 2{,}140 \text{ times}$$
$$= 66.6 \text{ db.}$$

giving a gain reduction due to negative feedback of 19.1 db. If X be taken as 0.8, a value below which it is not likely to fall in the circumstances of the use of the apparatus, then

$$SF = 1 + (19{,}300 \times 0.416 \times 10^{-3} \times 0.8)$$
$$= 7.4$$

So that the resulting change of gain under feedback conditions will be

$$\frac{20}{7.4} = 2.7 \text{ per cent} = 0.23 \text{ db} \quad .. \quad (1)$$

In the output stage the negative feedback is taken from a separate winding on the output transformer and is of such magnitude as to reduce the gain of the stage by 13 db.

For this stage, therefore

$$1 + A.\beta = 4.47$$
$$A.\beta = 3.47$$

and

$$SF = 1 + (3.47 \times 0.8)$$
$$= 3.78$$

so that, with $X = 0.8$ as before, the resulting change of gain with negative feedback will be

$$\frac{20}{3.78} = 5.3 \text{ per cent} = 0.45 \text{ db} \quad .. \quad (2)$$

It was found that, under the conditions shown, the valves used changed their g_m by about 7 per cent for an anode voltage change of 20 per cent, the maximum that might occur in use. Calculated as above it will be seen that this would cause a gain alteration of nearly 0.3 db. To assist in guarding against changes of this order in the absolute calibration, a variable resistance R_8, suitably decoupled, is connected in the common anode lead. A push-button switch connects the indicating meter as a voltmeter across the H.T. supply and R_8 enables the latter to be adjusted to a predetermined value. With the H.T. voltage fixed in this manner and the valve heaters supplied from an accumulator the only cause of gain change of the amount shown in (1) and (2) above would be valve ageing or replacement. This can, of course, be avoided by periodical test and a selection of the spare valves to be carried with the instrument.

For precision measurements the input impedance of the instrument is of course an important factor. The variation shown in Table 2 is largely due to the input transformer which in order to save space and weight is smaller than it might be if better results in this direction were required. The instrument is, of course, calibrated to give a reading proportional to the voltage across the input terminals and no correction has been made for variations of input impedance.

Initially, it was assumed that the instrument would be used to read R.M.S. on a sinusoidal wave. It was realized, of course, that the deflection of the meter, although calibrated on a pure sine wave to read R.M.S., was actually proportional to the rectified mean value. For this reason, it was thought better to use a thermal device for the fine control so that the error in reading the meter would not be misleading if the form factor of the wave were other than 1.11. Thus, although with an input of two tones of different frequency, but equal level, the coarse reading meter may read as much as 1 db low, balance on the fine control can only be achieved when all switches are set to read the level corresponding to the proper R.M.S. value of the resultant input signal.

TABLE 2

INPUT IMPEDANCE

Frequency c/s	Z ohms	
High Z—" *Level* "		
50	18,500	/40°
100	22,000	/27°
250	25,500	/14°
1,000	27,200	/ 5°
3,000	28,500	/2.5°
5,000	28,500	/ 0°
10,000	29,000	/ 0°
Low Z—" *Level* "		
50	590	
250	597	
1,000	599	
10,000	599	
High Z—" *Volume* "		
50	29,700	
1,000	29,900	
10,000	29,900	
Low Z—" *Volume* "		
1,000	595	
" *Noise* "		
1,000	530	

Peak Programme Meter

For some years now, the British Broadcasting Corporation has standardized the method of measuring programme volume on a meter designed to register the full peak of the signal, if that peak be of 5 (or more) milliseconds in duration. In this instrument the deflection of the pointer is proportional to the logarithm of the input-signal voltage. In other words, the scale is divided into equal db increments and so, over reasonable limits, provides an indication of the loudness of the programme (Fig. 6). All stations are fitted with these instruments so that at any point the " volume " line up may be checked and watched during programme transmission. The term " volume " is used to distinguish measurements made on a fluctuating programme signal, from " level " measurements made on steady tone.

A comprehensive investigation some years ago indicated that in average programmes the peak value (ignoring peaks of less than 5 milliseconds duration) was about 8 db higher than the equivalent R.M.S. value of the programme. Thus, zero volume is defined as that which will peak 8 db higher than will zero level tone on a meter of the appropriate characteristics fed from the standard rectifier circuit. The meter is specially designed so that it gives full deflection on a signal lasting 5 milliseconds and this explains why the particular type of instrument shown in Fig. 6 is used. A larger meter would have been rather better for level indications but would not have been suitable for peak readings. It would, of course, be difficult to read the meter deflection if it were allowed to operate with the same speed in both directions, so the return movement is arranged to be relatively slow. Referring to Fig. 3, it will be seen that for volume measurements the circuit-selector switch, S_2, is set to position (1) or (2). In this position, apart from an additional input-loss pad, the calibrated input potential dividers, S_1 and R_2, followed by the three-valve amplifier, operate as for level measurements. The additional loss pad guards the amplifier against overload, as in " volume " measurements the peak value of the signal is at least 8 db higher than the peak value of the corresponding "level". Also, as will be seen from Fig. 6, the scale is so marked that it is possible to allow the meter to deflect 12 db higher than the normal balance point for level measurements. With switch

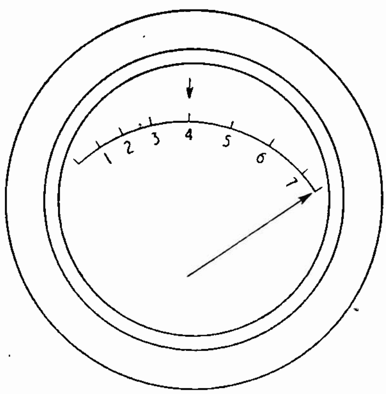

Fig. 6. *Scale of peak programme meter is 4 db per division between 1 and 7.*

S_2 in position (1) or (2) the output is switched from transformer T_6 to T_5. This latter transformer provides the input to the double diode, the output of which rapidly charges C_3. If the input signal is removed (or diminished) C_3 discharges slowly through R_{10}. Thus the grid of the variable-mu pentode V_7 is energized suddenly by the rectified voltage of any peak signal and this voltage decays slowly. The time constant of charge is

$$T = CR$$

and since R is about 25,000 ohms

$$T = \frac{0.1 \times 25{,}000}{10^3} = 2.5 \text{ milliseconds.}$$

its characteristic such that the anode current is proportional to the logarithm of the input (grid voltage). The controls R_{12} (grid bias), R_{11} (screen-grid potential), and R_9 (sensitivity), are adjusted on test so that the correct law, sensitivity and zero reading with no input are arrived at. R_{12} and R_9 should not then need readjustment unless a valve is changed. R_{11} may be used as required to reset zero, if this is necessary due to normal variations in supply voltages, without disturbing the other requirements. All adjusters are arranged to operate by screw driver only

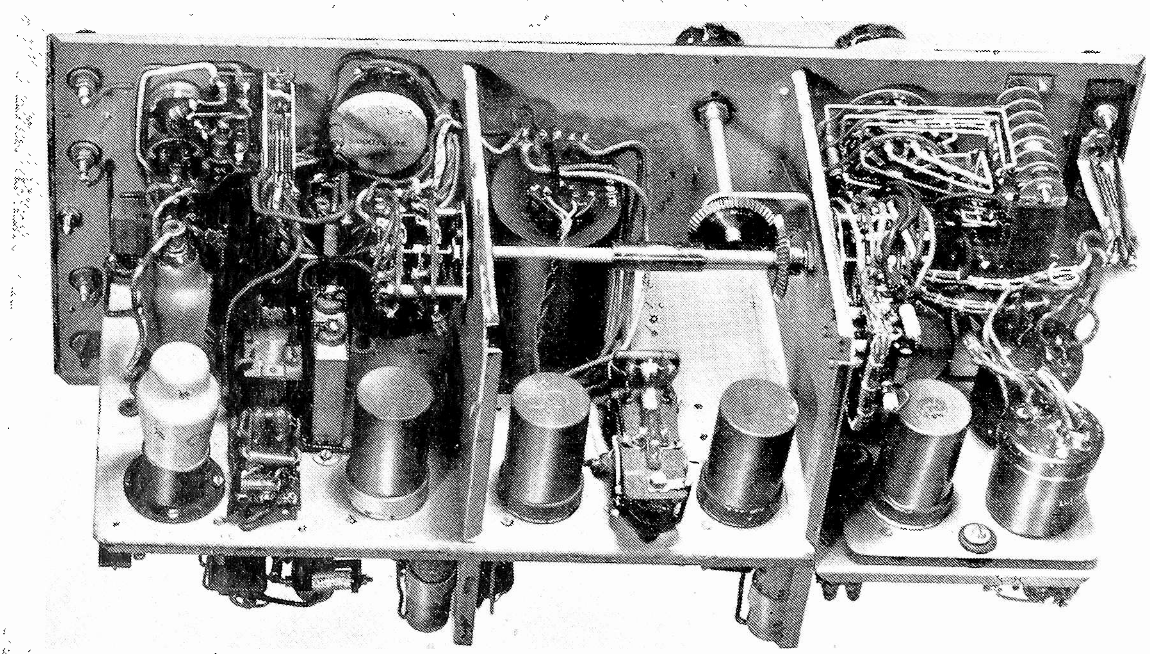

Fig. 7. *Interior of the amplifier-detector.*

With this value of time constant a pulse of E volts amplitude and 5 milliseconds duration will charge C_3 to a voltage E_1 such that

$$E_1/E = (1 - e^{-t/CR})$$
$$= 1 - e^{-5/2.5} = 0.865$$

that is C_3 will be charged to a voltage within about 1.2 db of E. The time constant of discharge is similarly

$$T = \frac{0.1 \times 10^7}{10^3} = 1{,}000 \text{ milliseconds.}$$

and the time of discharge is relatively slow, the capacitor voltage falling in 1 second to the fraction of its original value equal to e^{-1}, that is, nearly 9 db. The variable-mu pentode is arranged to operate on a part of

and are protected from the likelihood of accidental movement.

The amplitude—frequency response of the unit used as a peak programme meter is within about half a decibel from 50 to 10,000 c/s.

Noise (Peak Value)

It is logical to use the same type of instrument for the measurement of noise as has been used for the measurement of programme except that in the latter case a linear amplitude response is required, while in the former the response should be weighted to allow for the relative audibility of noise of different frequencies. Various curves have been published from a vast accumulation of observations showing the variation in apparent loudness with pitch. From this information it would appear that the amount of weighting with respect to frequency depends on the general loudness of the noise from the absolute point of view. Rather than fit this piece of apparatus with weighting networks of this kind, it was decided to keep its response reasonably flat and connect any required networks externally. This arrangement left the instrument fairly simple for its size and afforded a facility for actual noise and crosstalk measurements at very low levels indeed.

One of its main uses is met at new broadcasting points where at an early stage no amplifiers or even power supplies are available. The land line is to be tested in advance to ensure that it is satisfactory for programme transmission and to determine values of equalization. Obviously, it would be erroneous to assess the noise on such a circuit before its equalizer is installed. In the course of these tests, therefore, a temporary (at least) equalizer is constructed and a noise measurement made. Now the equalized transmission equivalent of such a circuit may easily be 40 to 50 db. For cross talk and other reasons the sending level is not often above + 10 db so that a satisfactory noise level in some cases should have an absolute level not exceeding — 100 db. The maximum sensitivity of this device is therefore arranged to be 110 db.

This is accomplished by some sacrifice of frequency response. When switch S_2 is set to position (3) an extra input transformer replaces the fixed input loss pad described earlier, and the double diode receives a greater part of the output from V_3. This has the total effect of increasing the gain from input to meter by 40 db, so that a signal of — 90 db will provide a deflection to "6" and an input of — 110 db a deflection of "1." Due largely to the big step-up in voltage provided by the input transformer (impedance ratio 1 : 50) the inherent noise level of the unit is such that no deflection can be observed on the meter when there is no input signal. The use of such a transformer prohibits a high-impedance input with maximum sensitivity, but so far no need has been felt for this. The response for peak noise measurements is shown in Table 3.

In conclusion, the authors wish to emphasize that in the individual circuits they can claim nothing new, but that the combination of these circuits has resulted in a compact and accurate amplifier-detector incorporating other useful facilities.

TABLE 3

FREQUENCY RESPONSE

Volume		Noise	
Frequency c/s	db	Frequency c/s	db
50	− 0.2	50	− 2.7
250	− 0.1	250	− 0.5
1,000	0	1,000	0
5,000	+ 0.1	5,000	+ 0.3
10,000	0	10,000	+ 0.1

The authors wish to express their gratitude to the British Broadcasting Corporation for their permission to publish this article, and to Messrs. Rantzen and Rendall for general help and advice during the development of the apparatus.

Reference

[1] Becker: "Negative Feedback in Amplifiers". *Proc. Instn. Rad. Engn.*, June 1944.

APPENDIX

The resistance of a lamp alters considerably with temperature and the relation between the input current and output voltage of a bridge connected as in Fig. 8 is of the form shown in Fig. 9. At the

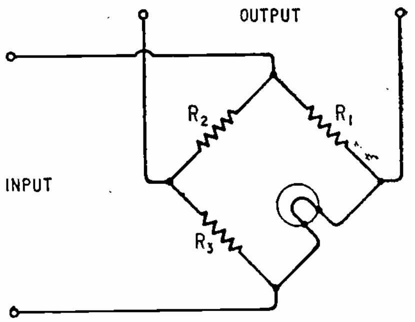

Fig. 8. *Basic circuit of a lamp bridge.*

point C the current through the lamp is of such magnitude as to cause the lamp to have a resistance equal to $\frac{R_1 R_3}{R_2}$ thus balancing the bridge. By using a sensitive device to indicate this balance the bridge can be made to measure with accuracy a given input power level. This form of lamp bridge is used as a standard of level measurement in the Precision Amplifier-Detector. The lamp is an ordinary 6-V indicator lamp; $R_2 = R_3 = 2{,}000$ ohms and $R_1 = 50$ ohms.

With these values the bridge will balance at an input power of about + 10db, varying somewhat with the particular lamp in use. It has been found that lamps intended for use in a bridge of this kind must be aged by burning them at their rated voltage for at least eight hours, after which they become stable. It has also been found that the balance point of the bridge is affected by the ambient temperature to an extent which falls as the lamp working temperature is increased, and that the power input to the bridge should not be, for this reason, much below + 10 db at which level the balance point alters by 0.25 db for an ambient temperature change of 45° F. The small capacitor

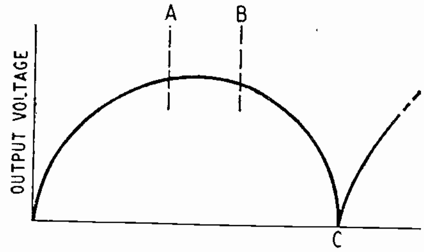

Fig. 9. *Relation between input current and output voltage of a lamp bridge.*

connected across one arm of the bridge in the Precision Amplifier Detector is to balance out the small reactance of the resistance cards which otherwise causes an ill-defined balance at high frequencies.

The region between the points *A* and *B* of Fig. 9 shows that over this range of input current the output voltage of the bridge remains practically constant due to the fact that the tendency of the output to rise, because of the rising input, is counteracted by the tendency to fall, due to the approach to balance. It can be shown that—with R_2 replaced by another lamp—when the current taken by the output circuit is small compared with that taken by the lamp and the resistance—current curve of the lamp is a straight line over the range required, generally approximately true, the percentage variation in output is $-\frac{D^2}{100}$, where D is the percentage variation in input.

A stabilizing bridge of this kind is used in the Precision Amplifier-Detector to stabilize the current required to bias-back the peak programme meter for use in the level-measuring circuit, so that variations in the L.T. supply, from which the current is derived, do not affect appreciably the zero setting of the meter. The lamps are the same type as before and R_1 and R_3 are each 150 ohms. A resistance in series with the input is adjusted so that the stabilization occurs over the required range (5.5 V to 6.3 V) of battery voltage.

POWER PULSE GENERATOR*

By M. Levy, A.M.I.E.E., M.Brit.I.R.E.

(Research Laboratories of the General Electric Company)

SUMMARY.—Description of a highly efficient pulse generator † in which voltage-pulse amplification is avoided by producing directly pulses of the required amplitude in a high impedance. The power of this initial generator is very small but it is amplified by a succession of cathode-followers which increase the peak power, lower the impedance and do not affect very much the amplitude.

With two S.T.C. valves type 4071A working as a pulse generator, and one S.T.C. valve type 4033A working as a cathode-follower, one can obtain pulses of about 1,600 volts in an impedance of 1,500 ohms and with two more 4033A valves in parallel, working as a second cathode-follower, one gets about 1,000 volts in 150 ohms.

The efficiency of such a circuit (output power divided by power supplied to the circuit) is of the order of 20 per cent.

THE use of pulse transmitters has been developed considerably since 1939. The present pulse generator was developed at that date as a modulator for a power-pulse transmitter. The requirements were to produce pulses of 1,000 volts in an impedance of about 150 ohms at a repetition frequency of 50 cycles per second. The peak power was about 6.5 kilowatts and the mean power about 50 watts.

To obtain this power, the usual method was, at that time, to use a low-power pulse generator followed by a pulse amplifier. The disadvantage of this solution is its inefficiency because in every other valve in the amplifier circuit current must flow all the time with the exception of the small intervals when the pulses are produced.

To eliminate this loss of power, the writer tried to avoid voltage amplification and to use valves in which the current flows only when the pulses are produced. To obtain this result, he used a low-power but high-voltage pulse generator, followed by peak-power amplifier valves, instead of voltage-amplifier valves, all working at nearly the same pulse amplitude, that is cathode-followers mounted in series. The pulse generator has a low

* MS. accepted by the Editor, February 1946.

† British Patent pending.

efficiency but, since it is only a lower-power generator, it does not greatly affect the overall efficiency. On the other hand, the power amplifier valves have a high efficiency and improve considerably the overall value.

In order to obtain pulses of large amplitude and of low mean power, low-power valves are used with voltages much greater than the

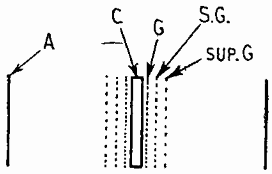

Fig. 1. *Diagrammatic section of a high-slope pentode. The grid, screen and suppressor are very close to the cathode, the anode is much further away.*

rated values applied to the anode, for instance 1,500 volts instead of 200 to 300 volts. This is, of course, a very unusual method, but with high-slope pentodes the perturbations produced are reduced to a minimum. In these valves, the grid, the screen and the suppressor, are very close to the cathode while the anode is at a distance. Fig. 1 shows diagrammatically a 5A-105A Standard valve.* The suppressor is about 1.5 millimetres from the cathode and the anode about 5 millimetres. If the grid, screen, and suppressor are working at the rated values, a high voltage on the anode will not affect the electrostatic field near the cathode and deterioration of the cathode by ion bombardment will not occur. The writer used this type of valve with an anode voltage of 1,500 volts without any apparent deterioration of the characteristics. However, the tests lasted only some days and due to the urgency of war requirements, no methodical study has been made of this question.

* The 5A-105A Standard valve is nearly equivalent to the R.C.A. television high-slope pentode type 1852.

1. High-voltage Low-power Pulse Generator

For simplicity let us start from the simplified circuit of Fig. 2. The primary of a transformer is fed by a sinusoidal source having the same frequency as the required recurrent frequency. The secondary feeds the grids of two pentodes in nearly opposite phase, the approximation being adjustable by a small capacitor C. Each winding gives a high peak voltage of the order of 1,500 volts applied to the grid through a high dropping resistance R_0. The positive voltage on the grid is limited by the grid current. The negative voltage is limited in amplitude by a diode. The anodes of the two pentodes are connected together and fed by an H.T. supply voltage of the order of 1,000 volts or more.

Fig. 3 shows how the pulses are produced in this circuit. In (*a*) are represented the two sinusoidal voltages applied to the grids of the pentodes through high resistances. These waves are not exactly in opposition of phase, the shift being adjusted by the capacitor C. In (*b*) is reproduced in dotted lines one of these sinusoidal voltages. As its amplitude is very great, only a small fraction is transmitted to the grid, the difference being a drop of voltage across resistance R_0 produced by the grid and diode currents. The voltage

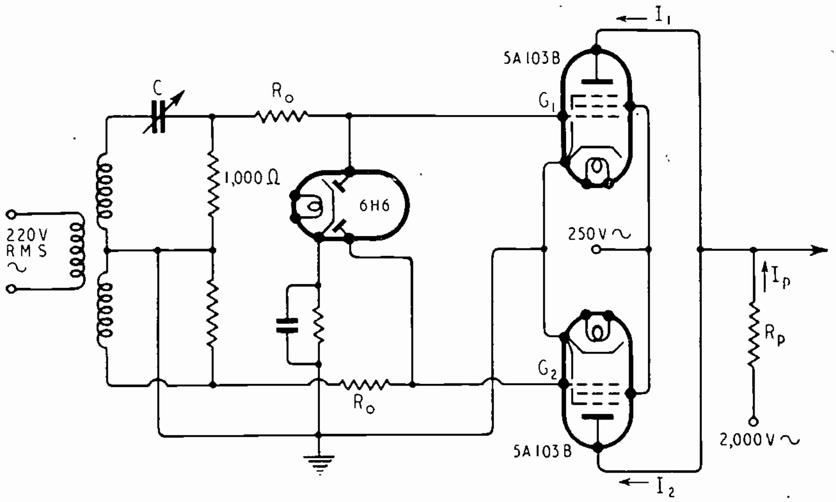

Fig. 2. *Circuit of a high-voltage low-power pulse generator. Large pulse amplitude is obtained by applying a high supply voltage to the anode circuit of the pentodes.*

really applied on the grid is represented by the heavy line. It has the shape of a succession of trapezoids placed alternately above and below the time axis. The slope of the edges is usually very great. With a peak amplitude of 1,500 volts for the sinusoidal wave, and high-slope pentodes, such as the

Standard valve type 5A.103B (cut-off at —9 volts), the time of build up is of the order of one thousandth of the duration of each trapezoid. With a recurrence frequency of 50 c/s this gives a time of build-up of about 10 microseconds, which is sufficient in many applications. With a recurrence frequency of 500 c/s, the build-up time is of the order of one microsecond.

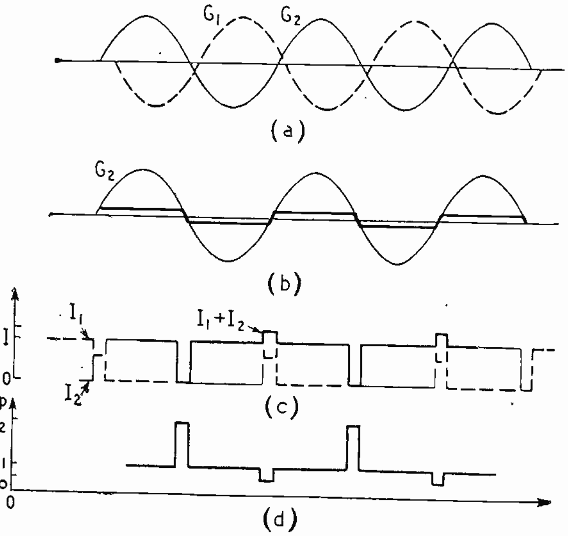

Fig. 3. *Diagrams explaining how the pulse generator of Fig. 2 works when a high-supply voltage is used :— (a) sinusoidal voltages applied on the grids G_1 and G_2 of the pentodes through resistances R_0 ; (b) sinusoidal voltage applied to grid G_1 through resistance R_0 and effective voltage appearing on this grid ; (c) anode currents I_1 and I_2 and resultant current $(I_1 + I_2)$; (d) output pulses appearing across resistance R_p.*

Peak sinusoidal voltages of the order of 1,500 volts will not overload the valves if R_0 is of the order of 1 megohm, since in this case the grid current is 1.5 milliamperes and the grid voltage does not rise above 10 volts.

The anode currents of the two pentodes have the shape of rectangles in nearly opposite phase. The resultant current flowing in the common anode resistance R_p, has the shape represented in Fig. 3 (*c*). It is a succession of positive and negative pulses interlocked, with equal width adjustable by means of capacitor C. The resultant anode voltage is represented in Fig. 3 (*d*). If the H.T. voltage applied to resistance R_p is 2,000 volts, the pulses have an amplitude not much smaller if R_p has a sufficiently high value.

When current is flowing in the valve, the anode voltage falls because of the voltage drop in resistance R_p. If this resistance has a high value, the drop of voltage can be sufficiently great to make the power dissipated at the anode very low.

This power can be still further reduced by feeding the anodes and screens with a sinusoidal H.T. voltage of frequency equal to the pulse recurrence frequency. The working diagram of the circuit is shown in Fig. 4 where (*a*) and (*b*) represent respectively the voltage applied to the grid of one of the pentodes through resistance R_0 and the current in the common anode circuit. The sinusoidal H.T. voltage feeding the anodes through resistance R_p is shown at (*c*) and is approximately 90° out of phase with the sinusoidal voltages applied on the grid circuits and is maximum when the anode current is zero. The anode voltage has the shape represented in (*d*). Where the anode voltage differs from the H.T. supply voltage, the latter is represented by dotted lines.

The anode voltage is maximum or negative when there is no current and is low when current flows. For instance, if the anode current is 200 milliamperes, with an H.T.

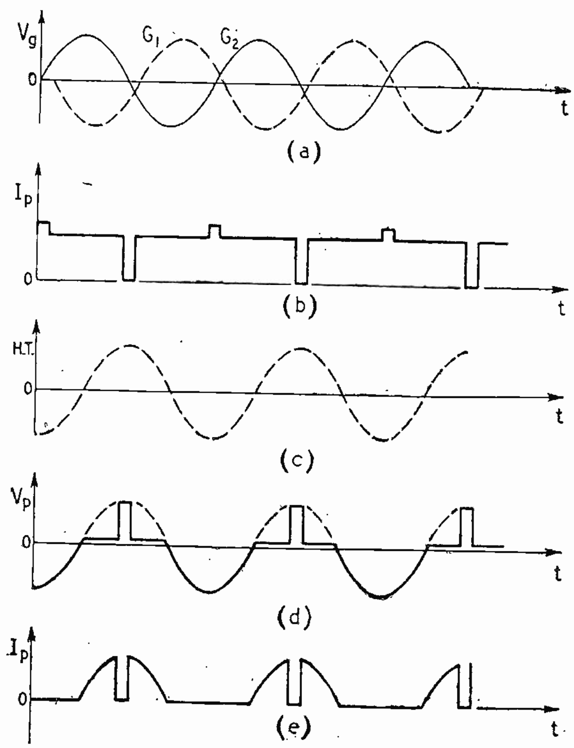

Fig. 4. *Diagrams explaining how the pulse generator of Fig. 2 works when an A.C. high-tension supply voltage is used ; (a) same as Fig. 3 (a) ; (b) same as Fig. 3 (d) ; (c) sinusoidal H.T. voltage supply applied on the anodes of the pentodes through resistance R_p ; (d) output anode voltage ; (e) current flowing through resistance R_p.*

peak voltage of 2,000 volts and a resistance R_p of 10,000 ohms, the anode voltage when current flows is less than 100 volts, while the peak pulse voltage is nearly 2,000 volts. Each valve works during 1/4 of a period and the mean current is $\frac{1}{4\sqrt{2}}$ or about 1/6 of the peak current. The peak current can thus be 6 times greater than the average rated value. Also, since the anode voltage is one-half to one-third of the normal value, this peak current can be 2 or 3 times greater still, that is 12 to 18 times the normal rated current.

The screens are also fed by a sinusoidal source in phase with the source supplying the anodes, but the peak voltage must not be too much greater than the normal screen rated voltage. For instance, on the screen of valves type 5A.103B the sinusoidal peak voltage must be less than 300 volts (the rated value is 250 volts). In this case the cathode, the grid, the screen and the suppressor are working under normal conditions.

Fig. 5 shows a circuit with two pentodes type 5A.103B or 4071A. The normal anode current of these valves is 50 mA and the anode power dissipation is 12 watts. The valves are used with a peak current of 300 mA which leaves a good margin of safety. The anode is supplied with a sinusoidal wave of 2,000 volts peak value, and R_p is 7,000 ohms. The transformer gives two secondary voltages of 1,000 volts R.M.S. each, corresponding to a build-up time of 10 to 20 microseconds according to the type of valves used. The width of the pulses is adjustable between some tens to some thousands of microseconds.

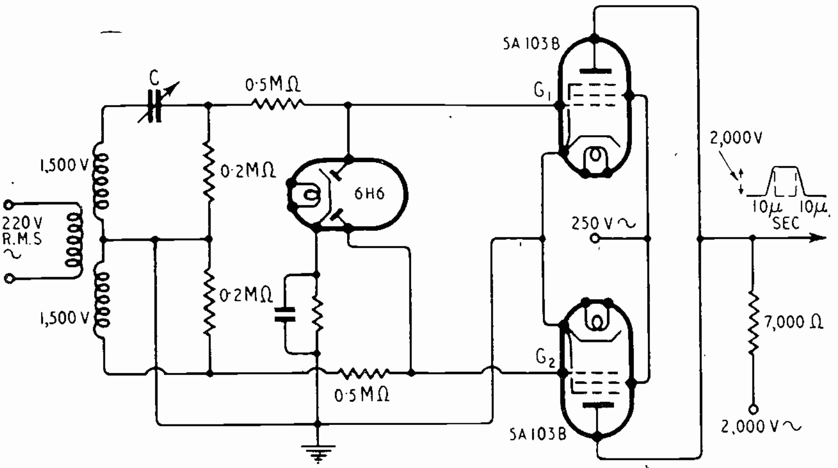

Fig. 5. *Practical circuit of the high-voltage low-power pulse generator producing pulses at a recurrence frequency of 50 c/s. The pentodes are fed directly by the mains through a convenient low-time-constant transformer.*

2. Power-Pulse Amplifier

The pulse generator described above gives pulses of high voltage but low power, in a high resistance. We must now add to this generator a power-pulse amplifier which does not affect too much the pulse amplitude but increases the peak power. Such a power amplifier is really an impedance transformer and cathode-followers give exactly the results required.

A single-stage circuit is represented in Fig. 6. The pulses are applied to the grid and the output is taken from a resistance connecting the cathode to earth. The pulse amplitude is transferred from grid to cathode with a very small loss, while the cathode resistance can be much smaller than the input impedance. For example, with a 4033A (triode of 25 watts, slope 9 mA/V,

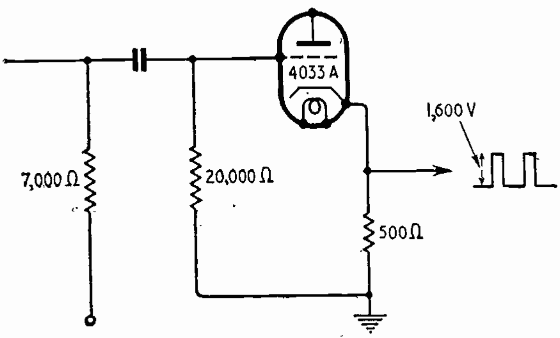

Fig. 6. *Cathode follower working as a peak-pulse power amplifier.*

filament consumption 8.5 watts), working with 2,000 volts applied to the anode, one can get 1,500 volts peak pulse amplitude on the cathode across a resistance of 1,500 ohms with a grid current of 50 mA, the grid being fed by the circuit of Fig. 5, that is by pulses of 2,000 volts peak amplitude appearing across a resistance of 7,000 ohms. Current in the valve flows only during the generation of pulses. When a pulse appears, the voltage drop between anode and cathode is 500 volts for pulses of 1,500 volts. Hence if the valve

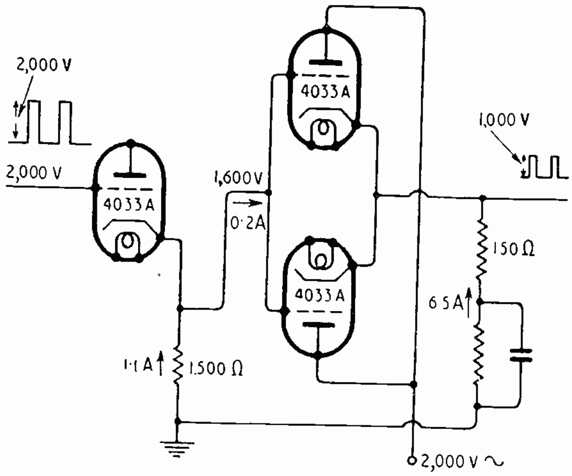

Fig. 7. *Two-stage cathode-follower working as a peak-pulse power amplifier. When coupled to the pulse generator of Fig. 5 it produces pulses of about 1,000 volts in an impedance of 150 ohms (6.5 kilowatts peak power).*

dissipates 25 watts, the maximum mean pulse power is 75 watts, which represents an efficiency of 75 per cent.

To get pulses of greater peak power, one can use many cathode-followers in series.

cathode current is of the order of 6.5 amperes. This stage gives pulses of 1,000 volts and its efficiency is 50 per cent. This means that the output mean pulse power is 50 watts maximum, that is, smaller than for the preceding stage, *but the peak pulse power has increased from 1.6 to 6.5 kilowatts.*

The circuit of the pulse generator followed by the peak-power pulse amplifier is represented in Fig. 8. The power dissipated is distributed as follows :

Generator : 150 watts.
Output Stages : 250 watts.
Output Pulse Power : 50 watts.
Efficiency : 12 per cent.

All stages can be supplied with alternating current, the frequency being equal to the recurrence frequency. If transformers are used, care should be taken to reduce their time constants to a minimum since these transformers work only during the generation of pulses and have to supply power very suddenly.

The writer constructed a circuit similar to the one represented in Fig. 8 generating pulses at a recurrence frequency of 50 c/s. Three small 75-watt transformers were used to supply power to the generator and the peak-power amplifier. The whole circuit

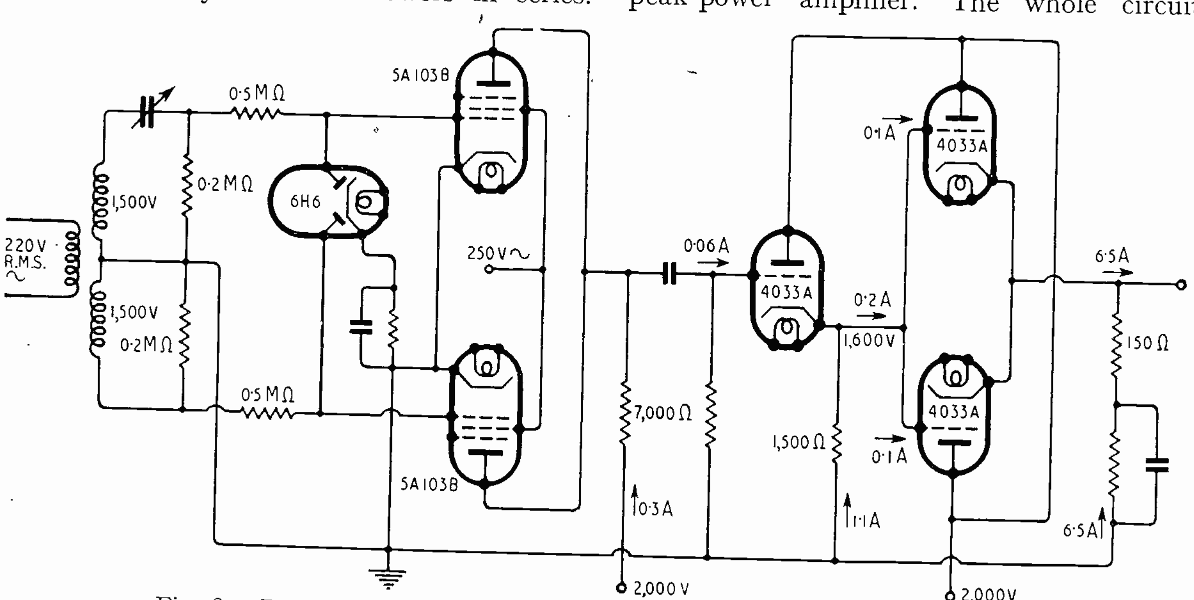

Fig. 8. *Peak-pulse power generator with an output of 6.5 kW peak-pulse power.*

Such a circuit is represented in Fig. 7. The first stage is a cathode-follower with a resistance between cathode and earth of 1,500 ohms or more. The second stage has two 4033A valves in parallel and a resistance of 150 ohms connecting the cathodes to earth. For a grid current of 350 milliamperes the

was of very small dimensions and was used to modulate a R.F. valve of 200 watts.

This study was made in the "L.M.T. Laboratories" in Paris in 1939. Acknowledgements are due to Standard Telephones and Cables for permission to publish these results.

FILTER DESIGN TABLES BASED ON PREFERRED NUMBERS*

High-Pass Filters

By H. Jefferson, B.A., A.Inst.P., A.M.I.E.E.

IN previous papers† the author has shown how preferred numbers can be applied to filter design so that the capacitance values are necessarily preferred, and has given tables for the design of constant-k low-pass filters. In this paper tables are given for the design of constant-k high-pass filters. As before, the values in the tables are those of the ladder network elements. Where single sections only are used the actual principal element values are those shown in Fig. 1; L_k and C_k are the values obtained from the tables, and are approximations to

$$L_k = \frac{R}{4\pi f_c}$$

$$C_k = \frac{1}{4\pi f_c R}$$

where R is the design impedance and f_c is the cut-off frequency.

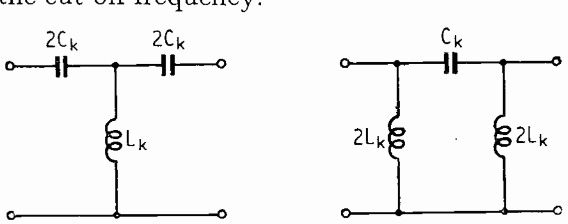

Fig. 1. *Basic T- and π-sections.*

For all preferred values of X there exist preferred values of $2X$, and these are listed below for reference.

* MS accepted by the Editor, January 1946.

† "Preferred Numbers and Filter Design": *Wireless Engineer*, October 1945. "Filter Design Tables Based on Preferred Numbers — Low-pass Filters": *Wireless Engineer*, January 1946.

As before, the tables are in pairs, each pair being used to determine the value of one element of the filter. The first table of each pair is of coarse mesh, in half-decade (logarithmic) steps. From this, the order of magnitude of the capacitance or inductance is found by examination of the values which border it. The second table covers only one decade and enables the significant figures to be found.

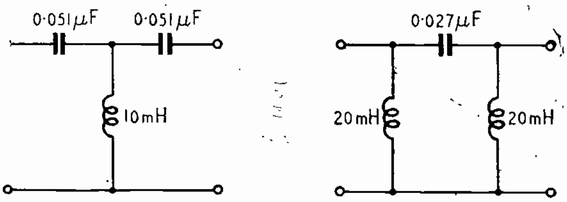

Fig. 2. *Single sections of a filter having the values derived in the text are shown here.*

As an example of the use of the tables, let us consider a high-pass filter of 620 ohms impedance and 5,100 c/s cut-off frequency. From Table I, the capacitance is in the square bounded by 8.2×10^{-2} μF, 2.7×10^{-2} μF, 8.2×10^{-3} μF and 2.7×10^{-2} μF. From Table III, the inductance is in the square bounded by 27 mH, 8.2 mH, 2.7 mH. and 8.2 mH. Table II gives the significant figures for the capacitance as 27, so that the actual value of capacitance is 0.027 μF. Table IV gives the significant figures for the inductance as 10, so that the actual value of the inductance is 10 mH. An exact computation gives $L_k = 9.6$ mH and $C_k = 0.0251$ μF. The physical form of a single section is shown in Fig. 2.

PREFERRED VALUES OF $2X$ FOR PREFERRED VALUES OF X.

X	10	11	12	13	15	16	18	20	22	24	27	30	33
$2X$	20	22	24	27	30	33	36	39	43	47	51	56	62

X	36	39	43	47	51	56	62	68	75	82	91	100
$2X$	68	75	82	91	100	110	120	130	150	160	180	200

TABLE I

CAPACITANCE C_k OF HIGH-PASS FILTER

DESIGN IMPEDANCE (OHMS)

CUT-OFF FREQUENCY	1	3.3	10	33	100	330	1 000	3 300	10 000	33 000	100 000	330 000
1	82×10^3	27×10^3	8 200	2 700	820	270	82	27	8.2	2.7	0.82	0.27
3.3	27×10^3	8 200	2 700	820	270	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}
10	8 200	2 700	820	270	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}
33	2 700	820	270	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}
100	820	270	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}
330	270	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820
1 000	82	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270
3 300	27	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270	82
10 000	8.2	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270	82	27
33 000	2.7	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270	82	27	8.2
100 000	0.82	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270	82	27	8.2	2.7
330 000	0.27	8.2×10^{-2}	2.7×10^{-2}	8.2×10^{-3}	2.7×10^{-3}	820	270	82	27	8.2	2.7	0.82
c/s	μF (values left of stepped line)					μμF (values right of stepped line)						
Mc/s	μμF (values left of stepped line)					μμμF (values right of stepped line)						

TABLE II

SIGNIFICANT FIGURES FOR C_k OF HIGH-PASS FILTER

DESIGN IMPEDANCE

CUT-OFF FREQUENCY	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	100
10	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82
11	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75
12	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68
13	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62
15	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56
16	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51
18	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47
20	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43
22	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39
24	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36
27	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33
30	30	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30
33	27	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27
36	24	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24
39	22	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22
43	20	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20
47	18	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18
51	16	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16
56	15	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15
62	13	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13
68	12	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12
75	11	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11
82	10	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10
91	91	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91
100	82	75	68	62	56	51	47	43	39	36	33	30	27	24	22	20	18	16	15	13	12	11	10	91	82

TABLE III

INDUCTANCE L_k OF HIGH-PASS FILTER

DESIGN IMPEDANCE—OHMS

CUT-OFF FREQUENCY	1	3.3	10	33	100	330	1 000	3 300	10 000	33 000	100 000	330 000
1	82	0.27	0.82	2.7	8.2	27	82	270	820	2 700	8 200	27 000
3.3	27	82	0.27	0.82	2.7	8.2	27	82	270	820	2 700	8 200
10	8.2	27	82	0.27	0.82	2.7	8.2	27	82	270	820	2 700
33	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82	270	820
100	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82	270
330	0.27	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82
1 000	82	0.27	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27
3 300	27	82	0.27	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2
10 000	8.2	27	82	0.27	0.82	2.7	8.2	27	82	0.27	0.82	2.7
33 000	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82	0.27	0.82
100 000	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82	0.27
330 000	0.27	0.82	2.7	8.2	27	82	0.27	0.82	2.7	8.2	27	82

	Columns 1–330	Columns 1 000–330 000
c/s	μH	mH
kc/s	μH x 10^{-3}	μH
Mc/s	$\mu\mu$H	μH$\times 10^{-3}$

TABLE IV

SIGNIFICANT FIGURES FOR INDUCTANCE L_k OF HIGH-PASS FILTER

DESIGN IMPEDANCE

CUT-OFF FREQUENCY	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	100
10	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82
11	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75
12	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68
13	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62
15	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56
16	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51
18	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47
20	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43
22	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39
24	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36
27	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33
30	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27	30
33	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24	27
36	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22	24
39	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20	22
43	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18	20
47	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16	18
51	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15	16
56	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13	15
62	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12	13
68	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11	12
75	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10	11
82	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91	10
91	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82	91
100	82	91	10	11	12	13	15	16	18	20	22	24	27	30	33	36	39	43	47	51	56	62	68	75	82

NEW BOOKS

Heaviside's Electric Circuit Theory

By H. J. Josephs, M.I.E.E. Pp. 115 + viii and 15 Figs. Methuen & Co., Ltd., London. Price 4s. 6d.

This is one of the series of monographs on physical subjects. The author is senior physicist at the Post Office Engineering Department and Dr. W. G. Radley, the Controller of Research, has contributed a foreword in which he says that the book was written at the suggestion of Professor Willis Jackson with the needs of electrical engineering students in mind. As Dr. Radley says, circuits are becoming more complicated and the growing importance of transient effects makes problems harder to solve. When he refers to the Heaviside Operational Calculus as being, in effect, a simple shorthand technique for evaluating the results of Fourier integral analysis, he is evidently using the word "simple" in a relative sense.

An outstanding feature of the monograph is the development of a "far-reaching theorem" which the author has reconstructed from the scattered papers of Heaviside; as it was probably the last theorem that Heaviside deduced, the author has called it "Heaviside's Last Theorem." The first chapter is entitled "The Foundations of Electric Circuit Theory"; in stating Kirchhoff's Laws, the author changes the order from that usually employed, and calls the circuit law the first and the currents meeting at a point the second law. Moreover, he takes liberties with the circuit law and states it as follows: "In any closed circuit in a network of conductors the algebraic sum of the potential differences is zero." In other words, if you return to the point from which you started the ups and the downs exactly cancel out, which is very true and obvious, but entirely misses the point of Kirchhoff's law.

Clerk Maxwell* says "Kirchhoff has stated the conditions of a linear system in the following manner, *in which the consideration of the potential is avoided.* (1) (Condition of "continuity"). At any point of the system the sum of all the currents which flow towards that point is zero.

(2) In a complete circuit formed by the conductors the sum of the electromotive forces taken round the circuit is equal to the sum of the products of the currents in each conductor multiplied by the resistance of that conductor."

Throughout this chapter the author has made a brave attempt to write "capacitance" and not "capacity"; occasionally he succeeds, but very rarely. The second chapter deals with the expansion theorem. The author has obviously made a study not only of the Heaviside theorems, but also of the mental processes by which Heaviside arrived at many of his results and it is interesting to trace the paths which he followed. The expansion theorem is further developed in the third chapter which deals with power series solutions.

Chapter 4 deals with ladder networks, artificial lines and cables. Here again, when he comes down from mathematics to electrical matters, the author appears to be careless of details; Fig. 3 which is stated to be composed of a series of T-sections, is incorrectly drawn at the receiving end, and the same applies to Fig. 4. The description is also confused, for he speaks of the middle of a section when the end of the T-section is meant; the confusion is apparently between T- and Π-sections. Chapter V deals with impulse functions, transfer operators, and spotting functions and discusses the contributions of Carson and Bromwich to the subject. Chapter VI is entitled "The Establishment of Operational Formulae" and includes the "shifting" transformation and fractional order derivatives. Chapter VII is devoted to the very practical subject of transmission lines, one of the most important applications of Heaviside's methods. The final chapter is concerned with the application of modern theories of integration to the solution of circuit problems and deals with complex integration (something is missing in line 5 on p. 95), contour integrals, expansion theorems and Fourier integrals.

This monograph is a valuable addition to the Heaviside literature. It can be heartily recommended to the more mathematically minded students of electrical engineering. G. W. O. H.

* "Elementary Treatise on Electricity."

Plastics for Electrical and Radio Engineers.

By W. J. Tucker and R. S. Roberts. Pp. 148 + xi. Published by The Technical Press Ltd., "Piccancot," Gloucester Rd., Kingston Hill, Surrey, Price 12s.

The introductory chapter on "The Chemistry of Plastics and Insulating Materials" covers the subject matter briefly and forms a necessary introduction to a subject which has advanced in recent years to such an extent that it is an unknown quantity to many engineers. It is felt that this chapter might well have been expanded to link plastics with the materials with which they will be associated under service conditions, i.e. liquid dielectrics and metals. There is no mention of the catalytic action of metals and the electrolytic effects on the insulation value of plastics with catalysts under high electrical stress, where ionization, gas occlusion and ageing effects accumulate to deteriorate the efficiency of the material as a dielectric, often to ultimate breakdown.

It is interesting to note that some of the polymers of the liquid types are added to insulating oils as viscosity adjusters and to improve the electrical properties of the latter, particularly in respect of power factor, dielectric resistance and reduction in tendency to produce gas or polymerization products at high voltages.

This aspect of the problem will be of most interest to the electrical engineer, but it is of considerable importance to realize the breadth of the field covered by the substances generically termed "plastics." It would be of value if the authors could consider, for possible future editions, an expansion of the chemical section to include allied dielectric materials such as hydrocarbon oils and synthetic oils of the silicone type, particularly as many plastics are derived from petroleum products.

The second chapter forms an excellent survey of the field of "Materials Available" and makes a valuable guide to the choice of materials in the design stage.

Eight tables are included which give all the essential information on the mechanical and electrical characteristics of phenol, urea-formaldehyde and aniline derived materials together with thermoplastics, synthetic rubbers, silicone and melamine plastics.

The treatment of silicones merits expansion in view of their increasing importance. Their products range from low-viscosity fluids for use in transformers, switchgear and similar applications to high-polymer resins for impregnation processes.

A chapter on terms and definitions follows and is well conceived; it includes standard specifications. There is, perhaps, a bias in the direction of high-frequency applications, but with certain qualifications, which are referred to in the book, the fundamental principles apply equally at power-supply frequency.

The authors then turn to the important matter of the choice of material to suit the design requirements.

The allocation of articles into one or other of five classes according to functional requirements enables the designer to decide quickly the generic class of plastic for a specific purpose.

This is followed by a chapter on moulding and manufacturing processes, which contains a comprehensive resumé of the many possible methods of moulding plastics, and practical information on suitable cements. It is undoubtedly of assistance to all engineers, who are faced with repair problems involving plastic materials.

This chapter, together with the succeeding chapter VI, should assist designers to avoid some of the glaring examples of faulty mechanical or electrical design which have been perpetrated because of a lack of adequate appreciation of the medium.

The remainder of the book is devoted to specialized applications, the coating of wires to serve as an insulating covering, the production of insulated sleeving, insulation impregnants and cable coverings, with particular reference to the polyvinylchloride, polythene and polystyrene groups.

The book as a whole is an excellent example of a technical data book on a complex subject, for the presentation is acceptable and it is accurate in matters of fact. It can be recommended as a practical reference book to designers, engineers and students whose work necessitates essential data for applications in the electrical and radio fields.

G. W. I.

Mechanische Eigenschaften quasi-elastischer isotroper Körper

By FRIEDRICH POPERT. Pp. 105, and 30 Figs. Verlag A.G. Gebr. Leemann & Co., Zürich.

This paper-covered monograph, with the subtitle "Development of a new method of measurement for determining the shear modulus and internal friction in connection with a new process of television large scale projection" is a thesis presented at the Technische Hochschule at Zürich. The work was done under the direction of Professor Fischer and a number of references are given to papers by him on the subject; these would have to be consulted before one could really get a clear idea of the object of the research. Apparently, the fluorescent screen of the cathode-ray tube is replaced by a thin layer of transparent semi-conducting material. This layer is known as the Eidophor. This material undergoes deformation which must disappear in the period between two successive pictures, *i.e.*, in 1/25 second. This led to the examination by experimental methods of the mechanical properties of suitable materials. The first half of the book is devoted to the theory of deformation and relaxation of elastic, viscous, plastic and quasi-elastic materials. In the second half the experiments are described for determining the modulus and the internal friction when subjected to small sinusoidal deformations at frequencies of from 10 to 55 cycles per second. These mechanical properties were determined from the electrical behaviour of the material such as variation of capacitance, and this part of the work involved elaborate circuit arrangements with modulators, demodulators, low-pass filters, valve voltmeters, etc. Diagrams and photographs of the apparatus are given and the results are analysed and plotted.

G. W. O. H.

Radar

By Major R. W. Hallows, T.D., M.A.Cantab., A.M.I.E.E. A simple non-technical explanation of the basic principles of radiolocation. Pp. 140. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 7s. 6d.

Basic Mathematics for Radio Students covers elementary algebra, geometry and trigonometry before proceeding to treat complex numbers, series, vectors, operators and the differential and integral calculus. It is intended primarily for radio engineers, but the main stress is on the mathematical ideas and it is thus equally suitable for students of other subjects. The application of mathematics to radio is chiefly dealt with in the concluding chapter.

Written by F. M. Colebrook, B.Sc., D.I.C., A.C.G.I., the book aims at helping students whose mathematical education has been interrupted by the war and throughout the method is to discuss basic ideas in some detail rather than to lay down rules of thumb and formulae. It is published by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 10s. 6d. There are 270 +x pages.

Radio-Communication Convention

THE Institution of Electrical Engineers is holding a Radio-Communication Convention on March 25th-29th, 1947. Like the recent radar convention, its aim is to present papers covering wartime wireless development, but this time in the field of communications.

The annual dinner of the Radio Section of the Institution will be held on the first day of the convention.

CORRESPONDENCE

Letters of technical interest are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.

Power Loss in Electromagnetic Screens

To the Editor, "Wireless Engineer."

SIR,—In the article by Davidson, Looser and Simmonds, appearing in your January issue, the eddy current density in the infinite shielding plane is derived theoretically for a single wire loop, while the measurements were made by using a coil, of length comparable to its distance from the screen, in order to energize this screen.

It is quite easy to extend the method of the authors of the above article in order to obtain an expression for the eddy current density when the energizing factor is a coil, instead of a single loop, and I should like to do so here:

Let the coil be situated so that its axis is perpendicular to the infinite shielding plane and the distance of its middle plane from the shield is a, while its length is $2c$. Using the same notation as in the above-mentioned article and the same units, one can just as easily show that the magnetic potential of the coil is given now by the expression

$$A_\phi' = (\mu/\pi)\, bnI \cos \omega t \int_{a-c}^{a+c}\int_0^{\pi/2} \frac{2\sin^2\theta - 1}{[(b+\rho)^2 + (z-Z)^2 - 4b\rho\sin^2\theta]^{1/2}}\, d\theta dZ$$

where I is the current per turn, n the number of turns per unit length, and Z the longitudinal co-ordinate of a point situated on the coil.

The magnetic potential of the eddy currents is, then,

$$A_\phi = (\mu/\pi)\, bnI\omega \int_0^\infty \int_{a-c}^{a+c}\int_0^{\pi/2} \frac{(2\sin^2\theta - 1)\sin\omega(t-\tau)}{[(b+\rho)^2 + (Z - z - \frac{2s}{\mu}\tau)^2 - 4b\rho\sin^2\theta]^{1/2}}\, d\theta dZ d\tau$$

and, through the same approximation, as used by Davidson, Looser and Simmonds, we find that, at high frequencies,

$$A_\phi + A_\phi' = -\frac{2bnIs}{\pi\omega}\sin\omega t \int_{a-c}^{a+c}\int_0^{\pi/2} \frac{(Z-z)(2\sin^2\theta - 1)}{[(b+\rho)^2 + (Z-z)^2 - 4b\rho\sin^2\theta]^{3/2}}\, d\theta dZ$$

and, accordingly,

$$i_\phi = \frac{2bnI}{\pi}\cos\omega t \int_{a-c}^{a+c}\int_0^{\pi/2} \frac{Z(2\sin^2\theta - 1)}{[(b+\rho)^2 + Z^2 - 4b\rho\sin^2\theta]^{3/2}}\, d\theta dZ$$

By writing $k^2 = 4b\rho/[(b+\rho)^2 + Z^2]$, we obtain, with the authors,

$$i_\phi = -\frac{nI\cos\omega t}{4\pi b^{1/2}\rho^{3/2}} \int_{a-c}^{a+c} k\left(2K - \frac{2-k^2}{1-k^2}E\right) ZdZ$$

But $ZdZ = -2b\rho d(k^2)/k^4$

Therefore

$$i_\phi = \frac{nI\cos\omega t}{2\pi}\left(\frac{b}{\rho}\right)^{1/2} \int_{Z=a-c}^{Z=a+c} \frac{1}{k^3}\left[2K - \left(1 + \frac{1}{1-k^2}\right)E\right] d(k^2)$$

Referring, now, to the integral formulae for complete elliptic constants, as given by Jahnke and Emde: "Tables of Functions" (Dover Publications —New York 1943) p. 78, and writing, also,

$$u^2 = 4b\rho/[(b+\rho)^2 + (a+c)^2]$$
and $$v^2 = 4b\rho/[(b+\rho)^2 + (a-c)^2]$$

we obtain, finally,

$$i_\phi = \frac{nI\cos\omega t}{\pi}\left(\frac{b}{\rho}\right)^{1/2}\left\{(1/u)\,[2E_u - (2-u^2)K_u] - (1/v)\,[2E_v - (2-v^2)K_v]\right\}$$

the subscripts denoting the moduli of K and E.

We may still simplify this expression by using the notation of Jahnke and Emde, and, actually,

$$i_\phi = \frac{nI\cos\omega t}{\pi}\left(\frac{b}{\rho}\right)^{1/2}(v^3C_v - u^3C_u)$$

The complete elliptic integral C appearing in the above final expression for the eddy current density is tabulated for intervals of 0.01 of k^2 on p. 82 of the above edition of Jahnke & Emde.

C. A. SIOCOS.

Stanford University,
California, U.S.A.

Beam Tetrodes

To the Editor, "Wireless Engineer"

SIR,—It is generally recognised that when the primary current density flowing into the screen-to-anode space falls below a limiting value, it is not then always possible to ensure the formation of a potential minimum in this space by the charges due to primary electrons alone; this situation is especially true when the anode voltage is approximately one-quarter of the screen voltage. It has consequently been suggested by several writers that the space charge arising from secondary electrons plays an important role in producing a potential minimum when the space charge due to primary electrons is inadequate. The computation of the magnitude of the effect is fairly difficult, and can only be performed if there is sufficient data regarding the amount of the possible emission and the velocity distribution.

A great simplification can be obtained, however, if we may postulate that the secondary electrons can be emitted copiously with zero velocities of emission; we then have the condition that the secondary electron flow is limited to the value which sets up just enough additional space charge in the screen-to-anode space to reduce (dV/dx) at the anode to zero.

If this assumption is made the equation giving the potential distribution in the screen to anode space is

$$\frac{d^2V}{dx^2} = \frac{4\pi}{\sqrt{2\epsilon/m}}\left[\frac{I_P}{\sqrt{V}} + \frac{I_S}{\sqrt{V - V_2}}\right]$$

Where I_S is the secondary current density
I_P is the primary current density.

If I_S/I_P is denoted by γ, it can be shown that the following equation serves to determine γ :—

$$\sqrt{J_P} = \int_0^{(1-W_2)^{3/4}} \frac{dZ}{\sqrt{\frac{\sqrt{W_2 + Z^{4/3}} - W_2^{1/2}}{Z^{2/3}} + \gamma}}$$

Where

$$J_P = \frac{I_P}{I_D};\ I_D = \frac{\sqrt{2\epsilon/m}}{9\pi}\ \frac{V_1^{3/2}}{x_a^2};\ W_2 = \frac{V_2}{V_1}$$

V_1 = screen voltage
V_2 = anode voltage
x_a = screen-to-anode gap.

I_D is, of course, the current density in a plane diode of anode voltage V_1 and gap x_a. The results show that for $J_P = 1$, γ does not exceed 0.2, even when $W_2 = \frac{1}{4}$. $J_P = 1$ may be considered to correspond to a current density less than half the peak current density, and the analysis confirms that the space charge due to secondary electrons does in fact considerably help to suppress the retrograde flow of secondary electrons.

S. RODDA.

Enfield, Middx.

Spectrum of a Phase- or Frequency-Modulated Wave

To the Editor, "Wireless Engineer"

SIR,—In a paper in *Wireless Engineer* for March 1944, Mr. F. M. Colebrook pointed out some interesting features of the spectrum of a wave sinusoidally modulated in phase or frequency. The object of the present note is to generalize these results somewhat and in particular to consider the case in which the carrier frequency is an integral or half-integral multiple of the modulation frequency. In this case each sidewave is a doublet and in general the mean square value of the wave is not equal to half the square of the amplitude.

A general representation of a wave of unit amplitude sinusoidally modulated in phase or frequency is

$$z = x + jy = \exp j\,[\omega_0 t + m \sin (pt + \phi)] \quad (1)$$

and by taking the real or imaginary part of z and by giving ϕ any value the complete range of cases can be considered.

The wave can be expanded into the spectrum

$$z = \exp (j\omega_0 t) \sum_{n=-\infty}^{\infty} J_n(m) \exp j^n(pt + \phi) \quad .. \quad (2)$$

giving

$$x = \cos [\omega_0 t + m \sin (pt + \phi)]$$
$$= \sum J_n \cos [(\omega_0 + np)t + n\phi] \quad .. \quad (3)$$

$$y = \sin [\omega_0 t + m \sin (pt + \phi)]$$
$$= \sum J_n \sin [(\omega_0 + np)t + n\phi] \quad .. \quad (4)$$

Since n assumes all values from $-\infty$ to $+\infty$ it is seen that when n is negative and greater in magnitude than ω_0/p the frequency terms become negative but with the identities

$$\cos (-qt + n\phi) \equiv \cos (qt - n\phi)$$
$$\sin (-qt + n\phi) \equiv -\sin (qt - n\phi)$$

are transformed into the corresponding positive frequencies. This implies that there are two series of spectral lines :

(i) with $n \geqslant -\frac{\omega_0}{p}$ and (ii) with $n < -\frac{\omega_0}{p}$

which for convenience may be termed the positive series and the negative series respectively.

A special case is that in which the two series coincide in frequency which occurs when $2\omega_0/p$ is either an integer or a half-integer. If $2\omega_0/p = N$ it is seen that the nth and the $-(N + n)$th sidewaves coincide and have the frequency

$$\omega = \omega_0 + np = -[\omega_0 - (N + n)p] \quad .. \quad (5)$$

when N is even the lowest frequency is zero and corresponds to the single $(-\frac{1}{2}N\text{ th})$ component; when n is odd the lowest frequency is $p/2$ and is a doublet corresponding to the $-\frac{N-1}{2}$th and $-\frac{N+1}{2}$th components.

The spectrum (2) may then be written

$$z = \sum_{n_0}^{\infty} \{J_n \exp j(\omega t + n\phi) + J_{-N-n} \exp [-j(\omega t + \overline{N + n}\,\phi)]\} \quad .. \quad .. \quad (6)$$

where ω is related to n by equation (5) and n_0 is $-\frac{N-1}{2}$ when N is odd and $-N/2$ when N is even except that only *one* term of zero frequency is to be included in the summation.

The coincidence of the two series of sidewaves affects the calculation of the mean square value of the wave. When they are not coincident the mean square value is as Colebrook showed

$$\overline{x^2} = \overline{y^2} = \tfrac{1}{2} \sum_{-\infty}^{\infty} J_n^2 = \tfrac{1}{2} \quad .. \quad .. \quad .. \quad (7)$$

In the case of coincidence the mean square value may be greater or less than $\frac{1}{2}$ depending upon the values of N and ϕ. The value may be found either by summing the squares of the resultant side-wave amplitudes given by equation (6) or, more directly, averaging by integration over a period $2\pi/p$ of the modulation frequency. Since

$$\overline{x^2} + \overline{y^2} = |z|^2 = 1$$

it is only necessary to find x^2, and y^2 is then also determined. Now

$$\overline{x^2} = \frac{1}{2\pi}\int_0^{2\pi} \frac{1 + \cos [2Npt + 2m \sin (pt + \phi)]}{2}\, d(pt)$$
$$= \tfrac{1}{2}[1 + (-)^N J_N (2m) \cos N\phi] \quad .. \quad .. \quad (8)$$

by well-known integral formulae. The fractional departure of $\overline{x^2}$ or $\overline{y^2}$ from $\frac{1}{2}$ cannot exceed $J_N(2m)$ and in practice this will be an extremely small quantity since ω_0 $(= \frac{1}{2}Np)$ is always large compared with the maximum frequency excursion $\delta\omega$ $(= mp)$.

In any event it is doubtful if an ideal wave of the types represented by equations (2) and (3) can be very closely approached in practice. Nevertheless the influence of the ratio $\omega/_0p$ on the spectrum and its content is of some intrinsic theoretical interest.

R. E. BURGESS.

National Physical Laboratory.

Pulse Modulation

To the Editor, "Wireless Engineer."

SIR,—Without committing ourselves to the detailed formulae quoted by Mr. Shepherd (*Wireless Engineer*, April, 1946, p. 114), we find ourselves agreeing with his general conclusions in point of rigour, but as he himself notes, the quantitative discrepancies are negligible in most practical cases. The contradiction which he mentions in connection with our Section 1.4.3 is no more real than that which might be adduced between any pair of first and second order approximations. That Mr. Shepherd's analysis is still an approximation seems to follow from his assumption that "r" is a constant, although it is not difficult to suggest how his method could be extended to more general modulation waveforms.

Other questions which arise in more exact analyses are whether in the case of length or delay modulation the trailing edge of the pulse is controlled by the modulation, and in the case of amplitude modulation whether the top of the pulse is truly flat or follows the modulation itself.

The analysis of length- and delay-modulated pulses with high modulation indices has already received attention in several quarters and will, no doubt, be published in due course. We look forward with interest to Mr. Shepherd's fuller account of his calculations.

F. F. ROBERTS.
J. C. SIMMONDS.

London, N.W.2.

J. L. Baird

IT is with regret that we have to record the death of John Logie Baird at his home at Bexhill on 14th June after an illness which started in February. Born in 1888 at Helensburgh, Scotland, he was the son of the minister of the West Parish Church and was educated at Larchfield and the Royal Technical College, Glasgow. At the age of 18, when he was forced by indifferent health to give up London business life, he started a small television laboratory at Hastings.

By 1926 he had achieved true television and demonstrated the transmission of living subjects with light, shade and detail to members of the Royal Institution. In 1929 experimental television transmissions by his system were started, first by the German Post Office and then by the B.B.C. Shortly before the war Baird demonstrated colour television, using a cathode-ray tube and a series of colour filters to give a projected picture of 2ft 6in by 2ft. He has also the credit of carrying out the first transatlantic television demonstration in 1928 and of inventing the Noctovisor—an apparatus for seeing in the dark by invisible rays.

Since 1941 he has been consulting technical adviser to Cable & Wireless.

WIRELESS PATENTS

A Summary of Recently Accepted Specifications

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

ACOUSTICS AND AUDIO-FREQUENCY CIRCUITS AND APPARATUS

574 036.—Preventing phase-distortion in loudspeaker installations when separate horn instruments are used to reproduce the higher and lower ranges of frequency.

Western Electric Co. Inc. Convention date (U.S.A.) 30th December, 1942.

574 370.—Loudspeaker system for projecting sound uniformly over a predetermined solid angle from one or more horns backed by an elliptical reflecting surface.

Western Electric Co. Inc. Convention date U.S.A .) 30th December, 1942.

574 394.—Acoustic horn of hyperbolic design which is stated to give optimum impedance conditions over a wide range of frequencies.

Jensen Radio Manufacturing Co. Convention date (U.S.A.), 23rd July, 1942.

574 463.—Construction and assembly of a multi-plate piezo-electric transducer unit, say for driving a loudspeaker.

The Brush Development Co. (assignees of J. P. Arnot, Junr.). Convention date (U.S.A.) 11th January, 1943.

574 557.—Regulating the degree of automatic volume-expansion to be applied, when reproducing from any given sound record, by utilizing a photo-electric control-current derived from an auxiliary strip on the record.

The British Thomson-Houston Co. Ltd. and A. P. Castellain. Application dates 24th August, 1943, and 13th January, 1944.

574 611.—Directional microphone in which one side of the diaphragm is coupled to the atmosphere through a phase-shift network including a resistance and a chamber with spaced apertures.

Western Electric Co., Inc. Convention date (U.S.A.) 16th January, 1943.

DIRECTIONAL WIRELESS

574 319.—Radio-altimeter of the phase-difference type in which a cathode-ray tube indicates the presence of comparatively small reflecting obstacles projecting above the general level of the ground.

Standard Telephones and Cables Ltd. and R. M. Barnard. Application date 5th April, 1940.

574 340.—Radio course-indicating system of the overlapping beam type, in which the continued functioning of the transmitter is positively recorded even when the plane is on the correct "no signal" course.

Standard Telephones and Cables Ltd., C. W. Earp, and J. D. Weston. Application date 20th January, 1944.

574 546.—Electro-mechanical filter, involving commutation of the selected frequency, particularly applicable to direction-finding apparatus.

Radio Transmission Equipment Ltd. and C. E. G. Bailey. Application date 4th September, 1941.

574 610.—Radiolocation equipment in which exploring pulses are alternately switched, through wave-guides and reflecting mirrors, along two slightly divergent beams.

Western Electric Co., Inc. Convention date (U.S.A.) 19th August, 1942.

574 651.—Arrangement of spaced pick-up devices for indicating the location of any selected one of a number of sources which are radiating pulsed or sinusoidal waves of sound or other forms of energy.

Hazeltine Corporation (assignees of H. M. Lewis). Convention date (U.S.A.) 23rd May, 1942.

574 675.—Radiolocation system in which the exploring signals are radiated along a beam which is oscillating about a mean position, the critical direction being determined by the merging together of the reflected signals on a C.R. indicator.

Standard Telephones and Cables, Ltd. (assignees of H. G. Busignies). Convention date (U.S.A.) 8th March, 1941.

574 676.—Radiolocation system in which exploring pulses are radiated in rapid succession from the four limbs of crossed dipoles, and the position of a reflecting target is shown, either above or below, or to one side or other, of the centre of a C.R. indicator.

Standard Telephones and Cables, Ltd. (assignees of E. Labin). Convention date (U.S.A.) 13th March, 1941.

RECEIVING CIRCUITS AND APPARATUS

(See also under Television)

574 047.—Means for controlling or modifying the field-strength of a distant transmitter so as to diminish its interference effect at a given point of reception.

J. Robinson. Application date 2nd May, 1940.

574 075.—Preventing "mistracking" in the tuning control of a radio receiver, when the input inductance is partly shunted by a frame aerial.

Marconi's W.T. Co. Ltd. (assignees of W. F. Sands). Convention date (U.S.A.) 30th December, 1942.

574 078.—Cathode-ray receiver for making a visible record of incoming signals on an external strip of sensitized paper.

Marconi's W.T. Co. Ltd. (assignees of R. L. Snyder, Junr.). Convention date (U.S.A.) 31st December, 1942.

574 350.—Printing telegraph receiver of the facsimile type comprising a marking-wheel with flexible or pivoted arms for transferring the code signals to sensitized paper.

G. T. Evans, F. O. Morrell, and W. E. Finlason. Application date 17th January, 1941.

574 373.—Pocket-type receiver with a frame aerial which is normally housed in a recess in the casing, but which is hinged so that it can be used either as a carrying-handle, or as an easel-support.

Philco Radio and Television Corp. (assignees of G. Patterson, Junr.). Convention date (U.S.A.) 28th July, 1943.

574 407.—A frame-aerial feeding a permeability-tuned input-circuit and arranged to give constant-coupling over a wide frequency range.

Marconi's W.T. Co. Ltd. (assignees of G. L. Beers). Convention date (U.S.A.) 28th January, 1943.

TRANSMITTING CIRCUITS AND APPARATUS

(See also under Television)

574 204.—Method of connecting coaxial cables through a spacing-member which is formed with a cavity to hold a joint-sealing plastic composition.

Standard Telephones and Cables Ltd. and H. Birkby. Application date 15th January, 1944.

574 230.—Connecting two coaxial transmission-lines, so that whilst both are in axial alignment, one section of line can be rotated relatively to the other.

Bruno Patents Inc. (assignees of W. A. Bruno). Convention date (U.S.A.) 14th November, 1942.

574 349.—Printing telegraph transmitter of the facsimile type based on the use of a static keyboard and code contacts in the form of wires stretched beneath the keyboard.

G. T. Evans, F. O. Morrell, and W. E. Finlason. Application date 17th January, 1941.

SIGNALLING SYSTEMS OF DISTINCTIVE TYPE

574 627.—Repeater system for pulse-modulated signals, allowing simultaneous two-way working on one carrier-frequency, with a single aerial at each station.

Standard Telephones and Cables, Ltd. (communicated by International Standard Electric Corporation). Application date 11th February, 1944.

574 647.—Phase-modulating system in which a high degree of linearity is secured with the aid of a comparatively-low ratio of frequency-multiplication.

Hazeltine Corporation (assignees of B. D. Loughlin). Convention date (U.S.A.) 3rd March, 1942.

574 675.—Pulsed-signalling system in which the spacing between successive pulses is respectively decreased or increased in proportion to the value of the positive or negative signal-voltage.

Marconi's W.T. Co., Ltd. (assignees of C. W. Hansell). Convention date (U.S.A.) 29th November, 1940.

574 686.—Frequency-modulating system comprising a stabilized and a non-stabilized oscillator, and a mixing circuit which delivers a signal output derived from both oscillators.

Standard Telephones and Cables, Ltd. (communicated by International Standard Electric Corporation). Application date 11th February, 1944.

CONSTRUCTION OF ELECTRONIC-DISCHARGE DEVICES

574 430.—Process for reducing the brittleness of carburized tungsten filaments used in electron-discharge tubes.

Standard Telephones and Cables Ltd. (assignees of C. V. Litton). Convention date (U.S.A.) 23rd November, 1942.

574 453.—Means for controlling the cycloidal movements of the electrons in a discharge device of the magnetron type.

Standard Telephones and Cables Ltd. (communicated by Western Electric Co., Inc.). Application date 28th March, 1942.

574 480.—Spacing and supporting the electrodes of a discharge tube which is required to withstand high mechanical stress, or to be suitable for short-wave working.

Ferranti, Ltd., A. L. Chilcot, and S. Jackson. Application date 27th June, 1942.

574 500.—Process for making a metal-to-glass seal, suitable for withstanding high temperature-changes, in an electron-discharge device.

Philips Lamps Ltd., O. Pressel, and G. A. M. Diepstraten. Application date 3rd February, 1944.

574 512.—Discharge tube wherein the electron stream is focussed into the form of a ribbon and is velocity-modulated by electrodes spaced apart along its length.

L. F. Broadway and C. S. Bull. Application date 5th March, 1940.

574 551.—Short-wave magnetron comprising an annular resonator the interior surface of which is divided by a tortuous slot into two areas of opposite polarity.

"Patelhold" Patentverwertungs &c. A.G. Convention date (Switzerland) 9th February, 1942.

574 594.—Construction of valve in which two electrode-systems co-operate with different parts of the same elongated cathode.

The M-O Valve Co., Ltd. and C. W. Cosgrove. Application date 2nd February, 1944.

574 708.—Arrangement of a hollow resonator and an electron-discharge tube so as to minimize the dielectric losses caused by the glass envelope of the tube.

A. D. Blumlein. Application date 23rd September, 1940.

SUBSIDIARY APPARATUS AND MATERIALS

574 398.—Piezo-electric oscillator mounted between electrodes which are relatively rotatable to allow the operating frequency to be varied within limits.

The General Electric Co. Ltd. and S. K. Lewer. Application date 11th August, 1943.

574 401.—The use of "steel wool" as a screening or attenuating medium for preventing the leakage of centimetre waves through small apertures or passages.

The General Electric Co. Ltd., E. G. James, and A. O. E. Lindell. Application date 20th August, 1943.

574 428.—Current-converting system in which a "master" vibrating relay controls one or more "slave" relays in synchronism or in a given phase-relation.

H. M. Harmer and F. J. Cook. Application date 18th November, 1943.

574 501.—Assembling the metallized sheets, and fixing the terminal foils to a capacitor of the stack type.

M. Emanuel. Application date 4th February, 1944.

574 574.—Fixed capacitor consisting of a copper core, coated with vitreous material, and a superposed silver burnish, for use on aircraft, or military vehicles.

R. F. Oxley. Application date 26th June, 1942.

574 596.—Construction of a rotary-disc type of trimming capacitor to facilitate adjustment *in situ*.

Ashley Accessories, Ltd. and W. P. Kempster. Application date, 5th *February,* 1944.

574 612.—Design of ribbon cable for multiplying terminal banks in a telecommunication system.

Standard Telephones and Cables, Ltd. (assignees of G. Deakin). Convention date (U.S.A.) 5th February, 1943.

574 618.—Test equipment for indicating any deviation or eccentricity of the conductor, relatively to the dielectric, in an insulated cable.

V. Planer and F. E. Planer. Application date 9th February, 1944.

574 665.—Balanced-bridge circuit, comprising two adjustably-biased thermionic valves, for measuring either direct or alternating voltages.

Standard Telephones and Cables, Ltd. (assignees of J. R. Banker). Convention date (U.S.A.) 24th April, 1943.

574 775.—High-frequency ignition system, particularly for aircraft engines required to work at high altitudes.

The British Thomson-Houston Co., Ltd., D. F. Welch and A. Grieve. Application date 7th September, 1942.

574 816.—Thermo-electric generator comprising a battery of thermo-couples, with heating and cooling means to maintain a temperature-difference between the hot and cold junctions.

Eaton Manufacturing Co. Convention date (U.S.A.) 1st April, 1943.

574 830.—Valve-voltmeter circuit, with negative feed-back, for measuring either direct or alternating voltages.

Standard Telephones and Cables, Ltd. (assignees of J. R. Banker). Convention date (U.S.A.) 24th April, 1943.

574 837.—The use of a saturated "electret" (i.e. a dielectric in which static charges are permanently stored), as a frequency-changer, or as a modulating device.

Standard Telephones and Cables, Ltd. (assignees of G. C. Southworth). Convention date (U.S.A.) 25th March, 1941.

ABSTRACTS AND REFERENCES

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The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. The abbreviations of the titles of journals are taken from the World List of Scientific Periodicals. Titles that do not appear in this List are abbreviated in a style conforming to the World List practice.

ACOUSTICS AND AUDIO FREQUENCIES

534.21 **1744**

Sound Radiation from a Source Placed in Water at a Small Depth.—L. M. Brekhovskikh. (*C.R. Acad. Sci. U.R.S.S.*, 30th May 1945, Vol. 47, No. 6, pp. 396–399. In English.) If the depth of the water is large compared with the distance from source to receiver, the sound pressure at the receiver varies as the inverse square of the distance; for water of depth small compared with the sender-receiver distance, and with a perfectly reflecting bottom the pressure varies as the inverse square root of the distance. In both cases the pressure increases with depths of source or receiver to a distance approximately equal to a quarter of a wavelength. The case of a source attached to a solid submerged hemisphere is discussed briefly. For description of confirmatory experiments see 1745 below.

534.21 **1745**

Radiation of a Sound in Water as affected by Depth of Submersion.—N. N. Andreyev, L. M. Brekhovskikh & L. D. Rosenberg. (*C.R. Acad. Sci. U.R.S.S.*, 30th May 1945, Vol. 47, No. 6, pp. 400–402. In English.) Description of experiments carried out to confirm the theory put forward by Brekhovskikh (see 1744 above). The experimental curves follow the theoretical curves well, and variations about them can be explained by interference due to multiple reflections between bottom and surface. The maximum sound pressure is attained at a depth of a quarter of a wavelength, as predicted by theory.

534.24 **1746**

Acoustic Reflection from Triplanes, Spheres, and Disks.—C. J. Burbank. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, p. 136.) ". . . reflection from a triplane (an object made of three mutually perpendicular square plates with coinciding centres) is compared [experimentally] with the back reflection from a sphere and a disk." Abstract of an Amer. Phys. Soc. paper.

534.26 **1747**

On Diffraction of Elastic Waves.—Scherman. (*See* 1906.)

534.321.9 **1748**

Ultrasonic Generator.—F. W. Smith, Jr. & P. K. Stumpf. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 116–119.) The basic piezoelectric transducer is an X-cut quartz crystal excited in the thickness mode and loaded (usually) with transformer oil, which has high acoustic resistance and good dielectric properties. The design of a crystal holder with an airpocket which makes the radiation unidirectional is described. The crystal, which may be 10 cm in diameter, is silver plated and clamped at its edge.

The input impedance is equivalent to about 10 000–250 000 Ω shunted by about 100 $\mu\mu$F. Methods of matching this to the usual class-C amplifier are discussed, and a π-matching network is favoured. The r.f. generator may be crystal-controlled, but the radiating crystal may not be used, as its frequency varies with loading. Frequencies used are usually 150–1 000 kc/s, but frequencies up to 500 Mc/s have been used.

534.321.9 : 534.2 **1749**

A Variable Path Ultrasonic Interferometer for the Four Megacycle Region with Some Measurements on Air, CO_2, and H_2.—J. L. Stewart. (*Rev. sci. Instrum.*, Feb. 1946, Vol. 17, No. 2, pp. 59–65.) Alignment of the piston and crystal to the order of 10^{-5} inch in this interferometer gave an accuracy of 0.1% in the measurement of velocity in gases, and of 50% in the measurement of absorption and reflection coefficients. Preliminary measurements on H_2 gave evidence of molecular dispersion in the range 4–8 Mc/s.

534.417 : 534.88 **1750**
Sonar for Submarines.—R. S. Lanier & C. R. Sawyer. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 99–103.) Description of an underwater sonic and supersonic listening system. The pickup, a magnetostriction hydrophone, incorporates a magnetized nickel tube 3 ft long and 2 inches in diameter. The hydrophone output is taken to a 5-stage resistance-coupled amplifier supplying a loudspeaker or headphones. The amplifier has 5 frequency-response characteristics, any one of which may be selected. The sensitivity is about 20 db above that required to raise the water noise to audibility. A frequency converter may be switched into the circuit to reduce the frequencies of supersonic signals to below 5 kc/s.

534.417 : 621.396.9 : 355.326.4 **1751**
The Sonobuoy.—K.H. (*See* 1855.)

534.43 : 621.395.61 : 621.396.619.018.41 **1752**
An FM Phono Pickup.—A. Badmaieff. (*Radio Craft*, Nov. 1945, Vol. 17, No. 2, p. 106.) An application of 1144 of May.

534.833.1 **1753**
Demountable Soundproof Rooms.—W. S. Gorton. (*Communications*, March 1946, Vol. 26, No. 3, pp. 30, 33.) See 825 of April.

621.395[.61 + .625 **1754**
A.I.E.E. Winter Convention January 1946.—(*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 29..35.) Abstracts are given of the following papers presented at the convention:—Inertia Throat Microphones, by E. H. Greibach & L. G. Pacent. Laboratory Method for Objective Testing of Bone Receiving and Throat Microphones, by E. H. Greibach. A New Wire-Recorder-Head Design, by T. H. Long. A B-H Curve Tracer for Magnetic-Recording Wire, by T. H. Long & G. D. McMullen. Signal and Noise Levels in Magnetic Tape Recording, by D. E. Wooldridge. Phonograph Reproducer Design, by W. S. Bachman. Recently Developed Tools for the Study of Disk-Recording Performance, by H. E. Roys. Sound Recording in Business, by L. D. Norton. Titles of other papers are given in other sections. For other abstracts, see *Electronics*, April 1946, Vol. 19, No. 4, pp. 230..266.

621.395.61 **1755**
Microphones: Parts 1 & 2.—S. W. Amos & F. C. Brooker. (*Electronic Engng*, April & May 1946, Vol. 18, Nos. 218 & 219, pp. 109–111 & 136–141.) 1. It is shown that the basic differential equations for the oscillations in electrical, mechanical and acoustic systems are similar in form. The electrical equivalents of various acoustic networks consisting of combinations of cavities, tubes and slits are given, with indication of how they may be applied to microphone design.

2. The mechanisms of pressure-operated and velocity-operated (differential) microphones are analysed, and typical response curves given.

621.395.61 : 621.395.623.8 **1756**
Microphone Design in Electric Megaphones [to reduce acoustic feedback].—A. J. Sanial. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 30..61.) See also 17 of January.

621.395.645.3 : 621.385.4 **1757**
Intermodulation Tests for Comparison of Beam and Triode Tubes used to drive Loudspeakers.—Hilliard. (*See* 2043.)

621.395.665 **1758**
Contrast Expansion.—Parnum. (*See* 1793.)

621.395.665 **1759**
Contrast Expansion.—White. (*See* 1792.)

621.395.667 **1760**
Paraphase Bass-Treble Tone Control.—D. L. Jaffe. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 17, 51.) A detailed account of a single RC network, giving an independent variation in bass and treble response about an arbitrary cross-over frequency in the a.f. spectrum.

621.395.667 **1761**
Improved [tone] **Compensator.**—F. C. Davis. (*Radio Craft*, March 1946, Vol. 17, No. 6, p. 425.) Independent bass and treble control are achieved by splitting the signal between two channels, in which these controls are respectively situated, and afterwards recombining the two outputs.

621.395.667 : 534.43 : 621.395.61 **1762**
High Fidelity Bass Compensation for Moving Coil Pick-Ups.—F. M. Haines. (*Electronic Engng*, April 1946, Vol. 18, No. 218, p. 121.) Correction to a circuit diagram in 833 of April. For an illustrated summary of the original article see *Radio, N.Y.*, March 1946, Vol. 30, No. 3, p. 4. (Note correction of wrong UDC number applied to 833 of April.)

621.395.92 + 621.396.62 **1763**
Radio Hearing Aid.—A. Montani. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 392, 438.) Description and circuit diagram of a combined hearing aid and pocket radio.

AERIALS AND TRANSMISSION LINES

621.315.21.029.6 : 621.396.9 **1764**
Radar Cables—Recent Developments in Conductors for Very High Frequencies.—E. W. Smith. (*Wireless World*, April 1946, Vol. 52, No. 4, pp. 129–131.) The chief objective in development was reduction in the power factor of the dielectric. This was achieved first by making air-dielectric cables and later by the use of polythene. With polythene, much progress has been made in manufacturing methods, especially in the avoidance of air inclusion, and in attaining the accurate uniformity of diameter necessary to reduce standing waves. Some special types of cable (*e.g.* delay and low-impedance types) are mentioned, and methods of mechanical and electrical testing briefly described.

621.315.211.2.029.5/.6 **1765**
Applications of High-Frequency Solid-Dielectric Flexible Lines to Radio Equipment.—H. Busignies. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 295–301.) A review of the present and past needs for flexible moisture-proof r.f. lines. The polystyrene dielectric formerly used has largely been replaced by polyethylene. The mechanical and electrical requirements are detailed, together with the corresponding methods of test. The importance of electrical balance and stability of electrical length is emphasized, particularly in relation to directional systems used for navigation and aircraft landing.

621.315.212.1 1766

Flexible Coaxial Cable.—R. M. Krueger. (*QST*, April 1946, Vol. 30, No. 4, pp. 51–53.) A survey of solid-dielectric concentric and unscreened twin cables using polyethylene as dielectric. A list of abridged specifications of U.S. Army-Navy standard coaxial cables is given.

621.315.213.14.017.2 1767

Determination of the Temperature Rise and the Maximum Safe Current through Multiconductor Electric Cables.—H. P. Iskenderian & W. J. Horvath. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 255–262.) The temperature rise in rubber-insulated cables is calculated using the thermal constants of the cable. The theory has been confirmed experimentally and the thermal resistivity constants obtained as a function of size and composition. The maximum safe current to limit the temperature rise at the centre to 25°C is predicted.

621.396.611.029.63/.64] : 621.392 1768

Semi-Transparent Oscillating Electromagnetic Cavities.—Kahan. (*See* 1795.)

621.396.67 + 621.396.11 1769

The Ratio between the Horizontal and the Vertical Electric Field of a Vertical Antenna of Infinitesimal Length Situated above a Plane Earth.—K. F. Niessen. (*Philips Res. Rep.*, Oct. 1945, Vol. 1, No. 1, pp. 51–62.) The Hertzian vector function is simplified (for the case of a radio landing beacon) by considering the observer to be a large number of wavelengths away from the emitting aerial and relatively close to the reflecting earth. The reflection formula so derived is only applicable under certain conditions of height and angle of elevation which are deduced. The resulting horizontal to vertical field ratio is obtained, and is shown to be reduced when the aerial is raised a little above the ground.

621.396.67 1770

The General Reciprocity Theorem in the Theory of Receiving and Transmitting Antennae.—J. N. Feld. (*C.R.Acad. Sci. U.R.S.S.*, 10th September 1945, Vol. 48, No. 7, pp. 476–478. In English.) "The reciprocity theorem for two arbitrary antennae in the case of harmonic oscillations of one and the same frequency f is written . . . $I^{(1)} E_1 = I^{(2)} E_2$, where $I^{(1)}$ and $I^{(2)}$ are the currents passing through the terminals of the first and second antennae when operating as receiving aerials, and E_1 and E_2 are the total e.m.f.s of the generators connected to the terminals of the antennae when the latter are operating as transmitting aerials. . . [This theorem] holds, however, only under the condition that the internal (complex) resistances of the generators z_1 and z_2 corresponding to the resistances of the receivers $Z^{(1)}$ and $Z^{(2)}$ . . . are equal." The more general case, when the condition is not fulfilled, is considered in this paper.

621.396.67 1771

The Thin Cylindrical Antenna: A Comparison of Theories.—D. Middleton & R. King. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 273–284.) The solutions of Hallén's integral equation given by Hallén (2763 of 1939), Bouwkamp (2197 of 1944), Gray (1931 of 1944), King & Middleton (1453 of June) are compared together and with Schelkunoff's transmission-line theory (1049 of 1942 and 1930 of 1944) and with experiment. The King-Middleton second-order theory agrees best with experimental results. It is concluded that the integral-equation method of Hallén leads to a satisfactory theory of the thin cylindrical aerial.

621.396.67 1772

I.R.E. Winter Technical Meeting 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22 . . 66.) Abstracts of some of the papers read. For titles, see 1448 of June.

621.396.676 : 621.396.932.029.54 1773

Radiation of Ship Stations on 500 Kc/s.—Marique. (*See* 2071.)

621.396.677 1774

A Theory for Three-Element Broadside Arrays.—C. W. Harrison, Jr. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 204–209.) "The vector relationship between the voltages that must be applied across the terminals of a three-element array, to maintain input currents of the same amplitude and phase, is determined. Each antenna is of half-length h, and of radius a. The spacing between antennas is b. Two broadside arrays having the following dimensions are analysed numerically: (*a*) $h = \lambda/2$, $b = \lambda/2$, and $\Omega = 2 \ln (2h/a) = 20$; (*b*) $h = \lambda/4$, $b = \lambda/2$, and $\Omega = 20$. The results of these calculations are supplied in the form of vector diagrams."

621.396.677.029.62 1775

A V.H.F. Directive Antenna System.—A. Niutta. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 18–20.) A simple unidirectional aerial system for 100 Mc/s is obtained by using a pair of horizontal centre-fed full-wave dipoles, side by side, spaced a quarter of a wavelength apart. Transformer connexions are such that there is a $\pi/2$ phase difference between the two dipoles. The theory of the design is given, and alternative means of obtaining the required phasing are discussed.

621.396.677.029.64 : 564.566 1776

Laguerre Functions in the Mathematical Foundations of the Electromagnetic Theory of the Paraboloidal Reflector.—Pinney. (*See* 1909.)

CIRCUITS

621.3.011.2 : 621.385.2 1777

Radio Design Worksheet: No. 46 — Non-Linear Resistance.—(*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 31–32.) Consideration of the relationships between current, p.d., and power in a diode for d.c. and a.c. excitation.

621.3.012.8 : 512.831 1778

Tensors and Equivalent Circuits.—Hoffmann. (*See* 1898.)

621.318.572 1779

Signalling System.—R. F. Massoneau. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, p. 28.) A method of counting the number of cycles in a pulse of electrical energy, suitable for use in transmission of numerical data. Summary of U.S. Patent 2 379 093.

621.318.572 : 621.317.755 1780

Four-Channel Electronic Switch.—N. A. Moerman. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 150–153.) To enable 4 signals, whose frequencies need not be related, to be viewed simultaneously on a single-beam tube. The inputs are applied to gate amplifiers which are switched at 25 kc/s by a crystal-controlled ring counter. The latter allows accurate measurement of short time intervals. Useful resolution is obtainable well above commercial power frequencies.

621.385.38 : 621.396 **1781**
Thyratrons and Their Applications to Radio Engineering.—Maddock. (*See* 2090.)

621.392 + 621.396.622 + 621.396.64 **1782**
I.R.E. Winter Technical Meeting 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22..66.) Abstracts of some of the papers read. For titles, see 1462 of June.

621.392.4.012 **1783**
Graphical Solution of Series Circuits.—P. K. Hudson. (*Communications*, March 1946, Vol. 26, No. 3, pp. 48–49.) It is shown that a simple chart for converting polar coordinates into rectangular coordinates can be applied to circuit problems concerning series resistances and reactances.

621.392.43 **1784**
Conjugate-Image Impedances.—S. Roberts. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 198–204.) An analysis of the power in a load connected to a signal generator by a four-terminal network, in relation to the matching of generator and load to the conjugate impedance of the network terminals. The power gain (*i.e.* ratio of power in the load to power available from the generator) is calculated, with discrimination between ultimate, available, and actual gains, corresponding respectively to the cases of conjugate-impedance match at both output and input of the network, at the output only, and at neither output nor input. The analysis is applied to an oscillator problem.

621.392.5 **1785**
Transient Delay Line.—J. M. Lester. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 147–149.) Design criteria for a pulse-delay network. If the highest-frequency component of the transient is known, a simple graphical solution is possible for the values of inductance and capacitance.

621.392.5 **1786**
Solving 4-Terminal Network Problems Graphically.—R. Baum. (*Communications*, March 1946, Vol. 26, No. 3, pp. 50..53.) The networks contain either lumped or distributed constants. The use of the Smith diagram (1372 of 1939) and of inversion diagrams is explained in detail.

621.392.52 **1787**
A.I.E.E. Winter Convention January 1946.—(*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 29..35.) Abstracts are given of the following papers presented at the convention :—A Tunable Rejection Filter, by R. C. Taylor. A New Crystal Channel Filter for Broad-Band Carrier Systems, by E. S. Willis. Titles of other papers are given in other sections. For other abstracts see *Electronics*, April 1946, Vol. 19, No. 4, pp. 230..266.

621.394/.395].645.34 **1788**
Graphical Analysis of Degenerative Amplifiers.—R. G. Middleton. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 23–24, 50.) A current-feedback amplifier is analysed by making certain algebraic transformations on the characteristic curves of the valves. The technique can also be applied to voltage feedback.

621.394/.397].645.2 **1789**
Wide-Band Amplifiers : Part 2.—(*Wireless World*, April 1946, Vol. 52, No. 4, pp. 125–126.) Broadening the bandwidth by critical mistuning or stagger gives a higher gain per stage than does increase of damping in coincidence-tuned stages. For part 1 see 1190 of May.

621.394/.397].645.3 **1790**
Shifting Concepts.—"Cathode Ray". (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 6..12.) Illustrated summary of 1192 of May ("Cathode Ray") on negative feedback.

621.395.645.3 : 621.385.4 **1791**
Intermodulation Tests for Comparison of Beam and Triode Tubes used to drive Loudspeakers.—Hilliard. (*See* 2043.)

621.395.665 **1792**
Contrast Expansion.—J. G. White. (*Wireless World*, April 1946, Vol. 52, No. 4, pp. 120–123.) Circuits described in 3489 and 3929 of 1945 (White) use variable negative feedback to produce contrast expansion ; a slight modification of these eliminates unwanted current-feedback and can lead to 8 db increase in expansion. The effect of control bias on reproduction distortion is discussed at some length. An error in one of the earlier papers (3489 of 1945) is pointed out. See also 1793 below.

621.395.665 **1793**
Contrast Expansion.—D. H. Parnum. (*Wireless World*, April 1946, Vol. 52, No. 4, p. 136.) Discussion of 3489 and 3929 of 1945 (White). See also 1792 above.

621.396.6.018.1 **1794**
Phase Relationships.—C. E. Cooper. (*Wireless World*, April 1946, Vol. 52, No. 4, pp. 127–128.) When considering the difference between grid and anode signals it is better to use the term "reversed polarity" than "180 degrees out of phase".

621.396.611.029.63/.64] : 621.392 **1795**
Semi-Transparent Oscillating Electromagnetic Cavities.—T. Kahan. (*C. R. Acad. Sci., Paris*, 4th April 1945, Vol. 220, No. 14, pp. 496–497.) A cavity is said to be semi-transparent if part of its wall is made of a partly-reflecting film, *e.g.* a very thin metal film on a low-loss dielectric base. A cavity consisting of a metal cylinder closed at one end by a thin film and at the other by a reflecting piston can be made, by proper choice of the film density and piston position, to be a non-reflecting termination to a waveguide. Other applications of partly reflecting films for matching discontinuities in waveguide circuits are briefly mentioned.

621.396.615 **1796**
Three-Phase R-C Oscillator for Radio and Audio Frequencies.—H. Rakshit & K. K. Bhattacharyya. (*Sci. Culture*, March 1946, Vol. 9, No. 9, pp. 509–510.) A three-stage resistance-coupled amplifier with regenerative feedback made with suitable component values is shown to have two possible stable modes of oscillation. The normally favoured mode generates a radio frequency ; on suppressing this, by means of a simple adjustment, the audio frequency is obtained. In the example quoted, the two frequencies were about 2 Mc/s and 250 c/s.

621.396.615.14.029.63 1797

Coaxial Butterfly Circuits.—E. E. Gross, Jr. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 156–160.) Wide-frequency-range circuits for use with the 2C43 lighthouse valve are described and illustrated. A theoretical chart showing the resonant frequency as a function of the loading capacitance for various Z_0 is given, and is useful for design. A typical circuit gave 1 000–1 300 Mc/s and a power of 0.3–0.7 W at 250 V, for use in a beat-frequency oscillator for obtaining low-frequency pulses with rapid build-up. A wide-range oscillator covering 620–1 340 Mc/s is also described. The arrangements for the output coupling loop and the possibility of extending the circuits to higher frequencies are discussed. See also 3260 of 1945 (Karplus). Abstracts noted in 884 of April and 1209 of May.

621.396.615.17 1798

Multivibrator Theory.—S. C. Snowdon. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, p. 134.) "The transient response of a symmetrical multivibrator has been analysed neglecting the effect of shunt capacities and grid current." Abstract of an Amer. Phys. Soc. paper.

621.396.615.17 : 621.317.755 1799

Time-Base Converter and Frequency-Divider.—Moss. (*See* 2093.)

621.396.619.16 1800

Pulse [width] Modulation.—A. T. Hickman. (*R.S.G.B. Bull.*, April 1946, Vol. 21, No. 10, pp. 150–153.) A typical modulation circuit is described, and the frequency spectrum analysed.

621.396.645.3.029.5 1801

Station Design and Planning: Part 2—The Power Amplifier.—W. H. Allen. (*R.S.G.B. Bull.*, Jan. 1946, Vol. 21, No. 7, pp. 103–105.) An elementary account of the design of a low-power transmitter, including considerations of valve type, biasing, and anode circuit. For part 1 see 1058 of April, for parts 3, 4 and 5 see 2067 and 1980.

621.396.66 : 621.385.2 1802

Limiting Circuits.—J. McQuay. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 396..427.) An explanation of the principles, using a diode as a limiter, and description of various forms of limiting actions.

621.396.662 1803

The Design of Band-Spread Tuned Circuits for Broadcast Receivers.—D. H. Hughes. (*J. Instn Elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 87–96.) The design of preselector and oscillator circuits is discussed. The basic circuit for band-spread tuning by variable capacitance is analysed, formulae are developed for calculating the elements of the capacitance network, and graphical methods of solution are developed and illustrated. The use of temperature-compensated capacitors, and methods of circuit trimming are discussed.

621.396.662.34 1804

H.F. Band-Pass Filters: Part 4.—H. P. Williams. (*Electronic Engng*, May 1946, Vol. 18, No. 219, pp. 158–162.) Gives a practical example of band-pass design. For previous parts see 1498 of June and back references.

621.396.69 1805

Printed Electronic Circuits.—Brunetti & Khouri. (*See* 1887.)

621.318.7 1806

An Introduction to the Theory and Design of Electric Wave Filters. [Book Review]—F. Scowen. Chapman & Hall Ltd., London, 1945, 164 pp., 15s. (*Engineering, Lond.*, 22nd Feb. 1946, Vol. 161, No. 4180, p. 171. *Elect. Rev., Lond.*, 25th Jan. 1946, Vol. 138, No. 3557, p. 146. *Electronic Engng*, May 1946, Vol. 18, No. 219, p. 164.)

GENERAL PHYSICS

535.312/.313 1807

Fresnel's Formulae for the Reflection of Light and the Misunderstandings in Their Application.—T. Kravetz. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 59.) Abstract of a paper of the Acad. Sci., U.S.S.R.

535.37 1808

The Phosphorescence of Various Solids.—J. T. Randall & M. H. F. Wilkins. **Phosphorescence and Electron Traps: I & II.**—J. T. Randall & M. H. F. Wilkins. **Short Period Phosphorescence and Electron Traps.**—G. F. J. Garlick & M. H. F. Wilkins. (*Proc roy. Soc. A*, 6th Nov. 1945, Vol. 184, No. 999, pp. 347–364, 365–389, 390–407 & 408–433.)

535.43 1809

On the Problem of the Diffuse Reflection of Light.—V. Ambarzumian. (*J. Phys., U.S.S.R.*, 1944, Vol. 8, No. 2, pp. 65–75.) Previous solutions ignore the effect of multiple scattering which is included in the present analysis for the case of a medium in plane parallel layers. The indicatrix (the angular distribution of the scattered rays in the elementary process) is assumed to be spherical. The reflection coefficient r, and R ($= 4\eta r/\lambda$) are calculated in terms of functions of η ($= \cos\theta$) and η_0 ($= \cos\theta_0$), where θ and θ_0 are the angles between the normal and the reflected and incident rays respectively (λ = coefficient of pure scattering/sum of coefficients of absorption and pure scattering).

Lambert's empirical law that the coefficient of brightness ($\rho = r/\eta$) is constant for white bodies ($\lambda \approx 1$) is found theoretically to hold when ρ is averaged over all azimuths and for angles of incidence and reflection not too large ($\theta, \theta_0 \not> 70°$).

537.525 1810

On the Kinetic Theory of an Assembly of Particles with Collective Interaction.—A. Vlasov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 25–40.) Usually, in the collision theory of the many-body problem, the long range forces (operating at distances greater than the mean particle spacing) are neglected. By taking account of these forces it is shown that new dynamic properties of polyatomic systems are revealed, such as eigenfrequencies, a quasi-crystal structure in gases, and the presence of currents in a medium due to collective interaction of the particles. There is previous work on the subject by Vlasov in *Zh. eksp. teor. Fiz.*, 1938, Vol. 8, p. 291.

537.525 1811

Oscillation and Relaxation Processes in the Electron Plasma of the Discharge.—E. Adirovich. (*C. R. Acad. Sci. U.R.S.S.*, 20th Sept. 1945, Vol. 48, No. 8, pp. 551–554. In English.) A theoretical consideration of the processes of propagation of small disturbances in the plasma leads to conclusions that longitudinal density oscillations on a frequency higher than that deduced by Langmuir are possible. The theory also deals with the development of relaxation processes in the plasma.

537.525 **1812**

Disintegration of the Plasma of a Low-Pressure Electrical Discharge.—V. L. Granovsky. (*J. Phys., U.S.S.R.*, 1944, Vol. 8, No. 2, pp. 76–88.) An investigation of the deionization of gas in a discharge tube after the electric field is removed. Expressions are derived theoretically for the rates of decrease of the temperature and concentration of the electrons, which are initially exponential. The decrease of the velocities of the ions is much more rapid than that of the electrons, and the ambipolar diffusion coefficient D_{am} decreases relatively slowly. The effect of fresh ionization during the process is practically negligible.

The plasma disintegration of Hg vapour in cylindrical tubes of 65 and 105 mm diameter at various pressures from 2.3 to 65 μ Hg was investigated experimentally. A 50-c/s recurrent technique with oscillographic display was used, and the p.d. across a low resistance in the probe circuit was passed to the c.r.o. through a d.c. amplifier. The ionization decreased in the predicted manner, and the time constant τ_0 of the initial process was computed and found to be in good agreement with the value derived from D_{am} in stationary processes. 37 references are given.

537.525 **1813**

Propagation of Waves and Retardation of Electron Beams in Plasma.—E. Adirovich. (*C. R. Acad. Sci. U.R.S.S.*, 30th Sept. 1945, Vol. 48, No. 9, pp. 630–632. In English.) Sequel to 1811 above.

537.525 : 621.3.015.532 **1814**

Variation of the Mobility of Negative Ions in Strong Fields and the Influence of this Variation on the Characteristics of the Corona Discharge.—A. Kaptzov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 62–63.) Abstract of a paper of the Acad. Sci., U.S.S.R.

537.525.8 **1815**

Cathode Dark Space and Negative Glow of a Mercury Arc.—C. G. Smith. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, pp. 96–100.) Discussion of an experimental attempt to distinguish between field and emission theories of electron liberation. The voltage gradient at the cathode surface is deduced from accurate measurements of the thickness of the cathode dark space. "The inferred voltage gradient at the cathode is entirely too small for the field theory of electron liberation, and . . . [furthermore] a powerful ionizing agent must be operative . . . at the . . . [cathode] surface."

537.591 **1816**

On the Existence of Highly Ionizing Particles in the Soft Component [of cosmic rays]. —A. Alichanian, A. Alichanow & S. Nikitin. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 56–58.)

541.14 **1817**

Some Observations on the Inner Photoeffect in Crystals of Alkali-Halide Salts.—N. Kalabuchov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 41–44.) It is suggested that light may induce the formation of colloid particles in crystals at low temperatures, a phenomenon already known to exist at high temperatures. Measurements of the saturation current due to photoconductivity in crystals of alkali-halide salts seem to indicate an effect similar to the Ramsauer effect which occurs in gases.

621.315.61 + 537.226] : 536.2 **1818**

On the Thermal Conductivity of Dielectrics at Temperatures Lower than that of Debye.—I. Pomeranchuk. (*J. Phys., U.S.S.R.*, 1942, Vol. 6, No. 6, pp. 237–250.) Theoretical analysis extending the previous work of Debye and Peierls and including the effect of the scattering of elastic waves (phonons) at impurities (*e.g.* chemical, lattice defects, isotopes). The results are shown graphically where the conductivity K is given as a function of the absolute temperature T and of the relative concentration of the impurities ϵ. For values of ϵ greater than a critical concentration ϵ_0 the conductivity is proportional to $L^{\frac{1}{2}}/T^{\frac{3}{2}}$ where L is the linear dimension of the crystal. Over a certain range of low temperatures K is proportional to $L^{\frac{1}{2}}$ but independent of T, an effect observed experimentally for diamond for $T = 24–343°$K. This temperature range is wide for dielectrics with high Debye temperatures, but may be absent when the Debye temperature is low and ϵ is small. At very low temperatures, where the free path of the phonons is of the order of L, the conductivity varies as LT^3 (*e.g.* diamond below 10°K). The effect of crystal twinning is discussed briefly and found to be unimportant in the case of sodium chloride.

621.383.2 + 535.215.1 **1819**

Complex Photoelectric Cathodes.—N. Khlebnikov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 63.) A new conception of complex cathode emitters, in which the emission is considered as the external photoelectric effect of semiconductors possessing unusually low values of the work function. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.385.833 : 537.533 **1820**

Field-Emission of Electrons.—Lukirsky. (*See* 1952.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.7 + 550.38]"1945.10/.12" **1821**

Solar and Magnetic Data, October to December, 1945, Mount Wilson Observatory.—S. B. Nicholson & E. S. Mulders. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 55–56.)

523.7 : [525.23 + 525.24 **1822**

A Possible Atmospheric Solar Effect in Both Geomagnetism and Atmospheric Electricity.—O. R. Wulf. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 85–87.) "In the average behaviour of the daily variation of the horizontal magnetic force there appears in the summer months a recognizable effect [a maximum] which occurs at closely the same universal time [2000 GMT] at Cheltenham (Maryland), Tucson (Arizona) and Honolulu (Hawaii) . . ." which suggests ". . . something unusual in the reaction of the Earth to solar radiation when the Sun is over the longitude . . 105° to 120° west."

523.72 : 621.396.822 **1823**

Radio-Frequency Energy from the Sun.—J. L. Pawsey, R. Payne-Scott & L. L. McCready. (*Nature, Lond.*, 9th Feb. 1946, Vol. 157, No. 3980, pp. 158–159.) An account of observations of radiation from the sun on a wavelength of 1.5 metres during October 1945. The mean intensity is correlated with the total sunspot area. It is suggested that "cosmic static" originating in the region of the Milky Way may be attributed to similar bursts of radiation from stars, caused by gross electrical disturbances analogous to terrestrial thunderstorms. See also 1824/1826 below, and 323 of February (Appleton).

523.72 : 621.396.822 **1824**

Noise Observed during Radio Fade-Out, August 17, 1945.—J. M. Watts. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 122–125.) Observations made at ionospheric station at Maui, Hawaii.

523.72 : 621.396.822 **1825**

Solar Radiations in the 4-6 Metre Radio Wave-Length Band.—J. S. Hey: F. J. M. Stratton. (*Nature, Lond.*, 12th Jan. 1946, Vol. 157, No. 3976, pp. 47–48.) Radiation of the order of 10^5 times the power expected, assuming the sun to behave as a black-body radiator, was observed on Army radar equipments on 27–28th February 1942, and appeared to be associated with a big solar flare occurring at that time.

523.72 : 621.396.822 **1826**

Short-Wave Radio Emission from the Sun.—(*Engineering, Lond.*, 15th Feb. 1946, Vol. 161, No. 4179, p. 164.) A brief account.

523.72 : [550.38 + 551.51.053.5 **1827**

Variation of the Sun's Ultra-Violet Radiation as Revealed by Ionospheric and Geomagnetic Observations.—C. W. Allen. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 1–18.) From a study of critical frequency variations (E, F_1 and F_2) at Washington, Huancayo, Watheroo and Mount Stromlo (1937–44) and of variations in the S_q magnetic field at Apia, Watheroo and Cape Town (1937–43) it is concluded "(*a*) The variable part of the Sun's ultra-violet illumination comes mainly from active regions characterized by the appearance of sunspots, flocculi, and faculae. (*b*) The sources of ultra-violet have a longer life than sunspots, and possibly a longer life than faculae. (*c*) The three ionospheric layers E, F_1 and F_2, and the S_q field are influenced by the same sources of ultra-violet light. (*d*) The sources emit considerable ultra-violet radiation when at the centre of the Sun and probably emit some radiation when near the limb. (*e*) F_2 electrons take periods of one or two days to reach equilibrium concentration—at the level of S_q currents recombination is much more rapid. (*f*) The variable part of the ultra-violet flux is proportional to sunspot-number, and is about equal to the steady part at sunspot-maximum. This applies to radiation exciting the E-, F_1-, and F_2-regions. (*g*) There is a linear relation between F_2 and sunspot-number. (*h*) Faculae could produce continuous ultra-violet radiation that might account for ionospheric and geomagnetic variations."

523.74 : 550.38 **1828**

Distribution of Solar Eruptions in Relation to Magnetic Storms.—P. Bernard. (*C. R. Acad. Sci., Paris*, 4th April 1945, Vol. 220, No. 14, pp. 506–508.) Eruptions in the central zone of the solar disk have a preponderating influence on terrestrial magnetism because they are apparently more frequent and greater in extent. It seems that apart from this effect of geometrical position, no part of the sun is more effective than another as regards eruptions and related geomagnetic disturbances.

523.746 "1945.10/.12" **1829**

Provisional Sunspot-Numbers for October to December, 1945.—M. Waldmeier. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, p. 36.)

523.746.5 **1830**

An Addition to the Table of Secular Variations of the Solar Cycle.—W. Gleissberg. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, p. 121.) Addition to the table given in 1388 of 1945. The epoch of the last sunspot minimum is taken as 1944.2, and the smallest relative sunspot number is 7.7, giving 1923.5 for the epoch of the secularly smoothed minimum of 1923. This confirms the existence of a long period (about 80-year) cyclical variation of the 11-year cycle.

523.78 : [551.51.053.5 + 621.396.11 **1831**

The Solar Eclipse of 1945 and Radio Wave Propagation.—R. L. Smith-Rose. (*Nature, Lond.*, 12th Jan. 1946, Vol. 157, No. 3976, pp. 40–42.) A preliminary summary of observations made in Britain. Ionospheric soundings showed a reduction in ionization before the optical eclipse, which may be associated with a corpuscular eclipse, though the main reduction of 30–45% occurred during the optical eclipse. Similar effects were also observed in the U.S.S.R. Ionospheric absorption at vertical incidence at 2 Mc/s was reduced by roughly 10 db. Long-distance communication showed a small but definite decrease in absorption in the band 60 kc/s–1 Mc/s. Long-distance direction-finding observations and v.h.f. propagation measurements showed no appreciable change.

523.78 : 551.51.053.5 **1832**

Scientists' Study of Last Solar Eclipse.—S. P. Chakravarti. (*Curr. Sci.*, Nov. 1945, Vol. 14, No. 11, p. 283.) Brief account of the radio investigations on the ionosphere during the eclipse of July 1945.

525 + 526 + 55 + 91] : 001.4 **1833**

Some Thoughts on Nomenclature.—S. Chapman. (*Nature, Lond.*, 30th March 1946, Vol. 157, No. 3987, p. 405.) 'Geonomy', analogous to 'astronomy', is suggested as a comprehensive word covering all the studies of the earth such as geography, geophysics, etc. 'Aeronomy' is suggested to replace meteorology.

550.38 **1834**

Induction Effects in Terrestrial Magnetism: Part 1—Theory.—W. M. Elsasser. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, pp. 106–116.) A mathematical paper dealing with the electromagnetic effect of motions in the earth's core, considered as a fluid metallic sphere. "The secular variation of the [terrestrial magnetic] field is interpreted as a modification of the current system caused by inductive interaction between mechanical motions of the fluid and the magnetic field."

550.38 "1941/1944" **1835**

Three-Hour-Range Indices, K, of Geomagnetic Activity at the Magnetic Observatory, Hermanus, Comparison with K-Indices at American-Operated Observatories, and Mean K-Indices, K_A, for the Years 1941-44.—A. Ogg. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 75–83.)

550.38 "1945" 1836
American Magnetic Character-Figure C_A, Three-Hour-Range Indices, K, and Mean K-Indices, K_A, for October to December, 1945, and Summary for Year 1945.—W. E. Scott. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 57–66.)

550.38 "1945" 1837
The Spherical Harmonic Analysis of the Earth's Magnetic Field for the Epoch 1945.—V. I. Afanasieva. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 19–30.)

551.51.052 1838
Radiative Equilibrium of the Atmosphere and the Thermal Structure of the Troposphere.— R. Ananthakrishnan. (*Curr. Sci.*, Nov. 1945, Vol. 14, No. 11, pp. 298–299.) An analysis of records from sounding balloons released at Agra over a number of years shows a thermal structure of the upper troposphere with marked lapse-rates and inversions; this can be explained by the existence of a heat-emission layer, as postulated by Albrecht (1931 Abstracts, p. 493).

551.51.053.5 1839
Cause and Effect in Region F_2 of the Ionosphere.—J. Bannon & F. W. Wood. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 89–102.) From an analysis of $f^0{}_{F_2}$ values for ionosphere stations in the neighbourhood of latitude 35° it is concluded that "(*a*) There is a variation, in the composition of region F_2, from place to place over the Earth's surface. (*b*) The annual effect found by Berkner and Wells may be due to the variation in composition of region F_2, and to the differences in $\bar{s}\cos^{\frac{1}{2}}\bar{\chi}$ in the two hemispheres. (*c*) The annual effect has not a sidereal cause. (*d*) As far as annual mean values of maximum electron-density are concerned, the transition from noon to midnight is not influenced by the number of sunspots. (*e*) If the thermal-expansion hypothesis is correct, midnight temperatures are probably low, and do not vary much throughout the year. Summer-noon temperatures are very much higher than temperatures at midnight."

551.51.053.5 : 621.396.11 1840
Intense Scatter in E_s-Region at Christmas Island.—R. C. Peavey. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 126–127.) Very marked scattering of sporadic-E echoes has been observed. It occurs mainly in the frequency band 3.7–4.4 Mc/s, and occasionally at higher frequencies. It occurs regularly during daylight hours, but only infrequently at night.

551.51.053.5 : 621.396.11 1841
Low-Level Reflections Observed at Christmas Island.—R. C. Peavey. (*Terr. Magn. atmos. Elect.*, March 1946, Vol. 51, No. 1, pp. 125–126.) A report on weak echo signals from apparent heights of 40–70 km on frequencies between 1.0 and 2.0 Mc/s, observed during daytime in June 1945. Signals cannot have been reflected from terrestrial objects, because of the isolation of the island. The possibility of reflections from heavy cloud formation is mentioned.

621.396.11 : 551.53.051.5 1842
Short Period Fluctuations in the Characteristics of Wireless Echoes from the Ionosphere.—Eckersley & Farmer. (*See* 1968.)

621.396.91.087.5 : 551.51.053.5 1843
A Simple Kerr Modulator for Ionospheric Recording.—Rydbeck. (*See* 2049.)

551.57 : 621.396.82 1844
Precipitation Static.—(*See* 1991/1993.)

LOCATION AND AIDS TO NAVIGATION

534.417 : 534.88 1845
Sonar for Submarines.—Lanier & Sawyer. (*See* 1750.)

621.383 : 551.576 1846
The Cloud Range Meter.—Moles. (*See* 1943.)

621 396.9 1847
A.I.E.E. Winter Convention January 1946.—(*Elect. Engng*, Jan. 1946, Vol. 65, No. 1, pp. 29..35.) Abstracts are given of the following papers presented at the convention :—Techniques and Facilities for Microwave Radar Testing, by E. I. Green, H. J. Fisher & J. G. Ferguson. Radar Systems Considerations, by D. A. Quarles. Marine Radar for Peacetime Use, by L. H. Lynn & O. G. Winn. Air-Borne Radar for Navigation and Obstacle Detection, by R. C. Jensen & R. A. Arnett. Shoran Precision Radar, by S. W. Seeley. The SCR-584 and SCR-784 Equipments, by M. R. Briggs. Titles of other papers are given in other sections. For other abstracts see *Electronics*, April 1946, Vol. 19, No. 4, pp. 230..266.

621.396.9 1848
The Decca Navigator.—M. G. Scroggie. (*Communications*, March 1946, Vol. 26, No. 3, pp. 21–24.) For another account see 1242 of May.

621.396.9 1849
Radar Navigation.—(*Electrician*, 10th May 1946, Vol. 136, No. 3545, pp. 1245–1246.) A short account of the reading before the Radio Section of the I.E.E. of papers on radar navigation, Gee, Oboe (ground-controlled precision bombing aid), H_2S (airborne navigation and bombing aid), and radar interrogator-beacon systems. The respective authors were R. A. Smith, R. J. Dippy, F. E. Jones, C. J. Carter, and K. A. Wood.

621.396.9 1850
I.E.E. Radiolocation Convention.—(*Electrician*, 29th March & 5th April 1946, Vol. 136, Nos. 3539 & 3540, pp. 798–810 & 887–892.) A summary of the proceedings. The main contributions dealt with developments of aerials and waveguides; importance of meteorological factors in propagation; applications and developments of c.r. tubes, discussion of trace visibility and use for display; difficulties in precision radar, and range and azimuth measurement; development of u.h.f. valves, and the outstanding value of the magnetron; u.h.f. measurements and test gear; decimetre- and metre-wave transmitters and receivers; applications of radar to navigation and gunnery.

621.396.9 1851
Radar Technique.—H. Stoelzel. (*Schweiz. Bauztg*, 1st Dec. 1945, Vol. 126, No. 22, pp. 249–252. In German.) A short and elementary account of the basic principles of radar sets and of their applications in war and peace.

621.396.9 1852
Radiolocation or Radar.—R. L. Smith-Rose. (*R.S.G.B. Bull.*, Feb. 1946, Vol. 21, No. 8, pp. 119–125.) Optical methods are used to illustrate the

underlying principles. Historical development is traced from early ionosphere experiments to centimetre radar. Reference is also made to location by sound.

621.396.9 **1853**

Radar Countermeasures.—(*Engineer, Lond.*, 7th Dec. 1945, Vol. 180, No. 4691, pp. 460–461.) Outline account of ground-based and airborne operations which were successful in reducing the efficiency of German radio communication and radar systems. "Hoaxing" operations connected with D-day are described in some detail.

621.396.9 (091) **1854**

The Historical Development of Radar.—E. G. Bowen. (*Proc. Instn Radio Engrs, Aust.*, March 1946, Vol. 7, No. 3, pp. 3–9.) Abstract of lecture and discussion before the Institution. Radar developments in England and U.S. during the war are outlined. Radar was in early use in Germany but research ceased in 1941. Japanese radar and its operational use were very backward.

621.396.9 : 355.326.4 : 534.417 **1855**

The Sonobuoy.—K. H. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 154–155.) Description of an expendable radio transmitter, modulated by signals from an underwater magnetrostriction hydrophone, for revealing the presence of submerged submarines to patrol ships and aircraft.

621.396.9 : 523.3 **1856**

Radar Echoes from the Moon.—J. Mofenson. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 92–98.) Experiments by the U.S. Signal Corps using considerably modified radar equipment. The crystal-controlled transmitter was operated at 111.5 Mc/s with a pulse recurrence period of 4 seconds and pulse lengths of 0.02–0.25 sec at 3 kW power. The crystal-controlled receiver had a noise factor of [illegible] db (using 2 grounded-grid r.f. stages) and a bandwidth of 50 c/s for maximum sensitivity. The aerial system with 8 × 8 horizontal dipoles in a vertical plane gave a beam width of 15°, and was only suitable for use at times near moonrise and moonset. Assuming no attenuation in space the calculated signal/noise ratio was 20 db, which checked closely with experiment. The anticipated delay time of 2.4 sec and Doppler frequency shift due to the moon's radial velocity were observed.

621.396.9 : 621.385.832 **1857**

Cathode-Ray Tube Displays.—J. G. Bartlett, [illegible] S. Watson & G. Bradfield. (*Electronic Engng*, May 1946, Vol. 18, No. 219, pp. 143–150.) The displays are classified as conventional, pictorial, realistic, or instructional, and are further classified as general or precision. The principles of all displays are given, with more detailed descriptions of operational displays developed in the period 1936–45. Methods of improving the visibility of the tube traces are discussed. Long summary of a paper read at I.E.E. Radiolocation Convention.

621.396.9 : 621.385.832 : 778 **1858**

Use of Film in Radar Training.—(*Electronic Engng*, May 1946, Vol. 18, No. 219, p. 150.) Records made on film are used to control dummy p.p.i. displays for training operators. The process is briefly described.

621.396.9 : 629.13 **1859**

Radar for Civil Aviation.—R. A. Smith. (*Nature, Lond.*, 9th Feb. 1946, Vol. 157, No. 3980, pp. 151–153.) An outline of the difficulties of applying wartime radar methods and navigation aids to civil flying. Considerations of "pay-load" and number of crew limit the equipment that can be carried. Possible uses of existing equipment are given, and unsolved problems are discussed.

621.396.91 **1860**

More on Spherics, Storm Detector.—U.S. Signal Corps. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 224..228.) An account of a low-frequency (3.6–17.5 kc/s) crossed-loop c.r.d.f. receiver for instantaneous indication of sources of atmospherics.

621.396.93 **1861**

Radio Direction Finder.—D. G. C. Luck. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, p. 29.) Compensating lines counteract the effect of pickup on the transmission line shields of a shielded-U Adcock system. Summary of U.S. Patent 2 387 670.

621.396.932 + 621.398 **1862**

The Engineering Work of the Clyde Lighthouses Trust.—D. A. Stevenson. (*Engineer, Lond.*, 23rd & 30th Nov. 1945, Vol. 180, Nos. 4689 & 4690, pp. 425–426 & 443.) An historical account, including notes on the remote radio control of fog signalling equipment, and the application of synchronous sound and radio signals for distance measurement.

621.396.933 **1863**

F. M. Radar Altimeter.—D.G.F. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 130–134.) An airborne f.m. transmitter is used to obtain reflection from the ground; the height of the aircraft is determined by the average frequency difference of the transmitted and received signals, as given by the average beat frequency produced on combining them. The transmitter frequency is 440 ± 20 Mc/s, with modulation frequency 120 c/s, which gives an average beat note of 19 c/s per foot of altitude. This system is used up to a height of 400 ft, above which the frequency deviation is reduced to 2 Mc/s.

The transmitter is modulated mechanically, a 120-c/s oscillator driving one capacitor plate in the tank circuit of the transmitter by means of a loudspeaker voice-coil assembly. A push-pull triode oscillator is used giving about 100 mW. The receiver detector mixes the reflected signal with a signal taken directly from the transmitter, and a d.c. voltage proportional to the resulting beat frequency is obtained from counter circuits.

The equipment is designated AN/APN-1.

621.396.933.2 : 621.396.91 **1864**

The Application of Ultra-Short-Wave Direction Finding to Radio Sounding Balloons.—R. L. Smith-Rose & H. G. Hopkins. (*Proc. phys. Soc.*, 1st March 1946, Vol. 58, Part 2, No. 326, pp. 184–200.) A pre-war investigation of the possibilities of determining wind velocities at high levels. The accuracy of the direction-finding technique used for taking bearings on the signals from balloon transmitters is discussed in relation to accuracy of location of the balloon. Direction finders using closed loops and spaced aerials working on wavelengths between 8 m and 10 m were used. After correcting for the ground calibration, the probable error of mean observed bearings was about 0.3°.

621.396.933.23 1865
[U.S.] Army Air Forces' Portable Instrument Landing System.—S. Pickles. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 262–294.) A very detailed technical and theoretical description of a mobile (truck-borne) equipment comprising a "localizer" on 108–110 Mc/s, a "glide-path" on 332–335 Mc/s, and three "marker" beacons on 75 Mc/s. The localizer radiator is a linear array of five horizontal broad-band square-loop elements, a main group of three, and an auxiliary group of two. Modulation, at 90 and 150 c/s, is by a mechanical system (a rotor which periodically tunes and distunes a stub-line). A system of balanced bridges divides and distributes the carrier and sideband energies between the elements of the array, with suitable phase differences. Only the centre element of the main group carries both carrier and sidebands. The others are fed with the sidebands only, phased to give the necessary balance of the 90-c/s and 150-c/s polar diagrams about a vertical plane containing the axis of the array (see also 1548 of June). A dipole monitor set, located at some distance from the transmitter, responds to any change in the course marked by the localizer which lasts more than a few seconds, by switching off the transmitter and giving bell and light warning signals.

The glide-path radiator system has two elements, the lower about 4–6 ft above the ground, and the upper about 25 ft above it. The upper radiator is a 60° V-shaped dipole with a linear parasitic dipole reflector, with a similar system a half-wavelength above it. The lower is essentially a square loop radiator bisected by a vertical reflecting screen. The glide-path is equi-signal for the 90 and 150 c/s modulations of the upper and lower radiators.

The marker beacons, at the approach end of the runway, at 1 mile, and at $4\frac{1}{2}$ miles distance, are modulated with a 3 000 c/s tone, 1 300 c/s dots, and 400 c/s dashes respectively. They project narrow bands of radiation across the localizer course, and give the pilot his distance from the landing runway.

621.396.933.23 1866
Use of Microwaves for Instrument Landing: Part 1.—D. F. Folland. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 18–22, 47.) The value of using sharp microwave beams for producing precision courses, unaffected by weather or by buildings, is discussed. A Sperry system of two mobile ground transmitters, suitable for the blind landing of aircraft, is described in some detail.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788 : 539.164.92 1867
Radium-Type Vacuum Gage.—G. L. Mellen. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 142–146.) Ionization of the gas is caused by the radiation from a sealed radium source. The construction of the gauge and associated high-gain d.c. amplifier is described. The gauge has scale ranges 0–0.1, 0–1, 0–10 mm Hg.

533.55 1868
The Theory of the Mercury-Vapour Vacuum Pump and a New High-Speed Pump.—P. Alexander. (*J. sci. Instrum.*, Jan. 1946, Vol. 23, No. 1, pp. 11–16.) "Theoretical considerations and experimental results show that the pumping effect of a mercury-vapour pump, usually called a 'diffusion pump', is not explained by Gaede's theory of the diffusion principle. Starting from Langmuir's condensation principle the same considerations lead to a different theory; a new pump has been designed on the basis of this theory. This pump has a volumetric pumping speed of the order of 1 000 L/sec, and its effective working range extends from the lowest pressures up to 10^{-1} mm of mercury."

533.56 1869
On the Theory of Diffusion Pump.—K. Ray & N. D. Sen Gupta. (*Indian J. Phys.*, Aug. 1945, Vol. 19, No. 4, pp. 138–145.) Experiments show that the pressure can be reduced far below the vapour pressure of the pumping fluid. The success of a diffusion pump depends largely on jet design.

535.37 1870
Phosphorescence.—Randall, Wilkins & Garlick. (*See* 1808.)

535.37 + 621.385.832 1871
Uniform Luminescent Materials.—C. G. A. Hill. (*Science*, 8th Feb. 1946, Vol. 103, No. 2667, pp. 155–158.) Discussion of the luminescent characteristics of various inorganic solids, and a theoretical outline of the relation of these properties to the composition and method of preparation. Details are given of the preparation of suitable examples of the silicate, tungstate and sulphide classes.

537.525 : 621.3.029.5 1872
Probe Method in the Study of High Frequency Discharges.—N. R. Tawde & G. K. Mehta. (*Sci. Culture*, March 1946, Vol. 9, No. 9, pp. 485–488.) Analysis is made of the techniques employed by various investigators. Summarized results indicate a close analogy between the h.f. discharge and a d.c. discharge under similar conditions, and suggest a Maxwellian distribution of electron velocities. Suggestions are made for improvements in further work.

548.0 : 061.6 : 621.386 1873
Recent Research Work in the Davy Faraday Laboratory.—K. Lonsdale. (*Nature, Lond.*, 23rd March 1946, Vol. 157, No. 3986, pp. 355–357.) The substance of a lecture at the Royal Institution. Three main lines of research are indicated: Studies of the vibrations of atoms in crystals; of the subcrystalline changes which occur at the transition points of certain crystals such as Rochelle salt, KH_2PO_4, and KH_2AsO_4; of the texture of various crystals, by means of Laue photographs and of divergent X-ray beam photographs.

Progress is noted in the application of the technique of X-ray scattering and in the interpretation of the complex phenomena observed. In the case of Rochelle salt the change in crystalline structure associated with the very marked changes in dielectric and piezoelectric properties is accomplished by a change of axial angle of only 2′ of arc. The anomalies appear to be due to changes in the length of the hydrogen bonds, combined with changes in the mobility of the hydrogen atoms.

549.514.1 : 537.228.1 1874
Control of Electrical Twinning in Quartz.—W. A. Wooster & N. Wooster: L. A. Thomas, J. L. Rycroft & E. A. Fielding. (*Nature, Lond.*, 30th March 1946, Vol. 157, No. 3987, pp. 405–406.) The electrical twinning of quartz can be eliminated by suitable combinations of stress and temperature. The method can be applied to most of the rotated

Y-cut plates, including the BT-cut (but not the Y-cut itself or the Z-cut), with so high a proportion **of successes** that the large-scale processing of quartz **plates** is practicable.

549.514.1 : 621.396.611.21 **1875**

Crystal Grinding Without Tears.—F. R. Cowles. (*QST*, April 1946, Vol. 30, No. 4, pp. 48–50.) Hints on how to grind and clean AT- and BT-cut crystals. Activity can be increased by edge-grinding or by changing electrodes.

621.3(213) **1876**

Tropical Moisture and Fungi: Problems and Solutions.—E. S. McLarn, H. Oster, H. Kolin & A. Neumann. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 303–313.) A comprehensive and detailed review of the effects of tropical conditions on radio and electrical components and materials, and the means of protection against them. The protective measures include initial design, selection of suitable materials, and the use of fungicidal coatings. Moisture proofing is the prime necessity and requires hermetic sealing in many cases. Recommended materials at the present time include ceramics having a glazed finish, porcelain, glass, and glass-bonded mica. Plastic sleeving of the polyvinyl-chloride type has proved preferable to fabric and cellulose acetate sleeving.

Details are given of the nature, characteristics, and limitations of the three main types of fungicidal agents: phenyl mercurials, chlorinated phenols, and salicylanilides.

The advances made in this technique during the war open up new possibilities of development in regions where climatic conditions had previously prevented the use of modern technical equipment.

See also 1561 (Prentice) and 1562 (Leutritz & Herrmann) of June.

621.3.011.2 : 546.49.1 **1877**

The Temperature Dependence of the Resistance of Liquid Metals at Constant Volume.—S. Gubar & Kikoin. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 52–53.) Experiments on the resistance of a column of mercury completely filling a closed stout-walled glass capillary tube are briefly described, from which it is concluded "... it may be regarded as directly proved that for mercury the increase of resistance normally observed with temperature rise is associated exclusively with the effect of its thermal expansion. ... It should be noted that ... with an appropriate selection of the glass used it is possible to make the resistance of the specimen entirely independent of temperature."

621.3.011.2 : 546.87 **1878**

Negative Resistance-Temperature Coefficient of Thin Evaporated Films of Bismuth.—T. J. Tulley. (*Nature, Lond.*, 23rd March 1946, Vol. 157, No. 3086, p. 372.) A letter briefly describing observations. Films of bismuth were evaporated on to microscope slides at a pressure of about 10^{-3} mm Hg using a mercury diffusion pump without a trap. Values of the resistance-temperature coefficient for various thicknesses of film are tabulated, giving a peak value of -31.2×10^{-4} per °C, for an estimated film thickness of 1.5 microns, which falls to -20.8×10^{-4} for a thickness of about 0.03 microns and to -16.8×10^{-4} for a thickness of 0.5 microns. Some values of the (positive) coefficient for other metals are added for comparison.

621.315.551 : 621.396.823 : 621.365 **1879**

Interference with Broadcast Reception by Electrical Heating Apparatus.—Gerber & Werthmüller. (*See* 1996.)

621.315.58.029.54/.64 **1880**

The Electrical Properties of Salt-Water Solutions Over the Frequency Range 1-4 000 Mc/s.—R. Cooper. (*J. Instn elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 69–75.) Stationary-wave measurements with a parallel-wire transmission line have been made to determine the refractive index and absorption coefficient of solutions of salt in concentration up to 4% in the frequency band 690–4 320 Mc/s. The conductivities were obtained in the range 0.95–13 Mc/s by measuring the change in Q of a resonant circuit shunted by a column of the solution in a capillary tube. Comparison is made with existing data on sea water at the lower frequencies. The results are examined in relation to the Debye-Falkenhagen electrolyte theory and to the theory of anomalous dispersion in dipolar liquids, and it is shown that the ionic and dipolar conductivities can be added arithmetically.

621.315.611.011.5 **1881**

Dependence of the Dielectric Constant of Barium Titanate upon the Pressure.—B. M. Wul & L. F. Vereshchagin. (*C. R. Acad. Sci. U.R.S.S.*, 30th Sept. 1945, Vol. 48, No. 9, pp. 634–636. In English.) A brief description of the apparatus used to measure the pressure variation is given. It was found that over the range of 300–2 000 atmospheres, the dielectric constant increased at a steadily diminishing rate. The work is being extended to include higher pressures and different temperatures.

621.315.615.017.143 **1882**

The Effect of High-Frequency Alternating Currents on Liquid Semiconductors.—J. Granier & G. Granier. (*C. R. Acad. Sci., Paris*, 16th April 1945, Vol. 220, No. 16, pp. 555–557.) Figures for resistivity (ρ) and loss angle (α) are given for hexane, ether, and vaseline oil at frequencies of 0, 10^3, 10^4, 10^5 and 10^6 c/s.

621.315.617.3 : 519.283 **1883**

Quality Control of Insulating Varnishes.—L. P. Hart, Jr. (*Gen. elect. Rev.*, April 1946, Vol. 49, No. 4, pp. 8–15.) The need for systematic checking of the composition and physical properties of the varnishes is pointed out, and a routine proved to be satisfactory in practice is described.

621.315.618.011.5 **1884**

The Dielectric Constants of Eight Gases.—L. G. Hector & D. L. Woernley. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, pp. 101–105.) The constants for He, Ne, A, H_2, O_2, N_2, CO_2 and dry air at STP have been measured to a few parts in 10^7 by a heterodyne method of observing the change in frequency of a tuned circuit on introducing the gas to a previously evacuated capacitor. The results are discussed in relation to previous work.

621.316.86 : 546.281.26 **1885**

[Silicon-carbide] **Non-Ohmic Resistors.**—F. Ashworth, W. Needham & R. W. Sillars. (*Electrician*, 20th March 1946, Vol. 136, No. 3539, pp. 817–818.) Summary and discussion of an I.E.E. paper.

621.319.51 : 546.78 **1886**

Electrical Properties of Tungsten Oxide Films.—F. L. Jones. (*Nature, Lond.*, 23rd March 1946, Vol. 157, No. 3986, pp. 371–372.) Letter briefly describing experiments on the intensity of cold-cathode electronic emission from tungsten electrodes on which were formed films of tungsten oxides, carried out with a view to devising a self-triggering two-electrode spark gap. The electrodes were used in a short spark gap with an applied impulsive electric field, the p.d. across the gap at breakdown being taken as a measure of the concentration of the initial electrons. Properties of rough and oxidized surfaces of tungsten were investigated with gaps in air and nitrogen at atmospheric pressure. Considerable emission was indicated for a surface coating of a mixture of the yellow and blue oxides of tungsten, and a polarity effect was observed when one of the electrodes was smooth clean tungsten. Roughened electrodes show emission without polarization. It is suggested that, in the case of oxide films, emission of electrons is due to intense microscopic electric fields set up by positive charges on the upper surface of the film, while with roughened electrodes photo-ionization takes place throughout the gap due to photons emitted from minute discharges at the microscopic points on the electrode. Normally the oxide surfaces show some degree of roughness and both causes probably operate.

621.396.69 **1887**

Printed Electronic Circuits.—C. Brunetti & A. S. Khouri. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 104–108.) Details of a technique for preparing compact radio apparatus. The "chassis" is a block of ceramic material such as steatite, upon which the circuit is built in the following stages:—(*a*) The wiring, consisting of silver in the form of a paint or paste, is applied to the base through a silk or metal stencil, and subsequently bonded by heat treatment. (*b*) Resistors in the form of a carbon or resin mixture are sprayed through masks in the appropriate positions in the circuit. (*c*) Small disk-type ceramic capacitors, and (*d*) any other components such as valves, are soldered directly to the silver wiring, using a 2% silver solder. Performance of these printed circuits and component stability are similar to those of ordinary equipment.

621.791.75 : 621.362 **1888**

Welding Fine Thermocouple Wires.—E. D. Hart & W. H. Elkin. (*J. sci. Instrum.*, Jan. 1946, Vol. 23, No. 1, pp. 17–18.) Simple method for wires of size 40–50 s.w.g.

621.791.76 : 546.621 **1889**

The Development of the Spot-Welding of Aluminium.—A. von Zeerleder. (*Schweiz. Arch. angew. Wiss. Tech.*, July 1944, Vol. 10, No. 7, pp. 218–226. Discussion, Nov. 1944, Vol. 10, No. 11, pp. 358..362. In German.) A brief historical survey and very detailed metallurgical study of present practice, with a bibliography of about 25 items. The discussion is mainly on the mitigation of the effects of spot-welding machines on the supply network.

621.791.76 : 621.3.011.2 **1890**

Measurement and Effect of Contact Resistance in Spot Welding.—R. A. Wyant. (*Trans. Amer. Inst. elect. Engrs*, Jan. 1946, Vol. 65, No. 1, pp. 26–33.) Static measurements using bridge circuits and dynamic measurements using oscillograph records were made on aluminium, magnesium and nickel alloys, and steel, with surfaces chemically and mechanically cleaned. Results are shown graphically, and remaining research problems are reviewed.

666.189.4 : 621.385 **1891**

Sintered Glass.—E. G. Dorgelo. (*Philips tech. Rev.*, Jan. 1946, Vol. 8, No. 1, pp. 2–7.) The technique is particularly useful in the construction of lamps and tubes for experimental purposes. The main features and applications are described.

679.5 **1892**

Plastics for the Amateur: Part 2.—A. G. Chambers. (*R.S.G.B. Bull.*, Jan. 1946, Vol. 21, No. 7, pp. 106–107.) A practical article describing recommended methods of working plastic materials with particular reference to the thermo-setting (Bakelite, Paxolin, Tufnol) and thermo-plastic (Perspex, Distrene, Alkathene) groups. For part 1 see 956 of April.

679.5 **1893**

Plastics and Chemicals.—(*Gen. elect. Rev.*, Jan. 1946, Vol. 49, No. 1, pp. 60–61.) Annual review of developments.

549.211 : 62 **1894**

Diamond Tools. [Book Review]—P. Grodzinski. N. A. G. Press, London, 1945, 20s. (*Engineering, Lond.*, 30th Nov. 1945, Vol. 160, No. 4168, p. 441.) Applications of diamonds described include hardness testing, crystal cutting, jewel bearings. "An invaluable work of reference for all who make use of diamonds in production."

621.315.6(083.75) **1895**

A.S.T.M. Standards on Electrical Insulating Materials (With related Information). [Book Review]—A.S.T.M. Committee D-9. American Society for Testing Materials, Philadelphia, 1945, 545 pp., $3.25. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, p. 210.) "This book contains all of the essential data which normally would be of interest to engineers engaged in the design or testing of electrical insulating materials and is presented in clear and easily readable form." See also 1274 of May.

679.5 : 621.3 **1896**

Plastics for Electrical and Radio Engineers. [Book Review]—Tucker & Roberts. Technical Press, Kingston, Surrey, 1946, 12s. (*Electrician*, 19th April 1946, Vol. 136, No. 3542, p. 1037.) ". . . explains sufficient about the manufacture and properties . . . and describes their methods of application . . ."

778 : 62 **1897**

Photography in Engineering. [Book Review]—C. H. S. Tupholme. Faber & Faber, London, 1945, 276 pp., 188 plates, 42s. (*Engineering, Lond.*, 30th Nov. 1945, Vol. 160, No. 4168, pp. 440–441. *Nature, Lond.*, 12th Jan. 1946, Vol. 157, No. 3976, pp. 32–33.) ". . . forms a greatly needed and compact source of information on the subject." Applications of photography to workshop and drawing-office practice are included.

MATHEMATICS

512.831 : 621.3.012.8 **1898**

Tensors and Equivalent Circuits.—B. Hoffmann. (*J. Math. Phys.*, Feb. 1946, Vol. 25, No. 1, pp. 21–25.) Criticism of Kron's work on equivalent circuits (2905 of 1943 and 2838 of 1944) for mechanical, electrodynamical, and other systems.

517.3 1899

An Extension of Schuster's Integral.—H. Bateman. (*Proc. nat. Acad. Sci., Wash.*, March 1946, Vol. 32, No. 3, pp. 70–72.) The integral occurs in the theory of total reflection of light.

517.564.3 1900

A Note on Bessel Functions of Purely Imaginary Argument.—E. W. Montroll. (*J. Math. Phys.*, Feb. 1946, Vol. 25, No. 1, pp. 37–48.)

517.947.44 1901

On the Near-Periodicity of Solutions of the Wave Equation: Part 1.—S. L. Soboleff. (*C.R. Acad. Sci. U.R.S.S.*, 20th Sept. 1945, Vol. 48, No. 8, pp. 542–545. In French.) Mathematical analysis of the wave equation for the general case of a space of n variables leading to the conclusion that subject to the continuity of certain derivatives of the solution to the wave equation, the latter can be shown to be periodic or nearly periodic.

517.947.44 1902

On the Near Periodicity of Solutions of the Wave Equation: Part 2.—S. L. Soboleff. (*C.R. Acad. Sci. U.R.S.S.*, 30th Sept. 1945, Vol. 48, No. 9, pp. 618–620. In French.) "In an earlier note [see 1901 above] it was shown that the solutions of the wave equation with constant coefficients were nearly periodic. . . . In the present note a generalization of the earlier results for the case of a wave equation with variable coefficients is given."

518.5 1903

A Computer for Solving Linear Simultaneous Equations.—Berry, Wilcox, Rock & Washburn. (See 1927.)

518.5 1904

Integrating Machine for Ordinary Differential Equations.—R. Sauer & H. Pösch. (*Z. Ver. dtsch. Ing.*, 17th April 1943, Vol. 87, Nos. 15/16, p. 221–224.) Brief description of the design and testing of a mechanical integrator.

518.5 : 621.38 1905

[U.S.] War Department unveils 18 000-Tube Robot Calculator.—U.S. Army Ordnance Dept. (See 1928.)

534.26 1906

On Diffraction of Elastic Waves.—D. I. Scherman. (*C. R. Acad. Sci. U.R.S.S.*, 30th Sept. 1945, Vol. 48, No. 9, pp. 626–629. In English.) A short mathematical paper on the calculation of the vector components of a steady vibration propagated in an elastic medium.

[illegible]–526 1907

On the Method of van der Pol and its Application to Non-Linear Control Problems [servo mechanisms].—B. V. Bulgakov. (*J. Franklin Inst.*, Jan. 1946, Vol. 241, No. 1, pp. 31–54.) "The construction of approximate differential equations of a mechanical or electrical pseudo-linear oscillatory system with many degrees of freedom. . . . applicable to the study of the transitory or quasi-periodic processes and not only of the periodic vibrations" as previously investigated.

The analysis is applied to an automatically controlled system with inertia (a servo mechanism) in which feedbacks proportional to the departure from the preselected state and the first and second time derivatives of this quantity are present. It is shown that in the absence of continuous external perturbations the effect of the acceleration control is equivalent to the alteration of the constants in a system without such control.

Periodic vibrations of the system are studied by an "approximate linearization" of the equation expressing the behaviour of the servo motor, and the conditions for stability are investigated.

621.395.4 1908

The Probability Distributions of Sinusoidal Oscillations Combined in Random Phase.—M. Slack. (*J. Instn elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 76–86.) A theoretical discussion of "the probabilities associated with the instantaneous value and the length of the resultant vector obtained by combining n cosine oscillations of equal amplitude and random phase relationship. It is mainly concerned with very small values of n (= 2, 3, 4, . . . 12), and gives, for the first time, a complete set of curves showing the probabilities of the instantaneous value and the length of the resultant vector exceeding any given limits." The problem is fundamental to multichannel transmission through a common amplifier, the operational loading of which depends on whether there can be simultaneous occurrence of peak values in all the speech channels.

538.566 : 621.396.677.029.64 1909

Laguerre Functions in the Mathematical Foundations of the Electromagnetic Theory of the Paraboloidal Reflector.—E. Pinney. (*J. Math. Phys.*, Feb. 1946, Vol. 25, No. 1, pp. 49–79.) The laws of geometrical optics are not rigorously applicable for microwave radiation within a paraboloidal reflector; differences from experimental results are considerable, even for reflector diameters as great as 10–15 wavelengths. The paper establishes "a beginning point for this practical development of a more rigorous paraboloidal theory". Extensive bibliographies are given for the polynominals $L_n(z)$ and $L^a{}_n(z)$.

MEASUREMENTS AND TEST GEAR

621.3.011.2 : 546.87 1910

Negative Resistance-Temperature Coefficient of Thin Evaporated Films of Bismuth.—Tulley. (See 1878.)

621.317 1911

A.I.E.E. Winter Convention January 1946.—(*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 29 . . 35.) Abstracts are given of the following papers presented at the convention:—Electronically Balanced [Potentiometer-] Recorder for Flight Testing and Spectroscopy, by A. J. Williams, Jr., W. R. Clark & R. E. Tarpley. Techniques and Facilities for Microwave Radar Testing, by E. I. Green, H. J. Fisher & J. G. Ferguson. Titles of other papers are given in other sections. For other abstracts, see *Electronics*, April 1946, Vol. 19, No. 4, pp. 230 . . 266.

621.317 1912

A Braille Analyzer.—W. S. Wartenberg. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 387–388.) An instrument for use by the blind for measuring

621.319.51 : 546.78 **1886**

Electrical Properties of Tungsten Oxide Films.—F. L. Jones. (*Nature, Lond.*, 23rd March 1946, Vol. 157, No. 3986, pp. 371–372.) Letter briefly describing experiments on the intensity of cold-cathode electronic emission from tungsten electrodes on which were formed films of tungsten oxides, carried out with a view to devising a self-triggering two-electrode spark gap. The electrodes were used in a short spark gap with an applied impulsive electric field, the p.d. across the gap at breakdown being taken as a measure of the concentration of the initial electrons. Properties of rough and oxidized surfaces of tungsten were investigated with gaps in air and nitrogen at atmospheric pressure. Considerable emission was indicated for a surface coating of a mixture of the yellow and blue oxides of tungsten, and a polarity effect was observed when one of the electrodes was smooth clean tungsten. Roughened electrodes show emission without polarization. It is suggested that, in the case of oxide films, emission of electrons is due to intense microscopic electric fields set up by positive charges on the upper surface of the film, while with roughened electrodes photo-ionization takes place throughout the gap due to photons emitted from minute discharges at the microscopic points on the electrode. Normally the oxide surfaces show some degree of roughness and both causes probably operate.

621.396.69 **1887**

Printed Electronic Circuits.—C. Brunetti & A. S. Khouri. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 104–108.) Details of a technique for preparing compact radio apparatus. The "chassis" is a block of ceramic material such as steatite, upon which the circuit is built in the following stages:—(*a*) The wiring, consisting of silver in the form of a paint or paste, is applied to the base through a silk or metal stencil, and subsequently bonded by heat treatment. (*b*) Resistors in the form of a carbon or resin mixture are sprayed through masks in the appropriate positions in the circuit. (*c*) Small disk-type ceramic capacitors, and (*d*) any other components such as valves, are soldered directly to the silver wiring, using a 2% silver solder. Performance of these printed circuits and component stability are similar to those of ordinary equipment.

621.791.75 : 621.362 **1888**

Welding Fine Thermocouple Wires.—E. D. Hart & W. H. Elkin. (*J. sci. Instrum.*, Jan. 1946, Vol. 23, No. 1, pp. 17–18.) Simple method for wires of size 40–50 s.w.g.

621.791.76 : 546.621 **1889**

The Development of the Spot-Welding of Aluminium.—A. von Zeerleder. (*Schweiz. Arch. angew. Wiss. Tech.*, July 1944, Vol. 10, No. 7, pp. 218–226. Discussion, Nov. 1944, Vol. 10, No. 11, pp. 358..362. In German.) A brief historical survey and very detailed metallurgical study of present practice, with a bibliography of about 25 items. The discussion is mainly on the mitigation of the effects of spot-welding machines on the supply network.

621.791.76 : 621.3.011.2 **1890**

Measurement and Effect of Contact Resistance in Spot Welding.—R. A. Wyant. (*Trans. Amer. Inst. elect. Engrs*, Jan. 1946, Vol. 65, No. 1, pp. 26–33.) Static measurements using bridge circuits and dynamic measurements using oscillograph records were made on aluminium, magnesium and nickel alloys, and steel, with surfaces chemically and mechanically cleaned. Results are shown graphically, and remaining research problems are reviewed.

666.189.4 : 621.385 **1891**

Sintered Glass.—E. G. Dorgelo. (*Philips tech. Rev.*, Jan. 1946, Vol. 8, No. 1, pp. 2–7.) The technique is particularly useful in the construction of lamps and tubes for experimental purposes. The main features and applications are described.

679.5 **1892**

Plastics for the Amateur: Part 2.—A. G. Chambers. (*R.S.G.B. Bull.*, Jan. 1946, Vol. 21, No. 7, pp. 106–107.) A practical article describing recommended methods of working plastic materials with particular reference to the thermo-setting (Bakelite, Paxolin, Tufnol) and thermo-plastic (Perspex, Distrene, Alkathene) groups. For part 1 see 956 of April.

679.5 **1893**

Plastics and Chemicals.—(*Gen. elect. Rev.*, Jan. 1946, Vol. 49, No. 1, pp. 60–61.) Annual review of developments.

549.211 : 62 **1894**

Diamond Tools. [Book Review]—P. Grodzinski. N. A. G. Press, London, 1945, 20s. (*Engineering, Lond.*, 30th Nov. 1945, Vol. 160, No. 4168, p. 441.) Applications of diamonds described include hardness testing, crystal cutting, jewel bearings. "An invaluable work of reference for all who make use of diamonds in production."

621.315.6(083.75) **1895**

A.S.T.M. Standards on Electrical Insulating Materials (With related Information). [Book Review]—A.S.T.M. Committee D-9. American Society for Testing Materials, Philadelphia, 1945, 545 pp., $3.25. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, p. 210.) "This book contains all of the essential data which normally would be of interest to engineers engaged in the design or testing of electrical insulating materials and is presented in clear and easily readable form." See also 1274 of May.

679.5 : 621.3 **1896**

Plastics for Electrical and Radio Engineers. [Book Review]—Tucker & Roberts. Technical Press, Kingston, Surrey, 1946, 12s. (*Electrician*, 19th April 1946, Vol. 136, No. 3542, p. 1037.) ". . . explains sufficient about the manufacture and properties . . . and describes their methods of application . . ."

778 : 62 **1897**

Photography in Engineering. [Book Review]—C. H. S. Tupholme. Faber & Faber, London, 1945, 276 pp., 188 plates, 42s. (*Engineering, Lond.*, 30th Nov. 1945, Vol. 160, No. 4168, pp. 440–441. *Nature, Lond.*, 12th Jan. 1946, Vol. 157, No. 3976, pp. 32–33.) ". . . forms a greatly needed and compact source of information on the subject." Applications of photography to workshop and drawing-office practice are included.

MATHEMATICS

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621.395.4 1908
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621.317 1912
A Braille Analyzer.—W. S. Wartenberg. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 387–388.) An instrument for use by the blind for measuring

direct current, p.d., and impedance. The unknown quantity is balanced against a standard, essentially by the use of potentiometer circuits. The out-of-balance current is passed through earphones, and is interrupted by a vibrator switch so as to produce an audible note that vanishes in amplitude when balance is reached. The potentiometer control and circuit switches have Braille markings.

621.317.3.029.58/.62] : 621.315.213.12 **1913**
Apparatus for Measurements on Balanced-Pair High-Frequency Cables in the Range 10-200 Mc/s.—J. C. Simmonds. (*J. Instn elect. Engrs*, Part I, March 1946, Vol. 93, No. 63, pp. 148–149.) Summary of 667 of March.

621.317.3.029.63/.64 **1914**
Radio Measurements in the Decimetre and Centimetre Wavebands.—R. J. Clayton, J. E. Houldin, H. R. L. Lamont & W. E. Willshaw. (*J. Instn elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 97–117. Discussion, pp. 117–125.) A survey of apparatus and methods used in the research laboratory of the (British) General Electric Co. A large number of subjects are briefly discussed under the headings of circuit theory, signal sources, the measurement of frequency, power, impedance, and field strength, and measurements on receivers and aerials. The paper is followed by a long discussion.

621.317.3.029.63/.64] : 621.315.611 **1915**
Resonance Methods of Dielectric Measurement at Centimetre Wavelengths.—F. Horner, J. A. Taylor, R. Dunsmuir, J. Lamb & W. Jackson. (*J. Instn elect. Engrs*, Part I, March 1946, Vol. 93, No. 63, pp. 149–150.) Summary of 966 of April.

621.317.33.029.63 **1916**
The Measurement of Impedances particularly on Decimetre Waves.—J. M. van Hofweegen. (*Philips tech. Rev.*, Jan. 1946, Vol. 8, No. 1, pp. 16–24.) At wavelengths greater than 1 m, the detuning and damping of a tuned circuit by the impedance is measured, using a diode voltmeter. At shorter wavelengths, *e.g.* 50 cm, a screened twofold Lecher system is used.

621.317.35 **1917**
Complex Waveforms : The Harmonic Synthesiser.—H. Moss. (*Electronic Engng*, April 1946, Vol. 18, No. 218, pp. 113–116.) Part 4 of a series on c.r.t. traces. Three types of wave symmetry (alternance, normal and skew symmetry) are illustrated, and their application to wave form analysis discussed. For part 3 see 3988 of 1945.

621.317.361+621.396.611.21 **1918**
Low-Frequency Quartz Crystals.—C. E. Lane. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 12, 14.) Illustrated summary of 1582 of June.

621.317.7 : 621.319.4 **1919**
Capacitors for Measurement.—C. G. Garton. (*Electrician*, 1st March 1946, Vol. 136, No. 3535, pp. 543–544.) An account of the reading and discussion of an I.E.E. paper on the characteristics and errors of capacitors used for measurement purposes.

621.317.7 : 621.396.62 **1920**
Sensitive [Signal-] **Tracer.**—C. Zwicker. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 393–394.) Description and circuit diagram of a tracer for use in servicing receivers.

621.317.7 : 621.396.82 : 551.57 :629.135 **1921**
[U.S.] **Army-Navy Precipitation-Static Project : Part 2—Aircraft Instrumentation for Precipitation-Static Research.**—Waddel, Drutowski & Blatt. (*See* 1992.)

621.317.725 : 621.385 **1922**
Converting D.C. [volt] **Meter to A.C. V.T.V. Use.**—W. M. Breazeale. (*Communications*, March 1946, Vol. 26, No. 3, pp. 38–39.) A circuit comprising a triode cathode follower that rectifies the signal, and a pentode cathode follower that operates the d.c. meter. Diode overload protection is included.

621.317.761.029.62/.64 **1923**
The Measurement of Frequencies in the Range 100 Mc/s to 10 000 Mc/s.—L. Essen & A. C. Gordon-Smith. (*J. Instn elect. Engrs*, Part I, March 1946, Vol. 93, No. 63, p. 147.) Summary of 679 of March.

621.317.763.029.62/.64] : 621.396.611 **1924**
Cavity-Resonator Wavemeters.—L. Essen. (*Wireless Engr*, May 1946, Vol. 23, No. 272, pp. 126–132.) A detailed description of " four simply constructed cavity-resonator wavemeters covering the frequency ranges 10 000 Mc/s–4 000 Mc/s, 5 600 Mc/s–2 000 Mc/s, 2 700 Mc/s–1 000 Mc/s and 1 000 Mc/s–200 Mc/s. The mode of resonance employed is the hybrid between the cylindrical TM_{010} mode and the coaxial TM_{00p} mode, and the frequency variation is effected by the axial movement of a plunger attached to a micrometer head. For the first three wavemeters the plunger is of a non-contact design, thus obviating the necessity for a good electrical contact which has hitherto caused considerable manufacturing difficulties. The setting accuracy of the instruments is shown to be better than 1 part in 10^4 of frequency throughout the greater part of the range."

621.317.79 : 621.39 **1925**
New Test Equipment Circuits.—(*Radio, N.Y.*, March 1946, Vol. 30, No. 3, p. 30.) Circuit diagrams of an intermodulation analyser and a dual RC sine-wave signal generator.

621.396.611.21 : 621.396.615.14 **1926**
Frequency Stabilization at 450 Mc/s.—P. B. Myers. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 214..216.) Generator using the fifth harmonic of a 10-Mc/s crystal with two electronic triplers. The output at 450 Mc/s is as stable (2.5 parts in 10^6) as the crystal's fundamental frequency.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

518.5 **1927**
A Computer for Solving Linear Simultaneous Equations.—C. E. Berry, D. E. Wilcox, S. M. Rock & H. W. Washburn. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 262–272.) Basic electrical circuits for representing the mathematical relations are given, and a commercial model of a 12-equation computor described. This may be applied to any problem involving simultaneous linear equations, and it is found that solving 12 equations requires only 1/4 to 1/7 of the time required by conventional methods.

518.5 : 621.38 **1928**

[U.S.] **War Department unveils 18 000-Tube Robot Calculator.**—U.S. Army Ordnance Dept. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 308..314.) Description of the Electronic Numerical Integrator and Computer (Eniac) designed for aiding ordnance calculations. It is a digital machine, performs a single addition in 1/5000 sec, and can carry out more than 10^7 additions or subtractions of ten-figure numbers in 5 minutes. The arithmetic, memory, and control elements are described, and the use of punched cards for external memory is noted.

53 + 6](73) **1929**

American Trends of Development in the Physical Sciences.—Overbeck. (*See* 2073.)

621.3 : 629.13 **1930**

Air Forces' Needs in Electric Equipment.—G. C. Crom, Jr. (*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 17–22.) The substance of a lecture reviewing control, communications, and navigation.

621.317.39 **1931**

Electrical Non-Destructive Testing of Materials.—. R. Polgreen & G. M. Tomlin. (*Electronic Engng*, April 1946, Vol. 18, No. 218, pp. 100–105.) The correct correlation between the electrical and magnetic properties of the materials and the corresponding physical properties, which the instruments are required to measure, is dealt with in general. Details are given of a magnetic sorting bridge for testing the chemical composition, hardness and tempering of springs, valves, and gudgeon pins for internal combustion engines. Also described are an r.f. method for detecting and measuring longitudinal cracks, laps, or seams in uniform-cross-section conductors of any length, and diameters ranging from 1/8 inch to 6 inch, the ait layer-thickness meter for measuring non-magnetic coatings on a magnetic base, and an electronic micrometer for the continuous measurement of metal foil thickness.

21.318.572 : 778 **1932**

Spectrograph Exposure Control.—J. R. Cosby. *Electronics*, April 1946, Vol. 19, No. 4, pp. 123–125.) semi-automatic device for obtaining duplicate exposures of spectrographic plates despite variation source intensity. The current through a photo-ll exposed to the light source charges the grid of cold-cathode tube which ultimately fires, operates ratchet counter, and re-establishes its initial erating condition. The exposure is ended after a edetermined number of impulses.

1.365.5 + 621.317.39 **1933**

A.I.E.E. Winter Convention January 1946.—*lect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, . 29..35.) Abstracts are given of the following pers presented at the convention :—Induction ating of Long Cylindrical Charges, by H. F. orm. Stress Measurement by Electrical Means, S. B. Williams & R. E. Kern. Titles of other pers are given in other sections.

For other abstracts see *Electronics*, April 1946, l. 19, No. 4, pp. 230..266.

1.365[.5 + .92 **1934**

Role of Automatic Rematching in H.F. Heating.—Mittelman. (*Elect. World, N.Y.*, 4th Aug. 1945, p. 98.) Abstract in *Electronic Engng*, May 1946, Vol. 18, No. 219, p. 155.

621.365[.5 + .92 **1935**

High-Frequency Electric Heating.—(*Electrician*, 8th Feb. 1946, Vol. 136, No. 3532, pp. 351–354.) A number of industrial applications are discussed.

621.365.5 + 621.365.92] : 621.396.662 **1936**

A.F.C. for R.F. Heating.—S. I. Rambo. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 120–122.) The changing load during a heat cycle makes some form of frequency control essential to avoid interference with communication services. Crystal oscillators with power amplifiers may be suitable for low powers. Mechanical variation of the tuning circuit is cheaper and simpler for powers over about 10 kW. A practical system using a reversible motor is outlined, and a method of regaining control when the frequency is outside the bandwidth of the discriminator is described.

621.365.52 **1937**

Steel Furnaces : Coreless Induction Type.—M. J. Marchbanks. (*Elect. Rev., Lond.*, 19th & 26th April 1946, Vol. 138, Nos. 3569 & 3570, pp. 603 & 641.) Summary and discussion of an I.E.E. paper.

621.365.52 **1938**

H.F. Inductor Heating.—(*Elect. Rev. Lond.*, 15th March 1946, Vol. 138, No. 3564, pp. 399–403.) Special attention is given to cases where only part of the object requires heat treatment. The equipment described (Birlec Ltd.) includes a spark-gap type for uncritical operations, frequency up to 100 kc/s, and h.f. alternator, frequency up to 12 kc/s for heating more than 200 lb of metal per hour, and a valve generator, frequency above 12 kc/s, for heating less than 200 lb per hour.

621.365.92 : 664.6 **1939**

R.F. Heating in Bakery Industry.—V. W. Sherman. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 166..186.) A survey of applications and costs. Report of lecture.

621.38 + 621.395/.396] (43) : 06.064 **1940**

Exhibition of German Electronic Equipment.—P. I. Nicholson. (*Electronic Engng*, May 1946, Vol. 18, No. 219, pp. 156–157.) An account of the exhibition at Earls Court, which included radio components, valves, relays, communications equipment, acoustic instruments, infra-red equipment, radio navigational aids and control units for rockets and other missiles.

621.38 + 621.396 **1941**

Electronics.—(*Gen. elect. Rev.*, Jan. 1946, Vol. 49, No. 1, pp. 54–58.) Annual review of developments.

621.38 : 62 **1942**

Electronics in Engineering.—(*Engineer, Lond.*, 25th Jan. 1946, Vol. 181, No. 4698, pp. 82–83.) Description of some instruments designed by the (British) General Electric Co., including magnetic sorting bridge, r.f. crack detector, film thickness meter, and metal thickness meter.

621.383 : 551.576 **1943**

The Cloud Range Meter.—F. J. Moles. (*Gen. elect. Rev.*, Apr. 1946, Vol. 49, No. 4, pp. 46–48.) An optical device analogous with radar. Very intense light flashes of one microsecond duration are produced by a high-voltage spark gap at the focus of a paraboloidal reflector. The beam is aimed at the cloud and the flashes are reflected back to a receiving paraboloidal mirror with a photocell at its focus. Both mirrors are mounted on the same support, point in the same direction, and move together. The pulses from the photocell are amplified in a high-gain video amplifier and displayed on a c.r. oscillograph. The timebase sweep is started in synchronism with the transmitted pulse, so the position of the reflected pulse along the sweep is a measure of the cloud distance; a calibrated scale on the mirror support gives the cloud elevation. The whole apparatus is compact and transportable.

621.385.833 **1944**
The Measured Characteristics of Some Electrostatic Electron Lenses — Discussion.—K. Spangenberg. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 379–380.) Discussion of 1294 of 1944 (Spangenberg & Field) explaining an apparent discrepancy, and correcting a typographical error.

621.385.833 **1945**
Calculation of Fields of the Simplest Electrostatic Lenses.—A. Vlasov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 60.) Abstract of a paper of the Acad. Sci., U.S.S.R.

621.385.833 **1946**
A Short Magnetic Lens with a Minimum Spherical Aberration.—A. Vlasov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 60.) Abstract of a paper of the Acad. Sci., U.S.S.R.

621.385.833 **1947**
Further Improvement in the Resolving Power of the Electron Microscope.—J. Hillier. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 307–309.)

621.385.833 **1948**
Electron Microscope of the State Optical Institute.—V. Vertzner. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 60.) The instrument gives a magnification up to 25 000 with a resolving power of 75–100 Å, providing two microphotographs per charge of the camera. In an investigation of the evaporation of silver on a celluloid film, particle dimensions of 75–300 Å with separations of 200 Å were noted, corresponding to 13 $\mu g/cm^2$. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.385.833 **1949**
A Shadow-Casting Adaptor for the Electron Microscope.—T. F. Anderson. (*Rev. sci. Instrum.*, Feb. 1946, Vol. 17, No. 2, pp. 71–72.)

621.385.833 **1950**
Preparation of Electron Microscope Specimens for Determination of Particle Size Distribution in Aqueous Suspensions.—A. M. Cravath, A. E. Smith, J. R. Vinograd & J. N. Wilson. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 309–310.)

621.385.833 **1951**
Electron Microscope and Investigation of the Structure of Ceramic Materials.—I. I. Kitaigorodsky. (*C. R. Acad. Sci. U.R.S.S.*, 20th Sept. 1945, Vol. 48, No. 8, pp. 563–564. In English.)

621.385.833 : 537.533 **1952**
Field-Emission of Electrons.—P. Lukirsky. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 59–60.) The field-emission current from a metal usually takes place at lower fields than is required by the Fowler-Nordheim theory because of surface roughness. With smooth spheres, theoretical values of the current agree with experiment. Complex cathodes were investigated and current resulted at field strengths of 10^6 V/cm. The energy spectrum of the emitted electrons and field emission from single crystals was examined in relation to the field-emission electron microscope. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.386.1 : 6 **1953**
Prague Conference on the Use of X-Rays in the Metal Industries.—V. Vand. (*Nature, Lond.*, 30th March 1946, Vol. 157, No. 3987, pp. 415–416.)

621.396.9 : 529.781 **1954**
Pocket Radio Watch.—E. A. Witten. (*Radio Craft*, March 1946, Vol. 17, No. 6, p. 389.) Non-technical description of proposed broadcast time-signal service that would operate with pocket receivers.

621.396.91 : 550.37 **1955**
Radio-Sonde Recording of Potential Gradients.—K. Kreielsheimer & R. Belin. (*Nature, Lond.*, 23rd Feb. 1946, Vol. 157, No. 3982, pp. 227–228.) The modulation frequency of the balloon transmitter is varied by changes in the modulator grid potential caused by passing the current due to a point discharge through a resistor. The discharge is initiated by a field of 3 V/cm with a 64-ft collector wire. A sample record of a balloon flight through an isolated CuNb cloud is shown.

621.396.933.2 : 621.396.91 **1956**
The Application of Ultra-Short-Wave Direction Finding to Radio Sounding Balloons.—Smith-Rose & Hopkins. (*See* 1864.)

621.398 + 621.396.932 **1957**
The Engineering Work of the Clyde Lighthouses Trust.—Stevenson. (*See* 1862.)

621.3.078 : 54 **1958**
Principles of Industrial Process Control. [Book Review]—D. P. Eckman. J. Wiley & Sons, New York, 1945, 237 pp., $3.50. (*J. sci. Instrum.*, Jan. 1946, Vol. 23, No. 1, p. 18. *Electronic Industr.*, Feb. 1946, Vol. 5, No. 2, pp. 161–162.) " . . . deals essentially with the design and operation of controllers and control instruments which are used in the chemical industry."

621.365.92 **1959**
Capacity Current Heating. [Book Review]—T. H. Messenger & D. V. Onslow. British Electrical & Allied Industries Research Assn., London, 1945, 9s. (*Engineering, Lond.*, 7th Dec. 1945, Vol. 160, No. 4169, p. 474.) Summarizes available information on existing applications. The report is in three sections dealing with theory, applications, and equipment costs, and contains a bibliography of 241 items.

621.388.833 **1960**
Electron Optics and the Electron Microscope. [Book Review]—V. K. Zworykin, G. A. Morton, E. G. Ramberg, J. Hillier & W. A. Vance. John Wiley & Sons, New York, 754 pp., $10.00. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, p. 212.)

PROPAGATION OF WAVES

621.396.11 + 621.396.67 **1961**

The Ratio between the Horizontal and the Vertical Electric Field of a Vertical Antenna of Infinitesimal Length Situated above a Plane Earth.—Niessen. (*See* 1769.)

621.396.11 **1962**

On the Propagation of Radio Waves along an Imperfect Surface : Part 3.—E. Feinberg. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 1–6.) This part deals with the effective path of the ground ray. It is suggested that the earth regions immediately surrounding the transmitter and receiver are of much greater importance than the rest of the intervening path. The analysis is based on Sommerfeld's theory, but has limited application as it applies only for large numerical distances where the integrals involved may be approximated by asymptotic formulae. The parameters characterizing an imperfect intermediate region of the path are negligible only in so far as the assumed perfect initial and final regions have the dimensions for which the numerical distances, calculated with respect to the properties of the intermediate region, are large compared to unity. For previous work see 2529/2531 of 1945.

621.396.11 : 061.6 **1963**

Interservice Radio Propagation Laboratory.—(*J. Franklin Inst.*, Jan. 1946, Vol. 241, No. 1, pp. 62–63.) An account of the laboratory set up at the National Bureau of Standards during the war to supply radio propagation information to the Armed Forces.

621.396.11 : 551.51.053.5 **1964**

Forecasting for Radio.—M. G. Morrow. (*Sci. News Lett., Wash.*, 13th Apr. 1946, Vol. 49, No. 15, pp. 234–235.) Simple account of the predictions based on ionospheric and solar observations.

621.396.11 : 551.51.053.5 **1965**

Short-Wave Conditions.—T. W. Bennington. (*Wireless World*, April 1946, Vol. 52, No. 4, p. 124.) Propagation conditions are forecast for April 1946, with tables of maximum usable frequencies. Conditions occurring in February are described, including the effect of a large sunspot group.

621.396.11 : 551.51.053.5 **1966**

Low-Level Reflections Observed at Christmas Island.—Peavey. (*See* 1841.)

621.396.11 : 551.51.053.5 **1967**

Intense Scatter in E_s-Region at Christmas Island.—Peavey. (*See* 1840.)

621.396.11 : 551.53.051.5 **1968**

Short Period Fluctuations in the Characteristics of Wireless Echoes from the Ionosphere.—T. L. Eckersley & F. T. Farmer. (*Proc. roy. Soc. A*, 1st Aug. 1945, Vol. 184, No. 997, pp. 196–217.) A spaced-frame direction-finder system is used with a twin-channel amplifier and c.r.t. display. The phases and amplitudes of the e.m.f.s in the aerial system can be determined from the elliptical trace, by using appropriate aerial connexions. Pulse transmissions can be examined by means of an adjustable gating device that desensitizes the receiver for all but about 15 μs of the timebase cycle. Rapid changes in polarization and direction can be studied.

F-layer echoes show little change in characteristics over a period of about 20 seconds, abnormal-*E* and scatter reflections change in one second or less, but a continuity of phase was noticed even during the most rapid changes. The scatter echoes show remarkable variability of phase and direction. Skellett's suggestion (1752 of 1938) of meteoric origin of these echoes seems unlikely, as meteoric velocities of 100 km/s would be required.

621.396.11 : 523.76 : 551.51.053.5 **1969**

The Solar Eclipse of 1945 and Radio Wave Propagation.—Smith-Rose. (*See* 1831.)

621.396.11.029.56/.58 **1970**

The NBS-ARRL Radio Observing Projects.—T. N. Gautier, Jr. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 18–23.) Since 1941, members of American Radio Relay League observed signal strengths and the highest frequencies received in the band 1.5–30 Mc/s. In 1943 similar observations were started using transmitter WWV (2.5, 5, 10 and 15 Mc/s). Charts show how the observations agreed with the maximum usable frequencies and the lowest useful high frequencies forecast by the National Bureau of Standards. See also *J. Franklin Inst.*, March 1946, Vol. 241, No. 3, pp. 243–244.

621.396.11.029.64+621.396.24+621.385.1 **1971**

Simultaneous Use of Centimeter Waves and Frequency Modulation.—A. G. Clavier & V. Altovsky. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 326–338.) English translation of 402 of February.

621.396.11.029.64 : 551.577 **1972**

The Effect of Rain upon the Propagation of Waves in the 1- and 3-Centimeter Regions.—S. D. Robertson & A. P. King. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 178–180.) Observations were made on wavelengths of 1.09 cm and 3.2 cm over sufficiently short paths (1260 ft and 900 ft) to obtain uniformity of rainfall. There was a definite correspondence between heaviness of rainfall and attenuation of the radio signal on both wavelengths, the effect being greater on the shorter wavelength. Results were obtained mainly from two heavy storms, and mean values deduced from them were 0.05 db/mile path loss per mm/hr rainfall for $\lambda = 3.2$ cm and 0.3 db/mile per mm/hr for $\lambda = 1.09$ cm. During extremely heavy rain the attenuation was roughly 5 and 30 db/mile respectively for the two wavelengths.

621.396.11.029.64 : 551.577 **1973**

Propagation of 6-Millimeter Waves.—G. E. Mueller. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 181–183.) Observations on the effect of rainfall on waves of length 0.62 cm were made over a 1200-ft path. The method used was similar to that of Robertson & King (see 1972 above) and gave a mean value of 0.6 db/mile attenuation per mm/hr rainfall. The nonlinearity of the attenuation/wavelength curve found in a comparison with the results of Robertson & King is explained qualitatively in terms of the relative influence of scattering and absorption by the drops. Atmospheric absorption was found to be small (perhaps 0.2 db/mile) compared with loss due to rain.

RECEPTION

621.396.1 1974
CAA Alaskan Diversity Receiving System: Part 2.—Ivers. (*See* 2002.)

621.396.11.029.64+621.396.24+621.385.1 1975
Simultaneous Use of Centimeter Waves and Frequency Modulation.—Clavier & Altovsky. (*See* 1971.)

621.396.61.029.62 1976
The "Tiny Tim" Handie-Talkie.—Haist. (*See* 2063.)

621.396.62+621.395.92 1977
Radio Hearing Aid.—Montani. (*See* 1763.)

621.396.62 1978
Radio Design Data presented in Chicago.—(*Electronics*, April 1946, Vol. 19, No. 4, pp. 216 . . 224.) Abstracts of papers on f.m. receiver design, trends in receiver response, and intermodulation effects in audio amplifiers presented at the Conference of the Chicago Section of the I.R.E.

621.396.621 1979
I.R.E. Winter Technical Meeting 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22 . . 66.) Abstracts of some of the papers read. For titles, see 1649 of June.

621.396.621 1980
Station Design and Planning: Parts 4 & 5. The Amateur Bands Receiver.—W. H. Allen. (*R.S.G.B. Bull.*, March 1946, Vol. 21, No. 9, pp. 138–141, April 1946, Vol. 21, No. 10, pp. 154–156.) A general account of the desirable features with elementary hints and suggestions for obtaining good performance, and notes on the design of a.f. stages. For previous parts see 1058 of April, 1801 and 2067.

621.396.621 1981
Super-Reflex Radio.—W. T. Connatser. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 403 . . 424.) Description and circuit of a three-valve superheterodyne broadcast-receiver.

621.396.621 1982
Hi-Fi T.R.F. Tuner.—W. F. Frankart. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 401, 415.) Circuit diagram and constructional details of a three-stage tuner for a.m. broadcast reception.

621.396.621 1983
Radio Data Sheet 333.—(*Radio Craft*, March 1946, Vol. 17, No. 6, p. 395.) Servicing data for (U.S.) General Electric receivers 100, 101, 103 and 105.

621.396.621 : 621.396.619.018.41 1984
F.M. Radio Service.—J. King. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 391, 443–444.) Some instructions for servicing f.m. receivers, indicating the main differences between a.m. and f.m. receivers.

621.396.621.53 1985
Superheterodyne Frequency Conversion using Phase-Reversal Modulation.—E. W. Herold. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 184–198.) "The principle of conversion herein described is to reverse the phase of the signal output periodically at a rate which differs from the signal frequency by the intermediate frequency. This may be done either by continuous variation of phase or by continuous variation of tube transconductance from positive to negative. The result is a conversion transconductance which is twice as high as had heretofore been believed ideal. Furthermore, if the phase-reversal rate is made by any integral multiple of an applied local-oscillator frequency, equally good conversion is obtained at a harmonic of the local oscillator without spurious responses at any other harmonic than the one chosen. An electron tube with a multi-humped characteristic has been devised as a means to this end since the transconductance characteristic will then vary from positive to negative as the control voltage is varied. An analysis of such a tube is carried out in detail, including the effect of fluctuation noise.

"The analysis shows that the new conversion method doubles the conversion gain possible in a tube with a given maximum transconductance. In an ideal case with no second-stage noise, the signal/noise ratio is as good as with the same tube used as amplifier; even in practical cases, the mixer is only 10%–20% poorer than the amplifier. This is in contrast with conventional mixer methods in which the signal/noise ratio is from two to three times poorer than when the same tube is used as an amplifier.

"Conversion at a harmonic may also be achieved with high gain but it is found that the signal/noise ratio is not as favourable as with fundamental operation."

621.396.621.53 1986
Non-Linear Analysis.—H. Stockman. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 14, 47.) Illustrated summary of 1492 of June.

621.396.621.53.029.58 1987
A Band Pass 28-Mc/s Converter.—B. Goodman. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 44 . . 120.) The construction of a fixed-tune, two-stage amplifier using staggered, single-tuned, low-Q circuits to obtain a pass-band $\pm$ 1.25 Mc/s at 29 Mc/s. A triode oscillator and a pentode mixer convert the signal frequency to 7.3 $\pm$ 1.25 Mc/s. A conventional communication receiver follows the converter.

621.396.622.71 1988
A Low-Distortion Diode Detector.—R. Knowles. (*R.S.G.B. Bull.*, Jan. 1946, Vol. 21, No. 7, p. 108.) An arrangement of a double-diode-triode (HL41/DD) to provide an efficient detector free from peak-clipping. A capacitor connected in the cathode circuit ensures that the input conductance, and therefore the damping of the tuned circuit, is small.

621.396.622.71 1989
Low Distortion Diode Detector.—R. G. Kitchenn: F. A. Ruddle. (*R.S.G.B. Bull.*, April 1946, Vol. 21, No. 10, p. 161.) Correspondence on 1988 above.

621.396.82 1990
Beat-Frequency Interference Chart.—D. Barton. (*Electronics*, April 1946, Vol. 19, No. 4, p. 162.) Chart showing possible interfering signal frequencies when using a receiver with an i.f. of 445 kc/s, tuned within the range 550 to 1 600 kc/s. The curves are computed from formulae in 1879 of 1941 (Adams).

621.396.82 : 551.57 : 629.135 1991
[U.S.] **Army-Navy Precipitation-Static Project: Part 1—The Precipitation-Static Interference**

Problem and Methods for Its Investigation.—R. Gunn, W. C. Hall & G. D. Kinzer. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 156–161.) The general nature of the project is reviewed, and the main lines of investigation discussed. One of the most important causes of precipitation static is the corona discharge which follows charging either by thunderstorms or by frictional electrification of the plane in flying through normal precipitation. Details of investigations on the various types of charging and discharging are given in ensuing papers. See 1992, 1993, and three other papers to be published later.

621.396.82 : 551.57 : 629.135 : 621.317.7 **1992**

[U.S.] **Army-Navy Precipitation-Static Project: Part 2—Aircraft Instrumentation for Precipitation-Static Research.**—R. C. Waddel, R. C. Drutowski & W. N. Blatt. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, pp. 161–166.) Electric-field meters and wick dischargers measure the intensity and direction of the electric field, and an artificial charger simulates autogenous charging conditions. "A radio-noise meter is used to measure the interference level associated with precipitation static. Search electrodes, termed patches and probes, provide both integrated and detailed information on the charging processes concerned when precipitation strikes solid surfaces. An air-conductivity meter is provided for measuring the conductivity and ion content of the atmosphere. An accelerometer utilizing a telegauge tube measures turbulence. Data from the above and other instruments are brought to a central meter panel and intermittently photographed in flight. This photo-observer is supplemented by a disk voice recorder."

Some details are given of the various instruments used.

[62]1.396.82 : 551.57 : 629.135 **1993**

[U.S.] **Army-Navy Precipitation-Static Project: [P]art 3—Electrification of Aircraft flying in Pre[ci]pitation Areas.**—R. G. Stimmel, E. H. Rogers, E. Waterfall & R. Gunn. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, [pp]. 167–177.) The main cause of electrification [ca]using precipitation static is friction between the [air]craft and particles of snow and ice. The charging [ch]aracteristics of typical aircraft flying through [dr]y snow are given and correlated with reliable [da]ta obtained on the ground under controlled [co]nditions. It is shown that the charging depends [bo]th in rate and sign on the material of the surface [of] the aircraft. It was possible to make a non-[cha]rging aircraft by coating part of the surface [wit]h colloidal silica, so that the charging of the [co]ated and uncoated parts balanced, but the con[ta]mination of the surface after ordinary servicing [of] the aircraft destroyed the non-charging property. The charging current is a maximum at about [...] to −10°C under otherwise similar conditions. [Un]der most conditions the charging current in[crea]ses as the cube of the air speed.

Discharge first occurs by thermal ionization of [the] exhaust gases, and then, at higher voltage [gra]dients (*e.g.* ~ 200 V/cm), corona from aerials, [win]g and propeller tips, etc., carries the main dis[cha]rge. Discharge by convection and atmospheric [con]ductivity are unimportant.

Charging due to thunder conditions are discussed [brie]fly. The fields at the aircraft surfaces due to this cause vary rapidly and can be very high (*e.g.* ~3 000 V/cm) for short periods.

621.396.82 : 621.396.619.018.41 **1994**

Interference in Frequency Modulation.—N. Marchand. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 38–40, 42.) A theoretical comparison of f.m. and a.m. receiver responses to adjacent-carrier, random-noise, and impulse-noise types of interference. The signal/noise ratio is in each case greater for f.m., particularly if de-emphasis is used. This paper is a sequel to 1675 of June.

621.396.82 : 621.396.619.018.41 **1995**

Effect of Common-Channel Interference on Frequency Modulation Broadcasting.—A. L. Durkee. (*Proc. Instn Radio Engrs, Aust.*, March 1946, Vol. 7, No. 3, pp. 10–11.) Reprint of 2591 of 1945.

621.396.823 : 621.365 : 621.315.551 **1996**

Interference with Broadcast Reception by Electrical Heating Apparatus.—W. Gerber & A. Werthmüller. (*Tech. Mitt. schweiz. Telegr. Teleph. Verw.*, 1st Dec. 1945, Vol. 23, No. 6, pp. 241–247. In German.) Domestic receivers usually take a considerable part of their h.f. power from the house power-supply wiring system. Consequently, interference can be caused by variations in the h.f. currents in the house wiring, resulting from periodic variation of the h.f. impedance of the wiring. Hum interference due to this cause is estimated to affect 20% of broadcast receivers. The hum tunes in with a received signal, and is sometimes thought by the listener to be due to modulation of the transmitter. It has previously been shown by the writers' department (evidently the Swiss Post Office—no reference is given to previous publications) that such interference is almost entirely associated with domestic heating appliances, and is due to the use of ferromagnetic alloys for the heating elements. The h.f. impedance of these elements varies with permeability, the permeability depends on the temperature of the heater, and the temperature varies at double the frequency of the alternating heating current. The ferromagnetic properties of the nickel-chromium-iron heater-wire alloys are discussed, and recommendations made for the selection of non-magnetic types. The nature of the interference modulation is discussed in some detail. The shunting of heating devices with by-pass capacitors is an effective method of reducing the interference.

STATIONS AND COMMUNICATION SYSTEMS

621.39 : 623.6 **1997**

Infantry Combat Communications.—R. E. Willey. (*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 1–7.) A description of the radio and line, telephone and telegraph equipment used by the U.S. infantry. The range, frequency, and power output of various radio sets are given together with their uses in combat. Examples are quoted of communication problems encountered in action and unorthodox methods used in overcoming them.

621.395.1 **1998**

Communication System.—T. W. W. Holden. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 29, 48.) A device for securing voice transmission, using a frequency band much narrower than that usually required, by leaving "repetitious" waves out of the transmission and reintroducing them at the receiver. Summary of U.S. Patent 2 387 906.

621.395.4 1999

The Probability Distributions of Sinusoidal Oscillations Combined in Random Phase.—Slack. (*See* 1908.)

621.395.44 2000

The Unit Bay 1B Coaxial Cable Transmission System : Part 3.—R. A. Brockbank & C. F. Floyd. (*P. O. elect. Engrs' J.*, April 1946, Vol. 39, Part 1, pp. 14–17.) Continuation of 184 of January, describing the terminal repeater station equipment.

621.396.1 2001

Frequency Service Allocations.—P. D. Miles. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, pp. 188–192.) An account of the principles underlying the (U.S.) Federal Communications Commission's plan for frequency allocation announced in May, 1945.

621.396.1 2002

CAA Alaskan Diversity Receiving System : Part 2.—J. Ivers. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 56–58, 61.) The rectified outputs from the eight diversity receivers are combined and used to key the output from an a.f. oscillator. The outputs from a number of diversity systems may be transmitted over one telephone line, using highly stable Wien-bridge oscillators on different audio frequencies. For part 1 see 1669 of June.

621.396.11.029.64 + 621.396.24 + 621.385.1 2003

Simultaneous Use of Centimeter Waves and Frequency Modulation.—Clavier & Altovsky. (*See* 1971.)

621.396.61.029.58 2004

200-Kilowatt High-Frequency Broadcast Transmitters.—Romander. (*See* 2061.)

621.396.619.16 2005

Pulse [width] **Modulation.**—A. T. Hickman. (*R.S.G.B. Bull.*, April 1946, Vol. 21, No. 10, pp. 150–153.) A typical modulation circuit is described and the frequency spectrum analysed.

621.396.619.16 2006

Pulse Modulation.—"Cathode Ray". (*Wireless World*, April 1946, Vol. 52, No. 4, pp. 113–117.) A discussion of the various types of modulation, explaining the advantages of pulse modulation at very high frequencies.

621.396.721 2007

Mobile 2 to 18 Mc/s Radioteletype for Long-Range Operation.—H. L. Landau. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 36..74.) The AN/MRC-2, designed for tactical army use, has been installed in a railway coach and in an aircraft. A 2-kW transmitter, with frequency-shift keying, and dual space-diversity receivers are used. The transmitter is remotely controlled, and can be converted for hand keying.

621.396.82 : 621.396.619.018.41 2008

Interference in Frequency Modulation.—Marchand. (*See* 1994.)

621.396.97(73) 2009

Broadcasting in U.S.A.—Report on Post-War Trends.—A. Dinsdale. (*Wireless World*, April 1946, Vol. 52, No. 4, pp. 132–135.) The economic position of American broadcasting, with its great dependence on advertising rents, is such that rapid development in television and in f.m. transmission is unlikely.

SUBSIDIARY APPARATUS

53 + 6] (73) 2010

American Trends of Development in the Physical Sciences.—Overbeck. (*See* 2073.)

531.788 : 539.164.92 2011

Radium-Type Vacuum Gage.—Mellen. (*See* 1867.)

621–526 2012

On the Method of van der Pol and its Application to Non-Linear Control Problems [servo mechanisms].—Bulgakov. (*See* 1907.)

621–526 2013

Theory of Servo Systems.—A. L. Whiteley. (*Electrician*, 29th March 1946, Vol. 136, No. 3539, pp. 823–824.) Summary and discussion of an I.E.E. paper.

621.3 2014

A.I.E.E. Winter Convention January 1946.—(*Elect. Engng, N.Y.*, Jan. 1946, Vol. 65, No. 1, pp. 29..35.) Abstracts are given of the following papers presented at the convention :—Applications of Thin Permalloy Tape in Wide-Band Telephone and Pulse Transformers, by A. G. Ganz. A B-H Curve Tracer for Magnetic-Recording Wire, by T. H. Long & G. D. McMullen. An Automatic Oscillograph with a Memory, by A. M. Zarem. Electronic Generator Voltage Regulator, by J. E. Reilly and C. E. Valentine. Titles of other papers are given in other sections.

For other abstracts see *Electronics*, April 1946, Vol. 19, No. 4, pp. 230..266.

621.314.2.017 2015

Thermal Characteristics of Transformers : Part 1.—V. M. Montsinger. (*Gen. elect. Rev.*, Apr. 1946, Vol. 49, No. 4, pp. 31–35, 38–42.) Power transformer loadings approved by the A.I.E.E. Standards are governed by the "eight degree" rule, which states that the rate of mechanical deterioration of Class A insulation is doubled for each eight degrees centigrade increase in temperature.

In determining the effect of high operating temperatures on the life of a transformer, measurement of the dielectric strength of the insulation is not a safe guide, since the determining factor is the ability of the materials involved to withstand abnormal mechanical stresses.

It has been found that the eight degree rule is fairly reliable in the range 115–200° C ; it decreases from eight degrees at 115° C, gradually, down to about three degrees at 75° C.

Practical temperature standards and other factors governing the design of transformer cooling systems are considered.

621.314.2.017 2016

Temperature Rise of Water-Cooled Power Transformers.—J. R. Meador. (*Gen. elect. Rev.*, Apr. 1946, Vol. 49, No. 4, pp. 55–59.)

621.314.22/.23 2017

The Impedances of Multiple-Winding Transformers : Part 2.—S. A. Stigant. (*Beama J.*, March 1946, Vol. 53, No. 105, pp. 109–114.) The derivation of the impedance tensor $Z_{\alpha\beta}$ and the construction of equivalent impedance network diagrams for *m*-winding transformers. For part 1 see 1685 of June. To be continued.

621.314.632.029.6 : 546.28 **2018**

H.F. Crystal Diodes.—LeDuc. (*See* 2077.)

621.314.65 : 621.396.71 **2019**

The Application of High-Voltage Steel-Tank Mercury-Arc Rectifiers to Broadcast Transmitters.—P. A. T. Bevan. (*J. Instn elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 131–136.) Long abstract of 206 of January.

621.314.65 : 621.396.71 **2020**

High-Voltage Steel-Tank Mercury-Arc Rectifier Equipments for Radio Transmitters.—J. C. Read. (*J. Instn elect. Engrs*, Part III, March 1946, Vol. 93, No. 22, pp. 128–130.) Long abstract of 205 of January.

621.316.54 **2021**

Fundamental Properties of the Vacuum Switch.—R. Koller. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, p. 134.) "An exhaustive study of the basic mechanism affecting the d.c. operation of the vacuum switch." Abstract of an Amer. Phys. Soc. paper.

621.316.86 : 546.281.26 **2022**

[Silicon-carbide] **Non-Ohmic Resistors.**–Ashworth, Needham & Sillars. (*See* 1885.)

621.317.35 **2023**

Complex Waveforms: The Harmonic Synthesiser.—Moss. (*See* 1917.)

621.317.755 **2024**

High Speed Oscillograph.—N. Rohats. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 135–137.) An oscillograph for transient measurements at writing speeds greater than 50 cm/μs using a sealed hot-cathode tube described in 3117 of 1937. A balanced thyratron sweep generator that can trigger or be triggered by the transient under observation is also described. Speeds up to several metres per microsecond may be used with a camera lens of aperture f/1.5.

621.318.572 **2025**

Electronic Contactors for Control Applications.—W. D. Macgeorge. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 186..206.) A survey of switch circuits using hard valves and hot- and cold-cathode relay tubes. Typical trigger requirements and power handling capacity are quoted.

621.318.572 : 531.76 : 539.16.08 **2026**

Experimental Arrangement for the Measurement of Small Time Intervals between the Discharges of Geiger-Müller Counters.—B. Rossi & N. Nereson. (*Rev. sci. Instrum.*, Feb. 1946, Vol. 17, No. 2, pp. 65–71.) A circuit is designed to give a voltage pulse of which the magnitude is a function of the time interval. The recovery time is sufficiently long to allow either visual observations or photographic recording with a c.r.t. Details are also given of an arrangement using a pen recorder.

621.319.4 : 621.317 **2027**

Capacitors for Measurement.—Garton. (*See* 1919.)

621.383 **2028**

[Photoelectric] **Electron Multipliers.**—E. Kormakova. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 62.) The multipliers described have semicircular emitters located on a cylindrical surface. Caesium-oxide surfaces, prepared on glass or nickel, are used as emitters and cathode. The cylindrical type with 10 or 12 emitters and a grid, has a sensitivity of 0.5–5 A/Lumen, with "dark" current 0.52 μA. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.383 **2029**

Some Results of the Application of Principle of Secondary-Electron Transformation.—L. Kubetzky. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 62.) A highly sensitive photocell has been derived from a secondary electron mechanism. An efficient emitter of high stability has been discovered, being a combination of copper, sulphur, and caesium. A new photocathode with improved spectral characteristics is also mentioned. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.383.2 + 535.215.1 **2030**

Complex Photoelectric Cathodes.—Khlebnikov. (*See* 1819.)

621.383.2 **2031**

New Sb-Cs Photocells.—N. Khlebnikov & A. Melamid. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 64.) Two new types, one for use down to 1900 Å and the other a highly sensitive (50μA/Lm) model showing no fatigue even at high cathode illumination (10 Lx). Abstract of a paper of the Acad. Sci., U.S.S.R.

621.383.2 **2032**

Energy Distribution of the Electrons and Dependence of Photocurrent for Caesium-Oxide Cathodes on the Angle of the Incidence of Light.—A. Pyatnitzky. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 64.) Semitransparent photocathodes on a glass surface were used, and the emission found to depend on the angle of incidence, wavelength, and cathode structure. The largest increase was found for an angle of incidence of 70°, when illuminated by blue light. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.383.2 **2033**

Physical Properties of Silver-Caesium-Oxide Cathodes.—P. Morozov & M. Butslov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 63–64.) The spectral distribution of the sensitivity of a caesium-oxide photocathode of variable thickness has been investigated, and found to be directly connected with the thickness. The structural peculiarity of the cathode leads to a spectral absorption and scattering of the incident light. The work function was found to be 0.78–0.90 V. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.383.4 **2034**

A New Electrolytic Selenium Photo-Cell.—A. von Hippel, J. H. Schulman & E. S. Rittner. (*J. appl. Phys.*, April 1946, Vol. 17, No. 4, pp. 215–224.) ". . . consists of a metal electrode [cathode] completely coated with metallic selenium, immersed in an aqueous solution of an electrolyte, preferably selenium dioxide, together with an auxiliary electrode of a noble metal. . . ." "Our cell differs from . . . earlier electrolytic selenium cells chiefly in that directly electrodeposited metallic selenium gives rise to a higher sensitivity and that the selenious acid permits a higher lifetime as well as hermetical sealing of the cell . . ." A full description of the cell construction is given, with its characteristics as a function of operating voltage, temperature, external resistance, and time, and an account of its response to unmodulated, modulated, and monochromatic light. A feedback circuit is described, which greatly improves the voltage output of the photo-element and which "is generally applicable to photoconductive and photovoltaic cells."

621.383.5 **2035**

Photometric Equipment for Blocking-Layer Light-Sensitive Cells.—H. T. Wrobel & H. H. Chamberlain. (*Gen. elect. Rev.*, Apr. 1946, Vol. 49, No. 4, pp. 25–29.) A compact laboratory equipment for the quick and accurate testing of the temperature characteristics of barrier-layer selenium cells.

621.384.6 **2036**

Acceleration of Charged Particles.—(*Nature, Lond.*, 23rd March 1946, Vol. 157, No. 3986, pp. 381–382.) A brief review of 439 of February (McMillan) and of *Phys. Rev.*, 1945, Vol. 68, p. 233 (Kerst).

621.384.6 **2037**

A Proposed High Energy Particle Accelerator—The Cavitron.—R. F. Post. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, pp. 126–127.) A proposal for obtaining high intensity electron accelerating fields by replacing the usual "dee" assembly and acceleration chamber by an electromagnetic cavity resonator.

621.384.6 **2038**

Combination of Betatron and Synchrotron for Electron Acceleration.—H. C. Pollock. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, p. 125.) Comment on 439 of February (McMillan).

621.384.6.017.6 **2039**

Radiation Losses in the Induction Electron Accelerator.—J. P. Blewett. (*Phys. Rev.*, 1st/15th Feb. 1946, Vol. 69, Nos. 3/4, pp. 87–95.) A discussion of the possibility that, because of the high radial accelerations experienced by the electrons in an induction electron accelerator the radiation losses may introduce limitations in the design of accelerators for energies above 100 MeV. Radiation effects consistent with theoretical predictions have been observed. The radiation itself has not yet been detected.

621.385.832 : 621.396.9 **2040**

Cathode-Ray Tube Displays.—Bartlett, Watson & Bradfield. (*See* 1857.)

621.394.64 : 621.394.3 **2041**

Electronic Regeneration of Teleprinter Signals.—H. F. Wilder. (*Trans. Amer. Inst. elect. Engrs*, Jan. 1946, Vol. 65, No. 1, pp. 34–40.) A description of an electronic device for receiving weak and distorted teleprinter signals and retransmitting them in correct sequence. The received signal is corrected for time of duration by means of a timing delay network controlling balanced trigger circuits. Starting and stopping is performed by electronic bridge relays.

621.394.652 : 621.394.141 **2042**

An Electrical Keying Device.—F. Dearlove. (*R.S.G.B. Bull.*, March 1946, Vol. 21, No. 9, pp. 136–137.) An arrangement of a polarized relay to provide an automatic morse key. The device is simple, easy to adjust, uses no valves, is noiseless in operation, and is capable of very high speeds.

621.395.645.3 : 621.385.4 **2043**

Intermodulation Tests for Comparison of Beam and Triode Tubes used to drive Loudspeakers.—J. K. Hilliard. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 15–17, 54.) The usual high distortion of the beam power valve is overcome by careful amplifier design with little negative feedback. The main requirement is for an output transformer with high self-impedance, high coupling coefficient, low distributed capacitance, and carrying capacity such that the output power shall be uniform over a wide frequency range. Intermodulation tests, which compare favourably with listening tests, showed that beam power amplifiers gave the same or less distortion than triodes, and have advantages of less hum and greater efficiency.

621.396.664 **2044**

An Interlocked Line-Switching System.—H. E. Adams. (*Communications*, March 1946, Vol. 26, No. 3, pp. 34–36.) For feeding programmes to any of four lines from either of two control rooms, with interlocking to prevent both control rooms from feeding the same line together. Description of the design, construction, and operation.

621.396.682 : 621.397.62 **2045**

Television Receiver R-F Power Supply Design.—H. C. Baumann. (*Communications*, March 1946, Vol. 26, No. 3, pp. 26 . . 70.) The advantage of using an r.f. (50–300 kc/s) oscillator, step-up transformer and rectifier to supply 10–50 kV 1 mA are outlined, and the design and construction of such an equipment are described. See also 2169 of 1943 (Schade).

621.396.69 **2046**

The Design of a Screened Room.—C. C. Eaglesfield. (*Electronic Engng*, April 1946, Vol. 18, No. 218, pp. 106–108, 112.) Detailed description of a room 10 ft × 8 ft × 8 ft high, made with copper sheet, giving an attenuation of outside interference of 100 db at frequencies 1–550 Mc/s. A fan outside provides forced ventilation, the air inlet and outlet apertures being covered with perforated zinc. Power supplies are introduced through low- and high-frequency filters designed to give the same attenuation as the screening.

621.396.69 **2047**

Post-War Components.—(*Wireless World*, April 1946, Vol. 52, No. 4, pp. 106–112.) A review of an exhibition by the Radio Component Manufacturers' Federation (Feb. 1946) which illustrates modern trends in design. A list of manufacturers and products is given.

621.396.69 : 06.064 **2048**

Reports on Exhibitions. — (*Electronic Engng*, April 1946, Vol. 18, No. 218, pp. 122–128.) Brief notes on some of the electronic equipment exhibited at the Institution of Electronics, Manchester, at the Radio Component Manufacturers' Federation Exhibition, and at the North-East Coast Exhibition.

621.396.91.087.5 : 551.51.053.5 2049
A Simple Kerr Modulator for Ionospheric Recording.—O. E. H. Rydbeck. (*Chalmers tekn. Högsk. Handl.*, 1945, No. 44, 13 pp. In English.) Detailed description of the design and construction of a Kerr cell suitable for replacing the point glow lamp used in certain types of ionosphere recording equipment.

771.448.1 : 778.39 2050
An Apparatus for Stroboscopic Observation.—S. L. de Bruin. (*Philips tech. Rev.*, Jan. 1946, Vol. 8, No. 1, pp. 25–32.) A capacitor discharge is used to provide repeated current impulses in a high-pressure argon tube, with time intervals of between 2 and 0.004 sec. Light flashes of about 10^{-5} sec duration are obtained.

TELEVISION AND PHOTOTELEGRAPHY

621.397 2051
Color Television on Ultra High Frequencies.—D.G.F. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 109–115.) The present C.B.S. system uses 525 lines, interlaced 2 : 1, the interlaced fields being scanned at 120 per sec. Improved definition is obtained with a 10-Mc/s bandwidth in the band 480–920 Mc/s, and single-sideband operation is eventually contemplated. The transmitter used a disk-seal triode (6C22) giving 1 kW peak or 600 W average ; a slotted waveguide radiator gives a concentration in the horizontal direction with a power gain of 20. The use of the vision flyback period for sound permits transmission up to 10 500 c/s. Of two receivers demonstrated, one gives direct vision of a 10-inch c.r. tube and the other an optical system giving a 17 × 22-inch picture. A tunable crystal mixer and 105-Mc/s i.f. amplifier with a bandwidth of 12 Mc/s gives an equivalent input noise level of 8 μV. The colour wheel uses standardized green, blue, and red filters, giving an average transmission of 14%. The required bright phosphor image is obtained with an accelerating voltage of [illegible] 000. Details of the camera and pickup equipment are given.

621.397 2052
"Videosonic" Sound.—D. I. Lawson. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 385..422.) For other descriptions of this system of transmitting sound and vision on one carrier see 459 of February and back references. See also *Electronics*, April 1946, Vol. 19, No. 4, pp. 208..212.

621.397 2053
Improved Phototelegraphy.—(*Electrician*, 22nd March 1946, Vol. 136, No. 3538, pp. 734–736.) A description and block diagram of a new phototelegraphic equipment designed at the (British) Post Office Research Station for overseas transmissions by Cable & Wireless Ltd.

621.397 2054
I.R.E. Winter Technical Meeting January 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22..66.) Abstracts of some of the papers read. For titles, see 1704 of June.

TRANSMISSION

621.314.65 : 621.396.71 2055
The Application of High-Voltage Steel-Tank Mercury-Arc Rectifiers to Broadcast Transmitters.—[illegible]van. (*See* 2019.)

621.385.3 2056
Grounded-Grid Power Amplifiers.—Spitzer. (*See* 2085.)

621.394.652 : 621.394.141 2057
An Electrical Keying Device.—Dearlove. (*See* 2042.)

621.396.11.029.64 + 621.396.24 + 621.385.1 2058
Simultaneous Use of Centimeter Waves and Frequency Modulation.—Clavier & Altovsky. (*See* 1971.)

621.396.61 2059
I.R.E. Winter Technical Meeting January 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22..66.) Abstracts of some of the papers read. For titles, see 1715 of June.

621.396.61.029.56 2060
A Self-Contained 60-Watt C.W. Transmitter.—D. Mix. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 13–17, 114.) The construction and adjustment of a set comprising a Tri-tet crystal oscillator driving an 807 output stage, for use in the 3.5, 7 and 14 Mc/s bands.

621.396.61.029.58 2061
200-Kilowatt High-Frequency Broadcast Transmitters.—H. Romander. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 253–261.) A technical description of two transmitters recently installed at Delano and Dixon (California). For a previous description of the circuit, see 787 of March.

The beam aerials are arranged in groups of three for each sector to be covered, the aerials of each group being graded so that a wide range of frequencies can be covered with uniform gain. The description is illustrated by photographs and circuit diagrams.

621.396.61.029:62 2062
Stabilizing the 144-Mc/s Transmitter.—G. Grammer. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 24–30.) Unwanted frequency modulation can be reduced by the use of a buffer amplifier between the master oscillator and the power amplifier. Constructional details are given for a 40-W three-stage (buffered) transmitter, and its performance is compared with that of two-stage and single-stage transmitters.

621.396.61.029.62 2063
The "Tiny Tim" Handie-Talkie.—C. T. Haist, Jr. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 58–59.) A pocket-size 144-Mc/s-band transceiver using two midget triodes as detector-oscillator and audio-amplifier/modulator. Range about one mile.

621.396.61.029.62 : 621.396.619.018.41 2064
250-Watt F.M. Transmitter for 88 to 108 Mc/s.—M. B. Kahn & S. L. Sack. (*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 44..53.) The use of balanced reactance-modulators and a push-pull oscillator provides twice the frequency swing of a single modulator, so that only three doubler stages are necessary. Stabilization of centre frequency is obtained by mixing the output with the signal from a standard crystal oscillator, and passing the resulting a.m. and f.m. audio output to a phase detector. The d.c. voltage so obtained controls thyratrons which operate a motor that tunes the master oscillator. Frequency stability is better than ± 1 500 c/s.

621.396.61.029.63 2065
Oscillators and Amplifiers at 1 000 Mc/s.—P. S. Rand. (*QST*, Apr. 1946, Vol. 30, No. 4, pp. 34–40.) Detailed description (with diagrams and photographs) of the use of "Lighthouse" tubes and cavity resonators in a U.S. Navy 25-W 900-Mc/s transmitter. The modifications necessary for operation on 1 215 Mc/s are described.

621.396.611.21 : 621.396.615.14 2066
Frequency Stabilization at 450 Mc/s.—Myers. (*See* 1926.)

621.396.615.17 + 621.396.619 2067
Station Design and Planning : Part 3—Frequency Multiplication and Keying.—W. H. Allen. (*R.S.G.B. Bull.*, Feb. 1946, Vol. 21, No. 8, pp. 126–127.) Frequency-doubling circuit resembles power amplifier. Keying is best performed by grid-blocking of the oscillator. Necessary precautions are outlined. For part 1 see 1058 of April, for parts 2, 4 & 5 see 1801 and 1980.

621.396.619 : 621.396.619.018.41 2068
Reactance Tube Modulators.—N. Marchand. (*Communications*, March 1946, Vol. 26, No. 3, pp. 42–45.) Circuit equations for an f.m. source are derived, including cases of effective capacitive and inductive inputs. Distortion can be minimized by using balanced reactance tubes. A deviation of ± 3.75 kc/s is easily obtainable with a source frequency of 5 Mc/s and gives ±75 kc/s at a radiated frequency of 100 Mc/s. For previous parts in this series see 1675 of June and 1994.

621.396.645.3.029.5 2069
Station Design and Planning : Part 2—The Power Amplifier. Allen. (*See* 1801.)

621.396.664 2070
Radio-Frequency Transmitter.—J. N. Whitaker. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, p. 29.) A method of switching the tank circuits of an h.f. oscillator, without using metallic contactors. Summary of U.S. Patent 2 388 233.

621.396.676 : 621.396.932.029.54 2071
Radiation of Ship Stations on 500 Kc/s.—J. Marique. (*Wireless Engr*, May 1946, Vol. 23, No. 272, pp. 146–151.) A summary of the results of measurements made on the polar diagrams and range (in terms of metre-amperes) of a number of ship stations on about 500 kc/s—the frequency used for distress traffic. It was found that the horizontal polar diagram of typical ship aerials may show 2 : 1 variations of effective height with directions relative to the fore-and-aft line, and that the radiated power W_r can be represented by $W_r = (\text{Metre-amperes}/K)^2$, where $K^2 = \lambda^2/160\pi^2\alpha^2$, α being the "form factor" of the aerial. K lies between 25 and 50 at 454 kc/s.

The paper includes a graph showing the relation between field strength and distance for daytime conditions over sea as functions of aerial power and aerial height.

621.396.721 2072
Radio Amateur's Examination.—(*R.S.G.B. Bull.*, Feb. 1946, Vol. 21, No. 8, pp. 117–118.) The syllabus of the new [British] Radio Amateur's Examination of the City and Guilds Institute, the passing of which qualifies for a G.P.O. amateur transmitting licence.

VALVES AND THERMIONICS

53 + 6] (73) 2073
American Trends of Development in the Physical Sciences.—C. J. Overbeck. (*J. sci. Instrum.*, Jan. 1946, Vol. 23, No. 1, pp. 1–10.) Includes disk-seal, radial-beam, and photo-multiplier tubes, and many other devices.

537.533 2074
On the Secondary Electron Emission of Solid Bodies.—S. Lukianov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 62.) The emission is affected by (*a*) the total energy loss per unit length suffered by the primary particle, and (*b*) the range of the secondary electron in the given substance. The mean energy of formation of secondary electrons is estimated (in aluminium $E = 15$ eV). The small emission of pure metals and the high emission of certain non-metals are discussed. Abstract of a paper of the Acad. Sci., U.S.S.R.

537.533 2075
On the Influence of Strong Electric Fields on the Secondary Electronic Emission of Dielectric Films.—D. Zernov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, pp. 61–62.) The characteristics of emission from Al, Cs and Mg oxides are discussed, and the emission shown to depend on the primary current, collector potential, and velocity of the primary electrons. The secondary current practically ceases to follow primary-current variations at audio frequencies. Abstract of a paper of the Acad. Sci., U.S.S.R.

537.583 2076
The Emission of Oxide-Coated Cathode under Impulse Excitation.—A. Andrianov. (*J. Phys., U.S.S.R.*, 1945, Vol. 9, No. 1, p. 60.) Experiments were made using diodes with concentric cylindrical electrodes. The current impulse was of 3–4 μs duration and the repetition frequency 50 c/s. The saturation current at different temperatures was measured. The volt/amp characteristic given by this method for small values of average current differs from that given by large values. Abstract of a paper of the Acad. Sci., U.S.S.R.

621.314.632.029.6 : 546.28 2077
H.F. Crystal Diodes.—H. A. LeDuc. (*Radio Craft*, March 1946, Vol. 17, No. 6, pp. 386, 428.) A short description of the theory, construction, and main uses in u.h.f. equipment, of stable cartridge-mounted germanium and silicon rectifiers. A table of the properties of eighteen types is added. See also 1728 of June.

621.38 2078
I.R.E. Winter Technical Meeting January 1946.—(*Communications*, Feb. 1946, Vol. 26, No. 2, pp. 22..66.) Abstracts of some of the papers read. For titles see 1730 of June.

621.383 2079
[Photoelectric] **Electron Multipliers.**—Kormakova. (*See* 2028.)

621.385.1 2080
Reflex-Klystron Oscillators.—E. L. Ginzton & A. E. Harrison. (*Proc. Inst. Radio Engrs, N.Y.*, Part I, April 1946, Vol. 34, No. 4, p. 209.) Correction to 1734 of June.

621.385.1 **2081**

What are the Klystron and the Rhumbatron ?—J. Baltá Elias. (*Euclides, Madrid*, May/June 1945, Vol. 5, Nos. 51/52, pp. 287–297.) A simple account of the limitations of triode oscillators at u.h.f., and of the development of velocity-modulated oscillators.

621.385.1 + 621.385.16 **2082**

The Magnetron and the Klystron.—T. F. Wall. (*Engineering, Lond.*, 8th, 15th & 22nd Feb. 1946, Vol. 161, Nos. 4178–4180, pp. 125–127, 148 & 184–185.) Description of the mode of operation, including a simplified mathematical treatment. The discussion of the magnetron oscillator is limited to the split-anode type with external tuned circuit. Two-cavity klystron amplifiers and oscillators are considered.

621.385.1.029.63/.64 **2083**

The Klystron and Other Micro-Wave Oscillators.—A. C. Ramm. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1945, Vol. 6, No. 5, pp. 3–4.) Summary of a talk on the development of Barkhausen-Kurz, magnetron, and klystron oscillators.

621.385.16 **2084**

Development of the Magnetron.—J. T. Randall. (*Electrician*, 1st March 1946, Vol. 136, No. 3535, pp. 537–538.) A summary of a paper read before the Royal Society of Arts describing the practical and theoretical development during the war.

621.385.3 **2085**

Grounded-Grid Power Amplifiers.—E. E. Spitzer. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 138–141.) The lower capacitance of this amplifier permits wider-bandwidth operation than the conventional capacitance-neutralized triode, with reduced possibility of self-oscillation. Some 3–10 times greater driving power is needed, but this is transferred to the anode circuit. The 9C21 type (a 100-kW triode) is described ; its use in an amplifier and its modulation characteristics are considered.

621.385.3/.5].012 **2086**

Pentodes and Tetrodes Operating as Triodes.—. C. McCallum. (*Electronic Engng*, March 1946, Vol. 18, No. 217, pp. 82–83.) Chart showing, on log-log plot, the r.m.s. input voltage and the a.f. output power for various triodes and triode-connected pentodes and tetrodes. A maximum second-harmonic distortion of 5% and the use of optimum load resistance is assumed. British and American types are included.

621.385.3/.5].032.24 **2087**

The Current to a Positive Grid in Electron Tubes : The Current Resulting from Electrons Flowing Directly from the Cathode to the Grid.—J. L. H. Jonker & B. D. H. Tellegen. **II. The Current Resulting from Returning Electrons.**—J. L. H. Jonker. (*Philips Res. Rep.*, Oct. 1945, Vol. 1, No. 1, pp. 13–32.) 1. Electron paths are calculated for the case of a planar triode by taking into account an extra velocity moment gained by electrons in passing close to the grid wires. This gives a second approximation to the expression for the direct electron current that agrees well with observed data. 2. The angular deflexions suffered by electrons in passage through one or more grids are investigated, and the electron current that returns to the positive grid is calculated from the proportion deflected through more than a certain critical angle. The effect of relative pitch in two grids is discussed in some detail.

621.385.3(091) **2088**

Saga of the Vacuum Tube : Parts 21 & 22.—G. F. J. Tyne. (*Radio News*, Feb. & April 1946, Vol. 35, Nos. 2 & 4, pp. 54–56, 130 & 52..133.) Concludes a survey of development in France and Germany during the first world war. For part 20 see 489 of February.

621.385.38 : 537.56 **2089**

Note on the Ionization and Deionization Times of Gas-Filled Thyratrons.—J. C. R. Cance. (*J. sci. Instrum.*, March 1946, Vol. 23, No. 3, pp. 50–52.) "The ionization time of G.T.1C thyratrons determined at currents ranging from 5 to 25 mA is shown to be independent of (*a*) anode current, (*b*) anode voltage, (*c*) rate of change of grid potential, and is sensibly constant at 1.4 ± 0.4 µsec. The relation between de-ionization time and negative grid voltage is illustrated graphically for different values of anode volts and current. At constant grid volts and anode current, the de-ionization time is shown to be independent of the magnitude of anode-cathode potential change used to effect extinction."

621.385.38 : 621.396 **2090**

Thyratrons and Their Applications to Radio Engineering.—A. J. Maddock. (*Elect. Comm.*, 1945, Vol. 22, No. 4, pp. 339–378.) A review of the nature, mechanism, and characteristics of thyratrons, of the range of existing types, and of the main types of controlling circuits in which they are used, illustrated by application to operation timing, peak voltmeters, overload relays, over-modulation indicators, frequency meters, d.c. amplification, transmitter keying, pulse generation, c.r. tube switching and time bases, harmonic generators, frequency dividing, power-supply regulation and control, rectification, and inversion. The paper is illustrated by numerous typical circuit-diagrams and has a bibliography of 66 items.

621.385.4 **2091**

Beam Tetrode Characteristics.—S. Rodda. (*Wireless Engr*, May 1946, Vol. 23, No. 272, pp. 140–145.) The anode-current/anode-voltage characteristic is deduced on the assumption that the electrons entering the screen/anode space have a distribution in angle given by a continuous function of the sine of the angle of entry. (Previous treatments have assumed a discontinuous function.) Even with the continuous distribution in angle, the action of space charge produces "regions of instability" with "sharp knees". See also 1807, 2222 and 2635 of 1945 (Walker).

621.385.5 : 621.396.619 **2092**

New Modulation Tube for Frequency Modulation.—(*Electronics*, Feb. 1946, Vol. 19, No. 2, pp. 204..212.) An illustrated account of the "phasitron" described in 1405 of May.

621.396.615.17 : 621.317.755 **2093**

Time-Base Converter and Frequency-Divider.—H. Moss. (*Wireless Engr*, May 1946, Vol. 23, No. 272, p. 152.) A letter supporting the writer's previous contention that the introduction of new types of components is only justified by a substantial technical advantage to be gained, and that the case for such technical advantage is not valid in the case of the deflexion-modulated valves ("signal-converters") proposed by Nagy and Goddard in their original paper. See 3891 of 1945 and 3393 of 1943.

MISCELLANEOUS

003.6 : 621.392.5 **2094**
Graphical Symbols for Filters and Correcting Networks.—G. H. Foot. (*Wireless Engr*, April 1946, Vol. 23, No. 271, pp. 103–106.) Suggested new symbols based on the shape of the performance graph of attenuation against frequency.

519.283 : 621.315.617.3 **2095**
Quality Control of Insulating Varnishes.—Hart. (*See* 1883.)

62 "1945" **2096**
Progress in Engineering Knowledge during 1945 : Design Engineering.—P. L. Alger, J. Stokley, C. F. Scott, H. B. Marvin, J. L. Tugman, K. W. Given. (*Gen. elect. Rev.*, Feb. 1946, Vol. 49, No. 2, pp. 9–19.) A review, with an extensive bibliography, of many fields, including the solution of partial differential equations by equivalent electrical circuits, the measurement and recommended field strength limits for interference from electrical apparatus, improvements in television fluorescent-screen construction, and a combined triode-cavity resonator for radar applications.

621.316.96 : [621.38/.39 **2097**
Vibration and Shock Testing of Mobile Equipment.—J. H. Best. (*Electronics*, April 1946, Vol. 19, No. 4, pp. 126–129.) Testing techniques for newly developed anti-vibration mountings for electronic equipment. In addition to a test on the unmounted unit for vibration resonance of any particular part over a range of frequencies, data are obtained on the vibration-isolation efficiency of the mount itself. Vibration tests in three mutually perpendicular directions are made, and account taken of any tendency for torsional oscillation.

621.396.6 **2098**
Naval Wartime Communication Problems.—J. O. Kinert. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, pp. 193–195.) As a result of experience gained during the war the following recommendations are urged for the design of military equipment :—(*a*) the greatest simplification consistent with satisfactory performance ; (*b*) the maximum practicable reduction in weight and size ; (*c*) standardization of parts and components ; (*d*) maximum use of automatic features.

621.396(73) **2099**
Those New Frontiers.—P. A. Porter. (*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, pp. 185–188.) A general discussion of the future of radio engineering in America.

621.396 "1945" **2100**
Radio Progress During 1945.—(*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, pp. 164–184.) Survey of world progress, based on a bibliography of over 400 references.

621.396.6(083.75) **2101**
Proposed Standards of the [U.S.] **Radio Manufacturers' Association.**—(*Proc. Inst. Radio Engrs, N.Y.*, Part II, April 1946, Vol. 34, No. 4, pp. 198–200.) Summaries of proposals 163–169, concerned with details of receivers, gramophone records, and valve type designations.

621.396.712 **2102**
From Studio to Master Control.—H. J. Seitz. (*Radio News*, Jan. 1946, Vol. 35, No. 1, pp. 47..158.) Description of the various duties of the broadcast engineer, including field broadcasting, maintenance, master control, and studio operation, the latter being concerned with acoustics and realistic reproduction.

621.396.721 **2103**
Radio Amateur's Examination.—(*See* 2072.)

621.798 **2104**
Protective Packaging.—O. C. Rutledge. (*Gen. elect. Rev.*, Dec. 1945, Vol. 48, No. 12, pp. 16–19.) A review of new methods for protecting equipment against corrosion and shock while in storage or in transit.

621.798 **2105**
Dynamics of Package Cushioning.—R. D. Mindlin. (*Bell Syst. tech. J.*, July/Oct. 1945, Vol. 24, Nos. 3/4, pp. 353–461.) A comprehensive analysis of the protective cushioning necessary in the transportation of packaged articles. The four parts of the paper are concerned with (*a*) methods for predicting the maximum acceleration that the cushioning permits the packaged item to reach, (*b*) the form of the acceleration/time relation, (*c*) the effect of acceleration on the packaged article with methods for determining whether or not the strength of the packaged article will be exceeded, (*d*) the influence of distributed mass and elasticity in both the packaged article and cushioning medium. The results of the analysis have been applied to the packaging of large vacuum tubes.

621.798 : 621.396.69 **2106**
Hermetic Sealing.—A. L. Anderson. (*Radio, N.Y.*, March 1946, Vol. 30, No. 3, pp. 25–27, 46.) Describes the technique of filling an enclosure with inert gas under a pressure of 5–10 lb/sq inch above atmospheric. See also 811 of March (Herbert).

654.19 **2107**
1946 Radio Statistics.—(*Electronic Industr.*, Jan. 1946, Vol. 5, No. 1, p. 63.) Figures for the production of broadcast receivers in the years 1922–1945.

016 : [621.38/.39 **2108**
The Electronic Engineering Master Index. [Book Review]—F. A. Petraglia (Ed.). Electronics Research Publishing Co., New York, 1945, 318 pp., $ 17.50. (*Electronic Industr.*, Jan. 1946, Vol. 5, No. 1, p. 128.) "A comprehensive and painstaking subject index of electronic engineering periodicals covering, in separate sections, the two decades from 1925 to June 1945."

5 (082.2) **2109**
The Autobiography of Science. [Book Review]—F. R. Moulton & J. J. Schifferes (Eds.). Doubleday, Doran & Co., New York, 1945, 666 pp., $ 4.00. (*Sci. Mon., N.Y.*, Dec. 1945, Vol. 61, No. 6, pp. 489–491.) Selections from original scientific writings of historical interest. ". . . an excellent effort to offer the best in scientific literature. . ."

519.283 **2110**
Statistical Analysis, Quality Control, etc. [Book Reviews]—(*ASTM Bull.*, Jan. 1946, No. 138, pp. 60–62.) Reviews of 13 books and pamphlets condensed from *J. Amer. Statistical Assoc.*, Sept. 1945.