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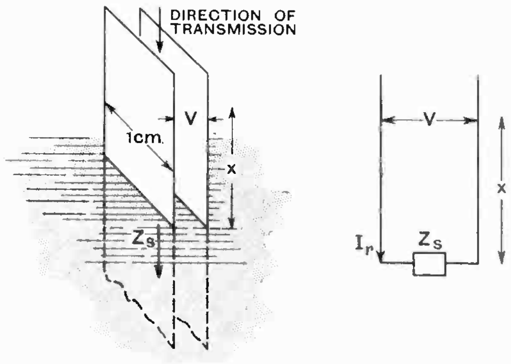
Reflection of Waves at Earth's Surface

WE propose in this note to deal only with waves incident normally; that is, with waves travelling vertically downwards and being reflected at the earth's surface. We shall assume that the waves are plane. In such a case the waves are of exactly the same character as those transmitted between two parallel conducting strips. The two strips in the figure are assumed to extend indefinitely in both directions, upwards into the air, and downwards into the earth; they are assumed to have no resistance and the dielectric between



them is air for the upper portion and earth for the lower portion. Although the simple formulae for the inductance, capacity, and leakance of such a line are only strictly correct if the distance between the strips is small compared with their width, no error is ultimately made, and the formulae are simplified, by assuming both the width and the distance apart to be 1 cm. The formulae are then:

L = inductance per cm $= 4\pi \times 10^{-9}$ henries ($\mu = 1$)

G = conductance per cm $= \dfrac{1}{\rho} = \dfrac{\sigma}{9 \times 10^{11}}$

where σ = conductivity in e.s. units,

and

C = capacitance per cm $= \dfrac{\kappa}{4\pi} \cdot \dfrac{1}{9 \times 10^{11}}$ farads.

If Z_s denotes the impedance of the line extending downwards into the soil, as measured at the surface, we have

$$Z_s = \sqrt{\frac{Z}{Y}} = \sqrt{\frac{j\omega L}{G + j\omega C}} = R_s + jX_s$$

On substituting the above values for L, G, and C, putting $\omega = 2\pi f$, and $n = \dfrac{f\kappa}{2\sigma}$, it is found that

$$R_s = 60\pi\sqrt{\frac{f(\sqrt{1 + n^2} + n)}{\sigma(1 + n^2)}}$$

and $$X_s = 60\pi\sqrt{\frac{f(\sqrt{1 + n^2} - n)}{\sigma(1 + n^2)}}$$

or, putting $N = \dfrac{n}{\kappa\sqrt{1 + n^2}}$ (as in *W.E.*, Nov., 1933, p. 591)

$$R_s = 60\,\pi\,\sqrt{2}\,\sqrt{N(1 + \kappa N)}$$
$$X_s = 60\,\pi\,\sqrt{2}\,\sqrt{N(1 - \kappa N)}$$

These are then the two components of the impedance Z_s which may be regarded as the load connected across the bottom end of the air transmission line which may be assumed to terminate on reaching the earth's surface as shown on the right of the figure.

The voltage V at any point at a distance x from the receiving end of a transmission line is given by the formula

$$V = I_r(Z_r \cosh ax + Z_0 \sinh ax)$$

where I_r is the current at the receiving end,
Z_r is the impedance of the load which in our case is Z_s,
Z_0 is the characteristic impedance of the line, i.e., the impedance for infinite length,

and $a = \sqrt{ZY}$ of the line per unit length.

This may be written

$$V = I_r\left(\frac{Z_r + Z_0}{2}e^{ax} + \frac{Z_r - Z_0}{2}e^{-ax}\right).$$

The first term represents the downward wave and the second the upward reflected wave; hence putting

$$\frac{\text{Amplitude of reflected wave}}{\text{Amplitude of incident wave}} = \eta$$

we have $\eta = \dfrac{Z_r - Z_0}{Z_r + Z_0} = \dfrac{Z_s - Z_0}{Z_s + Z_0}$

In air $G = 0$ and $Z_0 = \sqrt{\dfrac{j\omega L}{j\omega C}} = \sqrt{\dfrac{L}{C}} = 120\pi.$

Hence

$$\eta = \frac{R_s + jX_s - Z_0}{R_s + jX_s + Z_0}$$
$$= \frac{60.\pi.\sqrt{2N}(\sqrt{1+\kappa N} + j\sqrt{1-\kappa N}) - 120\pi}{\text{ditto} \qquad + 120\pi}$$
$$= \frac{\sqrt{2N(1+\kappa N)} - 2 + j\sqrt{2N(1-\kappa N)}}{\sqrt{2N(1+\kappa N)} + 2 + j\sqrt{2N(1-\kappa N)}}$$
$$= \frac{N - 1 + j\sqrt{2N(1-\kappa N)}}{N + 1 + \sqrt{2N(1+\kappa N)}}$$

This gives the real and imaginary components, i.e., the in-phase and the quadrature components of the reflection coefficient.

If the earth's surface were perfectly conducting $\sigma = \infty$, $n = f\kappa/2\sigma = 0$ and $N = 0$
$\therefore \eta = -1$
and the voltage of the line or the electric field of the wave would be reversed on reflection without change of amplitude.

If $\sigma = 0$ (perfect insulator), $n = \infty$, $N = 1/\kappa$ and

$$\eta = \frac{1 - \kappa}{1 + \kappa + 2\sqrt{\kappa}} = -\frac{\kappa - 1}{(\sqrt{\kappa} + 1)^2}$$

Here again the reflected wave is exactly 180 deg. out of phase with the incident wave but is not of the same amplitude, the difference giving the amplitude of the wave transmitted into the dielectric.

The reflection coefficient η can also be expressed in terms of its modulus or magnitude and its angle; thus

$$\eta = \frac{\sqrt{1 + N^2(1 - 2\kappa)}}{N + 1 + \sqrt{2N(1+\kappa N)}}\ \underline{|\theta}$$

where $\tan\theta = \dfrac{\sqrt{2N(1-\kappa N)}}{N - 1}$.

These formulae are thus obtained from the ordinary telephone transmission formulae, and by introducing N are given a relatively simple form very suitable for rapid computation.

The amplitude of the wave transmitted into the earth is given at the surface by the formula $V_s = I_r Z_s$.

Hence

$$\frac{\text{transmitted wave}}{\text{incident wave}} = \frac{Z_s}{\dfrac{Z_s + Z_0}{2}} = \eta + 1$$

If $\sigma = 0$ (perfect insulator) $\eta + 1 = \dfrac{2}{1 + \sqrt{\kappa}}$

This wave transmitted downwards into the earth is damped out in accordance with the exponential e^{-ax} where $a = p + jq$.

It was shown in the *Wireless Engineer* for November, p. 590, that the attenuation constant p is given by the formula

$$p^2 = \frac{4\pi^2}{9 \times 10^{20}} f\sigma(\sqrt{1 + n^2} - n)$$

and hence $p = \dfrac{\omega}{3 \times 10^{10}}\sqrt{2\left(\dfrac{1}{N} - \kappa\right)}$

where $\omega = 2\pi f$.

If d denotes the depth at which the amplitude is reduced to a tenth of its surface value, we showed that this was related to the wavelength in air by the formula

$$\lambda/d = 1.94\sqrt{\frac{1}{N} - \kappa}$$

G. W. O. H.

The Alternating-current Inductance of an Iron-cored Coil Carrying Direct Current*

By R. T. Beatty, M.A., D.Sc.

List of Symbols

L	A.C. Inductance.
I	Direct Current.
m	Average Magneto-motive Force per cm.
H	Magnetic Force.
μ_1	Incremental Permeability.
B	Steady Flux Density.
A	Area of Core Section.
x	Length of Path in Iron.
V	Volume of Core.
a	Length of Air Gap.
T	Number of Turns in Winding.

In the theoretical discussion in Sections 1—3 electromagnetic C.G.S. units are used for the first five symbols. In Section 4, which deals with practical applications, we introduce practical units.

Section 1.—Comparison of Methods of Design

IN 1927 it was shown by Hanna† that in the case of an iron-cored coil carrying direct current the data required for design could be obtained from a single curve. Hanna proved that for a core of given magnetic properties the relation between LI^2/V and TI/x can be expressed as a curve whose shape depends only on the gap ratio a/x. When a number of such curves is drawn as in Fig. 1 it is evident that when TI/x is fixed the maximum value of LI^2/V is the ordinate to the curve which is drawn to touch all the gap ratio curves. This tangential curve, when furnished with a scale of gap ratios, gives the data required for design.

Although the final result obtained by Hanna's method is simplicity itself, yet the labour involved in calculating the subsidiary curves is considerable, and accordingly in the present paper an alternative method is described which requires only two curves (1) a curve in which B is plotted against H (2), a curve in which B is plotted against $B/\mu_1 - H$. In addition the present method is thought to give a more graphic picture of the result of varying the quantities concerned.

The method is described in the following section and the necessary mathematical proof of its correctness is reserved for Section 3.

Section 2.—A New Geometrical Representation

The two curves referred to above are plotted in Fig. 2 on opposite sides of the vertical zero line. In order to simplify the discussion all magnetic quantities are expressed in electromagnetic units, *i.e.*, gauss or lines per cm², while in Fig. 5 which is intended for actual design operations practical units are employed.

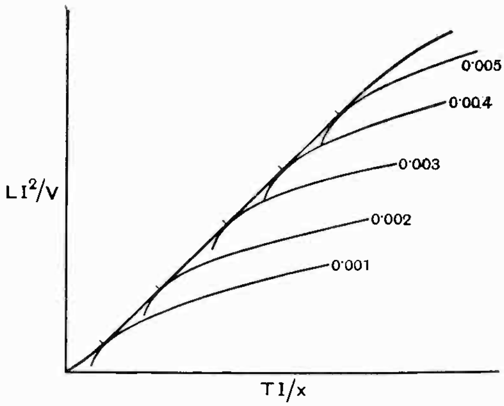


Fig. 1.—*Hanna's design curve: its construction involves a curve drawn to touch a number of subsidiary curves, each of which refers to a different gap ratio.*

In Fig. 2 take on the horizontal axis a point P corresponding to the magnetic-motive force per cm. chosen‡. Draw any

* MS. accepted by the Editor, September, 1933.

† C. R. Hanna, *J. Am. Inst. El. Eng.*, 46, 1927, p. 128.

‡ *i.e.*, the value obtained by dividing the total magneto-motive force by the total mean path through iron and air-gap.

line PQR to cut the left-hand curve. Then, anticipating for the moment any mathematical proof of the statement, we assert that LI^2/V equals twice the area of the shaded triangle and that by drawing a horizontal line RS and a sloping line SP we find an angle α such that tan α equals the gap ratio a/x. A similar construction starting from Q gives another and larger value of α with a consequently larger gap ratio.

Thus in general there are two gap ratios each of which gives the same value of LI^2/V.

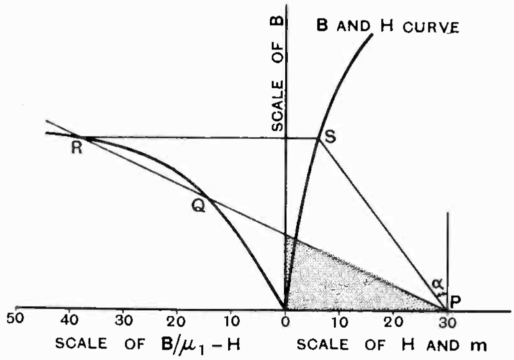


Fig. 2.

It is evident that with P fixed the largest value of LI^2/V is obtained when PR is a tangent to the curve. In this case Q and R coincide and there is only one value for the gap ratio—the optimum value.

Section 3.—Mathematical Proofs

To prove that twice area of shaded triangle $= m^2 . dB/dm$. The magneto-motive force round the whole magnetic circuit is $Hx + Ba$. Hence the average magneto-motive force per cm. is given by*

$$m = H + Ba/x \quad \ldots \quad (1)$$

When the magnetic quantities change by the amounts dm, dH, dB,

$$dm/dB = dH/dB + a/x \quad \ldots \quad (2)$$

Eliminating a/x between (1) and (2) and remembering that $\mu_1 = dB/dH$,

$$dm/dB = 1/\mu_1 + (m - H)/B \quad \ldots \quad (3)$$

Therefore

$$B . dm/dB = B/\mu_1 + (m - H) \quad \ldots \quad (4)$$

* To a close approximation: strictly we should divide by $x + a$ instead of x.

Now in Fig. 3 $PO = m$

$$OT = B/\mu_1 - H$$

Therefore $PT = m + B/\mu_1 - H$

or by (4) $PT = B . dm/dB \quad \ldots \quad (5)$

and $RT = B \quad \ldots \quad (6)$

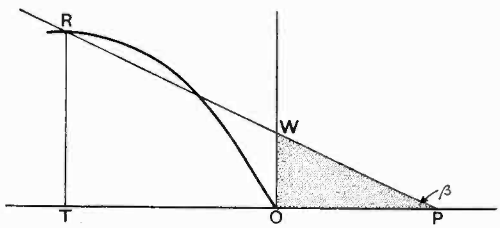


Fig. 3.

Hence $\tan\beta = RT/PT = dB/dm$ by (5) and (6) $\ldots$ (7)

Accordingly twice area of shaded triangle

$$= \tan\beta \times OP^2$$
$$= m^2 . dB/dm \quad \ldots \quad (8)$$

To prove that $LI^2/V = m^2 . dB/dm$.

Since inductance is rate of change of linkages with current

$$L = TA . dB/dI \quad \ldots \quad (9)$$

Since magneto-motive force per cm. = current × turns/cm.

$$m = TI/x^* \quad \ldots \quad (10)$$

Eliminating T between (9) and (10) we have

$$L = mxA/I \times dB/dI$$
$$= mV/I \times dB/dI \quad \ldots \quad (11)$$

Now $dB/dI = dB/dm \times dm/dI$

or in view of (10)

$$= dB/dm \times m/I \ldots (12)$$

Eliminating dB/dI between (11) and (12) we have

$$L = mV/I \times m/I \times dB/dm$$

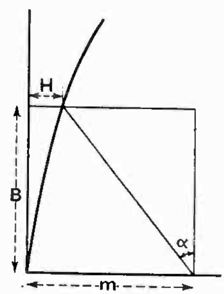


Fig. 4.

Hence

$$LI^2/V = m^2 . dB/dm \ (13)$$

To prove that LI^2/V = *twice area of shaded triangle.*

This follows at once from (8) and (13).

To prove that the gap ratio = *tan* α.

From Fig. 4 $\tan \alpha = (m - H)/B$

From (1) $a/x = (m - H)/B$

Hence a/x, the gap ratio = $\tan \alpha$.

Section 4.—Practical Applications

For purposes of design it is desirable to use a practical system of units and in Fig. 5, which represents the data* for stalloy, the horizontal scale is expressed in ampere-turns per cm. while the vertical scale is, as before, expressed in gauss. μ_1 is derived from these practical units as shown in Fig. 6.

The two fundamental relations now become

$$\frac{LI^2}{V} \times 10^8 = \text{twice area of shaded triangle}$$

where L = henrys, I = amperes, V = cubic centimetres and the gap ratio $= \frac{4\pi}{10} \times \tan \alpha$.

Thus if $m = 40$ amp-turns per cm.

$$LI^2/V = 2 \times \text{area of triangle} \times 10^{-8}$$
$$= 7{,}800 \times 40 \times 10^{-8}$$
$$= 3.12 \times 10^{-3}$$

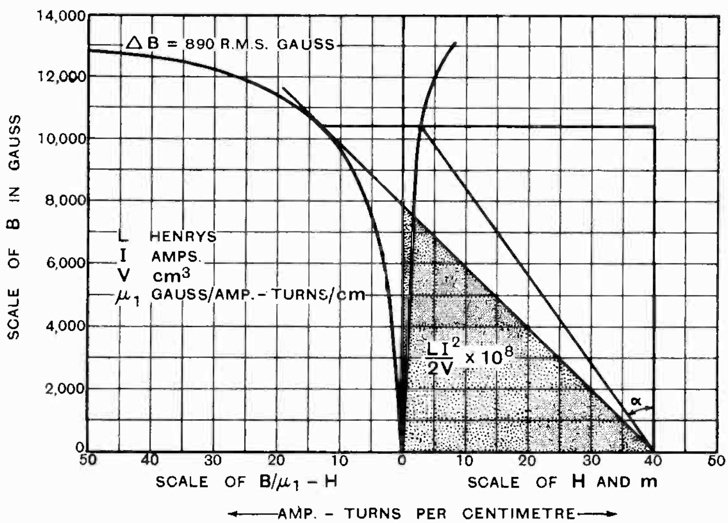


Fig. 5.

and if $I = 0.1$ amp. and $V = 100$ cm.^{3} then $L = 31.2$ henrys.

Again the gap ratio $= \frac{4\pi}{10} \times \tan \alpha$

$$= \frac{4\pi}{10} \times \frac{37.3}{10{,}400}$$
$$= 4.5 \times 10^{-3}.$$

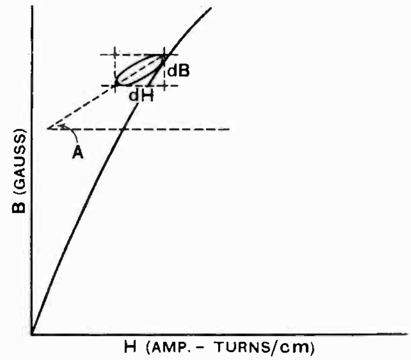


Fig. 6.—*If at any point of the $B - H$ curve a small cyclic variation in H is superposed, a hysteresis loop is obtained. The incremental permeability is defined as $\mu_1 = dB/dH$, and evidently $\mu_1 = \tan A$.*

The percentage decrease in inductance due to a given variation of the gap ratio from the optimum value, is easily ascertained from Fig. 5.

If no gap is used then, referring to the lettering of Fig. 2, we must draw PS vertically from P to meet the $B - H$ curve: SR will then intersect the left-hand curve at a very remote point R and the slope of the line PR will be small, so that the shaded area will be greatly reduced. Even for such a small value as $m = 5$ the inductance is reduced to 59 per cent. of its optimum value by failure to provide an air gap.

* The data are taken from Symons: *Experimental Wireless*, 1928, p. 485.

A Thermionic Valve Amplifier
for use with a
Duddell Oscillograph*

By W. Jackson, M.Sc.

(College of Technology, Manchester)

THE direct application of the vibrating mirror type of oscillograph to the investigation of transient phenomena in audio-frequency networks is frequently impossible because the currents available are too small for immediate use. This difficulty can be overcome, however, by the provision of a device capable of amplifying voltage, subject to its satisfying the following conditions. In the first place, the device must have so high an input impedance that its connection to the network under investigation does not modify the impedance characteristics of the latter. Secondly, the device must amplify linearly in the steady state, and, finally, its own transient response to suddenly applied voltage pulses must exert no distorting effect on the transient wave to be amplified.

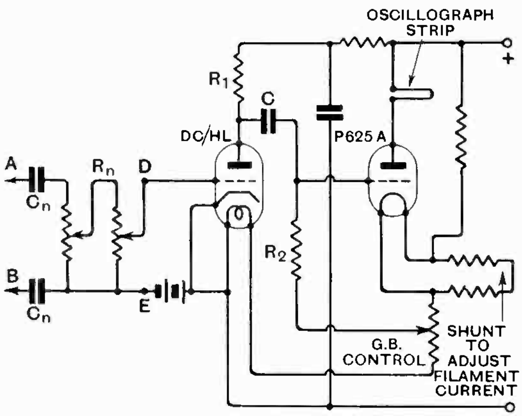


Fig. 1.

The first requirement of an approach to infinite input impedance is satisfied in a thermionic valve amplifier biassed to avoid grid current, while linear amplification is largely a question of suitable adjustment of the operating voltages. The ability of linear networks to respond without distortion to suddenly applied voltage pulses of arbitrary form is specified completely, through the Principle of Superposition, by their ability to reproduce ideally the unit voltage pulse, as represented by a voltage wave of zero value up to time $t = 0$—the reference or switching-in time—and of value unity for all values of $t > 0$. Excepting the conductively resistance-coupled amplifier, all thermionic valve amplifier circuits, in that they contain inductive and capacitive elements, give a distorted reproduction at their output terminals of a unit voltage pulse applied to their input. With a suitably designed resistance-capacity coupled amplifier, however, this deviation from the ideal can be made sensibly unimportant. The deviation consists of a gradual, as opposed to an instantaneous, rise in output voltage at $t = 0$, followed by a gradual decay in voltage after the maximum has been reached, as against the required maintenance of constant voltage following this attainment. The former results from the presence of stray capacitance between grid and filament, grid and plate, and across the anode load resistance, but the delay in voltage rise from these causes will generally be small compared with the normal lag in response of the oscillograph strip. The tendency of both these effects is to reduce the ability of the combined equipment to record high-frequency variations. The decay of output voltage results from the presence of the intervalve coupling condenser. The time constant of this decay is directly proportional to the coupling condenser value, and is given by $T = \dfrac{C(R_1R_2 + R_2R_a + R_aR_1)}{R_1 + R_a}$, where C is the coupling capacity, R_a the valve internal resistance, R_1 the anode load resistance, and R_2 the grid leak resistance (Fig. 1). By making C sufficiently large this time constant can be made appreciably

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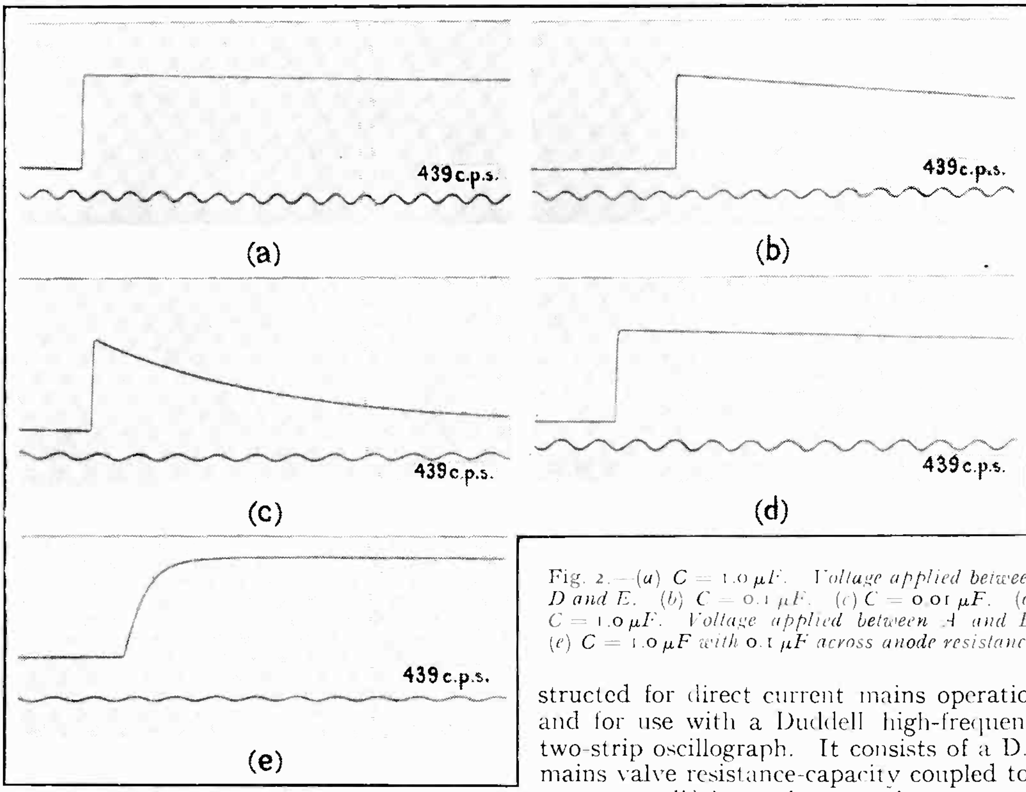


Fig. 2.—(*a*) $C = 1.0 \mu F$. *Voltage applied between D and E.* (*b*) $C = 0.1 \mu F$. (*c*) $C = 0.01 \mu F$. (*d*) $C = 1.0 \mu F$. *Voltage applied between A and B.* (*e*) $C = 1.0 \mu F$ *with* $0.1 \mu F$ *across anode resistance.*

greater than that of the lowest frequency phenomena to be recorded.

Fig. 1 shows the details of an amplifier constructed for direct current mains operation, and for use with a Duddell high-frequency two-strip oscillograph. It consists of a D.C. mains valve resistance-capacity coupled to a power amplifying valve carrying one strip in its anode circuit. This strip is at high potential relative to the amplifier input terminals, and relative to any network

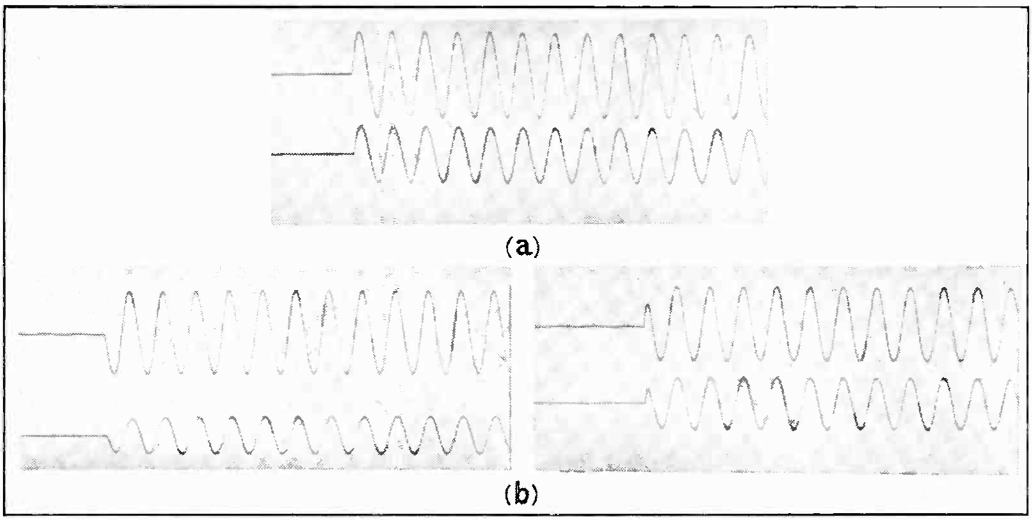


Fig. 3.—(*a*) *Strips in series.* (*b*) *Input to (lower) and output from amplifier.*

across a portion of which the amplifier may be connected. The danger exists, therefore, of imposing full mains voltage between the two strips should the other strip be connected directly to the network under investigation. This possibility can be avoided, however, by the addition of the condenser-resistance feed circuit C_nR_n. While this addition causes the output voltage of the amplifier, in response to a unit voltage pulse applied between A and B, to decay more rapidly than if the voltage were applied between the terminals DE, its effect can be made relatively unimportant by making the time constant of the feed circuit very high by use of large values for C_n and R_n. The use of a potentiometer for R_n gives a valuable flexibility to the amplifier by increasing the range of voltage values which can be handled without introducing non-linear distortion.

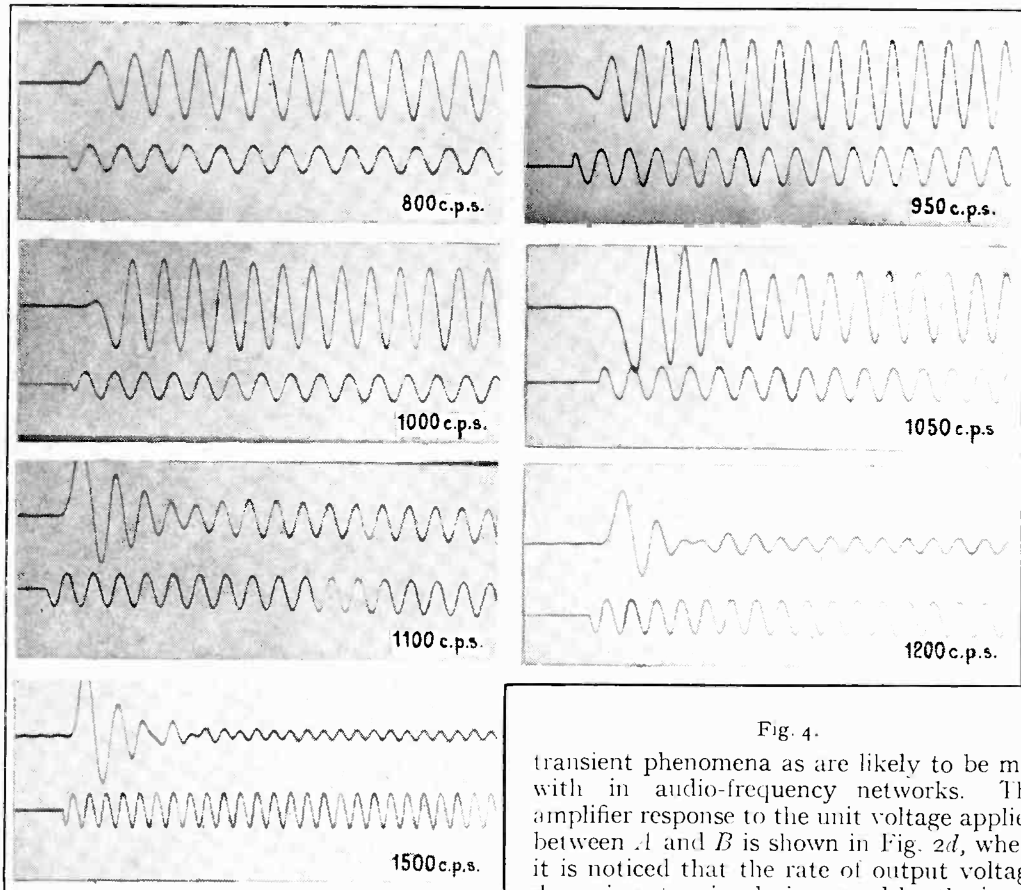


Fig. 4.

The performance of the amplifier in response to the application of the unit voltage pulse between the points DE is shown in oscillograms 2*a*, 2*b* and 2*c*, which correspond to values of 1.0, 0.1 and 0.01 microfarad respectively for the intervalve coupling condenser C. It is seen that the rate of decay of the output voltage increases as C decreases, and that the use of 1.0 microfarad for C permits of accurate recording of such transient phenomena as are likely to be met with in audio-frequency networks. The amplifier response to the unit voltage applied between A and B is shown in Fig. 2*d*, where it is noticed that the rate of output voltage decay is not seriously increased by the input isolating arrangement.

The action of stray shunting capacitance in retarding the initial response is brought out by Fig. 2*e*, which resulted on the application of voltage between DE with 1.0 microfarad for C and with 0.1 microfarad across the anode load resistance R_1. This gives an exaggerated impression, but demonstrates the nature of the effect.

The ability of the complete equipment to reproduce alternating phenomena is shown by Figs. 3*a* and 3*b*. Fig. 3*a* resulted on the sudden application of an 800 cycle per second voltage to a resistance network through the strips in series, while Fig. 3*b* shows the response as recorded direct on one strip and after passage through the amplifier on the other.

The oscillograms of Fig. 4 illustrate the application of the amplifier in obtaining records of the building-up process in a three-section low-pass filter,* of cut-off frequency (if correctly terminated in its hypothetical characteristic impedance) 1,000 cycles per second, under suddenly applied alternating voltages at frequencies both inside and outside the transmission band. The filter was actually terminated, at both ends, in the nominal characteristic impedance and energised from a generator of very low transfer impedance. The lower trace in each case represents the applied voltage to the network, and the upper the voltage as measured through the amplifier across the output termination. The input voltage was maintained approximately constant throughout the series of measurements, but the potentiometer R_n was adjusted at each recording to compensate for the increasing attenuation in the region of and beyond the cut-off frequency, and to provide a trace of adequate amplitude.

* For a theoretical discussion of this problem, *see* W. Cruickshank, "Voice Frequency Telegraphy," *I.E.E. Journ.*, Vol. 67, 1929, p. 813.

New Light Modulator for Television

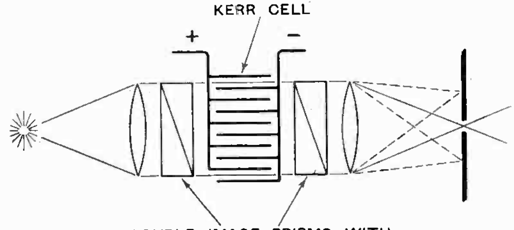
A Recent Demonstration

IT is generally agreed that the use of a Kerr cell for light modulation in Television has two serious disadvantages. Primarily there is considerable absorption of light by the liquid dielectric employed, usually nitrobenzene, and secondly the liquid under stress gradually becomes disintegrated, carbon molecules being deposited on the electrodes. These carbon molecules are highly conducting so that the efficiency of the device is at once impaired when the resistance of the cell is thus reduced. Both of these drawbacks seriously affect the commercial employment of the cell as a light modulator.

In a paper read before the Television Society, on Dec. 13th, Mr. L. M. Myers described in detail, and then demonstrated, a novel application of piezo-electric quartz designed to overcome the objections referred to above. The principle underlying the device was that the intensity of light emerging from the polariscope in which the piezo quartz was introduced depended entirely on the amplitude of vibration of the crystal. In an earlier demonstration in the lecture a long glass strip was set into vibration and it was seen that at the node of vibration at which point the stress in the glass was greatest the field of the polariscope became brilliantly illuminated. The same effect took place when the quartz crystal was set into vibration by means of a local single valve oscillator tuned to about 100 metres. Thus the crystal was vibrating in the direction of the electric axis at 3 megacycles.

By modulating the oscillations of the local oscillator it is possible to vary the strength of the signal and thus the vibration amplitude of the crystal. This, in turn, controls the illumination of the field and the relation between intensity of light and control voltage is a linear one.

Mr. Myers also introduced a new form of double image polariscope for use either with the crystal or with the present type of Kerr cell. In demonstrating this device two double image prisms were used for the polariser and the analyser. They were disposed in such a manner that their principal planes were parallel and two spots were formed on the screen when an image of an aperture was projected through them. But on the introduction of stressed material within the polariscope a third central spot was formed and gradually as the stress became greater the light from the two outside spots became concentrated on the centre one. Finally, when the stress was such that half wave retardation was set up the central spot received all the light and the two outside spots became extinguished. Actually the centre spot was formed by two beams of light; one the ordinary ray of the polariser, and the other the extraordinary ray of the polariser. Thus, both beams were used as against the one beam of the present type single-image polariscope. By interposing a screen with a central aperture, it is possible to prevent the decentralised spots from reaching the Television screen and thus it will be



illuminated by light passing through the centre aperture only. In the figure the Kerr cell is shown disposed in the double-image polariscope, the dotted lines show the paths of the two beams when the cell is unstressed. These, of course, do not pass through the screen.

H. A. HANKEY.

The Performance of a Thermionic Tube as Rectifier *

By T. Tanasescu

I.—General

THE performance of a thermionic tube can be determined using the characteristic of the tube and taking into account the electric elements of the rectifying circuit.

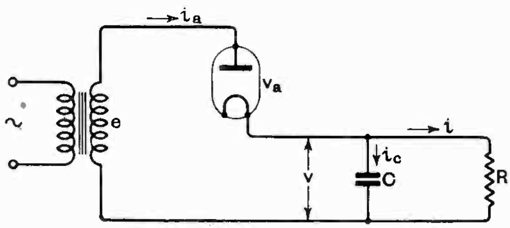


Fig. 1.

Let us consider the simplest circuit in which the diode is used as a rectifier. The circuit (Fig. 1) contains the diode, a resistance R and a condenser of capacity C, for smoothing the d.c. tension across R. When the anode is at a positive potential with respect to the filament, a certain current i passes through the resistance R and the condenser C is charged. The next instant, when the anode potential is negative relative to that of the filament, no current flows to the anode, but the condenser C is discharged, so that a current is flowing through the resistance R, even during this interval.

The interpretation of the following equations allows an exact understanding of the phenomena :

$$e = E \sin \omega t = v + v_a$$

$$v = Ri$$

$$i_a = f(v_a) \text{ the characteristic of the tube}$$

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

and $i_a = i_c + i$

The problem to be resolved is the following : given E, $f(v_a)$, C and R, to determine first the mean values V and I of v and i respectively, and secondly, it is interesting to know the variation of i_a, v, i and v_a during a period. We may look at the problem also from another point of view : for instance, instead of R, V may be looked upon as known, so that R has to be determined afterwards instead of V.

From the point of view of the radio engineer, it is interesting to know first the characteristic of the rectifier $V = f(I)$ when R—the load—has different values, and secondly, the maximum variation of v with respect to the mean value V, in a period.

It is difficult to give a solution of the problem without making some hypothesis which may not be realised in practice.

The method described here is exempt from this inconvenience, and it can be applied in any case met in practice.

We suppose—as a first approximation—that *the rectified potential v is constant during a period.* The rectifying process tends to this condition.

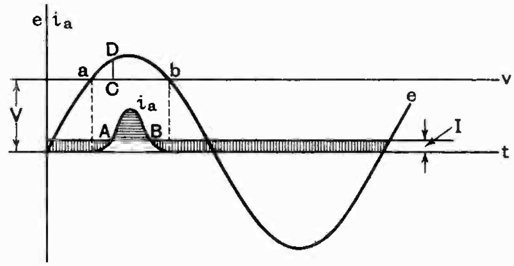


Fig. 2.

The anode current i_a may then be determined as a function of time, plotting in a diagram (Fig. 2) the sinusoidal value of e as a function of time and at the same time the straight line $v = V$. The segment $\overline{CD}$, the difference between e and v, represents at any moment the anode potential v_a. When this potential is positive, then the anode current i_a has a certain value, corresponding to the characteristic of the valve $i_a = f(v_a)$.

* MS. accepted by the Editor, February, 1933.

We suppose that the characteristic of the valve is already known. Using this characteristic we can draw the curve (Fig. 3) of the anode current during a period; for each segment $\overline{CD}$ we find the corresponding value of the anode current on the valve characteristic.

We pass next to the determination of the mean value I of the current i, in a period, which is at the same time the mean value of i_a. (In the first approximation, when the rectified tension V is supposed to be constant during a period, the current i must also remain constant.) This value is determined using the anode current diagram and a planimeter.

The value of R is deduced by dividing V by I.

We have to take now in account *that v is not perfectly constant*, but that it varies during a period.

The condenser current is represented at each moment by the difference $i_a - i$ or $i_a - I$. The charging and discharging periods of C can be easily seen in Fig. 2. During the charge, the potential of C increases slightly—contrary to the first hypothesis which supposed $v =$ constant. This increase $\frac{1}{C}\int i_c dt$ above the mean value, is proportional at any moment to the corresponding area between A and the considered moment, striped horizontally in Fig. 2.

The total variation of the tension v is represented by the area between A and B. Passing the point B, we can determine in a similar way, at each moment, the decrease of v under the highest value it had in B (Fig. 3).

The variation of v between a and b is represented by the total area delimited by i, minus the area of the rectangle of base ab and height I.

Thus, we can draw the variation curve of v during a period. Dividing this curve by R we obtain the variation curve of i.

It is interesting to know how the mean value I, calculated above, supposing $v =$ constant, is affected by the variation of v. We plot first the variation of v remarking that it is not necessary to calculate for too many points the integral of v. It is sufficient to integrate between a and b, in order to obtain the total variation of v between these points. We divide this value in two halves adding and substracting them from V and we determine thus the two points of intersection of the curves e and v (Fig. 3). The variation of v may be roughly represented by a straight line passing through the two points of intersection or—more exactly—by a portion of a curve (the dotted line in Fig. 3) determined by the slope of the tangent in its inflection point $\left(\frac{i_{a\,\max.}}{C}\right)$.

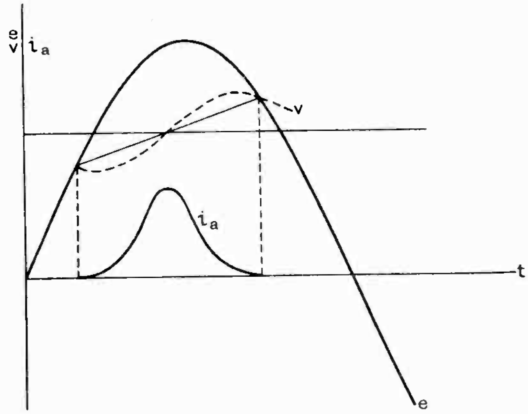


Fig. 3.

Having drawn the curve of variation of v during the charge period, we proceed to a new determination of the curve i_a as a function of time, using the valve characteristic, as it has already been done above: for a difference $e - v = v_a$ (Fig. 3) we seek on the characteristic the corresponding value of i_a. We deduce, by means of a planimeter, the area delimited by i_a and we find a new and correct value of I; this value is generally smaller than that obtained above. We can now make a correction to the variation of v, but a third approximation is not needed, because the values already obtained are sufficiently exact for practical purposes.

The problem is thus entirely solved. For a given value of the rectified tension V we have found the rectified direct current I. We may calculate, in the same way, other pairs of values V and I in order to get the characteristic of the rectifier. It is worthy of note, that instead of the capacity of the smoothing condenser, we might have taken as known the highest possible variation of this tension, corresponding to full load; then this capacity would have been determined so that the rectified tension may not have variations higher than a given limit, during a period. (It should be noted here that the first hypothesis $v =$ constant is equivalent to the use of a condenser of very big capacity.)

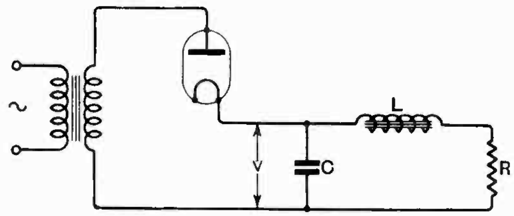


Fig. 4.

If the rectifier is provided also with a choke coil (Fig. 4) for a more efficient filtering of the rectified tension, we may extend the calculation, in order to determine the final rectified tension. The value of the inductance L must be as big as possible if we want to reduce the variations of v. If we take into account only the fundamental of the periodic variation of v—the smoothing effect of the harmonics increasing with their order—we may state that $L\omega$ has to be big compared with R. Only a part of the variation of v—equal to $\frac{R}{L\omega}$—will be transmitted to the terminals of R. Thus, if the amplitude of the fundamental v is denoted by V_1, the amplitude of the fundamental of the variation of the tension across R will be $\frac{R}{L\omega} V_1$. (The variation of the tension across R is nearer a sinusoidal curve than the variation of v, due to the efficient smoothing effect of the harmonics through L.)

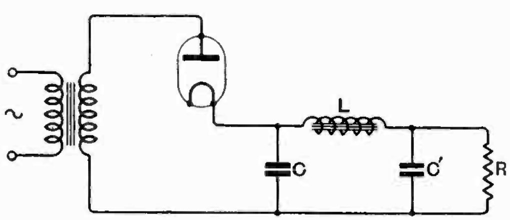


Fig. 5.

We could say the same concerning the rectified current: its variations are reduced in the same ratio as the variations of v.

If the rectifier uses a filter π (Fig. 5) the filtering is better, the amplitude of the fundamental of the variation of the tension across R being $\frac{V_1}{C'L\omega^2}$.

It is obvious that in this case $\frac{1}{C'\omega}$ has to be smaller than R, and that the frequency of resonance of L and C' must be lower than the frequency of the fundamental.

The method described here can be applied also in the case of polyphase rectifiers.

II.—Remarks Concerning the Valve Characteristic

In order to predetermine the performance of a thermionic valve as a rectifier, we have to use a characteristic of the valve taken

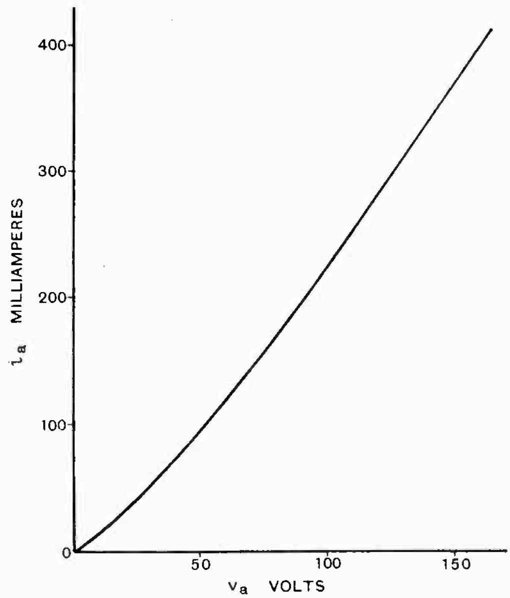


Fig. 6.

in the same conditions of overheating of the filament as those which take place in practice when using a rectifying circuit.

In the case of direct heated valves, during the rectifying process, the values reached by the anode current are sometimes comparable with the values of the filament current. In this case the anode current flowing through portions of the filament may overheat it. This overheating increases at the same time as the value of the anode current. It is probable that the overheating may be constant during a period, owing to the thermal inertia of the filament.

Therefore, when using the valve characteristic in order to find the anode current—for instance, for the anode tension $\overline{CD}$ (Fig. 2)—we have to make sure that the corresponding point on the valve characteristic was obtained in the same overheated conditions of the filament as those which occur in the effective rectifying process.

III.—Application of the Method to a Philips 505 Valve

The characteristic of the valve was determined, using an indirect experimental method which took into account the observations made above. The curve obtained is shown in Fig. 6. Assuming then the rectifying circuit of Fig. 1 containing the same valve, we determined the performance of the circuit, supposing

$E_{ef} = 400$ volts, $V = 400$ volts, $C = 8\mu$F.

We have drawn in Fig. 7 the sinusoidal curve e, and the horizontal line (v) and have determined for each ordinate limited by the sinecurve and the horizontal line, the corresponding anode current (using the characteristic Fig. 6).

We thus obtain the curve (i) of mean value 60.7 mA (this case corresponds to

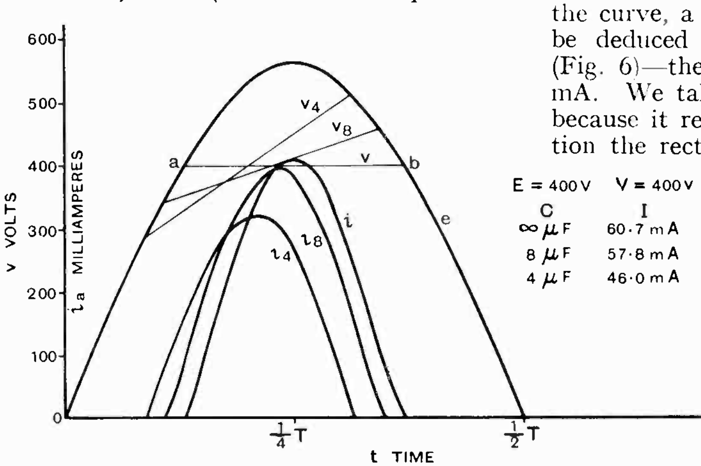


Fig. 7.

$C = \infty$). By subtracting from the area deduced before and used in finding the mean value, the rectangle of base ab and height 60.7 mA, we obtain the quantity of electricity which has passed into C and thus determine the total variation of the rectified tension v. We obtain 114 V, *i.e.*, 57 V above and 57 V below the mean value of 400 volts. Assuming that the tension v increases proportional to the time during the charge we

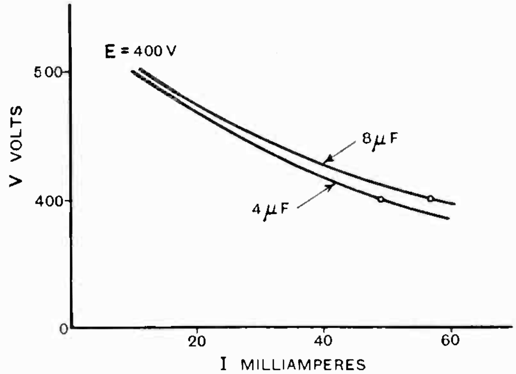


Fig. 8.—*Philips rectifying valve* 505.

determine on the curve e the two ordinates:

$$400 + 57 = 457 \text{ v. and } 400 - 57 = 343 \text{ v.}$$

We obtain in this way the line (v_8) representing the variation of v.

We see then that $v_a = e - v_8$ has a different variation during a cycle from that assumed at the beginning.

From these new values of v_a, taken from the curve, a new curve (i_8 Fig. 7) of i_a can be deduced from the valve characteristic (Fig. 6)—the mean value of which is 57.8 mA. We take this as the final value of I, because it represents to a close approximation the rectified direct current. The load resistance is

$$\frac{V}{I} = \frac{400}{0.0578} = 6{,}920 \text{ ohms.}$$

Secondly, we have considered the case

$E_{ef} = 400$ v., $V = 400$ v., but $C = 4\mu$F.

The filtering being less efficient, the variation of v is twice that obtained above (108 V. above and below the mean value) and the mean value of the rectified anode current is 46 mA.

We have checked these calculated values with those deduced from experiments; in Fig. 8 are represented two experimental load characteristics of a rectifier using a Philips 505 valve. One curve is for $C = 8\mu F$ and the other for $C = 4\mu F$. The curve for $8\mu F$, gives for 400 V a rectified current of 57 mA instead of 57.8 mA as calculated, and the curve for $4\mu F$, 49 mA instead of 46 mA calculated.

We have to note that the errors increase when the variations of v increase; this is due to the fact that the initial hypothesis that v is constant, is more inaccurate. In conclusion, errors higher than 6 per cent. cannot occur if the variations of v above and below the mean value are not bigger than 25 per cent. of this mean value.

In practice, the variations of tensions are always less than 25 per cent. The method may thus be applied in all practical cases.

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.

Beat Frequency Oscillator

To the Editor, The Wireless Engineer

SIR,—I should like to express my appreciation of the highly instructive article by M. F. Cooper and L. G. Page, on Beat Frequency Oscillators, which appeared in your September issue.

As I found it necessary to employ such a device at the factory where I am chief engineer, I had an instrument constructed on approximately the same lines, but with slight alteration to meet my particular need. The stability of the oscillator is most surprising, and, although I have previously attempted the design and construction of this type of generator, I have never had such successful results.

In your December issue I notice a letter by Mr. A. W. Stewart, which raises an interesting point. Possibly my understanding of the matter is not correct, and with it an altogether too great a realisation of my lack of knowledge on the subject, that I venture to suggest that the original explanation of the high-frequency component present is the correct one. Your correspondent says that the surface noise of gramophone records is apercodic. If so, how it is possible to arrange a tuned scratch filter rather passes my comprehension.

To my mind, any sound must have a definite electrical equivalent wave form, and if valve hiss is audible, it must have a wave form of some description or other.

It is noticeable that the phenomena mentioned only occurs when working at high gain, and it does not appear in the other photographs where presumably the gain was lower.

I personally would welcome a little more light on the subject. F. G. MORGAN.

Manchester.

Detector Characteristics

To the Editor, The Wireless Engineer

SIR,—Some recent practical investigations on detector performance have led me to discover something which, so far as I know, has not been revealed before. If the phenomenon is well known, however, it is quite useless to publish this letter.

We were anxious to analyse the performance of valves which could efficiently simultaneously perform the functions of detector and power output valve. In order to test the detector linearity we set up a circuit which is illustrated in regard to essentials in Fig. 1.

We plotted V_o against I_a and were surprised (and gratified) to find the resulting curve to be a sensibly straight line right up to $V_o = 0$. The usual bottom bend (so described because most people plot $\triangle I_a$ against V_o) did not show itself. I suggested connecting a valve voltmeter between grid and filament and plotting V_g against I_a. The curve plotting V_g against I_a was quite different from the curve plotting V_o against I_a, the latter being typical of ordinary detector curves as we know them. The curves I_a against V_o and V_g are shown in Fig. 2.

The explanation of the discrepancy between the two curves is, I suggest, explained when it is realised that grid leak detection produces, between grid and filament, a source of strong harmonics of the (fundamental) frequency applied to the detector.

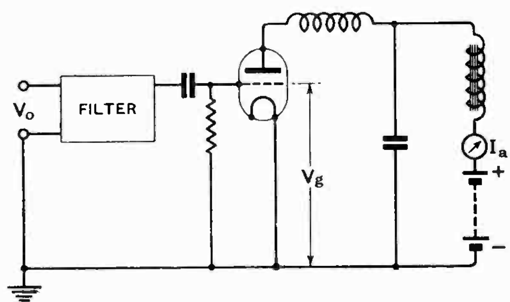


Fig. 1.

The readings of a valve voltmeter of the Moullin type are, I understand, greatly influenced by the amount of harmonic content in the voltage to be measured. The band pass filter in Fig. 1 will prevent the grid-circuit generated-harmonics from affecting the reading of a voltmeter at the input end of the filter. Moreover, this voltmeter was, in the experiment, a hot wire low impedance instrument.

In order to see if, in fact, the harmonics in the grid circuit were appreciable, I arranged a frequency selective voltmeter between grid and earth and thereby isolated and measured the harmonic

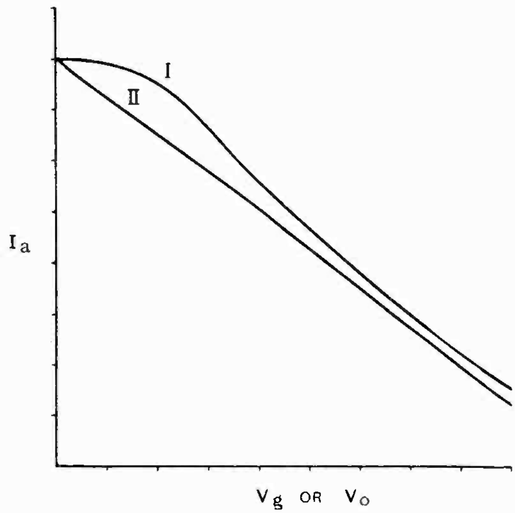


Fig. 2.—*I* = V_g *(measured by valve voltmeter) against* I_a.
II = V_0 *against I.*

content. The $2n$ harmonic appeared to be of the order 15 per cent. of the fundamental and was therefore quite strong enough to produce fictitious readings on the valve voltmeter measuring V_g.

I was using throughout these experiments frequencies of the order 20-40 kc/sec.

I hope that the information I have given, showing once again the necessity always to question the method by which quantities are measured, may be of some value and interest to your readers.

London, S.W.3. P. P. ECKERSLEY.

Electron Coupled Transmitter

To the Editor, The Wireless Engineer

SIR,—It is with considerable interest that I have read the article in the *Wireless Engineer* for December on High Power Pentode as an Electron Coupled Transmitter. You will recollect that I recently submitted to you an article on these lines, but owing to pressure of business I was unable to re-arrange it according to your requirements for publication.

It is very interesting to note that I commenced work on this type of oscillator early in 1930, and that all the circuits described are covered by British Patents Nos. 380144 and 357244. It appears that Lieutenant J. B. Dow in America must have been working on the same lines at much about the same time.

I note that the authors state that by the use of a pentode they estimate to make neutralising unnecessary. Actually I found that the amount of screening possible by the suppressor grid was negligible, and that neutralising had to be applied, the major function of the suppressor grid being to prevent the development of negative resistance if at any time the instantaneous screen grid voltage should exceed the instantaneous anode voltage.

The point to which neutralising had to be applied depended on the ratio of the voltages on the first two grids and the ratio of their capacity to the other electrodes—for example with 160 peak volts on the first grid, and 100 peak volts on the second grid, a small neutralising capacity had to be connected between the second grid and the anode.

With equal voltages on these grids no neutralising is necessary, and with the higher voltage on the second grid the neutralising condenser has to be connected from the anode to the first grid.

If, therefore, satisfactory operation could be obtained with equal voltages on the first two grids, neutralising would be avoided. With the standard valves which I had available, this was not possible, and a small amount of neutralising had to be included.

The ratio of these voltages also affects the output, for it is obvious that as the first two circuits are oscillating, their voltages are 180° out of phase, and the question of which voltage controls the anode swing depends on the relative amplitude, and it was found that the best output and efficiency was obtained with a ratio of peak volts on grid 1 to peak volts on grid 2 of .76.

The variations of output with varying ratio of voltages on the two grids led to the possibility of harmonic generation by distorting the anode current wave form due to the swing on the second grid, for at the point of maximum instantaneous anode current, the control grid or grid 1 is positive, and the second grid is at its minimum instantaneous voltage.

The effect of this on the anode will be that the positive instantaneous voltage of the first grid will tend to increase the flow of anode current, while the lower instantaneous voltage on the second grid will tend to decrease this.

By obtaining the correct ratio of the D.C. voltage on grid 2 to the D.C. voltage on the anode, and the correct ratio of A.C. voltage on the first two grids, the anode current may be distorted almost in any desired manner. Variation of the negative voltage on grid 1 may also be used to accentuate the production of harmonics. In fact it is possible to so arrange these voltage relations that at the point of maximum instantaneous positive voltage on grid 1, the anode current may be reduced to a value less than 50 per cent. of its peak value, while the peak anode current will occur at points on either side of the maximum positive grid voltage, thus producing a double humped wave form.

In one arrangement a harmonic analysis was carried out of the wave form obtained by static methods, that is the instantaneous voltages were calculated for different ratios of A.C. grid voltages and D.C. voltage, and applied to the valves by D.C. and the instantaneous current noted. Admittedly this is not an accurate method, but it did indicate that the device could be arranged as a very good harmonic generator, and the figures obtained from an analysis of the wave form so derived indicated that 66 per cent. second, fourth, and fifth harmonic might be obtained.

Unfortunately, these figures were never checked with the aid of a cathode ray oscillograph, but it seems possible that for short wave working the master oscillator could be set at a wavelength of 20 metres, while 10 or 5 metres at reasonable efficiency would be obtained in the anode circuit. The efficiency of 5 per cent. given by the authors seems very low.

With the neutralised circuit or with equal voltage swings on the grids, the frequency stability for changes of output tuning is extremely good, and with the output circuit completely out of tune on either side a change of beat note of 400 to 500 cycles in 3,000 kilocycles was all that was noticed.

With regard to modulation, attempts to modulate on the suppressor grid were not successful.

The valves used in these experiments were Marconi PT.4 and Mullard PM.24.B, and it was found that at zero bias no current was obtained on the suppressor grid.

Modulation was carried out on these valves on the second grid, and it was found that quite a linear relationship existed between the D.C. voltage on this grid and output current up to a point where grid voltage approached 40 per cent. of the anode voltage.

For best operating A.C. voltage relationship between the two grids, the maximum output was obtained with a D.C. voltage to the screen or second grid of 55 to 60 per cent. of the anode volts. This point gave a maximum telegraph output, and for modulation the grid voltage had to be reduced to about 30 per cent. Under these conditions a good depth of modulation up to 70% without distortion was possible.

No doubt with a specially constructed valve, modulation on the suppressor grid should be possible, but I doubt if this grid can ever be used for proper screening without increasing the impedance of the valve beyond all reason.

The authors are very fortunate in being able to get a valve specially constructed. My experimental work was sadly limited by the unwillingness of the valve manufacturers to produce a valve designed to work in this manner, with the result that the high capacity of the ordinary pentode limited the wavelengths which I could reach, and experiments below 40 metres could not be carried out.

Several small power transmitters have since been built incorporating this device, and working on wavelengths between 50 and 200 metres, which have given very satisfactory results. Furthermore, as a harmonic generator for use in the early stages of a high power transmitter, this circuit with one valve or two in push-pull should give good results.

I trust you will be able to spare the space in your correspondence column to publish this letter.

Ruislip, Middx. A. D. HODGSON.

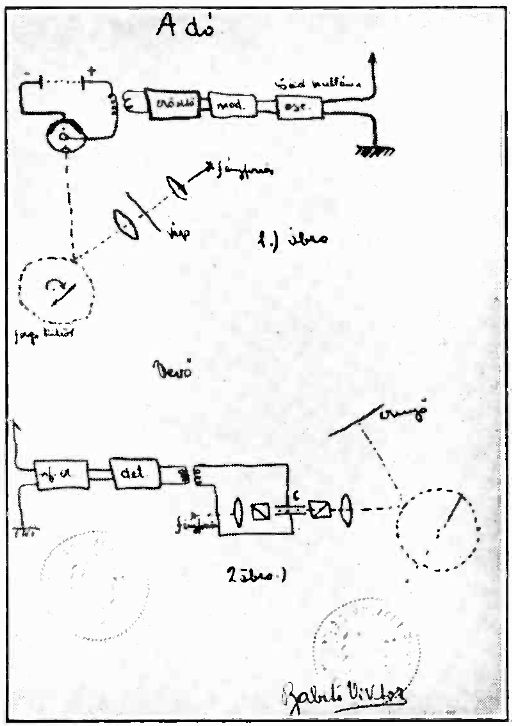
A New Television Receiver

To The Editor, The Wireless Engineer

SIR,—On page 540 in the October, 1933 issue of your journal appeared a photograph and a description of a new television receiver founded on Baird's mirror drum principle.

As is already mentioned elsewhere in the English literature, this principle is that the picture of the person or object to be televised is dissolved into its elements by a Weiller mirror drum (Staged-mirror) after which it is reflected on a photo-electric cell, with the amplified current of which we modulate a transmitter device. In the receiver apparatus of this television system the received signal modulates the intensity of a polarised light beam passing a Kerr-cell, which light beam is then reflected from the Weiller mirror drum, this rotating synchron to the mirror-drum of the transmitter device, on to a screen, where the image of the televised object appears.

Referring to this, it may interest you to hear that F. Schröter published the device mentioned above in the *Telefunken Zeitung*, page 16, October, 1928, and that the Telefunken Society introduced this same device on the occasion of an exhibition in 1929.



I myself lodged exactly the above mentioned device at the Royal Hungarian Patent Office already on the 1st April, 1926, with the number 3750/B.10106, as can be seen from the enclosed photograph made of the official copy of my announcement. Besides, I published the device at the same time in the *Magyar Radio Ujsag*.

VIKTOR BABITS.

University of Technical Sciences,
Budapest, Hungary.

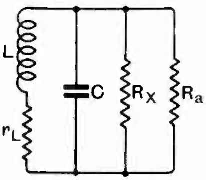
Applications of the Dynatron

To the Editor, The Wireless Engineer

SIR,—Mr. Scroggie asks for comments on the discrepancy between theory and experimental results in connection with the oscillation frequency of a dynatron oscillator.

A consideration of his circuit arrangement shows that the resultant applied negative resistance

$$R_a' = \frac{R_a R_x}{R_a + R_x}$$



is constant throughout the experiment, and if its components are purely resistive, cannot alter the frequency of oscillation.

If the circuit magnification had been reduced by increase of the series circuital resistance (r_L), the results would, no doubt, have conformed to the equation

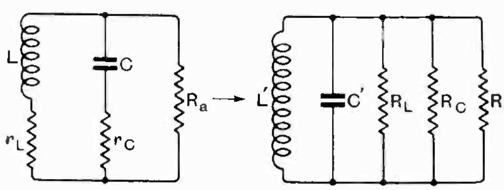
$$\omega = \sqrt{\frac{1}{LC}\left(1 + \frac{r_L}{R_a}\right)} \qquad \ldots \quad \ldots \quad (1)$$

The stimulation of oscillation by the simple neutralisation of circuit resistance will always result in an oscillation of pulsatance

$$\omega = \sqrt{\frac{1}{LC}}$$

provided that the values of L and C here considered are those consistent with their respective losses being expressed as parallel resistances if the source of power is applied in parallel, or as series resistances if the source of power is applied in series.

In the usual case the losses are expressed as a series resistance and the source of power is applied in parallel, and the resultant correction to be applied to the LC value often (but need not) contains that unfortunate scapegoat R_a. In my opinion, it is best to transfer all losses to the parallel connection before application of R_a. It will then be clearly seen that the deviation from the LC value is quite independent of R_a, but depends only on how L and C were measured.



For maintenance

$$\frac{1}{R_L} + \frac{1}{R_c} + \frac{1}{R_a} = 0$$

$$L' = L\left(1 + \frac{r_L^2}{\omega^2 L^2}\right)$$

$$C' = C(1 + \omega^2 C^2 r_c^2)^{-1}$$

$$\therefore \quad 1 = \omega^2 L'C' = \omega^2 LC \left\{\frac{1 + \dfrac{r_L^2}{\omega^2 L^2}}{1 + \omega^2 C^2 r_c^2}\right\}$$

whence (approx.)

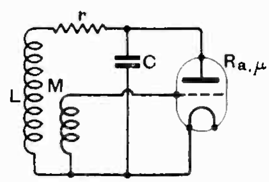
$$\omega^2 LC = 1 + \frac{C}{L}(r_c^2 - r_L^2) \qquad \ldots \quad \ldots \quad (2)$$

It will be seen that ω increases with r_c and decreases as r_L increases, this latter result being in agreement with experimental results but directly contrary to that indicated by equation (1) as interpreted by McLachlan (*W.E.* 9 p. 132 3/32) and others. R_a and r_L in this equation are not independent variables.

It is possible to make the oscillation frequency conform to the "LC value" by making $r_c = r_L$, or by putting a reactance in series with R_a, or, dare I suggest, by altering L or C. None of these methods will confer directly any additional degree of frequency stability upon the circuit, nor will the use of a low decrement circuit as suggested by Percival. The second method, as shown by Prof. Mallett, leads to the interesting result that, if r_c is assumed to be negligible, the series reactance required is an inductance of value equal to L. Any losses in the condenser branch, however, or parallel losses across the tuned circuit will cause the required inductance to be greatly reduced. Thus it may be possible to explain Mallett's experimental results without recourse to the postulation of a non-linear R_a.

The above can be applied equally well to the triode generator, which can readily be seen to have an equivalent dynamic valve resistance

$$R_a' = R_a\left(1 + \mu\frac{M}{L}\right)^{-1}$$



on the assumption that the valve is non-reactive and there is no leakage in the transformer. It is the presence of these impurities, the effect of which is dependent on R_a, which makes the feedback oscillator so variable in frequency. Of course, the use of a low decrement circuit contributes indirectly to the stability as it allows the value of R_a to be increased, thus lessening the effective values of the transmitted impurities.

In conclusion, may I protest against the use of formulae in which the sign of a resistance is changed in order that a negative resistance may be given positive values (as in Mr. Scroggie's and Dr. McLachlan's contributions to your journal). In most cases the resistance is not inherently negative, and when positive must be regarded as having negative values; a confusing state of affairs.

G. FARREN CLARKE.

Handsworth,
Birmingham, 20.

The Physical Society's Exhibition

Matters of Wireless and Allied Interest

THE Twenty-Fourth Annual Exhibition of the Physical Society, held at the Imperial College, South Kensington, on 9th, 10th and 11th January, again fulfilled its now well-established function of keeping the scientific worker informed as to the latest practices and developments in the tools of his craft. As has been the case in each of the past few years, the observer again could not but be struck by the increasing degree to which apparatus primarily of wireless origin is being adapted to other purposes, concurrently indeed with a notable general tendency to utilise electrical indication wherever possible.

The thermo-junction thermometer with remote electrical indication is, of course, an old device, and new forms and applications for various industrial purposes were prominent, *e.g.*, at the stand of the CAMBRIDGE INSTRUMENT Co. Another typical example of increasing commercial interest is that of the photocell and electrical indication for a large number of luminous measurements and comparisons. The use of such devices as "exposure meters" is fairly recent and a number of instruments of this type were shown by the "optical" firms, such as J. H. DALLMEYER, as well as by the more "electrical" concerns, such as WESTON, G.E.C. (Salford Instruments), EVERETT EDGCUMBE,

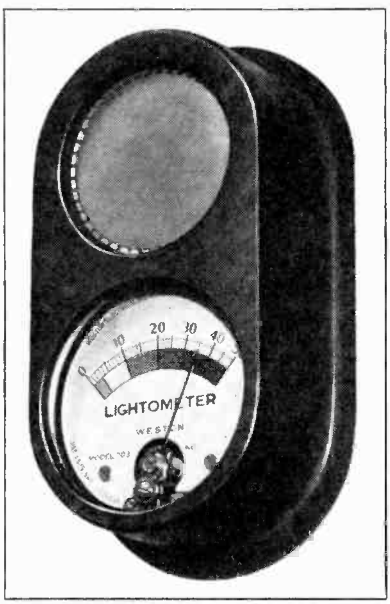


Fig. 1.—*Weston Model 703, portable illumination meter, calibrated in foot-candles.*

including instruments of this type for the measurement of reflections from polished surfaces.

Another relatively new electrical application was that of the electrical tachometer and speed indicator increasing numbers and improved models of these being shown by several makers—G.E.C. (Salford Instruments), RECORD ELECTRICAL Co., etc.

A particularly interesting new application of a

Fig. 2.—*Weston radio set analyser, Model E665.*

wireless principle was shown in the various magnetostriction devices for marine echo-sounding shown by H. HUGHES AND SON.

Electrical Measuring Instruments

General electrical measuring instruments (of the ammeter voltmeter type) again showed development rather than radical novelty.

Perhaps the most wide display of this class was that of the WESTON ELECTRICAL INST. Co. In addition to their well-known standard and sub-standard instruments and a range of various portable instruments, this Company showed an extensive range of portable testing instruments for radio service—set analysers, output meters, capacity meters, etc.—and a range of meters of the "photronic" type and of the speed-indicator and allied type.

The display of FERRANTI, LTD., was also chiefly devoted to instruments of the smaller class and contained some new and useful types. Valve testers and radio-service testers were special features, as were also an a.c./d.c. test set and an a.c./d.c. "fundamental" instrument giving—with simply applied external attachments—an extremely wide range of a.c. and d.c. values. Amongst developments in electrostatic voltmeters should be mentioned new instruments of 0–150 v. scale and another of 0–12 kv scale.

A very extensive exhibit of measuring instruments was also made by ERNEST TURNER, LTD., including miniature instruments in a 2 $\frac{1}{16}$-inch case available as d.c. microammeters and voltmeters, as thermal and hot-wire instruments, as rectifier instruments and as moving-iron voltmeters and ammeters. At the other end of the scale was an extensive range of instruments of the switchboard type, while this company also featured output meters of constant impedance type, capable of calibration in decibels for power-level checking.

In addition to laboratory equipment, mentioned later, SALFORD ELECTRICAL INSTS. (G.E.C.) showed several novel instruments, *e.g.*, of the logarithmic scale type, a linear decibel-meter and several instruments of the photronic and tachometer type.

EVERETT EDGCUMBE'S exhibit comprised rectifier instruments of low scale-values, but of robust construction, a.c. ohmmeters for various purposes, programme and timing clocks and various industrial recording instruments in which this firm specialises, as well as photoelectric photometers.

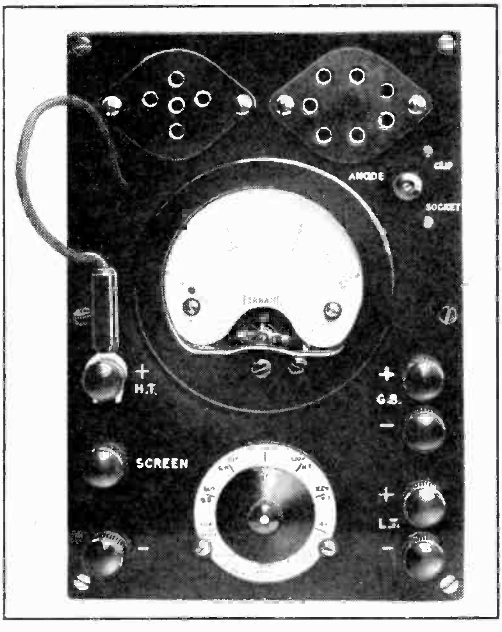


Fig. 3.—*Ferranti universal valve tester.*

In addition to a large number of intruments of the "power" type, ELLIOTT BROS. had a display of remote electrical indication of various quantities, while amongst small instruments were shown miniature a.c. and d.c. miniature instruments of 2 inch dial and of "miniature edgewise" type in a particularly neat construction.

A new instrument by EVERSHED AND VIGNOLES was a capacity meter of the "Megger" type, while the same firm showed a new circuit tester of highly portable type, in addition to a complete range of their "Megger" type instruments.

The display of the RECORD ELECTRICAL Co. ("Cirscale" instruments) was chiefly devoted to instruments of the tachometer type, while NALDER BROS. AND THOMPSON devoted their exhibit chiefly to instruments of the power class, as did CROMPTON PARKINSON, LTD., who also had a display of their well-known range of galvanometers.

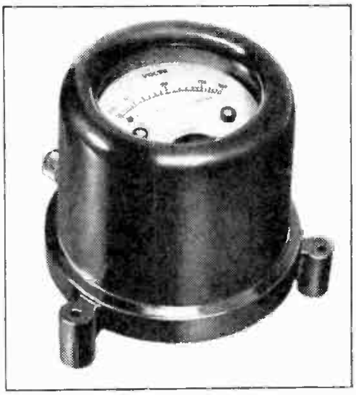


Fig. 4.—*Ferranti electrostatic voltmeter* (0-150 *volts*).

Laboratory and Measuring Apparatus

As was the case last year it was again extremely difficult to draw a hard-and-fast line between apparatus of the "laboratory" class and measuring gear of a more "engineering" character.

The display of H. W. SULLIVAN, LTD., was devoted entirely to apparatus of this class for radio- and audio-frequency work, including frequency standards and wavemeters, audio oscillators and a.c. bridges, capacity bridges and test sets, and inductance and capacity standards for all frequencies. Amongst frequency standards and wavemeters should be mentioned the latest model of the Lucas-Sullivan Quartz Frequency Standard (50 kc/sec.), a Rack-Mounted Crystal-Controlled Frequency Equipment (1 to 10 000 kc/sec.) and the Sullivan Griffiths Dynatron Oscillating Wave-

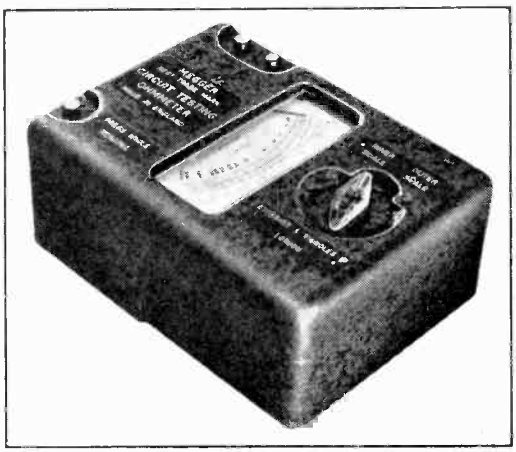


Fig. 5.—*Evershed and Vignoles "Megger" circuit tester.*

meter (10 to 10 000 metres). Amongst L.F. gear the heterodyne oscillator to the design of Dr. Ryall of the P.O. Research Laboratories, shown last year in the Research Section, was displayed this year as a production model.

MUIRHEAD AND Co. also showed standard frequency apparatus based on the N.P.L. 1 000 cycle fork while new high frequency apparatus included a new precision heterodyne wavemeter (30 to 30 000 metres), and a radio-frequency oscillator for servicing purposes. This firm also had an extensive display of new components and accessories, such as non-reactive decade resistances, gain control potentiometers, screened attenuation

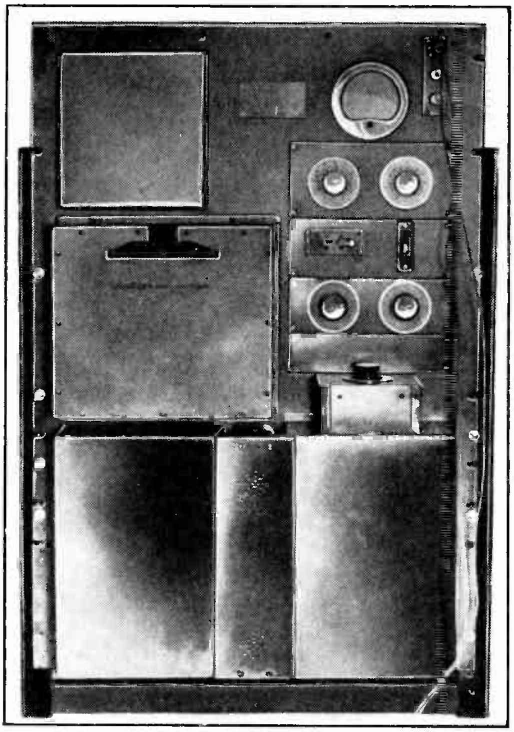


Fig. 6.—*Ryall-Sullivan precision heterodyne oscillator.*

boxes, logarithmic volume controls, and a group of rack-mounted measuring gear comprising bridges, attenuation networks, etc.

In addition to the instruments already mentioned the SALFORD ELECTRICAL INSTRUMENTS (G.E.C.) had a range of all-metal test apparatus for various types of laboratory and test purposes, this construction being used for oscillators, amplifiers, bridge circuits, valve voltmeters, etc., as well as units for power supply and time-base supply for cathode-ray tubes. This company also had a display of inductances and magnetic materials for all frequencies,

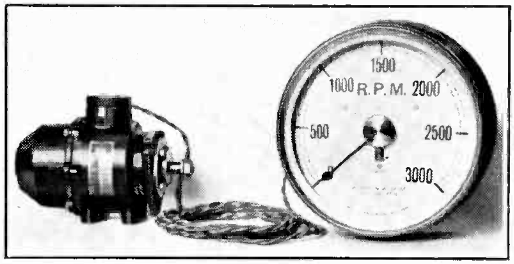


Fig. 7.—*Record electrical revolution indicator.*

including their "Gecalloy" and their make of "Ferrocart" for radio-frequency work.

STANDARD TELEPHONES AND CABLES had a display devoted entirely to apparatus of laboratory and allied use. Prominent was their cathode-ray oscillograph equipment, comprising, besides the tube itself, a most extensive range of auxiliary apparatus including supply and time-base units, frequency-comparison units, dual-wave units and various camera units. This display constituted the most complete supply of cathode ray oscillograph equipment that has appeared on the market from one firm. Other items of this firm included an acoustic noise meter, a heterodyne oscillator (20 c/sec. to 11.5 kc/sec.) attenuation networks, transmission measuring set and other items of telephone and communication practice as well as a radio servicing test-set and a service station signal generator.

The exhibits of the CAMBRIDGE INSTRUMENT Co. contained rather less than usual of interest in the radio laboratory, but mention should be made of the high-speed cathode ray oscillograph, shown last

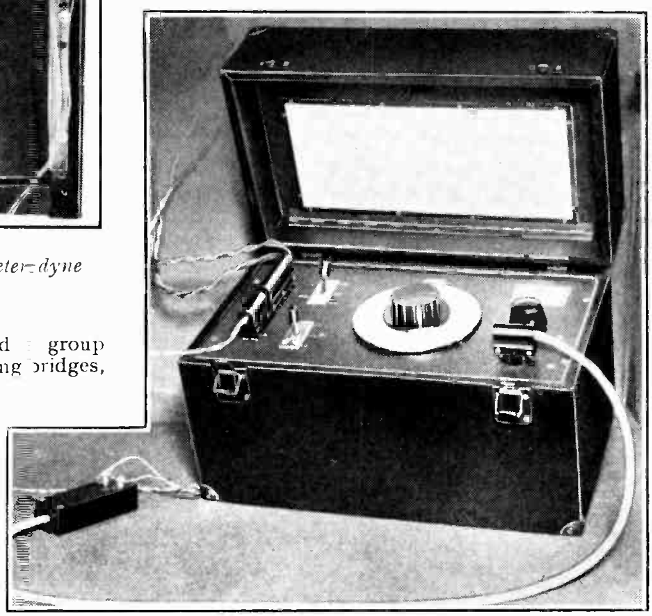


Fig. 8.—*Muirhead type 5-A service test oscillator.*

year in experimental form and on view this year in a production model. A 1 000 cycle reed hummer was a new feature as an L.F. source, while other new instruments included a capacity meter cable fault localiser and a resistance-meter accessory to the Company's versatile galvanometer, already well known to laboratory workers.

GAMBRELL BROS AND CO., LTD., had a display devoted chiefly to bridges and associated apparatus, variable and fixed precision condensers and radio-

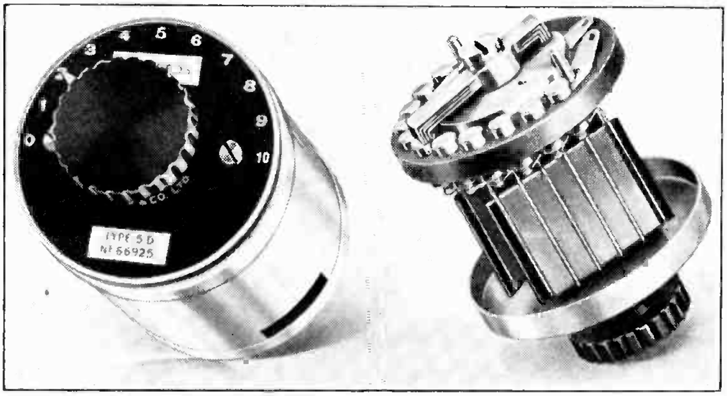


Fig. 9.—*Muirhead non-reactive decade resistances.*

frequency instruments comprising resistance boxes and bridges for high frequency and a wavemeter of 20 to 2 000 metres for operation by absorption or self-oscillation.

The display of H. TINSLEY AND Co also contained a large variety of bridges, non-inductive resistance boxes, attenuators, potentiometers, etc., the latter including a new form of Dr Drysdale's a.c. potentiometer. Other new instruments included a capacity meter for rapid measurement and an electrometer valve voltmeter for voltage measurements in circuits of very high resistance. Another feature of laboratory interest was the adaptation of this firm's portable self-contained reflecting galvanometer in a number of calibrated forms. This was shown as a rectifier voltmeter (0-0.18 v), microhmmeters, etc., forming a useful range of sensitive but robust laboratory tools.

The association of wireless practice with other physical measurements was excellently illustrated by the valve potentiometer shown by W. G. PYE AND Co., this being an extremely sensitive device intended for the rapid determination of hydrogen ion concentration, although adaptable to other laboratory purposes.

A new and inexpensive cathode ray oscillograph was exhibited by ISENTHAL AND Co. Unfortunately this was not demonstrated in operation, but was stated to be available with photographic or visual screens, while the dimensions suggested the possibilities of high deflectional sensitivity.

Wireless Apparatus and Accessories

The displays of more purely wireless interest were again those of the MARCONIPHONE Co. and of the MARCONI WIRELESS TELEGRAPH Co. The former exhibited several of their standard model receivers, *e.g.*, models 276, 272, and 269, as well as their 4-valve and 7-valve radiogramophone sets. This company also had a very complete display of Marconi valves including "Catkins," new h.f. pentodes, class "B" valves, and indirectly heated rectifiers.

The Marconi Co. showed a short-wave diversity receiver, complete with combining apparatus along with valve diathermy apparatus, mains operated. Another instrument by this company was an LC circuit of 100-3 000 kc. with valve detector and galvanometer indicator as a frequency meter.

The exhibit of the WESTINGHOUSE Co. was largely devoted to radio interest in connection with their metal rectifiers. "Westectors" for high-frequency applications were on display, while the company's normal range of supply rectifiers was also shown, as well as power panels, and a new type of high-voltage rectifier for high-potential small-current applications. This company's stand also contained a

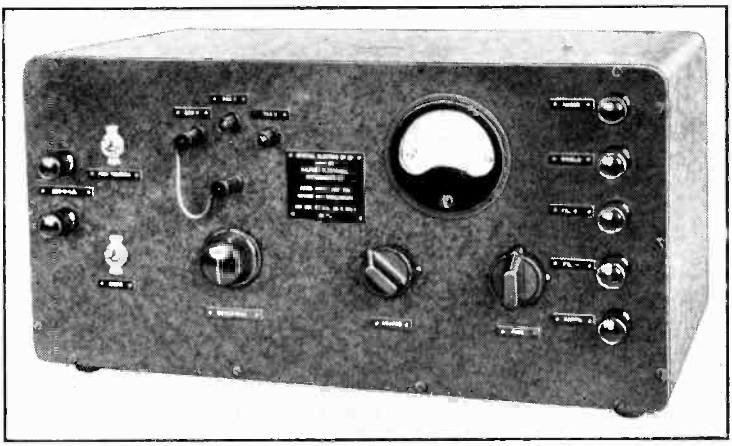


Fig. 10.—*Cathode ray power supply unit—an example of the all-metal instruments of Salford Electrical Instruments Ltd.*

selection of instruments of various makers incorporating their metal rectifiers.

The EDISWAN Co.'s display was devoted almost

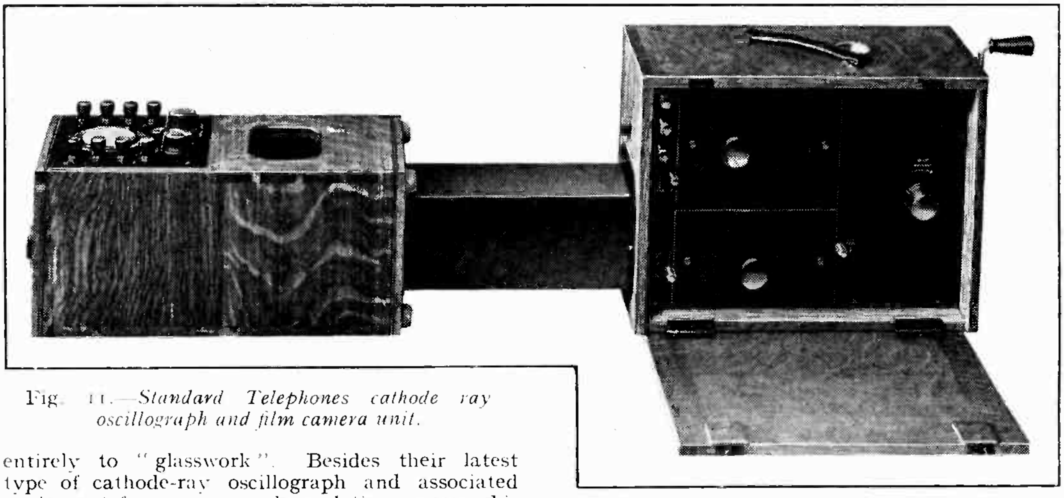


Fig. 11.—*Standard Telephones cathode ray oscillograph and film camera unit.*

entirely to "glasswork". Besides their latest type of cathode-ray oscillograph and associated equipment for power supply and time sweep, this included screened grid valves for short waves, high-output L.F. valves, mercury vapour rectifiers of various sizes, barretters, and special thyratrons for use with cathode ray tubes.

The exhibit of the DUBILIER CONDENSER CO. was devoted entirely to condensers and noise-

Fig. 12.—*Standard Telephones linear time base unit.*

suppression devices. The former included a complete selection of the firm's well-known condensers, including their various new electrolytic models, while the noise suppression devices comprised condenser filters, choke-condenser filters and condenser-resistance suppressors for sparking contacts as well as various suppressor units for use in automobile radio.

Other subsidiary apparatus was shown in the exhibits of the BRITISH ELECTRICAL RESISTANCE CO.—rheostats, potentiometers, fixed wire-wound resistors, the ZENITH ELECTRIC CO.—resistances, fixed and variable, transformers, noise-suppression filters, etc.

As is usually the case, this section contained a considerable number of exhibits of wireless and allied interest.

The exhibit of the NATIONAL PHYSICAL LABORATORY contained capacity and inductance elements for an oscillatory circuit of high frequency-stability, viz., a temperature-compensated variable condenser and a temperature-compensated inductance, the combination intended for use as a master oscillator. Another exhibit of interest was an instantaneous (cathode ray) direction finder for operation on short-duration signals for collision-prevention as in conditions of fog at sea, this being demonstrated in operation.

THE POST OFFICE RESEARCH STATION (Dollis Hill) showed a valve oscillator with automatic control of purity and output, using an auxiliary valve; also an oscillator giving constant output independent of load or supply voltages, using a gas-discharge valve as a controlling device. Other apparatus was for harmonic analysis of audio-frequency current waves (using a balanced modulator of the Carson type) and a rectifier network for correcting valve distortion in an amplifier.

THE EDISWAN CO. had an exhibit in this section illustrating the use of the cathode-ray tube, including a demonstration of television, while MR. R. W. CORKLING also showed apparatus for generating saw-tooth voltage for cathode-ray television scanning.

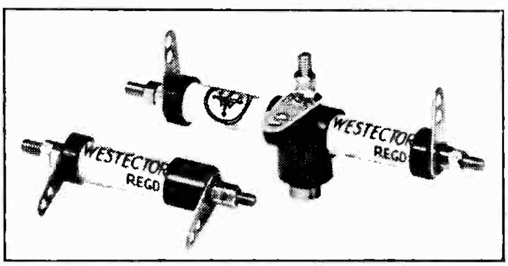


Fig. 13.—*Westinghouse type "WX" "Westectors" for radio frequencies.*

THE G.E.C. RESEARCH LABORATORIES (Wembley) showed a valve test-set designed to measure the static and dynamic curves of valves of all types, along with scales for determination of the harmonic content of output valves. Other H.F. exhibits comprised capacitative attenuators for high radio frequencies, exhibit of a new construction of receiving valves for accurate mass production and a new type of mains-operated valve voltmeter, a modification of a model shown in the commercial section last year.

In the Research Section the MARCONI Co. had an exhibit of an ultra-high-frequency oscillation generator (for medical purposes), using a split-anode magnetron, while another interesting exhibit was the Marconi-Stille Recording Apparatus, this being on the steel-tape system, the exhibit being arranged on an endless band to give a short-period delay (comparable to an echo-period) between the recording and reproducing processes.

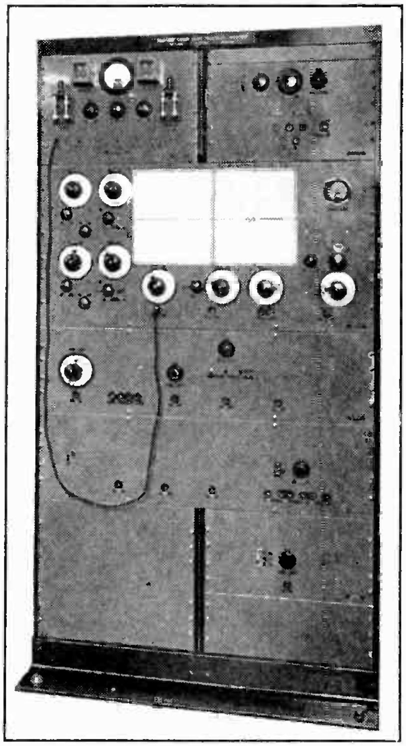


Fig. 14.—*Marconi "Diversity" receiver for short waves.*

MR. F. C. CONNELLY had exhibits showing the projection of valve characteristics by means of two oscillographs and several forms of relaxation oscillators, while MESSRS. L. S. PALMER, D. TAYLOR and R. WITTY had an exhibit showing the current distribution round a short-wave frame aerial and DR. N. L. YATES-FISH had a demonstration of the properties of short waves (65 cm.) reflection polarisation, diffraction, interference, etc.

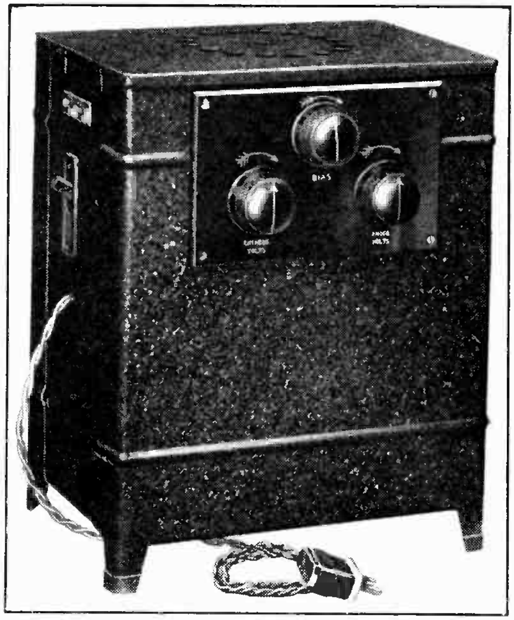


Fig. 15.—*Ediswan power supply unit for cathode ray tubes.*

Book Review

Electricity.

By JOHN PILLEY. Pp. 348 + xiv., with 181 diagrams and illustrations. *Oxford University Press*, Amen House, Warwick Square, London, E.C.4. Price, 7s. 6d.

The underlying idea of this book seems to be to describe all electric and magnetic phenomena in terms of the modern knowledge of electrons and protons. The author in the Preface says that the "present book does not claim to be a text-book, nor is its primary purpose to impart knowledge of the kind usually demanded in examinations. Its aim is to arouse interest in the science of electricity by making its logic appear in the clearest possible light."

In carrying out this plan, the author appears to assume no previous knowledge of electricity and magnetism, and in consequence although there is a great deal that is of very great interest to a wireless engineer, there is also a great deal of somewhat elementary matter.

While the number of footnotes and references to later pages in the book destroy continuity of the early chapters, ancient and modern are occasionally strangely blended, and the wireless man will read the following with amusement: "One of the most familiar forms of condenser with solid dielectric is the Leyden jar," and a little later: "Condensers are sometimes also made by interleaving sheets of metal foil with plates of suitable dielectric." E.M.

Beam Arrays

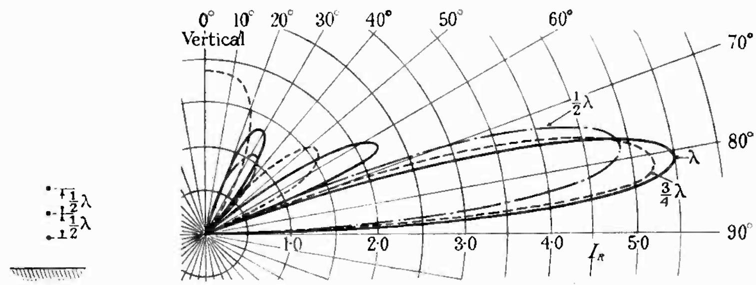
Investigation of the Economic Factors of Design

Paper by Mr. T. Walmsley, B.Sc., read before the Wireless Section, I.E.E. on January 3rd, 1934

Abstract

THE first part of the paper gives an extended discussion of theoretical and experimental work on the arrangement and elevation of arrays for the purpose of projecting the signal energy at various angles to the vertical. The concentration in one such angle of elevation is illustrated by considering successively one-tier, two-tier, and three-tier arrays of horizontal aerials, the vertical polar diagram of the last named being shown in Fig. 5.* The polar diagram of an eight-tier array is also shown in Fig. 19.

Details are given of small-scale tests and of large-scale tests between Rugby on the one hand and America, Teneriffe and Germany on the other.

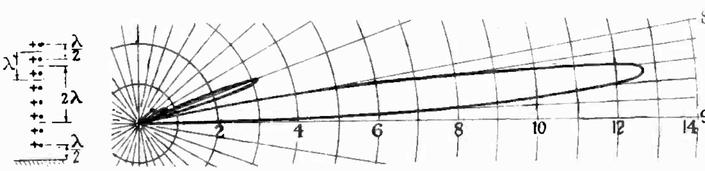


(*Above*) Fig. 5.—*Vertical polar diagram of horizontal 3-tier aerial in normal vertical plane. (The sketch on left represents horizontal radiators above earth.)*

——— *Lower radiator* 1 *wave-length above earth.*

— — — *Lower radiator* ¾ *wave-length above earth.*

— · — · *Lower radiator* ½ *wave-length above earth.*



(*Below*) Fig. 19.—*Vertical polar diagram of field strength for the 8-tier aerial shown on left (the dots represent horizontal radiators above earth).*

The tests were made primarily with the practical object of ascertaining whether particular angles of projection of a beam resulted in improved field-strength values at the distant receiving station. The American tests were more comprehensive and exact than the others, and it was usually possible to measure the downcoming angle at the receiving end at the same time as the angle of projection was measured at the transmitter. The first fact of note was that the best angle of projection on 20.78 metres during daylight conditions appeared to be about 78° to 80° to the vertical. As the distance between transmitter and receiver is about 5,400 km., this angle suggests that propagation takes place in two skips from an ionised layer 460 to 400 km. high. Since local measurements at Slough gave heights of the *F* layer usually between 200 and 300 km., it could also be argued, with a greater degree of probability, that three skips were made, the height of the layer being between 275 and 230 km. With this height two skips would require an angle of projection of approximately 85° to 86.5°. which values are usually too high to permit penetration of the *E* layer, even in winter when ionisation is a minimum. Repeated tests giving maximum radiation between 85° and 86° failed to produce evidence of appreciable energy being received by a path starting from the transmitting aerial at such angles, and the received fields supported the view that the major portion of the received energy was projected from the transmitter at angles around 80°. It was a note-worthy fact that the downcoming angle was quite independent of the type of transmitting aerial used.

With regard to the angle of reception in U.S.A., generally on 20.78 metres, the average value varied a few degrees on both sides of 76°, with a few occasions when angles greater than 85° were registered.

With regard to tests on 30.645 metres, sufficient evidence was not yet available regarding the best angle of projection, although tests in November, 1932 showed definitely that the angle was about the same as with the 20.78-metre transmissions.

The practical conclusions can be summarised by stating that there is a definite relationship between the value of field-strength at the receiver and the angle of projection of the ray at the transmitter. This angle depends on the distance apart of the stations and on the ionisation of the *E* and *F* layers, varying with the time of day, the season and the year. In the case of transmissions on

* The author's original figure-numbers are adhered to throughout.

20.78 metres from Rugby to New York, for all-daylight conditions an angle of projection varying a few degrees on either side of 79° to the vertical was found best. These results prove the necessity whenever a new service is under consideration, of making tests over a reasonable period to ascertain the best angle of projection, and of repeating these tests at regular intervals after the service has been inaugurated.

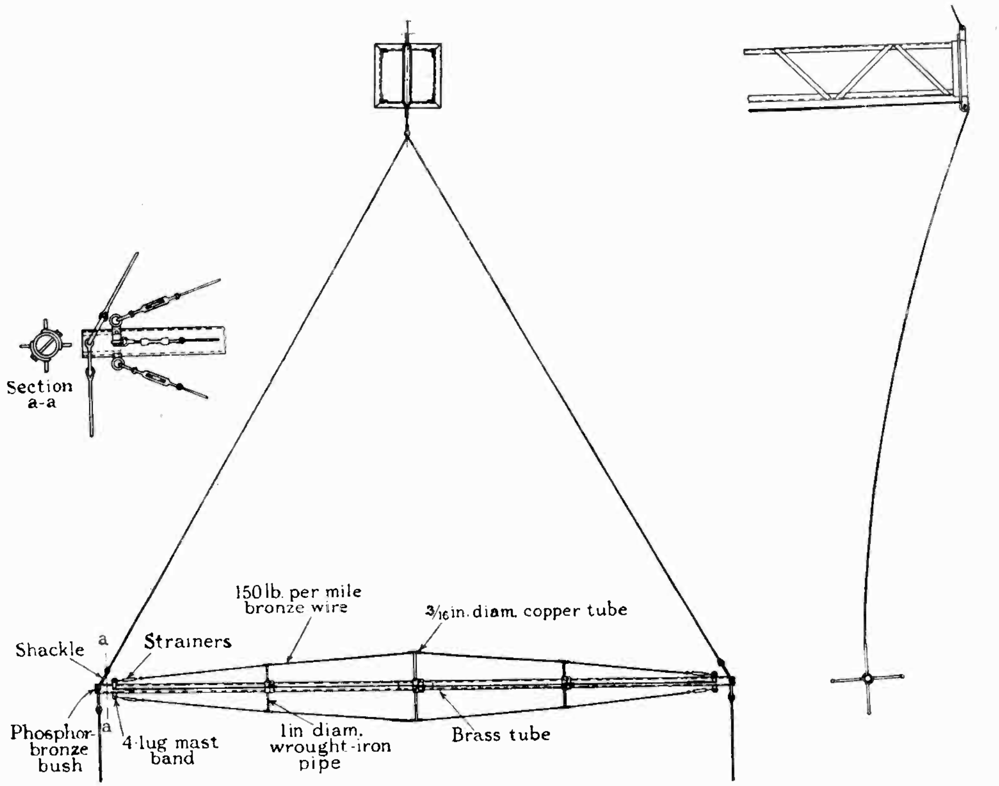


Fig. 28.—*Spreader for short-wave arrays.*

The second part of the upper discusses supporting structures for arrays. Design cannot be divorced from cost, and since the greatest cost usually lies in the structure it is necessary to have data for computation. This section therefore briefly discusses wind-load, bracing, strut formulae, etc. Arrays usually have two curtains suspended about ¼ wavelength apart from the cross arms of towers. This necessitates provision for torsional resistance in the design of the towers, since for maintenance purposes it might be necessary to remove one of the curtains. The provision of a cross arm increases the cost of each tower very appreciably, not only on account of cost but also owing to the increased mass of the tower which has to be designed to resist torsion and the extra top wind-load. To remove this objection the author has designed spreaders built up of central tubes and outer silicon-bronze tension wires. A typical design and the method of suspending the spreader from a tower are shown in Fig. 28. The longest spreader as yet used is of 24ft., a length suitable for an array designed for a wavelength of 30 metres. An additional advantage of the spreaders is that they enable the whole array to be lowered in one operation, since they are suspended from one steel rope passing over a pulley at each tower.

The third part of the paper discusses transmission lines. In the case of feeders to transmitting aerials, the total loss in the lines is usually of greater importance than the distribution of radiation from the lines. On the reception side however, particularly where feeders from different aerials run fairly close to each other, the distribution of the field from the transmission lines is more important. Transmission lines generally may be of open-wire or concentric-tube type, and curves given in the paper illustrate that although the calculated values of the resistance losses of the two types are almost the same there is an appreciable difference in the measured losses, the wire line being more efficient. The fact that—in the cases discussed by the author—insulators are spaced every 150 feet on the open line and every 272 feet on the tube line possibly accounts for this higher efficiency. The results of these and of other tests show that overhead twin-wire lines can be used with reasonable efficiency and that the pick-up, which might be undesirable in the case of a receiving station, need not be unduly large. Where several open wire lines enter a receiving station in close proximity to each other the "throw-in" or "cross-talk" can be reduced to very small limits by transposing the pairs within the building at distances of about 18 inches.

The last section of the paper discusses the relations between capital outlay on array systems and resulting gains in field-strength. Attention is particularly directed to the cost of array installations to give maximum gains over a standard half-wave aerial for different angles of projection and for various arrays, *e.g.*, 4-wavelength span, 6-wavelength span, and 8-wavelength span. Curves are given for each of these cases with 4-tiers, 3-tiers and 2-tiers, analysing the cost of towers, and the cost of array and 1,000 feet. transmission lines, and showing the maximum gain over an actual standard half-wave aerial and over a hypothetical half-wave aerial. The results are summarised in Fig. 41. For example at a projection-angle of 80° a 4-tier 6-wavelength span array for 24 metres costs £720 complete, while a 2-tier 8-wavelength array having the same approximate gain costs £670. It is concluded (1) that the cost of array systems rises rapidly for a given gain as wavelength increases, (2) that the cost of array systems designed for a particular wavelength rises rapidly as the gain increases, particularly in the case of arrays designed for the longer wavelengths; (3) that the cost of arrays designed for a particular wavelength increases rapidly for a given gain (over the hypothetical aerial) as the angle of projection approaches 90°, for example, the costs of complete array systems for a gain of 16 decibels over the hypothetical aerial for 24 metres are £510, £540 and £980 respectively for angles of 78°, 80° and 85°.

Discussion

Col. A. S. Angwin, who opened the discussion, referred to the extent of the author's work, and to various practical improvements which had been effected by the application of it. He asked why the author had confined his investigation so much to horizontal antennae and whether similar economic considerations could conveniently be applied to the case of vertical radiators.

Mr. N. Ashbridge referred to the difficulties of the B.B.C. in their Empire broadcasting service. These services were not point-to-point, as were communication channels, but attempted to serve large zones. It was difficult to get reliable reports of reception due to the great differences of observers, but they had got some very useful information. Horizontal dipoles had given them better results than vertical, but the French station at Pontoise, with a Chireix type array, was known to be the best short-wave broadcasting station in the world.

Mr. T. L. Eckersley queried the value of the downcoming angle in the presence of more than one ray. The number of rays varied with wavelength. Three methods of deducing the downcoming angle had, however, given results in good agreement. These were the method of varying the height of the antenna, facsimile transmissions and the spaced-dipole method in use by the Radio Research Board.

Mr. J. F. Herd referred to results obtained by the last method, and illustrated recent measurements on Rocky Point and Lawrenceville on about 22.5 metres, when both stations gave practically identical downcoming angles at Slough. He also referred to observation of pulses which were hoped to elucidate the number of rays present.

Mr. H. L. Kirke expressed satisfaction at the agreement between calculation and measurement, and raised a few queries on the values of downcoming angle at the receiver quoted in the paper. The case mentioned by the previous speaker was interesting since the transmitting aerials were certainly different.

Mr. J. S. McPetrie raised a few points on earth constants, but reserved lengthier contribution for written communication.

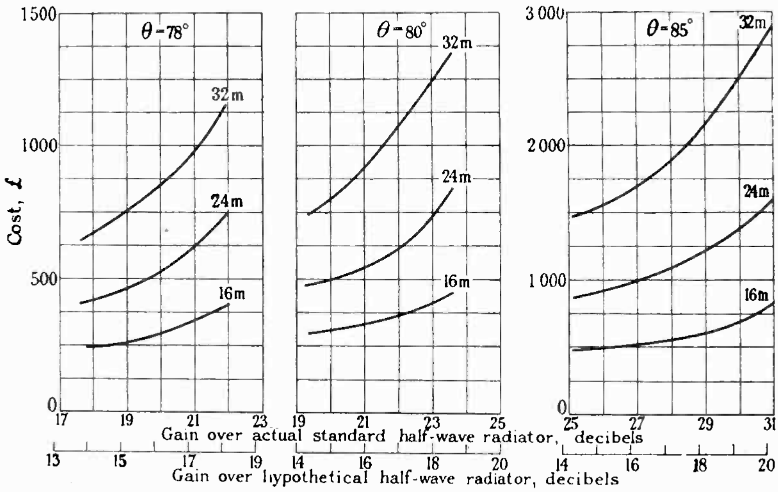


Fig. 41.—*Maximum cost of horizontal-radiator type aerial array systems to give various gains over a single half-wave horizontal radiator fixed ½ wavelength above earth.*

Mr. Dewhurst referred to the advantage of the diamond array and to the possibility which it afforded of providing a convenient means of making small variation of the angle of projection.

Mr. A. J. Gill raised a few points of accuracy in the text.

After the author had briefly replied to the discussion a vote of thanks was accorded on the motion of the Chairman, Mr. G. Shearing, O.B.E.

Abstracts and References

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PROPAGATION OF WAVES

MEETING FOR DISCUSSION ON THE IONOSPHERE.—E. V. Appleton, S. Chapman, C. T. R. Wilson, T. L. Eckersley, R. A. Watson Watt, J. A. Ratcliffe, F. A. Lindemann. (*Proc. Roy. Soc.*, Sept., 1933, Vol. 141, No. A 845, pp. 697–722.)

The opening address by Appleton has already been abstracted (Sept. Abstracts, 1933, p. 494). Chapman discussed the absorption of solar radiation by various constituents in the upper atmosphere and, regarding the decay of electron content, expressed the opinion that the average of a large number of experimental curves might show that recombination was a more important factor than attachment to neutral particles in F layer also. Calculations of the expected variation of the electron density during the Canadian eclipse of Aug. 31st, 1932, assuming ultra-violet light as the sole ionising agent and a degree of recombination compatible with Appleton's daily variation curves for E layer, showed that "there was no need to attribute any part of the residual 40% electron content at totality to another ionising source." Wilson discussed the possible connection between the ionosphere and thunderstorms, in the light of his "runaway electron" theory. Eckersley described measurements of the polarisation characteristics and intensity of pulses reflected from the ionosphere; the experimental results were in agreement with the magneto-ionic theory of wave propagation. He also found a value of 1.9 : 1 for the ratio of maximum summer midday density to maximum winter midday density [of F layer] and a recombination coefficient between 1.3 and 1.5×10^{-10}. His observations agreed with the theory of decay of electron content by recombination. Watson Watt dealt with the structure of the ionosphere in horizontal section; rapid increases of the density of E layer, of very short duration, are not infrequently noted under summer conditions and are found just to precede the arrival of thunderstorms in the area within 50 km of the recording station. A possible 27-day recurrence tendency in thunderstorms is suggested. As to the fine structure of E region in the vertical section, it may be that there is more than one sharply marked level of maximum density therein. Ratcliffe gave a preliminary survey of curves of effective layer height against time on any one frequency and called attention to nocturnal increases in E region ionisation, correlated with disturbed magnetic conditions. "The presence of intense ionisation in the E region for an unusually long time after sunset is correlated with the occurrence of thunderstorms." The records showed abundant evidence of the region between E and F regions (described in the opening address). Polarisation measurements indicated that free electrons were effective in all ionised regions. The speaker considered that E and F region ionisations were due to different causes. Lindemann emphasised that "there does not seem to be any conclusive evidence that the equivalent heights are closely related with the actual heights." He rejected the electron cloud explanation of echoes of long delay.

RADIO STUDIES OF THE IONOSPHERE [especially the Presence of the Intermediate Layer].—(1) J. P. Schafer and W. M. Goodall: (2) D. F. Martyn and A. J. Green: (3) W. B. Ross and J. T. Henderson. (*Nature*, 30th Sept., 1933, Vol. 132, pp. 521–524.)

The first writers give the results of recent observations in continuation of their letter dealt with in Abstracts, 1933, p. 558. They give a virtual height contour map for frequencies from 1 400 to 6 000 kc/s for March 27, 1933, showing the various parts of E, M and F regions. They find the ionisation in the lower parts of both E and F regions to be substantially the same from day to day and due principally to ultra-violet light of solar origin. In other regions, random variation is found. Maximum ionic density is found to occur about noon in winter but near sunset in summer.

The second writers have also found the ionised region between E and F layers described by Appleton (1933, pp. 558–559) and by Schafer and Goodall (*loc. cit.*).

The third writers have noticed disappearance of echoes from F region before those from region E as the frequency is increased, and also the presence of the intermediate region.

KURZWELLENAUSBREITUNG IN DER ATMOSPHÄRE (Propagation of Short Waves through the Atmosphere).—K. Försterling and H. Lassen. (*Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, pp. 158–178.)

This paper summarises previous papers of the authors, dealt with in Abstracts, 1932, pp. 87 and 217, and January, pp. 28–29. A discussion of "round the earth" signals is included, in which the conclusion is reached that the intensity of the "round the earth" echo must be of the same order of magnitude as the direct-signal. Recent German experimental results are also drawn upon in support of the authors' theoretical conclusions.

POLARISATION MEASUREMENTS [with Cathode-Ray Oscillograph Film Records] FOR THE INVESTIGATION OF NIGHT ERRORS IN RADIO DIRECTION FINDING.—Plendl. (*See* under "Directional Wireless.")

NOTE ON A MULTI-FREQUENCY AUTOMATIC RECORDER OF IONOSPHERE HEIGHTS [and the Existence of Three Layers].—T. R. Gilliland. (*Bur. of Stds. Journ. of Res.*, October, 1933, Vol. 11, No. 4, pp. 561–566.) The I.R.E. Convention paper, an abstract of which was dealt with in 1933 Abstracts, p. 439.

WIRELESS APPARATUS FOR THE STUDY OF THE IONOSPHERE [including King's College and Polar Year Expedition Equipments].—G. Builder. (*Journ. I.E.E.*, October, 1933, Vol. 73, No. 442, pp. 419–436.)

THE TILT OF RADIO WAVES AND THEIR PENETRATION INTO THE EARTH [Application of Telephone Transmission Formulae: the Effect of Permittivity: etc.].—G. W. O. H. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, pp. 587–591.)

EXPERIMENTAL DATA ON THE LONG-DISTANCE ULTRA-SHORT-WAVE COMMUNICATION BETWEEN KEIJO AND TOKYO [75 Watts on 7.56–8.4 Metres: Distance 1 150 Kilometres].—K. Umeda. (*Journ. I.E.E. Japan*, October, Vol. 53 [No. 10], No. 543, pp. 844–846: English summary p. 81.)

ULTRA-SHORT-WAVE TELEVISION RECEPTION OVER 284 MILES WITH VERY HIGH AERIAL.—(*Television*, November, 1933, Vol. 6, No. 69, p. 386: in an article on "Progress in Germany.")

56-Mc [Ultra-Short-Wave] WORLD'S RECORDS? [235 Miles from Aeroplane at 4 000 Feet over Dover].—van Baerle and Fereday. (*QST*, December, 1933, Vol. 17, No. 12, pp. 21, 62 and 64.)

NOTES ON PROPAGATION OF ULTRA-SHORT WAVES [56 Mc/s, in Boston].—L. C. Sigmon. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 20–21.)

RADIO SURVEY [Ultra-Short-Wave] OF THE CITY OF BOSTON.—Replogle. (*See* under "Stations, Design and Operation.")

DISCUSSION ON "LINEARLY TAPERED LOADED TRANSMISSION LINES."—Starr: Arnold and Taylor. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, p. 1609.)

Referring to Arnold and Taylor's paper (1933 Abstracts, p. 150, l-h col.), Starr refutes a restriction placed on his own solution.

ATTENUATION AND DISTORTION OF WAVES [travelling in Lines: a Multi-Conductor Multi-Velocity Theory, of which the Conventional Theory is a Special Case].—L. V. Bewley. (*Elec. Engineering*, December, 1933, Vol. 52, No. 12, pp. 876–884.)

THE ELECTRICAL PROPERTIES OF SEA-WATER FOR ALTERNATING CURRENTS.—R. L. Smith-Rose. (*Proc. Roy. Soc.*, December, 1933, Vol. 143, No. A 848, pp. 135–146.)

The specific conductivity of sea-water obtained from the English Channel is found to increase from 3.9×10^{10} e.s.u. at a frequency of 500 c/s to 5.4×10^{10} e.s.u. at a frequency of 10 000 kc/s, for a temperature of 20° C. The actual value of the dielectric constant is found to be probably about 80; high apparent values are due to polarisation films round the electrodes. The mean temperature coefficient for conductivity between 0° and 40° C is about + 2.7% per degree C.

THE TRANSMISSION OF WAVES THROUGH AN IONISED GAS [Oscillatory Discharge in Mercury Vapour].—R. W. Revans. (*Phys. Review*, 15th Nov., 1933, Series 2, Vol. 44, No. 10, pp. 798–802.)

Under certain conditions the glow in a mercury vapour discharge seems to vibrate as a whole, like the air in a Helmholtz resonator, with frequencies ranging from about 2×10^4 to 10^6 c/s.

EXPERIMENTAL EVIDENCE FOR THE ABSENCE OF SCATTERING OF LIGHT BY LIGHT.—F. L. Mohler. (*Journ. Opt. Soc. Am.*, November, 1933, Vol. 23, No. 11, pp. 386–387.)

ATMOSPHERICS AND ATMOSPHERIC ELECTRICITY

AUDIO-FREQUENCY ATMOSPHERICS.—Burton and Boardman. (*Bell S. Tech. Journ.*, October, 1933, Vol. 12, No. 4, pp. 498–516.) *See* Jan. Abstracts, p. 31, l-h column.

COMPACT [Cathode-Ray] DIRECTION FINDERS FOR ATMOSPHERIC DISTURBANCES.—Burgess. (Summary only in *Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, p. 1518.)

VARIATION WITH TEMPERATURE OF THE ELECTRIFICATION PRODUCED IN AIR BY THE DISRUPTION OF WATER DROPS, AND ITS BEARING ON THE PREVALENCE OF LIGHTNING.—J. Zeleny. (*Phys. Review*, 15th Nov., 1933, Series 2, Vol. 44, No. 10, pp. 837–842.)

Rain temperature is found to be an important factor in determining the frequency and the intensity of lightning discharges.

THUNDERSTORMS IN SOUTH INDIA.—S. P. Venkiteshwaran. (*Nature*, 11th Nov., 1933, Vol. 132, p. 754.)

DETONATING FIREBALL OF AUGUST 13TH, 10h 30m P.M.—(*Nature*, 18th Nov., 1933, Vol. 132, p. 789.)

Note on an observation of a detonating fireball observed at Widnes and near Markyate. Particulars of the real path are given and the interval between sight and sound agrees with an estimate made at the time of observation.

ON THE SPOTS FREQUENTLY STRUCK BY LIGHTNING, IN THE DEPARTMENT OF AVEYRON.—G. Dauzère. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1684–1685.)

CIRCULAR SPARKS [Kreisfunken] IN ELECTRIC DISCHARGE FIGURES.—M. Toepler. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 527–530.) *See* also Jacobi, *ibid.*, pp. 530–532.

SUNSPOTS AND WEATHER [Submultiples of 23-Year Cycle and Their Importance in Forecasting].—C. G. Abbot. (*Science*, 8th Dec., 1933, Vol. 78, No. 2032, pp. 518–519.) Further development of the work dealt with in 1932 Abstracts, p. 516.

SUNSPOTS AND RADIO RECEPTION [and the Passing of the Sunspot Minimum].—H. T. Stetson. (*Science*, 8th Dec., 1933, Vol. 78, No. 2032, Supp. pp. 10 and 12.)

THE AURORAL SPECTRUM AND THE UPPER ATMOSPHERE.—L. Vegard. (*Nature*, 28th Oct., 1933, Vol. 132, p. 682.)

A note on a discussion of the results of investigations since 1912. The conclusion is reached that "nitrogen must be carried to high altitudes through the effect of an electric state set up by the action of solar rays of short wavelength."

AUDIBILITY OF THE AURORA AND LOW AURORA [Testimony of Inhabitants of Land Surrounding Hudson Bay].—F. T. Davies and B. W. Currie. (*Nature*, 2nd Dec., 1933, Vol. 132, pp. 855–856.)

ON THE DISPLACEMENT, IN AN ELECTROSTATIC FIELD, OF MAGNETO-ELECTRONIC SPIRALS [and an Oscillatory Action analogous to an Aurora Borealis Effect].—L. Cartan. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1604–1606.)

ON THE ORIGIN OF THE ATMOSPHERIC OZONE: RESEARCHES AT SCORESBY SOUND DURING THE POLAR YEAR [Ozone produced by Auroral Activity: Reaches Ground in 1 Month in Calm Air: destroyed by Solar Radiation].—A. Dauvillier. (*Comptes Rendus*, 27th Nov., 1933, Vol. 197, No. 22, pp. 1339–1341.)

THE ABSORPTION OF ULTRA-VIOLET RADIATIONS IN THE LOWER ATMOSPHERE [and the Absorption Bands of Oxygen].—L. Herman. (*Ibid.*, pp. 1342–1344.)

THE RÔLE OF SPACE CHARGE IN ATMOSPHERIC ELECTRICITY [Experimental Investigation].—J. G. Brown. (*Sci. Abstracts, Sec. A*, November, 1933, Vol. 36, No. 431, p. 1190.)

PHASE OF THE SEMI-DIURNAL COMPONENT OF THE ELECTRICAL POTENTIAL GRADIENT.—R. Guizonnier. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1682–1683.)

OBSERVATIONS OF THE ELECTRICAL FIELD OF THE AIR AT THE OBSERVATORY OF KSARA (LIBAN) DURING THE ECLIPSE OF THE SUN OF 21ST AUGUST, 1933.—J. Chevrier. (*Comptes Rendus*, 13th Nov., 1933, Vol. 197, No. 20, pp. 1143–1145.)

SOLAR ACTIVITY AND COSMIC RAYS [No Relation with Sunspot Numbers: Slight Decrease of C.R. Ionisation after Beginning of Magnetic Disturbance: Support for Corpuscular Theory].—V. F. Hess and R. Steinmaurer. (*Nature*, 14th Oct., 1933, Vol. 132, pp. 601–602; *also* Note, Vol. 132, p. 608.)

ON MEASUREMENTS OF THE FLUCTUATIONS OF COSMIC RADIATION. II.—W. Messerschmidt. (*Zeitschr. f. Physik*, 1933, Vol. 85, No. 5/6, pp. 332–335.)

For reference to Part I *see* 1933 Abstracts, p. 34. The present paper discusses so-called fluctuations of the second kind and finds an explanation for them as deviations from the mean barometer effect and probably also as results of the influence of the earth's magnetic field.

ON THE NATURE OF COSMIC RAY SHOWERS.—B. Cassen. (*Phys. Review*, 15th Sept., 1933, Series 2, Vol. 44, No. 6, p. 513.)

AZIMUTHAL ASYMMETRY OF COSMIC RADIATION.—S. A. Korff. (*Phys. Review*, 15th Sept., 1933, Series 2, Vol. 44, No. 6, p. 515.)

The experimental results here reported, when interpreted on the basis of the Epstein–Lemaître–Vallarta theory, assign a lower limit of about 8×10^9 volts to the energy of the magnetically deviable component of the primary cosmic radiation.

ABSORPTION OF COSMICAL RADIATION [in Water: Correct Form for Treatment of Absorption Curve].—F. Soddy: H. Booth. (*Nature*, 21st Oct., 1933, Vol. 132, pp. 638–639.)

THE ABSORPTION OF THE PENETRATING RADIATION IN WATER AND THE ANALYSIS OF THE ABSORPTION FUNCTION.—W. Kramer. (*Zeitschr. f. Physik*, 1933, Vol. 85, No. 7/8, pp. 411–434.)

MEASUREMENT OF THE ABSORPTION OF THE PENETRATING RADIATION AT VARIOUS ZENITHAL INCLINATIONS.—G. Bernardini and S. de Benedetti. (*La Ricerca Scientifica*, 15/31 Aug., 1933, 4th Year, Vol. 2, No. 3/4, pp. 73–80.)

THE ABSORPTION OF COSMIC RADIATION.—H. J. Bhabha. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 1/2, pp. 120–130.)

THE DISTRIBUTION OF COSMIC RAY PATHS IN A VERTICAL CYLINDER [Theoretical Investigation].—W. F. G. Swann. (*Journ. Franklin Inst.*, November, 1933, Vol. 216, No. 5, pp. 559–581.)

ENERGY DISTRIBUTION IN COSMIC RAYS [Theories of Their Cosmic Origin].—W. G. Pollard. (*Phys. Review*, 1st Nov., 1933, Series 2, Vol. 44, No. 9, pp. 703–706.)

COSMIC RAYS AND THE LAW OF CONSERVATION OF ENERGY.—C. W. Gilbert. (*Science*, 10th Nov., 1933, Vol. 78, No. 2028, Supp. p. 8.)

COSMIC RAYS [Short Note on an Inaugural Address]. —P. M. S. Blackett. (*Nature*, 11th Nov., 1933, Vol. 132, pp. 741–742.)

COSMIC-RAY POSITIVE AND NEGATIVE ELECTRONS.—C. D. Anderson. (*Phys. Review*, 1st Sept., 1933, Series 2, Vol. 44, No. 5, pp. 406–416.)

"A determination of the specific ionisation of cosmic-ray particles . . . has shown that the great bulk of the cosmic-ray particles of positive charge are positive electrons . . . Positive and negative electrons were found to occur in nearly equal numbers and to have similar distributions in energy." Questions of energy and absorption properties of the particles are discussed.

THE NATURE OF COSMIC RADIATION [Summarising Report].—W. Kolhörster. (*Physik. Zeitschr.*, 15th Nov., 1933, Vol. 34, No. 22, pp. 809–819.)

SPECIFIC COINCIDENCE CAPABILITY OF COSMIC RAYS IN FREE AIR AND BEHIND 10 CM LEAD AT SEA LEVEL [determined as 0.55 and 0.70 respectively].—W. Kolhörster and L. Tuwim. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 78, pp. 530–531.)

LATITUDE EFFECT OF COSMIC RADIATION [New Observations supporting Clay's Results rather than Hoerlin's)].—J. A. Prins. (*Nature*, 18th Nov., 1933, Vol. 132, p. 781.)

LATITUDE VARIATION OF COSMIC RAYS [between Bremen and Peru: Agreement with Clay's Results].—H. Hoerlin. (*Naturwiss.*, 17th Nov., 1933, Vol. 21, No. 46, pp. 822–823.) For Clay's results *see* 1933 Abstracts, p. 34, l-h column: *cf.* also Prins, above.

FURTHER MEASUREMENTS OF COSMIC RADIATION IN THE STRATOSPHERE [with Open Ionisation Chamber].—E. Regener. (*Physik. Zeitschr.*, 15th Nov., 1933, Vol. 34, No. 22, pp. 820–823.)

NEW RESULTS IN COSMIC RAY MEASUREMENTS [including Curve suggesting Connection between Ray Intensity and Earth's Magnetic Field Intensity: support for Electromagnetic Nature of the Radiation].—E. Regener. (*Nature*, 4th Nov., 1933, Vol. 132, pp. 696–698.)

STUDY OF THE VARIATION OF THE COSMIC RADIATION BETWEEN THE LATITUDES 45°N and 38°S [Radiation affected by Earth's Magnetic Field and partly formed of Charged Corpuscles].—P. Auger and Leprince-Ringuet. (*Comptes Rendus*, 20th Nov., 1933, Vol. 197, No. 21, pp. 1242–1244.)

REMARK ON THE VARIATION WITH DIRECTION OF GEIGER-MÜLLER COUNTERS AT GREAT HEIGHTS [Curvature of Paths of Secondary Particles in Earth's Magnetic Field].—P. Kipfer. (*Naturwiss.*, 17th Nov., 1933, Vol. 21, No. 46, pp. 823–824.)

AZIMUTHAL ASYMMETRY OF THE COSMIC RADIATION IN COLORADO.—E. C. Stevenson. (*Phys. Review*, 15th Nov., 1933, Series 2, Vol. 44, No. 10, p. 855.)

In geomagnetic latitude 48°N and elevation 9 500 ft a difference is found between west and east intensities of cosmic radiation of about 2 per cent. for angles of 30° and 40° from the vertical.

PRELIMINARY REPORT OF THE RESULTS OF ANGULAR DISTRIBUTION MEASUREMENTS OF THE COSMIC RADIATION IN EQUATORIAL LATITUDES.—T. H. Johnson. (*Phys. Review*, 15th Nov., 1933, Series 2, Vol. 44, No. 10, pp. 856–858.)

Curves are given showing the asymmetries observed and calculated on the basis of Vallarta's theory (1933 Abstracts, p. 562), for three elevations on the magnetic equator. The conclusion is reached that no appreciable amount of negative radiation is present.

COSMIC RAYS ["Hearts of Atoms positively charged by Action of Starlight on Interstellar Gas and accelerated in Cosmic or Terrestrial Electric Field."].—T. H. Johnson. (*Science*, 1st Dec., 1933, Vol. 78, No. 2031, Supp. p. 8.)

ATOMIC DISINTEGRATION AND THE COSMIC RADIATION.—E. Rupp. (*Zeitschr. V.D.I.*, 2nd Dec., 1933, Vol. 77, No. 48, pp. 1277–1279.)

PROPERTIES OF CIRCUITS

DAS VERHALTEN EINER RAUMLADEGITTERRÖHRE BEI ANWENDUNG EINER RÜCKKOPPLUNG IM RAUMLADEGITTERKREIS (The Behaviour of a Space-Charge-Grid Valve with Retroaction Coupling in the Space-Charge-Grid Circuit).—W. Buhk. (*Hochf:tech. u. Elek: akus.*, November, 1933, Vol. 42, No. 5, pp. 152–154.)

The falling characteristic of the space-charge-grid current in a s.c.g. valve offers the possibility of applying, in a single-valve circuit, a galvanic retroaction of correct phase. Theoretically it should be possible, in such a circuit, to obtain an infinitely steep slope; in practice, however, the possible increase in steepness is comparatively small, being limited by the appearance of instability. The writer found that with a type RE 074d valve a 6-fold increase of slope was attainable by the use of retroaction, with a serviceable degree of stability. In the present paper he gives an analysis of the action, and shows that the instability is due to the fluctuations of heating voltage. The influence of this voltage on the anode- and s.c. grid-currents is shown by curves and its physical significance discussed. It is shown how the effect of retroaction increases the influence of the heating voltage more than it increases the slope of the anode-current characteristic.

In a d.c. amplifier, therefore, the use of retroaction with a s.c.g. valve will not allow a smaller input potential to be measured. The smallest measurable input potential is limited by the level of background noise, and this latter will be magnified by retroaction more than the input potential. All that retroaction can accomplish is to make it possible to use a less sensitive instrument in the output circuit.

ON THE DESIGN OF SPACE-CHARGE-GRID VALVES [and the Attainment of Mutual Conductances of more than 50 mA/v].—von Ardenne. (*See* under "Valves and Thermionics".)

PERFORMANCE CHARACTERISTICS OF LINEAR TRIODE AMPLIFIERS [Audio- and Radio-Frequency: Class A, B, C and AB Operation: Theoretical Treatment].—A. P. T. Sah. (*Sci. Abstracts, Sec. B*, November, 1933, Vol. 36, No. 431, p. 739.)

THE SYNCHRONISATION OF TWO VALVE OSCILLATORS [Curves differing from the Usual "Ziehen" Curves].—W. Majewski. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 6–10.)

Author's summary:—The author examines the mutual reaction of two oscillators whose powers are of the same order of magnitude. The oscillators are coupled by an intermediate circuit, across whose capacity the potential is measured. It is found that, near the resonance point, this potential is not a unique function of the capacity of the oscillator: its value depends on the *sense* of the variations of this capacity. As the shape of the curves observed differs a little from that obtained for the effect known under the name "ziehen" [oscillation hysteresis], a more detailed examination will be made. [In Polish.]

THE DISTORTION OF TRANSIENT-MODULATED RADIO-FREQUENCY ENERGY IN TUNED CIRCUITS [and Its Correction].—Builder. (Appendix to paper referred to under "Propagation of Waves".)

NON-LINEAR DISTORTION FACTOR AND CHARACTERISTIC CURVES OF [Single-Grid] AMPLIFIER VALVES.—Gehrts. (*See* under "Valves and Thermionics.")

CURRENT LIMITATION IN VALVE SYSTEMS [Output Limiters in Telegraphic Amplifiers: the Influence of the Detector Bridge Capacity and Resistance on the Time Constant and on the Value of the Limited Current].—J. Gurtzman and J. Kahan. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 24–26.) In Polish.

ELECTRIC WAVE FILTERS.—G. J. S. Little. (*Inst. P.O. Elec. Engineers*, Printed Paper No. 143, 68 pp.)

FILTERS IN ACTION [Study by Mechanical Analogy using Series of Pendulums].—C. E. Lane. (*Elec. Engineering*, December, 1933, Vol. 52, No. 12, pp. 813–816.)

ELECTRICAL EQUIVALENT CIRCUITS OF COUPLED MECHANICAL OSCILLATING SYSTEMS [Shafts, etc.].—L. Kettenacker. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 515–517.)

INFLUENCE OF SATURATION ON THE DISTRIBUTION OF ALTERNATING CURRENT IN IRON CONDUCTORS OF CIRCULAR SECTION.—J. Hak. (*Rev. Gén. de l'Élec.*, 2nd Dec., 1933, Vol. 34, No. 22, pp. 755–763.)

RADIATION AND INDUCTION [and the Confusion caused by the Similarity of Vector Potential of Radiation and Scalar Potential of a Magnet].—R. R. Ramsey. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1586–1589.)

TRANSMISSION

ÜBER PARASITISCHE SCHWINGUNGEN BEIM ULTRAKURZEN OSZILLATOR (Parasitic Oscillations in the Ultra-Short-Wave Oscillator [with Inductance Coil in Anode Circuit: Relaxation Oscillations which reduce the Ultra-Short-Wave Output]).—H. Ataka. (*Hochf: tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, pp. 155–157.)

Heegner and Watanabe have described a dynatron circuit, with an inductance coil in the anode circuit, whose oscillations are little influenced by capacity (1929 Abstracts, pp. 628–629). The writer finds that when an inductance coil is introduced into the anode circuit of an ultra-short-wave oscillator (*e.g.*, a Mesny circuit), the same kind of oscillation is produced, in this case in addition to the u.s.w. oscillation. In his experiments the latter was of 4.03 m wavelength, while the parasitic oscillation was found (under one set of conditions, the inductance being 2.8 mH) to be of wavelength 3 420 m. It is however a type of relaxation oscillation, formed as follows:—in a stationary condition of the u.s.w. oscillations an unvarying current flows through the inductance, but a slight increase of this current produces an induced e.m.f. at the ends of the coil, acting on the anode in a direction opposed to the battery voltage and thus reducing the u.s.w. amplitude. This causes another rise in anode current (the battery voltage being constant) and in this way the relaxation oscillations are set up. Their production is favoured by high anode potential, large heating current and high grid resistance. They can be eliminated by connecting a resistance (of the order of 700 ohms) in series with the inductance in the anode circuit.

When the oscillator circuit is used as a transmitter it is liable to these parasitic oscillations, on account of the high grid resistance. On the other hand, in a receiving circuit the anode voltage is commonly low, so that in spite of high grid resistance the parasitic oscillations do not occur. But if a higher anode voltage is employed they make their appearance, and can be used as the interrupting oscillations for super-regenerative reception.

VACUUM TUBE ELECTRONICS AT ULTRA-HIGH FREQUENCIES [Analysis taking Electron Flight-Time into account: Application to Diodes and Triodes, including Barkhausen Triodes: all Wavelengths from Infinity to a few Centimetres].—F. B. Llewellyn. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1532–1573.)

Following on the lines of Benham's investigations (1931 Abstracts, p. 212). In this extension not only actual cathodes have to be considered but also virtual cathodes, where the assumption of zero a.c. velocity and acceleration is unwarranted. In the section dealing with triodes with negative grid and positive plate, it is mentioned that as yet no accurate expression for the grid/plate impedance has been obtained, either at the low frequencies where transit times are negligible or at the higher frequencies. "The reason for this lies in the repelling force on the electron stream of the negative grid, so that the assumption of current flow in straight parallel lines is not valid in so far as current from the grid to the plate is involved. It has been shown that both the cathode/grid path and the grid/plate path contain resistive components with corresponding losses which increase with increase of frequency. This loss may be cited as a reason why triodes with negative grids cease to oscillate at the higher frequencies. . . ." The writer mentions that the "small signal" theory here developed should be supplanted by an "approximate" theory when questions as to the power efficiency arise.

ON THE MECHANISM OF ELECTRONIC OSCILLATION [Barkhausen-Kurz Type: Origin in Density Fluctuation of Space Charge outside Grid when Partially Saturating Voltage is applied to Grid].—K. Morita. (*Journ. I.E.E. Japan*, October, 1933, Vol. 53 [No. 10], No. 543, pp. 900–904: English summary p. 88.)

Observations on some tens of newly designed triodes show that the passing-out current i_g, responsible for the space charge, increases with V_g when V_g is smaller than the saturation voltage V_s, but decreases with a further increase of V_g when the latter becomes larger than V_s. This is the cause of the oscillations. The wavelengths calculated on this conception agree fairly well with the experimental results.

MODULATION OF A MAGNETRON ULTRA-SHORT-WAVE TRANSMITTER BY CONTROLLING ONE ONLY OF SEVERAL PARTS OF ANODE ARRANGED DIAMETRALLY TO CATHODE.—Internat. Gen. Elec. Company. (German Pat. 579 927, pub. 3.7.1933: *Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, pp. 183–184.)

ON THE PRODUCTION OF ULTRA-SHORT-WAVE OSCILLATIONS WITH COLD-CATHODE DISCHARGE TUBES [and Strong Magnetic Field].—K. Okabe. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1593–1598.)

On the work referred to in 1933 Abstracts, p. 501, r-h column.

VALVE GENERATION OF 3 CM MICRO-WAVES FOR RESEARCH ON COBALT.—Potapenko. (*See* reference under "Subsidiary Apparatus and Materials," p. 108.)

AN EFFICIENT C.W. AND 'PHONE TRANSMITTER USING THE NEW TUBES AND CIRCUITS [particularly the Type 800 Valve: 100–150 Watt Output: Multi-Band Operation: Tri-Tet Crystal Control. Part I].—L. C. Waller. (*QST*, December, 1933, Vol. 17, No. 12, pp. 13–17 and 72, 74, 76.)

A GLOW-DISCHARGE TUBE WITH THIRD ELECTRODE BEHIND A NETWORK CATHODE, AS A GENERATOR OF OSCILLATIONS.—Badareu. (*See* abstract under "Subsidiary Apparatus and Materials.")

HIGH-POWER PENTODE AS AN ELECTRON-COUPLED TRANSMITTER [Suppressor Grid acting as Electrostatic Screen, obviating the Usual Neutralising and Secondary Emission: Wavelengths down to 15 Metres: 4 kw Pentode modulated by Receiving Valve].—J. C. W. Drabble and R. A. Yeo: Dow. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, pp. 648–656.) For Dow's original work *see* 1932 Abstracts, pp. 164 and 222: *see* also p. 582 (Ross Jones), r-h column.

THE FREQUENCY OF ASYMMETRICAL POLYPHASE OSCILLATING SYSTEMS [Excited by Dynatrons].—J. Groszkowski and B. Ryniejski. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 12–15).

Leading from the researches dealt with in 1933 Abstracts, p. 445. A mathematical investigation of the frequency as a function of the deviations of the capacities from the values corresponding to symmetry. In Polish.

CONSTANT-FREQUENCY GENERATORS: DYNATRON WITH AUTOMATIC [Grid-Bias] CONTROL OF OSCILLATION.—J. Groszkowski. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 3–6.)

Further development of the work dealt with in 1933 Abstracts, p. 564. The writer makes the oscillating circuit of the dynatron feed a rectifier which passes on the rectified potential to the control grid of the dynatron, in such a way that the grid bias becomes more and more negative as the amplitude of the oscillations increases. Thanks to this arrangement, the amplitude keeps always in the zone of the critical condition, in which the frequency is determined only by the electrical constants of the oscillating circuit and is thus independent of the working conditions of the dynatron. The writer refers to Arguimbau's work (1933 Abstracts, p. 211). In Polish.

APPLICATIONS OF THE DYNATRON [and the Use of Automatic Gain Control].—F. M. Colebrook: Scroggie: Groszkowski. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, pp. 663–664.) In connection with Scroggie's paper (January Abstracts, p. 34), Colebrook quotes Groszkowski's paper dealt with above.

LIABILITY TO FREQUENCY DRIFT IN DYNATRONS DUE TO CHANGES IN SECONDARY EMISSION.—F. M. Colebrook. (*See* letter referred to above.)

IMPROVEMENTS IN QUARTZ CONTROL [Connection between Grid and Neutralising Condenser: Uniform Current of Warmed Air through Space containing Valve, Oscillatory Circuits, and Quartz in Thermostatic Chamber].—Lorenz Company. (German Pats. 579 735 and 573 547, pub. 5.7.1933, and 3.4.1933: *Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, p. 184.)

OPERATION OF TUBE OSCILLATORS ON A COMMON LOAD [for obtaining High Power from Large Number of Valves: Disadvantages of Parallel Connection of Valves overcome by division into Groups with their Tank Circuits coupled to a Common Load Circuit].—S. I. Model, Leningrad. (*Proc. Inst. Rad. Eng.*, December, 1933, Vol. 21, No. 12, pp. 1722–1739.)

NOTE ON THE PRINCIPAL ADVANTAGES OF THE S.F.R.-CHIREIX "DE-PHASING" MODULATION SYSTEM.—(*Bull. de la Soc. Franç. Radioélec.*, July-Aug.-Sept., 1933, Vol. 7, No. 4, pp. 81–86.) *See* Singer, 1933 Abstract, p. 99, l-h column, and back references.

THE SIDE BANDS OCCURRING IN FREQUENCY MODULATION [Experimental Verification of Theory].—E. D. Scott and J. R. Woodyard. (*Electronics*, December, 1933, p. 341: summary only.)

OVER-MODULATION AS A CAUSE OF INTERFERENCE IN THE AMATEUR BAND.—J. J. Lamb. (*QST*, December, 1933, Vol. 17, No. 12, pp. 18–19 and 72.)

TELEGRAPHY ON 30 C/S ON SAME WAVE AS BROADCAST TRANSMISSIONS.—Lorenz Company. (German Pat. 580 080, pub. 5.7.1933.)

RECEPTION

REDUCTION OF THE EFFECT OF MUTUAL DEMODULATION OF SIGNALS BY THE USE OF "SYNCHRONOUS" RECEPTION.—J. Groszkowski: de Bellescize. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 27–30.)

De Bellescize's idea of "synchronous" reception (1933 Abstracts, p. 38) is applied theoretically to reduce the effect of apparent demodulation of a weak signal by a stronger. The conclusions are checked by an investigation with a cathode-ray oscillograph. In Polish.

A L.F. AMPLIFIER WITH A NEW COUPLING [Glow-Discharge-Tube Coupling: with Constructional Details].—W. Stockhusen. (*Funktech. Monatshefte*, November, 1933, No. 11, pp. 443–446.) *Cf.* Smith and Hill, Peek, January Abstracts, p. 36, l-h column.

APPARENT DEMODULATION IN EXCESS OF THEORY: SUGGESTED PERFECT OBLITERATION OF UNWANTED SIGNAL BY RECTIFIER WITH SLOPE DECREASING WITH INCREASED VOLTAGE.—G. F. Clarke: Callendar. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, p. 612.) Letter prompted by Callendar's paper (Jan. Abstracts, p. 35, r-h column).

PARASITIC OSCILLATIONS IN AN ULTRA-SHORT-WAVE OSCILLATOR [and Their Use in Super-Regenerative Reception].—Ataka. (*See* end of abstract under "Transmission.")

DECOUPLING EFFICIENCY [Barclay's Results Much Too High].—R. I. Kinross: Barclay. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, p. 612.)

CONDITIONS NECESSARY FOR AN INCREASE IN USABLE RECEIVER FIDELITY.—A. N. Goldsmith. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 22–23.)

IS GOOD QUALITY WORTH WHILE? [Individual Preferences of Groups of University Students].—E. E. Free. (*Radio News*, September, 1933, Vol. 15, pp. 140–141 and 161.)

THE EXTERNAL LOUD SPEAKER AND THE MINIATURE RECEIVER [Good Quality by use of Large M.C. Loud Speaker: Desirable Modifications].—B. S. Trott. (*Rad. Engineering*, September, 1933, Vol. 13, No. 9, pp. 16–17.)

CONTROLLING RECEIVERS FROM THE BROADCAST TRANSMITTER [by Inaudible Control Tone on Carrier Wave: Preliminary Tests].—(*Electronics*, December, 1933, p. 327 and 331.)

RECENT DEVELOPMENTS IN AUTOMATIC VOLUME CONTROL.—(*World-Radio*, 24th Nov., 1933, Vol. 17, No. 435, pp. 689–690.)

THE GLOW-DISCHARGE LAMP AS AUTOMATIC FADING REGULATOR [and the Pressler "Siebröhre S.R. 155" with Auxiliary Anode and "Exploring" Electrode].—K. Nentwig. (*Radio, B., F. für Alle*, December, 1933, No. 12, pp. 545–550.)

MINIATURE INCANDESCENT LAMPS [as used for Radio Fuses] AS TUNING AND OVER-CONTROL INDICATORS IN RADIO RECEIVERS.—R. Vieweg. (*Radio, B., F. für Alle*, December, 1933, No. 12, pp. 538–539.)

HIGH QUALITY CLASS "B" AMPLIFICATION.—K. A. Macfayden. (*Wireless World*, 15th December, 1933, Vol. 33, pp. 454–455.)

Class B amplification, while affording a marked saving in h.t. battery current, is not without its special problems. In this article the effect of leakage-inductance in the driver and output transformers is discussed and it is shown that by careful design reproduction of a very high quality is obtainable with this system.

TRENDS IN RADIO RECEIVER DESIGN [particularly the Need for Better Tuning-Adjustment Methods: Lack of Mechanical Skill in Radio Designers].—R. H. Langley. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 12–14.)

STATION NAMES ON "TRANSFERS" FOR APPLYING TO TUNING SCALES.—(*Die Sendung*, 10th Nov., 1933, Vol. 10, No. 46, p. 1008.)

METHODS OF TONE CONTROL AND NOISE SUPPRESSION [Survey].—T. Sturm. (*Funktech. Monatshefte*, November, 1933, No. 11, pp. 423–430.)

RADIO RECEPTION—INTERFERENCE DUE TO ELECTRICAL APPARATUS AND HEAVY PLANT.—A. Morris. (*Electrician*, 24th Nov., 1933, Vol. 111, No. 2895, p. 645.)

Summary of I.E.E. paper.

Electrical Interference with Broadcast Reception [Discussion of German Draft Regulations].—G.W.O.H. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, pp. 645–647). Editorial on the VDE proposals referred to in January Abstracts, p. 35, l-h column.

Suppression of Radio [Man-Made] Interference with Capacitance Filters.—C. V. Aggers and W. E. Pakala. (*Sci. Abstracts, Sec. B*, October, 1933, Vol. 36, No. 430, p. 656.)

Pin Insulators [free from Radio Interference].—H. H. Brown. (*Electrician*, 24th Nov., 1933, Vol. 111, No. 2895, pp. 646–649.)

Man-Made Interference [German P.O. Statistics as to Sources: 20 per cent. of Cases traced to Complainants' Own Sets].—(*World-Radio*, 15th Dec., 1933, Vol. 17, No. 438, p. 779.)

Suppression of Auto Radio Noise.—G. H. Browning and R. Haskins. (*Electronics*, October, 1933, pp. 273 and 283.)

Progress in Automotive Radio Design.—H. J. Benner. (*Rad. Engineering*, October, 1933, Vol. 13, No. 10, pp. 8–9.)

Pre-Selection and Image Rejection in Short-Wave Superhets.—J. J. Lamb and F. E. Handy. (*QST*, December, 1933, Vol. 17, No. 12, pp. 9–12 and 76.)

Notes on Dual-Band Receiver Design [1 500–540 kc/s and 340–140 kc/s].—E. Messing. (*Electronics*, November, 1933, pp. 300–301 and 316.)

Resistance-Coupled Push-Pull Amplifier with Diode Detection.—L. Medina. (*Funk-Magazin*, December, 1933, Vol. 6, No. 12, pp. 807–808.)

Simultaneous Change of L.F. Grid Bias with Volume-Controlling Change of R.F. Grid Bias, to maintain Constant Total Anode Current in Mains-Driven Receivers.—Telefunken. (German Pat. 574 955, pub. 22.4.1933.)

The Wireless World A.V.C. Straight Four [for A.C. Mains].—(*Wireless World*, 24th November and 1st December, 1933, Vol. 33, pp. 402–404 and 418–421.)

Everyman A.C. Super [Number of Valves reduced to Four].—W. T. Cocking. (*Wireless World*, 22nd and 29th December, 1933, Vol. 33, pp. 472–474 and 488–490.)

Philips' Receiver—Dynamic Resistance [High Values *Not* obtained by Deliberate and Controlled Regeneration].—A. B. Calkin. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, p. 664.)

The Present Condition of Broadcast Technique [Vienna Exhibition].—E. Mittelmann. (*Elektrot. u. Masch:bau*, 29th Oct., 1933, Vol. 51, No. 44, p. 580–582.)

Olympia, 1933: a Review of Exhibits of Technical Interest.—(*Wireless Engineer*, October, 1933, Vol. 10, No. 121, pp. 543–551.)

AERIALS AND AERIAL SYSTEMS

Variation of Multi-Parabolic Reflectors [for Ultra-Short Waves: made up of Rod Wave Reflectors of Varying Lengths].—H. Kikuchi. (*Journ. I.E.E. Japan*, September, 1933, Vol. 53 [No. 9], No. 542, pp. 758–762: English summary pp. 76–78.) Continuation of the work dealt with in 1932 Abstracts, pp. 461–462 and 462.

"Sleeve" Coupling of Electrically Oscillating Systems [for Ultra-Short Waves: Alternate "Wave Directing" and "Wave Reflecting" Action of Rod gradually inserted into Tube of Equal Length].—S. Nakamura: Yagi. (*Journ. I.E.E. Japan*, September, 1933, Vol. 53 [No. 9], No. 542, pp. 718–721: English summary pp. 68–69.)

Matching the Transmission Line and Aerial without Coupling Device, by Quarter-Wave Section of Closely-Spaced Tubing.—R. P. Glover. (*Electronics*, November, 1933, p. 317.)

The Current Distribution on a Straight Wire excited at its Centre, and its Impedance at the Feeding Point.—Y. Kato. (*Journ. I.E.E. Japan*, September, 1933, Vol. 53, [No. 9], No. 542, pp. 746–749: English summary p. 74.)

Radiation Power from Conductors carrying the Current of Steady Flow [Mathematical Analysis].—G. Hara. (*Journ. I.E.E. Japan*, September, 1933, Vol. 53 [No. 9], No. 542, pp. 750–756: English summary pp. 74–76.)

Broadcasting Aerials for Increased Ground Wave.—Lorenz Company: Peters. (*Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, p. 183: German Pat. 579 999, pub. 3.7.1933.)

Aerial system, composed of dipoles, not exceeding one half-wavelength in total extent (height or width). In two component dipoles the currents are 180° out of phase, and with vertical polarisation the metre-amperes of the lower dipole are smaller than those of the upper; with horizontal polarisation the reverse is the case.

The Antennae of "La Pauline" Radio Station, near Toulon.—M. Bourseire. (*Génie Civil*, 18th Nov., 1933, Vol. 103, No. 21, pp. 492–495.)

Earth Connections—the Need for Further Investigations.—T. C. Gilbert. (*Elec. Review*, 24th Nov., 1933, Vol. 113, No. 2922, pp. 729–730.)

VALVES AND THERMIONICS

Zur Dimensionierung von Raumladungsgitterröhren (On the Design of Space-Charge-Grid Valves [and the Attainment of Mutual Conductances of more than 50 mA/v]).—M. von Ardenne. (*Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, pp. 149–154.)

The control electrode in ordinary types of valve is situated where the velocity integral of the electrons, of many different speeds, has attained an important fraction of the final velocity. The maximum voltage-sensitivity of control, on the other hand, would be obtained if the plane of control could be made to coincide with the plane of minimum electron velocity. "On this optimum condition in amplifier valves the writer has been unable to find anything in the literature" [except some quite recent introductory work, *e.g.*, Hasenberg].

There are two possible ways of arriving at the optimum condition: the first is by placing the control electrode directly in front of the cathode, in the plane of potential minimum produced by the space charge: this plan presents great difficulties in insulation, and would also lead to serious disturbance owing to the strong concentration of the space charge. The second and more hopeful method is first to speed up the electrons by an accelerating electrode and then to retard them more or less completely by a second electrode and to control them in or near the plane of this electrode. The voltage sensitivity entirely depends on how uniformly this braking of all the electrons in one plane can be carried out in practice. A certain lack of sharpness of the second potential minimum is unavoidable, for electrical and mechanical reasons; these are discussed in turn and the steps necessary to minimise their effects are deduced. Thus a drop of heating voltage along the cathode and a magnetic field due to the heating current must both be avoided, so that an indirectly-heated cathode with bifilar filament is necessary. The electrons emitted from the cathode are accelerated by the grid G_1 (Fig. 2) to a hundred volts or so, and those which pass through G_1 are retarded by G_2 (at an adjustable potential not far from zero) which also functions as the control grid. Most of the precautions necessary are connected with the preservation of symmetry: thus cylindrical electrodes are chosen, and the construction must be such that even the considerable heating (especially of G_1) must not upset the symmetry: the wire and mesh of G_2 must be such as to give the effect of a smooth surface as nearly as possible. Retarding-field oscillations must be avoided by taking care that the cathode shows no saturation and by giving G_1 a suitable potential.

Preliminary experiments indicate the possibility of slopes of over 50 mA/v. Fig. 3 gives a suitable circuit for amplifying purposes. Fig. 4 is another circuit in which the anode resistance consists of a retroaction coil and a loud speaker: if the cathode is sufficiently emissive such a circuit is suitable for broadcast reception in spite of the decrease in output power by the combination of rectification with output amplification. Fig. 5 shows an application to a "kipp" circuit for television, in particular for the Thun "line control" (varying spot speed) system. The writer suggests that valve design on these principles should be valuable for retarding-field oscillators, giving simple and very efficient modulation: also that the same principles can well be applied to cathode-ray tubes and to tubes for the modulation of light, with the attainment, in each case, of high voltage sensitivity.

THE BEHAVIOUR OF A SPACE-CHARGE-GRID VALVE WITH RETROACTION COUPLING IN THE SPACE-CHARGE-GRID CIRCUIT.—Buhk. (*See* under "Properties of Circuits.")

BEOBACHTUNGEN ÜBER EIN AUFTRETEN VON DOPPELCHARAKTERISTIKEN BEI STREUELEKTRONENSTRÖMEN IN VAKUUMRÖHREN (Observations on the Occurrence of Double Characteristics due to Stray Electronic Currents in Vacuum Tubes).—W. Molthan. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 546–551.)

Disturbances due to stray currents (such as the unwanted charging or even heating-up of the electrode supports or parts of the tube wall) can be strongly influenced by subsidiary electric fields. The experiments here described, with special valves, show that in valve arrangements in which strong stray currents are liable to be produced two different conditions of discharge may occur, as is evidenced by the existence of a double current/voltage characteristic (Fig. 3). The effects, on the discharge conditions, of charges on the walls of the tube, and the part played by the positive ions present, are investigated. It is concluded that the occurrence of the double characteristic is due to the secondary emission at the wall. A transition from one branch of the double characteristic to the other can be brought about by a momentary voltage impulse applied to an external electrode (M, Fig. 1). The resulting "jump" effect makes the arrangement applicable as an almost inertia-less relay: the control current is very small, depending only on the very small capacity of M. The impulse can be applied capacitively or inductively: in the latter case the device seems particularly suitable for signal transmission to rapidly moving vehicles such as trains. To control an ordinary electro-magnetic relay without amplification, the larger of the repose currents must be of the order of 0.5 mA. Valves of the type shown in Fig. 2b will more than fulfil this requirement; the "jump" given is from a larger current of 7.0 mA to a smaller of 2.5 mA.

KLIRRFAKTOR UND KENNLINIE DER VERSTÄRKERRÖHREN (Non-Linear Distortion Factor and Characteristic Curves of [Single-Grid] Amplifier Valves).—A. Gehrts. (*E.N.T.*, November, 1933, Vol. 10, No. 11, pp. 436–445.)

Author's summary:—We can express the anode alternating current, in a single-grid amplifier valve with negative grid bias, as a function of an alternating e.m.f. impressed on the grid (which, if there is no current, in the grid-input-circuit, is given independently of the valve), by a series involving increasing powers of the grid a.c. potential. As load in the anode circuit we assume a pure ohmic resistance. The linear term by itself then represents the pure amplifying effect. By including the term involving the square, we can also take into account the non-linear distortions (damping distortions dependent on amplitude, appearance of higher harmonics and combination tones). For the non-linear distortion factor k, which Küpfmüller puts equal to the ratio of the rectification factor S' to the working slope S, we thus obtain the formula

$$k = S'/S = R_i' \cdot R_i / D(R_i + R_a)^2,$$

where D = "durchgriff" (penetration coefficient), R_i = valve internal resistance, R_i' = first differential [with respect to anode potential], and R_a = external ohmic load.

In order to find the connection between the non-linear distortion factor and the valve dimensions we must first determine more accurately the valve characteristic field. The representation of the short-circuit characteristic by means of the simple formula $I_a = C \cdot U^{\gamma}_{st}$ (where U_{st} is the modulating voltage and C and γ are constants, γ lying between 1.5 and 2.5) does *not* reproduce with sufficient accuracy the form of the characteristic curves in the normal working region of an amplifier valve. Experience shows that in many valves the short-circuit characteristic may be considered as a straight line over a large region. A discussion of the short-circuit-characteristic formula derived (from the space-charge law) for single-cylindrical-grid valves with tungsten cathodes (along whose surface the temperature is uniform) shows that contact potential, electron potential in the radial direction, and heating voltage (the last with sufficient truth when $U_{st} >$ heating voltage) produce only a parallel displacement of the short-circuit characteristic [for U_{st} = heating voltage the error is less than 2%, and decreases rapidly as U_{st} increases]. The influence of the space-charge field on the modulation potential at the grid has a flattening, but not a shape-changing, effect. A shape-changing effect which, however, is only noticeable for small current values, is produced by the variation with current of the threshold potential. Of great influence, however, on the course of the short-circuit characteristic (prevention of an increase of slope) is the temperature distribution along the cathode, depending on the conducting-away of heat by the leads carrying the current. The decrease in slope given by a tungsten cathode after being thoriated is explained by an increase of the length of the cooled ends with decreasing temperature. In valves with cathodes with an applied layer of oxide the transverse resistance of the oxide layer also contributes a flattening effect on the characteristic, especially when the layer is of considerable cross section.

ON THE VARIATION OF THE INTER-ELECTRODE CAPACITY OF A TRIODE AT HIGH FREQUENCIES.—B. C. Sil. (*Phil. Mag.*, December, 1933, Series 7, Vol. 16, No. 109, pp. 1114–1128.)

"It is found that, when an accelerating voltage is applied to the grid to draw the electrons from the hot filament into the space between the grid and the plate, the effective value of the capacity undergoes changes, the sense and magnitude of which depend upon the voltage of the plate with respect to the filament."

CATHODE SECONDARY EMISSION: A NEW EFFECT IN THERMIONIC VALVES AT VERY SHORT WAVELENGTHS.—E. C. S. Megaw. (*Nature*, 2nd Dec., 1933, Vol. 132, pp. 854–855.)

"The object of this note is to describe a case in which electrons were observed to arrive at the most negative electrode in a thermionic valve with sufficient energy to cause secondary emission." This may occur when the time of transit becomes an appreciable fraction of the oscillation period.

THE ELECTRONIC EMISSION FROM THE GRID ["Inverse" Grid Current from Grid close to Cathode of Indirectly Heated Receiving Valve].—J. Groszkowski and S. Ryzko. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 21–23.)

VACUUM TUBE ELECTRONICS AT ULTRA-HIGH FREQUENCIES.—Llewellyn. (*See* under "Transmission.")

VACUUM TUBES OF SMALL DIMENSIONS FOR USE AT EXTREMELY HIGH FREQUENCIES [Micro-Waves: Triode and Screen-Grid Models].—B. J. Thompson and G. M. Rose, Jr. (*Proc. Inst. Rad. Eng.*, December, 1933, Vol. 21, No. 12, pp. 1707–1721.)

The full paper, a summary of which was referred to in Abstracts, 1933, p. 450: *see* also p. 624. "Receivers have been constructed using the screen-grid tubes which afford tuned r.f. amplification at 100 cm and 75 cm, a gain of approximately 4 per stage being obtained at the longer wavelength."

DYNAMIC CHARACTERISTICS OF THYRATRONS [for A.C. up to 500 c/s: "Toulon" and Magnetic Control].—I. Kano and K. Takahashi. (*Journ. I.E.E. Japan*, October, 1933, Vol. 53 [No. 10], No. 543, pp. 856–859: English summary pp. 83–84.) Continuation of the researches dealt with in January Abstracts, p. 52–53 (Watanabe and Takano).

ON THE DISCHARGE PRODUCED BY THE SUPERPOSITION OF A CONSTANT FIELD AND A FIELD OF HIGH FREQUENCY [analogous to "Rocky Point Effect" in Transmitting Valves].—M. Chenot. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1599–1601.) For Gossling's papers on "Rocky Point Effect" (Flash-Arc) *see* 1933 Abstracts, p. 41, and 1932, p. 409.

THE MODE OF ACTION OF SCREEN-GRID TRANSMITTING VALVES.—C. J. de L. de la Sablonière: Philips' Company. (*L'Onde Élec.*, Aug./Sept., 1933, Vol. 12, No. 140/141, pp. 415–440.) *See* Abstracts, 1932, pp. 527–528. For later work *see* 1933, p. 507 (three).

HIGH-POWER VALVE WITH TUBULAR CATHODE HEATED BY ELECTRON BOMBARDMENT FROM INTERNAL ELECTRODE: HEAT LOSS BY RADIATION FROM END PREVENTED BY CONCENTRIC TUBULAR SCREENS.—Siemens & Halske. (German Pat. 574 812, pub. 22.4.1933: *Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, p. 184.)

A NEW CONSTRUCTION FOR RECEIVING VALVES ["Catkin" Types].—C. J. Smithells and D. A. Rankin. (*G.E.C. Journ.*, November, 1933, Vol. 4, No. 4, pp. 229–235.)

USE OF THE 1A6 TUBE [2-Volt Pentagrid Converter as Oscillator-Mixer and Combination Diode-Tetrode].—(*Rad. Engineering*, October, 1933, Vol. 13, No. 10, p. 26.)

THE STUDY OF VALVES BY MEANS OF THEIR CHARACTERISTIC CURVES [Efficiency as Ratio of Output Triangle Area to Total Anode Power Rectangle Area: etc.].—F. Berg. (*Funktech. Monatshefte*, November, 1933, No. 11, pp. 431–438.)

THE PERFORMANCE CHARACTERISTICS OF LINEAR TRIODE AMPLIFIERS [and the Need for Specifying the "Utilisation Factor," etc.].—A. Pen-Tung Sah. (Short abstract only in *Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, p. 1616.)

CIRCLE DIAGRAMS OF VALVE INPUT ADMITTANCE AND AMPLIFICATION FACTOR.—F. M. Colebrook. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, pp. 657–662.)

A VALVE IMPEDANCE RULE [for Use with Valve Charts].—(*World-Radio*, 15th Dec., 1933, Vol. 17, No. 438, p. 794.)

EQUIVALENT CIRCUIT FOR TETRODES AND PENTODES [The Superiority of the Equivalent Parallel Circuit].—W. M. Goodhue. (*Electronics*, December, 1933, p. 341.)

SVEA METAL—ITS APPLICATION AND USE [and the Production of the Carbonised Variety].—H. C. Todd. (*Rad. Engineering*, September, 1933, Vol. 13, No. 9, pp. 26–28.) *See* also 1933 Abstracts, pp. 281 and 451.

GRAPHITE ANODES IN TRANSMITTING TUBES.—D. E. Replogle. (*Electronics*, December, 1933, pp. 338–339.)

ON THE PROBLEM OF THE EMISSION MECHANISM OF OXIDE-COATED CATHODES.—H. Kniepkamp and C. Nebel. (Summary in *Elektrot. u. Masch:bau*, 17th Dec., 1933, Vol. 51, No. 51, p. 671.)

PHOTOELECTRIC INVESTIGATION OF THE DEPENDENCE ON TEMPERATURE OF THE ELECTRON WORK FUNCTION AT A NICKEL SURFACE COVERED WITH ATOMIC BARIUM.—Suhrmann and Deponte. (*See* under "Phototelegraphy and Television," p. 102.)

ÜBER DIE ENERGIEVERHÄLTNISSE AN GLÜHKATHODEN IN DAMPF- UND GASGEFÜLLTEN ENTLADUNGSGEFÄSSEN (The Energy Relations of Incandescent Cathodes in Discharge Vessels Containing Vapour and Gas [Effect of Rise of Cathode Temperature under Influence of Anode Current]).—E. Kleiner. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. 5, pp. 529–556.)

THE THERMIONIC CONSTANTS FOR PLATINUM.—H. L. Van Velzer. (*Phys. Review*, 15th Nov., 1933, Series 2, Vol. 44, No. 10, pp. 831–836.)

If the thermionic constant A in Richardson's equation is taken to be 60 amp./cm^2 deg.^{2}, the work function ϕ is estimated to be 5.29 volts.

THE EFFECT OF TEMPERATURE ON THE EMISSION OF ELECTRON FIELD CURRENTS FROM TUNGSTEN AND MOLYBDENUM.—A. J. Ahearn. (*Phys. Review*, 15th Aug., 1933, Series 2, Vol. 44, No. 4, pp. 277–286.)

The full paper, an abstract of which was referred to in September Abstracts, 1933, p. 507.

SOURCES OF POSITIVE IONS: THERMIONIC PROPERTIES OF THE SYSTEM Li_2O, Al_2O_3, SiO_2.—E. J. Jones and S. B. Hendricks. (*Phys. Review*, 15th Aug., 1933, Series 2, Vol. 44, No. 4, p. 322: abstract only.)

RATE OF VAPORISATION OF MOLYBDENUM *in Vacuo*.—L. Norris and A. G. Worthing. (*Phys. Review*, 15th Aug., 1933, Series 2, Vol. 44, No. 4, p. 323: abstract only.)

THE CLEAN-UP OF HYDROGEN BY MAGNESIUM [in High-Vacuum Technique].—A. L. Reimann. (*Phil. Mag.*, September, 1933, Series 7, Vol. 16, No. 106, pp. 673–686.)

THE SURFACE IONISATION OF POTASSIUM ON MOLYBDENUM.—R. C. Evans. (*Proc Camb. Phil. Soc.*, 1933, Vol. 29, Pt. 4, pp. 522–527.)

DETERMINATION OF THE DISTRIBUTION AND MAXIMUM VALUE OF THE TEMPERATURE IN THE NEIGHBOURHOOD OF A POINT OF DIMINISHED CROSS-SECTION OF A WIRE GLOWING IN A VACUUM.—L. Prásnik. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 3/4, pp. 253–261.)

DIRECTIONAL WIRELESS

EIN BEITRAG ZUR GLEITWEGBLINDLANDUNG VON FLUGZEUGEN (A Contribution to the Blind Landing of Aeroplanes by means of a Gliding Beam [of Ultra-Short Waves]).—E. Kramar. (*E.N.T.*, November, 1933, Vol. 10, No. 11, pp. 451–453.)

According to the DVL investigations of the Diamond and Dunmore landing beam developed in America there is a danger that an unintentional variation in transmitter power, a change in receiver sensitivity, or an effect due to the ground flown over, may lead a pilot to follow a landing curve which either takes him too near to obstacles on the ground, or else makes him reach the ground at too steep an angle. To avoid this danger, Hahnemann has suggested that the gliding path should not be indicated as a curve of constant intensity, but that the field intensity should increase according to a definite law as the landing point is approached. According to this plan the receiver or its indicating instrument would have its sensitivity automatically and progressively decreased from the moment that the operation of landing began, by means of a clockwork device which would be set in action by the pilot. The signals would then first be received at, say, two-thirds of their normal strength, increasing gradually to a final value (if the proper curve were followed) of twice that normal strength. The clockwork would then automatically stop, and the final landing would be accomplished by following the gliding beam at the increased intensity. The path thus followed is shown in Fig. 2, where B is the point at which the clockwork is set in action: flight is at first horizontal, then from A to C there is a practically straight line glide: at C the clockwork stops and the landing is completed. It will be seen that the whole first part of the curve is concave (as seen from the ground) rather than convex, as is the case with the constant-intensity beam (Fig. 1).

If there is an accidental variation of transmitter or receiver sensitivity, the clockwork is set going at a point different from B—say B_1 or B_2 (Fig. 2):

but the maximum landing angle is hardly at all increased, and the ground is covered at a safe height. Even if the duration of the landing is altered (*e.g.* by a change of speed due to wind) Fig. 3 shows that the resulting landing curve is not unfavourable, while Fig. 4 shows that even if the landing is started at a wrong height ("which with the other system would lead to much too steep an angle") the curve is still a good one.

Fig. 5 shows the experimental model of the instrument. *Z* represents the intensity indicator, *M* the time marker: during the landing this marker moves slowly from the point *A* to the point *B* on the scale. In the above description the simple linear intensity change is considered, but by suitably choosing the time during which the clockwork runs, and the law controlling the intensity change, any desired landing path can be indicated.

A New Field of Application for Ultra-Short Waves [Pilot Ray (U.S.W. Equi-Signal Beacon) for Fog Landing: 30 km Range].—E. Kramar: Lorenz Company. (*Proc. Inst. Rad. Eng.*, November, 1933. Vol. 21, No. 11, pp. 1519–1531.)

Latest development of the u.s.w. beacon dealt with in 1933 Abstracts, p. 162. Besides giving the direction, the beacon gives the signal for penetrating the clouds by the interruption of signals when the aircraft is vertically above the beacon: at a height of 200 metres there is no reception for about 4–5 seconds. Simultaneous visual and aural reception is possible without changing the method of keying. An instrument connected to a copper-oxide rectifier indicates the distance and the cessation of reception above the beacon. For American work on an u.s.w. beacon *see* Chinn, 1933 Abstracts, p. 508.

Fog Loses Its Peril [Blind Flying and Landing Equipment at College Park and Newark Airport].—J. H. Williams: Bureau of Standards. (*Sci. News Letter*, 18th Nov., 1933, Vol. 24, No. 658, pp. 330–331 and 335.)

Performance Tests of Radio System of Landing Aids [at Newark Airport and elsewhere: including Description of System].—H. Diamond. (*Bur. of Stds. Journ. of Res.*, October, 1933, Vol. 11, No. 4, pp. 463–490.)

Radio Direction Finder for Use on Airplanes [Visual Indication, free from 180° Ambiguity, on Small Rotatable Loop].—(*Bur. of Stds. Tech. News Bull.*, August, 1933, No. 196, pp. 83–84: *Elec. Engineering*, November, 1933, Vol. 52, No. 11, pp. 779–780.)

Aircraft Landing Aid at Aerodromes by Means of Buried Cables [Height and Direction Indication: the Villeneuve-les-Vertus Installation].—J. Blancard: Soc. Loth. (*Rev. Gén. de l'Élec.*, 2nd Dec., 1933, Vol. 34, No. 22, pp. 765–776.)

Latest developments of the Loth leader cable system referred to in Abstracts, 1930, pp. 47 (Loth) and 572 (Bourgonnier). A section deals with the suitable l.f. receiver (and the use of automatic volume control), while a final section gives the results of flight tests. With a frequency of 1 500 c/s the range was rather disappointing (about 4 km with reception on a horizontal frame, or 2–3 km at a height of 2 000 m), but when the ground absorption was diminished by decreasing the frequency to about 1 000 c/s the range was increased to 6–7 km; similarly in America (Dayton) a 7–8 km range was attained on 900 c/s. The installation was designed to give two "height planes," and as a result the signal pattern was somewhat complicated. In practice, one height plane would probably be sufficient, and the signal code could be correspondingly simplified.

Aircraft Height determined by Effect on Aerial: Errors eliminated by Differential Arrangement of Aerials above and below Aircraft.—Ges. für Elektrische Apparate. (German Pat. 579 669, pub. 30.6.1933: *Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, p. 184.)

Polarisationsmessungen zur Untersuchung der nächtlichen Peilstrahlwanderungen bei der Funkpeilung (Polarisation Measurements for the Investigation of Night Errors in Radio Direction Finding).—H. Plendl. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 518–522.)

The wavelength used in these DVL investigations was 178 m, with 10 km between transmitter and receiver. To cut out, almost entirely, the effects of the ground wave, the transmitting aerial was a horizontal dipole oriented at right angles to the direction of the receiving station. To make sure that with the given wavelength and distance strong d.f. errors would actually occur, the dipole was unbalanced so that a strong ground wave was received: night- and twilight-errors then showed themselves, up to 90°, and for minutes on end no minimum at all, or only a very broad one, could be found. It was concluded, therefore, that the polarisation results obtained in the series of tests, and the conclusions derivable from them, were of general application in explaining the cause of night errors.

The writer agrees that the method of determining the polarisation changes (by cathode-ray oscillograph) is in itself not new; only their recording on film is claimed as a novelty, and is the only way in which such changes can be studied quantitatively. "It is proposed in the next few months to develop a larger programme with this apparatus. In this programme a major feature will be the determination of the correlation of the phase variations with those micro-pulsations of the earth's magnetic field which are indicated by radio propagation. Records of terrestrial magnetism up to the present do not show these pulsations, owing to the too great inertia of the apparatus used: a special equipment must therefore be built for this purpose."

As regards the tests already carried out, the present paper gives some specimens of the films taken and draws the conclusions that the phase variations are due to three types of change: (1) the above-mentioned rapid, and for the most part only slight, changes of the earth's magnetic field, which affect the magnetic double refraction in the ionosphere; these are liable to occur the whole of the time; (2) changes in the electron and carrier densities at the points of reflection in the ionosphere : and (3) changes in the path length of the ionosphere waves ; these last two causes only affect the polarisation locally and therefore probably only have marked influence at the times of change between day and night. The writer ends by mentioning the relation between these polarisation changes and short-wave fading, and the DVL method, based on these ideas, of eliminating fading (Abstracts, 1932, p. 156 : see also 1933, p. 557). Deductions from the results relating to polarisation changes dependent on frequency, as they may affect layer-height measuring methods, are also referred to (1933, pp. 383–384).

ELIMINATION OF DETUNING OF FRAME AERIAL CIRCUIT WHEN VERTICAL AERIAL IS CONNECTED FOR SENSE DETERMINATION.—Telefunken. (German Pat. 577 785, pub. 3.6.1933 : *Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, p. 184.)

COMPACT [Cathode-Ray] DIRECTION FINDERS FOR ATMOSPHERIC DISTURBANCES.—Burgess. (Summary only in *Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, p. 1518.)

THE POSITION AT SEA BY RADIOGONIOMETRIC BEARINGS TAKEN ON BOARD.—P. de Vanssay de Blavous. (*Hydrographic Review*, November, 1933, Vol. 10, No. 2, pp. 87–109.)

RADIO BEACONS [Equi-Signal System, using Vertical Tower Aerials in place of Loops].—F. S. Mabry. (*Sci. Abstracts, Sec. B*, October, 1933, Vol. 36, No. 430, pp. 655–656.)

ULTRA-SHORT-WAVE TWO-BEAM BEACON [Swinging Radiator and Mirror, excited only at End of Swing].—Telefunken : Ludenia. (German Pat. 578 850, pub. 19.6.1933). For another variation *see* 1933 Abstracts, p. 451.

RADIO BEACON CONSISTING OF TWO ROTATING BEAMS, EACH MODULATED WITH A PROGRESSIVELY VARYING NOTE : EVERY DIRECTION REPRESENTED BY EQUAL SIGNAL STRENGTHS OF TWO DEFINITE NOTES.—L. Levy. (German Pat. 578 145, pub. 10.6.1933.)

AUTOMATIC WIRELESS BEACONS IN CHINESE WATERS.—(*Overseas Engineer*, December, 1933, Vol. 7, No. 75, p. 99 : paragraph only.)

ACOUSTICS AND AUDIO-FREQUENCIES

ÜBER DIE INTENSITÄTSVERHÄLTNISSE VON NATÜRLICHEN KLANGBILDERN MIT BESONDERER BERÜCKSICHTIGUNG DER RUNDFUNKSENDUNG (On the Intensity Proportions of Natural [not subjected to "Control"] Sound Spectra [Speech, Music from Symphony and Dance Orchestras, etc.], with Special Reference to Broadcasting).—H. J. von Braunmühl. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 507–512.)

An experimental examination, with an electrochemical recorder embodying eleven simultaneously acting roller contacts driven by a series of valve peak voltmeter circuits with successively increasing negative grid bias, of the possibility of reducing the amount of "control" in the transmission of programmes of various types.

"PLASTIC" MUSIC REPRODUCTION [Stereoscopic Reception produced by Second Loud Speaker giving Echo Effect by means of Endless Steel Wire on Circumference of Rotating Disc].—H. Dillge. (*E.T.Z.*, 14th Dec., 1933, Vol. 54, No. 50, p. 1218.)

DOUBLE CHANNEL TRANSMISSION [Stereoscopic or Binaural Effect an Illusion? Greater Importance of Microphone Improvement and Faithful Phasing].—G. Sayers. (*Wireless Engineer*, December, 1933, Vol. 10, No. 123, p. 664.)

THE "STEREOSCOPIC" REPRODUCTION OF SOUND [Problems involved in Binaural Hearing or Stereophonic Reproduction, and Discussion of Results of Past Researches].—A. B. Howe. (*World-Radio*, 1st Dec., 1933, Vol. 17, No. 436, pp. 725–726.) *See* also 1933 Abstracts, pp. 627 (Fletcher), and 452 ("Auditory Perspective"), both r-h columns.

PERFECT TRANSMISSION AND REPRODUCTION OF SYMPHONIC MUSIC IN AUDITORY PERSPECTIVE.—F. B. Jewett, W. B. Snow and H. S. Hamilton. (*Sci. Abstracts, Sec. B*, October, 1933, Vol. 36, No. 430, pp. 648–649.) *See* also 1933 Abstracts, p. 396 and 396–397.

ELECTRODYNAMIC HEAD TELEPHONES [using a Zig-Zag of Metallic Ribbon].—G. Longo. (*L'Onde Élec.*, October, 1933, Vol. 12, No. 142, pp. 462–464.)

On the same lines of design as the electrostatic headphones dealt with in 1933 Abstracts, p. 571. 40 or 50 "cells" may be combined to form a cubical block of, say, 1 cm sides : this block is placed between the poles of a magnet so that the field is parallel to the breadth of the ribbon. No experimental results are mentioned, but "from the acoustical point of view the instrument should behave like the electrostatic telephone ; on the other hand, its electrical impedance (including therein the reaction due to the acoustical vibrations) should be, for all frequencies, practically equal to its ohmic resistance. The instrument should therefore give very faithful reproduction." If, without making the whole instrument too heavy, the field can be made sufficiently strong (of the order of a thousand gauss), the current can be kept well below one ampere even for the strongest sounds : the resistance being of the order of a tenth of an ohm, the power necessary would be very low.

EXPLORING DIAPHRAGM RESONANCES.—F. R. W. Strafford. (*Wireless World*, 15th December, 1933, Vol. 33, pp. 456–457.)

The cone-diaphragm moving-coil loud speaker is dependent on resonances for its high electro-acoustic efficiency, and in developing a design for commercial production it is essential to control the distribution of resonances for best results. At high frequencies the use of a stroboscope is impracticable, but reliable observations may be made with the aid of a modified surgical stethoscope.

SUB-HARMONICS.—Strafford: Pedersen. (*World-Radio*, 15th Dec., 1933, Vol. 17, No. 438, p. 801.) On the work of Strafford and Pedersen (1933 Abstracts, p. 626).

NEW ELECTROPHONES FOR HIGH-FIDELITY SOUND REPRODUCTION [Horn Loud Speaker with Piezoelectric Diaphragm of 4 "Bimorph" Rochelle-Salt Elements: Cut-off at 8 000 or 16 000 c/s].—W. G. Ellis. (*Rad. Engineering*, October, 1933, Vol. 13, No. 10, pp. 18–19 and 21.)

A STRETCHED MEMBRANE ELECTROSTATIC LOUD SPEAKER [Mathematical Analysis applied to a Vogt Loud Speaker].—N. W. McLachlan. (*Journ. Acoust. Soc. Am.*, October, 1933, Vol. 5, No. 2, pp. 167–171.)

ZUR FRAGE NACH DER HÖCHSTEMPFINDLICHKEIT VON UMKEHRBAREN ELEKTROAKUSTISCHEN EMPFÄNGERN (The Question of the Maximum Sensitivity of Reversible Electroacoustic Receivers [Microphones: Reaction of Electric Load on Mechanical Oscillating System]). —H. Lueder and E. Spenke; W. Schottky. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 78, pp. 537–549.)

"The sensitivity of the condenser microphone can be increased arbitrarily as a linear function of the field strength, with unaltered position of the resonance frequency. This is not possible with the electrodynamic microphone for which there is an optimum value of the mutual inductance."

THE VELOCITY ["Ribbon"] MICROPHONE [including the New Technique involved in Its Use].—A. Barbieri. (*Rad. Engineering*, October, 1933, Vol. 13, No. 10, pp. 14–16.)

A UNI-DIRECTIONAL RIBBON MICROPHONE.—Weinberger, Olson and Massa. (*Journ. Acous. Soc. Am.*, October, 1933, Vol. 5, No. 2, pp. 139–147.)

PUBLIC ADDRESS AT THE CENTURY OF PROGRESS EXPOSITION, CHICAGO [using Crystal Microphones].—(*Electronics*, October, 1933, pp. 274–275 and 283.)

SINGING THROUGH CELLOPHANE [Hood for Broadcasting Sopranos to prevent Microphone Vibration].—(*Scient. American*, December, 1933, Vol. 149, No. 6, p. 286.)

PIEZOELECTRIC GRAMOPHONE PICK-UPS WITH PRACTICALLY UNIFORM FREQUENCY RESPONSE AND LITTLE RECORD WEAR.—(*Electronics*, November, 1933, p. 319.)

THE TECHNIQUE OF TRANSCRIPTIONS FOR BROADCAST USE [Vertical Cut Recording, with Gold-Sputtered Wax Master and Cellulose Acetate Discs].—J. E. Dickert. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 14 and 26.)

QUANTITATIVE INVESTIGATIONS INTO THE HOME-RECORDING OF GRAMOPHONE DISCS [including an Optical Method of Magnifying and Recording the Track Amplitudes].—J. Dürrwang. (*Funktech. Monatshefte*, November, 1933, No. 11, pp. 420–422.)

SOME THEORETICAL AND PRACTICAL ASPECTS OF NOISE INDUCTION [between Power and Telephone Lines—Physical Processes Involved and Means of Qualitative Demonstration].—R. F. Davis and H. R. Huntley. (*Bell S. Tech. Journ.*, October, 1933, Vol. 12, No. 4, pp. 469–497.)

SPEECH TRANSMISSION OVER LONG LINES WITHOUT THE USE OF VALVE REPEATERS [and the Conditions necessary for Fidelity].—B. Pieske. (*Zeitschr. f. Fernmeldetech.*, 14th Oct., 1933, Vol. 14, No. 10, pp. 152–157.)

THE AIR-GAP TRANSFORMER AND CHOKE [particularly the Output Transformer of a Radio Receiver: Nearly Constant Inductance under All Working Conditions].—F. W. Lanchester. (*Journ. I.E.E.*, October, 1933, Vol. 73, No. 442, pp. 413–418.)

FILTER-TYPE INTERSTAGE AMPLIFIER COUPLING: CORRECTION.—Stone: Salisbury. (*Electronics*, September, 1933, p. 259.) See 1933 Abstracts, p. 628, l-h column.

MODULATED PENTODE OSCILLATOR.—(*Wireless World*, 25th August, 1933, Vol. 33, p. 183.)

ON FREQUENCY-MODULATED SIGNALS ["Warble Tones"] IN REVERBERATION MEASUREMENTS. —F. V. Hunt. (*Journ. Acoust. Soc. Am.*, October, 1933, Vol. 5, No. 2, pp. 127–138.)

ÜBER DIE HÖRSAMKEIT HOLZAUSGEKLEIDETER RÄUME (The Acoustic Properties of Wood-Lined Rooms).—E. Meyer and L. Cremer. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 500–507.)

Among the results of this experimental investigation is that the wood lining diminishes the reverberation time for the lower frequencies; unvarnished wood may behave as a porous wall to high frequencies. By the use of wood it is possible to make the reverberation time to a certain extent independent of frequency.

DIE BEDINGUNGEN FÜR DEN GÜNSTIGEN SCHALLSCHLUCKER (The Conditions for the Optimum Absorption of Sound [Theoretical Investigation with Application to Improvements in Sound-Insulating Materials]).—A. Gemant. (*E.N.T.*, November, 1933, Vol. 10, No. 11, pp. 446–450.)

NBC's NEW STUDIOS IN RADIO CITY.—(*Electronics*, December, 1933, pp. 324–326.)

ROOM NOISE AND REVERBERATION AS PROBLEMS IN TELEPHONY.—W. West. (*Inst. P.O Elec. Engineers*, Printed Paper No. 145, 55 pp.)

STROBOSCOPY BY MEANS OF IMPRESSED EYE MOVEMENTS OR MIRROR VIBRATION [Application to Tonoscope for Acoustic Measurements].—M. Metfessel. (*Science*, 3rd Nov., 1933, Vol. 78, No. 2027, pp. 416–417.)

A NOMOGRAPHIC METHOD FOR ASCERTAINING ACOUSTIC ENERGY SPECTRA.—D. A. Rothschild. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 587–589.)

NOISE MEASUREMENT BEING STANDARDISED. I: PROGRESS IN NOISE MEASUREMENTS. II: PROPOSED STANDARDS FOR NOISE MEASUREMENTS.—P. L. Alger: Harvey Fletcher. (*Elec. Engineering*, November, 1933, Vol. 52, No. 11, pp. 741–744: 744–746.)

THE REPRESENTATION AND MEASUREMENT OF ELECTRICAL PROCESSES—ANALYSIS AND STATISTICS [and a New Apparatus for Measuring Noises and Interference].—Feldtkeller. (*See* under "Measurements and Standards.")

LOUDNESS, ITS DEFINITION, MEASUREMENT AND CALCULATION.—H. Fletcher and W. A. Munson. (*Journ. Acoust. Soc. Am.*, October, 1933, Vol. 5, No. 2, pp. 82–108: *Bell S. Tech. Journ.*, October, 1933, Vol. 12, No. 4, pp. 377–430.)

PROPOSED STANDARDS FOR NOISE MEASUREMENT.—(*Journ. Acoust. Soc. Am.*, October, 1933, Vol. 5, No. 2, pp. 109–111.)

SOUND MEASUREMENTS [with the "Total-Noise" Meter] *versus* OBSERVERS' JUDGMENTS OF LOUDNESS.—P. H. Geiger and E. J. Abbott. (*Elec. Engineering*, December, 1933, Vol. 52, No. 12, pp. 809–812.)

Complex sounds of about the same level but of materially different quality were used. The results showed the superiority of noise-meter readings over the judgment of any single observer, but there was surprisingly close agreement between the meter readings and the average judgments of a group of observers.

AUDITORY NERVE CANNOT CARRY HIGHEST AUDIBLE FREQUENCIES [Above 2 800 c/s Pitch Discrimination cannot depend on Frequency of Nerve Impulses].—H. Davis, A. Forbes, A. J. Darbyshire. (*Sci. News Letter*, 25th Nov., 1933, Vol. 24, No. 659, p. 339.)

THE THEORY OF HEARING [Experiment supporting Hypothesis of Pulsating Electric Currents in Cochlea produced, by some Chemical Means, by an Acoustic Tone].—O. Voss. (*Naturwiss.*, 6th Oct., 1933, Vol. 21, No. 40, p. 721.)

THE SENSE OF HEARING.—R. T. Beatty. (*World-Radio*, 15th Sept., 1933, Vol. 17, No. 425, pp. 329, 330: to be continued.)

ON THE STRIKING TONE OF BELLS.—E. Meyer and J. Klees. (*Naturwiss.*, 29th Sept., 1933, Vol. 21, No. 39, pp. 697–701.)

The "striking tone" of a bell is the frequency first perceived by the ear. The writers find that it cannot be physically demonstrated but is a physiological difference tone between two objective partial tones.

RESONANCE IN COUPLED PIPES.—A. E. Bate. (*Phil. Mag.*, September, 1933, Series 7, Vol. 16, No. 106, pp. 562–574.)

"The results of this [experimental] investigation confirm a theoretical formula, originally given by Aldis, for the resonant tones of a compound pipe consisting of two pipes of different diameters joined end to end."

TONE FORMATION IN LIP PIPES.—J. Zahradníček. (*Physik. Zeitschr.*, 1st Aug., 1933, Vol. 34, No. 15, pp. 602–604.)

SOME FREQUENCIES OF MULTIPLE RESONATORS [*e.g.* Violins], *and* TONE ANALYSIS AND PHYSICAL CHARACTERISTICS OF VIOLINS.—R. O. Jenkins and R. B. Abbott: T. H. Stevens and R. B. Abbott. (*Phys. Review*, 15th Aug., 1933, Series 2, Vol. 44, No. 4, p. 321: abstracts only.)

A SOUND TRACK OF THE VOWEL *ah*.—E. W. Scripture. (*Nature*, 23rd Sept., 1933, Vol. 132, pp. 486–487.)

DETONATION AND THE THEORY OF HEARING.—G. v. Békésy. (*Physik. Zeitschr.*, 1st Aug., 1933, Vol. 34, No. 15, pp. 577–582.)

CHARACTERISTIC INTERVALS OF ENGLISH VOWELS.—P. Kucharski. (*Nature*, 11th Nov., 1933, Vol. 132, pp. 752.) *See* also 1933 Abstracts, p. 276, r-h column.

EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON THE NATURAL LONGITUDINAL OSCILLATIONS OF RODS AND TUBES. [Application to Rod-Shaped Piezoelectric Quartz Oscillators].—E. Giebe and E. Blechschmidt. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. S. 4 and 5, pp. 417–456 and 457–485.)

THE OPTICAL PROOF OF THE HARMONIC VIBRATIONS OF A QUARTZ CRYSTAL BY THE METHOD OF DEBYE AND SEARS, AND ITS APPLICATION TO THE MEASUREMENT OF THE VELOCITY OF SOUND IN LIQUIDS.—L. Bergmann. (*Physik. Zeitschr.*, 15th Oct., 1933, Vol. 34, No. 20, pp. 761–764.)

OSCILLATIONS OF SOLIDS IN AIR OR WATER: INSTANTANEOUS CURRENT LINES AND THE FORMATION OF ZONES OF SILENCE.—L. Marty. (*Journ. de Phys. et le Rad.*, October, 1933, Vol. 4, No. 10, pp. 557–569.)

A SUPERSONIC INTERFEROMETER FOR THE STUDY OF THE PRESSURE COEFFICIENT OF VELOCITY [and Some Results].—J. C. Swanson. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 603–605.)

INVESTIGATION OF SUPERSONIC WAVES [in Liquids] WITH THE RESISTANCE THERMOMETER.—N. N. Malov. (*Hochf:tech. u. Elek:akus.*, October, 1933, Vol. 42, No. 4, pp. 115–119.)

Author's summary:—It is shown that for the investigation of the energy distribution of supersonic waves in liquids a resistance thermometer (as also a thermojunction) is serviceable [and superior to a thermojunction, which has considerable thermal inertia and involves a certain amount of difficulty in keeping the second junction at a constant temperature. Sometimes the resistance wire was enclosed in an ebonite cylinder with a slot to admit the waves: this increased its sensitivity].

The energy distribution of supersonic waves ($f = 573$ kc/s), reflection, dispersion, refraction and the formation of standing waves in liquids [including conducting liquids in which the quartz oscillator could not be immersed] were examined.

The velocities of propagation in transformer oil, water, and 7% salt solution in water, were measured: the values are in good agreement with those of Hubbard and Loomis.

Some Experiments on the Diffraction of Light by Supersonic Waves.—Bär and Meyer. (*Helvet. Phys. Acta*, Fasc.4, Vol. 6, 1933, pp. 242–244.)

Coefficients of Absorption of Supersonic Waves by Different Liquids.—P. Biquard. (*Comptes Rendus*, 24th July, 1933, Vol. 197, No. 4, pp. 309–311.)

Further development of the work referred to in Abstracts, 1931, p. 562, r-h col. *See* also 1932, p. 576, r-h col., and 1933, pp. 31, 220 and 453.

Supersonic Vibrations set up in a Zinc Bar undergoing Transverse Vibrations.—K. Prosad and S. Sharan. (*Nature*, 3rd June, 1933, Vol. 131, pp. 803–804.)

The Formation of Emulsions under the Influence of Supersonic Vibrations.—W. Daniewski. (*Physik. Ber.*, 15th Aug., 1933, Vol. 14, No. 16, p. 1301.)

Intensity Measurements in a Supersonic Field of Small Dimensions [Calorimetric Method].—Biancani and Dognon. (*Comptes Rendus*, 6th Nov., 1933, Vol. 197, No. 19, pp. 1070–1071.)

On the Intervention of Thermal Phenomena in the Biological Action of Supersonic Waves.—Biancani and Dognon. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1693–1694.)

"Elements of Engineering Acoustics."—L. E. C. Hughes. (Book Review in *Wireless Engineer*, December, 1933, Vol. 10, No. 123, p. 656.)

PHOTOTELEGRAPHY AND TELEVISION

Die Braunschen Röhre als elektronenoptisches Problem (The Cathode-Ray Tube as a Problem in Electron Optics [Calculation of Positions of Electrodes for High Sensitivity combined with Brightness and Sharpness of Spot: a New Design]).—E. Brüche and O. Scherzer. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 464–466.)

With a gas-concentrated tube the maximum sensitivity is obviously obtained when the deflecting plates are as close as possible to the cathode, for the concentrating ions are produced by the ray itself: the ray moves as a whole. With high-vacuum tubes matters are not quite so simple, owing to the presence of the concentrating "lenses": optical considerations show that maximum sensitivity is obtained when lens and deflecting plates are at the same point or as close as possible.

The writers then consider, for the high-vacuum tube, the more complex question of the electrode positions giving as small and bright a spot as possible without diminishing the sensitivity. Here a law of Helmholtz' is usefully applied to electron optics: it states that the magnification equals the ratio of the angles γ and β (Fig. 3) at which the optical axis is cut, at the source and at the screen, by a ray passing from the mid-point of the source to the mid-point of the image, multiplied by the ratio of the electron velocities v_g and v_b at the source and at the image; that is, magnification $V = \gamma/\beta . v_g/v_b$. From this it is seen that there are three possible ways of keeping the spot magnification small without decreasing the sensitivity by diminishing the gap from lens to screen: (1) making v_g much smaller than v_b; (2) carrying the ray within the concentrating organ so far from the axis that β is much greater than γ (Fig. 4a); and (3) making the ray cut the axis at three points (Fig. 4b) so as to form an intermediate image at Q; this corresponds to Rogowski's pre-concentration technique.

Fig. 5 shows an AEG tube modified by the writers by the introduction, close to the deflecting plates (*see* above), of an electrical lens of three electrodes: the electron velocity was made smaller on the cathode side of the lens than on the image side, agreeing with (1) above, and the first part of the concentrating system acted as a dispersing lens carrying the electron beam away from the axis, agreeing with (2) above. This arrangement, in a highly exhausted tube, gave a sharp spot, and voltages at high frequencies could be oscillographed without the defects met with in gas-concentrated tubes. Up to 5×10^5 c/s there was no deviation from proportionality between potential and deflection, and naturally no zero-point anomaly. The writers end by urging that only by attending to optical considerations in this way is further progress likely to be made—for example in television.

Eine neue Methode zur Beseitigung der Verzerrungen durch Raumladung in Braunschen Röhren (A New Method of Eliminating the Distortions due to Space Charge in [Gas-filled] Cathode-Ray Tubes [Zero-Point Error]).—M. von Ardenne: Lorenz Company. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 461–464.)

After discussing various methods of eliminating the zero-point anomaly (Bedell and Kuhn, Abstracts, 1931, p. 51; Hudec, 1933, p. 453; both r-h cols.) the writer first proposes the device of making the earthed deflecting plate, in each pair, of a resistive material, so that a potential drop along it can be formed by an external current source: by this arrangement a distribution of the space-charge effect is obtained which is completely uniform over the whole screen surface, provided the p.d. along the plate is greater than the amplitude of the deflecting potential.

He then goes on to describe a similar but simpler solution: one plate, or where necessary one plate of each pair (preferably the earthed one), is divided into two halves which are maintained at different potentials by an auxiliary battery. When both pairs of plates have one plate thus divided, the half-plates at the same potential may be joined internally, in which case the number of connections led out from the tube is no greater than in the ordinary tube. This plan is useful when the tube is to be used for definite purposes, such as television: for universal use it is better to lead-out the half-plates separately.

HALATION IN TELEVISION RECEPTION WITH CATHODE-RAY TUBES [and an Optical Bench for the Investigation of Halation].—M. von Ardenne. (*Funk-Magazin*, December, 1933, Vol. 6, No. 12, pp. 804–806 and 808). Most of the ground is covered in the longer paper (Jan. Abstracts, p. 44.)

TELEVISION WITH CATHODE-RAY TUBES [Scanning with the "Iconoscope," Reproduction with the "Kinescope"].—V. K. Zworykin. (*Journ. I.E.E.*, October, 1933, Vol. 73, No. 442, pp. 437–451.)

"The sensitivity of the iconoscope, at present, is approximately equal to that of a photographic film operating at the speed of a motion picture camera. The resolution of the iconoscope is high, much higher than is necessary for television of the highest quality. . . The whole system is completely automatic and the receiving sets are almost as easy to operate as the ordinary radio receivers."

RECEIVERS FOR BROADCAST TELEVISION [Te-Ka-De Developments, especially the Mirror Screw and the Zinc Sulphide Crystal Light-Control Cell].—F. von Okolicsanyi. (*Funk-Magazin*, December, 1933, Vol. 6, No. 12, pp. 780–786.)

RADIO-A.G. D.S. LOEWE [and Its Television Film Transmitter and Cathode-Ray-Tube Receivers].—Loewe Company. (*Ibid.*, pp. 787–789.)

FERNSEH-A.G. [and Its Continuous-Film Television Transmitter and Cathode-Ray-Tube and Mirror Screw Receivers].—Fernseh Company. (*Ibid.*, pp. 789–794.)

MIHALY-FERNSEHAPPARATE-G.m.b.H. [and Its "Mirror Wreath" with Rotating Central Mirror].—von Mihaly. (*Ibid.*, pp. 794–795.)

MARCONI TELEVISION SYSTEM.—Marconi Company. (*Ibid.*, pp. 796–797.)

TELEVISION AT THE PATENT OFFICE [Recent Ideas: including Stereoscopic Transmission and Recording on Light-Sensitive Discs for Direct Reproduction].—(*Funk-Magazin*, December, 1933, Vol. 6, No. 12, pp. 765–768.)

WHAT CONSTITUTES PERFECT DETAIL IN TELEVISION [Necessity of "Right Frame of Mind": 180-Line Results at least as good as "Home Movies"].—W. H. Peck. (*Scient. American*, December, 1933, Vol. 149, No. 6, p. 273.)

CHAIN TELEVISION [Suggested Ultra-Short-Wave Television Service by 1 kw Relay Stations 30 Miles apart].—Hollis Baird. (*Rad. Engineering*, September, 1933, Vol. 13, No. 9, p. 24.)

ULTRA-SHORT-WAVE TELEVISION RECEPTION OVER 284 MILES WITH VERY HIGH AERIAL.—(*Television*, November, 1933, Vol. 6, No. 69, p. 386: in an article on "Progress in Germany.")

RECENT DEVELOPMENTS IN TELEVISION [Lecture on Present Position].—A. Church. (*Nature*, 30th Sept., 1933, Vol. 132, pp. 502–505.)

THE PRACTICE OF TELEVISION [Short Surveys of Various Systems].—Telefunken: Zworykin: von Ardenne: Baird. (*Funk-Magazin*, December, 1933, Vol. 6, No. 12, pp. 769–780.)

THE DE FRANCE TELEVISION SYSTEM.—(*Television*, October, 1933, Vol. 6, No. 68, p. 351.)

POSITIVE SYNCHRONISING [for Reception of Baird Transmissions: Local 375 c/s Oscillator synchronised by Signal].—K. S. Davies and E. L. C. White. (*Television*, December, 1933, Vol. 6, No. 70, pp. 411–413 and 416.)

ELIMINATION OF GEAR TO OBTAIN THE CONSTANT SHAFT SPEED OF 1 440 R.P.M. NECESSARY FOR TELEVISION FROM STANDARD FILMS.—W. H. Peck. (*Television*, December, 1933, Vol. 6, No. 70, p. 406.)

FILTERS FOR MIRROR DRUMS [Spring Coupling to Eliminate Hunting].—C. P. Hall. (*Television*, November, 1933, Vol. 6, No. 69, pp. 389 and 391.)

PIEZOELECTRIC QUARTZ LIGHT-MODULATING DEVICE: *and* A SIMPLE DOUBLE-IMAGE POLARISCOPE [enabling Ordinary and Extra-ordinary Beams to be used].—H. A. Hankey: Myers. (*Electrician*, 22nd December, 1933, Vol. 111, No. 2899, p. 780.) Summary of a Television Society paper and demonstration by Myers.

MOTOR-CAR HEADLIGHT BULB AS LIGHT SOURCE FOR TELEVISION [giving Image "385 Times as Bright as that obtained with Best Crater Lamp"].—W. H. Peck. (*Television*, December, 1933, Vol. 6, No. 70, p. 406.)

A PROJECTOR TYPE LIGHT FLUX GENERATOR FOR TESTING LIGHT-SENSITIVE DEVICES [Photocells, Neon Lamps, etc.; "Variable Area" Sound Film on Rotating Drum, with Standard Sound-Head Lamp, etc.].—E. B. Kurtz and J. L. Potter. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1599–1602.)

ÜBER DIE SOGENANNTE "EMPFINDLICHKEIT" LICHTELEKTRISCHER ZELLEN VERSCHIEDENER WIRKUNGSWEISE (On the So-Called "Sensitivity" of Photoelectric Cells with Various Modes of Action [Resistance, Alkali and Barrier-Layer Types]).—W. Kluge and H. Briebrecher. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 533–538.)

The writers urge that the generally used term "sensitivity," *tout court*, is altogether too vague and is liable to lead to confusion, especially when cells of entirely different modes of action come to be compared. They advocate the abolition of the term and its replacement by four precisely defined terms "spectral sensitivity," "current sensitivity," "voltage sensitivity" and "power [or output] sensitivity." There is also "dynamic sensitivity," relating to the magnitude of the a.c. potential yielded by a cell to the input resistance of an amplifier when subjected to alternating illumination, but this depends rather on circuit conditions and is not further considered; nor do the writers include the "crystal" photocell in their treatment, in which they make use of the more abstract work of Earl D. Wilson (1932 Abstracts, p. 173).

Dealing first with spectral sensitivity, the writers point out the importance of plotting the distribution of sensitivity over the spectrum and the complication resulting from the change of current sensitivity (measured in ampere/lumen) with the colour temperature of the light source. In certain cases, where the liberated photoelectrons produce no secondary (ionising) effects, it is possible to speak of an *absolute* spectral sensitivity, based on the number of electrons set free in one second by an irradiation of one calorie per second. In other cases only a *relative* spectral sensitivity can be considered. Next, current sensitivity is dealt with, and defined as $\sigma_i = di/d\phi$; this is a function of the external resistance, decreasing as the latter increases. Voltage sensitivity is defined as the differential coefficient of the voltage/flux characteristic ($\sigma_e = de/d\phi$). This is of special importance when the cell is used in combination with an amplifier. Finally, the power sensitivity (of special importance when the cell feeds a load directly) is given as $\sigma_L = dL/d\phi$, being derived from the current and voltage sensitivities according to the equation $\sigma_L = de \,.\, i/d\phi = e \,.\, \sigma_i + i \,.\, \sigma_e$. The maximum power sensitivity lies between the open-circuited and short-circuited conditions.

In their final section the writers apply their results to the three types of cell, resistance (selenium, thallium), alkali, and barrier-layer. For the first two types the external resistance conditions for maximum values of σ_i, σ_e and σ_L are the same, namely, $R_a = 0$, $R_a = R_i$, and $R_a = R_i/2$ respectively. For the barrier-layer cell they are $R_a = 0$, $R_a = \infty$, and $R_a = R_i/2$.

FATIGUE IN CAESIUM-OXYGEN-SILVER PHOTOELECTRIC CELLS: ITS CAUSE AND CURE [No Fatigue with Infra-Red Light].—J. H. de Boer. (*Physica*, No. 9, Vol. 13, 1933, pp. 285–288.)

ZUR LICHTELEKTRISCHEN SENSIBILISIERUNG DES ZÄSIUMS (The Photoelectric Sensitising of Caesium).—W. Kluge. (*Physik. Zeitschr.*, 15th Nov., 1933, Vol. 34, No. 22, pp. 844–846.)

It is found that the electron emission from a surface layer of the type carrier-metal/cs_2o/cs is produced, in the visible and infra-red regions, by the adsorbed cs-layer, but in the ultra-violet region by the intermediate layer.

VACUUM PHOTOELECTRIC CELL IN MOTOR HEADLAMP BULB [Sensitivity equal to that of Gas-Filled Cell].—(*Gen. Elec. Review*, October, 1933, Vol. 36, No. 10, p. 466.)

CONDUCTION OF THE SECOND TYPE IN A GAS-FILLED PHOTOELECTRIC CELL.—L. Dunoyer and P. Paounoff. (*Sci. Abstracts, Sec. A*, November, 1933, Vol. 36, No. 431, p. 1255). *See* 1933 Abstracts, p. 278, for a *Comptes Rendus* Note on these researches.

THE TITANIUM PHOTOELECTRIC CELL.—J. W. Marden and K. O. Smith. (*Sci. Abstracts, Sec. B*, October, 1933, Vol. 36, No. 430, p. 644.)

CUPROUS OXIDE PHOTOCELLS [Liquid and Dry: New Developments: the Cuprous Iodide Cell].—H. Wolfson. (*Television*, December, 1933, Vol. 6, No. 70, pp. 408–410.)

SELF-GENERATING PHOTOCELL [the Acoustolite Cell, giving 1 Milliampere in Direct Sunlight: Straight-Line Characteristic].—(*Electronics*, October, 1933, p. 290.)

LICHTELEKTRISCHE UNTERSUCHUNG DER TEMPERATURABHÄNGIGKEIT DER ELEKTRONENAUSTRITTSARBEIT AN EINER MIT ATOMAREM BARIUM BEDECKTEN NICKELOBERFLÄCHE (Photoelectric Investigation of the Dependence on Temperature of the Electron Work Function at a Nickel Surface covered with Atomic Barium).—R. Suhrmann and R. Deponte. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 9/10, pp. 615–634.)

The values found for the work function in the case of a barium layer of atomic thickness increase linearly with the cathode temperature from about 100° C. upwards; the temperature coefficient is 1×10^{-4} to 3×10^{-4} volts per degree, according to the thickness of the layer. The work function increases as the layer thickness decreases. In the case of a layer of more than atomic thickness, there is no noticeable temperature variation of the work function.

THE EMISSION OF ELECTRONS FROM TUNGSTEN AND MOLYBDENUM UNDER THE ACTION OF SOFT X-RAYS FROM COPPER [and the Effect of Heat Treatment].—J. Bell. (*Proc. Roy. Soc.*, Sept., 1933, Vol. 141, No. A 845, pp. 641–651.).

THE WORK FUNCTIONS OF ELECTRONS, AND THE PHOTOELECTRIC PROPERTIES OF METALS.—P. I. Lukirsky. (*Physik. Zeitschr. der Sowietunion*, No. 2, Vol. 4, 1933, pp. 212–238.)

MEASUREMENTS AND STANDARDS

DARSTELLUNG UND MESSUNG ELEKTRISCHER VORGÄNGE—ANALYSE UND STATISTIK (The Representation and Measurement of Electrical Processes—Analysis and Statistics [and a New Apparatus for Measuring Noises and Interference]).—R. Feldtkeller. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 456–461.)

Noises and disturbances, such as those in broadcast reception, in telephone circuits due to power-line switching, cross-talk, etc., are not satisfactorily represented by oscillograms, since it is practically impossible to work out the required numerical values from these. On the other hand, although there are electrical methods of recording the Fourier spectrum of a noise, such a record involves a complicated equipment and the expenditure of much time. The apparatus here described is designed to avoid all these difficulties, and to give a record which is half-way between an oscillogram and a Fourier spectrum (*see* Fig. 4, where *a* represents an oscillogram, full of information as a function of time but completely uninformative as to frequency; *c* a Fourier spectrum, which is just the reverse; while *b* represents the "half-way house"—a combination of oscillogram with a coarse amplitude spectrum made up of short frequency-steps).

The process consists in recording the time-course of the energy in frequency-bands of finite width and then applying statistical methods to restore the fine structure of the coarse amplitude spectrum thus obtained. Equipments are described by which this is done semi-automatically or automatically.

METHOD OF MEASURING THE NON-LINEAR DISTORTION OF TRANSMISSION EQUIPMENTS FOR ELECTRICAL OSCILLATIONS: SIMULTANEOUS EXPLORATION BY TWO SINUSOIDAL OSCILLATIONS OF CONSTANT FREQUENCY-DIFFERENCE: DISTORTION MEASURED BY STRENGTH OF DIFFERENCE OSCILLATIONS.—von Braunmühl and Weber. (German Pat. 577 554, pub. 1.6.1933.)

NEUERE MESSMETHODEN MIT SCHWINGKONTAKT-GLEICHRICHTERN (New Measuring Methods [for Current Magnitude and Phase] with Vibrating-Contact Rectifiers).—J. Krönert. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 474–477.)

A vibrating-contact rectifier is described in which the contact motion is only a fraction of a millimetre and the blade is quite outside the leakage field of the exciting system: the contact time is not intended to be exactly a half-period, but to be almost completely constant. With this apparatus not only can very small alternating currents be rectified (barrier-layer rectifiers can be made to do this) but by means of a phase-adjuster in the exciting circuit the phase difference between the exciting current and the current under rectification can be adjusted as desired. This leads to a number of new methods of measurement, which are described in turn. These include the measurement of the energy component and the wattless component of a current, the recording of a.c. wave form, the definite determination of the vanishing point of a current (*e.g.* in a bridge circuit), dielectric loss-angle measurement, and magnetic measurements on small samples of iron.

THE MEASUREMENT OF PHASE ANGLES AT HIGH FREQUENCIES BY AN ELECTRO-OPTICAL [Kerr Cell] METHOD.—L. Pungs and H. Hoyer. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14 1933, pp. 485–487.)

Extension of the voltage-measuring technique (Jan. Abstracts, p. 49) to phase measurement, by the introduction of a second Kerr cell crossed with the first. The ray passing through the two cells is compared with a ray from the same source which reaches the Pulfrich photometer after reflection at two mirrors. By adjusting two current- and potential-dividing condensers the field on each Kerr cell is so adjusted that the double refraction, and hence the illumination with crossed Nichols, is the same for each. This intensity is measured; the two cells are then brought in together and the new intensity measured. The ratio of these two intensities, with the help of the calibration curve, gives the phase angle. Or if a Franke machine or phase transformer is available, the phase angle between two h.f. voltages can be measured by replacing them by equal l.f. voltages and adjusting the angle so that the intensity is the same in both cases: then the phase displacement is also equal in the two cases.

THE BEHAVIOUR OF THE CROOKES RADIOMETER IN A HIGH-FREQUENCY DISCHARGE [and Its Use for Studying the Energy consumed in the Interior of an Ionised Gas].—Th. V. Jonescu. (*Comptes Rendus*, 13th Nov., 1933, Vol. 197, No. 20, pp. 1103–1104.) For Beauvais' different type of radiometer *see* 1933 Abstracts, p. 558, l-h column.

GRENZEN DER MESSTECHNIK (The Limits of Measuring Technique).—M. Czerny. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 436–440.)

LIMITS OF ELECTRICAL MEASUREMENT [Survey based on Papers at "Deutsche Physiker- und Mathematikertag," 1933].—R. Vieweg. (*Zeitschr. V.D.I.*, 18th Nov., 1933, Vol. 77, No. 46, pp. 1235–1236.)

THE "SPREAD" [Maximum Difference] AS A MEASURE OF DEVIATION IN PHYSICAL MEASUREMENTS.—E. Q. Adams. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 620–623.)

ÜBER DIE GENAUIGKEIT VON WECHSELSTROMMESS-BRÜCKEN (On the Accuracy of A.C. Bridges).—R. Tamm. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 472–474.)

A NEW BRIDGE FOR THE MEASUREMENT OF SMALL PHASE-DIFFERENCES.—Wirk. (*See* Tamm's paper referred to above, p. 474.)

A TEST-ROOM RESISTANCE BOX WITH VERY SMALL PHASE-ERRORS.—Wirk. (*Ibid.*, p. 473.)

A RESISTANCE BOX WITH CONSTANT PARALLEL CAPACITY [Many Resistances in Parallel] FOR ULTRA-HIGH FREQUENCIES.—Tamm. (*Ibid.*, pp. 473–474.)

ON THE INITIAL CAPACITY OF DECADE CONDENSER SYSTEMS [and a Form of Calibration Table avoiding the Ambiguity due to the Initial Capacity].—J. Kahan and S. Dierewianko. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 15–16.)

A STANDARD OF PHASE ANGLE.—C. W. La Pierre and A. R. Hand. (*Gen. Elec. Review*, November, 1933, Vol. 36, No. 11, pp. 506–507.)

A BRIDGE FOR SMALL INDUCTANCES [Modified Series-Resonant Bridge for Wider Range of Inductance and Frequency].—A. T. Starr. (*Journ. Scient. Instr.*, November, 1933, Vol. 10, No. 11, pp. 361–362.)

CLASSIFICATION OF BRIDGE METHODS OF MEASURING IMPEDANCES.—J. G. Ferguson. (*Bell S. Tech. Journ.*, October, 1933, Vol. 12, No. 4, pp. 452–468.)

IMPROVED CIRCUITS FOR MEASURING NEGATIVE RESISTANCE [particularly for Iinuma's Method of Measuring R.F. Resistances].—F. E. Terman. (*Electronics*, December, 1933, p. 340.)

Combining the simplicity of the Dingley bridge

(Abstracts, 1932, p. 97) and the capacity-balance feature of the Tuttle circuit (1933, p. 506), and thus not limited to low resistances nor involving a complicated transformer and decimal attenuator.

MESSUNGEN BEI SEHR HOHEN FREQUENZEN (Measurements at Ultra-High Frequencies).—K. Küpfmüller. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 447–456.)

A survey leading to the conclusion that "since the technical application of the ultra-short waves extends to over 10^9 c/s . . . quite a lot of work has still to be done to develop a measuring technique corresponding to practical requirements." In section 1 ("sources of error") the writer begins by showing curves of the lengths of copper wires, of three different diameters, which give an inductive resistance of 1 ohm. Even the thickest (3 mm) wire reaches this value, at 10^8 c/s, with a length of 1 cm, compared with about 20 cm at 10^6 c/s and over 100 cm at 10^5 c/s: the difficulties arising from the earthing of certain points of a measuring circuit (so useful at ordinary frequencies), and the ineffective nature of the earthing given by even a comparatively short earth-lead, are thus obvious. The next diagram shows how the measurements at ultra-high frequencies may be falsified by the capacity to earth of the circuit components: a 10 cm rod of 1 cm diameter at a distance from other conductors possesses at 10^6 c/s an apparent impedance to earth of over 100 000 ohms: at 10^8 c/s, about 900, and at 10^9 c/s about 90 ohms.

The next long sub-section (*c*) deals with the electrical and magnetic leakage fields and their screening: the need for perfect joints and absence of apertures in the screens is emphasised, and the effectiveness of multiple screening in eliminating defects in this direction. "By the careful construction of the containers an almost loss-free passage of electromagnetic energy should be attainable, like that of water in a tube: at present too little use is made of this possibility in the range of ultra-high frequencies." The last sub-section of section 1 deals with skin effect (Fig. 7: also Fig. 3, which gives the penetration into copper and iron sheet).

Section 2 deals with reference resistances: the limitations of wire resistances are first discussed, and it is concluded that such resistances can only be satisfactory up to about 100 ohms. For higher values carbon resistances, especially of the Siemens & Halske Carbowid type, are recommended (Abstracts, 1929, p. 342, Hartmann and Dossman: 1931, p. 395, Wien).

Section 3 discusses various methods of current and voltage measurement. Moullin's method (1931, p. 47), applied to a 25 A range, gives errors due to skin effect of the order of 17% at 6×10^7 c/s: it is suggested that an improvement could be made by correcting the frequency dependence by means of "electrical lead arrangements." Thermal methods, hot-wire (*e.g.* Fortescue and Moxon, 1930, p. 461), thermoelectric (Schwarz, 1932, p. 471) and barretter (Wien, 1931, p. 48) are referred to; but on account of their defects it is often recommended that potential, not current, should be measured, the current being subsequently deduced. For potential measurement the methods quoted are those of Moullin (*loc. cit.*), R. King (1930, p. 640: not as given in the paper), Rohde and Bahnemann (1931, p. 616; 1933, p. 159), and the Kerr cell method of Pungs (1931, p. 567). Finally the recent use of electrometers is described (Nissen, 1933, p. 574).

Section 4 deals with the measurement of a.c. resistances, and begins with an illustrated description of the Siemens & Halske differential bridge for impedances between 0.1 and 10 000 ohms for frequencies up to 1.6×10^6 c/s: an iron-cored instrument transformer is incidentally discussed. Calorimetric methods are then examined (*e.g.* Esau and Busse, 1930, pp. 287–288; Vogler, 1931, pp. 451–452; Benz, 1931, p. 48, and Schwarz, 1932, pp. 471–472). Resonance methods are next considered (*e.g.* Pauli, 1930, p. 166); the importance of perfect screening is emphasised, Nissen's apparatus (*loc. cit.*) being illustrated. Rohde and Schlegelmilch's resonance method of measuring loss angles is referred to (1933, pp. 512–513). The paper ends by references to the capacitive potential divider of Schlesinger (1932, p. 650) and the use of Lecher wires (Strutt, 1931, p. 28; Schmidt, 1933, pp. 160 and 222) and concentric-tube lines (Sterba and Feldmann, 1932, pp. 585–586; Roosenstein, 1931, p. 36; *also* p. 441; and Baumann, 1931, p. 616). For an earlier survey on the same lines *see* Schwarz, reference given above.

MESSUNG VON WELLENWIDERSTÄNDEN BEI HOCHFREQUENZ (The Measurement of Characteristic Impedances at High [and Ultra-High] Frequencies).—H. O. Roosenstein. (*Hochf:tech. u. Elek:akus.*, November, 1933, Vol. 42, No. 5, pp. 154–155.)

The writer's previous method (depending on the shortening of the transmission line by $\lambda/8$ and the restoring of the resonance thus destroyed by a variable condenser—1931 Abstracts, p. 36, l-h col.) is not applicable to lines which cannot thus be shortened: for such cases, which often arise, he has evolved a new method. This requires only a high-frequency variable resistance R which, in one position of a double-pole switch, is connected directly to the output circuit of a signal generator; in the other position of the switch R is connected to the far end of the h.f. feeder, while the input end of the latter is connected to the signal generator. R is adjusted so that, on throwing over the switch from one position to the other, the current indicated by a meter in the generator output circuit remains unchanged: the value of R then gives the characteristic impedance of the feeder. The sensitivity of the arrangement is a maximum when the length of the feeder is an odd multiple of a quarter wavelength, and a minimum when it is an even multiple: but the greater the damping of the feeder under measurement, the less the influence of these minima on the sensitivity.

MODIFICATIONS IN THE NEW IMPEDANCE MEASURING SET [and a Model for Very High Frequencies, using Capacitances in place of Resistances].—A. T. Starr. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, pp. 609–611.) *See* 1933 Abstracts, p. 49, l-h column.

SIMPLE ULTRA-SHORT-WAVE WAVEMETERS [Several Ranges, down to 45 cm: Advantages over Lecher Wires].—W. H. Moore. (*Electronics*, November, 1933, p. 311.)

SUPER-REGENERATIVE WAVE-METER FOR ULTRA-SHORT WAVES [for Outputs too small for Lecher-Wire Measurements—*e.g.*, Receivers].—H. Ataka. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1590–1592.)

A NEW AND PRACTICAL MULTI-VIBRATOR [Defects of Relaxation Oscillation Circuits avoided by Use of Three-Grid Type 78 Valve in " Electronic Tie-In " Circuit].—S. S. Egert and S. Bagno. (*Rad. Engineering*, September, 1933, Vol. 13, No. 9, pp. 20–21.)

FREQUENCY COMPARISON WITH THE CATHODE-RAY OSCILLOGRAPH [for Calibration of Multi-Frequency Valve Oscillators : a Method of Maintaining a Continuous Check on the Reference Oscillator Frequency, by Sine-Wave Ripple running round Periphery of Lissajous' Figure].—C. B. Fisher. (*Electronics*, November, 1933, pp. 310–311.)

PAPERS RELATING TO THE VIBRATIONS OF QUARTZ OSCILLATORS.—Giebe and Blechschmidt : Bergmann. (*See* under " Acoustics and Audio-frequencies," p. 99).

FREQUENCY AND TEMPO OF THE QUARTZ CLOCKS OF THE PHYSIKALISCH-TECHNISCHE REICHSANSTALT : RESULTS OF MEASUREMENT. I.—A. Scheibe and U. Adelsberger. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. 1, pp. 1–25.)

THEORIE DES SCHUTZPENDELS (Theory of the Guard Pendulum [for Accurate Pendulum Clocks : Protection against Vibration and Second-Order Disturbance Effects]).—E. Rieckmann. (*Physik. Zeitschr.*, 15th Nov., 1933, Vol. 34, No. 22, pp. 841–842.)

AUTOMATIC [Anode-Current] COMPENSATION IN VALVE VOLTMETERS [and a Two-Valve Voltmeter with Amplifying Valve acting simultaneously as Compensating Valve].—J. Groszkowski and S. Dierewianko. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 17–18.)

A TETRODE VOLTMETER [fed by One 12-Volt Battery : the Unfavourable Working Conditions of Usual Valve Voltmeters, due to Low Supply Voltage].—S. Wolski. (*Wiadomości i Prace Inst. Radjotechnicznego, Warsaw*, No. 1/3, Vol. 5, 1933, pp. 18–21.)

A VECTOR VOLTMETER.—D. C. Gall. (*Journ. Scient. Instr.*, December, 1933, Vol. 10, No. 12, pp. 391–393.)

ON THE ELECTROSTATIC PEAK VOLTMETER WITH EXTENDED RANGE [with Audio- and Radio-Frequency Applications].—L. G. A. Sims. (*Journ. Scient. Instr.*, November, 1933, Vol. 10, No. 11, pp. 344–349.)

AN ELECTROSTATIC GENERATING VOLTMETER [Strictly Linear, without Commutators].—G. P. Harnwell and S. N. Van Voorhis. (*Review Scient. Instr.*, October, 1933, Vol. 4, No. 10, pp. 540–541.)

AN ABSOLUTE H.T. VOLTMETER IN COMPRESSED GAS [Electrostatic Force balanced by Constant Weight, Length of Adjustable Gap providing the Voltage Reading].—A. Palm. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 14, 1933, pp. 390–392.)

THE CALIBRATION OF HIGH VOLTAGE ELECTROMETERS, USING CATHODE RAYS [whose Velocity is measured by a Crossed Field System].—K. H. Stehberger. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. 5, pp. 586–592.)

MEASURING RESISTANCES [by High-Resistance Galvanometer or Voltmeter : the Use of Alignment Charts].—W. A. Barclay. (*Wireless Engineer*, October, 1933, Vol. 10, No. 121, pp. 552–555.)

ON THE SUPPRESSION OF HARMONICS OF THE EINTHOVEN STRING GALVANOMETER.—A. H. Bebb. (*Journ. Scient. Instr.*, November, 1933, Vol. 10, No. 11, pp. 362–364.)

OPTICAL AMPLIFICATION OF THE DEFLECTIONS OF A MIRROR GALVANOMETER [especially the Use of a Fixed Convex Mirror].—L. Dubar. (*Rev. Gén. de l'Élec.*, 18th Nov., 1933, Vol. 34, No. 20, pp. 669–676.)

A MULTI-RANGE DIRECT-READING OHMMETER [and Its Special Usefulness in Measuring Low Resistances suspected of being Variable].—M. G. Scroggie. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, pp. 606–608.)

THE ELECTRICAL PROPERTIES OF SEA-WATER FOR ALTERNATING CURRENTS.—Smith-Rose. (*See* under " Propagation of Waves.")

A TEST FOR SHORTED TURNS [using the Coils as Oscillator Inductances in Dynatron Circuit and judging by Grid or Plate Current].—(*Electronics*, December, 1933, p. 341.)

SUBSIDIARY APPARATUS AND MATERIALS

ON THE CONTROL AND EXTINCTION OF A GLOW DISCHARGE IN A TUBE WITH NETWORK CATHODE AND A THIRD ELECTRODE.—E. Badareu : Güntherschulze and Keller. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 540–543.)

The first writer describes a further investigation of the phenomenon discovered by the second workers (1932 Abstracts, p. 227, r-h column). He used a tube through which a stream of very pure nitrogen or air was drawn (at a pressure of about 2.3×10^{-2} mm Hg) and in which the anode and grid-formed cathode were fixed while the auxiliary, solid electrode could be moved to any distance between 5 and 140 mm on the far side of the cathode. The characteristic curves of the discharge were plotted for various values of auxiliary electrode potential, and the influence of the gap between that electrode and the network cathode was investigated. Fig. 2 shows that with a gap of 20 mm both the main discharge current (network cathode current) and the auxiliary electrode current fall very rapidly directly the auxiliary electrode is positive to the cathode, and become zero (extinction of discharge) for a value of + 2 v, even when the main potential is 1 000 v.

The investigation leads to the conclusion that the effect is due to secondary electrons, derived from the auxiliary electrode and the canal ray region, arriving in the main discharge zone and producing there a kind of auxiliary excitation whose amount can be altered by the value of the auxiliary electrode voltage.

If a high a.c. voltage is applied across anode and network cathode, and a small positive bias put on the auxiliary electrode, a rectified current can be produced. Further, the great change of main current for a small change of auxiliary electrode potential enables such a tube to act as an oscillation generator.

A PRACTICALLY INERTIA-LESS RELAY BASED ON THE DOUBLE CHARACTERISTIC DUE TO STRAY ELECTRONIC CURRENTS IN A VACUUM TUBE [particularly suitable for Train Signalling].—Molthan. (*See* abstract under "Valves and Thermionics.")

A NEW HIGHLY SENSITIVE CONTACT RELAY FOR USE WITH A BARRIER-LAYER PHOTOCELL.—L. Bergmann and H. Fricke. (*Zeitschr. f. Fernmeldetech.*, 14th Oct., 1933, Vol. 14, No. 10, pp. 151–152.)

The pointer of a sensitive m.c. galvanometer movement terminates in a small ball moving close to, but clearing, when free, a smooth surface comprising two contact faces, one at each end of a short insulating path. A flat spring of magnetic material, whose end is as wide as the whole of this surface and is parallel to it, tends to press the small ball against the surface and to hold it from moving; this pressure, however, is removed at regular time intervals by an electromagnet, and the pointer is then free to move from above the insulating part of the surface to above one of the contact faces. The next moment, by the release of the flat spring from the electromagnet, the sphere is pressed tightly down against the contact face. A current of 3×10^{-7} A to the moving coil (corresponding to one lux on a 10 cm² selenium cell) gives a certain contact.

THE PRESSLER GLOW-DISCHARGE LAMP WITH AUXILIARY ANODE AND EXPLORING ELECTRODE.—Pressler. (*See* under "Reception," Nentwig.)

VACUUM TUBE DELAY CIRCUITS.—M. W. Muehter. (*Electronics*, December, 1933, pp. 336–337.)

THE IGNITION CONDITION OF HOT-CATHODE GRID-CONTROLLED MERCURY-VAPOUR TUBES.—B. Kirschstein. (*Archiv f. Elektrot.*, 3rd Nov., 1933, Vol. 27, No. 11, pp. 785–793.)

HIGH-FREQUENCY GLOW DISCHARGE [Simultaneous Measurement of Space and Maintaining Potentials, at Very High Frequencies].—A. C. van Dorsten. (*Nature*, 28th Oct., 1933, Vol. 132, pp. 675–676.)

THE RELAXATION INVERTER [One Tube giving Good A.C. Wave Form from D.C. Supply].—H. J. Reich. (*Elec. Engineering*, December, 1933, Vol. 52, No. 12, pp. 817–822.) For previous papers *see* 1933 Abstracts, p. 339.

THE DEVELOPMENT OF THE [Mercury-Vapour] CHARGING RECTIFIER FOR TELEPHONE CENTRAL BATTERIES.—H. John. (*E.N.T.*, September, 1933, Vol. 10, No. 9, pp. 386–388.)

THE HARMONICS OF THE D.C. VOLTAGE AND PRIMARY MAINS CURRENT IN RECTIFIER INSTALLATIONS.—H. Meyer-Delius. (*E.T.Z.*, 5th Oct., 1933, Vol. 54, No. 40, pp. 959–963.)

A CONTRIBUTION TO THE CALCULATION OF THE PARALLEL DC-AC INVERTER.—I. Runge and H. Beckenbach. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 14, 1933, pp. 377–385.)

IMPROVING THE POWER FACTOR OF THE GRID-CONTROLLED RECTIFIER BY MEANS OF AUXILIARY ANODES.—E. Uhlmann. (*Elektrot. u. Masch:bau*, 10th Dec., 1933, Vol. 51, No. 50, pp. 649–651.)

THE MEASUREMENT OF RIPPLE IN RECTIFIED CURRENTS AND VOLTAGES [Survey of Direct and Indirect Methods].—W. Spielhagen. (*Archiv f. Elektrot.*, 3rd Nov., 1933, Vol. 27, No. 11, pp. 805–812.)

A NEW VIBRATING-CONTACT RECTIFIER [especially for Measuring Purposes].—Kronert. (*See* abstract under "Measurements and Standards.")

"POINT" EFFECT AND CRYSTAL DETECTION [The Influence of the Curvature of the Metallic Electrode in a "Sensitive" Galena Detector].—E. Cabanel and J. Cayrel. (*Comptes Rendus*, 18th Dec., 1933, Vol. 197, No. 25, pp. 1602–1604.)

Some workers (particularly Reisshaus, 1929 Abstracts, p. 403) insist that crystal rectification depends on the difference in curvature of the two electrodes. The tests here discussed show that although the use of a pointed metallic electrode helps the rectifying action of "sensitive" galena (Cayrel, 1933 Abstracts, p. 459), this "point" effect is only secondary and cannot be considered as the cause of the rectification.

STOPPING LAYER OF RECTIFIERS.—W. Ch. van Geel. (*Nature*, 4th Nov., 1933, Vol. 132, p. 711.)

The writer finds that the thickness of barrier layers of rectifiers is 10^{-4} to 10^{-3} cm. He can get rectification with every thickness of the barrier layer between 10^{-6} cm (oxide-coated aluminium or zirconium) and 10^{-3} cm (condenser paper). His experiments agree with the explanation of the rectifying process by cold emission (Abstracts, 1931, p. 513) and not with the Frenkel-Joffé-Nordheim-Wilson theory of the rectifying contact (*cf.* Fowler, 1933 Abstracts, p. 515, r-h column).

ON THE MECHANISM OF RECTIFICATION IN CUPRIC SULPHIDE/MAGNESIUM RECTIFIER [*e.g.*, Elkon Rectifiers].—M. Anastasiades. (*Comptes Rendus*, 4th Dec., 1933, Vol. 197, No. 23, pp. 1397–1399.)

The writer finds that the Elkon rectifier (Pb/CuS/Mg) presents marked similarities to his own (January Abstracts, p. 53, l-h col.). His investigation leads to the conclusion that in the former rectifier the active contacts are the series Pb/CuS/Cu_2S/Mg, the principal contact being the

Cu_2S/Mg. Fatigue is due to the formation of dendrites of CuS which shunt the mass of Cu_2S and reduce its high resistance.

THE INNER POTENTIALS OF SEMI-CONDUCTORS.—K. R. Dixit. (*Phil. Mag.*, November, 1933, Vol. 16, No. 108, pp. 980–994.)

A NEW METHOD OF ELIMINATING THE DISTORTIONS DUE TO SPACE CHARGE IN [Gas-Filled] CATHODE-RAY TUBES [Zero-Point Error].—von Ardenne: Lorenz Company. (*See* under "Phototelegraphy and Television.")

ON THE METHOD OF TAKING OSCILLOGRAMS OF IMPULSE VOLTAGE WITH CATHODE-RAY OSCILLOGRAPH [with Eccentric Cathode: Mains-Driven "Kipp" Relay: Adjustable Speed of Sweep: etc.].—Narasaki and others. (*Journ. I.E.E. Japan*, September, 1933, Vol. 53 [No. 9], No. 542, pp. 726–728: English summary pp. 71–72.)

A VOLTAGE-DOUBLING POWER SUPPLY FOR THE CATHODE-RAY OSCILLOGRAPH [Two Type 27 Rectifiers in Doubling Circuit: Free from Ripple and Very Compact].—C. Bradner Brown. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 27 and 30.)

THE CATHODE-RAY TUBE AS A PROBLEM IN ELECTRON OPTICS [Calculation of Positions of Electrodes for High Sensitivity combined with Brightness and Sharpness of Spot: a New Design].—Brüche and Scherzer. (*See* under "Phototelegraphy and Television.")

THE FORMATION OF OPTICAL IMAGES BY MECHANICAL SYSTEMS AND THE OPTICS OF GENERAL MEDIA [Theoretical Investigation, including Application to Electron Optics].—W. Glaser. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. 5, pp. 557–585.)

CRYSTALLOGRAPHIC INVESTIGATIONS [of Nickel Cathodes activated by Barium Azide] WITH THE ELECTRON MICROSCOPE.—E. Brüche and H. Johannson. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 487–488.)

THE ELECTRON MICROSCOPE [Survey with Bibliography including 1933].—G. Valle. (*L'Elettrotec.*, 25th Oct., 1933, Vol. 20, No. 30, pp. 697–705.)

CONTRIBUTION TO THE COMBINED USE OF ELECTRIC AND MAGNETIC ELECTRON LENSES [Lens Superposition: Refraction Formula].—H. Johannson and W. Knecht. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 5/6, pp. 367–372.)

FORMATION OF IMAGES IN THE ELECTRON MICROSCOPE WITH PHOTOELECTRONS [from Zinc Plate: Image of Plate formed by Magnetic Lens].—E. Brüche. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 7/8, pp. 448–450.)

A VACUUM ANNEALING FURNACE OF NOVEL DESIGN.—E. F. Lowry. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 606–609.)

THE RECORDING OF VARYING PROCESSES [Siemens & Halske "Compensograph": Hartmann and Braun Frequency Recorder: Diamond-Scratch Recording for Accelerometers, etc.: Askania Optical System: Piezoelectric Methods: Cathode-Ray Oscillographs (4-Ray Model): Statistical Methods].—R. Vieweg. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 441–447.)

THE AMPLIFICATION AND RECORDING OF RAPID GEIGER-MÜLLER COUNTER IMPULSES [up to about 1 400 per Second].—G. L. Locker. (*Journ. Franklin Inst.*, November, 1933, Vol. 216, No. 5, pp. 553–558.)

ARRANGEMENT FOR THE AUTOMATIC CALCULATION OF NETWORKS OF IMPEDANCES: APPLICATION TO DIPOLE AND QUADRIPOLE ELECTRIC FILTERS.—L. Abélès. (*L'Onde Élec.*, October, 1933, Vol. 12, No. 142, pp. 441–461.)

Author's summary:—"This study deals with linear networks, *i.e.*, those whose action is regulated by a system of linear differential equations. The fundamental properties of these networks are first indicated. Then, a choice having been made of notations which allow these properties to be expressed in a general and condensed form, the principle is described of a mechanical process for drawing the curves characterising the behaviour of the networks, such as the impedance curve of a dipole, the image impedances and transmission constant of a quadripole, etc." The October instalment contains the preliminary work: the principle of the method of calculation, and the description of the way of carrying it out, are reserved for later instalments.

DOUBLED FILTERS [as Substitutes for Zobel "Constant k" and "Derived m" Filter Structures and German Bridge Filters].—S. Matsumae and A. Matsumoto. (*Journ. I.E.E. Japan*, October, 1933, Vol. 53 [No. 10], No. 543, pp. 892–899: English summary pp. 86–87.)

ELECTRIC WAVE FILTERS.—G. J. S. Little. (*Inst. P.O. Elec. Engineers*, Printed Paper No. 143, 68 pp.)

A NOTE ON THE SIMPLE TWO-ELEMENT LOW-PASS FILTER OF TWO AND THREE SECTIONS [Most Economical Distribution of Capacity and Inductance: the Advantage of the Third Section].—L. B. Hallman. (*Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1603–1608.)

ELECTRIC FILTER DESIGN. PART V.—HIGH-PASS FILTERS.—C. A. Johnson. (*Radio News*, October, 1933, Vol. 15, pp. 216–217 and 247.)

DETERMINATION OF THE MAGNETIC PROPERTIES OF IRON WITH A.C. PRE-MAGNETISATION, AND ITS SIGNIFICANCE FOR THE DEVELOPMENT OF CURRENT-TRANSFORMER TECHNIQUE [Almost Constant Permeability Curve and 20 Times the Initial Magnetisation].—G. Stein. (*Zeitschr. f. tech. Phys.*, No. 11, Vol. 14, 1933, pp. 495–499.)

THE AIR-GAP TRANSFORMER AND CHOKE [particularly the Output Transformer of a Radio Receiver: Nearly Constant Inductance under All Working Conditions].—F. W. Lanchester. (*Journ. I.E.E.*, October, 1933, Vol. 73, No. 442, pp. 413–418.)

ARE THERE TRULY REVERSIBLE PROCESSES IN THE MAGNETISATION OF FERROMAGNETIC BODIES BY EXTREMELY SMALL ALTERNATING FIELDS?—H. Wittke. (*Ann. der Physik*, 1933, Series 5, Vol. 18, No. 6, pp. 679–700.)

The writer finds that, although from a purely scientific point of view reversible processes do exist, they are not of practical application; the action of a transformer on a weak alternating current never takes place without loss of energy.

THE MAGNETISATION CURVE OF FERROMAGNETIC MATERIALS FOR VERY WEAK FIELDS.—R. Gans. (*Ann. der Physik*, 1933, Series 5, Vol. 18, pp. 701–704.)

Theoretical considerations on the methods of investigation to be adopted in studies of the type referred to in the preceding abstract.

IRON-CORE INTERMEDIATE-FREQUENCY TRANSFORMERS [Universal Winding superior to Cylindrical, Toroidal and Bank-Wound Types: Optimum Coil Form: Comparative Efficiency of Air-Core Transformers].—A. Crossley: Polydoroff. (*Electronics*, November, 1933, pp. 298–299.)

MAGNETIC PERMEABILITY OF FERROMAGNETIC METALS AT VERY HIGH FREQUENCIES [$\lambda = 120$ cm to 12 cm: Decrease of Permeability].—G. Potapenko and R. Sänger. (*Naturwiss.*, 17th Nov., 1933, Vol. 21, No. 46, pp. 818–819.)

MAGNETIC TESTS ON COBALT AT ULTRA-HIGH FREQUENCIES [3 cm Waves: "Cobalt Vastly Superior to Iron and Nickel": etc.].—Potapenko. (*Electronics*, November, 1933, p. 316 and front cover.)

CONSTRUCTIONAL FORMS OF IRON-CORED [Ferrocart] HIGH-FREQUENCY COILS.—A. Schneider. (*Funktech. Monatshefte*, November, 1933, No. 11, pp. 439–443.)

FERROCART, A MAGNETIC MATERIAL FOR HIGH FREQUENCY WORK [including Methods of Varying the Inductance of Ferrocart Coils].—A. Schneider. (*Zeitschr. V.D.I.*, 18th Nov., 1933, Vol. 77, No. 46, pp. 1233–1235.)

ADJUSTABLE-VOLTAGE TRANSFORMER [giving Continuous Adjustment between 0 and 130 v on 115-Volt A.C. Mains].—(*Electronics*, October, 1933, p. 289.)

THE VARIAC POWER TRANSFORMER GIVING CONTINUOUS VOLTAGE ADJUSTMENT [with Contact Mechanism eliminating Short-Circuited Turns].—(*Rad. Engineering*, October, 1933, Vol. 13, No. 10, p. 28.)

AUTOMATIC CUTTING IN AND OUT OF A FLOATING BATTERY CHARGED THROUGH DRY-PLATE RECTIFIERS, BY A CHOKE-AND-PARALLEL-CAPACITY "KIPP" CIRCUIT BETWEEN TRANSFORMER AND RECTIFIERS.—H. Böhm. (*E.T.Z.*, 26th Oct., 1933, Vol. 54, No. 43, pp. 1037–1039.)

A SIMPLE HIGH RESISTANCE [Smoked Rod of Silky Quartz].—P. W. Burbidge: I. C. Jones. (*Nature*, 28th Oct. and 25th Nov., 1933, Vol. 132, pp. 677–678 and 823). The second letter refers to an improvement in the resistance described in the first.

A STUDY OF LITZ WIRE COILS FOR I.F. AND R.F. TRANSFORMERS.—Barden and Grimes. (*Electronics*, November and December, 1933, pp. 303–304 and 342–343.)

THE EFFECTS ON SELECTIVITY AND GAIN OF THE USE OF LITZENDRAHT WIRE IN I.F. AMPLIFIERS FOR SUPERHETERODYNE RECEIVERS.—Grimes and Barden. (Summary only in *Proc. Inst. Rad. Eng.*, November, 1933, Vol. 21, No. 11, pp. 1516–1517.)

SVEA METAL—ITS APPLICATION AND USE [and the Production of the Carbonised Variety].—(*Rad. Engineering*, September, 1933, Vol. 13, No. 9, pp. 26–28.) *See* also 1933 Abstracts, pp. 281 and 451.

ON THE VARIATION OF THE ELECTRICAL CONDUCTIVITY OF SOME DIELECTRICS WITH TEMPERATURE IN A RANGE FROM 20°C TO −110°C.—S. Shimizu. (*Journ. I.E.E. Japan*, October, 1933, Vol. 53 [No. 10], No. 543, pp. 847–855: English summary pp. 82–83.)

PROBLEMS OF PRACTICAL INSULATION TECHNIQUE [Fatigue, etc.: Suggested New Researches].—A. Imhof and H. Stäger. (*Bull. de l'Assoc. suisse des Élec.*, 29th Sept., 1933, Vol. 24, No. 20, pp. 487–494.)

PROGRESS IN THE FIELD OF HIGH-FREQUENCY INSULATING MATERIALS [including Special Calan, Mica, Quartz and Trolitul].—L. Rohde. (*Zeitschr. f. tech. Phys.*, No. 11 Vol. 14, 1933, pp. 480–483.)

EFFECT OF ATMOSPHERIC HUMIDITY AND TEMPERATURE ON THE RELATION BETWEEN MOISTURE CONTENT AND ELECTRICAL CONDUCTIVITY OF COTTON [used for Insulation in Telephone Apparatus].—A. C. Walker. (*Bell S. Tech. Journ.*, October, 1933, Vol. 12, No. 4, pp. 431–451.)

VARNISHED TUBING ["Spaghetti"] FOR RADIO RECEIVERS.—L. L. Jones. (*Rad. Engineering*, October, 1933, Vol. 13, No. 10, pp. 13 and 16.)

EVALUATING ARC RESISTANCE OF INSULATING MATERIALS.—K. G. Coutlee. (*Bell Lab. Record*, November, 1933, Vol. 12, No. 3, pp. 92–94.)

ELECTRICAL LEAKAGE OVER GLASS SURFACES.—W. A. Yager. (*Bell Lab. Record*, October, 1933, Vol. 12, No. 2, pp. 40–44.)

A RECTIFICATION EFFECT IN SOLID INSULATORS.—P. Böning. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 1/2, pp. 49–53.)

IMPROVEMENTS IN SOLID DIELECTRICS [Survey with Four-Year Bibliography].—R. W. Atkinson. (*Elec. Engineering*, December, 1933, Vol. 52, No. 12, pp. 923–927.)

SOME MECHANICAL AND THERMAL PROPERTIES OF ELECTRICAL INSULATING MATERIALS [Rubber-Containing, Fibrous, and Synthetic].—U. Retzow. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 551–554.)

THE ELECTRICAL BREAKDOWN OF LIQUID DIELECTRICS.—F. M. Clark. (*Journ. Franklin Inst.*, October, 1933, Vol. 216, No. 4, pp. 429–458.)

A DEVICE FOR PRODUCING SMALL DIRECT CURRENTS OF KNOWN MAGNITUDE [by Varying the Charge upon a Condenser].—A. Wikstrom. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 612–614.)

IMPROVED DESIGN OF THE MECHANICAL INTERVAL SORTER AND ITS APPLICATION TO THE ANALYSIS OF COMPLEX SPECTRA.—G. R. Harrison. (*Review Scient. Instr.*, November, 1933, Vol. 4, No. 11, pp. 581–586.) *See* 1933 Abstracts, p. 228, r-h column.

METHOD OF COINCIDENCE REGISTRATION WITH RESOLUTION TIME 10^{-5} SEC. [Circuit Diagram].—J. Barnóthy. (*Naturwiss.*, 24th Nov., 1933, Vol. 21, No. 47, p. 835.)

STATIONS, DESIGN AND OPERATION

RADIO SURVEY OF THE CITY OF BOSTON [for Police Radio on Ultra-Short Waves, with " Answer Back " from the Car].—D. E. Replogle. (*Rad. Engineering*, October, 1933, Vol. 13, No. 10, pp. 10–12 and 16.)

Among the conclusions reached are the following :—100 watts on about 30 Mc/s with adequate aerial systems would definitely cover the city with a usable signal level : answer-back range 3 miles: duplex entirely practical and desirable.

A TWO-WAY POLICE RADIO SYSTEM [Bayonne, New Jersey : on 8.6 Metre Wavelength].—J. Dunsheath. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 25–26.)

ULTRA-SHORT-WAVE TWO-WAY RADIO POLICE CRUISERS [New York and New Jersey].—J. H. Crider. (*Scient. American*, December, 1933, Vol. 149, No. 6, pp. 276–277.)

IMPORTANT ADVANCES IN AIRCRAFT PLANE/GROUND COMMUNICATION [Automatic Wavelength-Change by Dialling : Automatic Control of Voice Strength : etc.].—(*Rad. Engineering*, November, 1933, Vol. 13, No. 11, p. 30.)

RECEIVER DESIGN AND DEVELOPMENT AS AFFECTING BROADCAST ALLOCATION PROBLEMS.—J. H. Barron. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 16–17.)

VISUAL BROADCASTING [Facsimile Transmissions and Their Possibilities : the " Radio-Pen "].—J. V. L. Hogan. (*Rad. Engineering*, November, 1933, Vol. 13, No. 11, pp. 18–19 and 30.)

THE ITALIAN BROADCASTING SERVICE.—R. Chiodelli. (*L'Elettrotec.*, 5th, 15th and 25th Nov., 1933, Vol. 20, Nos. 31, 32 and 33, pp. 725–733, 757–762 and 780–787.)

CIVIL AVIATION SIGNAL SERVICES : CONSIDERATIONS AFFECTING THE CHOICE OF WAVELENGTHS [and Results of Special Tests : Wavelengths below 700 Metres unsatisfactory for Telephony Ranges up to 200 Miles : etc.].—N. F. S. Hecht and H. L. Crowther. (*Wireless Engineer*, November, 1933, Vol. 10, No. 122, pp. 596–605.)

TWELVE MONTHS PROGRESS [in Commercial Radio Communications].—Chetwode Crawley. (*Wireless World*, 29th December, 1933, Vol. 33, pp. 494–496.)

GENERAL PHYSICAL ARTICLES

DISTRIBUTION OF ENERGIES OF ELECTRONS IN GASES.—J. S. Townsend. (*Phil. Mag.*, October, 1933, Series 7, Vol. 16, No. 107, pp. 729–744.)

This paper gives arguments for assuming a wider distribution of energies of electrons in a gas, in the steady motion they attain under the action of an electric force, than was assumed by Didlaukis, and concludes that " the laws of collisions, which include the hypothesis that in the steady state of motion all the energies of the electrons are approximately the same, are not in accordance with ordinary mechanics or the results of simple experiments on diffusion."

MODELS [Three-Dimensional Characteristics] OF THE THEORY OF BREAKDOWN AND DISCHARGE IN GASES [Townsend's Theory extended by Space-Charge Considerations].—Rogowski and Fucks. (*Archiv f. Elektrot.*, 4th Oct., 1933, Vol. 27, No. 10, pp. 743–748.)

THE INFLUENCE OF SPACE CHARGE PHENOMENA IN THE MEASUREMENT OF EXCITATION FUNCTIONS [and a Method of Measuring the Velocity of Electron Bundles].—J. M. W. Milatz. (*Zeitschr. f. Physik*, 1933, Vol. 85, No. 9/10, pp. 672–675.)

AN EFFECT OF POSITIVE SPACE CHARGE IN COLLECTOR ANALYSIS OF DISCHARGES [in a Plasma].—R. H. Sloane and K. G. Emeleus. (*Phys. Review*, 1st Sept., 1933, Series 2, Vol. 44, No. 5, pp. 333–337.)

LIBERATION OF ELECTRONS FROM SURFACES BY IONS AND ATOMS.—H. Kallmann and A. Rostagni. (*Nature*, 7th Oct., 1933, Vol. 132, pp. 567–568.)

ON MODELS OF THE ELECTRIC FIELD AND OF THE PHOTON.—J. J. Thomson. (*Phil. Mag.*, October, 1933, Series 7, Vol. 16, No. 107, pp. 809–845.)

PROPAGATION OF A PLANE WAVE ASSOCIATED WITH THE MOTION OF A CORPUSCLE.—P. Copel. (*Comptes Rendus*, 30th Oct., 1933, Vol. 197, No. 18, pp. 976–978.)

ON THE NATURE OF WAVES AND CORPUSCLES.—E. Sévin. (*Ibid.*, pp. 980–982.)

THE DISTRIBUTION OF CURRENT IN A SUPERCONDUCTING SPHERE [Theoretical Investigation].—R. Becker, G. Heller and F. Sauter. (*Zeitschr. f. Physik*, 1933, Vol. 85, No. 11/12, pp. 772–787.)

ELECTROMAGNETIC INDUCTION [and the Conception of the Phenomena Involved].—G.W.O.H. (*Wireless Engineer*, August, 1933, Vol. 10, No. 119, pp. 409–412.)

THE STRUCTURE AND GAS CONTENT OF NICKEL LAYERS FORMED BY CATHODE SPUTTERING.—W. Büssem and F. Gross. (*Zeitschr. f. Physik*, 1933, Vol. 86, No. 1/2, pp. 135–136.)

MISCELLANEOUS

ELECTRICAL EQUIVALENT CIRCUITS OF MECHANICAL TORSIONAL OSCILLATION SYSTEMS TAKING INTO ACCOUNT THE AXLE MASS [and the Solution of the Mechanical Problems by the Use of the Telegraphy Equations].—L. Kettenacker. (*Archiv f. Elektrot.*, 3rd Nov., 1933, Vol. 27, No. 11, pp. 779–784.)

THE CIRCLE OF FREQUENCIES [and Its Use for the Simple Calculation of the Natural Frequencies of Two-Mesh Systems].—Th. Pöschl. (*Zeitschr. f. tech. Phys.*, No. 12, Vol. 14, 1933, pp. 565–566.)

ON THE SO-CALLED "CORRELATION COEFFICIENT."—M. Fréchet. (*Comptes Rendus*, 27th Nov., 1933, Vol. 197, No. 22, pp. 1268–1269.)

THE TESTING OF STATISTICAL HYPOTHESES IN RELATION TO PROBABILITIES *a priori*.—J. Neyman and E. S. Pearson. (*Proc. Camb. Phil. Soc.*, 1933, Vol. 29, Pt. 4, pp. 492–510.)

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Some Recent Patents

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.

TUNING DIALS

Application date, 4th February, 1932. No. 395777

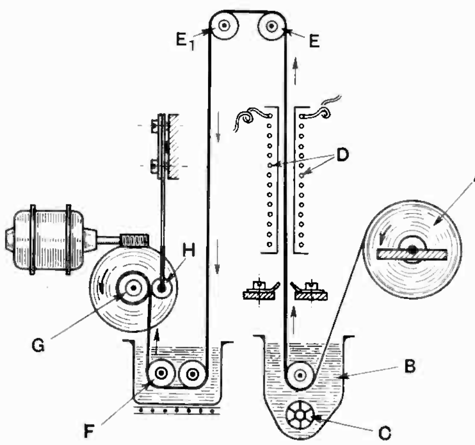
In a self-contained set both wave-band scales are marked, one above the other, on the periphery of the loud speaker cone or diaphragm, so as to co-operate with a single indicator needle. As the wave-band switch is changed from one setting to the other, the appropriate scale is automatically illuminated by one of two lamps, selected by the movement of the change-over switch.

Patent issued to E. K. Cole, Ltd., and E. J. Wyborn.

POWDER-CORE INDUCTANCES

Convention dates (Germany) 12th November, 1931, and 15th March, 1932. British Specification filed 14th November, 1932. No. 394870

Relates to the preparation of powdered magnetic cores for high-frequency inductances. A dipping process is employed for covering an insulated "carrier," such as paper, with a layer of an emulsion of magnetic powder, the layer being subsequently dried in such a way that the individual magnetic particles remain insulated from each other. As shown in the Figure, a sheet of paper from the roll *A* is first passed into a dipping-bath *B* containing finely divided (colloidal) iron, which is continually stirred up by a rotating vane *C*. The



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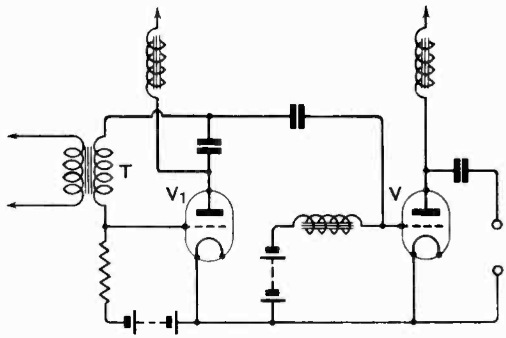
covered paper is drawn off vertically upwards to pass through an electric drier *D*, then over rollers *E*, *E1*, and through a bath *F* containing an adhesive or binding liquid, such as paraffin. It is finally wound up on a former *G* under pressure from a spring-pressed roller *H*. When completed the prepared roll is cut up into suitable core-shapes.

Patent issued to H. Vogt.

POWER AMPLIFIERS

Application date, 1st March, 1932. No. 396143

The amplifier *V* is fed with input voltage sufficient, under ordinary circumstances, to give rise to grid current, but distortion is prevented by the action of a compensating-valve *V1* connected in shunt across the grid and cathode of the first valve. The input transformer *T* is connected, as



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shown, across the grids of both the valves. When the effective grid voltage of the amplifier *V* becomes positive, that of the valve *V1* becomes more negative. The resulting increase in voltage across the higher valve impedance serves to stabilise the grid of the main amplifier.

Patent issued to W. Baggally.

ANTI-MICROPHONIC VALVES

Application date, 17th February, 1932. No. 395439

To protect a valve filament from external vibration, a damping member is arranged to press firmly across the middle of the wires. A thin strip of mica, which is held in a metal cross-bar supported from outside the electrode structure, projects through a slit in the anode and through one of the turns of the grid, until it rests transversely across the top of all four limbs of the W-shaped filament. A second mica strip may similarly be arranged to clamp the limbs from underneath.

Patent issued to The Mullard Radio Valve Co., Ltd., and B. Krol.

FREQUENCY-STABILIZERS

Application date, 22nd January, 1932. No. 395752

Piezo-electric control of the frequency generated by a magnetron oscillator of the split-anode type is effected by tapping the crystal across two inductances, which are connected to each plate of the split anode and form the tuned output circuit. The electrical centre of this circuit is connected back to the cathode.

Patent issued to The General Electric Co., Ltd.

SUPER-REGENERATIVE CIRCUITS

Application date, 27th June, 1932. *No.* 394815

Wavelengths of the order of 10 metres are received on a mains-driven set, without the use of expensive smoothing-condensers, by employing a two-valve super-regenerative circuit. The first valve is an indirectly-heated back-coupled rectifier, preferably having no separate source of plate voltage apart from that injected into it by the quenching valve. The plate supply for the latter is taken from an ordinary smoothing unit, whilst the filament is heated with "raw" A.C.

Patent issued to Telefunken Ges. fur Drahtlose Telegraphie m.b.h.

PHOTO-ELECTRIC CELLS

Convention date (Germany) 27th January, 1931.
No. 395049

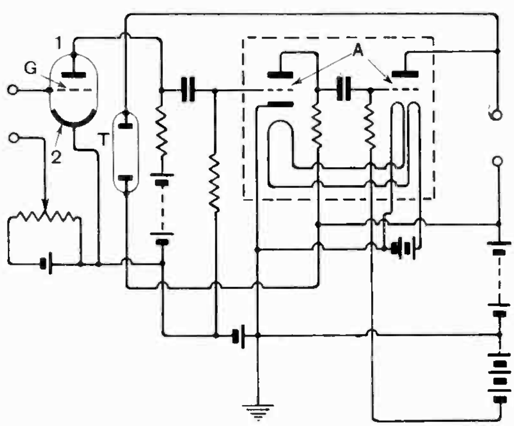
To prevent changes in the surrounding temperature from affecting the straight-line response of a photo-electric cell, the latter is enclosed by a second evacuated bulb, which acts as a heat insulator. The internal surface of the second bulb is covered with a reflecting coating of silver in which a gap or window is provided to allow the passage of light through to the cell proper.

Patent issued to International General Electric Co., Inc.

COLD-CATHODE VALVES

Application date, 29th March, 1932. *No.* 395104

A valve 1 with a photo-electric cathode 2 is coupled to a multi-stage valve amplifier *A* through a resistance of the order of megohms, so that the saturation current through the circuit as a whole is equal to the maximum emission obtainable from the valve. Under these circumstances it is possible to use a "cold" cathode coated with radium preparation, or potassium or rubidium, with satisfactory results. A grid *G* with a positive bias of 10 volts may be used to attract the electrons first emitted and to increase the available supply by secondary emission. A Geisler tube *T*, which may be mounted inside the valve bulb 1, is used as the source of illumination. Alternatively an additional electrode connected to a suitable source of supply is used to produce a glow discharge inside the bulb 1.



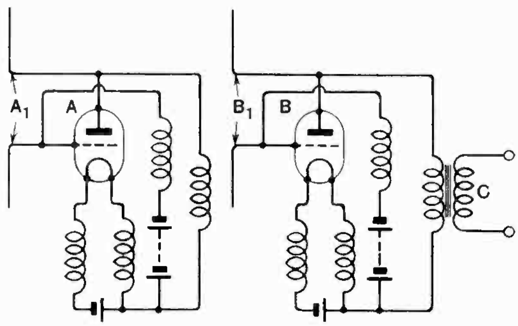
No. 395104.

Patent issued to M. von Ardenne.

SHORT-WAVE RECEIVERS

Convention date (Germany), 12th December, 1931.
No. 395248

To increase the amount of subsequent amplification possible in the reception of decimetre waves (ordinary cascade amplification being impracticable on account of the internal capacity of the valves) two Barkhausen Kurz circuits are coupled together as shown. The first valve *A* is set into oscillation by the received signals, and the amplified energy radiated from the dipole aerial A_1 is picked up by a second dipole aerial B_1 and fed to the amplifier *B*. The output from the latter is then coupled at *C* to further stages of amplification in the usual way.



No. 395248.

Patent issued to Telefunken Ges. fur Drahtlose Telegraphie m.b.h.

PUSH-PULL AMPLIFIERS

Convention date (U.S.A.), 30th January, 1932.
No. 395277

The valves in a push-pull combination are operated at zero grid bias, both stages being of the high-mu or screen-grid type with high internal resistance. A driver stage, also preferably push-pull, is used in conjunction with a low-impedance input coupling. This allows of considerable variation in the load impedance, whilst still maintaining a constant-current output. The push-pull stages may be of the pentode type. In each case the control and screening grids are connected together to form a single input electrode. This results in reducing the anode current practically to zero with no grid bias.

Patent issued to Marconi's Wireless Telegraph Co., Ltd.

AUTOMATIC VOLUME CONTROL

Convention date (U.S.A.), 25th November, 1931. No. 395569

To reduce "noise" when tuning between stations one of the LF stages is normally biased beyond the cut-off point, and a sharply tuned circuit is interposed between the last intermediate-frequency stage and the rectifier valve producing the AVC voltage. This ensures that only signals over a certain minimum strength can remove the prohibitive bias and so pass through to the loud speaker, all other signals and background noise being automatically eliminated.

Patent issued to Marconi's Wireless Telegraph Co., Ltd.

Convention date (Germany), 18th May, 1931. No. 395840

"Gain" regulation in the receiver is rendered unnecessary by making the modulation curve at the transmitter such that undistorted reproduction is possible at a volume which is independent (within wide limits) of the received field-strength. It is, of course, essential that the modulation curve of the transmitter and the demodulation characteristic of the receiver should correspond with one another. According to the invention both curves are of exponential form, following a specified logarithmic formula. At the transmitting end the effect is secured by using a plurality of transmitter or modulator valves, operating in parallel, with different anode voltages and equal grid bias; or alternatively by utilising valves having a variable-mu characteristic. In reception it is found that the super-regenerative type of circuit possesses the desired characteristic and gives a practically uniform output-volume in spite of any changes in field-strength due to fading.

Patent issued to Telefunken ges für Drahtlose Telegraphie M.B.H.

GANGED CONDENSER UNITS

Application date 22nd February, 1932. No. 395798

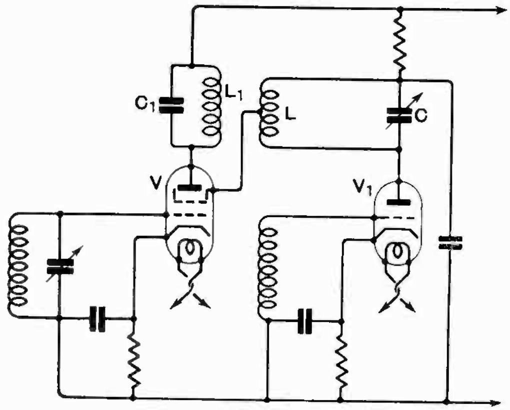
To facilitate the initial "matching" adjustments, and to minimise the risk of accidental capacity-variations due to the warping of the structure, the condensers are enclosed within a casing of sheet metal, all the accessory parts being connected together solely by welding, whilst the walls are of integral metal from one end to the other. The stator vanes of each condenser are formed from a single die-casting, and are supported in position, between opposite surfaces and parallel to the rotor spindle, in such a way that they can be adjusted during assembly in a direction parallel to the plane of the vanes.

Patent issued to Pye Radio, Ltd., and E. M. Butler.

SUPERHET CIRCUITS

Application date, 2nd March, 1932. No. 396145

The detector valve *V* is coupled to the local oscillator *V*1 by a lead taken from the coil *L* of the heterodyne circuit *L*. *C* direct to the screening-grid of the first valve. The tapping point on the coil *L* is varied to adjust the amplitude of the local oscillations fed back for mixing; or a suitable



No. 396145.

impedance may be included in the connecting lead for this purpose. The resulting intermediate-frequency oscillations are built up in the anode circuit *L*1, *C*1 of the detector valve.

Patent issued to A. L. McR. Sowerby and A. C. Cossor, Ltd.

MOVING-COIL SPEAKERS

Convention date (Germany), 12th February, 1931. No. 396440

The mechanically-moving parts of the speaker system do not generally radiate sound-frequencies below 100 cycles. This does not, however, prevent such frequencies (when they occur in the electrical parts of the system) from causing distortion, for instance by modulating the desired frequencies in the range between 100–10,000 cycles. According to the invention, frequencies lower than 100 cycles are suppressed either in or before they reach the moving coil. This object is attained either by suitably dimensioning the moving coil itself, or by interposing suitable filter chains, or by using amplifiers which are ineffective for the frequencies in question.

Patent issued to M. von Ardenne.

Application date, 5th July, 1932. No. 396925

An elastic member for controlling large-amplitude vibrations in a moving-coil speaker consists of a central annular portion to which the diaphragm or coil-carrying former is rigidly attached. Resilient arms radiate from the centre piece, and are bent round and back towards each other until they overlap. The overlapping parts are then connected to a pin projecting from the central core of the magnet.

Patent issued to The General Electric Co., Ltd., and E. M. Eden.