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Editorial

The Physics of the Divining Rod*

"THE divining rod has been used through long ages by magicians soothsayers and diviners in the search for water, minerals, witches, criminals, Catholics and Protestants, hidden valuables, dead bodies, lost people and even the seats of disease in the human body. In spite of this somewhat dubious history, I hope to show that a dowser may be a scientist who uses his rod to attest to physical phenomena just as the pointer of the galvanometer attests to the current that moves it."

This is from the introduction to Part III of a recently published book by Maby and Franklin bearing the above title. Some indication of the scope of the subjects dealt with is afforded by the chapter headings: a historical sketch; the problem of mineral and vital radiation; physical investigations in relation to dowsing; proofs of a physical basis to water divining; details of dowsing fields and reactions; geophysical and physiological considerations; applying the new knowledge in the field; electrical radiations relative to growth and disease; the dowser's reaction to physical stimuli; cosmic radiation; polarisation; the dowser's mode of reception of radiation; phenomena due to radiation; and finally, evidence in favour of a physical cause of certain dowsing phenomena. There is also a bibliography and a glossary of the terms employed.

The book undoubtedly represents a serious attempt to get to the bottom of the subject, and to put it, if possible, on a scientific basis. In the search for possible explanations of the link between the hidden stream of water and the muscles of the dowser, the reader meets magnetic and electric fields, electromagnetic waves, corpuscular radiation, cosmic rays, Lenard rays, neutronic rays, alpha and beta particles, N, X, gamma and ultra-violet rays, to say nothing of less familiar emanations such as Odic rays and digital effluvium.

The authors disclaim any concern in the book with psychical forms of divination, clairvoyance, etc., and confine themselves to physical and physiological matters, although the latter are sometimes tinged with traces of the former, which is to be expected from a writer who is evidently keenly interested in both. For example, on p. 23 we are told that *a small pendulum is handy for "dowsing" over maps and plans of distant regions.* Although the author says that this appears to belong to the "psychic" domain [we should consign it elsewhere] the fact that such a thing is seriously mentioned is calculated to undermine the reader's faith in the author's critical faculty.

The authors are fully alive, however, to the shady side of the business "for cranks

* By J. C. Maby, B.Sc., A.R.C.S., and T. B. Franklin, M.A., pp. xv + 452, with 51 Figs. G. Bell & Sons. Price, 21/-.

and charlatans of every kind flock around dowsing as they do around Spiritualism like vultures about a kill . . . to play the rogue as pedlars did with ' holy relics ' in Medieval times." On p. 21 we are told that "the violent reactions of some old-fashioned dowsers, using thick forked rods, were undoubtedly due to extreme fatigue . . . and to melodrama respectively," but why respectively?

Some of the quotations from the writings of past workers are very amusing. As late as 1910 Mager used a magnetic detector consisting of a long weakly magnetised needle delicately pivoted above a bobbin of several thousand turns of soft iron wire. He used the iron bobbin as a means to attract the lines of force which by "their tumultuous passage through the bobbin can influence a steel needle placed above the bobbin. . . . Deep water or water in small quantity will affect the needle only after five or seven minutes or will only cause an interrupted oscillation." This suggests that the water sprites cannot have a very keen scent if it takes them so long to spot the bobbin awaiting their tumultuous capers. It is only fair to add that the authors do not give this apparatus their blessing.

Those who employ dowsers should note that "they are bad at the job after a heavy meal . . . but alcohol tends to increase the reaction rather than diminish it, though it may endanger the dowser's discriminative faculties"—a useful hint on how to "treat" dowsers.

Is the Dowser a Human Wireless Receiver?

The authors are sometimes very definite about the nature of the link between the water and the dowser. On p. 105 they say that they "have been able to show instrumentally and physiologically that the intensity of the *Hertzian radiation* that is responsible for the dowsing reactions actually does vary in general relationship to meteorological conditions," and again on p. 173 of Part II, which is devoted to the authors' own experimental investigations, "since the dowser evidently reacts to the same fields of force as such ' ionisation counters ' . . . *it is evident that the dowser must respond to the high frequency effects, due to Hertzian radiation, we suggested above; his muscles acting both as receiving aerial and detector mechanism.*"

Again, on p. 186, "the fields . . . of an electromagnetic type, created by various phenomena of ' beats ' and polarisation of a natural Hertzian radiation (as in ' wireless ') . . . the dowser reacts . . . as in the case of an isolated frog's muscle used as a detector of Hertzian waves." And again, on p. 231, "we are only speaking here of fields of electromagnetic Hertzian radiation, as created by what we believe to be about a 10-metre etheric radiation," after which no one can doubt that this is a fit and proper subject for *The Wireless Engineer*.

There is a peculiar statement on p. 195, viz. that "a meter specially devised by the present writer *will be patented* and supplied to professional dowsers on application, *if there is sufficient demand for it*." The italics are not in the original.

How Radiation Affects Pumping and Jumping

In some sections of the book one's flesh is made to creep by the recital of the dire possibilities of the radiations in which we live and move and have our being; and although, in many ways, the twentieth is an improvement on the sixteenth century, some of the experiences related by Mr. Maby suggest that there is little to choose between being bewitched and being "beradiated." For example, "it is generally agreed that one ' gets along better ' on a pedal cycle after dark; so, too, did the writer find that he could always pump more water in less time after nightfall—the later the better, despite fatigue after a long day's work—than in the daytime. . . . The writer sometimes found that he tired much more quickly when (using his two arms) he stood on one side of the pump handle . . . and tests by a second person invariably showed that there was a beam of dowsing radiation from the pump and well-shaft that cut through the position in which one tired of pumping most rapidly." Another example: "A great proportion of those tested were definitely impressed by the seeming ' change of weight ' of, say, a 15 lb. block of iron . . . as compared with some distance off, and they were even more impressed by the fact that the weight seemed considerably heavier when they faced up-stream . . . than when they faced down-stream." Perhaps the palm should be given to the following remark about moving staircases: "it is a common matter of observation—especially by old and sensitive people—that it is much harder work to *walk* up such moving staircases than their static brethren of equal steepness. Such an effect must, *of course*, be due to the 'flow field' (electromagnetic origin) created by passing over underlying metal work." *Of course!* But we are responsible for the italics.

There is a startling idea for athletes on p. 381 where we are told that "it is almost certain that all competitive sports are essentially unfair for not only may one man be more affected by dowsing rays than his competitors and so unfairly handicapped . . . but it is also likely that in a feat such as the high-jump, for example, Jones, jumping from the left take-off, may be in a stronger or weaker zone of radiation than Smith, jumping from the right side! The trial is, therefore, unfair." Visions of a pugilist in the small hours exploring the "ring" with a bent twig and then later manoeuvring to put his adversary "on the spot."

Lay readers are likely to be much impressed by two curves which will, however, do the authors much harm in the eyes of the scientific reader. As the dowser walks away from a stream, he apparently passes through alternate bands of strong and weak fields. If plotted, his reaction therefore gives a wavy line. The author gives such curves and then reproduces the well-known diagram showing the *instantaneous* electric field in the neighbourhood of a vertical Hertzian oscillator and tells readers to note the excellent accordance with the dowsing field, being apparently unaware that the latter is only an instantaneous field diagram and that measurements of the field would show no such waviness.

How to Sleep in a Hertzian Field

A very interesting and important suggestion is that such things as rheumatism are not caused directly by damp but by rays emitted by the water, also that cancer may be caused by radiation from metals, and that the supposed increase in cancer is consequently a result of the increased use of metals in buildings, etc. Even spring mattresses are under suspicion. The metal is presumably excited into radiation by the impact of the cosmic rays. Such suggestions are worthy of the fullest investigation, but we are not so sure of the following: "There is the fact that both the Hertzian field and also the magnetic flow field are for ever reversing their polarities [this is certainly a habit of Hertzian fields] or direction of action on the body of the sleeper—especially if he sleeps extended full length, rather than doubled up in a W form, or with arms and legs stuck out at different angles; for the latter postures would tend to break the oscillatory effects to some extent." This should be a warning to a "sensitive" person—and who knows—not to sleep over "streams or mineral veins" or if compelled to do so, at least to be careful to double himself up "in a W form."

The effects of copper collars and bracelets have been attributed by Labergerie to "ionisation of the air in the magnetic field induced by the metallic oscillators," which sounds terribly scientific and complicated. As a final quotation which summarises the whole: "Our work then gives confirmation of the correctness of the belief held by so many dowsers that 'everything radiates' for on no other assumption can the fundamental phenomena of dowsing be explained."

It would be interesting to take one of those little pendulums used for dowsing over maps and diagrams, and experiment on p. 394; we wonder how it would react to "only a secondary phenomena." Seriously, however, there can be no question that this book is the most complete treatise on the subject that has been written, and it will be read with interest—if not with agreement—by all who wish to extend their knowledge of this ancient and much-debated subject.

G. W. O. H.

[*The Electrician* of 29th December appeared when we were busy with this review and in it, strangely enough, was the first of a series of articles on Radiesthesis and Electricity and a note saying that the writer had formed a College of Radiesthesis and was willing to instruct for three months without charge six electrical engineers or physicists attached to scholastic institutions. "Radiesthesia" is defined as sensitivity to radiation and "radiesthesis" as the sensing of "radiation"; it sounds better than "dowsing."—Ed.]

Velocity-Modulated Beams*

The Electron Density Distribution

By D. Martineau Tombs, M.Sc., A.C.G.I., D.I.C.

(*Communication from the Imperial College of Science and Technology,—City and Guilds College, London.*)

SUMMARY.—A simple graphical method is given from which curves are obtained for the electron density down the length of a velocity-modulated beam. A sinusoidal variation of modulating voltage is assumed.

A different distribution corresponds to each instant of time in the modulation cycle. Representative instants of time are chosen and curves are presented to show clearly the periodic formation and dispersion of regions of increased density in the beam. Curves of each depth of modulation 0.1, 0.2, 0.4, 0.6, and 0.8 are given. The density at any point on the curves is the mean density over a distance equal to one-twelfth of the distance travelled by an electron in one cycle at the unmodulated velocity.

Practical interest lies in the position, magnitude and phase of the density maximum. Simple equations are given expressing these, even for large depths of modulation.

No allowance is made for the redistribution of electrons under the influence of their own fields.

Subject to these limitations the curves are valid for any frequency, voltage or depth of modulation, or for apparatus of any dimension. The increase of electron mass with velocity is neglected.

The method of derivation of the curves is valid for any shape of modulating wave.

Preliminary

A THEORETICAL paper published by Heil in 1935† was, so far as the author is aware, the first paper proposing to utilise two new principles in the technique of the generation of alternating current at very high frequencies from direct current sources. The first of these is the principle of velocity modulating a beam of charged particles so that at a distance down the beam the more rapidly moving particles may have caught up the more slowly moving ones causing a local increase in density of charge. A cylindrical electrode placed at this point axially in the beam will have within it a charge varying in time at the modulating frequency. It can be shown that the energy abstracted from the beam in the form of alternating current energy is greater than that needed to modulate the beam, and consequently the device can be made to sustain oscillations at a frequency determined by an associated resonant circuit, and to deliver its excess power to a load circuit.

The second principle is that rapidly moving charged particles are not allowed to fall on any electrode withdrawing radio frequency energy from the beam. What kinetic energy must be dissipated in the form of heat is arranged to take place at a conveniently situated auxiliary electrode.

The Klystron

The Klystron of Varian and Varian‡ uses both these principles together with two resonant circuits of low decrement and very high natural frequency. In contrast to Heil's apparatus about which there is no published experimental information, experimental success is claimed for Varian and Varian's device. For the purpose of this paper it is first necessary to consider only a much simplified version of the cathode-end of the Klystron together with the modulating electrodes (G_1 and G_2, Fig. 1) and the cylinder C in which there is a field-free space. The paper deals only with the problem of the density of the beam inside the field free space from a given velocity-of-entry-time relationship. Electrons are accelerated from the cathode K to the first grid G_1 by a battery with a voltage V_b. Between the two grids G_1 and G_2 they are either accelerated more

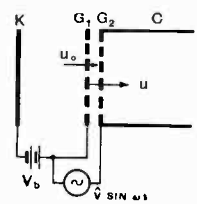

Fig. 1.—*Schematic.*

* MS. received by the Editor, December, 1939.

† *Zeitschr. für Physik*, 1935. Vol. 23, p. 752.

‡ *Journal of Applied Physics*, May, 1939, Vol. 10, No. 5.

or retarded, the voltage being applied from what may be represented as a generator giving a voltage $v = \hat{v} \sin \omega t$. G_1 and G_2 are so close that transit time between them is neglected. Electrons thus enter the field free space C at varying velocities proportional to $\sqrt{V_b + \hat{v} \sin \omega t} = \sqrt{V_b (1 + m \sin \omega t)}$

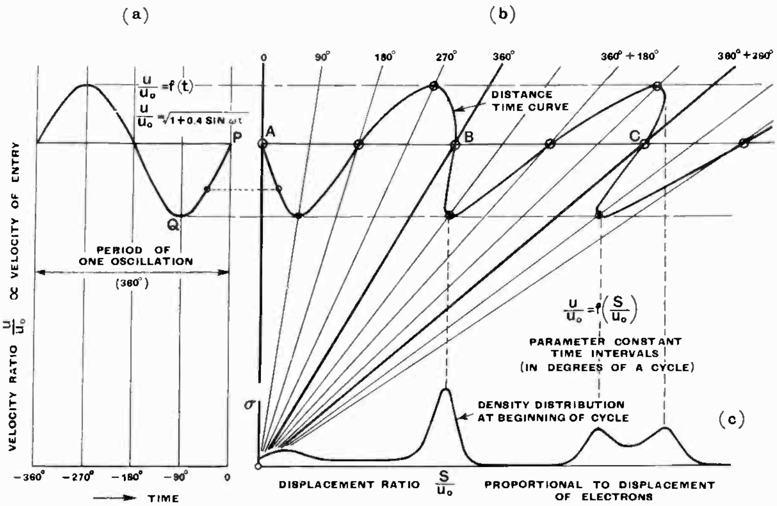

Fig. 2.—*Illustrating the graphical construction for deriving the density-distance curves (c), from the velocity-distance curves (b), corresponding to one instant in velocity-time curve (a).*

where $\frac{\hat{v}}{V_b} = m$ is the depth of modulation.§

Thus we write

$$\frac{u}{u_0} = \sqrt{1 + m \sin \omega t},$$

where u = velocity of entry at time t in the modulation cycle,

and u_0 = velocity with no modulation,

ω = angular frequency of modulating voltage.

We wish to find the electron density down the length of cylinder C at successive instants of time.

The Graphical Solution

We plot first on Fig. 2 (*a*) the function $\frac{u}{u_0}$ as ordinate with time as abscissa, choosing for this set of curves a modulation depth m of some particular value (say 0.4).

Next we prepare to plot a curve of $\frac{u}{u_0} = f\left(\frac{S}{u_0}\right)$ Fig. 2 (*b*), where S represents the distance travelled. A straight line through the origin will be the locus of a constant time interval. Lines of decreasing slope correspond to increasing values of the time interval. We may therefore draw a series of straight lines at time intervals corresponding to 0, 1, or 2 complete periods of the modulating frequency. These are shown in Fig. 2 (*b*) in heavy lines. For example the line through B represents time $= \frac{2\pi}{\omega}$ seconds. The intersections made with these lines and $\frac{u}{u_0} = 1$ (A, B and C) will represent the positions of electrons which entered the cylinder 0 1 or 2 cycles before the electron entering the cylinder at the instant in the modulating cycle represented by point P. Similarly we may draw a line between A and B corresponding to a half cycle (180°). The intersection of this line with $\frac{u}{u_0} = 1$ gives the position of an electron

§ We are not here concerned with the difficulty inherent in the Klystron, that the radio frequency currents remain on the inside of the rhumbatron producing fields between the inner surface of the rhumbatron grids, leaving the outer surface of the rhumbatron at the battery potential. Electrons crossing this outer surface (provided transit time in the rhumbatron is neglected) will emerge at battery velocity, viz. unmodulated whatever radio frequency fluctuations take place inside. The effect in any actual Klystron must involve transit time. This results in a velocity distribution which is not described by $K\sqrt{1 + m \sin \omega t}$. It is possible, however, to derive an equivalent generator of, in general, a non-sinusoidal voltage, which would make the electrons enter the field free space C with the same velocities as they would acquire allowing for transit time. If the fundamental component of this voltage wave is a sufficiently good approximation, the curves may be used directly.

that set out one half cycle (180°) prior to the moment being considered. The same argument can be applied for intermediary points. Thus an electron starting off one quarter of a cycle earlier (90°) will have entered the cylinder at a lower velocity $\left(\text{value of } \frac{u}{u_0}\right)$ than the previous points considered. The intersection of the 90° line with the horizontal through point Q will give the distance travelled by this electron in a quarter of a cycle. It is thus only necessary to take a sufficient number of points and obtain the intersection between the horizontal line through the point and the appropriate sloping line, to obtain the position of any electron starting with any given velocity at distance travelled by a u_0 electron in $\frac{1}{12}\left(\frac{2\pi}{\omega}\right)$ seconds.

This plot gives a picture of the electron density down the beam at a given moment P in the modulation cycle. Similar curves for different instants of time can be obtained by taking the datum point P at successive instants throughout the cycle and considering what has happened to electrons starting at instants prior to the datum point, each with their appropriate velocities. Figs. 3-7 give the results.

Comments and Results

The method adopted has the advantage of giving a fairly clear physical picture of what

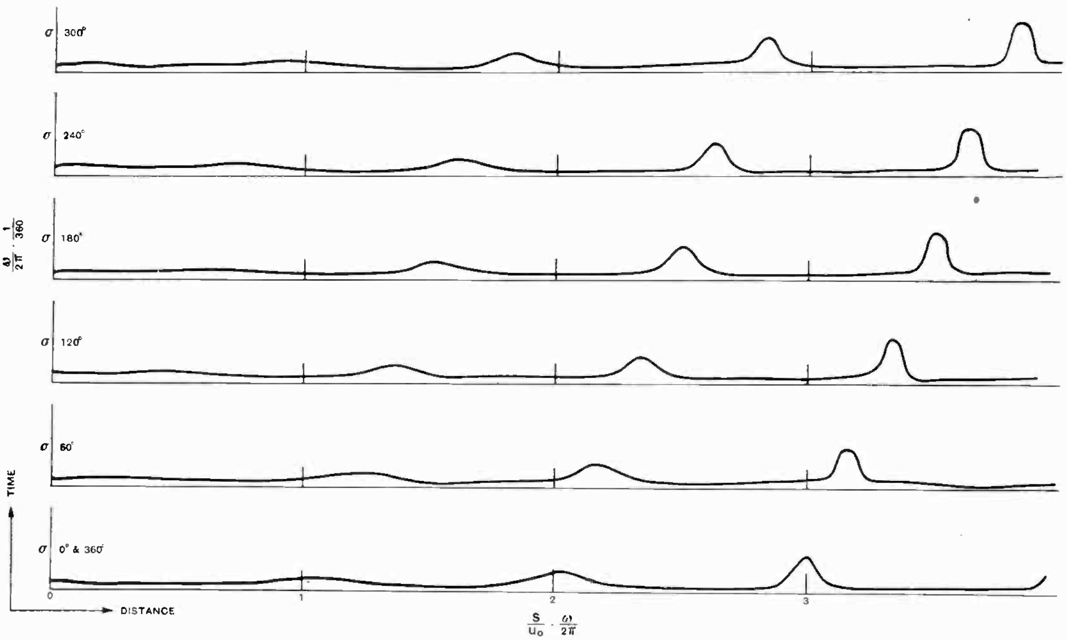

Fig. 3.—*Density-distance curves for a modulation depth of* 0.1.

any previous moment. The curve in Fig. 2(*b*) represents the locus of these intersections. In plotting the curves the period of one oscillation has been divided into 96 parts and the appropriate intersections plotted. By counting the number of electrons within a given horizontal distance, it was possible to plot mean density curves (Fig. 2 (*c*)) for each position down the cylinder, the distance over which the average was made was 1/12th of the distance AB (Fig. 2 (*b*)), i.e. the takes place in a velocity modulated beam. In Fig. 2 (*b*) for instance, points near the top of the diagram represent electrons travelling faster while those lower down represent particles travelling more slowly. The way the faster ones overtake the slower ones is easily seen considering successive complete cycles (compare, for example, points between A and B with points between B and C). Points of maximum density will clearly occur when the curve produced by the successive intersections runs practically vertically to the $\frac{S}{u_0}$ axis. There will thus be areas of increased density due to the top bend (electrons travelling with maximum relatively sooner. 100 per cent. modulation gives intersections at the maximum point at $\frac{u}{u_0} = 1.41$ and the minimum at $\frac{u}{u_0} = 0$. This means that electrons varying in velocity

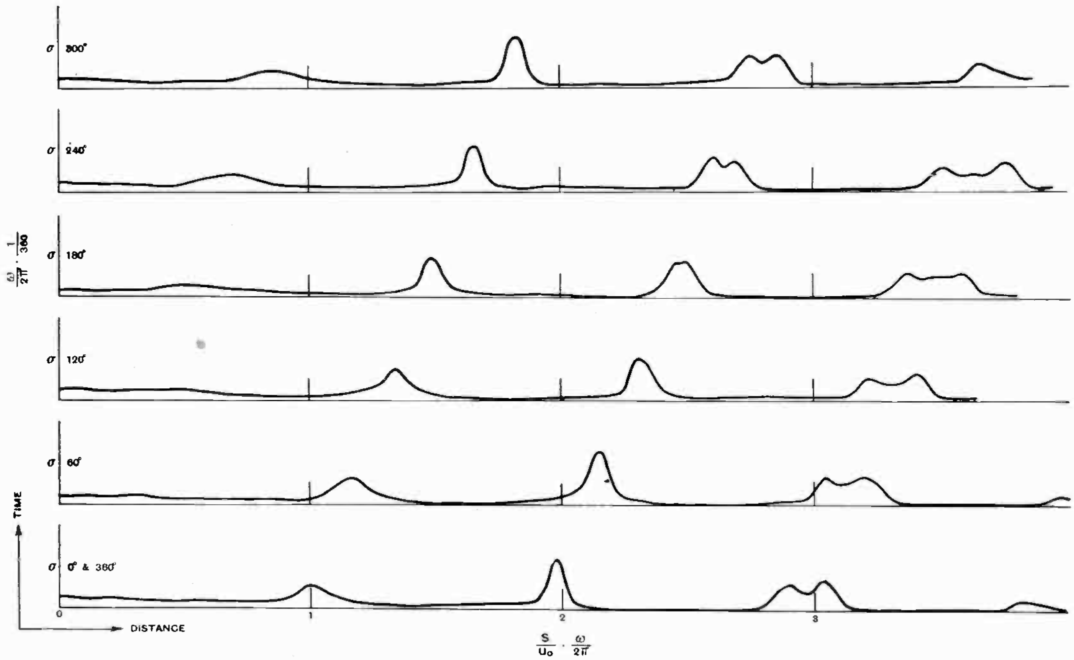

Fig. 4.—*Density-distance curves for a modulation depth of* 0.2.

velocity) and areas of increased density due to the bottom bend (electrons travelling with minimum velocity). Thus, where the top and bottom bends occur vertically above one another there is a point of maximum density. Beyond this point the more rapidly moving particles have overtaken the slower ones and the one peak due to the vertical coincidence of top and bottom bends, begins to degenerate into double hump curves. Beyond this point the top bend may coincide with a bottom bend of a previous cycle causing a point of increased density to occur. The maximum amplitude of these points is sometimes nearly as great as the first maximum.

It will be observed by comparing curves of different depths of modulation that maintaining all other factors constant, the distance at which the first maximum occurs is less for the greater depths of modulation, and degeneration of the electron bunching sets is from 0 to 1.41 u_0 are simultaneously in the cylinder, this is clearly of no practical importance since it means an accumulation of charges at the entry of the cylinder.

Practical interest, however, lies in the position, magnitude and phase of the density maxima.

Empirical formulae for the position of maximum density. The position of the first maximum S' will be found to be a function of m, u_0 and ω.

We plot a curve of $\frac{\omega}{2\pi} \cdot \frac{S'}{u_0} = f(m)$ (Curve A, Fig. 8). This appears to be hyperbolic for the lower values of m. Hence a curve is plotted of $\frac{2\pi}{\omega} \cdot \frac{u_0}{S'} = f(m)$ (Curve B, Fig. 8). The slope of this at $m = 0$ appears to be $2.23 \left(= \frac{1}{0.45}\right)$. This gives an approximate formula for the value of S' for small values of m ($m = 0.3$ gives S' approximately 8 per cent. low).

$$S' = 0.45 \left(\frac{2\pi}{\omega}\right) \cdot \frac{u_0}{m}.$$

Curve B goes to infinity for $m = 1$. This suggests an exponential fit, which takes the form

$$S' = 0.45 \cdot \frac{2\pi}{\omega} \cdot u_0 \frac{1}{\log_e \frac{1}{1-m}}.$$

This gives values within 10 per cent. of the graphical values for values of m up to 0.7.

It is clear that if the width, over which the density is averaged, is made less, the points at which these maxima occur come slightly further down the cylinder. This probably means that for low m the limiting value of

$$S' = 0.5 \left(\frac{2\pi}{\omega}\right) \cdot \frac{u_0}{m}.$$

However, since in practice we are not concerned with the density at a point but only the average density between the two catcher electrodes it is thought that presenting the curves in this way is not objectionable.

Taking figures—a 1,000-volt beam and a frequency of 10^9 c/s the distance over which an average is made is $\frac{1}{6}$ cm.

Empirical formula for the Phase Displaceplacement. The time taken for a particle to reach the position of maximum density is given by the same formula slightly re-arranged

$$T' = \frac{S'}{u_0} = 0.45 \frac{2\pi}{\omega} \frac{1}{\log_e \frac{1}{1-m}} \text{ seconds.}$$

This is independent of u_0 the unmodulated velocity, i.e., it is independent of the battery voltage.

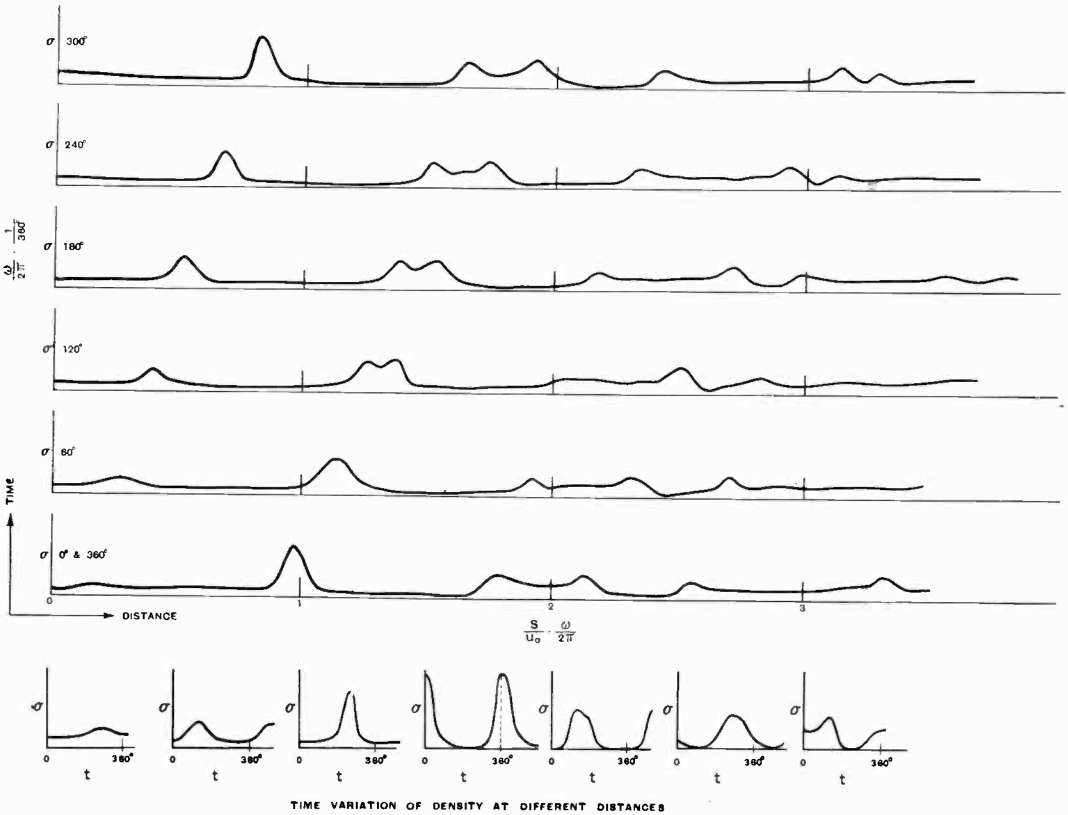

Fig. 5.—*Density-distance curves for a modulation depth of* 0.4 *together with some density-time cross-cuts at corresponding distances down the beam.*

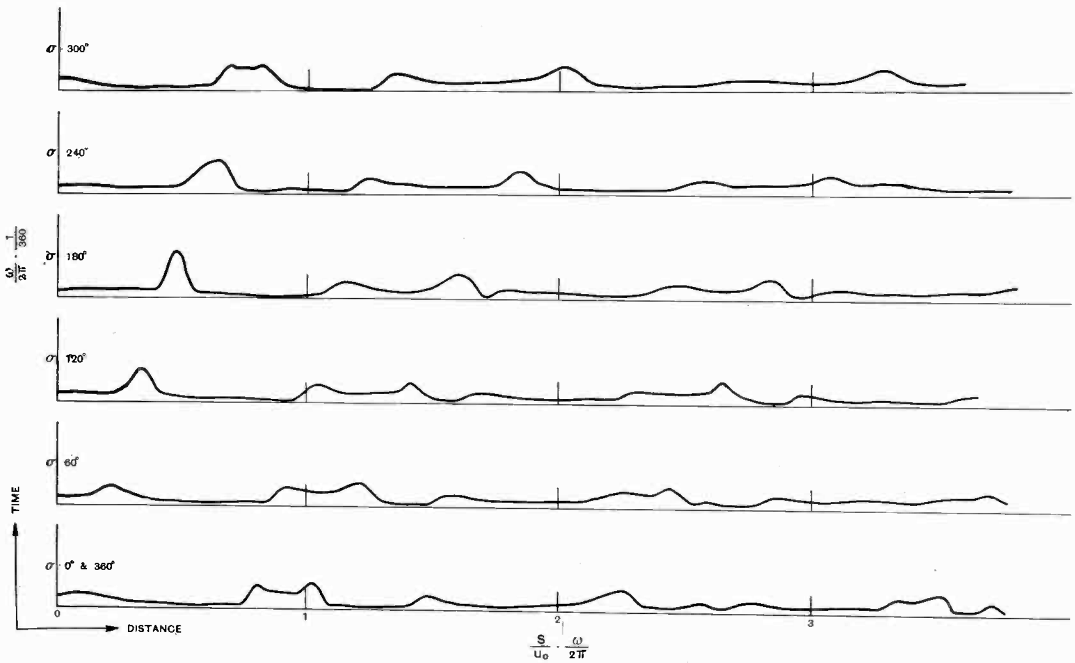

Fig. 6.—*Density-distance curves for a modulation depth of* 0.6.

This can be expressed as a phase displacement in radians.

$$\phi' = \omega T' = 0.45\ 2\pi \frac{1}{\log_e \frac{1}{1 - m}}$$

$$= 2.83 \frac{1}{\log_e \frac{1}{1 - m}} \text{ radians.}$$

Size of Maximum. The density increase at the point of maximum density is found to be about six times that at the entrance of the cylinder. It must be stressed that this is a function of the width over which the average is made—in this case over 1/12th of the distance a u_0 electron travels in one cycle.

It is of interest to note that at any given value of $\frac{S}{u_0}$ in the density curves a vertical cut represents the density variation in time. Such curves have been obtained for 40 per cent. modulation and are shown at the foot of Fig. 5.

A point also to notice is that since the

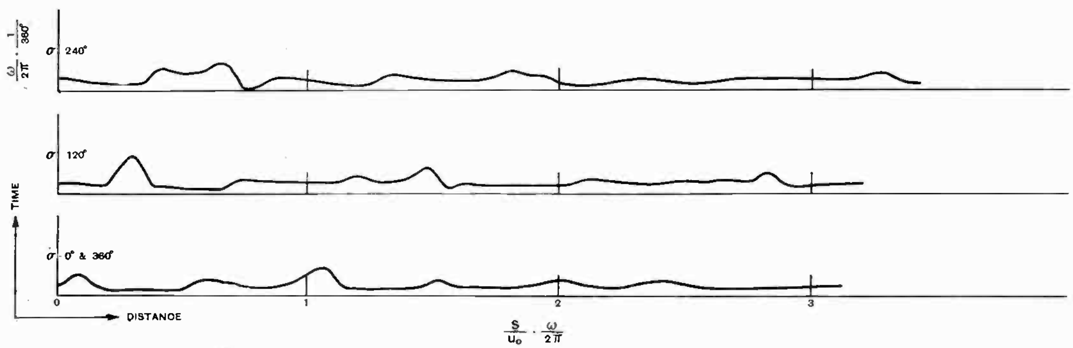

Fig. 7.—*Density-distance curves for a modulation depth of* 0.8.

density fluctuation is periodic in time the lower curve corresponding to 0° is the same as would appear at the top of the diagram for 360°. The formation and dispersal and reformation of secondary positions of increased density can thus be traced right through to as many cycles as may be of interest.

Non-sinusoidal Modulating Waves. The method of deriving the density curves is of course valid for any shape of modulating voltage and density curves can be obtained for any particular type of wave by this method.

Non-sinusoidal wave forms of equivalent voltage are obtained where the transit time between grids is a large fraction of the period of one complete cycle. Sloane and James* have shown how the anode velocities vary in a plane diode when the transit time is a large fraction of the period of anode voltage fluctuation. In their Fig. 3 the top curve shows how the velocities depart from those corresponding to the anode voltage at the time. A voltage curve corresponding to the velocity curve can be obtained and this would constitute the voltage of the equivalent generator.

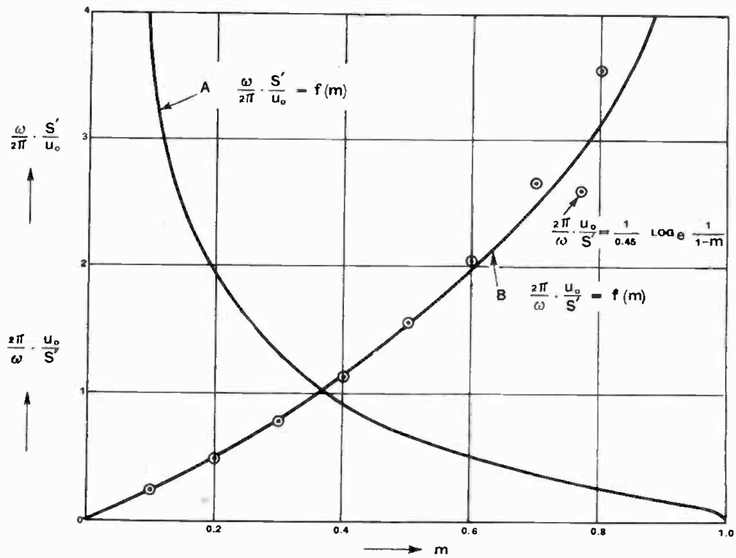

Fig. 8.—*Distance S′ at which maximum density first occurs plotted to a base of modulation depth m, Curve A. Curve B shows the reciprocal of S′ to the same base. Points show a mathematical fit to the reciprocal curve.*

If, however, the curve is not unduly distorted in wave form, an idea of the bunching action of such can be obtained by assuming a sine wave and then choosing the appropriate curve from those given.

A wave was chosen $m = 0.4$ and a 25 per cent. second harmonic (relative to the fundamental) at 180° phase displacement was added, the resulting wave of $\frac{u}{u_0}$ plotted and the density curves derived. This particular case showed only a very small change in the position of the maximum S'.

* "Transit time effects in diodes." *Journ. I.E.E.*, Vol. 79, p. 291.

Acknowledgments

The author wishes to express his thanks to Professor C. L. Fortescue of the Imperial College for encouragement in the preparation of this paper the outlines of which he included in his recent lectures on "Modern Radio Apparatus and Installations" at the Royal Institution, London, in November, 1939.

Mr. D. W. Hopkin has also kindly assisted in preparing the drawings for reproduction.

Non-Linear Circuits

SUBSEQUENT to passing for press, we received from the authors of the article "Non-Linear Circuits," which was published in the January issue, the following corrections.

In Fig. 6a the curve marked 100 ohms should be 1,000 ohms, and that marked 1,000 ohms should be 100 ohms.

For Fig. 7 in the eighteenth line from the foot of column one on page 9 read Fig. 6a.

For Fig. 8 in the twentieth line from the foot of column two on page 11 read Fig. 8a.

Trapezium Distortion in Cathode-Ray Tubes*

By B. C. Fleming-Williams

(Queen Mary College, London)

Introduction

In cathode-ray oscillograph tubes, the electron beam may be deflected over the fluorescent screen by either electromagnetic or electrostatic means. Each method has its own merits and demerits, and consequently its own particular applications.

Where simplicity of operation, and a wide frequency range is required—such as in the commercial oscilloscope for instance—electrostatic deflection is usually employed. If quantitative measurements are required, certain precautions have to be taken or the results may be inaccurate. One of these inaccuracies, known as trapezium distortion, is considered in this article.

For the best results, the mean potential of the two deflector plates of a pair, should remain constant and equal to the final anode potential of the electron gun. This is known as symmetrical, or push-pull deflection. Since it is usually the change in potential with respect to earth of a single point, which has to be delineated, symmetrical working requires relatively complicated phase reversing equipment. The obvious and usual method is to connect one plate of each pair to the anode, and to apply the work voltages to the remaining two. Three forms of distortion then make their appearance :

1. *Deflection de-focussing.* The deflection spot increases in size and is usually drawn out in the direction of deflection. This may in part be overcome by using a beam of small cross-section.

2. *Non-linearity.* Using push-pull, the deflection of the spot can be made very nearly proportional to the applied voltage. With asymmetric working the sensitivity falls off as the work plate is made positive. This is usually not very serious and can be allowed for in the calibration, or corrected in the amplifier.

3. *Trapezium distortion.* The sensitivity of the pair of plates nearest the gun is modulated by the potential applied to the other pair. The converse does not occur.

Experimental Results

When two voltages of saw-tooth wave form, and of widely different frequency, were applied asymmetrically to the two pairs of deflector plates of the normal cathode-ray tube, a raster as in Fig. 1 was seen, XX' and YY' being the locus of the spot for zero potential difference on the Y and X plates respectively. (In this article the pair of plates nearest the gun will be called the Y plates.) The Y deflection was always a minimum when the X work plate was positive, so that the smallest side of the trapezium was always nearest the work plate. When the raster was moved up and down the screen by varying the mean potential of the Y work plate, the angles at the corners of the trapezium depended on their distance from the X axis only. Thus if the top of the trapezium was made to coincide with the X axis, two angles of the trapezium were right angles. When the X amplitude changed, the angles of the trapezium did not change, *e.g.*, the slopes of AC and BD remained constant with respect to XX'.

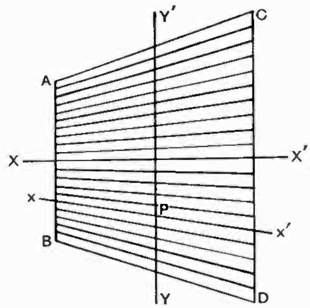

Fig. 1.

Fig. 1.—*Lines of deflection in a cathode-ray tube. XX' and YY' being the axes with zero deflecting potential. A voltage on the X plate would cause the spot to move along one of these lines, thus if by means of a shift control the zero was brought to a position P, the axes of deflection would be xx' and YY', and would no longer be at right-angles.*

It was thought at one time that this effect was due to an interaction between the electric fields of the two pairs of plates.

* MS. accepted by the Editor, October, 1939.

This was proved not to be the case when it was found possible to produce trapezium distortion using one set of plates only, deflection in the other direction being produced magnetically. The two alternating potentials were connected to the X plates, and to a pair of coils strapped to the neck of the tube. It was found that if the coils were nearer to the screen than the plates, the raster produced was rectangular, but if the coils were slid down the neck towards the gun, the raster became trapezoidal.

One further experiment gave the clue to the explanation of the effect. An alternating potential was applied to the Y plates, thus producing a line on the screen, the two X plates were shorted, and their potential was varied with respect to earth. It was found that the length of the line varied, increasing with negative, and decreasing with positive potential applied to the X plates. It thus became clear that when positive, the X plates were acting as a weak cylindrical electron lens, tending to re-concentrate the deflected beam back to the centre of the screen. No doubt if the X plates had been made sufficiently positive the beam would have always struck the centre of the screen, even if given an initial deflection by the Y plates.

In normal operation, if we assume that the beam remains half-way between the two X plates even when deflected (approximately true for small deflections at least), then when the plates are operating in push-pull the

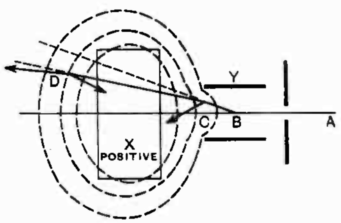

Fig. 2.

potential of the space in the path of the beam will not be very different from earth potential. If however the plates are connected asymmetrically the potential in the space mid-way between them will vary with respect to earth, and will be equal to half the deflection potential applied to the work plate. Thus the deflection produced by the Y plates will be modified, and this modification will be half that obtained by connecting the two X plates together as in the previous experiment.

Theory

Fig. 2 is a section through the tube in the plane containing the beam, and parallel to the plane of the X plates. If a potential is applied to one or both of the X plates with respect to the other electrodes, the equipotential lines will be approximately as shown.

Suppose that the electron beam, after passing through the final anode at A, is deflected by some means at B. Then if one of the X plates is positive, when the beam

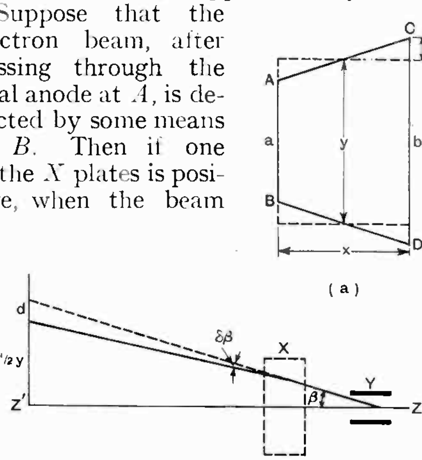

Fig. 3.

reaches C it will be accelerated in a direction indicated by the arrow, which has a component towards the axis. After passing between the plates, the electrons will be decelerated to a velocity equivalent to the earth potential, which deceleration also has a component towards the axis. Thus the total Y deflection is reduced during the passage of the electrons between the X plates. If the working X plate is negative, the converse will take place. This effect will occur both when one X plate is earthed, and when both X plates are at a potential different from earth.

Actually the application of a deflecting potential to the Y plates would alter the appearance of the field produced by the X plates. This is not shown in Fig. 2, as it would make the lens action less easy to understand, but the lens field produced by the X plates would still modify the Y deflection.

Let ZZ' (Fig. 3b) be the axis of a cathode-ray tube. The electron beam on reaching the Y plates is deflected through an angle β. For the sake of simplicity we will suppose that the deflection takes place at the centre of each pair of plates. On reaching the lens produced by the X plates it is again deflected through a small angle $\delta\beta$. If the angles concerned are small, we may say that $\delta\beta$ is proportional to the product of the distance of the ray from the axis at the X plates and the voltage difference which produces the lens. (Approximately half the deflection voltage.)

The voltage producing the lens is proportional to the X deflection (x). The distance of the ray from the axis is proportional to the mean Y deflection (y).

$$\text{Thus } \delta\beta = x \,.\, y \,.\, \text{constant.}$$

But $\delta\beta$ is proportional to the change d in the amplitude of the Y deflection :

$$i.e. \quad d = kxy$$

Where k is a constant.

It has been found convenient to define a distortion factor.

$$\text{This is} \quad \alpha = \frac{2(b-a)}{x(b+a)} \quad \text{see Fig. 3 (a)}$$

$$\text{which is} \quad \alpha = \frac{4d}{xy}$$

and the constant obtained theoretically :—

$$k = \alpha/4$$

The Table shows some results of measurements on two tubes of Type 3237.

The slope of the line AC :—

$$s = 2d/x = 2ky$$

Cossor Tube	Dimensions in Millimetres			α
	x	a	b	
Type 3237 (No. 3992)	48	66	69.5	1.1×10^{-3}
	43	45	47.5	1.25×10^{-3}
	48	25	26.5	1.21×10^{-3}
	74	23.5	25.5	1.1×10^{-3}
Type 3237 (No. 3882)	48	53.5	57	1.3×10^{-3}
	46.5	34.5	36.5	1.21×10^{-3}
	70	33.5	36.5	1.22×10^{-3}
Type 3243 (No. X1417)	52	44.5	45	0.22×10^{-3}

Thus the slope is only dependent on the distance from the X axis. This has already been found experimentally to be true.

Elimination of Trapezium Distortion

Fig. 4 (a) indicates a method of curing trapezium distortion. This is a view of the X plates with the tube axis perpendicular to the plane of the paper. The figure $ABDC$ indicates the shape of the raster as it would be seen on the screen if X' were the work plate, and if the plates were flat. By curving the plates as shown, the beam when deflected by the Y plates, is given its second deflection in the direction indicated by the arrows. The curvature being made such that this change of deflection just counteracts the lens effect of the plates, so that the resulting raster is rectangular.

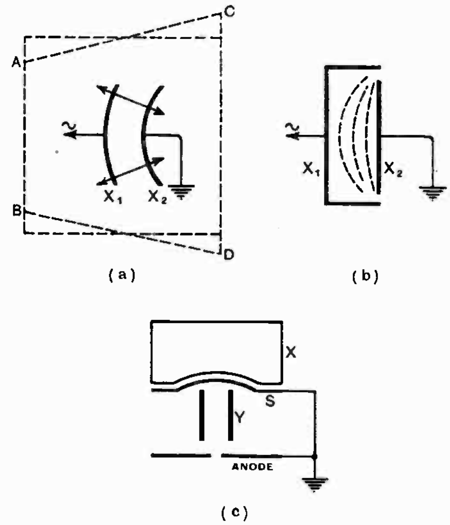

Fig. 4.

R. Wigand describes a tube of this type, in which the X plates have a cross section as shown in Fig. 4 (b). The equipotential planes (shown dotted) do not exactly follow the shape of the plates, but are curved, and so reduce the distortion as do the curved plates.

In this type of tube, if symmetrical deflection is used, or if the wrong plate is earthed, trapezium distortion results.

A consideration of the underlying principles leads one to see that there is another and better way of eliminating this effect.

Suppose we shape the X plates as shown in Fig. 4 (c), and an earthed screen S is interposed between the two sets of plates, the equipotential lines may be made concave towards the anode both at C, and at D (Fig. 2), and if there is a component of acceleration away from the axis at C, the inward deceleration at D can be made exactly to counterbalance it. In this way a complete correction for trapezium distortion can be made. The shaped and slotted screen S (Fig. 4 (c)) is necessary, otherwise the equipotential lines "bulge" into the space between the Y plates, and the advantage of shaping the X plates is lost.

By either of these two methods any degree of correction or over-correction may be obtained. In commercial production the distortion factor can normally be made less than 0.3×10^{-3}. The tube Type 3243 quoted in the Table has an electrode structure as in Fig. 3 (c).

Since the latter method is symmetrical, either plate can be earthed, or both may be used in push-pull. Moreover unlike the first method, if the X plates are shorted together, and their potential is varied with respect to earth, no change in Y deflection results.

For permission to publish this paper, I am indebted to the management of Messrs. A. C. Cossor Ltd., in whose Research Laboratory this work was done. I also want to thank my one-time colleagues of that department, who were so willing in giving their invaluable advice and assistance.

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New Books

Servicing by Signal Tracing

By John F. Rider. Pp. 360, 188 Figs. John F. Rider, 404 Fourth Avenue, New York, N.Y. Price $2.

Because "far too many servicemen are still using 'stone age' testing methods," the author has produced this book with a view to giving the servicing fraternity a technique that would be universal in application, and as applicable to receivers of to-morrow as to those of yesterday. The common denominator on which the described system of testing is based is the input signal which, if traced through the receiver until it departs from normal, will give the point where the trouble originates. The early chapters of the book are devoted to the behaviour of the signal in detectors, amplifiers and coupling devices. Chapters V–XI deal with the actual methods of tracing the signal in oscillator, mixer and detector circuits, P.A. systems and television receivers, whilst the last chapter is devoted to signal-tracing instruments.

Radio Service Trade Kinks

By Lewis S. Simon. Pp. 269, 27 Figs. McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price £1.

As the title of this book, which is of American origin, reveals, it is intended for the serviceman. The author, who is himself a serviceman, has arranged alphabetically under the names of the receivers, the solutions to various problems encountered during 18 years' servicing.

The Radio Amateur's Handbook, 1940

By the Headquarters staff of the A.R.R.L. Published by the American Radio Relay League, Inc., West Hartford, Conn., U.S.A. Pp. 576. Approximately 830 illustrations and 86 charts and tables. Price, paper bound, $1.00 in continental U.S.A., $1.25 elsewhere; buckram bound, $2.50.

The 32 chapters of this the seventeenth edition of this well-known handbook form a complete exposition of amateur S.W. radio construction and operation.

Communications—Wire and Wireless

By R. Barnard Way. Pp. 184 with 117 illustrations. Published by Wells Gardner, Darton & Co., Ltd., Craven House, Kingsway, London, W.C.2. Price 3s. 6d.

One of a series of books entitled "How It Works," this volume is devoted to the description of the transmission by wire and wireless of telegraphy and telephony.

N.P.L. Research

Abstracts of papers published by the staff of the National Physical Laboratory during 1938 have just been issued by H.M. Stationery Office as a shilling booklet (postage extra). A section of the publication is devoted to those papers dealing with wireless.

I.E.E. Meetings Resumed

THE Council of the Institution of Electrical Engineers having reviewed the position regarding the activities of the Institution in the light of present conditions, and in response to the requests of members, authorised the resumption of meetings in January. All meetings will be held from 6 to 8 p.m. On February 7th, at the first meeting of the Wireless Section, Mr. T. L. Eckersley will give a paper on "Analysis of the Effect of Scattering in Radio Transmission."

Abstracts and References

Compiled by the Radio Research Board and reproduced by arrangement with the Department of Scientific and Industrial Research

For the information of new readers it is pointed out that the length of an abstract is generally no indication of the importance of the work concerned. An important paper in English, in a journal likely to be readily accessible, may be dealt with by a square-bracketed addition to the title, while a paper of similar importance in German or Russian may be given a long abstract. In addition to these factors of difficulty of language and accessibility, the nature of the work has, of course, a great influence on the useful length of its abstract.

PROPAGATION OF WAVES

455. CONVEX ENDOVIBRATORS.—M. S. Neiman. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 1–11.)

The many disadvantages of ordinary oscillating systems using condensers and linear conductors, *i.e.* conductors whose cross-section is very small in comparison with their length, are pointed out, and it is suggested that hollow conducting geometrical figures, coupled to the source of energy and to the load, should be used as oscillating systems. The electromagnetic field of such systems is totally enclosed by the conducting surface; hence the name "endovibrators" as opposed to "exovibrators"—ordinary vibrators possessing an external field. The advantages of the endovibrators, which become the more pronounced the shorter the operating wavelength, are enumerated, and it is proposed to study first of all monospherical, monocylindrical, and other convex endovibrators made of one conducting surface. This will be followed by a study of toroidal and, finally, polycylindrical bodies. In the present paper the results of a mathematical investigation of monospherical endovibrators are published, determining the electromagnetic field within a perfectly conducting sphere and the resonant frequencies and damping coefficients for various types of oscillations. A number of diagrams are also shown for the electromagnetic field within the sphere.

456. ON THE DIELECTRIC CONSTANT OF SPACE CONTAINING ELECTRONS.—S. R. Khastgir & K. Sirajuddin. (*Phil. Mag.*, Nov. 1939, Series 7, Vol. 28, No. 190, pp. 532–543.)

For preliminary work *see* 2055 (*also* 2444) of 1937. Here a different method of measuring "the effective dielectric constant of an electronic medium for ultra-high radio-frequencies" is used. It is essentially the determination of the capacity of the condenser formed by the anode and the control grid of a screen-grid valve, using a Lecher-wire system, with the filament (1) cold, (2) hot. The experimental arrangement and the theory of the method are described. Results are given for the variation of the effective dielectric constant with frequency and with the thermionic current for a fixed frequency. The results are discussed; "it is significant that neither Benner's [1930 Abstracts, p. 152] nor Hollmann & Thoma's [3840 of 1938] formula was found to agree with the experimental results. Attributing, however, a natural frequency to the electrons corresponding to the resonance frequency of the . . . oscillatory circuit within the valve and introducing a multiplying factor to obtain the effect of the time of stay of the electrons in the inter-electrode space of the valve, it was found that the Lorentz expression for the dielectric constant for a frictionless medium would be consistent with our measurements."

457. TRANSMISSION ON 41 MEGACYCLES [Large Fluctuations between Pasadena & Mount Palomar (90.5 Miles) during Summer only].—S. S. Mackeown, B. M. Oliver, & A. C. Tregidga. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, pp. 414–415: summary only.)

458. THE DIELECTRIC CONSTANT OF WATER VAPOUR AT A FREQUENCY OF 42 MEGACYCLES [measured by Heterodyne Beat Method: Connection with Transmission of Radio Signals through Atmosphere].—A. C. Tregidga. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 856: abstract only.)

459. TRANSATLANTIC RECEPTION OF LONDON TELEVISION SIGNALS [on 41.5 & 45.0 Mc/s: Riverhead Observations since Sept. 1938: Correlation of 41.5 Mc/s Signal with Predicted Max. Usable Frequencies improved by Inclusion of Lorentz Term: Solitary Occasion when 45 Mc/s Signal was Very Strong but Sound Signal was Absent: etc.].—D. R. Goddard. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 692–695.) For previous work *see* 1793 of 1939.

460. ULTRA-HIGH-FREQUENCY PROPAGATION FORMULAS [for "Optical" Distances: Practical Formulae (for Certain Limited Constants) for Received Field & Power, Attenuation, and Radio-Relay Working: Appendix giving Received Field in Case where Constants do Not Fall within Limits].—H. O. Peterson. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 162–167.)

461. STYCTOGRAPHIC COHERERS.—D. I. Penner. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 444–449.)

Continuing previous work (2664 of 1938) experiments were made with filings of various metals (brass, zinc, nickel, & chromium) to determine their suitability for use in styctographic coherers. Curves are plotted showing the effect of the oxidisation temperature of the filings on the value of the breaking-down voltage of coherers. It appears that the metals experimented with do not differ much in this respect, but for the avoidance of premature ageing nickel and chromium filings are preferable. The effect of the size and shape of the filings on the operation of the coherers was also investigated, and particular attention was paid to the ease with which a coherer could be de-cohered.

462. THE PROBLEM OF A SPHERE PLACED IN A HOMOGENEOUS ALTERNATING MAGNETIC OR ELECTRIC FIELD.—Divil'kovski. (*See* 727.)

463. PROPAGATION PHENOMENA IN LONG-DISTANCE FACSIMILE TRANSMISSION BY SUB-CARRIER FREQUENCY MODULATION [Occurrence of "Gollywobble," etc.].—Mathes & Whitaker. (In paper dealt with in 720, below.)

464. ATMOSPHERICS AND RADIO TRANSMISSION PHENOMENA IN PUERTO RICO [1935/1939].—G. W. Kenrick & P. J. Sammon. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, p. 413: summary only.) For a previous paper *see* 3029 of 1939.

465. CHARACTERISTICS OF THE IONOSPHERE AT WASHINGTON, D.C., SEPTEMBER, 1939.—Gilliland, Kirby, & Smith. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 739–740.) This regular feature will not be referred to again except for special contents.

466. CRITICAL IONOSPHERIC FREQUENCIES OBSERVED IN ROME FROM DEC. 1938 TO SEPT. 1939.—I. Ranzi. (*La Ricerca Scient.*, Oct. 1939, Year 10, No. 10, pp. 926–929.)

467. HEIGHTS OF REFLECTION OF RADIO WAVES [6 Mc/s, F_2 Region] IN ROME FROM JAN. TO SEPT. 1939.—A. Bolle. (*La Ricerca Scient.*, Oct. 1939, Year 10, No. 10, pp. 930–932.)

468. INITIAL RECOMBINATION [Theory of Preferential and Initial Ionic and Electronic Recombination].—N. E. Bradbury. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 849: abstract only.)

469. THE GENERATION OF SQUARE-WAVE VOLTAGE AT HIGH FREQUENCIES.—Fenn. (*See* 563.)

470. ON THE GENERATION OF RECTANGULAR IMPULSES.—Miyoshi. (*See* 564.)

471. FLICKERING SEARCHLIGHT BEAM FOR THE STUDY OF THE ATMOSPHERE [Preliminary Experiments show that Study of Upper Atmosphere can be pushed to 90 km if 60-Inch Searchlight and Mirror are used].—E. A. Johnson. (*Science*, 17th Nov. 1939, Vol. 90, Supp. p. 8.) With the preliminary apparatus measurements were made at nearly 40 km. For previous work *see*, for example, 414 & 3472 of 1938 (Hulburt: Duclaux). For a later note, with suggested application to ozone and water-vapour measurements (of meteorological importance) see *Sci. News Letter*, 2nd Dec. 1939, Vol. 36, No. 23, pp. 365–366.

472. THE TRANSPARENCY OF THE ATMOSPHERE: III—CALCULATION OF OLD MEASUREMENTS [to see if They have been Interpreted Correctly].—J. Duclaux. (*Journ. de Phys. et le Radium*, Aug. 1939, Series 7, Vol. 10, No. 8, pp. 367–374.)

473. RESEARCHES ON ATMOSPHERIC ABSORPTION: II & III [Experimental Results: Deductions on the Rôle of Molecular Diffusion & Selective Absorption: etc.].—A. & E. Vassy. (*Journ. de Phys. et le Radium*, Sept. & Nov. 1939, Series 7, Vol. 10, Nos. 9 & 11, pp. 403–412 & 459–464.) For I *see* 1363 of 1939.

474. AURORA BOREALIS OF 13TH OCT. 1939 [General Description: Simultaneous Magnetic Storm].—P. Bonnal: C. Maurain. (*Comptes Rendus*, 6th Nov. 1939, Vol. 209, No. 19, pp. 695–696.)

475. ON THE CONDITIONS FOR THE EXCITATION OF THE NITROGEN SPECTRUM IN THE UPPER ATMOSPHERE.—J. Cabannes & R. Aynard. (*Journ. de Phys. et la Radium*, Nov. 1939, Series 7, Vol. 10, No. 11, pp. 455–458.)

476. FORBIDDEN TRANSITIONS IN NITROGEN [from New Afterglow Spectra: Bearing on Excitation Processes in Upper Atmosphere: Probable Dissociation of Molecules into Metastable Atoms].—J. Kaplan. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 858: abstract only.)

477. EXCITATION FUNCTION OF THE BANDS OF THE FIRST POSITIVE SYSTEM OF THE NITROGEN MOLECULE [Experimental Curve].—R. Bernard & Renée Fouillouze. (*Comptes Rendus*, 30th Oct. 1939, Vol. 209, No. 18, pp. 647–650.)

478. ABSOLUTE BRILLIANCE OF THE NIGHT SKY MEASURED AT GODHAVN (DISKO ISLAND, NW GREENLAND) DURING THE FRENCH EXPEDITION OF 1938/39 [New Binocular Photometer for Feeble Lights: Results for Different Colours].—H. Garrigue. (*Comptes Rendus*, 20th Nov. 1939, Vol. 209, No. 21, pp. 769–771.)

479. MEASUREMENT OF RADIATION OF THE SKY [by Confocal Nest of Four Mirrors: Deductions from Curves of Radiation Variation].—C. M. Heck. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 848: abstract only.)

480. Additional Remarks on the Articles "Researches on the Atmospheric Ozone" [Argument on the Best Way of Investigating the Average Temperature].—E. Vassy: Barbier & Chalonge. (*Journ. de Phys. et le Radium*, July 1939, Series 7, Vol. 10, No. 7, p. 366.) For earlier stages *see* 3467 of 1939.

481. Ozone in the '38 Hurricane.—C. A. Peters. (*Science*, 24th Nov. 1939, Vol. 90, p. 491.)

482. On Periodicities in Measures of the Solar Constant [Examination, by Least Squares, of Abbot's Ten-Day Mean Values].—T. E. Sterne. (*Proc. Nat. Acad. Sci.*, Nov. 1939, Vol. 25, No. 11, pp. 559–564.)

483. A Four-Year Record of Ultra-Violet Energy in Daylight.—Luckiesh & others. (*Journ. Franklin Inst.*, Oct. 1939, Vol. 228, No. 4, pp. 425–431.)

484. On the Establishment of Ultra-Violet Solar Radiation at $\lambda = 2150$ A.U.—E. Meyer & others. (*Helvetica Phys. Acta*, Fasc. 5, Vol. 12, 1939, pp. 415–420.)

485. Solar and Terrestrial Relationships [including Radio Effects, Solar Phenomena and Terrestrial Magnetism, Auroral Phenomena and Physics of Upper Atmosphere, Recurrence Tendency of Magnetic Storms, etc.].—E. V. Appleton & others. (*Nature*, 11th Nov. 1939, Vol. 144, pp. 808–810: summary of British Association discussion.)

486. The Solar Cycle and the F_2 Region of the Ionosphere [Method of Analysis of Critical-Frequency Data to show Correlation with Central-Zone Calcium Flocculi: Prediction of Critical Frequencies: etc.].—W. M. Goodall. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 701–703.) A letter to *Nature* was dealt with in 3437 of 1939.

487. The Present State of Solar Activity and Associated Phenomena.—H. T. Stetson. (*Science*, 24th Nov. 1939, Vol. 90, pp. 482–484.)

488. Statistical Study of the Eleven-Year Cycle of the Semi-Diurnal Component of the Magnetic Declination [Which is generally in Phase with Solar Activity].—Labrouste & Labrouste. (*Comptes Rendus*, 6th Nov. 1939, Vol. 209, No. 19, pp. 689–691.)

489. A Large Sunspot [Data for Spot of Oct. 19th/Nov. 1st].—(*Nature*, 28th Oct. 1939, Vol. 144, p. 748.)

490. Sunspots and Mysore Rainfall.—Seshachar & Iyer. (*Current Science*, Bangalore, Oct. 1939, Vol. 8, No. 10, pp. 466–468.)

491. The Disturbance Field of a High-Tension Discharge [Sphere Gap and Dipole with Central Gaps] in a Screened Room: Determination of the Screening Effect of the Screening employed [by Preliminary Tests with Continuous Waves of 13 m].—H. Kläy. (*Helvetica Phys. Acta*, Fasc. 5, Vol. 12, 1939, pp. 443–488.)

The paper ends: "For all screening there exists a minimum screening action for a definite wavelength. For shorter and longer waves the action increases strongly; for the shorter, because of damping in the layer (layer thickness an important factor); for the longer, because of refraction at the separating layers (layer thickness without influence). The formulae given for the penetrability of the guarding layer gives an idea of the screening action of any chosen arrangement for the wave-band involved. It emerges that the arranging of several layers one behind the other does not correspondingly increase the screening action. Much more effective is a thicker layer; a good electrical conductivity, as well as a high permeability, act in the same direction. For our network [a close-meshed well-earthed wire net—*see* p. 478] the minimum screening factor of 8400 (9 Nepers) comes out at $\lambda =$ 10 000 m. At 100 m it would be 16 Nepers; according to the P.T.R. measurements quoted [Lampe & Ferroni, 271 of 1938], the effective thickness is here estimated at 10^{-2} cm."

492. On a Method of Solution of Some Problems of the Diffraction Theory [Deduction of Inversion Formula on which Method is based: the Proposed Method: Application to Problem of Diffraction of Plane Electromagnetic Wave incident on Perfectly Reflecting Thin Plate: Advantages of Method].—M. J. Kontorowich & N. N. Lebedev. (*Journ. of Phys.* [of USSR], No. 3, Vol. 1, 1939, pp. 229–241: in English.)

493. Contribution to the Optics of Very Thin Metallic Films [Equation for Radiation incident Obliquely].—D. Hacman. (*Zeitschr. f. Physik*, No. 3/4, Vol. 114, 1939, pp. 170–177.)

494. Dispersion and Absorption of Electric Waves in Alcohols and Aqueous Solutions.—Slevogt. (*See* 754.)

495. The Diffraction of a Disrupted Elastic Wave from a Rectilinear Edge or Circular Orifice.—Kharkevich. (*See* 638.)

496. Filtration of Oblique Elastic Waves in Stratified Media.—Lindsay. (*See* 672.)

497. The Propagation Surface of Scalar Waves in a Medium resembling a Grid [Theoretical Considerations].—E. Fues. (*Ann. der Physik*, Series 5, No. 3/4, Vol. 36, 1939, pp. 209–226.)

498. Propagation of the Oscillations of H.F. Transmission along [Three-Phase] Electric Power Networks [for Telemetering, Telephony, etc.].—F. Carbenay. (*Bull. de la Soc. franç. des Élec.*, Nov. 1939, Vol. 9, No. 107, pp. 911–928.) *Comptes Rendus* notes on this analysis were referred to in 2678 of 1939 and back reference.

499. VELOCITY OF PROPAGATION AND TRANSIENT PERIOD ON UNIFORM LINES AND PUPINISED CABLES [and Other Low-Pass Filters: Treatment by Operational Calculus].—R. Possenti. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 576–577: summary only.)

500. MECHANICAL DEMONSTRATOR OF TRAVELLING WAVES.—C. F. Wagner. (*Elec. Engineering*, Oct. 1939, Vol. 58, No. 10, pp. 414–420.)

501. ATTEMPT TO MEASURE THE VELOCITY OF A SIGNAL [consisting of a Short Train of Waves (50 c/s) propagated along the Surface of a Liquid].—J. Baurand. (*Journ. de Phys. et le Radium*, Sept. 1939, Series 7, Vol. 10, No. 9, pp. 420–422.) On water, such waves would be 0.59 cm long, with a dispersion $dV/d\lambda$ of the order of 20 cm/sec/cm.

502. ON THE POSSIBILITY OF THE OBSERVATION OF LUMINOUS INTERFERENCE ARISING FROM TWO DIFFERENT SOURCES.—F. Esclangon. (*Journ. de Phys. et le Radium*, Sept. 1939, Series 7, Vol. 10, No. 9, pp. 391–398.) A summary was referred to in 3129 of 1938.

503. IS LIGHT SLOWING DOWN? [Survey of Problem].—D. W. F. Mayer. (*Scient. American*, Dec. 1939, Vol. 161, No. 6, pp. 336–338.)

ATMOSPHERICS AND ATMOSPHERIC ELECTRICITY

504. STATIC EMANATING FROM SIX TROPICAL STORMS, AND ITS USE IN LOCATING THE POSITION OF THE DISTURBANCE [C-R Direction-Finder Tests (with Photographic Recording) Aug./Oct. 1937: Apparent Position of Static Source and Centre of Storm Rarely Coincide: Possible Reasons, especially the Hypothesis that Static emanates from Periphery, Not Centre, of Storm: Hurricane Static may have Characteristic Wave Shapes distinguishable from Those of Lightning and Thunder-Shower Static? etc.].—S. P. Sashoff & J. Weil. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 696–700.)

505. DIRECTION-FINDING OF THE TRANSIENTS CAUSED BY ATMOSPHERIC DISTURBANCES.—F. Schindelhauer. (*Hochf:tech. u. Elek:akus.*, Oct. 1939, Vol. 54, No. 4, pp. 109–111.)

Atmospherics are generally regarded as due to radiation from lightning flashes of substantially vertical path. It has also been suggested (Schindelhauer, 1932 Abstracts, p. 277) that they may be caused by horizontal currents in the ionosphere. The writer therefore considered it useful to observe the state of polarisation of the atmospherics and to pay particular attention to horizontally polarised radiation. Preliminary experiments are here described; on a wavelength of 32 m, two horizontal dipoles were erected in the NS and EW directions and connected alternately to the single receiver. The quotient $Q =$ (number of disturbances in the NS dipole)/(number in the EW dipole) was calculated; this had a value nearer to unity than it should have had, as the dipoles picked up a considerable fraction of the vertically polarised radiation. For long waves, a frame aerial was used and the quotient $Q =$ (number of disturbances in EW direction)/(number in NS direction) was calculated. Fig. 1 shows the daily variation of the number of atmospherics, Fig. 2 the daily variation of Q. Fig. 3 the daily mean of Q for the whole series of observations. The general conclusions reached are (1) that the disturbances on low and high frequencies arise in general from the same sources, which emit a whole frequency spectrum; in the afternoons and evenings, there are indications of disturbances which contain only high frequencies and are most probably due to thunderstorms; (2) that the source of the greater part of the disturbances lies in the ionosphere and not on the earth's surface, and consists of currents flowing in direction EW, *i.e.* perpendicular to the earth's magnetic field. In the afternoon there is a fluctuation towards the NS direction. "The experiments indicate that cases also occur in which vertical lightning paths act as radiators. . . Practical methods of separating the two kinds of atmospherics are derivable from the experiments."

506. ATMOSPHERICS AND RADIO TRANSMISSION PHENOMENA IN PUERTO RICO [1935/1939].—G. W. Kenrick & P. J. Sammon. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, p. 413: summary only.) For a previous paper *see* 3029 of 1939.

507. DIRECT LIGHTNING STROKES ON H.T. OVERHEAD LINES, AND EXPERIMENTS WITH HAZEL-TWIG DIVINING.—Baumeister. (*See* 897.)

508. LIGHTNING STROKES IN FIELD AND LABORATORY.—P. L. Bellaschi. (*Elec. Engineering*, Nov. 1939, Vol. 58, No. 11, pp. 466–468.) *Cf.* 4321 of 1939.

509. "HOT" LIGHTNING USED IN TRANSFORMER TESTS.—(*Journ. Franklin Inst.*, Nov. 1939, Vol. 228, No. 5, p. 562: short note from *Power Plant Engineering*, Vol. 43, No. 8.) *Cf.* Bellaschi, 4321 of 1939.

510. IMPROVEMENT IN RADIO-SOUNDING BALLOONS: A SHORT-CYCLE RADIOSONDE.—J. Piccard & H. Larsen. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 352–355.)

511. THE MOBILITY SPECTRUM OF ATMOSPHERIC IONS.—E. A. Yunker. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 855: abstract only.)

512. THE THIRTIETH KELVIN LECTURE: "COSMIC RAYS."—P. M. S. Blackett. (*Journ. I.E.E.*, Dec. 1939, Vol. 85, No. 516, pp. 681–684.) *See* also p. 764.

PROPERTIES OF CIRCUITS

513. CONVEX ENDOVIBRATORS [and Their Advantages over Ordinary Oscillating Systems for Very Short Waves].—Neiman. (*See* 455.)

514. INPUT CONDUCTANCE NEUTRALISATION [at Ultra-High Frequencies].—Freeman. (*See* 599.)

515. The Application of Low Frequency Circuit Analysis to the Problem of Distributed Coupling in Ultra-High-Frequency Circuits [General Theory of Coupled Circuits: Necessary Simplifying Assumption of Loose Coupling: Solution of Primary Equation, of Secondary Equation: Generalisation of Solutions: Experimental Verification (Coupled Parallel Line, Coupled Antenna) and Significance].—R. King. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 715–724.)

516. The Application of the Tensor Concept to the Complete Analysis of Lumped, Active, Linear Networks.—Epstein & Donley. (*See* 694.)

517. The Behaviour of a Diode Detector to a Signal Modulated in Amplitude and Phase [particularly the Influence of the Condenser C_d, across the Output Resistance, on the Selectivity].—G. Cocci. (*Alta Frequenza*, Oct. 1939, Vol. 8, No. 10, pp. 612–636.)

If the results given by Williams (2223 of 1938 and back ref.) are correct, it should be possible by suitably proportioning the value of C_d to compensate for the damping introduced by the diode and thus to improve considerably the selective properties of the whole system. "In view of the theoretical and practical interest of such a result it has been thought desirable to carry out a theoretical and experimental analysis, which, while not confirming completely Williams's optimistic hypothesis, has brought out interesting and unforeseen properties of the mode of action."

Author's summary:—The study of a diode (peak) detector inserted between a modulated-carrier-frequency circuit and a modulation-frequency circuit can be developed without any assumption other than the knowledge of the carrier-frequency component passing through the diode. Such a component has the same phase modulation as the applied h.f. signal, and an amplitude modulation equal to twice the amplitude of the modulation-frequency component of the diode current. When the diode is not ideal but has a finite internal resistance, the action can be represented by that of the ideal diode with the addition of a resistance of suitable value in series with the second network. The new procedure is first applied to the case of signals with purely amplitude modulation, and gives the well-known impedance transformations; the influence, favourable under certain conditions, of the internal resistance of the diode is shown. In the case, however, of pure phase modulation the diode, with the second circuit, produces a damping expressed simply by a constant resistance (half the detection resistance). In the general case of signals with mixed amplitude and phase modulations, neither very deep, it is possible to deal with them separately and add the results.

Often the second circuit consists of a resistance with a condenser in parallel; in this case the combination diode/second-circuit strongly damps the higher-frequency components of the amplitude modulation and so increases the apparent selectivity of the associated h.f. circuits; whereas for phase modulation the combination behaves merely as a simple resistance.

In the simple case where the signals consist of two sinusoidal waves of [markedly] different amplitudes, the general results obtained above are completely confirmed. The specially noticeable feature is the production of a third signal, of frequency equal to that of the missing sideband (twice the frequency of the strong signal, minus that of the weak signal) and of such phase as partially to cancel the amplitude modulation, leaving the phase modulation unchanged.

Finally, considering the effect of the second-circuit condenser on the apparent selectivity of the system, it is found that when the interference is of the type known under the name of demodulation, the effect is nil; there is, however, a marked effect against aperiodic disturbances. Measurements were made on an experimental circuit, and the theoretical results were found to be confirmed quantitatively. The treatment leads to criteria for the better design of diode detectors, and possible applications are discussed [to ordinary radio receivers, for increasing the apparent selectivity: the use of the "third" frequency as possibly more convenient than the usual sum or difference frequency: restoration of the second sideband to a single sideband signal: etc.].

518. On the Theory of Retarding Back-Coupling.—Gorelik. (*See* 540.)

519. Quick Building-Up of the Electron-Coupled Quartz Oscillator.—Hayasi & Akasi. (*See* 552.)

520. Band Filters without and with Retroaction.—J. Mühlner. (*Hochf:tech. u. Elek:akus.*, Sept. 1939, Vol. 54, No. 3, pp. 80–93.)

"High-frequency amplifiers with narrow filters are investigated in the pass-band and its immediate neighbourhood without and with retroaction; the filters consist of single circuits separated by valves or of coupled circuits." The complex propagation constant [ratio (input voltage impressed on grid of valve preceding first circuit)/(output voltage measured across *n*th oscillating circuit)] is calculated and discussed. The advantages of this point of view are illustrated by the two-circuit filter, in which the propagation constant always lies on a parabola in the complex plane; thus all cases can be discussed on the basis of a single "unit parabola" in which the position of the origin of co-ordinates is determined by the nature of the circuit (*see* also Troeltsch & Steinmetz, 3357 of 1936). In this paper the propagation curve of a circuit is measured as a function of circuit parameters and compared with that obtained theoretically. The case of equal circuits decoupled by intermediary valves is first considered (Fig. 2). The effect of retroaction on the propagation constant is shown in Fig. 3; if the retroaction is independent of frequency, its effect is to displace the origin of the co-ordinates of the propagation-constant parabola.

Amplifiers with one, two, three, and more oscillating circuits are considered in detail on these lines in §B, each case being discussed without and with retroaction. In the case of one circuit it is found that "it is fundamentally impossible by using retroaction to attain anything which could not be attained by another oscillating circuit with different sharpness of resonance and different tuning. It is, however, of practical importance that retroaction can be used to obtain circuits of very high sharpness of resonance, which cannot be obtained without retroaction." For two circuits, "it is in principle possible to transform any possible propagation curve into any other by means of retroaction." "Practical advantages of the use of retroaction are found to be: (1) narrow filters demand considerable sharpness of resonance of the oscillating circuits; this may be attained by reducing the attenuation: (2) the form of the propagation curve of a filter can easily be varied by retroactions of a suitable kind; in many cases it is simpler to correct the propagation curve of a given amplifier to the desired form by a small retroaction than to maintain very exact conditions for the sharpness of resonance of the oscillating circuits and their detunings or couplings; this is shown by the coupled filter with three circuits: (3) in the case of the two-circuit filter, the band width can be regulated electrically in a simple way by means of retroaction."

521. VELOCITY OF PROPAGATION AND TRANSIENT PERIOD ON UNIFORM LINES AND PUPINISED CABLES [and Other Low-Pass Filters: Treatment by Operational Calculus].—R. Possenti. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 576–577: summary only.)

522. SOME NEW USES OF CAPACITORS IN CONTROL CIRCUITS [taking Advantage of Recent Improvements in Electrolytic Condensers].—F. H. Winter. (*Gen. Elec. Review*, Nov. 1939, Vol. 42, No. 11, pp. 462–465.)

523. TRANSIENT AMPLIFIER ANALYSIS [Shape & Magnitude of Amplified Pulse determined by Simple Operational Methods].—E. A. Walker. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 39–40.)

524. NOTE ON THE EFFECT OF THE SCREEN BY-PASS CAPACITY ON THE RESPONSE OF A SINGLE STAGE [Formula for Loss of Amplification due to Insufficient By-Passing: Experimental Confirmation].—W. G. Baker & D. H. Connolly. (*A.W.A. Tech. Review*, No. 2, Vol. 4, 1939, pp. 85–92.)

525. COMPENSATED AMPLIFIER CHART [for Gain & Phase Shift of One Stage of Compensated Resistance-Coupled Amplifier].—Y. J. Liu & J. D. Trimmer. (*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 34 and 35.)

526. POWER AND ATTENUATION IN TERMINATING RESISTANCES [Analysis for Two-Pole & Four-Pole Networks, giving Resistance Values for Maximum Power].—M. Skalicky. (*E.T.Z.*, 19th Oct. 1939, Vol. 60, No. 42, pp. 1203–1206.)

Among other results, "the maximum power in the terminating resistance of a quadripole . . . does not occur when the terminating resistance is vectorially equal to the characteristic impedance, but rather when the absolute values of these resistances are equal and when the terminating resistance possesses the greatest possible phase rotation ($2r$) with respect to the characteristic impedance."

527. A NETWORK-SELECTING CHART [for Design of Equalising & Balancing Networks].—P. J. Selgin. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 30–32.)

528. DISTORTION IN VALVES WITH RESISTIVE LOADS: GRAPHICAL METHODS FOR ITS DETERMINATION.—Bloch. (*See* 608.)

529. VALVE-OPERATED SMOOTHING CIRCUIT: BALANCING-OUT HUM.—(*See* 646.)

530. BEHAVIOUR OF HALF-WAVE RECTIFIERS [with Several Types of Load: Wave-Form Curves and Discussion based on Fourier Analysis].—M. B. Stout. (*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 32–34.) Application of the method (for full-wave rectifiers) dealt with in 4067 of 1935.

531. ON THE THEORY OF SYNCHRONISATION.—N. N. Bautin. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 510–513.)

In investigating, by the van der Pol method, the effect of an external force on an auto-oscillating non-linear system, various authors have obtained particular solutions of the system:

$$dx/dt = dx + by - x(x^2 + y^2)\ ;$$
$$dy/dt = cx + dy - y(x^2 + y^2) \quad .. \quad (A)$$

In the present paper a complete qualitative analysis of system (A) is given in a simple form. It is shown that there are not more than 5 points on the phase plane corresponding to the states of equilibrium of the system. The behaviour of the trajectories of the system is then investigated by examining the reflection of the phase plane on the Poincaré sphere. A simple and convenient method is also proposed for representing the relative positions of the regions of the system parameters (Fig. 6) corresponding to different cases of trajectories distribution on the Poincaré sphere (Figs. 1–5).

532. THE EQUIVALENT IMPEDANCE OF A NON-LINEAR ELEMENT IN A LINEAR SYSTEM.—B. K. Shembel. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 514–524.)

In designing a linear system containing a non-linear element, such as an electron or ion valve, it is usual to replace the element by an equivalent ohmic resistance. This may lead to serious errors, and in the present paper methods are accordingly indicated for determining the equivalent complex resistances of non-linear elements where (a) one element only is connected in the circuit (Fig. 1), and (b) the linear system contains a number of non-linear elements. The formulae derived are very convenient for practical purposes since they do not require any information additional to that normally used in engineering practice. The discussion is illustrated by a number of examples.

533. The Equation $d^2 \log y/dx^2 = 1 - y$ when $y > 0$ [defines a Manifold of Periodic Functions: Connection with Relaxation Oscillations of Neon Lamp: Wave-Form of Parameters: Numerical Solution].—J. Carson & L. F. Richardson. (*Proc. Roy. Soc.*, Series A, 10th Nov. 1939, Vol. 173, No. 952, p. S 111: abstract only.)

534. Cloud-Chamber Control Circuit [using Neon-Filled Cold-Cathode Thyratrons and performing Reproducible Cycles with Great Precision and Extreme Ease of Adjustment of Time Intervals between Successive Steps of Cycle].—I. A. Getting. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 323–324.)

535. The Design Calculation of a Surge Circuit for a Surge Voltage of Given Wave-Form.—W. Marguerre. (*E.T.Z.*, 13th July 1939, Vol. 60, No. 28, pp. 837–839.)

TRANSMISSION

536. Convex Endovibrators [and Their Advantages over Ordinary Oscillating Systems for Very Short Waves].—Neiman. (*See* 455.)

537. Wave Energy and Transconductance of Velocity-Modulated Electron Beams [Energy in a Space-Charge Wave: Calculation of Amplitude of Generated Waves: Effect of Finite Gap Length: Transconductance of Two Gaps].—W. C. Hahn. (*Gen. Elec. Review*, Nov. 1939, Vol. 42, No. 11, pp. 497–502.) Further development of the work dealt with in 3521 of 1939: some errata in that paper are corrected.

538. Corrections to "Small-Signal Theory of Velocity-Modulated Electron Beams."—W. C. Hahn. (*See* 537, above.)

539. Measurement and Calculation of the Oscillation Amplitude of a Retarding-Field Generator.—W. Schwarz. (*Hochf: tech. u. Elek:akus.*, July 1939, Vol. 54, No. 1, pp. 11–19.)

The experimental part of this paper describes the measurement, by a method given by Krause (2351 of 1935), of the attenuation (§ A.I.1) of the external emitting system connected to a retarding-field generator, and the measurement of the oscillating current (§ A.I.2) by a substitution method. From these the power and the efficiency of the emitter are determined (§ A.I.3). The natural frequencies of the external emitting system and some valve constants (grid/anode capacity, anode-current/anode-voltage, steepness, and grid transparency, etc.) are determined in § A.II. In § A.III the experimental data are used to determine the "excitation factor" (*see* Möller, 1931 Abstracts, p. 95, & back ref.) for the retarding-field oscillations, from which the amplitude can be obtained.

The theoretical part (§ B) extends Möller's theory of the Barkhausen oscillations to the oscillatory regions of the retarding-field generator where the wavelength of the oscillations depends on the tuning of the external Lecher-wire system (*A*-regions) and calculates the "excitation factor" from this extended theory. Satisfactory agreement with the experimental results is obtained.

540. On the Theory of Retarding Back-Coupling [including Application to Micro-Wave Oscillators].—G. Gorelik. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 450–454.)

A method is proposed for a mathematical analysis of an auto-oscillating system in which forces developed at a moment t are determined by the state of the system at a preceding moment $t - \tau$. The method is similar to that of "abbreviated equations" developed by van der Pol and Mandelstam & Papalexi, and is confined to systems with nearly sinusoidal oscillation. A solution of the general equation of the system (1) is found and, as an example, the operation of a valve circuit (Fig. 1) in which the anode current at the moment t is determined by the grid voltage at the moment $t - \tau$, is discussed (the exact nature of the retarding mechanism is not considered). For this particular case, conditions for self-excitation are established and equations are derived for determining the amplitude and frequency of the self-oscillations. The theoretical results arrived at are in agreement with observed phenomena in the operation of decimetric oscillators.

541. Investigation of the Internal Behaviour of Magnetrons by Measurement with External Excitation.—M. Jänke. (*Hochf: tech. u. Elek:akus.*, Sept. 1939, Vol. 54, No. 3, pp. 73–80.)

The paper aims at "measurement of the internal behaviour of the magnetron *alone* under externally impressed, arbitrarily controlled oscillating conditions. The results will make it possible to predict the self-excitation phenomena to be expected with known properties of the external circuit from simple equilibrium conditions." The ideas follow the lines of those referred to in 2122 of 1936 (Lotze) and 2769 (*see* also 3898) of 1938 (Gundlach). The measuring apparatus (§ II) is sketched in Fig. 1; a compensated tuned-diode voltmeter was used to observe the oscillating condition imposed on the magnetron by the generator (wavelengths 2.28, 1.52 and 0.84 m). The dynamic input resistance (or conductance) between the anode segments or segment-pairs of the magnetron was measured by a substitution method.

A theoretical review of the phenomena in the magnetron is given in § III, for plane electrodes and with other simplifications. The possible modes of excitation production are described: Fig. 6 sketches the scheme of loci of the conductance, Fig. 8a shows the measured values. The experimental results lead to the circuit of Fig. 10 as an equivalent to the mechanism of the conducting circuit in the valve. Fig. 11 shows conductance loci in the region of "mixed" oscillations. The observations are found to agree well with the theory. § V describes the conclusions to be drawn from the experimental results as regards the working of self-excitation. Fig. 16 illustrates the derivation of the quantities determining the self-excitation working from the set of loci of the magnetron conductance. The fundamental principle is found to be that, "for stationary oscillation, the frequency and amplitude must be such that the sum of the negative dynamic magnetron conductance and the positive conductance of the external circuit must be zero both in amplitude and in phase."

542. On the Calculation of the Static Characteristic of a Split-Anode Magnetron.—Yu. A. Katzman & T. F. Rubina. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 499–509.)

A formula (12) is derived for determining the radius of curvature of an electron trajectory when the electric field between the two magnetron segments is known. This field is determined experimentally from a hundred-times enlarged magnetron model and an electrolytic bath. Having obtained a sufficient number of trajectories for various voltages applied to the magnetron segments, the electron current flowing from the cathode can be calculated and the static characteristic plotted. It is suggested that 8 trajectories (Fig. 1) for each value of the anode voltage are sufficient, and this is confirmed by a close agreement between the experimental and theoretical characteristic curves (Fig. 15). A number of diagrams of the electric field in the magnetron and of electron trajectories are shown. It is claimed that the method is much simpler than those proposed hitherto.

543. Variation of Space Current in a Magnetron under the Action of the Magnetic Field [Theory giving Form of Current for Values of Field from Zero to the Critical Value producing Zero Current].—J. Bethenod. (*Comptes Rendus*, 4th Dec. 1939, Vol. 209, No. 23, pp. 832–834.)

544. Ultradynamic Lissajous' Figures [including the Analysis of Magnetron Oscillations].—H. E. Hollmann. (*Hochf:tech. u. Elek:akus.*, July 1939, Vol. 54, No. 1, pp. 19–30.)

"Ultradynamic Lissajous' figures are formed when the two pairs of deflecting plates of a cathode-ray tube are connected in parallel, and equal h.f. voltages are impressed upon them of frequency so high that noticeable transit-time phenomena of the second kind, *i.e.* phase displacements between the deflections, occur in both co-ordinates. If one pair of plates of a tube with external control is made rotatable with respect to the other, the elliptical Lissajous' figure given by sinusoidal plate voltage (§ I) may be transformed into a circle, in which case the angle between the two co-ordinates is the supplement of the transit-time angle (Fig. 3)." The theory of the figures obtained by superposition of odd and even harmonics or of frequencies in a rational relation to one another is developed (§ II; Figs. 4–10). § III gives a graphical method for determining the plate voltage as a function of time from an ultradynamic Lissajous' figure (Figs. 11, 12). In § IV examples are given of Lissajous' figures obtained experimentally with a magnetron emitter, which help in the analysis of the oscillations produced by the magnetron; double-wave figures are shown, due to self-modulation (Fig. 13) and superposition of two oscillations (Fig. 14). Examples are shown of figures for the second and third harmonics and for various rational frequency ratios (Figs. 15–19). Distortion of the figures and improvement of the resolving power by rotating one of the two co-ordinates are also illustrated (Figs. 20–21).

545. Frequency or Phase Modulation ?—D. I. Lawson & D. Weighton: G.W.O.H. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, p. 597.) Discussion of G.W.O.H.'s note, 77 of January.

546. Frequency-Modulated Transmitters [for 25 Broadcasting Stations: Various Designs ("Armstrong" & "Crosby" Circuits, etc.)].—(*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 20–24.)

547. High Frequency Pre-Emphasis [adopted (after NBC Tests) for Sound Channel in Television: Reduction of Noise & Distortion by Emphasis on High Audio Frequencies at Transmitter and Corresponding Attenuation at Receiver].—J. L. Hathaway. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 29–32.) "The system also appears to have some advantage in the standard broadcast band and may even be useful in video transmission."

548. Effect of Microphone Polarity on Percentage Modulation [Asymmetry of Speech Waves of Male Announcers makes 150% Modulation practicable by Proper Use of Polarity: the Use of the "Transverter": etc.].—J. L. Hathaway. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 28–29 and 51.)

549. Television Detail and Selective Sideband Transmission, *and* Asymmetric-Sideband Broadcasting [and Its Great Advantages over Single-Sideband Transmission].—Goldman: Koomans. (*See* 856 & 857.)

550. Steep-Slope Suppressor-Grid Modulation: a New Modulating System utilising the Negative Transconductance of the Pentode [Effective with Any Type of Pentode, but Particularly Sensitive with Specially Modified Type].—T. Hayasi & A. Isahara. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, p. 263.)

551. More on Cathode Modulation: a 'Phone/C.W. Transmitter with Volume Compression and Adjustable Audio Response.—F. Edmonds. (*QST*, Dec. 1939, Vol. 23, No. 12, pp. 52–54 and 57.) Further development of the work referred to in 79 of January. *See* also *ibid.*, p. 55, where Geiger & McGrath refer to previous work of their own.

552. Quick Building-Up of the Electron-Coupled Quartz Oscillator [Even the Ordinary Pierce Circuit gives Very Quick Building-Up at High (Not at Low) Keying Speeds: Explanation by Mechanical Damping: Special Electron-Coupled Circuit giving Very Steep Wave Front].—T. Hayasi & S. Akasi. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, pp. 219–222.) The oscillator starts within 1 msec. at 883 kc/s.

553. Piezo-Oscillators with Neutralisation of the Quartz [with Special Advantages at Very High Frequencies].—Boella. (*See* 731.)

554. Frequency Stability [Analysis of Change of Frequency caused by Alteration of External Circuits (*e.g.* Frequency Stabilisation by Auxiliary Triode): Influence of Phase Displacement: Change of Frequency caused by Alteration of Voltage (producing first a Change in Amplitude, causing a Change of C_{fg} and thus a Frequency Change): etc.: with Experimental Confirmation].—K. Posthumus & Tj. Douma. (*Philips Transmitting News*, Sept. 1939, Vol. 6, No. 2, pp. 31–35.) For previous work *see* 2109 of 1937.

555. On the Frequency Stability of Oscillators with Negative Differential Transconductance.—Faulstich. (*See* 734.)

556. Radio-Frequency Spark-Over in Air [with Application to Transmitter Design: Comparison with Curves for 60 c/s: Desirability of using Ultra-Violet Irradiation during Tests].—P. A. Ekstrand. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, p. 411: summary only.)

557. Pentodes on Short Wavelengths [Pentodes preferable to Triodes for 15–50 m Wavelengths].—Albricht. (*See* 602.)

558. Anti-Harmonic Filters: Their Uses in reducing Radiation.—A. G. Chambers & W. Bacon. (*Wireless World*, 28th Sept. 1939, Vol. 45, pp. 295–296.)

559. Short-Wave Telegraphy Transmitter Type KVC 1.5/14 [for Coastal Stations, Airports, or Long-Distance Stations].—(*Philips Transmitting News*, Sept. 1939, Vol. 6, No. 2, pp. 36–38.)

560. A Special-Events Transmitter [for Outside Broadcasts: 15-Watt Storage-Battery-Operated Equipment for Short Waves (1.6–2.8 Mc/s) with Additional U.S.W. Plug-In Unit].—D. F. Langham. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 19–21 and 59.)

561. The "Portable Five": a Midget Transmitter with 5 Watts Output [Crystal-Controlled: Weight under 2 lb: for 80, 40, & 20 Metres].—F. Sutter. (*QST*, Dec. 1939, Vol. 23, No. 12, pp. 32–33 and 84, 86.)

562. Five Bands without Changing Coils [Any Frequency between 1.75 and 30 Mc/s by setting Tuning Dial].—T. M. Ferrill, Jr. (*QST*, Dec. 1939, Vol. 23, No. 12, pp. 43–45 and 86.) Using the ganged condensers and coils dealt with in 86 of January.

563. The Generation of Square-Wave Voltage at High Frequencies [*e.g.* 200 kc/s: Methods utilising (1) Overloaded Direct-Coupled Amplifier and (2) Special Pulse Generator followed by Valve Trigger Circuit].—W. H. Fenn. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 850: abstract only.)

564. On the Generation of Rectangular Impulses [without Use of Any Mechanical Parts: Retardation-Network Circuit with Two Grid-Controlled Discharge Tubes, giving Two D.C. Voltages Equal in Magnitude and Opposite in Direction for Periods whose Difference is the Required Duration of Rectangular Impulse.]—Y. Miyoshi. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, pp. 225–229.)

The wave voltage may be several hundred volts; the period may be controlled in the wide range from a few microseconds to several seconds.

RECEPTION

565. On Certain Combined Resonance Phenomena in Super-Regenerators.—N. V. Osipov. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 525–527.)

A preliminary communication in which it is reported that while experimenting with a super-regenerative receiver (Fig. 1) designed for the reception of metric waves, good reception was obtained of distant short-wave stations operating on much longer waves (of the order of several tens of metres), although no aerials or amplifiers were used. Further experiments showed that reception was taking place at frequencies equal to the sum and difference of the frequencies of the signal and the superheterodyne oscillator. The effects of varying the distance between the super-regenerator and the oscillator, and their power outputs, were also investigated.

566. The Behaviour of a Diode Detector to a Signal Modulated in Amplitude and Phase.—Cocci. (*See* 517.)

567. A Note on the Reception of Telegraphic Signals [" Superiority " of C.W. Telegraphy over Tone Telegraphy is Not Inherent: Practical Considerations governing Choice between the Two Systems: " Internal Noise Level " (becoming Increasingly Common) is a Superfluous and Misleading Specification].—G. Builder. (*A.W.A. Tech. Review*, No. 2, Vol. 4, 1939, pp. 69–83.)

568. Increasing the Selectivity of the Modern Receiver by High-Frequency Negative Feedback [Method suitable for Single-Circuit Receiver].—K. Nowak. (*Funktech. Monatshefte*, Oct. 1939, No. 10, pp. 287–288.)

The recent plan of connecting two mutually detuned circuits in the cathode lead to give, with negative feedback, a steep-sided curve and increased selectivity, involves the use of two circuits both of which, unless they are in the i.f. part of a superheterodyne, have to be varied with the tuning of the receiver. The writer describes a one-circuit arrangement by which a high-quality single-circuit receiver can be obtained: it is based on a combination of positive feedback and a " reciprocal " negative feedback. In Fig. 2, curve 1 represents the characteristic of circuit *S* without any feedback (Fig. 3). Curve 2 shows the action of a negative feedback dependent on frequency (Fig. 1): there is nothing very special about this curve, it could equally well be obtained by a weaker excitation of S (curve 3) combined with positive feedback. Curve 4 is curve 1 improved by positive feedback (Fig. 4), and curve 5, with the same summit but more sharply sloping flanks, gives the result of combined positive and "reciprocally" frequency-dependent negative feedbacks (Fig. 5).

569. ELECTRICAL BAND-WIDTH CONTROL BY ALTERATION OF THE AMPLIFICATION OF VARIABLE-MU VALVES.—H. Boucke. (*Funktech. Monatshefte*, Oct. 1939, No. 10, pp. 281–287.)

(1) Selectivity control by alteration of back-coupling (variable-mu valve in the i.f. amplifier): simplest, but has defects: new improved circuits based on current-division control. (2) Selectivity control by variation of the internal resistance of the variable-mu valve. (3) Selectivity control with the help of two or more parallel reception channels, formerly two amplifiers in parallel, more recently one single hexode variable-mu valve (working on the current-division control principle) combined with suitable filter circuits (Figs. 9/11, designed specially as a device for the suppression of needle-scratch in gramophone reproduction, the filtering action becoming automatically weaker as the volume increases): simpler variations: combination of (3) with method (2): etc.

570. ARE EXPANDERS NECESSARY ?—V. A. Govyadinov. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 32–34.)

The question of whether it is advantageous to use expanders in broadcast receivers is discussed and the following conclusions reached: (1) with manual volume control at the transmitting station, the sound-intensity range of receivers is widened but programme distortion is introduced; (2) either the output must be decreased or an audio-amplifier system with a large power-handling capacity must be provided; and (3) the advantage is gained of reduced noise level during the silent periods of transmission.

571. DEAF-AID ADAPTOR FOR USE WITH A STANDARD BROADCAST SET.—R. H. Wallace. (*Wireless World*, 28th Sept. 1939, Vol. 45, No. 13, pp. 288–291.) *See* also *ibid.*, Nov. 1939, Vol. 46, No. 1, p. 27.

572. SWITCHING-ON THE NEWS: AUTOMATIC TIME SWITCHES FOR CONTROLLING MAINS AND BATTERY SETS.—(*Wireless World*, 28th Sept. 1939, Vol. 45, pp. 293–294.)

573. BRITISH RADIO EXPORTS: REMARKABLE OVERSEAS DEMAND STIMULATED BY STRINGENT TESTING DURING PRODUCTION [G.E.C. Technique].—(*Electrician*, 1st Dec. 1939, Vol. 123, p. 488.)

574. SPECIAL POINTS IN THE RECEIVER CIRCUITS OF THE 1939/40 SEASON [Six *versus* Seven Circuits: Detection: Philips "Loss-Free" Negative Feedback: etc.].—F. C. Saic. (*Funktech. Monatshefte*, Oct. 1939, No. 10, pp. 273–281.)

575. PYE "INTERNATIONAL" MODEL 906 [including Band-Spread Tuning on Six Short-Wave Ranges].—(*Wireless World*, Nov. 1939, Vol. 46, No. 1, pp. 16–19.)

576. PILOT "TWIN MIRACLE" PORTABLE [for Dry Battery, A.C. or D.C. Mains].—(*Wireless World*, Nov. 1939, Vol. 46, No. 1, pp. 30–32.)

577. [Proposed] STANDARDS FOR PLUG-AND-SOCKET DEVICES FOR BROADCAST RECEIVER INSTALLATIONS.—VDE Committee. (*E.T.Z.*, 19th Oct. 1939, Vol. 60, No. 42, p. 1208.)

AERIALS AND AERIAL SYSTEMS

578. ON THE DESIGN OF A "WAVE CANAL" WITH ACTIVE RADIATORS.—A. Z. Fradin. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 12–20.)

In order to obviate the difficulties in designing a Uda-Yagi type aerial ("wave canal," with "wave directors" and "wave reflectors": Yagi, 1928 Abstracts, p. 519, and Uda, 1930 Abstracts, pp. 392–393: also p. 215) all radiators in the aerial may be made active, and various authors have proposed approximate methods for designing such an aerial. In the present paper a more exact method, limited only by the accuracy of the tables giving the values of induced impedances, is described. It is shown that a "wave canal" can in general be resolved into "simple directional elements" of four different types. The phases of the electromagnetic fields due to these elements are compared, and the effect of simultaneous working of several elements on their directional properties is investigated. Conditions are established for the maximum directivity of the aerial, and a numerical example is given. The operation of an aerial with a flat mirror is also discussed, and methods are suggested for feeding such a system.

579. AN EXPERIMENTAL STUDY OF [Parasitic] PARABOLIC WIRE-REFLECTORS ON A WAVELENGTH OF ABOUT 3 METRES.—A. K. Dutta, M. K. Chakravarty, & S. R. Khastgir. (*Indian Journ. of Phys.*, Part 3, Vol. 13, 1939, pp. 167–184.)

The array, of focal length $\lambda/4$ and with wires $\lambda/2$ long, was excited by an earthed $\lambda/4$ aerial at the focus. The study yielded information about the dependence of forward & back radiation, total directivity, etc., on the number, spacing, and aperture of the reflectors. The experimental results are compared with the theoretical results derived from Ollendorff's formula, quoted by Nagy (1775 of 1936). "It should be remembered that for Ollendorff's formula to hold, the arrays should produce effects similar to those of metallic sheets. According to Blake & Fountain [*Phys. Review*, 1906] the spacing must then be $\lambda/30$ or $\lambda/40$. Complete agreement with theory is not, therefore, expected, since the spacing . . . in the experiments is about $\lambda/4$."

580. SIMPLE TELEVISION AERIALS [for Receiving, Half-Wave Dipole of Large-Diameter Conductors and Balanced Transmission Line, or (Better for Weaker Signals) "Folded" Dipole: for Transmission (Horizontal Polarisation), Pair of "Folded" Dipoles in Turnstile Array, fed in Quarter-Phase Relation: Electrical Advantages of Double-Cone ("Hour-Glass") Aerial, but Mechanical Disadvantages].—P. S. Carter. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 168–185.)

581. THE APPLICATION OF LOW-FREQUENCY CIRCUIT ANALYSIS TO THE PROBLEM OF DISTRIBUTED COUPLING IN ULTRA-HIGH FREQUENCY CIRCUITS.—King. (*See* 515.)

582. ACOUSTIC MODELS OF RADIO ANTENNAS [Measurement Difficulties in Usual R.F. Model Researches avoided by Decreasing the Propagation Velocity instead of Increasing the Frequency: New Fields opened in Design of Directional Arrays].—E. C. Jordan & W. L. Everitt. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, pp. 412–413: summary only.)

583. A DIRECT-READING FIELD-INTENSITY METER FOR MEASUREMENTS OF RADIATION FROM BROADCAST ANTENNAS [Importance of Comparison of Radiation Efficiencies, Measured and Calculated, as Indication of Merits or Defects of Aerial/Earth System: Desirability of Field-Strength Measurements with Errors less than 5%: a Light-Weight Equipment].—W. N. Christiansen. (*A.W.A. Tech. Review*, No. 2, Vol. 4, 1939, pp. 51–67.)

584. ON THE TUNING OF TOWER AERIALS [Stacked-Dipole Aerials of the Moscow Short-Wave Station].—I. M. Ruschuk. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 20–31.)

The Moscow 120 kw short-wave broadcaster is divided into two 60 kw sections: *see* 3791 of 1939. Each aerial handles the output of one 60 kw section only, and consists of a radiating curtain using either two or four $\lambda/4 + \lambda/4$ horizontal dipoles stacked $\lambda/2$ apart with the lowest $\lambda/2$ above the ground, and a similar reflecting curtain spaced 0.2λ behind the radiators, the two being supported on the opposite sides of a steel tower. The radiating dipoles are centre-fed from 200 ohm balanced lines fed in turn from a 100 ohm main feeder line, the feeder system branching off to maintain the total length of feeder the same for all dipoles (Fig. 1). The reflectors are not fed but are tuned by adjustable loops at the centre.

The tests described cover the adjustment of (a) the reflectors, (b) a condenser joining the $\lambda/4$ sections of each dipole, and (c) the main feeder. They also cover checking the symmetry of the aerial and the plotting of the polar diagram. A description is also given of the method for checking the correct phasing of the aerial systems fed independently from two 60 kw transmitting channels.

585. RADIATION COUPLING OF STRAIGHT LINEAR SKEW CONDUCTORS FOR PROGRESSIVE WAVES [Calculations].—W. Jachnow. (*E.N.T.*, July 1939, Vol. 16, No. 7, pp. 177–183.)

The general formula for the radiation coupling is first derived; the radiation coupling coefficient, which governs the radiation from the second conductor under the influence of the first, is defined by eqn. 3 and may be calculated from eqn. 18, which still contains an integral which must be evaluated numerically or graphically. This general formula is applied to the special cases of parallel radiators (eqn. 21: *see* also 3948 of 1939), a *V*-aerial (eqn. 23), and a rhombus aerial, for which the radiation resistance is calculated (eqn. 49).

586. SIMPLIFIED SHUNT FEEDING.—F. Bauer. (*Communications*, Sept. 1939, Vol. 19, No. 9, pp. 8–9 and 21.)

587. DIRECTIONAL RECEPTION: A "STEERABLE" SHORT-WAVE AERIAL.—C. R. Leutz. (*Wireless World*, Nov. 1939, Vol. 46, No. 1, pp. 25–26.)

588. A CENTRAL ANTENNA SYSTEM [for Block of Flats, etc: especially the Philips Antennaphil System].—D. J. Fruin. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 37–38.)

589. CORONA AND IONISATION DETECTION.—H. A. Brown & B. H. Weston. (*Communications*, Sept. 1939, Vol. 19, No. 9, pp. 5–7 and 30 . . 38.) A summary was dealt with in 121 of January.

VALVES AND THERMIONICS

590. WAVE ENERGY AND TRANSCONDUCTANCE OF VELOCITY-MODULATED ELECTRON BEAMS *and* CORRECTIONS TO "SMALL-SIGNAL THEORY OF VELOCITY-MODULATED ELECTRON BEAMS."—Hahn. (*See* 537 & 538.)

591. THE ANODE-TANK-CIRCUIT MAGNETRON [avoiding Limitation of Small Electrodes and greatly reducing Limitation due to Heat Dissipation: Anode in form of Tantalum Cylinder split along almost Its Complete Length, acting as Quarter-Wave Oscillator: Transmission Line connected to Open Ends: 20 Watts Output at 8 cm (Efficiency 22%)].—E. G. Linder. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 732–738.)

592. PAPERS ON MAGNETRON VALVES.—Jänke: Katzman & Rubina. (*See* 541 & 542.)

593. VARIATION OF SPACE CURRENT IN A MAGNETRON UNDER THE ACTION OF THE MAGNETIC FIELD.—Bethenod. (*See* 543.)

594. EXTREMELY BRIGHT SPOTS ON COOLIDGE TUBE TARGET [due to Electron Bombardment of Minute Protrusions].—I. Koga & M. Tatibana. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, p. 238.) *See* also 140 of January.

595. ELECTRON TRANSIT TIME: EFFECTS IN CATHODE-RAY TUBES AND DIODES [Analysis of Deflecting Condenser, with Curves: of the Temperature-Limited Diode, with Curves: Energetics of the Deflecting Condenser].—W. E. Benham. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, pp. 598–602.)

596. THE MEAN FREE PATH IN GASES CONTAINED IN A VESSEL [Relation between Mean Free Paths of Electrons (or Ions) in Gases, for Parallel-Plate, Coaxial-Cylinder, & Concentric-Sphere Configurations].—M. Saito. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 257–259.)

597. ON THE CURRENTS *in Vacuo* BETWEEN CO-AXIAL CYLINDERS [of Interest in Theory of Multi-Electrode Valves, where Space between Grid (with Sufficiently Great Positive Potential) and Next Grid, or Anode, is considered].—S. V. Bellustin. (*Journ. of Phys.* [of USSR], No. 3, Vol. 1, 1939, pp. 251–262: in English.)

Analysis of steady electron motion for arbitrary electric forces at electrodes and arbitrary initial velocity directed radially and common to all electrons (virtual emitter and reflector absent: case of a virtual emitter: case of reflector): potential distributions and current/voltage characteristics: etc.

598. CURRENT DIVISION IN PLANE-ELECTRODE TRIODES [Law of Primary-Current Division between Positive Grid and Plate deduced from Electron Paths: etc.].—K. Spangenberg. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, pp. 415–416: summary only.)

599. INPUT CONDUCTANCE NEUTRALISATION [at Ultra-High Frequencies, by Inclusion of Small Inductance in Series with Cathode: Improved Circuit-Design Flexibility and Q Value].—R. L. Freeman. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 22–23.)

600. THE BEHAVIOUR OF A DIODE DETECTOR TO A SIGNAL MODULATED IN AMPLITUDE AND PHASE.—Cocci. (*See* 517.)

601. MEASUREMENTS BY MEANS OF THE ELECTROMETER TRIODE [Philips Type 4060, with Filament between Plate-Formed Control Electrode & Anode: about 4 Volts on Anode: Methods of Application].—J. A. N. Thaes. (*Indian Journ. of Phys.*, Part 3, Vol. 13, 1939, pp. 199–204.)

602. PENTODES ON SHORT WAVELENGTHS [Pentodes preferable to Triodes for 15–50 m Wavelengths: Special Design of a Power Stage (17 m and 27 m) using Type PA 12/15 Water-Cooled Pentodes].—W. Albricht. (*Philips Transmitting News*, Sept. 1939, Vol. 6, No. 2, pp. 39–43.) Extending Posthumus's work (on ultra-short wavelengths: 3321 of 1937) to the short-wave range.

603. TUBE LIFE: 75 000 HOURS [New Type 102 F Triode Repeater Valve].—Western Electric. (*Electronics*, Nov. 1939, Vol. 12, No. 11, p. 26.)

604. MINIATURE BATTERY TUBES [1.4-Volt Filament, 45-Volt Anode Supply: Over-All Length below 2½ Inches: Types 1R5, 1T4, etc.].—RCA. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 27–28.)

605. MODERN VALVES FOR RADIO RECEIVERS.—E. A. Levitin. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 35–46.)

The operation and constructional features of the following types of valves, of foreign manufacture, are discussed: metal valves, single-ended metal valves, h.f. amplifiers, frequency changers, u.s.w. amplifiers, all-glass valves, and valves utilising secondary electron emission.

606. CATHODE-RAY TUBES FREE FROM "WHEATCROFT EFFECT."—Macfadyen: Cossor Company. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, p. 380.) For mention of such tubes *see* 153 of January.

607. DIRECT-VIEWING METHOD FOR POSITIVE-GRID CHARACTERISTICS [without Damage to Valve: 3-Thyratron Saw-Tooth Generator Circuit giving Complete Curve on C-R Screen].—T. Sawada & A. Kameyama. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, p. 239.)

608. DISTORTION IN VALVES WITH RESISTIVE LOADS: GRAPHICAL METHODS FOR ITS DETERMINATION [based on a Re-Writing of the Usual Formulae for a "5-Point Analysis"].—A. Bloch. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, pp. 592–596.)

609. CERTAIN PROPERTIES OF EFFECTIVE [Secondary-Electron] EMITTERS.—N. S. Khlebnikov. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 367–375.)

Extending previous work (1070 of 1939) in which the mechanism of secondary-electron emission from effective emitters (*i.e.* from emitters with σ greatly in excess of unity) was discussed, experiments were undertaken to determine the effect of temperature changes of the emitting layer on the value of σ. Sb-Cs layers were used with temperatures varying between 25° C and 150° C approximately. The experiments are described and curves plotted. The results obtained are discussed and the main conclusions reached are: (1) the secondary emission from a Sb-Cs layer depends to a great extent on the temperature of the layer and the density of the primary electron beam; (2) these properties are due to the semiconducting nature of the layer and are typical of effective emitters generally; and (3) it is advantageous to use thin layers.

610. PRODUCTION OF SECONDARY ELECTRONS BY HIGH-ENERGY ELECTRONS [Measurements on Traversal of Lead Foil].—W. A. Fowler & C. W. Sheppard. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 859–860: abstract only.)

611. MECHANISM OF SECONDARY ELECTRON EMISSION [Penetration Power of Secondary Electrons Smaller for Unordered Metallic Films than for Ordered Ones: Emitting Centres probably formed by Disturbances in Metallic Lattice].—R. Suhrmann & W. Kundt. (*Naturwiss.*, 20th Oct. 1939, Vol. 27, No. 42, p. 707.)

612. ON THE INVESTIGATION OF THE ELECTROCONDUCTIVITY OF SEMICONDUCTORS AT HIGH TEMPERATURES [with Bearing on Oxide-Coated Cathodes].—A. R. Schulman. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 389–398.)

The paper published by Fairbrother (134 of 1937) is criticised, and a detailed report is presented on an experimental investigation to determine the accuracy and limitations of the method proposed by him. It is claimed that the results obtained by Fairbrother at temperatures up to 1300° K are incorrect, since they are invalidated by an experimental error. It is also stated that the conclusion reached by Fairbrother regarding the diffusion of plasma electrons through the semiconductor has not been proved experimentally and is due to the faulty experimental technique. A new method is now being developed similar to that proposed by Fairbrother but free from above-mentioned defects.

613. A NEW METHOD FOR STUDYING THE ADSORPTION OF GASES AT VERY LOW PRESSURES AND THE PROPERTIES OF ADSORBED FILMS OF OXYGEN ON TUNGSTEN, *and* THE KINETICS OF THE FORMATION OF OXYGEN FILMS ON TUNGSTEN.—J. L. Morrison & J. K. Roberts. (*Proc. Roy. Soc.*, Series A, 10th Nov. 1939, Vol. 173, No. 952, pp. 1–13: pp. 13–27.)

614. THE FUSING OF INCANDESCENT TUNGSTEN FILAMENTS *in Vacuo* AND IN INERT GASES. —Z. S. Voznesenskaya & V. F. Soustin. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 399–405.)

The life of a tungsten filament working in an inactive medium is determined by (a) the speed of evaporation of the material and (b) the percentage loss in weight at which the filament fuses. In this paper a theoretical as well as experimental investigation of the second factor is presented. Equations are derived for determining the temperature of a defective section of the filament with a diameter smaller than the average (9), and the critical percentage loss in weight (16). This is followed by a report on experiments on the effect of the following factors on the critical percentage loss in weight: (a) surrounding medium (vacuum, 93% Kr + 7% Xe, 86% Ar + 14% N_2, and N_2), (b) filament diameter, (c) gas pressure, and (d) filament temperature. A summary of the conclusions reached is given.

615. A CRITICAL EXAMINATION OF THE BENEDICKS HOMOGENEOUS THERMOELECTRIC EFFECT [Postulated Connection with Positive Emission explains All Apparently Conflicting Evidence].—H. L. C. Ch'eng & W. Band. (*Proc. Camb. Phil. Soc.*, Nov. 1939, Vol. 35, Part 4, pp. 622–636.)

616. A THERMOELECTRIC METHOD FOR THE DETERMINATION OF WORK FUNCTIONS [from Temperature Effects for Thermionic Emission: Experimental Values for Average Net Energy Loss per Emitted Electron: Deduction of Work Function of Tungsten].—G. M. Fleming & J. E. Henderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 853: abstract only.) *Cf.* 624, below.

617. EVIDENCE OF A PERIODIC DEVIATION FROM THE SCHOTTKY LINE: I [Accurate Measurements of Thermionic Emission from Tungsten and Tantalum: Deviation Curves: Richardson Work Function a Periodic Function of $E^{\frac{1}{2}}$, showing Increasing Amplitude with Increasing Field]: II [More Detailed Study].—R. L. E. Seifert & T. E. Phipps: D. Turnbull & T. E. Phipps. (*Phys. Review*, 1st Oct. 1939, Series 2, Vol. 56, No. 7, pp. 652–663: 663–667.)

618. THE PERIODIC DEVIATION FROM THE SCHOTTKY LINE [Theory based on Partial Reflection of Thermions at Potential Hump between Parallel Plates].—H. M. Mott-Smith. (*Phys. Review*, 1st Oct. 1939, Series 2, Vol. 56, No. 7, pp. 668–669.)

619. ON THE THERMIONIC AND ADSORPTIVE PROPERTIES OF THE SURFACES OF A TUNGSTEN SINGLE CRYSTAL [Dependence of Emission on Crystallographic Direction: Observations on Crystal with Adsorbed Caesium and Barium].—S. T. Martin. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 947–959.)

620. EMISSIVE AND THERMIONIC CHARACTERISTICS OF URANIUM [Experimental Data].—W. L. Hole & R. W. Wright. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 785–787.)

621. EMISSION OF ELECTRONS FROM "COLD" METALLIC TARGETS UNDER HIGH-ENERGY POSITIVE-ION BOMBARDMENT.—J. B. Fisk. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 846: abstract only.)

622. THE VALIDITY OF THE FIELD-CURRENT EQUATIONS [Experimental Relation between Total Emission Current and Applied Voltage].—F. R. Abbott & J. E. Henderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 853: abstract only.)

623. THE FIELDS INVOLVED IN FIELD EMISSION.—J. E. Henderson & K. V. MacKenzie. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 857–858: abstract only.)

624. A NEW METHOD FOR THE MEASUREMENT OF WORK FUNCTIONS [depending on High-Energy Cut-Off in Normal Energy Distribution of Field-Current Electrons: Collector Potential at which Field Electrons begin to be measured gives Collector Work Function Directly].—W. H. Goss & J. E. Henderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 857: abstract only.) *Cf.* 616, above.

625. THE CONTACT DIFFERENCE OF POTENTIAL BETWEEN SILVER FILMS ON GLASS AND ON ROCKSALT [Study of Structural Dependence of Work Function of Silver].—P. A. Anderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 850: abstract only.)

626. A QUANTITATIVE STUDY OF THE CLEAN-UP OF HYDROGEN BY BARIUM.—G. W. Johnson, W. A. Hane, & P. A. Anderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 852: abstract only.)

627. MODERN VACUUM PRACTICE IN ELECTRONICS. —R. S. Morse. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 33–36.)

DIRECTIONAL WIRELESS

628. 40-CM WAVES FOR AVIATION [Experimental Demonstration at East Boston Airport: Klystron Oscillator & Horn Radiators for Blind Landing].—(*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 12–15.) For previous notes on this system *see*, for example, 1489, 2373, & 3595 of 1939.

629. AIRCRAFT INSTRUMENT LANDING RESEARCH AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—E. L. Bowles. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, p. 409: summary only.)

630. SUMMARY OF KNOWN SUGGESTIONS FOR DETERMINATION OF DISTANCE AND FOR REFLECTED-BEAM DIRECTION FINDING BY WIRELESS MEANS, AND THEIR CRITICAL CONSIDERATION [with Numerous Patent References].—K. Dziewior. (*Luftfahrt-Forschung*, 20th June 1939, Vol. 16, pp. 326–338.)

631. STUDY OF THE EFFECTS OF MOUNTAINS IN RADIOGONIOMETRY AND OF THE COMBINED USE OF RADIO BEACONS AND RADIO COMPASSES FOR AERIAL NAVIGATION.—A. Busignies. (*Proc. Inst. Rad. Eng.*, June 1939, Vol. 27, No. 6, p. 410: summary only.)

632. RADIO IN NAVIGATION [General Description of Direction-Finding, Variable Errors, Automatic Radio Bearing Indicators, Radio Beacons, Practical Applications: Bibliography].—C. D. Tuska. (*Journ. Franklin Inst.*, Oct. & Nov. 1939, Vol. 228, Nos. 4 & 5, pp. 433–443 & 581–603.)

633. DIRECTION-FINDING OF THE TRANSIENTS CAUSED BY ATMOSPHERIC DISTURBANCES.—Schindelhauer. (*See* 505.)

ACOUSTICS AND AUDIO-FREQUENCIES

634. INHOMOGENEITY OF THE MAGNETIC FIELD OF A DYNAMIC LOUDSPEAKER.—W. Reinhard. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 261–262.) Long summary of the paper dealt with in 2386 of 1939.

635. A HOME-MADE EXPONENTIAL HORN: INCREASING THE EFFICIENCY OF THE SMALL DYNAMIC SPEAKER.—E. E. Combs, Jr. (*QST*, Dec. 1939, Vol. 23, No. 12, pp. 20–23.)

636. AN ACOUSTIC TRANSMISSION LINE FOR IMPEDANCE MEASUREMENT [on Horns, Filters, etc: Rapid & Accurate Results].—W. M. Hall. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 140–146.)

637. ON THE RELATIONSHIP BETWEEN THE SHAPE OF A SOUND RADIATOR AND ITS TRANSIENT FUNCTION.—A. A. Kharkevich. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 491–494.)

Continuing a previous work (4142 of 1937), a theorem is derived enabling the transient function of a sound radiator of any configuration to be determined. Transient functions are then determined for a number of particular cases.

638. THE DIFFRACTION OF A DISRUPTED ELASTIC WAVE FROM A RECTILINEAR EDGE OR A CIRCULAR ORIFICE.—A. A. Kharkevich. (*Journ. of Tech. Phys.* [in Russian], No. 6, Vol. 9, 1939, pp. 495–498.)

A disrupted wave is defined as a wave whose front is characterised by a break in the pressure or velocity. In the present paper equations (2) and (4) are derived for determining the pressure at a given point *A* when the wave is diffracted from a rectilinear edge (Fig. 1) or a circular orifice (Fig. 3).

639. THE ASYMPTOTIC PROPERTIES OF THE CHARACTERISTIC FUNCTIONS AND PROPER VALUES OF VIBRATING PLATES [General Theory].—A. Pleijel. (*Comptes Rendus*, 13th Nov. 1939, Vol. 209, No. 20, pp. 717–718.) *See* also 3184 of 1939 (and 198 of January).

640. PIEZOELECTRICITY OF KH_2PO_4, *and* THE SPECIFIC-HEAT ANOMALY OF KH_2PO_4 AT THE UPPER CURIE POINT.—W. Lüdy: W. Bantle. (*Helvetica Phys. Acta*, Fasc. 4, Vol. 12, pp. 278–279: pp. 279–281.)

641. DIRECTIVE ACOUSTIC PICK-UPS ["Line" Microphones].—G.W.O.H: Olson. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, pp. 589–591.) Editorial on Olson's paper, 3600 of 1939.

642. MICROPHONE EFFICIENCY: A DISCUSSION AND PROPOSED DEFINITION.—F. Massa. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 222–224.)

643. EFFECT OF MICROPHONE POLARITY ON PERCENTAGE MODULATION.—Hathaway. (*See* 548.)

644. THEORETICAL OUTLINE AND CLASSIFICATION OF MICROPHONES [and the Conditions for Best Reproduction].—A. Gigli. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 537–559.)

645. A SOUND SOURCE FOR INVESTIGATING MICROPHONE DISTORTION [Standing-Wave Resonance System consisting of 8-Foot Iron Pipe with Loudspeaker at One End and Microphone supported from Movable Iron Piston].—W. D. Phelps. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 219–221.)

646. VALVE-OPERATED SMOOTHING CIRCUIT: BALANCING-OUT HUM [particularly for Microphone Amplifiers and Laboratory Equipment].—(*Wireless World*, Nov. 1939, Vol. 46, No. 1, pp. 28–29.)

647. LOAD-RATING THEORY FOR MULTI-CHANNEL AMPLIFIERS [Probability Theory applied to determine Max. Single-Frequency Output Power to avoid Inter-Channel Interference by Amplifier Overloading].—B. D. Holbrook & J. T. Dixon. (*Bell S. Tech. Journ.*, Oct. 1939, Vol. 18, No. 4, pp. 624–644.)

648. ELECTRO-MAGNETIC GRAMOPHONE PICK-UPS.—A. Pinciroli. (*Alta Frequenza*, Oct. 1939 Vol. 8, No. 10, pp. 637–657.)

Derivation of mechanical and electrical equivalent circuits of a moving-iron pick-up: theoretical treatment of the frequency characteristic and the various causes of distortion: experimental frequency characteristics and wave-forms for several types of commercial pick-up: division of types into 2 classes, the first using mechanical resonance to modify the frequency characteristic so as to obtain the desired results, the second using a suitable electrical circuit for the same purpose: objections to the first system, advantages of the second: future improvements will be based on situating the two chief mechanical-resonance frequencies outside the gamut of recording frequencies and correcting the characteristic purely by electrical means.

649. Gramophone Record Scratch: Minimising Surface Noise in Reproduction.—M. G. Scroggie. (*Wireless World*, Nov. 1939, Vol. 46, No. 1, pp. 3–7.)

650. Automatic Time and Weather Systems [Survey].—L. Winner. (*Communications*, Oct. 1939, Vol. 19, No. 10, pp. 7–9 and 14, 39.)

651. New Results in the Research on Violins [particularly a New Automatic Method for recording Their Resonance Curves in 30 Minutes, the Interpretation of Such Curves, and Some Conclusions].—H. Backhaus & G. Weymann. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 302–312.)

652. The Novachord [Hammond Electronic Piano].—F. D. Merrill, Jr: Hammond. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 16–19 and 92, 93.) For previous reference *see* 1950 of 1939.

653. Recent Investigations of Organ Pipes, *and* Resonant Frequencies of Certain Pipe Combinations.—A. T. Jones: J. D. Trimmer. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 122–128: pp. 129–133.)

654. The Synthephone [Apparatus for Synthesis of Musical & Other Sounds from Their Elemental Components].—C. A. Culver & D. T. Williams. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 319–321.)

Based on the electrostatic alternator dealt with in 1932 Abstracts, p. 598: *cf.* also Kurtz & Larsen, 1961 of 1939.

655. Remaking Speech [Description of the Vocoder, Automatic Electrical Device for analysing Speech and remaking It from Buzzer-like and Hiss Sounds with Changed Pitch and Spectrum].—H. Dudley. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 169–177.)

656. High-Precision Checking of the Standard Pitch Note [Frequency-Changing Equipment for obtaining the 440 c/s from 1000 c/s Frequency given by Quartz Oscillator: Multiplication by 11 (Gas-Filled Multivibrator) and Two Divisions by 5 (Vecchiacchi Disymmetrical Multivibrators)].—G. B. Madella. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 564–566.) For the Vecchiacchi multivibrator *see* Malatesta, 1635 of 1939.

656 *bis*. Continuous Broadcast of Standard of Musical Pitch Inaugurated [440 c/s Modulation Frequency on 5 Mc/s Carrier Frequency from Station WWV].—Nat. Bureau of Standards. (*Journ. Franklin Inst.*, Nov. 1939, Vol. 228, No. 5, pp. 655–656: short note only.)

657. Frequency Meter on the Compensation Principle.—Kaden. (*See* 736.)

658. A Stethoscope with Variable Sensitivity and Selectivity [by Provision of an Adjustable Leak].—H. J. Frossard. (*Comptes Rendus*, 13th Nov. 1939, Vol. 209, No. 20, pp. 728–730.) Based on the well-known fact that the low frequencies disappear as the intensity of sound is decreased.

659. Ear Defenders [Investigations on Ear-Plugging Devices on Market (for Swimmers and for Sound Deadening) and the Development of a New Device of Greater Efficiency].—V. O. Knudsen. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, p. 344: summary of paper in *National Safety News*.)

660. The Baneful Effects of Noise on Human Beings.—N. M. Basu. (*Sci. & Culture*, Calcutta, Sept. 1939, Vol. 5, No. 3, pp. 155–158.)

661. On the Perception of Vibration [Researches on the Propagation of Mechanical Vibrations through the Human Body: Perception of Pressure and Vibration involves Two Different Types of Nerve-Endings: Frequency Dependence of Vibration Threshold and Its Measurement: etc.].—G. von Békésy. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 316–334.)

662. Fluctuation of the Hearing Threshold.—S. Lifshitz. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 118–121.)

663. Deaf-Aid Adaptor for Use with a Standard Broadcast Set.—R. H. Wallace. (*Wireless World*, 28th Sept. 1939, Vol. 45, No. 13, pp. 288–291.) *See* also *ibid*., Nov. 1939, Vol. 46, No. 1, p. 27.

664. An Ear to the Future [Anniversary Address: the Amelioration of Impaired Hearing, the Conquest of Noise, and Modern Acoustics & Music].—V. O. Knudsen. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 29–36.)

665. Addresses at the Tenth Anniversary Meeting of the Acoustical Society of America.—(*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 5–36.)

666. Application of the Rayleigh Principle to the Calculation of Acoustic Systems.—F. H. van den Dungen. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 345–346: summary only.)

667. APPARATUS FOR THE AUTOMATIC RECORDING OF SOUND LEVELS UP TO 40 000 c/s [Level/Frequency Curves for Levels from + 20 to − 20 db and Frequencies from 40 c/s, with Accuracy within 0.2 db: Auxiliary Apparatus for Attenuation & Gain Measurements on Quadripoles of Any Image Impedance, Symmetrical or Asymmetrical with respect to Earth].—A. Ferrari-Toniolo. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 587–601.)

668. THE COMPUTATION OF THE COMPOSITE NOISE RESULTING FROM RANDOM VARIABLE SOURCES—E. Dietze & W. D. Goodale, Jr. (*Bell S. Tech. Journ.*, Oct. 1939, Vol. 18, No. 4, pp. 605–623.)

669. THE LOUDNESS OF CONTINUOUS SPECTRUM NOISE AND ITS APPLICATION TO LOUDNESS MEASUREMENTS [as a Reference Sound making possible Subjective Determinations in Any Surroundings instead of only in Heavily Damped Room].—F. H. Brittain. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 113–117.)

670. TERMINOLOGY FOR LOGARITHMIC FREQUENCY UNITS [as suggested by Fletcher].—R. W. Young. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 134–139.)

671. A METHOD OF RAPID FREQUENCY ANALYSIS [based on Directivity of Grouped Sound Sources depending on Their Frequencies: 24 (or More) Magnetostriction Generators as Grouped Sources, combined with Exploring-Note Analyser, give Analysis on C-R Screen].— Kobayashi, Hayashi, & Koseki. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 251–253.)

672. FILTRATION OF OBLIQUE ELASTIC WAVES IN STRATIFIED MEDIA [Extension of Previous Analysis to Oblique Incidence: Low-Pass Filter Action still holds (for Angles less than Critical) when One Layer-Substance is Solid, the Other Fluid: etc.].—R. B. Lindsay. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 178–183.) For the previous work *see* 1934 Abstracts, p. 329.

673. SOUND-INSULATION CHARACTERISTICS FOR IDEAL PARTITIONS [Mean Values of T.L. form Unsatisfactory Criterion of Performance of Sound-Insulating Structures: Ross's "Minimum Loudness Reduction" Factor: Morreau's Proposal and Its Limitations: the Usefulness of Family of Transmission Characteristics of "Ideal" Partitions].—K. C. Morrical. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 231–239: *Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 211–215.)

674. SOUND PROPAGATION ALONG POROUS MATERIALS.—K. Schuster. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 335–340.)

Author's summary:—The processes in the propagation of sound along a plane porous layer, and in tubes with porous walls, are in a wide degree analogous to those processes, theoretically treated by Sommerfeld, which occur in the propagation of electric waves along a conducting plane and along a conducting wire.

For porous planes the theory gives the observed phenomena: (1) a decrease of sound intensity, in the direction of propagation, greater than that for a spherical wave: (2) a decrease normal to the direction of propagation, as one approaches the absorptive material; (3) a change in direction of the wave front in the neighbourhood of the surface. For sound waves in tubes with porous walls, which belong to the type of surface waves, a formula [eqn. 33] for the tube attenuation is derived under special assumptions.

675. SOUND INSULATION MEASUREMENTS [Survey of Existing Technique, for Air-Borne Sound, Footstep Noises, etc: a New Method, giving Direct Measurement with Crossed-Coil Instrument: Results with Floors of Different Types].—W. Bausch. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, p. 343: summary only.)

676. ON THE DERIVATION OF THE REVERBERATION FORMULA.—K. Schuster. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 313–315.)

"It has repeatedly been stated in the literature that in the formula for reverberation time the absorption factor a does not enter directly, but rather the 'absorption exponent' $a' = -\log_e(1-a)$. The difference between a' and a is only noticeable for large values of a. Here however a difficulty arises: if, at any point on the partition, $a = 1$, the formula gives a reverberation time of zero. H. and L. Cremer conclude from this that 'in the case where the distribution of absorptive activity is very one-sided or very unequal, as for open windows between rigid walls, the reverberation theory fails.' In the following paper we show that fundamentally it is the absorption factor and not the absorption exponent which must be introduced into the formula."

677. ON THE DAMPING OF SOUND IN A ROOM WITH SOLID WALLS, AND ON THE DIFFUSION COEFFICIENT OF SOUND ABSORPTION.—B. P. Konstantinov. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 424–432.)

Using the methods of the statistical theory of acoustics of a room, a general formula (5) is derived for determining $\bar{\alpha}$, the average ("diffusion") coefficient of sound absorption, corresponding to the case when the sound-absorbing properties of the reflecting surface are uniform and α depends on θ, the angle of incidence of the wave. The dependence of α on θ was investigated in a previous paper (3992 of 1939) for the case of a plane sinusoidal wave falling on a flat and solid boundary; using the results obtained in this paper, formulae are derived for determining $\bar{\alpha}$ when the reflecting wall is (a) an ideal heat insulator (11) and (b) an ideal heat conductor (12). The standard reverberation time T of a chamber can be calculated for these two cases from formulae (13) and (14) respectively. A more general formula for determining T is also derived, in which the sound absorption by the gas filling the room is taken into account. A comparison between the calculated and experimental data does not show great divergencies.

678. Normal Modes of Vibration in Room Acoustics: Experimental Investigations in Non-Rectangular Enclosures [including Conclusion that Irregularly Shaped Rooms possess Discrete Normal Modes & Standing-Wave Patterns as Pronounced as Those in Rooms of Simple Shapes].—R. H. Bolt. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 184–197.)

679. The Measurement of Absorption Coefficients and the Application of Acoustical Absorbents: Symposium at the Tenth Anniversary Meeting.—(*Journn. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 37–106.) *See* also pp. 159–167.

680. The Transmission of Sound inside Pipes [of Rectangular Cross Section, with Absorbing Material on One or More Inner Surfaces (Curves also applicable to Calculations for Rectangular Rooms): also of Pipes with Circular Cross Section].—P. M. Morse. (*Journ. Acoust. Soc. Am.*, Oct. 1939, Vol. 11, No. 2, pp. 205–210.)

681. Sound Damping in Rigid- and Elastic-Wall Tubes.—E. Waetzmann & W. Wenke. (*Journ. Acoust. Soc. Am.*, July 1939, Vol. 11, No. 1, Part 1, pp. 154–155.) Long summary of the paper dealt with in 2409 of 1939.

682. Theories of the Diffraction of Light by Supersonic Waves.—N. S. Nagendra Nath. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 289–301.)

Concluded from 4590 of 1939. (3) Application of the elementary theories to the diffraction in solid bodies. (4) Limits of validity of the elementary theories for vertical incidence. (5) Strict theory of diffraction processes for liquids. (6) Results of the Extermann-Wannier theory, for vertical incidence. (7) Solutions for large values of ρ (where $\rho = \lambda^2/\mu_0\mu\lambda^{*2}$, λ being the light wavelength and λ^* the supersonic wavelength, μ_0 the mean value of the refractive index, and μ the variation of that index).

683. Measurements of the Velocity of Supersonic Waves [7.5 Mc/s, by Light Diffraction Method] in Liquid Argon.—H. W. Liepmann. (*Helvetica Phys. Acta*, Fasc. 5, Vol. 12, 1939, pp. 421–442.)

684. On the Dispersion of Supersonic Waves in Liquids.—L. Zachoval. (*Journ. de Phys. et le Radium*, July 1939, Series 7, Vol. 10, No. 7, pp. 350–354.)

685. Propagation of Plane Sound Waves in the Neighbourhood of an Absorptive Plane [and the Existence of "*S* Waves"].—J. Brillouin. (*Akustische Zeitschr.*, Sept. 1939, Vol. 4, No. 5, pp. 348–349: long critical summary.)

686. The Correlation between the Fundamental Equations of the Gaseous-Dynamic [Supersonic Motion of Perfectly Compressible Fluid] and the Electromagnetic Fields.—D. Riabouchinsky. (*Comptes Rendus*, 6th Nov. 1939, Vol. 209, No. 19, pp. 664–666.)

687. Connections between the Velocity of Sound and the Constitution of Organic Compounds [Theory].—W. Schaaffs. (*Zeitschr. f. Physik*, No. 3/4, Vol. 114, 1939, pp. 251–256.)

688. Improvements in the Method of Testing the Homogeneity of Solids with the Help of Supersonic Waves.—Giacomini & Bertini. (*La Ricerca Scient.*, Oct. 1939, Year 10, No. 10, pp. 921–925.)

689. An Ultrasonic Stroboscope for Measuring Sound Wavelength in Liquids.—F. E. Fox & G. D. Rock. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 345–348.)

PHOTOTELEGRAPHY AND TELEVISION

690. Influence of the Distribution of Light in the Spot on the Quality of an Image transmitted by Television.—P. Mandel. (*Bull. de la Soc. franç. des Élec.*, Sept. 1939, Vol. 9, No. 105, pp. 789–806.)

Author's summary:—Part I—Mathematical study of the distortions arising from the analysis of an image by a spot whose dimensions are comparable with those of the details to be transmitted. Comparison of the results arising from the use of various spots, for analysis and for reproduction. Chief deformations [variation of admittance as a function of frequency, leading to loss of details: generation of supplementary components not existing in the primary image]. Part II—Numerical results for a circular aperture having a light distribution following the law $E = \frac{1}{2}(1 + \cos \pi y)$. Conclusions as to the possible improvement of image quality ["if equality of horizontal and vertical details is demanded, improvement of the image quality cannot be obtained by a change in the shape, dimensions, or transparency of the spot, or by a simple widening of the band. The increase of the number of lines forming the image, combined with a corresponding widening of the band, seems the only means of obtaining such a result. . . . If the appearance of an image seems more pleasing when the horizontal detail is finer than the vertical, this simply means that the definition is not high enough for the subject and for the viewing distance; it by no means proves that the image would not be still more correct if the definitions were equal in the two directions."

691. Television Detail and Selective-Sideband Transmission [Analysis giving Theoretical Justification for Recent U.S.A. Adoption: at Best, for Same Width of Pass Band, Almost Two/One Superiority over Double-Sideband for Reproduction of Fine Detail].—S. Goldman. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 725–732.)

The treatment assumes 100% modulation, but an added section examines the case of smaller percentages and of small changes in the percentage. *Cf.* Koomans, 857, below.

692. TELEVISION SIGNAL-FREQUENCY CIRCUIT CONSIDERATIONS [for U.S.A. Standards, thus passing Sound (Double-Sideband) and Picture (Single-Sideband) Signals, *i.e.* Pass Band about 4.5 Mc/s: Analysis & Comparison of Pre-Selectors consisting of One and Two Tuned Circuits, etc: Internal Receiver Noise].—G. Mountjoy. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 204–230.)

693. MEASUREMENT OF THE COEFFICIENT OF ATTENUATION OF COAXIAL CABLES AT ULTRA-HIGH FREQUENCIES.—Malatesta. (*See* 725.)

694. THE APPLICATION OF THE TENSOR CONCEPT TO THE COMPLETE ANALYSIS OF LUMPED, ACTIVE, LINEAR NETWORKS [particularly Video-Amplifiers, including Those using Low-Pass Filter Networks].—D. W. Epstein & H. L. Donley. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 240–252.) Concluded from 3912 of 1939.

695. THE FUNDAMENTALS OF TELEVISION ENGINEERING: PART V—ELECTRON-BEAM DEFLECTION METHODS [and a Comparison between Electrostatic and Magnetic Systems: Saw-Tooth Generators]: PART VI—SYNCHRONISATION.—F. A. Everest. (*Communications*, Aug. & Sept. 1939, Vol. 19, Nos. 8 & 9. pp. 7–10 & 19–21.) For Parts I–IV *see* 4558 of 1939.

696. SOUND MOTION PICTURE FILMS IN TELEVISION: PART IV [Requirements of the Ideal Film Scanner, and particularly the Need for a Satisfactory Non-Intermittent Film Projector: Two Possible Systems of "Optical Rectification"].—J. A. Maurer. (*Communications*, Aug. 1939, Vol. 19, No. 8, pp. 17 and 25..34.) For previous parts *see* 4549 of 1939.

697. TRANSATLANTIC RECEPTION OF LONDON TELEVISION SIGNALS.—Goddard. (*See* 459.)

698. THE DEVELOPMENT AND PRESENT TENDENCIES OF TELEVISION IN FRANCE: EXPERIMENTAL RESEARCHES AND NEW INSTALLATIONS.—Mallein. (*Bull. de la Soc. franç. des Élec.*, Sept. 1939, Vol. 9, No. 105, pp. 807–816.) A summary was referred to in 3668 of 1939.

699. TELEVISION BROADCASTING IN GERMANY [Present Position].—(*E.N.T.*, July 1939, Vol. 16, No. 7, p. 206: short note only.)

700. PROGRAMMING THE TELEVISION MOBILE UNIT.—T. H. Hutchinson. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 154–161.)

701. TELEVISION ECONOMICS: PARTS VII–IX.—A. N. Goldsmith. (*Communications*, Aug./Oct. 1939, Vol. 19, Nos. 8/10, pp. 18–19 and 21..25, etc.) For previous parts *see* 4559 of 1939.

702. "ELECTRIC TELEVISION"—FIFTY YEARS AGO [Liesegang's Work as Forerunner of the Latest Large-Picture Apparatus: with List of Dates important in Television History].—E. Miehlnickel: Liesegang. (*Kolloid Zeitschr.*, Nov. 1939, Vol. 89, No. 2, pp. 128–135.)

703. THE CIRCUIT OF THE "UNIT" TELEVISION RECEIVER.—A. Köpping. (*Funktech. Monatshefte*, Oct. 1939, No. 10, Supp. pp. 69–72.) Based on the various *T.F.T.* papers dealt with in 4600/4603 of 1939.

704. A TELEVISION RECEIVER FOR THE HOME.—D. G. Fink. (*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 17–22.) Modification of the "laboratory" receiver referred to in 235 & 1076 of 1939.

705. SIMPLE TELEVISION AERIALS.—Carter. (*See* 580.)

706. THE IMAGE DISSECTOR [Farnsworth Pick-Up Tube: Development from Early Types: Latest Construction & Operating Characteristics].—C. C. Larson & B. C. Gardner. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 24–27 and 50.)

707. TELEVISION TRANSMITTING TUBES [Mosaic-Type Pick-Ups]: THEIR MANUFACTURE IN FRANCE [including a Section on the Analytical Expression of the Signal, with Remarks on the Differences between Iconoscope & Emitron: "Tilt & Bend Correction" for Local Variations of Mosaic Sensitivity: etc.].—P. Tarbès. (*Bull. de la Soc. franç. des Élec.*, Oct. 1939, Vol. 9, No. 106, p. 855–871.)

708. THE ORTHICON, A TELEVISION PICK-UP TUBE.—A. Rose & H. Iams. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 186–199.) Covering the same ground as the paper dealt with in 205 of January: *see* also 4567 of 1939.

709. MECHANISM OF SECONDARY ELECTRON EMISSION.—Suhrmann & Kundt. (*See* 611.)

710. A THERMOELECTRIC METHOD FOR THE DETERMINATION OF WORK FUNCTIONS, *and* A NEW METHOD FOR THE MEASUREMENT OF WORK FUNCTIONS.—Fleming & Henderson: Goss & Henderson. (*See* 616 & 624.)

711. CONTRIBUTION TO THE OPTICS OF VERY THIN METALLIC FILMS [Equation for Radiation incident Obliquely].—D. Hacman. (*Zeitschr. f. Physik*, No. 3/4, Vol. 114, 1939, pp. 170–177.)

712. THE CONTACT DIFFERENCE OF POTENTIAL BETWEEN SILVER FILMS ON GLASS AND ON ROCKSALT [Study of Structural Dependence of Work Function of Silver].—P. A. Anderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 850: abstract only.)

713. THE PREPARATION OF METALLIC FOILS [by depositing on Glass Plate coated with Very Thin Layer of NaCl, subsequently dissolved by Gradually Rising Water, so that Foil floats free on Surface: Use for Preparation of Selenium Barrier-Layer Photocells].—E. Fenner. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 20, 1939, pp. 295–296.)

714. THE SENSITISATION OF ANTIMONY-CAESIUM PHOTOCATHODES BY SULPHUR AND SELENIUM.—V. V. Zhukov. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 376–380.)

It is well known that oxygen possesses sensitising properties, and the paper records experiments to check whether such similar elements as sulphur and selenium act in the same way. The preparation of sensitised antimony-caesium photocathodes is described and experimental results are discussed. It appears that the integral sensitivity of a photocathode is greatly increased (in some cases as much as 20 times) if its surface is covered by a thin film of the sensitiser. The spectral and volt/ampere characteristics of the photocathode remain substantially unaffected by the process.

715. GAS-FILLED PHOTOCELLS WITH REDUCED INERTIA.—G. P. Bel'govski. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 381–388.)

It was shown in a previous work (629 of 1938) that the inertia of a photocell filled with argon is reduced if positive ions are deflected from the cathode to a special additional electrode. This phenomenon was observed at a frequency of 250 c/s. In the present paper a report is given on further experiments in which the effect, on the inertia, of the shape and material of the additional electrode was studied, using frequencies from 1000 to 6000 c/s. A new type of cell was also tested in which the grids are mounted in the cathode/anode space, close to the cathode and anode respectively (Fig. 1). These grids are connected through suitable resistances to the photocell battery and thus provide a circuit for filtering out the ion component of the photocurrent. Experimental frequency characteristics of various types of photocell (all using a silver-caesium cathode) are shown, and a method is also indicated for obtaining these theoretically. It is pointed out that although these experiments are of a preliminary nature only, the new type of photocell indicates the way for developing a multi-stage photocell with a considerably reduced inertia.

716. A THALLOUS SULPHIDE PHOTO-E.M.F. CELL.—F. C. Nix & A. W. Treptow. (*Journ. Opt. Soc. Am.*, Nov. 1939, Vol. 29, No. 11, pp. 457–462.)

"In the following we shall describe and discuss the method of production and characteristics of a new photo-e.m.f. cell of Tl_2S [not available for commercial distribution: a note by Kolomiez 'concerning a similar cell' (*see* perhaps 4489 of 1938 and 4062 of 1939, though the references do not tally) is mentioned]. We shall also show wherein the existing theories of photo-e.m.f. effects completely fail to explain the observed phenomenon."

717. PHOTOCONDUCTIVITY OF TARTARIC ACID CRYSTALS [Effect of Application of External E.M.F. to Crystal].—J. J. Brady & J. D. Todd. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 859: abstract only.) *See* also 2008 & 2869 of 1939.

718. SELENIUM IN CANADA.—Byers & Lakin. (*Canadian Journ. of Res.*, Nov. 1939, Vol. 17, No. 11, Sec. B, pp. 364–369.)

719. THEORIES OF THE DIFFRACTION OF LIGHT BY SUPERSONIC WAVES.—Nagendra Nath. (*See* 682.)

720. RADIO FACSIMILE BY SUB-CARRIER FREQUENCY MODULATION [Increased Fineness in Texture and Definition: Threefold Increase in Operating Speed: Selective-Fading Effects Minimised (and Further Improvement in Sight by Utilisation of Second-Harmonic Signal generated by Such Fading): Noise Effects Reduced: etc.].—R. E. Mathes & J. M. Whitaker. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 131–153.)

721. TWO-WAY FACSIMILE UNIT DEVELOPED FOR AVIATION [Information spotted on Map and Transmitted: Secrecy by Scrambling].—Finch. (*Sci. News Letter*, 25th Nov. 1939, Vol. 36, No. 22, pp. 341–342.)

722. PICTURES BY WIRE [Short Survey of Work of Acme News Pictures, Associated Press, Finch Telecommunications, etc.].—(*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 13–15 and 90, 91.)

MEASUREMENTS AND STANDARDS

723. A VARIABLE OSCILLATOR FOR ULTRA-HIGH-FREQUENCY MEASUREMENTS [on Lecher Wires: Fundamental Theory of Coupled Circuits with Distributed Constants, leading to Design of Oscillator with Continuously Variable Range 75–500 Mc/s, and fulfilling Special Requirements for Lecher-Wire Working].—R. King. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 325–331.)

724. THE APPLICATION OF LOW-FREQUENCY CIRCUIT ANALYSIS TO THE PROBLEM OF DISTRIBUTED COUPLING IN ULTRA-HIGH FREQUENCY CIRCUITS.—King. (*See* 515.)

725. MEASUREMENT OF THE COEFFICIENT OF ATTENUATION OF COAXIAL CABLES AT ULTRA-HIGH-FREQUENCIES.—S. Malatesta. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 495–511.)

Based on the measurement of the resonance coefficient (selectivity factor, $\epsilon = f_0/(f_2 - f_1)$, where f_1 and f_2 are the frequencies at which the input impedance is reduced to $1/\sqrt{2}$ of the max. value at the resonance frequency f_0) of the cable when it is oscillating in the stationary-wave régime. From this the attenuation coefficient α is derived by the simple relation $\epsilon = \pi/\alpha\lambda_i$. The method is suitable for application to factory lengths of cable. Some results are quoted and discussed, with certain conclusions concerning the design of such cables (*e.g.* comparison between insulation distributed uniformly along the length and insulation concentrated at intervals: pp. 509–510).

726. THE DIELECTRIC CONSTANT OF WATER VAPOUR AT A FREQUENCY OF 42 MEGACYCLES.—Tregidga. (*See* 458.)

727. THE PROBLEM OF A SPHERE PLACED IN A HOMOGENEOUS ALTERNATING MAGNETIC OR ELECTRIC FIELD.—M. A. Divil'kovski. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, pp. 433–443.)

Equations are derived for determining the magnetic or electric field set up inside or outside a homogeneous sphere of conductivity γ, permeability μ, and dielectric constant ϵ, when this is placed at the magnetic or electric antinode of a standing wave. Methods are indicated for calculating the power dissipated at low and high frequencies in the sphere, and curves are plotted showing the variation of losses with frequency in spheres made of various materials (metals, dielectrics, and electrolytes). It is shown that losses in polar dielectric liquids and in electrolytes, placed in an alternating magnetic field, become noticeable on decimetric waves. Formulae are also derived for determining the electric and magnetic moments of the sphere. For previous work on the measurement of field strengths (including those at ultra-high frequencies) by mercury and alcohol thermometers, *see* 1079 of 1937.

728. A Direct-Reading Field-Intensity Meter for Measurements of Radiation from Broadcast Antennas.—Christiansen. (*See* 583.)

729. On Metallic Materials for Thermo-elements—A. Schulze. (*E.T.Z.*, 12th Oct. 1939, Vol. 60, No. 41, pp. 1181–1182: long summary only.)

730. Radiation Properties of Different Substances within the Temperature Range 250° C to 800° C.—M. Pirani. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, pp. 372–378.)

731. Piezo-Oscillators with Neutralisation of the Quartz [with Special Advantages at Very High Frequencies].—M. Boella. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 512–515.)

Author's summary:—" A new piezo-oscillator circuit is described which belongs to the class where the quartz acts, in its current-resonance régime, as an essentially conductive retroaction-coupling element, and which is characterised by the fact that the electrostatic capacity of the quartz is neutralised by a suitable compensation circuit. In such an arrangement it is particularly convenient to use valves in which the direct capacity between anode and control grid is greatly reduced by means of a screen grid [and in which indirect heating is employed]. The method presents special advantages at very high frequencies, above 10 Mc/s " [and up to or beyond 30 Mc/s: for it avoids the occurrence of oscillations at frequencies other than that of mechanical resonance of the quartz, and at the same time improves the stability of the generated frequency]. The circuit is a development from that dealt with in 1931 Abstracts, pp. 569–570.

732. Quick Building-Up of the Electron-Coupled Quartz Oscillator.—Hayasi & Akasi. (*See* 552.)

733. Piezoelectricity of KH_2PO_4, *and* The Specific-Heat Anomaly of KH_2PO_4 at the Upper Curie Point.—W. Lüdy: W. Bantle. (*Helvetica Phys. Acta*, Fasc. 4, Vol. 12, pp. 278–279: pp. 279–281.)

734. On the Frequency Stability of Oscillators with Negative Differential Transconductance [and particularly Two Methods of Satisfying the Matching Condition between the Dynamic Resistance of a Given Oscillatory Circuit and the Differential Internal Negative Resistance, so as to obtain the Optimum Stability and Wave Form].—H. Faulstich. (*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 560–564.)

735. Polystyrene Applied to Radio Apparatus [including Design of a Temperature-Compensated H.F. Inductance on Polystyrene Former with Adjustable Powdered-Magnetic Core, giving Practically Constant Temperature Characteristic but Sufficient Inductance Change for Trimmer Purposes].—R. L. Harvey & W. L. Carlson. (*R.C.A. Review*, Oct. 1939, Vol. 4, No. 2, pp. 200–203.)

736. Frequency Meter on the Compensation Principle.—E. Kaden. (*E.N.T.*, July 1939, Vol. 16, No. 7, pp. 187–203.)

This frequency meter is designed for the audio-frequency range; it gives a direct current depending only on the frequency, and independent of any indicating instruments, recording apparatus, etc., which may be connected to it. A compensation circuit is used; mechanical controls are avoided, so that the adjustment may be rapid. Known frequency meters are first described (§ B); § C gives a general discussion of the compensation method: (1) the usual method of compensation of instantaneous values, (2) the integrating compensation, which compensates the integrated value of the quantity under measurement and then differentiates again; this is the more accurate method and is chosen for the construction of the frequency meter. The principle is described in § D.1, its electrical realisation in § D.2 (Fig. 5, circuit scheme; Fig. 6, circuit scheme with magnetising valve; Fig. 8, circuit for very large ranges; Fig. 9, circuit in which the magnetising current is zero for a frequency within the measuring range). The considerations governing the choice of the ranges and the single elements of the circuit are discussed in § D.3. A general mathematical treatment of the problem is given in § D.4; measurements of certain simple phenomena are calculated and compared with oscillograms (§ D.5). The complete circuit diagram is given in Fig. 16, the calibration curve in Fig. 17; reference is also made to possible applications of this frequency-compensation method (including adjustment of emitters and receivers, synchronisation devices, automatic tuning correction in broadcast receivers, d.c. compensation amplifier).

737. High-Precision Checking of the Standard Pitch Note, *and* Continuous Broadcast of Standard of Musical Pitch Inaugurated.—Madella: Nat. Bureau of Standards. (*See* 656 & 656 *bis*.)

738. Relaxation Methods applied to Engineering Problems: V—Conformal Transformation of a Region in Plane Space [with Example of Calculation of Electric Capacity of Straight Cable or Condenser].—R. W. G. Gandy & R. V. Southwell. (*Proc. Roy. Soc.*, Series A, 10th Nov. 1939, Vol. 173, No. 952, pp. S 113–S 114: abstract only.)

739. The New Prefixes for the Electrical Units [from "Giga" (10^{12}) and "Tera" (10^9) to "Nano" (10^{-9}) and "Pico" (10^{-12})].—French Electrotechnical Committee. (*Génie Civil*, 25th Nov. 1939, Vol. 115, No. 22, p. 392.)

740. Discussion on "The Production and Measurement of Small Voltages at Radio Frequencies."—G. Bozzi: Pinciroli. (*Alta Frequenza*, Oct. 1939, Vol. 8, No. 10, pp. 658–660.)

Bozzi points out various troubles likely to be encountered by Pinciroli in the development of the method dealt with in his paper (4084 of 1939) and refers to Diehl's remarks on the same system (1932 Abstracts, p. 594) and to a paper in *General Radio Experimenter* (Aug./Sept. 1937) on some more accurate, though naturally more complicated, methods. The author replies.

741. Vacuum-Tube Circuit to Measure the Logarithm of a Direct Current [depending on Maxwellian Distribution of Velocities of Thermoelectrons from Hot Cathode: Characteristics therefore Constant & Predictable].—R. E. Meagher & E. P. Bentley. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 336–339.)

742. A Direct-Reading Vacuum-Tube Millivoltmeter [primarily for Bio-Electronic Research where Stability of a High Order is required: Push-Pull Circuit using Pentodes].—W. Lyons & R. E. Heller. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 25 and 93..95.)

743. Advantages of the Cathode-Follower Connection for a Mains-Driven Valve Voltmeter of Very High Input Impedance.—Stephenson. (In paper dealt with in 904, below.)

744. Direct-Viewing Method for Positive-Grid Characteristics [without Damage to Valve: 3-Thyratron Saw-Tooth Generator Circuit giving Complete Curve on C-R Screen].—T. Sawada & A. Kameyama. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, p. 239.)

745. Measurements by means of the Electrometer Triode.—Thaes. (*See* 601.)

746. Measurement of the High-Frequency Loss Angle of Electrolytic Condensers.—E. von Kilinski. (*E.N.T.*, July 1939, Vol. 7, No. 16, pp. 184–186.)

These measurements were made using Lindemann's method (1909); § I gives results of measurements of the loss in commercial electrolytic condensers in the range 10^5–10^7 c/s and at 500 c/s. § II describes a condenser (Fig. 2) of very small capacity; curves are given of the frequency variation of its loss resistance, capacity, and loss factor (Figs. 4, 5, 6). § III gives a theoretical investigation of the frequency variation of these quantities (Fig. 7, equivalent circuit of the electrolytic condenser). Formulae are found which give good agreement with the experimental curves (Fig. 8).

747. A Method of measuring Electrolytic Conductivity at High Frequencies [based on Rate of Energy Absorption by Solution in H.F. Magnetic Field].—G. Stipe & J. H. Purks. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 843: abstract only.) *Cf.* 727, above.

748. Absolute Measurement of Electrical Resistance [by Method in which Potential Difference across Resistor is balanced by Average E.M.F. of Commutating Generator].—H. R. Nettleton. (*Nature*, 4th Nov. 1939, Vol. 144, pp. 782–783.)

749. Comparing Resistances of [Small] Four-Terminal Resistors [with No Current in "Potential" Leads: Use of Ordinary Laboratory Apparatus].—J. J. Dowling. (*Nature*, 18th Nov. 1939, Vol. 144, pp. 865–866.) *See* also Glynne, 270 of January.

750. Effect of Electrodes on the Measurement of Dielectric Losses [at 1.1 Mc/s].—Y. Asami & S. Ogawa. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, p. 237.)

It is concluded that the effect is large if the test piece is very thin, but that if it is thick the error in measurement may be eliminated by the use of proper contact materials or proper pressure between the electrodes.

751. Humidity Effect on Loss Angle of Insulator at High Frequencies [Tests on Borosilicate Glass, 300 kc/s to 10 Mc/s, with Relative Humidity 30% and 95%: Rough Agreement between Calculated and Measured Values].—T. Miura & T. Kambara. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, pp. 238–239.)

752. Proposed Rules for Electrical Tests on Insulating Materials.—VDE Committee. (*E.T.Z.*, 5th Oct. 1939, Vol. 60, No. 40, pp. 1155–1160.)

753. A Condenser for the Testing of Liquid Dielectrics [for Dielectric Constant & Power Factor: Suitable for R.F. (to about 20 Mc/s) as well as D.C. & L.F. Tests].—L. Hartshorn & E. Rushton. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, pp. 366–368.)

754. Dispersion and Absorption of Electric Waves in Alcohols and Aqueous Solutions [Method for Absolute Measurement: Results for Water, Alcohols, Gelatin and Sugar Solutions: Agreement with Debye's Theory except for Sugar Solutions].—K. E. Slevogt. (*Ann. der Physik*, Series 5, No. 2, Vol. 36, 1939, pp. 141–165.)

755. Protective Arrangements for Measuring Instruments [against Thermal & Mechanical Overloads: Use of Glow-Discharge Voltage Dividers combined with Relays].—U. von Brockdorff. (*E.T.Z.*, 14th Sept. 1939, Vol. 60, No. 37, pp. 1089–1091.)

756. A New Vibration Platform.—Zakharchevski & Razumovski. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 55–57.)

A report on a vibration testing machine in which the direction, frequency, and amplitude of the vibrations are all adjustable. The maximum load on the machine is 6 kg, the frequency range 10 to 50 p.p.s., and the maximum acceleration 30 m/sec.^{2}.

SUBSIDIARY APPARATUS AND MATERIALS

757. Electron Transit Time: Effects in Cathode-Ray Tubes and Diodes.—Benham. (*See* 595.)

758. Ultradynamic Lissajous' Figures [on the Cathode-Ray Oscillograph].—Hollmann. (*See* 544.)

759. Cathode-Ray Tubes free from "Wheatcroft Effect."—Macfadyen: Cossor Company. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, p. 380.) For mention of such tubes *see* 153 of January.

760. The Recording of Surges as Stationary Curves with the Cathode-Ray Oscillograph [Danzig Electrotechnical Institute Technique].—Campe & Matschull. (*E.T.Z.*, 7th Sept. 1939, Vol. 60, No. 36, pp. 1071–1073.)

761. External Camera Recording in Cathode-Ray Oscillography [Comparison between Efficiencies of Fluorescent Screens: Zn_2SiO_4 (Copper Base) better for Comparatively Low Sweep Velocity, $CaWO_4$ (Bakelite Base) better for High Velocity: Explanation on Basis of Respective Decay Times].—Fukuda, Hoh, & Shima. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, p. 262.)

762. Measurement of Total Light for Compound Phosphors with Mixed Luminescent Materials [Method of determining Fractions of Total Illumination due to the Separate Luminescent Materials: Results for CaO/PrSm Phosphors].—Brauer. (*Ann. der Physik*, Series 5, No. 2, Vol. 36, pp. 97–104: *Zeitschr. f. Physik*, No. 3/4, Vol. 114, 1939, pp. 245–250.)

763. Luminescence of Synthetic Halite Crystals [Sodium Chloride/Manganese Chloride: Optimum Percentages of Manganese].—Cohn. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 856: abstract only.)

764. The Spectra of Fluorescence and Absorption of Complex Molecules [and Levschin's "Law of Mirror Reflection"].—Blochinzev. (*Journ. of Phys.* [of USSR], No. 2, Vol. 1, 1939, pp. 117–124: in English.) The law should hold in the frequency interval $\overline{E}/h$, where $\overline{E}$ is the average molecular energy at double temperature.

765. A New Co-ordinate Recorder [Hardy and Economical Substitute for the C-R Oscillograph for Valve Characteristics, Resonance Curves, etc: Moving-Iron Instrument with Crossed Field-Coils].—Gruhn. (*E.T.Z.*, 27th July 1939, Vol. 60, No. 30, pp. 907–908.)

766. An Apparatus for the Superposition of Sinusoidal Lines [the "Darmstadt Oscillation Superimposer"].—Walther & others. (*Zeitschr. f. Instrumentenkunde*, April 1939, Vol. 59, No. 4, pp. 162–168.)

767. Remarks on Some Questions of Electron-Optics (Electron Lens with Intermediate Grid: Electron Mirror: Immersion Lens).—Picht. (*Ann. der Physik*, Series 5, No. 3/4, Vol. 36, pp. 249–264.)

Formulae are found for the focal length and the position of the principal points of the symmetrical and unsymmetrical electron lens with intermediate grid, neglecting the deformation in the potential surfaces produced by the openings in the grid. The difference between the new formula (eqn. 6) for the focal length of the symmetrical lens and the less exact one (eqn. 3) of Knoll & Weichardt (4542 of 1938) is discussed. The formulae for the symmetrical lens are extended to the electron mirror (eqns. 7, 12). The case is discussed in which the grid lies in the focal plane (on the object side) of the second apertured-stop lens. The effect of the deformation of the potential surfaces referred to above on the electron paths is discussed; its influence on the focal length is found to vanish under certain conditions. Some errors in the parts of the writer's book on "Introduction to the Theory of Electron Optics" referring to the immersion lens are corrected.

768. Point Projector Electron Microscope [based on Quasi-Rectilinear Propagation of Field Emission from Minute Cathode close to Object].—Morton & Ramberg. (*Phys. Review*, 1st Oct. 1939, Series 2, Vol. 56, No. 7, p. 705.)

769. The Magnitude of the Aperture Error in the Electron Microscope [Comparison of Equation Constants given by von Borries & Ruska and by Author: Apparatus for Measurement of Aperture Error: the Preparation of Apertures below 10μ in Diameter (Crossed-Slit Diaphragm or Diaphragm bored by "Ion Probe")].—von Ardenne. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 20, 1939, pp. 289–290.)

770. The Mean Free Path in Gases contained in a Vessel [Relation between Mean Free Paths of Electrons (or Ions) in Gases, for Parallel-Plate, Coaxial-Cylinder, & Concentric-Sphere Configurations].—Saito. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 257–259.)

771. Emission of Electrons from "Cold" Metallic Targets under High-Energy Positive Ion Bombardment.—Fisk. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 846: abstract only.)

772. Production of Secondary Electrons by High Energy Electrons [Measurements on Traversal of Lead Foil].—Fowler & Sheppard. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 859–860: abstract only.)

773. Numerical Calculations of the Reflection of Electrons by Metals.—MacColl. (*Phys. Review*, 1st Oct. 1939, Series 2, Vol. 56, No. 7, pp. 699–702.)

774. Extremely Bright Spots on Coolidge Tube Target [due to Electron Bombardment of Minute Protrusions].—Koga & Tatibana. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, p. 238.) *See* also 140 of January.

775. The Preparation of Metallic Foils.—Fenner. (*See* 713.)

776. A Quantitative Study of the Clean-Up of Hydrogen by Barium.—Johnson, Hane, & Anderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 852: abstract only.)

777. Study of Oil-Vapour Condensation Pumps with High Speed of Evacuation.—Matricon. (*Journ. de Phys. et le Radium*, Aug. 1939, Series 7, Vol. 10, No. 8, pp. 385–387.)

778. Design of an Up-to-Date High-Vacuum Pump Installation.—Michaelis. (*E.T.Z.*, 5th Oct. 1939, Vol. 60, No. 40, pp. 1161–1163.)

779. Modern Vacuum Practice in Electronics.—Morse. (*Electronics*, Nov. 1939, Vol. 12, No. 11, pp. 33–36.)

780. A New Quartz-Fibre Manometer of High Accuracy and Sensitivity [a Two-Fibre Instrument for Pressures down to 10^{-7} Torr or Lower].—Wetterer. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 20, 1939, pp. 281–283.) One "torr" is equal to 1 mm of mercury.

781. An Automatic Pirani Vacuum Gauge [Pirani Gauge combined with Valve Ohmmeter].—Scott. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 349–350.)

782. An Improved Form of Vacuum Arc Mercury Still for Laboratories.—Sivaramakrishnan. (*Indian Journ. of Phys.*, Part 3, Vol. 13, 1939, pp. 205–207.)

783. The Production of Large Ionic Currents by means of a Gasomagnetron.—Vigdorchik. (*Journ. of Phys.* [of USSR], No. 2, Vol. 1, 1939, pp. 151–158: in English.) The original Russian paper was dealt with in 2084 of 1939.

784. The Cyclotron of the Biochemical Research Foundation, *and* The Purdue Cyclotron.—Allen & others: Henderson & others. (*Journ. Franklin Inst.*, Nov. 1939, Vol. 228, No. 5, pp. 543–561: pp. 563–579.)

785. A Modified Arc Source for the Cyclotron.—McMillan & Salisbury. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 836.)

786. A Horizontal [Electrostatic] Band Generator after van de Graaff [for 10^6 V].—Baumhauer & Kunze. (*Zeitschr. f. Physik*, No. 3/4, Vol. 114, 1939, pp. 197–204.)

787. A New D.C. Generator for 3 Million Volts [Greinacher Principle, with 20 Series Condensers], *and* A Canal-Ray Tube for 3 Million Volts.—Imhof: Wäffler. (*Helvetica Phys. Acta*, Fasc. 4, Vol. 12, 1939, pp. 285–288: pp. 288–289.)

788. The Disturbance Field of a High-Tension Discharge in a Screened Room: Determination of the Screening Effect of the Screening employed.—Kläy. (*See* 491.)

789. The Effect of Humidity and Sphere Material on the Spark-Over Voltage of the 2-Centimetre Sphere Gap.—Lewis. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 846: abstract only.)

790. The Influence of Discharge-Chamber Geometry upon the Striking Potential of the H.F. Discharge.—Githens. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 845–846: abstract only.)

791. Measurements on the Sparking Potential in Deuterium and Hydrogen.—Leeman. (*Helvetica Phys. Acta*, Fasc. 5, Vol. 12, 1939, pp. 397–414.) Ending with a comparison with Jones's results (3337 of 1939).

792. Radio-Frequency Spark-Over in Air.—Ekstrand. (*See* 556.)

793. Corona and Ionisation Detection.—Brown & Weston. (*Communications*, Sept. 1939, Vol. 19, No. 9, pp. 5–7 and 30 . . 38.) A summary was dealt with in 121 of January.

794. Investigation on the Stepped Discharge with Cathode-Ray Oscillograph, *and* The Two-Stepped Discharge.—Nomoto. (*Electrot. Journ.*, Tokyo, Feb. 1939, Vol. 3, No. 2, pp. 36–38: Oct. 1939, No. 10, pp. 222–225.)

795. The Electric Glow between Carbon Electrodes.—Newman. (*Phil. Mag.*, Nov. 1939, Series 7, Vol. 28, No. 190, pp. 544–547.) Further experiments on work referred to in 1539 of 1937.

796. The Function of Anode Spots in the Glow Discharge [is to furnish Sufficient Positive Ions to Maintain Stable Discharge].—Rubens & Henderson. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 854: abstract only.)

797. The Luminous Intensity of the High-Pressure Mercury-Vapour Discharge, for Medium and Very High Pressures, as a Function of Power, Pressure, and Tube Diameter.—Kern. (*Zeitschr. f. tech. Phys.*, No. 9, Vol. 20, 1939, pp. 250–257.)

798. Circuit Arrangement for High-Pressure Mercury-Vapour Lamps for the Generation of Light Flashes [10^{-5} – 10^{-6} Second, for Continuously Running Films, Stroboscopes, etc.].—Ewest. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 20, 1939, p. 294.) Requiring only 300–400 v instead of the 10–20 kv required by previous arrangements.

799. The Testing of Electrical Valves [Ionic Rectifiers for Power Purposes] with Two Different Current Sources.—Marx. (*E.T.Z.*, 21st Sept. 1939, Vol. 60, No. 38, pp. 1119–1121.)

800. Behaviour of Half-Wave Rectifiers.—Stout. (*See* 530.)

801. A Rectifier Equipment with Output Voltage Independent of Load [by Use of Condenser/Iron-Cored-Choke Combination].—Harres. (*E.T.Z.*, 27th July 1939, Vol. 60, No. 30, pp. 889–892.) Giving a variation of at most $\pm$ 1.5–2% between no-load and full-load conditions.

802. Re-Ignition Voltage Characteristics of Grid-Controlled Discharge Tubes.—Watanabe & Nakamura. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 243–246.)

803. The Relation of Residual Ionisation to Arc-Back in Thyratrons.—Kingdon & Lawton. (*Gen. Elec. Review*, Nov. 1939, Vol. 42, No. 11, pp. 474–478.)

804. On the Investigation of the Electroconductivity of Semiconductors at High Temperatures.—Schulman. (*See* 612.)

805. On the Contact Resistance of Semiconductors [Introduction: the Field in the Semiconductor: Contact Potentials and Contact Resistances: the Case of a Potential Barrier (Sign of Rectification depends on Thickness of Barrier compared with Thickness of Space-Charge Layer): etc.].—Davydov. (*Journ. of Phys.* [of USSR], No. 2, Vol. 1, 1939, pp. 167–174: in English.)

806. "Semiconductors and Metals" [Book Review].—Wilson. (*Engineering*, 8th Dec. 1939, Vol. 148, pp. 631–632.) One of the "Cambridge Physical Tracts" series.

807. Application of "Selenofer" Rectifiers to Electro-Plastics [Special Suitability owing to Their High Efficiency, Safe Working at High Temperatures, etc.].—Giroz. (*Bull. de la Soc. franç. des Élec.*, Oct. 1939, Vol. 9, No. 106, pp. 821–842.)

808. Selenium in Canada.—Byers & Lakin. (*Canadian Journ. of Res.*, Nov. 1939, Vol. 17, No. 11, Sec. B, pp. 364–369.)

809. "Rotaceptors": Efficient Conversion of D.C. to A.C.—(*Wireless World*, Nov. 1939, Vol. 46, No. 1, p. 32.)

810. Fundamental Ideas of the General Technique of Switching [Connections made between Single Users and Energy Sources: General Theory and Tables].—Piesch. (*Arch. f. Elektrot.*, 20th Oct. 1939, Vol. 33, No. 10, pp. 672–686.)

811. Spun-Glass Flexible Resistors ["Glasohms"].—Mucher. (*Communications*, Sept. 1939, Vol. 19, No. 9, pp. 10 and 28.)

812. Resistors and Condensers in Mass Production [and the Use of Automatic & Semi-Automatic Machinery].—Chase. (*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 28–31.)

813. A Condenser for the Testing of Liquid Dielectrics.—Hartshorn & Rushton. (*See* 753.)

814. Measurement of the H.F. Loss Angle of Electrolytic Condensers.—von Kilinski. (*See* 746.)

815. Some New Uses of Capacitors in Control Circuits [taking Advantage of Recent Improvements in Electrolytic Condensers].—Winter. (*Gen. Elec. Review*, Nov. 1939, Vol. 42, No. 11, pp. 462–465.)

816. Electroplating Plastics [Deposition of Synthetic Resins on Metals (*e.g.* for coating Trimmer-Condenser Plates)].—(*Scient. American*, Dec. 1939, Vol. 161, No. 6, p. 354.) Note on article in *Industrial & Engineering Chemistry*.

817. A New Synthetic Material—a New Plastic ["Ultrapas", a Resin derived from Melamin].—(*E.T.Z.*, 5th Oct. 1939, Vol. 60, No. 40, p. 1170: summary only.)

818. "Mechanische Festigkeit von Phenol-Formaldehyd-Kunstoffen" [Book Review].—Thum & Jacobi. (*E.T.Z.*, 21st Sept. 1939, Vol. 60, No. 38, p. 1124.)

819. Methods of Pressing Amber.—Ignatovich. (*Journ. of Tech. Phys.* [in Russian], No. 5, Vol. 9, 1939, p. 458.) The manufacture of insulators from pressed amber powder is described. The resistance of insulators so obtained is 8×10^{15} ohms as compared to 10^{14} ohms for insulators from natural amber.

820. The Transition from Anatas into Rutil and the Influence of the Presence of Hydrochloric Acid Gas.—Hüttig & Kosterhon. (*Kolloid Zeitschr.*, Nov. 1939, Vol. 89, No. 2, pp. 202–208.)

821. Polystyrene: Its Characteristics and Application in Short [and Ultra-Short]-Wave Equipment.—Riddle. (*Wireless World*, 28th Sept. 1939, Vol. 45, p. 297.) Based on the paper dealt with in 4148 of 1939.

822. Polystyrene applied to Radio Apparatus.—Harvey & Carlson. (*See* 735.)

823. Fibrous Glass Insulation in Radio Apparatus.—Lee. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 33–34.)

824. Designing Die-Pressed Steatite Ceramics.—Scoville. (*Communications*, Oct. 1939, Vol. 19, No. 10, pp. 10–11 and 12, 14.)

825. A.C. Resistance of Ceramic Materials for Temperatures up to 600° [Measurements at Angular Frequencies 314 & 5000: Temperature Variation of Specific Resistance and Dielectric Constant of Various Commercial Materials].—Richter. (*Physik. Zeitschr.*, 1st Oct. 1939, Vol. 40, No. 19, pp. 597–603). For previous work *see* 2069 of 1938.

826. On the Thickness of Insulating Films [in Usual Breakdown-Voltage Researches, Measuring Technique gives only Max. Thickness of Film, whereas Min. Thickness is Operative : Advantages of Use of Leitz Metal Microscope].—Shimizu & Inai. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, p. 264.)

827. Research on Japanese Lacquer with Phenolic and Alkyd Resins : with Alkyd Resins and Asphalt : *and* with Phenolic and Coumarone Resins.—Shimizu & Inai. (*Electrot. Journ.*, Tokyo, Oct. 1939, Vol. 3, No. 10, pp. 230–236 : Nov. 1939, No. 11, pp. 254–256.)

828. Effect of Electrodes on the Measurement of Dielectric Losses, *and* Humidity Effect on Loss Angle of Insulator at High Frequencies.—Asami & Ogawa : Miura & Kambara. (*See* 750 & 751.)

829. How do Insulators Insulate ? [Account of Massachusetts Institute of Technology's Researches by Optical, Noise, & Photoelectric Methods].—von Hippel. (*Technology Review* of the M.I.T., Dec. 1939, Vol. 42, No. 2, pp. 65–67 and 85..88.)

830. Physical Problems of Commercial Insulating Materials [Many Points to be considered in Testing the Usefulness for Practical Purposes, illustrated by Experiments on Resin- and Paraffin-Type Mixtures : Variation, with Temperature, of Dielectric Constant & Loss Angle of Various Colophony Mixtures with Paraffin, Ozokerite (Ceresin), & Oil : Anomalies of Mipolam : Good Properties of Swiss Material Cibanite : etc.].—Goldschmidt. (*Helvetica Phys. Acta*, Fasc. 4, Vol. 12, 1939, pp. 303–312.)

831. The Electrical Breakdown Strength of Ionic Crystals as a Function of Temperature [Increase of Breakdown Strength with Temperature in Lower Range : Bearing on Breakdown Theories].—Buehl & von Hippel. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 941–947.)

832. Proposed Rules for Electrical Tests on Insulating Materials.—VDE Committee. (*E.T.Z.*, 5th Oct. 1939, Vol. 60, No. 40, pp. 1155–1160.)

833. A Study of Dielectric Absorption [giving Empirical Relation of Absorbed Current to Times of Charge, Discharge, and Recovery after Discharge].—Simmons. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 848 : abstract only.)

834. Influence of Molecular Form and Freely Rotatable Dipole Groups on Dielectric Relaxation [Calculations of Mean Moment of Molecules in H.F. Electric Field].—Budó. (*Physik. Zeitschr.*, 1st Oct. 1939, Vol. 40, No. 19, pp. 603–610.) Generalisation of theory referred to in 1238 of 1939 : *see* also 3330 of 1939.

835. Investigations of Dielectric Relaxation with Reference to the Molecular and Intermolecular Structure of Dipole Liquids [Theory : Experimental Results for Organic Liquids].—Fischer. (*Physik. Zeitschr.*, 1st Nov. 1939, Vol. 40, No. 21, pp. 645–663.)

836. A Method of Purification of Lubricating Oils [based on Effect of Electroconvective Eddies].—Avsec. (*Comptes Rendus*, 4th Dec. 1939, Vol. 209, No. 23, pp. 830–832.) *See* also 903, below.

837. Properties of Distilled Transformer Oil at High Vacuum and Temperature.—Shimizu. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, p. 260.)

838. Oxidation of Mineral and Soya-Bean Oils [under Action of Sunlight and of Heating].—Kumagai & Yoh. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 263–264.)

839. Tarnish Studies : the Electrolytic Reduction Method for the Analysis of Films on Metal Surfaces.—Campbell & Thomas. (*Bell Tel. System Tech. Pub.*, Monograph B-1170, 22 pp.)

840. Soil-Corrosion Studies, 1937 : Corrosion-Resistant Materials and Special Tests.—Logan. (*Journ. of Res. of Nat. Bur. of Stds.*, Oct. 1939, Vol. 23, No. 4, pp. 515–542.)

841. Permeability at Very High Frequencies.—Hughes : G.W.O.H. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, pp. 596–597.) Discussion of the editorial referred to in 357 of January.

842. Retardation of Magnetisation by Microscopic Eddy Currents [Calculations with Indication of Explanation of Vanishing of Ferromagnetic Susceptibility at High Frequencies].—Becker. (*Ann. der Physik*, No. 3/4, Vol. 114, 1939, pp. 340–348.)

843. Magnetic Test for Superstructure in Permalloy.—Pan. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 933–936.)

844. Plastic Hysteresis and Variable Magnetisation : Magnetic Viscosity, *and* A Possible Mechanism of Magnetic Viscosity.—Gilbert : Perrier. (*Helvetica Phys. Acta*, Fasc. 4, Vol. 12, pp. 290–291 : pp. 291–294.)

845. On Magnetic Texture and Magneto-Elastic Hysteresis [Influence of "Magnetic Texture" (created Artificially by Demagnetising a Single Crystal in Elastically Extended Condition) decreases as Field increases : Should therefore affect principally Values of Initial and Maximum Susceptibilities].—Dekhtjar. (*Journ. of Phys.* [of USSR], No. 2, Vol. 1, 1939, pp. 159–166 : in English.) Continuation of the work referred to in 1732 of 1939.

846. THE PROPERTIES OF PARAMAGNETIC SALTS AT LOW TEMPERATURE [Theory based on Simple Model].—Sauer & Temperley. (*Proc. Roy. Soc.*, Series A, 10th Nov. 1939, Vol. 173, No. 952, p. 117: abstract only.)

847. ANTIFERROMAGNETISM IN SOME MANGANOUS COMPOUNDS, *and* ELECTRICAL CONDUCTIVITY AS A FUNCTION OF TEMPERATURE OF SOME MANGANOUS COMPOUNDS.—Squire. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 922–925: p. 960.)

848. MINUTE "PRECISION SHAPES" IN METALS AND PLASTICS [for Instrument-Makers, etc.].—Precision Shapes, Inc. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, p. 382.)

849. THE MOULDING OF METAL DETAILS UNDER PRESSURE.—Spiridonov. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 47–51.)

The moulding under pressure of metal details for radio apparatus is described, and it is claimed that this process is much more economical than sand moulding, and gives a 25% increase in hardness.

850. THE DETERMINATION BY NOMOGRAMS OF THE WEIGHT OF MATERIAL USED WHEN STAMPING DETAILS FROM SHEETS.—Bazylev. (*Izvestiya Elektroprom. Slab. Toka*, No. 9, 1939, pp. 51–55.)

Nomograms are drawn showing the weight of material required per 100 details, as determined by the thickness of the sheet and the number of details stamped from one sheet: numerical examples are given.

851. PROTECTIVE ARRANGEMENTS FOR MEASURING INSTRUMENTS.—von Brockdorff. (*See* 755.)

852. PHENOMENA OF MELTING AND VAPOURISING WIRES WITH VERY HIGH CURRENT DENSITIES [Cathode-Ray Oscillograms].—Wrana. (*Arch. f. Elektrot.*, 20th Oct. 1939, Vol. 33, No. 10, pp. 656–672.)

853. IMPROVED COUNTING-RATE METER [up to 7200 Counts per Minute], *and* A DIRECT-READING COUNTING-RATE RATIO METER.—Evans & Alder: Evans & Meagher. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 332–336: pp. 339–344.)

854. SUPER HIGH-SPEED PIN-HOLE CAMERA [for 120 000 Frames per Second].—Prince & Rankin. (*Engineer*, 15th Dec. 1939, Vol. 168, pp. 596–597.)

855. STYCTOGRAPHIC COHERERS.—Penner. (*See* 461.)

STATIONS, DESIGN AND OPERATION

856. TELEVISION DETAIL AND SELECTIVE-SIDEBAND TRANSMISSION.—Goldman. (*See* 691.)

857. ASYMMETRIC-SIDEBAND BROADCASTING [and Its Great Advantages over Single-Sideband Transmission: Apparatus used in 1934 Kootwijk-Radio Tests: Supplement on Tests on Energy-Distribution in L.F. Spectrum, leading to 1500 c/s as Optimum Dividing Point].—Koomans. (*Proc. Inst. Rad. Eng.*, Nov. 1939, Vol. 27, No. 11, pp. 687–690.)

858. THROUGH TRAFFIC IN TELEPRINTING *via* WIRELESS AND CABLES.—Hudec. (*E.N.T.*, Aug. 1939, Vol. 16, No. 8, pp. 207–212.)

The introduction gives a general account of the transmission of printed matter *via* cables and wireless links; for the pulse method in the latter *see* 2143 of 1939. Transference of the signals from a wireless link to a cable is described in § 2; Fig. 2 shows the circuit scheme for connecting the two modes of transmission. The telegraphic signals which have been transmitted by wireless are stored up in reception relays by the distributor at the reception end and then keyed off through special cable distributors and sent into the cable. The method is explained in detail; photographs of the instruments are shown in Figs. 3a, b. The telegrams coming *via* cables to the wireless transmitter must be received there and transmitted at the proper time to suit the prevailing transmission conditions (§ 3). The arrangements at the transmitter (scheme Fig. 4) are shortly described. The method enables direct communication to be made between subscribers in oversea traffic.

859. INVESTIGATIONS ON RECIPROCATING MULTIPLE TRANSMISSION (MULTIPLEX TRANSMISSION).—Raabe. (*E.N.T.*, Aug. 1939, Vol. 16, No. 8, pp. 213–228.)

The circuit for multiplex transmission is shown in principle in Fig. 1; the system here considered is that of Delany. The theory is discussed in § II, with a Fourier analysis of the frequency spectrum of the unmodulated carrier in the form of periodic rectangular pulses. "The frequency spectrum of the modulated channel is found to be characterised by a modulation of each partial frequency of the Fourier spectrum to the same depth. The constant term in the Fourier series alone characterises the transmission of the modulating oscillations with the correct frequency. Distortions thus only occur in the frequency ranges in which the modulation band overlaps the sidebands of the harmonic carrier frequencies. The regions in which distortionless transmission is possible are given" (§ II.5). The question of the required frequencies and cross-talk is discussed in § II.6; an example is given to illustrate the complicated relations which arise. The example of the two-channel system is also worked out; it is here found to be theoretically possible to decouple the two channels completely if the first harmonic only is used, with a suitable pulse breadth. The effect of line distortions on cross-talk is calculated in § II.7 and explained with the help of an example.

In § III, after a discussion of known methods, a new method is given (§ III.2) using a two-channel system in which two amplifying valves are alternately switched in and out by a rectangular control alternating voltage (Figs. 17, 18). Four channels may be obtained by coupling two of the two-channel distributors in pyramid fashion (Figs. 19, 20). The process may be continued; a better method is shown in Fig. 21, in which the generators of the rectangular voltage are earthed and the voltages are summed in a circuit network. The spatial network for an eight-fold distributor is shown in Fig. 22, the generator giving a rectangular voltage in Fig. 23, the generator for the control voltage of a four-fold distributor in Fig. 25, the circuits of the transmitting and receiving distributors for a four-channel system in Figs. 26, 27 respectively. The lay-out of the method (plan Fig. 28) is described in § III.3; the results of some experiments with it are shown in oscillograms. These are found to give good agreement with the theory, while the apparatus is less expensive than those already known.

860. Byrd Antarctic Expedition to use Amateur Radio.—De Soto. (*QST*, Dec. 1939, Vol. 23, No. 12, pp. 11–15 and 25.)

861. Automatic Time and Weather Systems [Survey].—Winner. (*Communications*, Oct. 1939, Vol. 19, No. 10, pp. 7–9 and 14, 39.)

862. "Zeitsignale" [Time Signals: Book Review].—German Admiralty (issued by).—(*Zeitschr. f. tech. Phys.*, No. 9, Vol. 20, 1939, p. 279.)

GENERAL PHYSICAL ARTICLES

863. The Dimensions of Electromagnetic Quantities [and the Choice of Units to make These Dimensions as Simple and as Full of Meaning as possible].—Sommerfeld. (*Ann. der Physik*, No. 3/4, Vol. 114, 1939, pp. 335–339.)

864. The Natural Unit of Potential and the Absolute Definition of the Volt.—Laboccetta. (*La Ricerca Scient.*, Oct. 1939, Year 10, No. 10, pp. 961–964.)

865. On the Motion of Finite Masses according to Einstein's Theory of Gravitation.—Fock. (*Journ. of Phys.* [of USSR], No. 2, Vol. 1, 1939, pp. 81–116: in French.)

866. The Quantum Physics of Solids: I—The Energies of Electrons in Crystals.—Shockley. (*Bell S. Tech. Journ.*, Oct. 1939, Vol. 18, No. 4, pp. 645–723.)

867. Energy Fluctuations in the Electromagnetic Field [Quantum Theory].—Morrison. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 937–940.) *See* also 2591 of 1939 (and 380 of January).

868. The Correlation between the Fundamental Equations of the Gaseous-Dynamic [Supersonic Motion of Perfectly Compressible Fluid] and the Electromagnetic Fields.—Riabouchinsky. (*Comptes Rendus*, 6th Nov. 1939, Vol. 209, No. 19, pp. 664–666.)

869. On the Representation of the Wave Equation and the Evolution of the Electromagnetic Quantities in the Theory of the Photon.—Petiau. (*Journ. de Phys. et le Radium*, Sept. 1939, Series 7, Vol. 10, No. 9, pp. 413–419.)

870. Observations on "On the Nature of the Geometrical, Mechanical, and Physical Entities: Importance of the Consideration of Symmetries and Dissymmetries."—Karpen: Bouthillon. (*Bull. de la Soc. franç. des Élec.*, Oct. 1939, Vol. 9, No. 106, pp. 818–820.) *See* 4248 of 1939.

871. The Magnetic Moments of the Proton and the Deuteron: the Radio-Frequency Spectrum of H_2 in Various Magnetic Fields [Measurements].—Kellogg & others. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, pp. 728–743.)

872. "Theory and Practice of Electron Diffraction" [Book Review].—Thomson & Cochrane. (*Current Science*, Bangalore, Oct. 1939, Vol. 8, No. 10, pp. 482–483.)

873. Measurements of the Mobility of Potassium Ions at High Field Intensity and Low Pressure [Experimental Data bracketed by Theories of Langevin and Hassé & Cook], *and* A Theory for the Mobility of Ions of High Velocity.—Hershey. (*Phys. Review*, 1st Nov. 1939, Series 2, Vol. 56, No. 9, pp. 908–915: pp. 916–922.)

874. The Second Townsend Ionisation Coefficient for Nickel Cathodes in Pure Hydrogen [Experimental Results].—Hale. (*Phys. Review*, 15th Oct. 1939, Series 2, Vol. 56, No. 8, p. 858: abstract only.) *See* also 3372 of 1939.

875. On the Hall Effect in Ferromagnetic Bodies.—Rudnitsky. (*Journ. of Phys.* [of USSR], No. 3, Vol. 1, 1939, pp. 247–250: in English.)

MISCELLANEOUS

876. The Application of the Tensor Concept to the Complete Analysis of Lumped, Active, Linear Networks.—Epstein & Donley. (*See* 694.)

877. The Equation $d^2 \log y/dx^2 = 1 - y$ when $y > 0$.—Carson & Richardson. (*See* 533.)

878. Relaxation Methods applied to Engineering Problems: V—Conformal Transformation of a Region in Plane Space.—Gandy & Southwell. (*See* 738.)

879. Resultant Intensity of Vibrations whose Phase Differences are at Random [Equation for Mathematical Expectation of Intensity reduces to Simple Approximation for Large Number with Approximately Equal Intensities].—Nakagami & Ohno. (*Electrot. Journ.*, Tokyo, Nov. 1939, Vol. 3, No. 11, pp. 262–263.)

880. "Wahrscheinlichkeitsrechnung für Nichtmathematiker" [Probability Calculation for Non-Mathematicians: Book Review].—Dörge. (*Zeitschr. f. tech. Phys.*, No. 10, Vol. 20, 1939, pp. 299–300.)

881. "Mathematics applied to Electrical Engineering" [Book Review].—Warren. (*Electrician*, 8th Dec. 1939, Vol. 123, p. 505.)

882. "Die Differentialgleichungen der Technik und Physik" [Book Review].—Hort (edited by Thoma). (*E.T.Z.*, 19th Oct. 1939, Vol. 60, No. 42, pp. 1219–1220.)

883. "TABLES FOR CONVERTING RECTANGULAR TO POLAR CO-ORDINATES" [Book Review].—Miller. (*Wireless Engineer*, Dec. 1939, Vol. 16, No. 195, p. 597.)

884. A VECTOR CONVERSION CHART [for Conversion from Polar to Rectangular Co-ordinates & *vice versa*].—Gruenberg & others. (*Electronics*, Nov. 1939, Vol. 12, No. 11, p. 42.)

885. STANDARD GRAPHICAL SYMBOLS IN POWER AND COMMUNICATIONS ENGINEERING.—Lieber. (*E.T.Z.*, 14th Sept. 1939, Vol. 60, No. 37, pp. 1091–1094.)

886. "COMPLETE PROCEEDINGS OF THE WORLD RADIO CONVENTION, SYDNEY, 1938" [Book Review].—(*Communications*, Aug. 1939, Vol. 19, No. 8, p. 11.) Already referred to in 2237 of 1939.

887. I.R.E. CONVENTION, 1939 [New York: including Shelby's C-R Frequency Modulator, Brown's Coaxial "Notching" Filters for Vestigial-Sideband Television Transmissions, etc.].—(*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 14–17 and 70, 71.)

888. RADIO AT THE TWENTIETH MILAN FAIR.—(*Alta Frequenza*, Aug./Sept. 1939, Vol. 8, No. 8/9, pp. 602–608.)

889. THE 16TH GREAT GERMAN BROADCASTING AND TELEVISION EXHIBITION, BERLIN, 1939.—Salow. (*E.T.Z.*, 12th Oct. 1939, Vol. 60, No. 41, pp. 1173–1177.)

890. PROPAGATION OF THE OSCILLATIONS OF H.F. TRANSMISSION ALONG ELECTRIC POWER NETWORKS [for Telemetering, Telephony, etc.].—Carbenay. (*See* 498.)

891. THE PROBLEM OF A SPHERE PLACED IN A HOMOGENEOUS ALTERNATING MAGNETIC OR ELECTRIC FIELD.—Divil'kovski. (*See* 727.)

892. EFFECT OF ULTRA-SHORT RADIO WAVES ON PLANT GROWTH [Experiments on Young Corn Seedlings with 2.5 m Waves: Reduced Growth, accounted for as Heat Effect].—van Overbeek, Brantley, & Potapenko. (*Science*, 17th Nov. 1939, Vol. 90, pp. 470–471.)

893. THE ORIGIN OF CORTICAL POTENTIALS [Necessity for Third View including & supplementing Those of Berger and Adrian], *and* ELECTROENCEPHALOGRAMS OF MENTAL PATIENTS.—Bagchi: Davis & Davis. (*Sci. & Culture*, Calcutta, Sept. 1939, Vol. 5, No. 3, pp. 195–196: Oct. 1939, No. 4, pp. 255–256.)

894. SOME IDEAS ON HUMAN ELECTROENCEPHALOGRAPHY [Recording of Cortical Potential Rhythms].—Fischgold. (*Bull. de la Soc. franç. des Élec.*, Sept. 1939, Vol. 9, No. 105, pp. 749–760.)

895. A NEW BIO-ELECTRONIC APPLICATION: ELECTROENCEPHALOGRAPHY [with Description of Amplifier, Ink-Writing Recording System, etc.].—Rahm. (*Electronics*, Oct. 1939, Vol. 12, No. 10, pp. 11–13.)

896. BIOELECTRIC POTENTIALS OF THE HEN'S EGG [Differences between Fertile and Infertile Fresh Eggs].—Romanoff & Cottrell. (*Science*, 17th Nov. 1939, Vol. 90, pp. 471–472.)

897. DIRECT LIGHTNING STROKES ON H.T. OVERHEAD LINES AND EXPERIMENTS WITH HAZEL-TWIG DIVINING [Direct Hits identified by Definite Characteristics: Localities traced, without Exception, by Divining Rod: Technique requires No Special Qualifications: etc.].—Baumeister. (*E.T.Z.*, 27th July 1939, Vol. 60, No. 30, pp. 892–896.)

898. "HOT" LIGHTNING USED IN TRANSFORMER TESTS.—(*See* 509, above.)

899. THE TIME TELESCOPE [Valve Equipment for Automatic Control of Motion-Picture Camera in Time-Lapse Photography, for Study of Plant Growth, etc.].—Dudley: Veber. (*Electronics*, Sept. 1939, Vol. 12, No. 9, pp. 24–27.)

900. AN ULTRASONIC STROBOSCOPE FOR MEASURING SOUND WAVELENGTH IN LIQUIDS.—Fox & Rock. (*Review of Scient. Instr.*, Nov. 1939, Vol. 10, No. 11, pp. 345–348.)

901. SUPER-STROBOSCOPE [Combination of Slotted Disc and Geared Multi-Faced Mirror: giving Visual or Photographic (Stationary-Film) Studies of Transient, Aperiodic, or Periodic Movements].—Kern & Company: Schiller. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, pp. 381–382.) *See* also 298 & 1933 of 1938.

902. A METHOD OF PURIFICATION OF LUBRICATING OILS [based on Effect of Electroconvective Eddies].—Avsec. (*Comptes Rendus*, 4th Dec. 1939, Vol. 209, No. 23, pp. 830–832.) *See* also 903, below.

903. INSTANTANEOUS ELECTROCONVECTIVE EDDIES IN INSULATING LIQUIDS [Photographs: Same Explanation as Permanent Eddies].—Avsec. (*Comptes Rendus*, 20th Nov. 1939, Vol. 209, No. 21, pp. 750–752.) For these electroconvective eddies *see* 1697 of 1937.

904. AN ELECTRICAL [Direct-Reading] METHOD OF MEASURING THE THICKNESS OF THICK CELLULOSE FILMS, WITH SPECIAL APPLICATION TO THE "HOT LACQUER" PROCESS.—Stephenson. (*Journ. of Scient. Instr.*, Dec. 1939, Vol. 16, No. 12, pp. 378–379.)

The measured capacity (of the order of 60 $\mu\mu$F) over a given surface area was found to provide a satisfactory measurement of the thickness: the method adopted was to connect the capacity across a generator of suitable impedance and to note the reduction of voltage from the open-circuit value, the indicating instrument of the valve-voltmeter performing this function being calibrated to read the actual film thickness. A valve-voltmeter was developed with the advantages of very high input impedance and calibration practically independent of supply-voltage variations and valve replacement: it consisted of a cathode-follower (Blumlein & others, 637 of 1939) feeding a rectifier micro-ammeter through a high resistance.

Wireless Patents

A Summary of Recently Accepted Specifications

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

ACOUSTICS AND AUDIO-FREQUENCY CIRCUITS AND APPARATUS

513 678.—Preventing electric and acoustic feed-back, likely to produce "howling," in a loud-speaking telephone system.

Radio Gramophone Development Co. and H. F. Duffell. Application date 18th January, 1938.

513 729.—Preventing "tape-noise" in sound recording and reproducing apparatus utilising a travelling band or tape of steel.

P. C. E. Lindsay and W. W. Whiffen. Application date 13th April, 1938.

513 940.—Arrangement of baffle-plates designed to give an "exponential horn" coupling between the back of the diaphragm of a cabinet loud speaker and the outside air.

A. A. Thornton (communicated by Philco Radio and Television Corpn.). Application date 25th March, 1938.

514 285.—Continuously-adjustable tone-control network, for audio-frequency signals.

Marconi's W.T. Co. (assignees of R. C. Ballard). Convention date (U.S.A.) 30th April, 1937.

RECEIVING CIRCUITS AND APPARATUS

(*See also under Television*)

513 626.—Amplifying system in which negative feed-back is combined with accepter or filter circuits, to secure high selectivity.

L. de Kramolin. Application date (earliest) 22nd December, 1936.

513 605.—Selective amplifier with two branched feed-back circuits, tuned on each side of the desired frequency, and inserted between the anode and screen grid of the valve.

Marconi's W.T. Co. and K. R. Sturley. Application date 14th April, 1938.

513 656.—Means for stabilising the amplitude of the frequencies generated, over a wide range, by a valve oscillator of the "two-terminal" or single tuned-circuit type.

Marconi's W.T. Co. (assignees of R. H. Siemens). Convention date (U.S.A.) 30th March, 1937.

513 679.—Oscillation generator particularly designed for remote-control tuning in a superhet receiver.

Marconi's W.T. Co. and J. F. Ramsay. Application date 17th February, 1938.

513 965.—Quick-action make-and-break contact for a press-button tuning system of the motor-driven type

Murphy Radio; G. B. Baker; and J. D. A. Boyd. Application date 23rd April, 1938.

514 026.—Press-button tuning system of the mechanical or no-motor type, with component parts designed for mass production.

The Crosley Radio Corpn. (assignees of H. J. Tyzzer). Convention dates 24th February and 7th April, 1938.

514 055.—Means for adjusting the gain and "equalisation" of a negative feed-back amplifier.

Standard Telephones and Cables and A. H. Roche (addition to 506 765). Application date 21st April, 1938.

514 059.—Means for correcting "phase-shift" in an amplifier using negative feed-back, so as to ensure stability.

Standard Telephones and Cables and A. H. Roche. Application date 23rd April, 1938.

514 060.—Adjusting and selecting mechanism for a motor-driven press-button tuning system.

The Plessey Co.; P. J. Packman; and P. H. Morrison. Application date 23rd April, 1938.

514 073.—Means for maintaining a constant input-capacitance, during variations of the trans-conductance, of an amplifying stage in a superhet receiver.

Hazeltine Corpn. (assignees of J. F. Farrington). Convention date (U.S.A.) 25th September, 1937.

514 183.—High-frequency switch in which spring strip-members ride over contact stubs, particularly for changing the wave-band in a wireless receiver.

Marconi's W.T. Co. and F. W. J. Sainsbury. Application date 28th April, 1938.

514 187.—Motor-driven antomatic-tuning arrangement for a wireless set, with means for preventing the motor from over-running the selected station.

Detrola Corpn. Convention date (U.S.A.) 11th December, 1937.

514 213.—Multi-wave receiver with a single tuning condenser and a number of coils the inductance of which is constantly altered by the rotation of the condenser.

R. Bosch G.M.B.H. Convention date (Germany) 29th April, 1937.

TELEVISION CIRCUITS AND APPARATUS

For Transmission and Reception

513 549.—Television receiver in which a control screen is placed between a photo-electric cathode and a fluorescent screen, and is scanned at two different velocities by an electron stream.

Fernseh Akt. Convention date (Germany) 13th April, 1937.

513 628.—Cathode-ray tube in which television signals are derived from a "mosaic" electrode of which parts are continuously coated with photo-sensitive material.

Baird Television and V. A. Jones. Application date 19th January, 1938.

513 693.—Cathode-ray television receiver in which a screen possessing physical-optical dispersion effects is used to modulate the rays from an external source of light.

Scophony and A. H. Rosenthal. Application date 12th April, 1938.

513 740.—Television receiver in which a screen of electrostatically-movable elements is scanned by an electron stream in order to modulate the light passing through.

Fernseh Akt. Convention date (Germany) 16th April, 1937.

513 776.—Cathode-ray television receiver in which a screen of alkali-halide crystals modulates the light which passes through it from an external lamp.

Scophony and A. H. Rosenthal. Application date 3rd February, 1938.

513 810.—Television receiver with a volume control which regulates the gain both of the radio and intermediate-frequency stages.

The General Electric Co. and D. C. Espley. Application date 18th July, 1938.

513 878.—Oscillating circuit, responsive both to a fundamental frequency and to its lower harmonics, for use in television scanning.

Fernseh Akt. Convention date (Germany) 24th April, 1937.

513 984.—Synchronising system for television in which a difference in the slope of the edges of the line and frame impulses is utilised to effect separation, and to develop pulses of different amplitudes.

Hazeltine Corporation (Assignees of M. Cawein). Convention date (U.S.A.) 2nd December, 1937.

514 021.—Televising pictures in natural colour by a method which depends upon separating "brightness" components from "colour" components, and transmitting them alternately in rapid succession.

K. H. Kerber. Convention date (Germany) 11th September, 1937.

514 038.—Interlaced scanning system in which the line signals are dephased and rephased between successive frame signals.

Cie des "Compteurs." Convention date (France) 27th February, 1937.

514 065.—Thermionic valve circuit for "mixing" different trains of signals, and for producing synchronising impulses for use in television.

A. D. Blumlein. Application date 25th April, 1938.

TRANSMITTING CIRCUITS AND APPARATUS

(See also under Television)

513 655.—Method of cooling high-powered transmitter valves, and of preventing dielectric losses in the glass bulb.

Standard Telephones and Cables and W. T. Gibson. Application date 29th March, 1938.

514 286.—High-frequency oscillation-generator, the frequency of which is substantially independent of any variations in the amplifier—or other load—to which it is coupled.

Marconi's W.T. Co. (assignees of J. W. Conklin). Convention date (U.S.A.) 30th April, 1937.

514 418.—High-frequency generator provided with means for eliminating undesired harmonics and similar parasitic oscillations.

Marconi's W.T. Co. and E. Green. Application date 6th May, 1938.

CONSTRUCTION OF ELECTRONIC-DISCHARGE DEVICES

513 640.—Construction and assembly of the electrodes of a cathode-ray tube, particularly the cathode and associated parts.

Standard Telephones and Cables; F. D. Goodchild; D. H. Black; and C. H. Foulkes. Application date 11th March, 1938.

514 335.—Electron-multiplier which is divided into partitions by screens which are provided with an electron-permeable aperture in order to prevent disturbances due to random electrons and positive ions.

Baird Television (Fernseh Akt.). Application date 3rd May, 1938.

514 455.—Electrode arrangement to facilitate the heating of the anode of a valve by high-frequency induction in the process of manufacture.

Standard Telephones and Cables and F. D. Goodchild. Application date 6th May, 1938.

SUBSIDIARY APPARATUS AND MATERIALS

512 995.—Gas-filled discharge tube designed to allow a large output to be controlled by a low anode voltage and small grid-variations.

Marconi's W.T. Co. (assignees of H. Nelson). Convention date (U.S.A.) 27th March, 1937.

513 066.—Sensitive relay of the astatic type, suitable for automatically maintaining a predetermined voltage.

The English Electric Co. and G. Tilstone. Application date 28th March, 1938.

513 162.—Means for automatically switching-in a spare amplifier to replace one that is faulty.

Standard Telephones and Cables; K. G. Hodgson; and A. H. Roche. Application date 4th March, 1938.

513 536.—Multivibrator or cross-coupled valve circuit in which a square-topped voltage output is produced across an impedance in the cathode circuit of one of the valves.

E. L. C. White. Application date 11th April, 1938.