Gramophone pick-ups with sapphire and diamond styli have largely replaced the older pick-ups which used interchangeable steel needles. One important reason for this lies in the enormously lower wear styli have largely replaced the older pick-ups which is maintained the better. The photographs of fig. 1 show how well sapphire and diamond needles maintain their shape, even after hundreds of hours of use. A steel needle wears to the groove shape after only one playing. Another important advantage of the sapphire and diamond styli is that the moving system of the pick-up can be made with a much smaller moment of inertia than in the older types with their comparatively massive steel needle and holder. In modern pick-ups using sapphire and diamond styli, the effective mass at the needle point may be as little as 3 mg, resulting in a cut-off frequency due to stylus/groove resonance of the order of 20 kc/s, which is well above the limit of the audible frequency range 1).

Sapphire and diamond styli for gramophone pick-ups are manufactured in the Philips diamond factory at Valkenswaard (near Eindhoven). Sapphire cylinders 3 mm long and 0.4 mm in diameter, cut from sheets of synthetic sapphire, are mounted in small rotating heads by means of shellac. A number of such heads are placed at an angle (22°) to an equal number of cast-iron grinding wheels, the pores of which contain a little diamond dust in oil. The heads and the grinding wheels are rotated at high speed while at the same time the grinding wheels are given a slow reciprocating movement parallel to their surface in order to obtain uniform grinding (fig. 2).

In this way the cylinder is given a conical end. The process is stopped, however, before the cone is sharp-pointed, as this tends to cause breakages during further handling. The sapphire cylinder is then reversed and the coning operation repeated on the other end. Subsequently the needles are broken in half, ground to a length of 1 mm and cleaned, and are then ready for the radiusing of the points. This is done by placing a large number of them (several thousands) together in a bottle containing diamond dust in oil. The bottle is then vibrated for several days, after which the points are found to be spherical in shape. The radius becomes greater as the vibration is continued. In this way the required radius (25 μ for microgroove records, 75 μ for normal 78 r.p.m. records) is easily obtained 2).

For diamond styli, selected stones are first cut parallel to the (111) plane to give plates 1.6 mm in thickness (fig. 3). From these plates cylinders 0.3 mm in diameter are cut by means of thin-walled nickel tubes rotating at about 10 000 r.p.m. and containing diamond dust in oil. The ends of the cylinders which will become the points of the styli are therefore in the (111) plane. This plane is chosen partly because of its great wear resistance 3) but

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2) For an explanation of these terms and a fuller discussion of the questions involved, see J. B. S. M. Kerstens, Mechanical phenomena in gramophone pick-ups at high audio frequencies, Philips tech. Rev. 18, 89-97, 1956/57; also N. Wittenberg, A magnetodynamic gramophone pick-up, Philips tech. Rev. 18, 101-109 and 173-178, 1956/57.

3) The same technique is used for rounding off the edges of quartz oscillator crystals.

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Fig. 2. Part of the 10-head machine for grinding cones on the ends of sapphire and diamond cylinders. The frame of the machine is suspended on four flexible steel strips. At one end of the machine a cam imparts a slow reciprocating movement to the whole frame, parallel to the surfaces of the grinding wheels. The sapphire or diamond cylinders are fixed in the rotating heads by means of shellac.

Fig. 3. Diamond platelet, 1.6 mm thick, cut parallel to the octahedral (111) plane and drilled out to give cylinders of 0.3 mm diameter (see fig. 4, above).

also because (111) faces of reasonable area can be cut from the natural crystal without too much loss of material. Next a cone is cut at each end of the cylinder in the same way as for sapphire. In the case of diamond, however, the operation takes about 10 times longer. The radiusing of the ends cannot be effectively performed by the technique used for sapphire in view of the greater hardness and the fact that the mass of the diamond styli is considerably less. Diamond styli are therefore radiused by hand on a special grinding wheel. The rotating head containing the diamond stylus is removed from the coning machine and set in the radiusing machine; the latter is equipped with a microscope for control of the operation. The radiusing takes about one minute. The diamond cylinder is then reversed in the rotating head and replaced in the coning machine; this is again followed by the radiusing operation. After cleaving the pointed cylinder in half and cleaning, the styli are ready for mounting. Fig. 4 gives an idea of the size of the diamond cylinder and the finished stylus.

Of the original diamond, less than half can be drilled out into cylinders of the required dimensions. The remaining drilled stones are crushed to form diamond dust. Diamond dust is also recovered from

Fig. 4. Above, shadow photograph of diamond cylinder as bored from diamond platelet; below, shadow photograph of a finished stylus, 0.3 mm diam., 0.6 mm long.
A tiny aluminium bushing is picked up on the end of a 0.3 mm bore nickel tube through which air is sucked (tweezers are not very suitable for handling such small objects). The bushing is placed on a hollow jig mounted in a light press (fig. 5). Air is also sucked through this jig and the dimensions and pressure are so chosen that the bushing is taken over from the nickel tube and seated in the correct position. A stylus is then placed inside the bushing, point downwards; the suction causes the point to come up against a stop which ensures a constant projection of the stylus below the stylus arm. The latter is placed round the bushing and the press operated, providing a completely rigid mounting for the stylus (fig. 6).

The mounted styli are then individually checked in low-power projection microscopes (fig. 7).

A. W. PLOEGSMA.
ABSTRACTS OF RECENT SCIENTIFIC PUBLICATIONS BY THE STAFF OF N.V. PHILIPS' GLOEILAMPENFABRIEKEN

Reprints of these papers not marked with an asterisk * can be obtained free of charge upon application to the Philips Research Laboratory, Eindhoven, Netherlands.

2512*: J. Volger and J. M. Stevels: Continuation des recherches expérimentales sur les pertes diélectriques de certains verres aux basses températures (Verres et Réfractaires 11, 137-146, 1957, No. 3).

Translation of article in Philips Res. Repts 11, 452-470, 1956 (see these Abstracts No. R 301).


The preparation and the fungitoxic properties of some thiosulphonic esters (type \( p-\text{CH}_3\text{C}_6\text{H}_4\text{SO}_2\text{SR} \)) and of some reaction products of trichloromethanesulphonyl chloride with thiosulphonic acid salts and with thiophenols are described in this paper.


A mixed anhydride of trichloromethanesulphonic acid and benzoic acid has been prepared for which the name of benzoic trichloromethanesulphinic anhydride is proposed. Some chemical and biological properties of the new compound are described.


See book notice below, p. 332.


Survey of ferrite applications for modulation in tuned circuits, in phase and frequency modulators, in magnetic modulators and in absorption modulators for S.H.F.


It is well known that the efficiency of a triode decreases at higher frequencies. This is due to the fact that the transit time of the electrons is no longer negligible in comparison with the period of the oscillations. The transit time can be made small by mounting the electrodes very close together and by applying large potential differences. Both measures, however, give rise to large current densities. As a result, the design of high-frequency transmitting valves comes against a number of technological problems, of which two are mentioned in this article: cathodes with a high current-density emission and grids with a large specific dissipation. A new material for the grids (K-material) is described for which continuous dissipations of up to 30 W per cm² are possible. The high-frequency resistance is sufficiently low to permit use in transmitting valves for decimetre waves. The article concludes with a short description of such a valve.

2518: E. G. Dorgelo: Gitterprobleme bei Sendetrioden in Schaltungen der industriellen Elektronik (Funk-Technik 12, 528, 530 and 532, 1957, No. 15). (Grid problems in transmitting triodes used in industrial electronics; in German.)

It is common practice to include in the published data of transmitting valves, so-called limiting values for grid input. As long as this value is not exceeded, there ought to be no excessive thermal emission from the grid. There are three contributions to the total power, dissipated in the grid: heat generated by electron bombardment, absorbed radiation from other electrodes and R.F. losses. In general, the user can measure only the first mentioned. Even here errors can be made due to the fact that the measured grid current is not representative of the number of electrons arriving at the grid. When secondary emission is present, other electrons will leave the grid and the measured current is smaller than the actual grid current. In view of this...
fact that the valve manufacturer usually does not give an indication what he actually means by the published value and also because it is physically impossible to measure the true grid currents, it is rather difficult for the user to evaluate the quality of a valve merely from the published data. In an example the author compares two equivalent valve types of different make. Measurements reveal that the valve with the best-looking published data shows the highest thermal emission of the grid.


Various cobalt-ferrous ferrites show a constricted hysteresis loop. After magnetic annealing of the samples, the loop becomes rectangular. It appears that the magnetic annealing creates in each crystal a uniaxial anisotropy in a direction which is not necessarily the direction of the applied magnetic field but a crystallographic direction nearest to it. It is suggested that directional ordering is the most probable origin of the anisotropy found.


Extension of the work abstracted in No. 2519 to cobalt ferrites of other composition. When a ferrite containing cobalt is cooled in a magnetic field, diffusion of \( \text{Co}^{2+} \) ions causes a uniaxial anisotropy that is apparent in a rectangular hysteresis loop. In various ferrites containing only a small proportion of \( \text{Co}^{2+} \) ions, this diffusion is very slow. For the composition \( (\text{Mg}_{0.55} \text{Ni}_{0.45})_{0.98} \text{Co}_{0.02} \text{Fe}_2 \text{O}_4 \), however, this diffusion is fast; on cooling in a magnetic field, a weak coercive force and an extremely rectangular hysteresis loop are obtained. The loop is practically independent of temperature.


An analysis of the voltage pulses obtained across a secondary winding of a ferrite core on reversing the magnetization shows that in the reversal two stages should be distinguished, namely a fast response, related to a magnetization by rotations, and a slower response due to the displacements of domain walls. The viscous movement of the domain walls determines the switching time of the core. It appears that the switching times of rectangular-loop ferrites with widely varying chemical compositions are always of the order of magnitude of one microsecond when the coercive force is of the order of magnitude of one oersted. Higher values of the coercive force mostly go hand in hand with an increased switching time. In order to obtain some information about the origin of the damping of domain-wall displacements, switching times have been measured as a function of temperature and as a function of a uniaxial pressure applied to the core. In the temperature range -115 to +250 °C the switching time of an arbitrarily chosen rectangular-loop ferrite did not decrease more than by a factor of about three. A uniaxial pressure applied to a ferrite also increases both its coercive force and its switching time. It appears that the switching time is greater when the anisotropies in the ferrite are greater. This can at least partly be explained by the increased distance between the walls in the case of higher magnetic anisotropies.


In recent experiments the compositions and methods of preparation of various ferrites were varied with the aim of achieving optimum magnetic, magnetomechanical and mechanical performance. Essential improvements of the temperature dependence of the permeability, the piezomagnetic coupling coefficient and the mechanical resonant frequencies have been obtained. These were achieved by small cobalt substitutions in nickel and lithium ferrite and in mixed nickel-zinc and lithium-zinc ferrites. The total variations of the mechanical resonant and anti-resonant frequencies of ferrite filter elements in the temperature range 20-50 °C are normally 0.10-0.25% in existing commercial nickel and nickel-zinc ferrites, but have been reduced to 0.03% or less. The coupling coefficient at remanence of such a stable ferrite may be well above 0.20 with a suitably modified sintering treatment. Since the mechanical Q-factors are usually much better than 2000, such ferrite vibrators can be profitably applied to the construction of electrical and electromechanical band-pass filters. The cobalt substitutions, apart from leading to a very low temperature coefficient of the real part of the permeability, also decrease the imaginary part, so that these cobalt-substituted ferrites have a high figure of merit. (See also Philips tech. Rev. 18, 285-298, 1956/57 (No. 10), and No. R 310 of these Abstracts.)

This review paper, given for the Conference on Rock Magnetism (London, November 1956), mainly deals with previous work on ferrimagnetic oxides with spinel structure, described in Nos. R 248, R 249 and R 253 of these Abstracts, insofar as it has a bearing on the ferrimagnetic oxides occurring in nature. In § 1 a more suitable representation of the composition diagram FeO-Fe₂O₃-TiO₂ is proposed. § 2 treats the cation distribution among tetrahedral and octahedral lattice sites and its methods of measurement, the valency of the transition ions present and the saturation magnetization as depending on composition, and discusses the difficulty of establishing the presence of miscibility gaps in a solid-solution series. § 3 discusses the relative orientation of the ionic magnetic moments in the spinel, hematite and pseudobrookite structures, as derived from Anderson's theory. It is shown that none of the explanations so far given for the behaviour of ilmenite, FeTiO₃, are satisfactory. In § 4 attention is drawn to the probability of exchange coupling between two phases as a governing mechanism for reverse thermoremanent magnetization.


By heating silver containing e.g. 0.05% Mg in molten AgF, two diffusion zones are obtained. The two sharp boundaries are not affected perceptibly by grain boundaries. This "internal fluorination" causes hardening. Probably the inner zone contains MgF₂ and the outer zone a double fluoride like AgMgF₃.


Brief note on a calibrated, direct-reading microwave impedance. An absorbing vane is fixed on a plunger which can be moved axially and also rotated over 90° in a circular waveguide. The modulus of the reflection coefficient depends on the angular position of the plunger and its argument on the axial position.

2526: F. C. de Ronde: Une nouvelle méthode de mesure de la constante diélectrique et de la perméabilité magnétique des matières solides en ondes centimétriques (Arch. des Sci. 10, fasc. spéc. 6e Colloque Ampère, Rennes-St.-Malo, April 1957, pp. 68-70).

Brief description of a new method for measuring dielectric constant and magnetic permeability in solids at microwave frequencies. The method involves direct measurement of the characteristic impedance of a waveguide filled with the material.


Two valves, the EC 56 and the EC 57, for use in beam transmitters are described in this article. The use of L-cathodes, which give long life even at high current densities, and of discs of high H.F. conductivity, leads to an efficiency and a gain which are relatively high for triodes. Some details of the design and of the method of manufacture are given. The behaviour of the valves in an amplifier is discussed. The input impedance is given particular attention. The feedback is found to depend closely on the amplification factor of the valve and to exert an influence on the output power attainable. Finally various other applications of the valves are mentioned. (See also Philips tech. Rev. 18, 317-324, 1956/57 (No. 11) and 19, 145-156, 1957/58 (No. 5)).


In a non-oscillating cut-off magnetron the motion of the electrons gives rise to a space-charge cloud round the cathode. It is shown that by means of a narrow electron beam, injected parallel to the cathode, the electron paths can be imaged on a fluorescent screen. The electrons are found to describe cycloidal paths starting from the cathode; the radial velocity can be derived from the tangential component of the (thermal) initial velocity. The paths of the electrons are found to be strongly dependent on their initial velocity. To a first approximation, the density of the space-charge cloud is constant.


An oscillator tube is described which shows some resemblance to a magnetron both in construction and in operation. It differs from a magnetron, however, in that the path of the electron beam is
determined electrostatically. The beam moves in circular paths between two concentric cylinders. The inner cylinder, which is at a higher potential than the outer one, forms part of an H.F. circuit. In this respect also it differs from a magnetron, where the outer cylinder forms part of the resonant circuit. The maximum beam current and the oscillator frequency are calculated as functions of the electron velocity, and the results are compared with experimental observations. It is amusing to notice that the electrons behave as the electric analogue of planetary satellites: the orbiting electrons are in equilibrium with the attractive force of the electrostatic field.

2530: J. J. Balder: Illuminated borders to picture screens (Light and Lighting 50, 245-250, 1957, No. 8).

A series of tests was carried out in which a person looking at a picture screen was asked to give his opinion as to the ideal luminance and width of a uniformly illuminated border round the picture giving optimum viewing comfort. The observations were made by 20-25 persons for a number of luminance levels of both screen and surroundings. (See also Philips tech. Rev. 19, 156-158, 1957/58 (No. 5).)


Some partially hydrogenated derivatives of ergocalciferol are described; their structures are discussed, and their activities in raising the serum calcium level of rats are reported.


A chemical routine method for the determination of vitamins D₃ and D₄ in a number of preparations is presented. The results obtained agree very well with those obtained with the rat and chick assays respectively.


Adjustment of the activity of adsorbents for chromatographic use (e.g. Al₂O₃ or CaHPO₄ by the controlled take-up of water) can be done in a reproducible and accurate manner with the aid of the "shake test". It consists in shaking a weighed sample (2 g) of the adsorbent with a measured volume (10 ml) of the elution solvent in which the substance to be eluted (e.g. 1000 I.U. of vitamin A) has been dissolved. The activity is suitable if about 50% is adsorbed. The following operations can be performed by means of the shake test: 1) determination of the activity of adsorbents; 2) adjustment of the activity of an adsorbent; 3) replacement of an adsorbent by another of the same activity; 4) finding the correct composition of the elution solvent; 5) replacement of one solvent by another of equal eluting power. The shake test has been developed for a 10 cm column containing 10 g of Al₂O₃; 40% adsorption is satisfactory for rapid elution. If slower elution is wanted, or if thinner columns (containing less adsorbent) are employed, the percentage adsorption must be larger than 40%, up to 60%. The shake test is a purely practical test; no theoretical significance can be attached to it.


A description is given of an apparatus capable of producing a fast neutron flux exceeding 10¹⁰ neutrons per second from a D-D reaction. The set consists of a pressurized cascade generator and an accelerator tube with a rotary heavy-ice target. The rectifiers used are of the selenium type.

2535: F. W. Klaarenbeek and M. H. de Lange: Enkele aspecten van de warmtetechniek van glasmeltovens (Ingenieur 69, W137-W140, 27 Sept. 1957). (Some aspects of heating techniques in glass furnaces; in Dutch.)

A brief description is given of the melting process of glass and of the furnaces mostly used. An attempt is made to formulate the requirements of these furnaces. Some experiences from industrial practice are compared with the results of flame research at IJmuiden (Netherlands).

Experiments at low temperatures on solids with various lattice defects have revealed the existence of dielectric relaxation phenomena due to these defects. The relaxation times are governed by activation energies far smaller than those normally found with diffusion or migration of ions. Typical measurements are given and discussed qualitatively in relation to models of some lattice imperfections including colour centres.


Diffusion data, if available in the form \( D = D_0 \exp (-E/kT) \), yield two parameters, whereas for a molecular description more quantities are needed. Some difficulties encountered with this problem are discussed. This problem has kinetic as well as equilibrium aspects. The equilibrium aspect has been successfully attacked by the theory of lattice defects: it is possible to specify the atoms that are mobile as well as the frequency with which these mobile atoms jump. Recently, a novel kinetic aspect of the mechanism has become of interest, viz., the problem of correlation between the directions of consecutive jumps of an atom. These correlations effectively alter the self-diffusion coefficient in certain mechanisms, but not the diffusion coefficient for drift or the ionic conductivity. The latter aspect has recently been developed to a promising method of disentangling diffusion mechanisms, especially in ionic crystals.


Short survey article on investigations on hexagonal ferrites carried out in recent years at the Philips Research Laboratories. These ferrites, apart from various small metal ions, always contain at least one type of metal ion of larger radius, e.g. \( \text{Ba}^{2+} \). The crystal structures of a number of compounds of the ternary system \( \text{BaO-Fe}_2\text{O}_3-\text{MeO} \) are discussed (Me is a metal with small ionic radius). All these compounds have structures closely related to close-packed structures of the large ions (\( \text{O}^{2-} \) and \( \text{Ba}^{2+} \)). The unravelling of these structures has been accomplished by X-ray crystallographic methods. The magnetic properties of these compounds are the most important from the point of view of practical applications. (See Philips tech. Rev. 13, 181-193, 1951/52, and 18, 145-154, 1956/57.)


Three out of five sulfhydryl-containing compounds, subjected to amperometric titration with silver nitrate, appear to combine with more Ag than corresponds to their sulfhydryl content.


In recent years a colour-television transmission system using two sub-carriers for the transmission of the chrominance information has been developed. Practical results were demonstrated to Study Group XI of the C.C.I.R. in 1955 and 1956. The principles and evolution of the system have been described and discussed in previous articles. In this article the technical aspects are considered in more detail and data are given about modifications and improvements which have since been introduced.

2541: J. J. Balder: Erwünschte Leuchtdichten in Büroräumen (Lichttechnik 9, 455-461, 1957, No. 9). (Preferred values of luminances in office rooms; in German.)

A series of tests has established what luminance values the working surface, walls and ceiling should have in office rooms in order to make the surroundings as agreeable as possible to work in. The illumination system used during the tests was ideal in the sense that light falling on the working surface comes from the right directions, and the field of vision contains no disagreeably high luminances of lamps or reflections.


The phenomena involved in gas discharges at atmospheric pressure are of a complex nature. Although the application of arc welding has grown enormously in the last twenty years, only a very limited number of papers dealing with the theory of the arc have appeared. In the arc there is the extra complication that the arc is continuously
interrupted by the droplet transfer. Most investigations on the arc discharge have therefore been made using non-consumable electrodes (carbon arc welding and gas-shielded tungsten arc welding). This paper discusses the cathodic and anodic mechanisms, the questions of the extremely high temperature of the arc and the heating effects at the electrodes. In addition to the D.C. arc, welding with A.C. is also discussed and finally the mechanism of droplet transfer is briefly considered.


In arc welding of steel with coated electrodes, oxygen, nitrogen and hydrogen are taken up by the carbon-containing weld metal, the amounts taken up being mainly determined by the composition of the coating. In general no equilibria are established and the amounts of the gases taken up cannot therefore be calculated, but nevertheless the laws of chemical equilibrium do enable us to draw a few important conclusions of a qualitative nature. Two of the most important conclusions are: 1) the more stable the oxides of the coating, the less oxygen will be absorbed by the metal; 2) if the water content of the coating remains constant, the amount of hydrogen taken up by the metal will be greater the smaller the amount of oxygen taken up. When the metal solidifies, part of the C, O, N and H present is given off in the form of CO, CO₂, H₂O, H₂ and N₂. Under adverse conditions the evolution of these gases may lead to porosity of the weld. The role played by sulphur in this connection is discussed. The deleterious effects of oxygen, nitrogen and hydrogen left in the metal after solidification, especially aging effects, are also discussed. On the basis of dislocation theory, tentative conclusions can be arrived at regarding the influence of interstitial elements on the brittle fracture of steel and on the different sensitivities of ferritic and austenitic steels to these impurities.

H 1: F. Karstensen: Preferential diffusion of Sb along small-angle boundaries in Ge and the dependence of this effect on the direction of the dislocation lines in the boundary (J. Electronics and Control 3, 305-307, 1957, No. 3).

Note reporting experiments which show that the rate of diffusion of antimony along the dislocation lines forming a small-angle boundary in germanium exceeds that of self-diffusion in germanium. No such effect is observed in the crystal boundary perpendicular to the dislocation lines.

NOW AVAILABLE


This book (published only in French) forms a record of the papers presented at a colloquium held at Eindhoven in September 1956 on the subject of diffusion in metals. The first paper gives an introductory survey and, of the following papers, two are concerned with the effect of structural defects on the diffusion, four on the Kirkendall effect, two on the diffusion of interstitial atoms and one on the effect of elastic stress on diffusion. The English titles of the papers are as follows: Introduction to the study of diffusion, by A. D. le Claire; The diffusion of radio-tracers in solids, by K. Compaan and Y. Haven; Intergranular diffusion and its relation to grain boundary structure, by P. Lacombe; Intergranular self-diffusion of α-iron, by C. Leymonie and P. Lacombe; New observations on the Kirkendall effect and on electrolytic transport in solid alloys, by Th. Heumann; An electron-beam micro analyser and its use in the study of intermetallic diffusion, by J. Philibert; Study of the diffusion uranium-zirconium in the γ phase, by Y. Adda and J. Philibert; The Kirkendall effect and diffusion in the system gold-platinum, by A. Bolk and T. J. Tiedema; Diffusion of interstitial atoms, by J. L. Meijering; Study of the non-steady permeation of helium through silicon and germanium by means of a mass spectrometer, by A. van Wieringen; Effect of elastic deformation on the mobility of vacancies in copper, by C. W. Berghout.