

ABSTRACTS FROM THE SCIENTIFIC AND TECHNICAL PRESS.

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Air Flow Round a Model. The Soap Bubble Method. (M. H. Redon and M. F. Vinsonneau, *L'Aeron.*, No. 204, May, 1936, pp. 60-66.) (46/1 France.)

Certain defects of the smoke method when applied to the study of a flow which is not two-dimensional, *e.g.*, flow around a fuselage, particularly at the junction of wing and fuselage, has led to the development of a method which will show individual trajectories issuing from a single point in space. Use is made of resistant soap bubbles capable of traversing the whole field to be observed without bursting at any test speeds, and which are sufficiently light and small to follow the slightest changes in the aerodynamic field. A solution of 5 per cent. Marseille soap in distilled water gives bubbles capable of travelling the whole length (5.5 m.) of a wind tunnel. To ensure that the bubbles are sufficiently light, results obtained with them in two-dimensional flow are compared with results obtained by the smoke method and found to be identical. The emitting device, which can be moved at will in three directions at right angles, and the system for supply of air are fully described. Illumination is by a beam of plane parallel light and observation is in a direction perpendicular to this plane. One single trajectory then appears as a double luminous tract. Photographs are given showing the application of the method to study of the flow round simple bodies, round wing profiles, at the junction of wing and fuselage and to the study of a marginal vortex.

Methods of Rendering Air Flow Visible. (S. Eicke and R. Wille, *Forschung*, Vol. 8, No. 1, Jan.-Feb., 1937, p. 10-12.) (46/2 Germany.)

In order to render highly turbulent air streams visible, the suspended particles must possess very small rates of descent and at the same time be large enough to render short photographic exposure possible.

It has been found that metaldehyde flakes (obtained by sublimation of the solid) are very suitable for this purpose.

Various examples of stationary and non-stationary flow pictures are given, the air velocity exceeding 20 m./s. in some instances.

The method also lends itself to three-dimensional investigations with the stereo camera.

Buoyancy of Plane Gliding Surfaces. (F. Weinig, *Werft-Reederei-Hafen*, Vol. 18, No. 9, 23rd April, 1937, pp. 115-20.) (46/3 Germany.)

Possible methods of solving the problem of flow on gliding surfaces are briefly mentioned and the important case of plane surfaces dealt with by the hodograph method. A method for calculating flow on any curved gliding surface (the I—I

process) is described and experimental results are compared with the simple theory of lifting wings. It is shown that the pressures occurring in the case of a plane surface and an ideal fluid coincide to a great extent with those on the pressure side of thin lifting wings of similar form, so that the aerofoil theory can be applied to gliding surfaces for all conditions of flow so long as the effect of gravity is not taken into account. An attempt has been made to allow for this effect by an empirical interpolation formula obtained from the experimental results.

Vortex Formation and Action of Forces on Rotating Turbine Blades. (E. Frietsch, V.D.I. Forschungsheft, No. 384, May-June, 1937.) (46/4 Germany.)

This work represents a further advance in explaining experimentally the connection between fluid motion and exchange of energy in a turbine. The forces and types of flow about a rotating paddle wheel in an open circular tank, having sources of flow placed symmetrically about the axis, are investigated under different conditions of flow and both are recorded adjacently on a film; a good insight is thus obtained into the connection between the detachment of vortices and the forces acting. The films show that in the case of pure displacement flow, the force varies with the same period as that of detachment of vortices. Logarithmic spiral forms of blade give particularly small vortex formation and therefore small resistance. Experiments with blade grids enable the effect of a vortex on neighbouring blades to be seen; breaking away of a vortex can even cause a negative force effect on the subsequent blade. The experimental results are not only important in turbine construction, for explaining many abnormal types of operating conditions, but are of the greatest interest in general hydrodynamic problems.

Non-Stationary Gas Flow in Pipes of Variable Cross-Section. (J. Aschenbrenner, Forschung, Vol. 8, No. 3, May-June, 1937, pp. 118-30.) (46/5 Germany.)

In high speed steam or internal combustion engines, the velocity of the gas in the cross-sections of the valves or distributors varies very rapidly, and it is not possible to describe the movement by using only "quasi-stationary" formulæ. Methods of calculation for cylindrical tubes have already been given by F. Sasz, O. Lutz and A. Pischinger. In the present paper these methods of calculation are extended to tubes of variable cross-section. A graphical numerical method for dealing with non-stationary movement, with variable pressure and velocity, is developed.

Experiments in Making Lines of Flow Visible. (A. Lippisch, 1935 Year Book of the Vereinigung für Luftfahrtforsch., pp. 118-26.) (46/6 Germany.)

Difficulties encountered in making flow visible in a satisfactory manner are discussed. The author uses the well-known smoke method, taking the greatest precautions (rectifier and wire gauge grid) to ensure that the flow in the wind tunnel is absolutely steady, so that a smoke trace is maintained throughout the whole length of the tunnel. For this it is essential that the smoke is introduced under pressure in front of the nozzle so that it emerges with exactly the same speed as the air in the tunnel. The smoke producing substance proposed is the preparation "Euscol," a peat-like plant substance which gives a very dense white smoke and has not the disadvantage of ammonium chloride fumes which stop up pipe lines due to deposition of the salt on the walls. The smoke-producing equipment is described and a series of photographs obtained by the method is given.

The Evaluation of Gliding Surface Experiments. (A. Sambraus, 1935 Year Book of the Vereinigung für Luftfahrtforsch., pp. 127-38.) (46/7 Germany.)

Experiments with gliding plates were carried out with narrow plates and at highest possible Froude's numbers, in order to explain the difference between

theory and practice in the case of long plates, *i.e.*, to separate as far as possible the effect of gravity from that of finite angle of incidence.

The results showed that:—

1. At large values of Froude's number comparison with a lifting wing remains valid at higher angles of incidence, than originally expected.
2. Buoyancy is not a linear function of the angle of incidence.

The experiments also confirmed the theoretical conclusion that in the case of short plates the effect of gravity is to increase resistance.

Application of the Electrical Method to Some Questions of a Lifting Wing. (J. Pérès and L. Malavard, *Sci. Aérienne*, Vol. 5, 1936, pp. 361-73.) (46/8 France.)

The well-known electrical hydrodynamical analogy is applied to the solution of problems arising in the Prandtl first order wing theory, the particular problem considered being that of solving the monoplane equation experimentally by electrical means, instead of numerically. A simple electrical analogy is shown to exist for the basic integral equation giving the circulation distribution as a function of the variation of chord and angle of attack over the wing span. An apparatus based on this analogy is described diagrammatically. It enables this equation to be readily solved for any finite number of points along the span. The results of a series of calculations made with this apparatus are compared with corresponding results obtained in a wind tunnel or calculated by Lotz's method. The agreement is good in all cases. The time required for the solution of a definite problem is stated to be much less by the electrical than by the numerical method.

Some Research Apparatus of the D.V.L. (Rudder Position, Effort Meter for Moving Controls, Force Recorder for Parachutes). (R. Sancéry, *L'Aeron.*, No. 204, May, 1936, pp. 97-102.) (46/9 Germany.)

All the instruments operate on the "scratch" principle (D.R.P. 557, 378), in which records are made by a diamond on a glass or steel surface. Those described here are:—

Rudder Deflection Recorder.—This is generally attached to the fixed portion of the wing and records the deflection of rudder, elevator or aileron, the motion of the control surface being communicated to the diamond by means of a simple lever or strut.

Effort Meter (Main Control).—This is attached to the joy stick and the effort is measured by the deflection of a spring and recorded by the scratch method as before.

Effort Meter (Rudder).—Instruments are used in pairs, incorporated in the foot pedals and will operate in all flying attitudes.

Parachute Opening Shock Recorder.—The instrument is fitted between the parachute and the dummy. The measuring element consists of a spring of very high natural frequency, the shock being recorded directly by the scratch method.

(For an account of other D.V.L. instruments, see Translations Nos. 471-3.)

Tail Wheel or Nose Wheel? (F. R. Stanley, *Aviation*, Vol. 35, No. 6, June, 1936, pp. 29-32.) (46/10 U.S.A.)

The author investigates some of the causes of so-called "ground looping," *i.e.*, the instability observed with certain machines when landing in a cross wind and which causes them to swing violently after touching ground. The instability is largely due to the swivelled tail wheel whilst the nose wheel landing gear does not suffer from this defect. As ground stability is of great importance when landing blind, every attempt should be made to improve the stability of conventional types of landing gear in addition to carrying out experiments with the new nose wheel type. The author puts forward the following suggestions. The

ground stability of existing tail wheel landing gears could be improved by (1) locking or braking the tail wheel in landing; (2) further separating the front wheels; (3) increasing vertical travel of tail wheel so that it always hits the ground first; (4) modifying tyre treads so that side loads built up more readily on tail than on front wheels; (5) the conventional tail wheel gear can be made stable by swivelling the front wheels and keeping the tail wheel fixed; (6) with a stable tail wheel gear, it is best to land with brakes released until the tail carries some weight; (7) under the same circumstances steering on the ground might best be accomplished by steering the front wheels and have a non-swivelling tail wheel; (8) the ground stability of the nose wheel gear appears to be its most valuable asset.

Tests of Manœuvrability and Description of the Necessary Instruments. (F. Haus, l'Aeronautique, No. 209, Oct., 1936, Suppl. l'Aerotechnique, No. 166, pp. 129-39.) (46/11 France.)

Equipment for synchronous recording of all the variables influencing the flight of an aeroplane, and for testing its manœuvrability, has been designed by M. Bouny, of the School of Mines, Mons.

The method employed is that of cinematography of direct reading instruments, all of which are grouped on a panel measuring 550 by 460 mm. and placed horizontally in the aeroplane, the camera being fixed permanently opposite this panel. The equipment comprises:—Two speed indicators, one for each wing; two incidence recorders; two side-slip recorders; apparent gravity recorder (three components); angular velocity recorder (three components); position recorder for three principal control surfaces. The instruments are described and corrections to be applied to them discussed. The apparatus was used in test flights in a Fairey "Fox," and the readings obtained during various manœuvres (rolls, spins and movements in one plane) are discussed.

An Analysis of Lateral Stability in Power-off Flight with Charts for Use in Design. (C. H. Zimmerman, N.A.C.A. Report No. 589, 1937.) (46/12 U.S.A.)

The aerodynamic and mass factors governing lateral stability are discussed and formulæ are given for their estimation. Relatively simple relationships between the governing factors and the resulting stability characteristics are presented. A series of charts is included with which approximate stability characteristics may be rapidly estimated. The effects of the various governing factors upon the stability characteristics are discussed in detail. It is pointed out that much additional research is necessary both to correlate stability characteristics with riding, flying, and handling qualities and to provide suitable data for accurate estimates of those characteristics of an aeroplane while it is in the design stage.

The Focke-Wulf Helicopter. (Les Ailes, No. 838, 8/7/37, p. 4.) (46/13 Germany.)

According to information received a sensational helicopter flight has just been accomplished in Germany. The Focke-Wulf machine, piloted by Rohlo has reached an altitude of 2,500 m., and during a flight lasting 1 h. 20 min. it has covered a closed circuit of over 80 km. and a straight course of 16 km. at an average speed of 122 km./hour. Thus both the Breguet-Dorand and the Ascanio performances have been completely eclipsed. The German helicopter, designated as F.W. 61, has two rotors placed on either side of a normal fuselage provided with a normal landing gear. The tail unit consists of a fixed horizontal plane placed below the rudder.

The rotors are three-bladed and carried on steel masts. The drive is from a Siemens air-cooled radial engine Sh 14a (160 b.h.p.), which also drives a frontal

propeller. It is stated that the helicopter has been accorded the normal German airworthiness certificate as fulfilling all requirements.

This sudden success of a machine which will rise and descend vertically and also possesses translational speeds comparable to that of a normal aircraft will mark a new era in aircraft development.

Anti-Ice Devices. A Review of the Situation. (A. Faure and M. Rideau, Les Ailes, No. 839, 15/7/37, pp. 6-7.) (46/14 France.)

The problem of icing is being studied by a Committee of the International Air Traffic Association. As far as the propeller is concerned, the problem may be considered solved (glycerine compound admitted near the hub and distributed over the blades by centrifugal action). The problem of the leading edge of the wing is being attacked in several ways, but so far no complete solution has been found. Apart from mechanical devices (Goodrich de-icer) experiments have been carried out by covering the edge with certain grease compounds or by a continuous supply of chemicals which would lower the freezing point and thus cause the ice to melt. The grease paint will only be effective for a short time and there exists considerable difficulty in renewing it during flight. (Hopes that a highly polished surface would render the adhesion of ice more difficult were not borne out in practice.) Chemical lowering of the freezing point has been tried in England (Dunlop de-icer), but no definite information is available. A third alternative consists in applying sufficient heat to melt the ice. The article gives details of an electrical device for this purpose, which consists of a resistance network which is fastened to the parts requiring protection. The thickness of the heater (including insulator) is 3 mm. and the weight app. 1 kg. per sq. m. The energy consumption varies between 600 and 1,200 watts per sq. m. In the particular case of a 800 b.h.p. civil machine for which the Goodrich de-icers covered a surface of 7 m.², the power required is thus app. 1 per cent. of the engine b.h.p.

Is the Focke-Wulf a True Helicopter? (O. D. Asboth, Les Ailes, No. 839, 15/7/37, pp. 7-8.) (46/15 France.)

Asboth questions the German claims and is of the opinion that F.W. 61 is really a type of autogiro and not a true helicopter. The following are the main reasons for this statement:—

1. Professor Focke has no experience in the design of lifting screws (high efficiency) and the type of rotors adopted (similar to that of Cierva) are not efficient lift producers. It is estimated that with the power available (160 b.h.p.) each rotor would have to be 19 m. diameter to reach the height claimed.
2. Judging from the photographs, each rotor is approximately 6 m. diameter only, and this is estimated to give not more than 1,200 kg. total lift. As the machine will weigh at least 1,100 kg., the net lift is insufficient to give the height claimed.
3. It is probable that F.W. 61 only rose a few hundred metres as a true helicopter, and that the rest of the climb was carried out at a steep angle similar to that of an autogiro.

Loads on the Wings and Tail Unit Due to Rapid Upward Movement of the Elevator. (H. W. Kaul, 1935 Year Book of the Vereinigung fur Luftfahrtforsch., pp. 163-77.) (46/16 Germany.)

The loads on aeroplane wings and tailplanes caused by rapid upward movement of the elevators at different initial flying speeds, taken from published acceleration measurements in flight, are compared with approximate theoretical values, based on the static maximum lift coefficient and on the assumption that the speed remains constant until the elevator reaches its limiting position. It is found that the load

factor, derived from the measured acceleration, may be higher or lower than the calculated value according to the type of aeroplane. The rise in the dynamic maximum lift coefficient with increasing angular velocity tends to increase the wing load, while the reduction in flying speed during the manoeuvre decreases it. A series of test flights at the D.V.L. is described, also a scheme for future tests in which normal and angular accelerations and loads on the control column are to be measured. The order of magnitude of the loads on the tail unit is calculated for several cases from measured values of angular acceleration.

Pressure-Distribution Measurements on an O—2H Aeroplane in Flight. (H. A. Pearson, N.A.C.A. Report No. 590, 1937.) (46/17 U.S.A.)

Results are given of pressure-distribution measurements made over two different horizontal tail surfaces and the right wing cellule, including the slipstream area of an observation type biplane. Measurements were also taken of air speed, control surface positions, control stick forces, angular velocities, and accelerations during various abrupt manoeuvres. These manoeuvres consisted of push-downs and pull-ups from level flight, dive pull-outs, and aileron rolls with various thrust conditions. The results indicate that there is little, if any, dissymmetry of load on the tail due to slipstream rotation and that the up loads may be as much as the down loads. From the results of the wing investigation it was found that the relative efficiency of the wings depended upon the type of manoeuvre.

Flight Tests of the Drag and Torque of the Propeller in Terminal Velocity Dives. (R. V. Rhode and H. A. Pearson, N.A.C.A. Report No. 599, 1937.) (46/18 U.S.A.)

The drag and torque of a controllable propeller at various blade angle settings, and under various diving conditions, were measured by indirect methods on an F6C—4 aeroplane in flight. The object of these tests was (1) to provide data on which calculations of the terminal velocity with a throttled engine and the accompanying engine speed could be based, and (2) to determine the possibility of utilising the propeller as an air brake to reduce the terminal velocity. The data obtained were used in the establishment of propeller charts, on the basis of which the terminal velocity and engine speed could be calculated for aeroplanes whose characteristics fall within the range of these tests. It was found that the propeller reduced the terminal velocity about 11 per cent. with the normal blade angle setting of 19.0° and about 35 per cent. with a 5.5° setting. Indications were that the terminal velocity could be still further reduced by using even lower blade angle settings. A method is given for the calculation of the terminal velocity with throttled engine and the engine speed.

How Many Engines? (A. E. Lombard, Jr., Aviation, Vol. 36, No. 7, July, 1937, pp. 30, 31, 63, 64 and 67.) (46/19 U.S.A.)

Conclusions:—

1. The safety of two-engine and four-engine transport when operating over land is essentially equal. Although after a power failure of one engine, the four-engined machine will still have three-quarters of its power while the two-engined has only half, this is more than outweighed by the difficulty in crew co-ordination for the four-engined machine.

2. For a given size aeroplane requiring a certain total horse-power, the pay load, performance and operating costs are all best when the aircraft is designed to take the fewest number of the most powerful engines available.

3. A four-engined aeroplane must be at least one-third larger than a two-engined aircraft of the same type in order to have equal efficiency based on pay load, performance, and operating cost per pay load unit.

Sixth International Air Meeting at Zurich. (Inter. Avia, No. 454/5, 29/7/37, pp. 5-7.) (46/20 Switzerland.)

The following German machines are of interest:—

- (a) Single seat fighter Messerschmitt Bf. 109.
- (b) Single seat fighter Heinkel 112.
- (c) High speed bomber Do. 17.
- (d) Fieseler Fl. 156 "Storch."

(a) This won the climbing and diving competition, fitted with Daimler-Benz DB 600 engine (950 h.p.). Fitted with Junkers Jumo 210 (640 h.p.) the same type won the circuit race of the Alps. Both engines use petrol injection and are liquid cooled inverted 12-cylinder V type. The Daimler engine has three ducted radiators (two oil radiators, one on either side of the fuselage below the wing and a liquid cooler below the fuselage forward of the wing). VDM c.p. airscrews are fitted in each case. They are operated by means of two electro-motors and mechanical transmission.

(b) The Heinkel is fitted with Jumo 210 engine of 640 h.p.

(c) Do. 17 is fitted with two Daimler engines DB 600 of 950 h.p. each, main radiator below engine nacelle (ducted). Oil coolers (also ducted) below the wing.

(d) This machine is specially built for slow flying (slotted auxiliary wing and slotted flaps). A blind landing can be effected at stalling speed without levelling up. Carried on a moving vessel, the aircraft can start (and similarly land) without any take-off (or landing) run. Power plant Argus AS 10C of 240 h.p.

Variable Pitch Airscrews. British Patent No. 460,912 by Junkers. (Flight, Vol. 32, No. 1493, August 5, 1937, p. "d.") (46/21 Great Britain.)

In addition to a normal centrifugal control for the blade setting of a constant speed VP propeller, an over-riding control depending on the throttle opening is fitted. This control alters the tension of the governor spring and is directly connected to the throttle. In this way the datum line of the speed control is varied automatically with the fuel supply.

On the Vibration of Projectiles in Flight, and Solution of the Differential Equations Involved. (K. Popoff, Compt. Rend., Vol. 203, No. 3, 1936, pp. 295-7, and Vol. 203, No. 5, 1936, pp. 359-62.) (46/22 France.)

It is shown that the system of ordinary, simultaneous, differential equations, obtained by M. Burzio (Mem. Artillerie franc, Vol. 6, No. 3, 1927, pp. 295-7) for the movement of a projectile about its centre of gravity, can be reduced, in the case of the single Group III, to a system of integral equations of Volterra type by making use of Picard's method of successive approximations. This is very advantageous along the whole of the trajectory, particularly with respect to the convergence of the series developed. Integration by Poincaré's theorem (making use of integrals which can be developed as functions of a parameter), is possible by various methods. Thus, for example, one group of differential equations, if expanded into a series in terms of a parameter, can be converted into a system of linear differential equations which can easily be integrated. The parameter is such that when its value is unity the equations are replaced by the ordinary equations of external ballistics, not taking vibrations into account. From the solutions obtained a few conclusions are drawn regarding the movements of the axis of a projectile with respect to the tangent to its trajectory. (Translation No. 476.)

Preparation for and Carrying Through of a Bombing Attack. (M. Piccini, Luftwehr, Vol. 4, No. 5, May, 1937, pp. 176-184.) (From the Italian.) 46/23 Italy.)

The author points out the considerable amount of preparatory work required before a bombing squadron can start. Much of this work is of a routine nature

and by proper peace-time training the time required can be cut down without danger to thoroughness. All detailed instructions should be in writing and wherever possible telephone messages should be recorded (gramophone). The type of defensive tactics to be adopted against enemy attack (A.A. or fighters) should be carefully laid down. This applies especially to the machine gunners who must be trained to hold their fire till it becomes effective. Intercommunication between the members of the bombing squadron should be by wireless, special sets with a limited range of 2-3 km. being employed for this purpose. Whenever possible photographs should be taken of the effects of the bombing attack and all data, including shortcomings, should at once be communicated to a central information bureau. The object of a raid is the destruction of the target. Anything else is a failure. It is essential to break with all traditions based on the last war. It is futile to say that we do not yet know how future air wars will be conducted. We can afford to give the fighting pilot in the single-seater a free hand to adapt himself to eventualities. The bomber, on the other hand, will only be successful if his tactics are clearly laid down before the start.

Aerial Attack of Landing Grounds. (Wassiljew, Luftwehr, Vol. 4, No. 5, May, 1937, pp. 184-6.) (From the Russian.) (46/24 U.S.S.R.)

The object of a bombing attack on an aerodrome is to prevent enemy machines from taking off. The attack would usually be carried out at night and be followed by a day attack on the machines themselves.

The author calculates the time required to fill up ten bomb craters spread evenly over a landing field 100 by 800 m. and concludes that it would take 300 men at least five hours to render the landing ground serviceable. As an alternative he suggests the use of wooden cover plates for the craters as this would reduce the labour considerably.

It is the duty of the reconnaissance machine to locate the landing ground and for this purpose two or three machines of this type should precede the main bombing squadron. It is advisable wherever possible to carry out such attacks immediately after an enemy raid, *i.e.*, when the enemy machines have just landed on their own aerodrome.

Organisation of Supplies in Aerial Warfare. (O. Afanasijew, Luftwehr, Vol. 4, No. 5, May, 1937, pp. 186-9.) (From the Russian.) (46/25 U.S.S.R.)

Modern fighting aircraft consumes a considerable amount of stores (fuel, oil, ammunition, spares). It is generally admitted that compared with the last war, the rate of consumption per aircraft has increased sixfold. The actual consumption per flight may vary between one ton and ten tons, depending on type of aircraft and operation in view. It is clear that such quantities require very careful organisation. Not only have sufficient stores to be available on the advance flying grounds, but subsidiary bases have to be available in the rear from which the consumption at the front can be made good. A further difficulty is provided by the aircraft requiring repair or overhaul for which provision must also be made in the rear. This continuous stream of inward and outward material must not interfere and matters are further complicated if the air forces have to undergo regrouping arising from changes in war conditions. The author strongly urges a complete separation of supply organisation from the fighting units and that this supply organisation should be effectively trained in peace time so as to cope with all conditions likely to arise in war.

German Notes on Air Fighting in Spain. (Revue de l'Armee de l'Air, No. 94, May, 1937, p. 585.) (46/26 Germany.)

1. Even in the case of foreign aircraft occupied by well trained foreign crew the bombing accuracy is very poor.

2. The high landing speeds of modern aircraft require special landing grounds. If these are previously bombed, landing becomes very difficult. Emergency landings nearly always cause the loss of the machine and crew.

3. Machine gun fire in the air is only effective for distances of the order of 100 m. With the present high speeds, such distances are only maintained a fraction of a second, which is too short for effective fire. In the case of tail actions a longer time is available for gun adjustment. Such actions are, however, only possible by surprise and are consequently rare. All this points to the urgent need of a weapon which will increase the range to at least 800 m.

Influence of a Magnetic Field on the Coefficient of Viscosity of Liquids. (S. D. Chatterjee, Indian J. Physics, Vol. 10, No. 5, 1936, pp. 399-401.) (46/27 Great Britain.)

The effect of a magnetic field on the coefficients of viscosity of a few non-polar liquids and monohydric alcohols is investigated. While compounds of the first class show no change in viscosity in magnetic fields, in the case of alcohols effects of different magnitudes were observed. Straight chain molecules, *e.g.*, n-propyl alcohol, n-butyl alcohol and n-hexyl alcohol experience no change in viscosity; molecules having side chains, *e.g.*, iso-butyl alcohol and iso-amyl alcohol show an increase in viscosity; molecules of greater or less degrees of symmetry, *e.g.*, iso-propyl alcohol, secondary butyl alcohol and tertiary butyl alcohol showed changes too small to be determined with the apparatus used.

The Influence of Pressure on the Speed of Normal Flame Propagation. (L. Khitrin, Techn. Phys., U.S.S.R., Vol. 3, No. 11, 1936, pp. 926-39.) (46/28 U.S.S.R.)

The linear speed of flame propagation decreases with increasing pressure in the case of mixtures of benzene and ether with air. The mass velocity of flame propagation increases with increasing pressure, according to a relationship of the type $M = K_1 \sqrt{p} + K_2$, where K_1 and K_2 are constants. It is claimed that analysis of the results obtained by Ubbelohde, when using the burner method with mixtures of CO, C₂H₂ and C₂H₄, confirm the effects observed in the present experiments and the formula suggested for the relationship between pressure and the value of mass velocity of flame propagation for mixtures with air.

The Process of Flame Propagation in "Constant Pressure Bombs." (L. Khitrin, Techn. Phys., U.S.S.R., Vol. 3, No. 12, 1936, pp. 1028-33.) (46/29 U.S.S.R.)

The values for speeds of combustion of mixtures of oxygen or air with CO, CH₄ and other gases, obtained by Stevens by the soap bubble method, differed from those obtained by the burner method. The soap bubble method has therefore been investigated more closely. The gas mixture was ignited at the centre of the soap bubble by a spark. The process of combustion was photographed on a stationary plate which was illuminated intermittently by a rotating perforated disc. The photographs showed concentric rings at equal distances apart, from which it follows that (1) the speed of combustion is constant, and (2) it is the same in all directions. The speed of combustion measured in this way is too high because the outward flow of the gas is superposed on the actual speed of combustion. The true speed of combustion is given by $u = u_2 \times r_1^3 / r_2^3$, where u_2 is the speed as obtained by photographic measurement, r_1 is the radius of the soap bubble before combustion and r_2 its radius after combustion (shown by the radius of the outermost bright ring). The speeds obtained in this way agree well with those obtained by the burner method.

The Flow Resistance of Lubricating Oils at Low Temperatures. (S. Erk, Phys. Zeit., Vol. 38, No. 12, 15th June, 1937, pp. 449-53.) (46/30 Germany.)

The flow resistance of lubricating oils at low temperatures is an important factor in determining the power required to start an engine and to maintain lubrication both in the case of gravity and of pressure lubrication. The usual testing processes are unsatisfactory because they do not take into account all the engine requirements. Microscopic investigation of the process of solidification shows that the setting point coincides with the commencement of crystallisation of paraffin. Mechanical liquefaction is due to destruction of the crystal skeleton. In the case of the oil investigated two different kinds of paraffin compounds were observed, having different setting points and different crystal sizes; these properties determine the flow resistance and flow limits of the oil. Both quantities have been measured with a capillary viscometer at various pressures. When the crystal skeleton is destroyed the solidified oil is again able to flow, but its viscosity still depends on the rate of shear. Satisfactory criteria of the behaviour of lubricating oils on cooling can only be obtained by measurement of the flow resistance in relation to temperature and rate of shear.

How Does the Fuel Burn in a Diesel Engine? (1935 Year Book of the Vereinigung für Luftfahrtforsch., pp. 97-102.) (46/31 Germany.)

Work carried out by O. Hofelder and K. Zinner is summarised (see Z.V.D.I., 1932, 76, 1241; 1934, 78, 1007, and V.D.I. Forschungsheft, No. 374, 1935). Hofelder carried out bomb experiments in which the fuel was injected, for the period of a single working stroke, by means of a fuel pump operated by an electromotor. The cylindrical bomb, containing air under the requisite temperature and pressure conditions, had two opposite vertical windows through which film records were taken of the atomisation, ignition and combustion processes. Results are given for ordinary gas oil and for tar oil mixed with gas oil. The former showed a longer combustion time in spite of a shorter ignition lag. The apparatus is considered to form a suitable basis for working out standard methods of Diesel fuel testing. Zinner's experiments, carried out with various pre-chamber engines, show that it is more economical to adjust an engine to the properties of the fuel than to attempt by chemical alteration of the fuel to suit a particular engine.

Further work by Hofelder is being carried out for the German Air Ministry.

Radiation from the Combustion Space of High Speed Diesel and Otto Engines. Investigation by Means of a Photocell Sensitive to Infra-Red Rays. (L. Bisang, Z.V.D.I., Vol. 81, No. 27, 3rd July, 1937, pp. 805-9.) (46/32 Germany.)

The method of following temperature changes in the combustion space of an internal combustion engine by means of a photo-cell, is very suitable for following the rapid temperature variations caused by gas vibrations in the combustion space. Radiation is received through a quartz window on to a photo-cell which is specially sensitive in the region of 1.0μ (infra-red). The usefulness of the method has been demonstrated in the case of both Diesel and Otto engines and a standard procedure is in course of development.

A Preliminary Study of Flame Propagation in a Spark-Ignition Engine. (A. M. Rothrock and R. C. Spencer, N.A.C.A. Tech. Note No. 603, June, 1937.) (46/33 U.S.A.)

The N.A.C.A. combustion apparatus was altered to operate as a fuel injection spark-ignition engine, and a preliminary study was made of the combustion of gasoline air mixtures at various air fuel ratios. Air fuel ratios ranging from 10 to 21.6 were investigated. Records from an optical indicator and films from a high speed motion picture camera were the chief sources of data. Schlieren photography was used for an additional study. The results show that the altered

combustion apparatus has characteristics similar to those of a conventional spark-ignition engine and should be useful in studying phenomena in spark-ignition engines. The photographs show the flame front to be irregularly shaped rather than uniformly curved. With a theoretically correct mixture the reaction, as indicated by the photographs, is not completed in the flame front, but continues for some time after the combustion front has traversed the mixture.

Study of the Crystal Behaviour of Hydrocarbons. (R. T. Leslie and W. W. Heuer, Bur. Stan. J. Res., Vol. 18, No. 6, June, 1937, pp. 639-44.) (46/34 U.S.A.)

The construction and operation of a microscope for the observation of the growth of crystals at low temperatures are described. Photomicrographs of nine aromatic, six cyclo-paraffinic, eight normal paraffinic and five branched chain paraffinic hydrocarbons of known structure were obtained. It was shown that successive members of the homologous series of normal paraffins did not differ in crystal appearance. It was observed, however, that condensed molecules tended to crystallise in polyhedrons of about equal dimensions, whereas molecules with long chains tended to form long prisms. Mixed molecules showed modified forms depending on the relative influence of the chain and the condensed groups.

Effect of Air Humidity on Octane Number Determinations. (J. R. MacGregor, Oil and Gas J., Vol. 35, No. 37, 1937, pp. 164-5.) (46/35 U.S.A.)

Apparatus for ensuring constant moisture content of the combustion air when working with the C.F.R. motor is described. Tests were carried out with straight run petrol, petrol-benzol, petrol containing tetra-ethyl lead and an octane-pentane blend. The compression ratio was adjusted to that of a petrol-benzol mixture having an octane number of 65 when the atmospheric humidity was 35 grammes water per kilogramme of air. Within a humidity range of 2-23 grammes water per kilogramme air, the octane ratings varied as follows:—

For a 67.5-32.5 per cent. octane-heptane blend, by 5.1 units.

For a 55-45 per cent. petrol-benzol blend, by 7.9 units.

For 100 per cent. cracked petrol, by 7.9 units.

Variations of 2.5-3.4 units in octane number were caused by changing the air pressure by about 25 mm. Hg. at constant humidity. The observations explain the lack of agreement between octane numbers determined by different workers.

Mechanism of the Formation of Engine Carbon in Internal Combustion Engines. (A. Maillard and W. Edelberg, Ann. Off. Nat. Camb. Lig., Vol. 11, 1936, pp. 1117-26.) (46/36 France.)

The extent to which lubricating oil burns in an engine with deposition of carbon was investigated by employing hydrogen as fuel and determining CO_2 and H_2O in the exhaust gases. Only a small percentage of the total oil consumption was due to its combustion. About the same amount of carbon was formed when using fresh or used oil. When petrol was used as fuel a hard, lightly adhering deposit was formed on the piston. Carbon would not adhere to the latter when a rich fuel mixture was employed.

Physical Properties of Surfaces IV—Polishing, Surface Flow, and the Formation of the Beilby Layer. (F. P. Bowden and T. P. Hughes, Proc. Roy. Soc., Series A, Vol. 160, No. 903, 15/6/37, pp. 575-587.) (46/37 Great Britain.)

The process of polishing is greatly influenced by the relative melting point of the polisher and the solid. The relative hardness is comparatively unimportant. Experiment suggests that surface flow is brought about by an intense local heating of the surface irregularities to the melting or softening point. The molten or

softened solid flows or is smeared over the surface, and very quickly solidifies to form the polished Beilby layer.

These local high temperatures also play an important part in the wear and corrosion of sliding surfaces.

Elastic Couplings and Their Mode of Operation. (V. Rembold and J. Jehlicka, *Forschung*, Vol. 8, No. 3, May-June, 1937, pp. 109-118.) (46/38 Germany.)

The spring characteristics and construction of elastic couplings have a great effect on uniform running of shafts. To determine this effect, four types of couplings have been investigated in a certain combination of shafts and vibrations measured by a Geiger torsionograph. Results are shown diagrammatically. The behaviour of elastic couplings changes during operation if the parts are liable to wear and become deformed. It is important that the coupling should be built into the shaft in such a way that any play which is present originally or arises during running does not cause too great jolts. This can only be done on the basis of careful calculation of vibration, since the type and extent of vibration are greatly affected by the construction of the coupling. Accurate workmanship and careful fitting together of couplings will avoid the main disturbances even in small shafts.

A New Accelerometer and the Measurement of the Starting Phenomenon by Vibrographs. (G. Gerloff, *Forschung*, Vol. 8, No. 3, May-June, 1937, pp. 143-52.) (46/39 Germany.)

The question of how far it is possible to measure exactly the commencement of vibration by means of vibrographs is discussed. A new type of accelerometer is described, which differs from the two types hitherto used, namely, the quartz piezo-electric and the carbon-pressure accelerometer, in utilising the variation in electrical resistance of wires under stress. Results obtained in practice with the instrument are satisfactory.

Relaxation Methods Applied to Engineering Problems. I.—The Deflexion of Beams Under Transverse Loading. (K. N. E. Bradfield and R. V. Southwell, *Proc. Roy. Soc.*, Vol. 161, No. 905, 15/7/37, pp. 155-180.) (46/40 Great Britain.)

The power of relaxation methods has been demonstrated in relation to frameworks and continuous beams, but their scope is at present restricted to members having uniform flexural rigidity, for the reason that orthodox methods are not able to provide general solutions of the problems considered in this paper. Here, with the object of removing the restriction, two numerical methods are developed. They are quite general, and their accuracy as applied to a particular example gives promise of their being capable (possibly after slight modification) of solving more complex problems, e.g., beams subjected to transverse and end loading in combination, the critical loads of struts, the natural frequencies of airscrew vibrations, etc. These problems it is intended to treat in subsequent papers.

The Elastic Stability of a Thin Twisted Strip—II. (A. E. Green, *Proc. Roy. Soc.*, Vol. 161, No. 905, 15/7/37, pp. 197-220.) (46/41 Great Britain.)

The work of a previous paper on the elastic stability of a thin twisted strip has been corrected and extended to the consideration of the stability of the twisted strip when it is also subjected to a tension along its length. It is found that the strip becomes unstable at a definite value of the twist and that the instability is in the form of a number of loops superposed on the twisted strip in contrast to one loop in the case when no tension acts on the strip. The theory has been compared with experiment and satisfactory agreement between them is found.

Permissible Stress Range for Small Helical Springs. (F. P. Zimmerli, Department of Michigan, Ann Harbor, Engineering Research Bulletin, No. 26, July, 1934.) (46/42 U.S.A.)

The following conclusions are drawn:—(1) For a given spring steel the endurance limit or stress range in torsion, as obtained by fatigue tests, using helical compression springs, is directly proportional to the ultimate torsional strength. (2) Raising the ultimate torsional strength of a given spring steel by lowering the drawing temperature raises its available stress range. (3) No relationship appears to exist between the proportional limit in torsion and the endurance limit. (4) Variations in mill practice in the manufacture of a spring steel will often produce variations in the fatigue resisting properties of the steel. (5) Cold-drawn steel spring wire, as now produced, has lower stress range than heat-treated steel spring wire of the same ultimate torsional strength. (6) Chrome-vanadium steel had the highest stress range of any of the steels tested. (7) Silico-manganese steel and high manganese carbon steel are superior to straight carbon steel, but are not equal to chrome-vanadium steel. (8) Low carbon, 18 per cent. chromium, 8 per cent. nickel (stainless) steel has a fatigue resistance nearly as low as non-ferrous materials.

Author's Note.—This range is being increased now by new drawing methods so that the material is approaching in fatigue the lower quality hard drawn wires.

Measurement of the Tension on the Surface of Stressed Constructional Parts by Means of Polarised Light, without Use of Models. (G. Oppel, Z.V.D.I., Vol. 81, No. 27, 3rd July, 1937, pp. 803-4.) (46/43 Germany.)

The polarised light method for measuring strain, previously only applicable to transparent models, is now adopted to measure tension on the surface of opaque bodies. The surface is first polished or silvered and then coated with a layer of cellulose or natural, or synthetic resin, which is non-crystalline when free from strain, but when forced to change its shape exhibits a crystalline nature. The amount of surface deformation can be measured from the interference fringes formed when polarised light falls on the body. An example of the application of the method is given.

The Nature of Polish. (G. I. Finch, Trans. Faraday Soc., Vol. 33, No. 191, March, 1937, pp. 425-30.) (46/44 Great Britain.)

The evidence upon which the idea of a vitreous-like nature of polish is based is reviewed. It is pointed out that the phenomenon of surface flow does not settle the question as to the state, whether amorphous or crystalline, of the flowing material or final polish layer. The fact that metallic polish yields halo patterns by electron diffraction is also inconclusive, because not only amorphous, but also certain crystalline metal films behave similarly. The ability of metallic polish to dissolve metal crystals, not exhibited by corresponding crystalline films, strongly supports the view of the amorphous state of both surface flow and polish, as does also the fact that the temperature of flow is limited by the melting point of the metal.

Compensation of Strain Gauges for Vibration and Impact. (W. M. Bleakney, Bur. Stan. J. Res., Vol. 18, No. 6, June, 1937, pp. 723-9.) (46/45 U.S.A.)

In general, a strain gauge, when attached to a vibrating member, undergoes deformations on account of the inertia of its parts, and these may cause serious errors in the strain readings. It has been customary in the past to decrease the mass and increase the rigidity of the gauge in an effort to minimise these deformations and correct for the small resulting error. It is, however, frequently not feasible to construct a gauge sufficiently light and rigid to make this possible. This paper describes methods for so adjusting the ratio of inertia to rigidity of the parts of the gauge that these deformations are compensated. The indication

of the instrument may thus be made independent of any acceleration of the gauge as a whole.

The Determination of Size Distribution in Smokes. (H. S. Patterson and W. Cawood, *Trans. Faraday Soc.*, Vol. 32, No. 8, 1936, pp. 1084-8.) (46/46 Great Britain.)

A photometric method and a direct method of comparison, called the "graticule method," for determination of size distribution of smoke particles are described. In the latter method a small rectangle of known size is superimposed on the image of the precipitated smoke in a microscope; along both sides of the rectangle, on the outside, there is a series of circles or black discs, graduated in known sizes. The smoke particles visible within the rectangle (on an average only six) are counted and allocated to the appropriate circles or discs used for comparison. This process is repeated about fifty times in order to arrive at satisfactory statistics. A range of particles varying in radius by 1.10^{-5} to 25.10^{-5} cm. corresponds to each circle. Results obtained in this way with an MgO smoke are plotted graphically and briefly discussed.

Sorption of Fogs by Liquids. (H. Remy, *Trans. Faraday Soc.*, Vol. 32, No. 8, 1936, pp. 1185-90.) (46/47 Great Britain.)

The relationship between the reduction in concentration of a fog when bubbled through a liquid and the height of the liquid column is expressed by a theoretical formula. The latter has been tested and confirmed by experiments on the sorption of sulphuric acid vapours (mist) in sulphuric acid and soda solutions. The relationship between the absorption coefficients of the mist and the conditions of flow has also been determined experimentally. These and previous experiments show that the deciding factor for reduction in concentration when passing through the liquid is not sedimentation, but turbulence of the carrying gas. Similarly, the difference between the sorption capacities of these solutions and that of pure water does not depend on the effect of velocity of sedimentation.

Aircraft Struck by Lightning. (*Inter. Avia.*, No. 444, 22/6/37, p. 9.) (46/48 _____.)

Belgium: A three-engined Savoia S-73 air liner belonging to Sabena was struck by lightning on June 17, while on its way from Brussels to Prague; sole consequence, wireless installation damaged.—*Great Britain:* A four-engined DH-86 of British Airways was struck by lightning on June 17, while flying from Paris to Croydon, shortly before reaching the English coast; consequence, the fabric of the under part of the fuselage was stripped off, but the frame and undercarriage were not affected.—The third report was received on June 18 from the Junkers works and deals with a stroke of lightning in a twin-engined Junkers Ju-86 aircraft fitted with Diesel engines which was being flown to *Australia* and was over Australian territory. At an altitude of about 4,000ft. the aircraft flew into thick clouds without a thunderstorm being suspected. All of a sudden a disc of light of a yellowish-reddish colour and measuring about 2ft. in diameter flared up at the nose of the fuselage and the cabin was illuminated as if by photographic flash-light. Consequence, after the landing it was noticed that in the left aileron a piece of the outer covering of the size of a coin had melted away, from which it was concluded that the stroke of lightning had passed from the left aileron through the whole machine to the nose of the fuselage.

Lightning (with Discussion). (B. L. Goodlet, *J. Inst. Elect. Eng.*, Vol. 81, No. 487, July, 1937, pp. 1-56.) (46/49 Great Britain.)

The first part of this paper deals with lightning as a physical phenomenon. The formation of thunderclouds is associated with convectional instability of the atmosphere, the separation of charge being effected by the resulting upward

currents of air. Lightning strokes usually discharge negative electricity into the ground and consist of a preliminary "leader" stroke from cloud to ground followed by a powerful return stroke from ground to cloud. A complete flash usually consists of a sequence of such double strokes separated by time intervals of the order of 10^{-2} sec. The distribution of flashes to earth under a storm centre is influenced by the distribution of space charge above the ground and by discontinuities of conductivity in the ground itself.

The second part of the paper deals with the effects of lightning strokes on overhead transmission lines.

Thermal Gliding. (W. Georgii, 1935 Year Book of the Vereinigung für Luftfahrtforsch., pp. 332-9.) (46/50 Germany.)

The possibilities of soaring flight in thermal currents have been demonstrated under a variety of meteorological conditions. Powerful vertical air currents can be produced by local isolation of the ground, especially about mid-day in warm calm weather. In the evening thermal currents are mostly confined to altitudes above the inversion zones which form in the lower strata as the ground cools. Regular cloud streets, indicating vast regions of coherently rising currents, often accompany the influx of moist unstable air of maritime origin. They are most favourable for fast long distance cross-country flights. Over the tropical oceans an abundance of thermal vertical currents has been discovered. Tests to explore these by means of a hydro sailplane towed by aeroplane from a flight base ship stationed in mid-ocean are being prepared. At high altitudes thermal rising currents occur even in winter and at night.

P.A.A. Direction Finder. (Aero Digest, Vol. 30, No. 40, April, 1937, p. 62.) (46/51 U.S.A.)

The Pan-American direction finding is a development of the well-known Adcock system. The wave length (qualified as short) is not stated. The aircraft sends out a signal (long dash) and the ground station determines its bearing, position and direction of flight, using a 4-foot antenna array, approximately 150ft. square. Direction of the incoming signal is determined by a search coil goniometer and the slight octantal error of the system is kept to a minimum by selecting an electrically satisfactory site and finally eliminated by calibration. An effective range up to 3,800 miles is claimed. It is stated that difficulties due to night effect, fading, tropical static, rain and snow static (but not sunrise and sunset effect) are overcome.

It is stated that the equipment will be available for installation only within the U.S.A. and its possessions.

R.M.A. Specification for Testing and Expressing the Overall Performance of Radio Receivers. (J. Inst. Elect. Eng., Vol. 81, No. 487, July, 1937, pp. 104-22.) (46/52 Great Britain.)

The tests are partly electrical and partly acoustic. Such points as sensitivity, selectivity, noise, automatic volume control, frequency response, acoustic sensitivity, hum and acoustic output are considered.

The compilers of the specification have applied the various tests to their own products and have obtained satisfactory agreement between measurements made on the same receivers in different factories. Satisfactory agreement has also been obtained between response curves obtained in various damped rooms and in the open air. It is hoped, therefore, that the specification, though necessarily imperfect, is a practical document which manufacturers can safely apply and on

which governmental and other bodies may reasonably be expected to base their requirements.

The Return of Radio Waves from the Middle Atmosphere—I. (R. A. Watson Watt, A. F. Wilkins and E. G. Bowen, Proc. Roy. Soc., Vol. 161, No. 905, 15/7/37, pp. 181-196.) (46/53 Great Britain.)

Observations spread over a year from May, 1935, have established the existence of sustained stratified electrification, of such ionisation density and gradient as to return radio waves of frequency 6-12 Mc./sec. at vertical incidence, at a variety of levels in the troposphere and the stratosphere. Strata persisting without substantial change of level for at least several days have been identified at such heights as 8.5, 9.3, 10.3, 10.75 and 13.5 km. with reflexion coefficients of the order of 0.7, giving measurable echoes up to the tenth order, beyond which they are not readily distinguished from ionospheric echoes. Apparently independent stratification at 45-50 km., with a reflexion coefficient of 0.3 for 6 Mc./sec. waves, and in the D region at and above 60 km., are also recorded. Reflexions from all these regions are obtained, with significant reflexion coefficients, at and above the frequencies proposed for television services. The ionisation does not fall to very low values at night, and has no seasonal variation of large amplitude. Evidence is given of replenishment around the 20-30 km. levels by local thunderstorms.

A New Theory Concerning Aircraft Static. (U.S. Air Services, Vol. 22, No. 7, July, 1937, p. 28.) (46/54 U.S.A.)

Till recently it was believed that the static was caused by charged particles of ice, snow, rain or dust striking the metallic surface of the plane in flight.

According to experiments carried out by United Air Lines, the atmospheric static heard in the air pilot's earphones is caused by the discharge from the trailing edges of the wings and tail surfaces of the static already gathered from certain cloud formations.

Portable Picture Transmission Apparatus. (W. Keller, Z.V.D.I., Vol. 81, No. 29, 17/7/37, p. 861.) (46/55 Germany.)

The apparatus is intended for the transmission of pictures over normal telephone lines and has been developed for newspaper work by the German Post Office. The whole apparatus can be carried in two normal suitcases. Since the frequency range of telephone lines does not extend low enough for picture frequencies (500/sec.), a carrier wave with a frequency of 1,500/sec. is employed which is modulated by the picture frequency. The carrier frequency is obtained by a disc rotating in front of the photo-cell. The side bands are thus within the frequency range of the cable (300-2,600/sec.). The width of the frequency band is $1,300 \pm 550$ /sec.

The Spitz Flight Recorder. (Inter. Avia., No. 452, 20/7/37, p. 4.) (46/56 U.S.A.)

The ground installation of this apparatus shows the movement of an aeroplane by a pin point of light moving on a translucent map and makes it possible to guide the aircraft past obstacles (blind landing). Electrical impulses emanate continuously from a short wave transmitter on board the aeroplane. These impulses are picked up on the ground by two instruments, a "binaural selector" which discloses the plane's position and a "divergence meter" which measures the distance (probably from the field intensity).

The apparatus was recently demonstrated to American experts and quantity production is stated to be imminent.

Experiments with Underground Ultra-High Frequency Antenna for Aeroplane Landing Beam. (H. Diamond and F. W. Dunmore, J. Franklin Inst., Vol. 19, No. 1, July, 1937, pp. 1-20.) (46/57 U.S.A.)

Experiments on the electrical properties of an ultra-high frequency transmitting antenna operating very near to and below the ground surface, are described. The object of the work was to locate the landing beam in the centre of an airport in order to secure a steeper approach path and to provide for landing service for different wind directions. The effect of proximity of the ground to the transmitting antenna upon the low angle distribution of energy in the radiated field and upon the polarisation of the field is described. An approximate mathematical analysis is given of the mechanism of setting up a landing path when the transmitting antenna is below the ground surface.

The Sonic Locator. An Aid to Fog Navigation. (C. W. Rice, J. Amer. Acoust. Soc., Vol. 8, No. 1, 1936, pp. 30-33.) (46/58 U.S.A.)

A 3,000-cycle whistle is placed at the effective sound focus of a megaphone horn and serves as an emitter. In the case of ships, for example, the sound is sent out towards the horizon and eventual echos are heard by means of two listening horns, arranged parallel to the emitter on the same stand. Practical experiments gave very good results. For example, land could be detected at a distance of 550 to 900 m. Smaller objects were also detected at fairly large distances, *e.g.*, a rowing boat with three people at a distance of 370 m. For the method to be useful the following points must be observed:—(1) The frequency must be between 2,000 and 4,000 Hertz. (2) Acoustic filters are necessary on the receiving side to cut out disturbances. (3) The apparatus must be rotatable. (4) It is desirable that the range transmitted by the acoustic filter should be variable in order that eventually even fog signals, etc., may be picked up.

Apparatus for Demarcating the Air Space Above an Aerodrome. (Allgemeine Elektrizitäts Gesellschaft, D.R.P. 645, 922, 7/6/1937; from Flugsport, Vol. 29, No. 14, 7th July, 1937, Patent Sect., p. 24.) (46/59 Germany.)

Apparatus for demarcating the air space above an aerodrome by means of sound rays radiated from opposite side of the aerodrome is claimed. The sound is emitted from several groups of megaphones arranged in fan formation in such a way that the outer limits of the sound lie along the direction of the boundaries of the aerodrome while the inner boundaries of the sound lie within a certain angle at a given height above the landing ground. Different sound signals are sent out from opposite sides of the ground and taken up by special sound receiving apparatus on the aeroplane, used preferably in conjunction with an acoustic height recorder.

The Performance of Noise Meters in Terms of the Primary Standard. (B. G. Churcher and A. J. King, J. Inst. Elect. Eng., Vol. 81, No. 487, July, 1937, pp. 57-90.) (46/60 Great Britain.)

The paper discusses the performance of noise meters, such as are used for engineering measurements, in terms of the primary standard of "equivalent loudness" which has recently been formulated. The unit of equivalent loudness is the British Standard Phon. The technique for the basic determination of the equivalent loudness of a noise is discussed, and the Phon values for a number of specific noises of importance in engineering are given. The fundamentally important equal loudness relations for pure tones of differing frequency are considered, and the results of some direct determinations in the free field are given. The performance of subjective noise meters is then examined for noises of various types. A meter using two telephone receivers, which offers some advantage over the more usual types, is described. The performance of the objective

type of meter is also examined. The measurement of noise associated with irregular sound fields is briefly discussed.

Scattering of Light in the Near Infra Red. (D. L. Gamble and C. E. Barnett, Ind. and Eng. Chem. Anal. Ed., Vol. 9, No. 7, 15/7/37, pp. 310-314.) (46/61 U.S.A.)

The present paper represents practical application of a method proposed by Pfund (J. Optical Soc. Am., Vol. 24 (1934), p. 143) for measuring the size of suspended particles from the study of light transmission curves.

The results obtained are compared with direct microscopical measurements of particle size and it is noted that in the case of certain pigments the scattering method gives results in better agreement with practice (covering power).

The method is limited in the case of coloured pigments by the relative absorption which is superposed on the reflection and scattering phenomena.

Ten references.

German Accessories at the Brussels Aero Show. (Flugsport, Vol. 29, No. 12, 9/6/37, pp. 307-310.) (46/62 Germany.)

The firm of Bosch exhibited examples of light weight electrical apparatus:—

- (a) New double magneto for 12-cylinder engine weighs 7.9 kg., whilst the two normal magnetos weigh together 13.8 kg.
- (b) New 10 mm. spark plug weighs 16 gm.
- (c) 300-watt generator (375-watt for short periods) weighs 5 kg.

The firm also showed an ignition system fitted with a vibrator-interrupter supplying a trail of sparks for starting. An interesting novelty exhibited by Messrs. Bruhn refers to dial instruments. Instead of the normal 360° deflection, the new type cover two revolutions (720°). As the pointer passes the 360° , the scale which is visible through slots in the dial, is changed automatically.

Causes of Fire in Dirigible Balloons. (A. Milhoud, Comp. Rend., Vol. 205, No. 2, 12th July, 1937, pp. 113-5.) (46/63 France.)

The hypothesis is put forward that the ignition of airships during manoeuvres prior to landing is due solely to the electrical phenomena associated with flow of gas containing small drops of water through a narrow orifice into the electrical field surrounding the airship. In these circumstances the sudden variation in surface tension experienced by the drops gives rise to electrical potentials which may be sufficiently high to cause sparking. The more rapid the change in surface tension, the greater is the electromotive force produced; it also depends on the pressure of the gas in the bag and the hydrometric, electrical and other physical conditions of the surrounding air. This phenomenon would take place quite independently of any contact with the ground.