

ABSTRACTS AND NOTICES
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PART I.—PHYSICS AND ENGINEERING SCIENCE

Aircraft Design, Etc.

Tour of the Dornier Do.X, 1930-32. (Fr. Christiansen, Z.V.D.I., Vol. 77, No. 21, 27/5/33, pp. 561-564.) (5.10/27001 Germany.)

A brief analysis is given of the various sections of the flight, with a forecast of long distance flying developments.

Researches on the Effect of Wing Fuselage Interference in a Low-Wing Monoplane—N.A.C.A. Tech. Note No. 460. (M. J. Hood and J. A. White, Airc. Eng., Vol. 5, No. 55, Sept., 1933, pp. 203-206.) (5.11/27002 Great Britain.)

The sensitive flow over the upper surface of a wing is liable to serious disturbance by the body and struts, which may produce or accentuate tail vibrations, especially near stalling incidence.

Filletts smoothing off the sharp corner between body and wing had a beneficial effect and reduced the maximum amplitude of the vibration to one-seventh. A combination of fillet and N.A.C.A. engine cowling, by directing the wake over the wing, increased the maximum lift 11 per cent. and reduced the minimum drag 19 per cent., while reducing the amplitude to one-quarter.

Photographs and sketches show the dimensions and set up of the experiments, both model and full scale, and specify the filleting of the sharp corner.

Lift drag curves exhibit the experimental results. There are anomalies which obscure the general view of the phenomenon.

Heating and Ventilation of Aeroplane Cabins. (M. Gould Beard, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 53-60.) (5.14/27003 U.S.A.)

Wide extremes of temperature in a continental climate, cooling in summer and heating in winter, air temperatures of 90°F. in summer and -20°F. in winter (-40°F. in Canada) may be expected.

For cooling, good ventilation plus altitude are usually sufficient. Townend rings bring a layer of hot air over the nose of the aeroplane.

Aerofoil Characteristics as Affected by Protuberances of Short Span. (E. N. Jacobs and A. Sherman, N.A.C.A. Report No. 449, 1933.) (5.20/27004 U.S.A.)

In continuation of Report No. 446 (see Abstract 27005) experiments were carried out with faired protuberances extending only a small fraction of the span. The most sensitive position is at mid-span, where the decrease of lift is greatest.

Methods of aerofoil theory are used to generalise the results as a function of span lengths of protuberances. Distributions of lift are exhibited graphically and show a marked drop around the protuberance.

Four references.

Aerofoil Characteristics as Affected by Protuberances. (E. N. Jacobs, N.A.C.A. Report No. 446, 1932.) (5.20/27005 U.S.A.)

Protuberances were attached to the upper surface at four selected stations. The first type of protuberance consisted of a strip of sheet metal protruding at right angles from the aerofoil surface and may be regarded as a "spoiler." The second type was formed by adding fairing to the grid type and may be regarded as making the best of an essential external fitting, running the whole span length by fairing it. Extensive experimental data are given graphically in 48 charts in a form suitable for designers.

Five references.

New Resistance Measurements by the Momentum Method. (M. Holtermann, Z.F.M., Vol. 24, No. 6, 28/3/33, pp. 157-163.) (5.20/27006 Germany.)

The results obtained on wing profiles by the impulse method are in reasonable agreement with wind channel results obtained by direct weighing. In full-scale measurements the flow was too unsteady for comparison of results.

Theory of Arbitrary Wing Sections. (T. Theodorsen and I. E. Garrick, N.A.C.A. Report No. 452, 1933.) (5.20/27007 U.S.A.)

The Joukowski transformation is generalised by the introduction of Fourier expansion, and a number of elegant transformations of the analytical expression are given. The numerical solution proceeds by successive numerical approximations which converge with great rapidity for usual types of aerofoil, and for a wide range of other contours.

The successive steps in the transformation, from a square to a circle, are shown graphically. Tables are given to facilitate computation, and numerous contours and pressure distributions are shown graphically.

Nine references.

Relation between Incidence of a Wing Profile and Velocity and Pressure Fields. (F. Weinig, Werft-Reederei-Hafen, Vol. 14, No. 10, 15/5/32, pp. 127-131.) (5.20/27008 Germany.)

The elements of the circulation theory of lifts and transformation from a circle to a wing profile along with the corresponding velocity potential fields, are discussed and comparisons are made with experiments.

The Wing of Least Induced Resistance. (E. Prandtl, Z.F.M., Vol. 24, No. 11, 6/6/33, pp. 305-306.) (5.20/27009 Germany.)

The so-called elliptic distribution of lift gives the minimum induced drag for a given total wing lift, but this is a purely aerodynamical result and does not give the "best" distribution under consideration of structural weight and resistance.

The more general problem is intractable, but an intermediate problem is here stated and solved. The weight of the wing spars is taken into account and modifies the best shape and distribution of lift. The weight per unit length of the spar is taken as proportional to the bending moment at each point of the spar, to a useful approximation. The integral of the moment along the spar is then proportional to the total spar weight and is transformed, in a simple manner, into the 2nd moment of the lift along the spar. The modified problem of best lift distribution is found to be satisfied by the introduction of a quadratic factor and is solved formally. Numerical values are tabulated and shown graphically. The corresponding wing plan, for uniform incidence, is trapezoidal.

One reference.

Flow Round a Wing Profile with Applications to Hydraulic Machines. (F. Seewald, Z.V.D.I., Vol. 77, No. 21, 27/5/33, pp. 573-580.) (5.20/27010 Germany.)

A summary is given of the fundamental results of the circulation theory of reaction, with a cursory note on applications to compressors.

Thirty-nine references.

Trapezoidal Wings with Variable Incidence. (J. Hueber, Z.F.M., Vol. 24, No. 11, 6/6/33, pp. 307-310.) (5.20/27011 Germany.)

The methods of Prandtl's paper (see Abstract 27009) are extended to trapezoidal wings of variable incidence.

Examples of distribution of lift, incidence, circulation, induced resistance and induced downward velocity are shown graphically for various combinations of taper and incidence, taken from sailing aeroplanes.

Ten references.

Aerodynamical Properties of Biplane Wings of Trapezoidal Plan. (J. Hueber, Z.F.M., Vol. 24, No. 9, 13/5/33, pp. 249-251, and No. 10, 29/5/33, pp. 269-272.) (5.20/27012 Germany.)

Analytical methods are developed for calculating the circulation and effective incidence from the geometrical incidence and chord length. Developments are assumed in Fourier series and the coefficient determined by standard methods. Certain analytical irregularities, with a sharply cut-off wing tip are avoided by assuming a slight rounding off.

The calculated distributions of circulation lift, effective incidence, induced incidence and induced resistance are shown graphically for six degrees of taper and three aspect ratios. Derived relations and comparative values are also shown. The corresponding formulæ are given, but no numerical work is reproduced.

Ten references.

Drag of Streamline Bodies as Affected by Protuberance. (I. H. Abbott, N.A.C.A. Report No. 451, 1932.) (5.30/27013 U.S.A.)

The methods applied to wing profiles in Reports 446 and 449 are here applied to two model airship hulls. Streamline protuberances produced little adverse effect, especially on higher Reynolds numbers. Groups of six and eight tail fins produced an increase in drag of 8 per cent. and 11 per cent. respectively, and the cars an additional 10 per cent. of the fair hull drag.

Anomalies were found in reducing the measurements which are partly accounted for by mutual interference between car and hull.

Six references.

Aircraft—Landing Gear

Elastic Characteristics of Aeroplane Carriages. (R. Verduzio, L'Aerotecnica, Vol. 13, No. 3, March, 1933, pp. 163-177.) (5.50/27014 Italy.)

Expressions are formed for the work to be absorbed in landing and for the required elastic and damping forces in the undercarriage. Two diagrams of landing acceleration are reproduced, one for landing in stalled attitude with accelerations running up to 2.78, the other for a landing in normal flying attitude with initial landing acceleration exceeding 5g.

Parameters are introduced to simplify the equations, and their values are shown graphically for a range of conditions likely to occur in practice.

See Abstracts 27082 and 27083.

Hydrodynamics of Marine Aircraft. (J. H. Lower, J.R. Aer. Soc., Vol. 37, No. 269, May, 1933, pp. 423-434.) (5.51/27015 Great Britain.)

A concise account is given of test methods for determining hydrodynamic stresses on floats and hull, and resultant lift and drag. Observed stress distributions are shown graphically and applications to design are considered.

Photographs of large flying boats are reproduced.

Testing of Mechanical Brakes. (K. Kutzbach, Z.V.D.I., Vol. 77, No. 17, 29/4/33, pp. 443-447.) (5.58/27016 Germany.)

The unavoidable heating of brakes requires consideration as a fundamental factor in design, and the investigations here discussed enable the temperature rise to be predetermined with reasonable accuracy. The application of asbestos to protect the brake shoe allows a rise of temperature to as much as 400°C. without destructive action.

Numerical results are shown graphically in seven diagrams. A sketch of the test apparatus is given.

Four references.

Airscrews

Measurements of Free Running Screws in the Cavitation Tank of the Hamburg Shipbuilding Research Laboratory. (H. Lerbs, Werft-Reederei-Hafen, Vol. 14, No. 12, 15/6/33, pp. 169-172.) (5.60/27017 Germany.)

From the principles of dynamical similitude, rules for transformation from model to full scale are obtained and applied to expressions which are developed for the centrifugal reduction of pressure at the axis and illustrated graphically. The test installation is described with photograph and sectioned sketch. Velocity correction factors for different disc areas are calculated and plotted and a numerical example is worked out.

Seven references.

Investigation on Propeller Profiles, with Reduced Sensitivity to Cavitation. (H. Holl, F.G.I., Vol. 3, No. 3, May-June, 1932, pp. 109-116.) (5.60/27018 Germany.)

The experiments were carried out in a wind channel on a series of wing profiles with flat pressure side and suction side composed of one or more circular arcs. The symmetrical profiles with the greater thickness at mid-chord gave the smallest pressure range and were thus least subjected to cavitation. The results are stated to be in satisfactory agreement with theory.

Cycloidal Propelling Blades. (E. Schneider, Werft-Reederei-Hafen, Vol. 14, No. 12, 15/6/33, pp. 161-169.) (5.643/27019 Germany.)

An elaborate graphical vector diagram analysis is carried out of the reactions on impeller blades moving in helicoidal oscillating and cylindrical paths.

The method is analogous to that employed in turbine blade design, and no reference is made to modern theory of wing reactions.

Airscrew Design. (D. L. H. Williams, J.R. Aer. Soc., Vol. 37, No. 270, June, 1933, pp. 479-508.) (5.650/27020 Great Britain.)

The principles underlying the design of a successful aeroplane-engine-aircrew combination are reviewed. The paper is comprehensive but is in general qualitative, though illustrated by sufficient representative figures and data to give standards of present-day practice. Due importance is assigned to the development of aerodynamical theory on the one hand, and to systematic measurement on the other.

A number of specialists took part in the discussion which followed. Paper and discussion present the subject in sound perspective.

Airscrew Vibrations. (M. Hansen and G. Mesmer, Z.F.M., Vol. 24, No. 11, 6/6/33, pp. 298-304.) (5.660/27021 Germany.)

The work of British investigators published in Reports and Memoranda, and covering the period 1917-1926, is reviewed. A new analytical method of calculating vibration frequency is developed and checked by means of model experiments. There exists danger of resonance between natural harmonics of bending and firing impulses of the engine. The maximum stresses occur at approximately .7 to .8R., and in wooden propellers are marked by cracking of the varnish. In metal propellers resonance leads to fracture near the blade tips.

Instruments

Influence of Air Temperature and Pressure on Pressure Head Readings. (H. G. Kiel, Z.F.M., Vol. 24, No. 10, 29/5/33, pp. 281-284, D.V.L. Report 319.) (6.23/27022 Germany.)

Four types of Venturi pressure heads were calibrated and the coefficients, \bar{K} = pressure/suction, are shown as functions of Reynolds number R . An expression is formed showing the effect of pressure and temperature as an arbitrary function, and values of this function, as determined by experiment, are shown graphically. In unfavourable cases the error may be as great as -8 per cent., and in ordinary cases -5 per cent., an amount which certainly requires correction in accurate determinations of aeroplane speed.

Thirty references.

Principles of Hot Wire Instrument for Measurements of the Velocity Vector. (J. Ulsamer, F.G.I., Vol. 4, No. 3, May-June, 1933, pp. 121-128.) (6.40/27023 Germany.)

The elementary principles of heat conduction and electrical resistances are summarised, with their application in the three component hot wire instrument. Calibration is discussed and calibration curves are reproduced. Non-dimensional parameters are used freely in semi-empirical formulæ, and the results are generalised on the principle of dynamical similitude.

Seventeen references.

The D.V.L. Torsional Vibration Apparatus. (A. Stieglitz and E. Gilbert, Z.F.M., Vol. 24, No. 9, 13/5/33, pp. 253-255, D.V.L. Report 318.) (6.48/27024 Germany.)

A technical description is given of the installation, with two photographs and four sketches. A 5 k.w. D.C. motor drives the installation under test up to 10,000 r.p.m.

The installation is suitable for testing damping devices and for fatigue tests of materials. All the necessary data are recorded simultaneously, with sufficient accuracy.

Oscillographs for Ten Thousand Cycles per Second. (A. M. Curtis, Bell Tele. B.711, 1933.) (6.48/27025 U.S.A.)

The vibrator is strung to a natural frequency of 4,500 herz. and equalised up to from 10,000 to 12,000 herz. by electrical circuits. The description of the apparatus is illustrated by photographs and a perspective sketch of the whole assembly and of details. Characteristic curves show frequency as functions of resistance and of deflection under different settings. Three oscillograms are reproduced.

Six references.

A Simple Method for Making Photographic Records of Motion. (E. Raetsch, Z. Instrum., Vol. 53, No. 6, June, 1933, pp. 283-285.) (6.48/27026 Germany.)

Small vibrations in space or large vibrations in a plane are recorded by fixing one or more transparent screens to the object to be investigated. These screens are provided with a series of reference lines and points which are photographed on a rotating drive through a narrow slit. Numerical values of the displacements are obtained from the dimensions of the optical system and a separate calibration is unnecessary.

Gyro Compass and Ship Manœuvres. (J. W. Geckeler, Ingenieur Archiv, Vol. 4, No. 2, April, 1933, pp. 127-152.) (6.503/27027 Germany.)

In a previous communication (Ing. Archiv. Band 4, No. 1, 1933, p. 66) the general theory of the gyro compass was developed and the formal solution without damping was given. The present note considers the effect of damping.

For the use of artillery at sea, a steady compass reading (varying by not more than three minutes of arc per minute of time) is of greater importance than a true absolute reading. This seems to indicate that the amount of damping should be controllable.

A New Askania Pendulum Sextant. (H. Fuss, Z. Instrum., No. 4, April, 1933, pp. 152-159.) (6.532/27028 Germany.)

An air navigation sextant, constructed by Zeiss, employs a pendulum instead of the more usual bubble. The pendulum deflection is observed direct in the eye-piece, so that a number of observations can be taken in quick succession. The suspension and damping of the pendulum have been carefully studied.

An accuracy of $\pm 3'$ is claimed, giving a fix within about three miles.

Aircraft Sextant for Visible Horizon. (L. Becker, J.R. Aer. Soc., Vol. 37, No. 272, August, 1933, pp. 703-707.) (6.532/27029 Great Britain.)

Three short arcs on the visible horizon are brought into the field of view and appear as straight lines cutting at about 60° . When the centre of the field is brought to equi-distance from these three lines the best compromise is obtained. The error appears only in 2nd order terms, hence an error of $\frac{1}{2}^\circ$ in observation squared gives an error from the horizontal of the order of one minute.

The elementary spherical trigonometry is worked out.

Measurement of Fundamental Sound Generated by an Airscrew in Flight. (E. T. Paris, Phil. Mag., Vol. 16, No. 103, July, 1933, pp. 50-61.) (6.95/27030 Great Britain.)

The sound was recorded by a resonant hot wire microphone calibrated against a Rayleigh disc and tuned to the fundamental note of the airscrew, which is taken to be the number of airscrew blades multiplied by the revolutions per second in accordance with experiment. A diagram of connections shows the electrical layout. The frequency was recorded simultaneously.

Numerical results are given in a table. The sound energy output was computed as 55 watts, in comparison with the figure of 29 watts given by Kemp for a two-bladed screw developing 500 h.p. at 1,850 r.p.m.

Eleven references.

Aircraft Flight

Path of Minimum Flight Time between Two Points. (P. Frank, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 88-91.) (7.15/27031 Germany.)

The problem of the path of minimum flight time is analogous to the optical path of a ray in media of variable refractive index. A formal treatment in vector notation leads to the expected analogous result.

Six references.

Lateral Control near Stalling. (N.A.C.A. Reports and Technical Notes.) (7.25/27032 U.S.A.)

A research programme has been carried out under the following list of Reports and Technical Notes.

N.A.C.A. Reports.

- 419 Ordinary ailerons on rectangular wings. F. E. Weick and C. J. Wenzinger.
- 422 Slotted ailerons and frise ailerons. F. E. Weick and R. W. Noyes.
- 423 Ordinary ailerons rigged up 10° when neutral. F. E. Weick and C. J. Wenzinger.
- 424 Floating tip ailerons on rectangular wings. F. E. Weick and T. A. Harris.
- 439 Spoilers and ailerons on rectangular wings. F. E. Weick and J. A. Shortal.
- 444 Skewed ailerons on rectangular wings. F. E. Weick and T. A. Harris.

N.A.C.A. Technical Notes.

- 443 Handley Page tip and full span slots with ailerons and spoilers. F. E. Weick and C. J. Wenzinger.
- 445 Straight and skewed ailerons on wings with rounded tips. F. E. Weick and J. A. Shortal.
- 449 Tapered wings with ordinary ailerons. F. E. Weick and C. J. Wenzinger.
- 451 Various control devices on wing, with fixed auxiliary airfoil. F. E. Weick and R. W. Noyes.
- 458 Various floating tip ailerons on rectangular and tapered wings. F. E. Weick and T. A. Harris.

The details of the model apparatus are given by dimensioned sketches and tabulated numerical data. The results were obtained under specified wind channel conditions, the lift, drag, yawing and rolling moments being measured for systematic variation of the control settings.

A great mass of test figures is recorded in numerical tables and drawn graphically in diagrams of curves. Conclusions are drawn as to the comparative effectiveness of each device. Designers will find it advisable to study at first hand this body of experimental data which is not suitable for abstracting in detail.

Wings with Variable Curvatures and Slot Openings. (J. Lacaine, L'Aéron., No. 168, May, 1933 (Supplement), pp. 41-44.) (7.72/27033 France.)

The details of the variable wing are shown in sketches and in a photograph. Experimental polar curves of lift and drag are reproduced and show the increase

in lift and drag at three different settings. The results are in general agreement with previous work.

Three references.

Engines—Thermodynamics

Combustion Processes in Aircraft Engines. (H. K. Cummings, *Aeron. Eng.*, Vol. 5, No. 2, April-June, 1933, pp. 65-73.) (8.13/27034 U.S.A.)

A brief historical account is given of the development of research methods, illustrated with graphical characteristics, a photograph of flame propagation and photographs of comparative flame front spectra.

The complete analysis of the phenomena remains obscure, and recommendations for further research by an influential U.S.A. committee are reproduced.

Thirty-four references.

Pressure Increase, Gas Oscillation and Noise in the Explosion of Fuels. (O. Wawrziniok, *Autom. Tech. Zeit.*, Vol. 36, No. 5, 10/3/33, pp. 136-142.) (8.13/27035 Germany.)

During explosions of fuel in a bomb, electrical apparatus recorded faint sounds before the flame reached the wall, and with a frequency corresponding to natural periods of gas vibrations in the bomb.

Thermal Calculation Compared with Observed Relations in a Diesel Engine. (H. Schor, *Werft-Reederei-Hafen*, Vol. 14, No. 8, 15/4/33, pp. 106-110; No. 9, 1/5/33, pp. 119-123.) (8.13/27036 Germany.)

Elaborate thermo-chemical relations are applied to calculations of heat transformations. Corrections are introduced for variable specific heats, heat losses, etc.; the formulæ are modified by the introduction of empirical coefficients, and good general fits are finally obtained with observed temperatures, pressures, and heat relations.

Comparisons are made with the experimental results of Neumann, Lutz and Pflaum. The two last show substantial agreement and the discrepancies are accounted for by differences in assumptions as to dissociation, specific heat, and accumulation of errors in the elaborate graphical processes employed.

The Upper Pressure Limit in the Chain Reaction between Hydrogen and Oxygen. (G. H. Grant and C. N. Hinshelwood, *Proc. Roy. Soc.*, Vol. 141, No. A.843, 3/7/33, pp. 29-40.) (8.13/27037 Great Britain.)

The influence of hydrogen/oxygen ratio, inert gas, temperature and surface and diameter of vessel on the upper pressure limit of the low pressure explosion of hydrogen and oxygen has been investigated.

The authors hold that the results are inconsistent with surface adsorption relationships or differing thermal conductivities, but can be accounted for by branching chain reactions becoming de-activated in ternary collisions.

Engines—Design and Performance

Light Aeroplane Engines. (W. Kamm, *Z.V.D.I.*, Vol. 77, No. 22, 3/6/33, pp. 593-595.) (8.20/27038 Germany.)

The power of the Argus As.8 series has been increased from 90 h.p. at 1,400 r.p.m. to 155 h.p. at 2,350 r.p.m., and of the As. 10 series from 220 h.p. at 2,000 r.p.m. to 270 h.p. at 2,150 r.p.m.

The Hirth H.M.60 gives 70 h.p. at 2,150 r.p.m. and the H.M.150 gives 160 h.p. at 2,250 r.p.m. There is a corresponding reduction in specific weight to less than 1 kg./h.p.

Constructional details are given with two photographs and a sectional sketch.

Influence of Atmospheric Conditions on Engine Performance. (H. Oestrich, Autom. Tech. Zeit., Vol. 36, No. 9, 10/5/33, pp. 226-230, and No. 10, 25/5/33, pp. 270-274. D.V.L. Report No. 315.) (8.22/27039 Germany.)

Reference is made to U.S.A. experimental work on the influence of atmospheric pressure and temperature on engine performance. An elaborate discussion is given of the numerous factors entering into the problem.

The brake h.p. is taken as the experimental datum, with tacit recognition that indicated h.p. is unreliable in the present stage. Curves showing the experimental relations between brake h.p. and atmospheric conditions are compared with various empirical relations such as variations of temperature and square root of temperature. It is considered that no determinate relations between b.h.p. and atmospheric conditions can be formulated. Application of the method to Diesel engines is discussed.

Junkers Aeroplane Engine Supercharger. (R. Schulz, Luftwacht, No. 5, May, 1933, pp. 169-172.) (8.235/27040 Germany.)

The centrifugal fan is driven by means of oil pressure applied to a gear wheel pump. The leakage in the pump can be controlled and in this way variable fan speed obtained.

Air Compression with Temperature Rises above Adiabatic with Special Reference to Airplane Superchargers. (S. A. Moss, Aeron. Eng., Vol. 5, No. 1, Jan.-March, 1933, pp. 35-43.) (8.235/27041 U.S.A.)

The study of blower performance is confused by the use of the term "efficiency" without clear definition. Such terms as "temperature efficiency," "shaft efficiency," "adiabatic compression efficiency," refer to very different ratios but are often used indiscriminately.

Four references.

"Jumo 5" Heavy Oil Engine. (Flugsport, Vol. 25, No. 13, 21/6/33, pp. 262-264.) (8.25/27042 Germany.)

Junkers have produced a smaller edition of the well-known "Jumo 4," rated at 420 h.p. continuous output on a specific weight of 2.6lb. per h.p. The general layout follows the previous design.

Notes on Petrol and Diesel Engines. (H. R. Ricardo, J.R. Aer. Soc., Vol. 37, No. 270, June, 1933, pp. 509-546.) (8.265/27043 Great Britain.)

The main problems discussed were the wear of cylinder liners of carburettor engines and the cracking of white metal big end bearings in the case of Diesel engines. A number of engine designers and users contributed views. It appeared that corrosion due to fuel is largely responsible for the wear, whilst the cracking is in some way associated with the rapid rise of pressure of the Diesel cycle.

Storage Battery Grids. (G. W. Vinal, D. N. Craig and C. L. Snyder, Bur. Stan. J. Res., Vol. 10, No. 6, June, 1933, pp. 795-808.) (8.28/27044 U.S.A.)

The effect of antimony in producing excessive sulphation of negative plates in storage batteries was investigated. Twenty cells with lead plates containing various proportions of antimony and cadmium immersed in sulphuric acid were subjected to 115 charging and discharging cycles. The increase in weight of the negative plates was measured and the condition of the positive plates was observed.

The use of pure lead positive plates was found to improve the life of the cell and the uniformity of voltage by decreasing the sulphation of the negative plates.

Numerous experimental data are given in eight tables.

Nineteen references.

The Torsion of Crankshafts. (R. Grammel, *Ingenieur Archiv*, Vol. 4, No. 3, June, 1933, pp. 287-299.) (8.36/27045 Germany.)

The torsional couple on a crankshaft is applied by the thrust on the cranks of the connecting rods. In the usual mathematical investigation the twisting couple is considered as applied at the free ends of the shaft, an assumption which may lead to considerable error in estimating the stiffness of the shaft.

D.V.L. Torsional Strain Recorder. (H. Lürenbaum, *Z.F.M.*, Vol. 24, No. 7, 13/4/33, pp. 199-202.) (8.36/27046 Germany.)

An installation for measuring and recording at a distance torque strain on a length of shaft has been designed by the D.V.L. A technical description is given, with detailed end and side sketches and three photographs.

Record diagrams are scratched by a steel and diamond point on a uniformly moving strip. Calibration is discussed and three diagrams, enlarged about 16 times, are reproduced and show torque oscillations in considerable detail.

Improvements and applications are suggested.

Engines—Cooling

Convection of Heat from Plates and Cylinders in a Stream. (N. A. V. Piercy and H. F. Winny, *Phil. Mag.*, Vol. 16, No. 105, Aug., 1933, pp. 390-408.) (8.40/27047 Great Britain.)

Assuming constant thermometric conductivity and specific heat capacity, and neglecting viscosity, Boussinesq's expression for steady two-dimensional flow becomes linear and solutions may be built up by the usual methods.

In the present paper the solution takes the form of an integral equation, the discussion of which, in reference to assumed boundary conditions for flat plates and cylinders, forms the bulk of the paper.

Comparison with King's experiments is shown graphically. There are considerable difficulties of interpretation.

Seven references.

Research on Low Drag Cowlings—Bristol Aeroplane Co. (*Airc. Eng.*, Vol. 5, No. 55, Sept., 1933, pp. 209-212.) (8.426/27048 Great Britain.)

The introduction of supercharging and gearing down of airscrew speeds raised special problems in air-cooled engines, which were covered by U.S.A. investigations.

An account is given of the full-scale work carried out in conjunction with Messrs. Vickers. Sectioned diagram sketches show details of fixing with relative wind and speed distribution along the cylinder and disposition of cowlings.

Tables of qualitative results are given and recommendations are made.

Heat Transfer during the Flow of Viscous Fluid in Tubes. (N. Jakob and H. Eck, *F.G.I.*, Vol. 3, May-June, 1932, pp. 121-126.) (8.444/22.2/27049 Germany.)

Experiments of Holda on the warming of oil in a tube heater disagree with the mathematical expression of Graetz. The actual measured heat transfer and temperature distribution are affected by a compensatory radial flow of the oil due to viscosity differences.

Engines—Lubricants and Lubrication

Measurement of Thickness of Lubricating Film in Bearings. (H. Hoake, *Z.V.D.I.*, Vol. 77, No. 14, 8/4/33, p. 381.) (8.540/27050 Germany.)

A description is given of test apparatus with a conical shaft and bearing. The adjustment of the clearance can be read to 10^{-5} cm., and it is stated that lubrication is maintained down to a clearance of 10^{-4} cm.

The apparatus was designed without knowledge of the Prandtl apparatus (see Abstract No. 26060).

A Contribution to the Theory of Film Lubrication. (A. M. Robb, Proc. Roy. Soc., Vol. 140, No. A.842, 1/6/33, pp. 668-694.) (8.580/22.10/27051 Great Britain.)

The fundamental equation of Reynolds is modified to take into account the extent of the oil film, which is not necessarily equal to the length of the brass. With this modification it is possible to obtain agreement between experimental and calculated values of load carrying capacity and eccentricity locus.

Engines—Fuels

Application of Raman Spectra and Ultra Violet Absorption to the Identification of Hydrocarbons. (A. Andant, Pub. Sc. et Tech., No. 21, 1933.) (8.640/27052 France.)

The Raman spectra are examined with a photo-micrometer, and results for a number of fuels are given. It appears that mixtures of fuel can be analysed under certain conditions. The ultra-violet absorption bands are capable of determining the relative purity of a hydrocarbon, but are not applicable to the analysis of fuel mixtures.

Grading Fuels for Aeronautical Use. (W. W. White, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 97-99.) (8.640/27053 U.S.A.)

A vocabulary with definitions is given for use in drawing up specifications of fuel. Difficulties met with in drawing up specifications are quoted for Navy, Army and civil experience.

A list of 19 commercial and experimental fuels is tabulated with symbols indicating the appropriate specification.

Quality and Economics of Aviation Fuel. (G. G. Oberfell, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 79-87.) (8.640/27054 U.S.A.)

The physical properties of fuels are discussed and distillation characteristics are shown graphically. A graphical method is given for deriving vapour pressure characteristics from the distillation curves of the American Society for Testing Materials, and comparative calculated and observed values are given for 43 fuels in a numerical table.

Octane number, anti-knock characteristics, and gum content determination are discussed, and fuel specifications are given in tabular form.

Twenty-five references.

Effect of Gasoline Volatility on Miscibility with Alcohol. (O. C. Bridgeman and D. W. Querfeld, Bur. Stan. J. Res., Vol. 10, No. 6, June, 1933, pp. 841-850.) (8.640/27055 U.S.A.)

Increase in volatility of light motor spirit produces marked decrease in the critical temperature of solution with ethyl alcohol. Specifications by distillation temperatures and percentages of 21 gasolines are given, and of 31 aqueous solutions, with from 1 to 8 per cent. water, with specific gravities. A wide range of mixtures was examined, and the critical solution temperatures are given in tables and graphically.

One reference.

Effects of Pressure Piping on Fluid Injection. (C. W. Lawson, J.R. Aer. Soc., Vol. 37, No. 272, Aug., 1933, pp. 694-702.) (8.684/27056 Great Britain.)

The elasticity of fuel and pipe create a lag in delivery which increases with pipe length. Photographs and sketches show mechanical details and pump delivery diagrams show the delivery with a marked increase of lag as the pipe length increases. Numerous partial influences require further investigation.

Engines—Injection Systems

The Thermal Aspects of Carburation with Special Reference to the Vapourisation of Ethyl Alcohol. (J. Small, *Phil. Mag.*, Vol. 16, No. 106, Sept., 1933, pp. 641-656.) (8.701/27057 Great Britain.)

Total heat/mixture-ratio and total heat/entropy are plotted graphically. The importance of preheating alcohol fuels is demonstrated. Starting is facilitated by suitable throttling control and by large thermal capacity in the induction system. The detrimental effect on subsequent ignition of incomplete thermal equilibrium during compression is mentioned.

The Behaviour of Spring Loaded Injection Nozzles of Oil Engines. (O. Lutz, *Ingenieur Archiv*, Vol. 4, No. 2, April, 1933, pp. 153-168.) (8.705/27058 Germany.)

The mathematical investigations and experiments were carried out on a standard Bosch spring-loaded nozzle. The control of the needle valve depends both on the elastic properties of the fluid and on the spring constants. The working frequency of the needle is about double that under spring control only, and care must be taken in design that the component parts do not lose contact—with consequent excessive wear.

Engines—Exhaust Systems

Silencing Motor Car Exhausts. (M. Kluge, *Autom. Tech. Zeit.*, Vol. 36, No. 7, 10/4/33, pp. 192-196, and No. 9, 10/5/33, pp. 244-249.) (8.721/27059 Germany.)

The intensity of sounds in a busy street is taken as 50 phons, and it is considered that the intensity of exhaust noise should not exceed 70 phons at five metres. The elementary principles of acoustic filters are stated. An assumed pressure wave form is analysed into its "sound spectrum," the effect of an appropriate combination of acoustic filters is discussed, and elementary mathematical relations are obtained.

A numerical example is worked out and the damping shown as a function of frequency. A chamber volume of 4,300 cm. gave a damping of 17 phons, and of 1,000 cm. only 3 phons. The effect with three uniform damping chambers is compared with that of three staggered chambers.

It is concluded that the necessary damping to 70 phons is attainable.

Eight references.

Engines—Gears

Manufacture of Farman Airscrew Reduction Gear. (*Tech. Aéron.*, No. 127, 1933, pp. 62-72.) (8.761/27060 France.)

The main shaft of the gear is made of chrome-nickel molybdenum steel, and the gear wheels of high tensile case-hardening chrome-nickel steel. Details of the case-hardening process are given.

Fluid Gears. (W. Bauer, *Autom. Tech. Zeit.*, Vol. 36, No. 10, 25/5/33, pp. 258-262.) (8.761/27061 Germany.)

In hydraulic gears of the Hele-Shaw type there are considerable leakage losses. The author gives experimental evidence that spring-loaded poppet valves would control the oil flow effectively at high speed and reduce the leakage loss in gears of this type.

Armament

Field of Fire in an Aeroplane. (L. Kirste and L. Favre, L'Aéron., No. 168, May, 1933, pp. 117-119.) (9.17/27062 France.)

The authors state that the importance of measuring field of fire is a recent idea. The stereographic projection of a hemisphere is considered as the most consistent, and transformation to projections on a cube are discussed.

Projections from four different positions are reproduced separately and superposed to give a composite figure which takes account of the possible changes of position.

One reference.

Field of View of Hanriot 110. (L'Aéron., No. 168, May, 1933, p. 107.) (9.17/27063 France.)

A technical description includes projection on the sides of a cube of the solid angles of view with the pilot's head in two positions—central and 20 cm. to the right.

Materials—Characteristics

Stainless Steel in Aircraft Construction. (E. J. W. Ragsdale, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 89-95.) (10.102/27064 U.S.A.)

The elementary metallurgy of an alloy suitable for structural work is discussed to show the limitations under which desirable physical properties are maintained during fabrication and welding. Photographs are given of welds of built-up component parts of wings and ribs, of a boat hull in four stages of assembly, and of a complete seaplane structure. Costs are discussed.

Creep and Structural Stability of Nickel-Chromium Steels at 870°C. (W. A. Tucker and S. E. Sinclair, Bur. Stan. J. Res., Vol. 10, No. 6, June, 1933, pp. 851-862.) (10.104/27065 U.S.A.)

The apparatus for testing under high temperatures is shown in a sectioned diagrammatic sketch. Specifications of 26 alloys are tabulated. A mass of creep data is given showing creep after 500-700 hours as a function of temperature.

Comparison is made with previous tests at 538°C. Changes of structural grain are shown in 12 micro-photographs and are remarkably slight.

A New Light Alloy. (Autom. Tech. Zeit., Vol. 36, No. 10, 25/5/33, p. 269.) (10.231/27066 Germany.)

The Interessengemeinschaft Farbenindustrie have introduced under the trade name of "hydronalium" a new Al/mg. alloy ($\rho=2.6$) with forging properties similar to duralumin but with higher resistance to corrosion.

Aluminium Alloys in Aircraft Construction. (C. F. Nagel and G. D. Hogland, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 75-78.) (10.231/27067 U.S.A.)

Figures are given to show steady increase up to a guaranteed yield point of 30,000 lbs., and tensile strength 60,000 lbs., for duralumin and its variants as manufactured in U.S.A. Alclad has set an entirely new standard of resistance to corrosion.

Practice in riveting and welding is discussed briefly, and a comparative table of spot weld and rivet strength on the whole shows higher figures for welding. Applications to aeroplane construction are suggested.

In the discussion corrosion was the principal subject raised. In reply it was stated that paints and varnishes did not hold well on smooth duralumin surfaces, but that roughened duralumin surfaces were better than steel surfaces.

Influence of Initial Stress on Fatigue Strength. (P. Ludwik and J. Krystof, Z.V.D.I., Vol. 77, No. 24, 17/6/33, pp. 629-635.) (10.245/27068 Germany.)

When a variable load is superposed on a steady initial load an experimental relation is found between the initial load and the limiting variable load, the total load of rupture being the sum of the two former. The functional relation between any pair of these three quantities is shown graphically as a unicursal curve and a variety of transformation is available.

Extensive data are shown graphically and in numerical tables for 18 steels, cast irons and light and heavy alloys. Examples of the influence of corrosion and notching are given.

Twenty-eight references.

Elastic Deformation of Timber. (J. Stamer and H. Sieglerschmidt, Z.V.D.I., Vol. 77, No. 19, 13/5/33, pp. 503-505.) (10.400/23.10/27069 Germany.)

Young's modulus multiplied by the cube root of the cubic modulus and divided by the shear modulus is taken as independent parameter, and the ratio Young's modulus/shear modulus is plotted against it. The resulting locus is roughly linear for metals and timbers.

Numerical tables contain experimental values of the moduli.

Twelve references.

Glass with Internal Strains. (L. von Reis, Z.V.D.I., Vol. 77, No. 23, 10/6/33, pp. 615-618.) (10.406/27070 Germany.)

Methods of annealing glass are discussed and illustrated by sketches of the annealing apparatus and curves of cooling. The internal stress distribution is shown as a function of rate of cool and of thickness. Under certain conditions the initial strain gives higher resistance to loads.

A useful property is the shattering of the whole sheet into small particles which are less dangerous in an accident than large fragments.

Three photographs and 13 diagrams are given.

Materials—Defects and Treatment

Gases in Metals. (J. H. Scaff and E. E. Schumacher, Bell Tele. B.727, 1933.) (10.120/27071 U.S.A.)

Apart from case-hardening by the important nitriding process, the technical interest of absorption of gases in metals lies chiefly in the adverse effect on casting.

Methods of analyses and measurement of gases in metals are described, and apparatus for melting metals in high vacuum are illustrated by two photographs and a diagram. Electric melting in vacuo was developed on a manufacturing scale in Germany during the war, and vacuum furnaces of four-ton capacity are in operation. The difficulties met with and the advantages obtained are discussed.

Twenty-six references.

Spot Welding of Various Metals. (L. Ferguson, Bell Tele. B.748, 1933.) (10.140/27072 U.S.A.)

The results depend on the correct adjustment of the physical factors involved, which include electric current density and contact resistance of electrodes, electrical resistance, thermometric conductivity, cooling path and cooling surface, electrode cooling. Mechanical pressure influences the contact resistance and the welding action. The voltage, strength and duration of current are regulated to produce the best conditions.

From the metallurgical point of view, melting temperatures and mechanical strength of the alloy found are influenced by the volume and shape of the weld on the surrounding medium—air, hydrogen, water, etc.—the temperature and rate of cooling.

Sketches show different forms of electrodes and welded materials, the shape of the heated metal and the electric current lines. Specifications are given for welding various materials.

Eleven references.

Fatigue Strength of Welds. (G. Schaper, Z.V.D.I., Vol. 77, No. 21, 27/5/33, pp. 557-560.) (10.140/27073 Germany.)

A summary is given of research methods and results on welded joints by the V.D.I. and other laboratories. Numerous types of weld are indicated by sketches, with distribution of stress lines in one case. A short numerical table gives results of variable loads on beams with welded flanges. Rules are given for the permissible use of welded joints under different types of load.

Two references (see Abstract 27075).

Influence of Slag Inclusions on Electric Welds. (H. Blomberg, Z.V.D.I., Vol. 77, No. 18, 6/5/33, pp. 475-477.) (10.140/27074 Germany.)

Thirteen micro-photographs show forms of slag inclusion and distortion of films in butt welding. The effects are discussed and rules are given for avoidance of serious defects.

See Abstracts 27073 and 27075.

Fatigue Strength of Welds of Different Shape. (A. Thum and W. Schick, Z.V.D.I., Vol. 77, No. 19, 13/5/33, pp. 493-496.) (10.140/27075 Germany.)

A test piece without weld and 16 types of weld are shown in sketches. The variable load imposed was of the nature of a sine wave superposed on a constant value.

A summary is given of the effects of variations in shape on the reduction of strength. Seven photographs show welds and fractures. In general, smooth flow of stress lines through material and weld is of primary importance. The run of the stress lines is shown qualitatively for several specimens to illustrate the point.

Calculation of Spiral Springs of Rectangular Cross Section. (G. Liesecke, Z.V.D.I., Vol. 77, No. 16, 22/4/33, pp. 425-426.) (10.164/27076 Germany.)

Various approximations of the exact result are discussed and an approximate formula is selected which is stated to give sufficient accuracy for practical design.

The numerical results are given in a series of curves for different ratios of the sides and the projected radius of the spirals.

Design of Valve Springs. (F. Nixon, Airc. Eng., Vol. 5, No. 55, Sept., 1933, pp. 193-196.) (10.164/27077 Great Britain.)

The effect of surging in increasing the stresses in the material is considered briefly. When the maximum surging stresses have been brought within the permissible limit there still remains the question of local defects in the materials, which are considered by the author to be the source of most breakages.

Air Ministry specifications are quoted and charts and tables are prepared for rapid computations to determine the dimensions of the spring which will bring it within the prescribed conditions.

Harmonics in Valve Springs. (E. Lehr, Z.V.D.I., Vol. 77, No. 18, 6/5/33, pp. 457-462.) (10.164/27078 Germany.)

The stroboscopic method of observing periods is described. Numerical Table I gives an analysis by Runge's method of D.V.L. observed inlet and outlet valve motions to the 12th harmonic for three spring settings; Table II similarly for American experiments up to the 30th harmonic. The differential equation is formed and solved in the usual manner.

The damped reflections of a wave are exhibited graphically for an aeroplane engine at maximum speed. A three-dimensioned model exhibits a surface of amplitudes intuitively.

Eight references.

Protection of Timber from Flames. (Z.V.D.I., Vol. 77, No. 16, 22/4/33, p. 428.) (10.420/16.05/27079 Germany.)

A specification is given of some protective materials produced commercially, with a brief account of their action when the treated timber is exposed to flaming gases.

Instrument for Measuring Thickness, Compressibility and Resilience of Textiles, etc. (H. F. Schiefer, Bur. Stan. J. Res., Vol. 10, No. 6, June, 1933, pp. 705-713.) (10.424/27080 U.S.A.)

A disc, one inch in diameter, is pressed on a sheet of material laid on a plane table, the pressure and compression being indicated by dials. Eight experimental stress strain diagrams are drawn and numerical results are tabulated for 35 materials.

Three references.

Raw Rubber as Material of Construction. (A. Frank, Z.V.D.I., Vol. 77, No. 15, 15/4/33, p. 400.) (10.428/27081 Germany.)

Stress strain diagrams are shown for raw rubber and for sheets made up with alternate laminations of cork and papier maché. Other properties are given in a table.

Three references.

"Faudi" *Pneumatic Shock Absorber.* (Flugsport, Vol. 25, No. 6, 15/3/33, pp. 124-127.) (10.444/27082 Germany.)

In shock absorbers of combined oil and pneumatic type, troubles may arise from high viscosity at low temperature, from leakage or from corrosion. In the "Faudi" pneumatic absorber no oil is used and the weight is relatively small. Rubber packing rings render the air leakage small, with re-inflation at long intervals. It has passed successful tests at the D.V.L. and is fitted to the Heinkel He. 70.

Characteristics of Shock Absorbers. (H. O. Fuchs, Autom. Tech. Zeit., Vol. 36, No. 7, 10/4/33, pp. 169-172.) (10.444/27083 Germany.)

Single and double acting shock absorbers are shown in sectional diagrams. Pressure-stroke diagrams are shown for both types for three different rates of strain. Pressure-stroke characteristics are also given for different settings and rates of strain.

Seven references. See Abstract 27082.

Temperature Stress in Walls and Slabs. (N. S. Boulton, Phil. Mag., Vol. 16, No. 103, July, 1933, pp. 145-163.) (10.90/27084 Great Britain.)

Expressions are formed for temperature strains and corresponding internal stresses in the simple cases considered, a simple temperature distribution being assumed.

Numerical examples are worked out and distributions of temperature and stress are shown graphically.

Contribution to the Study of Corrosion of Iron and Steel. (J. Aubert, Pub. Sc. et Tech., No. 23, 1933.) (10.125/27085 France.)

The work is an extension of the researches of Evans'. Oxidising corrosion is largely governed by differences in oxygen concentration over the surface of the metal. The metal surface is in various states of activation and the resulting corrosion can be controlled by the presence of hydroxyl ions.

Protection Against Corrosion on the German Railways. (O. Lindermayer, Z.V.D.I., Vol. 77, No. 15, 15/4/33, pp. 385-392.) (10.125/27086 Germany.)

Climatic conditions are considered in different parts of Germany. A wide range of experience, particularly with steel construction is discussed.

Tabular specifications of treatment are given and costs of maintenance are shown graphically.

Fourteen references.

Electrochemical Oxidation and Protection of Iron and Duralumin in Aerated Saline Solutions. (E. Herzog, Pub. Sc. et Tech., No. 19, 1933.) (10.125/10.262/27087 France.)

A study of the polarisation of certain electrolytic cells shows that certain impurities act as accelerators or decelerators of corrosion, in a manner which accounts for the difference between the action of sea water and of salt solutions.

Influence of Heat Treatment on Corrosion of Rolled Aluminium Alloys. (Z.F.M., Vol. 24, No. 10, 29/5/33, pp. 284-285.) (10.260/27088 Germany.)

A specification is given of heat treatments applied in tests on duralumin and lautal.

The results of corrosion tests on the duralumin specimen are shown graphically in relation to the heat treatment temperature after 0, 2, 4, 6, 8 and 10 days' corrosion treatment. The curve of ultimate strength before corrosion treatment remains nearly constant for heat treatment temperatures from 18° to 145° and then falls over 10 per cent. for 180° re-heat temperature; the remaining curves are systematically lower as corrosion time increases and all show a marked dip for annealing temperature—135°—with recovery at about 160°.

Corrosion of Metals—Causes and Effect. (G. Guzzoni, L'Aerotecnica, Vol. 13, No. 6, June, 1933, pp. 714-744.) (10.262/27089 Italy.)

The author supports the differential aeration theory of Evans with a numerous selection of examples of aluminium alloys illustrated by photographs. The conclusions lead to the usual precautions and a summary is given of practice in producing resisting alloys of aluminium and in applying protective processes and coverings.

Duralumin Applied to Aircraft Construction. (W. H. Lewis, J.R. Aer. Soc., Vol. 37, No. 272, Aug., 1933, pp. 680-693.) (10.290/27090 Great Britain.)

The metallurgical aspect is discussed with curves showing the relation between heat treatment and ultimate stress. Corrosion and corrosion experiments are surveyed and anti-corrosion treatments are specified.

The manufacturing of strip and tubes and their working into frames and hulls are briefly described and illustrated by five photographs.

Testing Apparatus and Methods of Testing

Acrograms by Refraction of Hot Air Filaments. (A. Lafay, Pub. Sc. et Tech., No. 24, 1933, p. 25.) (11.105/27091 France.)

The experimental mounting is described with illustrations. A number of photographs are reproduced of the optical caustics produced by a beam of light

passing through hot air filaments travelling with the wind stream. The velocity field round a plate and stationary or rotating cylinders is shown by photographic records of the hot air filaments obtained in this way.

Aerofoil in Wind Channel of Elliptic Section. (L. Rosenhead, Proc. Roy. Soc., Vol. 140, No. A.842, 1/6/33, pp. 579-604.) (11.16/27092 Great Britain.)

Prandtl's method of images, applied to circular channels, and Glauert's numerous extensions to rectangular, elliptical and other channels, are given greater unity and generality by the author's more powerful analysis.

In a previous paper the doubly infinite series of images in a rectangular channel were expressed in terms of elliptic functions (theta functions). In the present paper, suggested by Glauert's work referred to above, expressions are formed in terms of theta functions for a complex function, the real and imaginary parts of which supply the stream lines and potential lines of the motion inside an elliptic boundary containing simple vortices.

The numerical parameters are the ratio of span to focal distance and the ratio of semi-diameters, as functions of which the coefficient of induced velocity is tabulated and shown graphically by families of curves, for closed and open streams.

Seven references.

Interference by Walls of Wind Channel. (L. Rosenhead, Proc. Roy. Soc., Vol. 142, No. A.846, 2/10/33, pp. 308-320.) (11.16/27093 Great Britain.)

Reference is made to Theodorsen's paper (see Abstract 27097).

Appropriate expressions for the induced velocity near a wing represented by a vortex doublet are formed in terms of theta functions. It is shown that an additional linear term must be taken into account, which vanishes when the stream has two closed sides parallel to the span and two open sides at right angles to it, but not when the doublet is turned through a right angle. This appears to have been overlooked by Theodorsen and leads him to erroneous results. The error is disclosed on comparison with known results from Glauert's theorem that if the open and closed parts of the boundary be interchanged the interference on the doublet turned through a right angle is the same numerically but has the opposite sign.

The coefficient of induced velocity is tabulated and plotted for all possible combinations of open and closed boundaries of rectangular stream.

Interference with Aerofoils of a Channel of Rectangular Section. (H. Glauert, Reports and Memoranda No. 1419.) (11.16/27094 Great Britain.)

Reference is made to the development of expressions in elliptic functions by Terazawa and Rosenhead. Their expressions are transformed and the new expressions are tabulated to facilitate numerical calculation.

The coefficient of induced velocity averaged across the wing span is a useful parameter in obtaining approximate numerical values of sufficient accuracy and is shown graphically for square and 2:1 rectangular channel, as a function of span/width of channel.

Four references.

Interference with Aerofoils of a Channel of Circular Section. (H. Glauert, Reports and Memoranda No. 1453.) (11.16/27095 Great Britain.)

The interference for elliptic and uniform distribution of circulation along the span discussed by Prandtl and Rosenhead is generalised for any distribution expressed as a Fourier series.

It is shown that the corrections obtained for induced drag and induced incidence are substantially negligible for usual aerofoil sections.

Two references.

Interference with Aerofoils of Wind Channels. (H. Glauert, Reports and Memoranda No. 1470, 1932.) (11.16/27096 Great Britain.)

Using the methods of conformal transformation, the aerofoil is taken to be small and replaced by a doublet of appropriate strength. The conditions required to bring the normal velocity to rest over a given boundary and to make the normal pressure zero over the same boundary are expressed by integrals over the boundary of equal magnitude and opposite sign, provided the aerofoil is turned through one right angle in the plane of the channel section in the respective cases. In the particular case where the channel section is an ellipse the coefficient of induced velocity is calculated for closed and open channels for various ratios of semi-diameters. The results are approximate; for an aeroplane of appreciable span/stream width ratio, higher integrals are required.

Wing Interference in a Rectangular Jet. (T. Theodorsen, N.A.C.A. Report No. 461, 1933.) (11.16/27097 U.S.A.)

The author refers to solutions of various wind channel interference problems by Prandtl, Glauert, Terazawa, Rosenhead, and Sanuki and Tani, and states that the solution for a rectangular stream with free boundaries above and below and rigid boundaries at the sides remains for detailed consideration. Following the method of Terazawa approximate expressions are formed for the doubly periodic distribution of vortices and reduced to series involving hyperbolic series. Numerical values are plotted graphically. The general expressions in terms of elliptic functions are not developed.

Nine references (including Sanuki and Tani's paper—see Abstract 27098). See also Abstract 27093 for criticisms by Rosenhead.

Interference in a Wind Channel of Elliptic Section. (Sanuki and Tani, Proc. of Physico-Mathematical Soc. of Japan, 3rd Series, Vol. 14, No. 10, Nov., 1932.) (11.16/27098 Japan.)

This paper is referred to by T. Theodorsen in N.A.C.A. Report No. 461—see Abstract 27097.

The Buckling of Spars. (J. Bach, Z.V.D.I., Vol. 77, No. 23, 10/6/33, pp. 610-614.) (11.34/27099 Germany.)

A summary is given of the results of experiments in comparison with various formulæ. The load factor should be defined with reference to the buckling load and not to the actual stress in the material.

Seventeen references.

Objects and Methods of Float Research for Seaplanes. (W. Pabst, Werft-Reederei-Hafen, Vol. 14, No. 11, 1/6/33, pp. 139-147. 108 Report of Hamburg Shipbuilding Research Institute.) (11.35/27100 Germany.)

A summary of the problems arising in float design refers to the starting resistance, throwing of spray, minimising of shock in a seaway while maintaining high load factor, heading into wind when drifting—particularly in a seaway, and stability—especially under the last condition, minimum air resistance, steerability in smooth water and directional stability in light seas.

There is some recapitulation of previous work (see Abstract 26096) but much new experimental work is introduced. A description is given of the experimental tank and travelling carriage with six-component equipment for measuring shocks. Cinematograph records show splash formations at successive time intervals.

Four autograph shock records are reproduced and moments about three arcs are shown graphically for a range of speeds. A wave recorder is described and illustrated and is considered an essential item of equipment.

Eleven references.

Test Machine for Rubber Tyres. (Z.V.D.I., Vol. 77, No. 17, 29/4/33, p. 451.) (11.45/27101 Germany.)

A photograph shows a rubber-tyred wheel mounted in a twenty-ton test machine with convenient devices for applying and reading total load and internal air pressure.

Some typical test loads and pressures are given in a table.

Airships

The Present Position of Airship Construction, Especially that of Rigid. (H. Ebner, Z.F.M., Vol. 24, No. 11, 6/6/33, pp. 311-316, and No. 12, 28/6/33, p. 331. D.V.L. Report No. 323.) (12.10/27102 Germany.)

This article is largely historical. Evidence is put forward in favour of wire braced girder structure which has been a characteristic of Zeppelin airships from the beginning.

Fifty-one illustrations and 39 references.

Pressure in Airships. (W. A. Klikoff, Aeron. Eng., Vol. 5, No. 1, Jan.-March, 1933, pp. 29-33.) (12.10/27103 U.S.A.)

The article refers particularly to metal coverings in which the shape is maintained chiefly by internal gas pressure. A photograph shows a U.S. Navy metal-clad airship. Elementary pressure tension relations are given and structural advantages are indicated. The risks of puncture followed by release of pressure and deformation suggest the compromise of a rigid metal-clad dirigible.

Three references.

Artificial Pay Load for Airships. (T. L. Blakemore, Aeron. Eng., Vol. 5, No. 2, April-June, 1933, pp. 61-64.) (12.30/27104 U.S.A.)

A number of suggestions are made for improving the design and for making the most of performance possibilities. The former include pre-heating the space between outer cover and helium gas cells and maintaining the heat as long as possible by use of the exhaust, with the incidental advantage of preventing ice formation; using swivelling airscrews for dynamic lift; retracting power units not in use within the hull.

Further suggestions are:—Completing the load from auxiliary aeroplanes after the flight has begun; using uninsured load equipped with parachutes as emergency ballast.

A total addition of 19 per cent. of the total lift as pay load is estimated. Comparative data of the Shenandoah, Akron and Los Angeles are given.

Mooring and Ground Handling of a Rigid Airship. (C. E. Rosendahl, Aeron. Eng., Vol. 5, No. 1, Jan.-March, 1933, pp. 45-52.) (12.33/27105 U.S.A.)

The experience obtained from handling a succession of U.S. Navy airships is the basis of the paper. A summary is given of the problems arising in equipping, maintaining and handling large dirigibles and of the various methods employed.

Three references.

Wireless

Radiation from Antennæ as Affected by the Electromagnetic Characteristics of the Earth. (M. J. O. Strutt, Ann. d. Phys., Vol. 17, No. 4, June, 1933, pp. 376-384.) (13.30/27106 Germany.)

Assigning a uniform dielectric constant and conductivity to the earth in the neighbourhood of the antennæ the electric and magnetic rays emitted are refracted at the earth's surface in a known manner.

The resultant field is expressed as an integral and an asymptotic approximation gives results in agreement with Weyl and Funk for a vertical electrical dipole and new formulæ for horizontal electrical and magnetic dipoles.

Six references.

Low Power Radio Transmitters for Broadcasting. (A. W. Kishpaugh and R. E. Coram, Bell Tele. B.722, 1933.) (13.31/27107 U.S.A.)

From authors' abstract:—The characteristics and more interesting features of a new line of transmitters covering the range of output from 100 to 1,000 watts are described. The basic unit is a 100-watt transmitter employing grid bias modulation which is novel in so far as American broadcast practice is concerned. The housings allow complete access for adjustment and maintenance.

Radio Range Beacon System—Problem of Night Effects. (H. Diamond, Proc. Inst. Rad. Eng., Vol. 21, No. 6, June, 1933, pp. 808-832.) (13.4/27108 U.S.A.)

Author's abstract:—A new antenna system is described for use at radio range beacon stations which eliminates the troublesome night effects hitherto experienced in the use of the range beacon system. Considerable data, comprising ground and flight measurements, are given on both aural and visual type range beacons using the present loop transmitting antennas, which show the severity of the night effects encountered.

Because of the magnitude of these effects, particularly in mountainous country, the range beacon course often becomes of no value beyond about thirty miles from the beacon station. With the new antenna system developed, referred to as the transmission line system, the beacon course is satisfactory through its entire distance range, the night effects becoming negligible.

Experimental data are given comparing the performance of the transmission line and loop antenna systems under nearly identical conditions. The paper includes a theoretical analysis of the phenomena underlying the occurrence of night effects and how to eliminate them.

Radio Range Beacon Free from Night Effects. (H. A. Chinn, Proc. Inst. Rad. Eng., Vol. 21, No. 6, June, 1933, pp. 802-807.) (13.4/27109 U.S.A.)

Author's abstract:—A radio range beacon, suitable for the guidance of aircraft along established airways, which is entirely free from atmospheric variations or "night effects," is described. Advantage is taken of the phenomenon that waves of frequencies higher than 30 megacycles per second, or thereabouts, are not usually refracted back to the earth by the Kennelly-Heaviside layer. Multiple path transmission, variation in signal intensity and in polarisation are thus avoided.

A four-course aural beacon operating on 34.6 megacycles per second was employed for the experimental work. Results and applications are discussed.

An Efficient Miniature Condenser Microphone System. (H. C. Harrison and P. B. Flanders, Bell Tele. B.679, 1932.) (13.5/27110 U.S.A.)

From authors' abstract:—It has been shown recently that microphones and contiguous amplifiers distort the sound field in which they are placed by reason of their size and the cavity external to the diaphragm of the microphone.

The paper describes a laboratory model of a Wentz type condenser microphone of high efficiency and an associated coupling amplifier, which are of such small size that reflection and phase-difference effects are of negligible importance within the audible frequency range, while the cavity is so proportioned that its resonance effect is an aid rather than a detriment to uniformity of response in a constant sound field.

Nine references.

Detection of Two Modulated Waves by Linear Rectifier. (C. B. Aiken, Bell Tele. B.730, 1933.) (13.5/27111 U.S.A.)

The action of an ideal linear rectifier is discussed mathematically. The expressions for two voltage waves impressed on a rectifier are combined into a single expression. The converse problem is attacked by expressing the composite wave in a series of derivatives of zonal harmonics from which the harmonics are extracted by one of two alternative methods. The analysis is arranged for convenient computation and interpretation and numerical examples are shown graphically.

Ten references.

Behaviour of Electron Tubes with a Magnetic Anode in a Magnetic Field. (H. A. Schwarzenbach, Ann. d. Phys., Vol. 17, No. 4, June, 1933, pp. 385-400.) (13.5/27112 Germany.)

A time-change in the electron stream takes place under a magnetic field parallel to the axis of symmetry of a triode. This is ascribed to changes in the magnetic field produced by temperature magnetic effects on the nickel anode cylinder. The relation between energy of the electron bombardment corresponding to the anode temperature and the magnetic field within the anode is investigated.

Magnetic fatigue and restoration are exhibited graphically as functions of time in five diagrams. Fatigued or unfatigued characteristics are also shown as functions of the voltage.

Twenty-three references.

Spread of Electromagnetic Fields Along River Courses. (V. Fritsch, H.F. Technik., Vol. 41, No. 3, March, 1933, pp. 100-104.) (13.6/27113 Germany.)

Communication along river courses should be within the 40-80 m. band, the spread of which is favoured by the river, especially at considerable distances from the sender.

Short-Wave Transmission from New York to South America. (C. R. Burrows and E. J. Howard, Bell Tele. B.720, 1933.) (13.6/27114 U.S.A.)

From authors' abstract:—A year's survey of transmission conditions between New York and Buenos Aires, in the short-wave radio spectrum exhibiting the received field strength as a function of time of day and frequency, shows that frequencies between 19 and 23 megacycles were best for daytime transmission and those between 8 and 10 megacycles for night-time transmission. Frequencies higher than about 30 megacycles could not be received.

Transmission Lines for Short-Wave Radio Systems. (E. J. Sterba and C. B. Feldman, Bell Tele. B.683, 1932.) (13.6/27115 U.S.A.)

From authors' abstract:—The requirements imposed on transmission lines by short-wave radio systems are discussed and the difference in the requirements for transmitting and receiving purposes is emphasised. The concentric tube line is particularly valuable in receiving stations where great directional discrimination is involved and low noise and static pick-up is required.

Excellent agreement between calculations and measurements is found for the high frequency resistance of concentric lines, using the asymptotic skin effect formula of Russell. Other losses in correctly designed concentric tube lines are found to be negligible.

Practical aspects of line constructions such as joints, insulation and provision for expansion with increasing temperature are discussed. Some difficulties encountered in transmission line practice, such as losses due to radiation, reflections from irregularities, effects of weather and spurious couplings between antenna and line are discussed.

Rectifier Cells for Measurements of Daylight. (H. H. Poole and W. R. G. Atkins, *Sci. Proc. of Roy. Dublin Soc.*, Vol. 20, Nos. 29-36, April, 1933, pp. 537-546.) (13.7/27116 Great Britain.)

Five types of cell were calibrated and the photo-electric characteristics are shown graphically. The temperature effect on the characteristics is shown in a second diagram. The sensitivity is shown as a function of wave-lengths in the range of visible rays. The characteristics of all but one type cell changed from day to day.

Subject to suitable calibration, with re-calibration from time to time, the cells examined are suitable for comparative records of intensity of daylight.

Ten references.

Application of a Pile of Electrical Semi-Conducting Material to Pressure Measurements. (W. Glamann and H. Triebnigg, *F.G.I.*, Vol. 4, No. 3, May-June, 1933, pp. 137-146.) (13.81/27117 Germany.)

The electrical conductivity of a pile of thin discs of carbon is a function of the end pressure. This is applied to the construction of pressure indicators shown in section sketches. Calibration curves are given and sources of error are discussed.

Specimen indicator diagrams obtained from a Diesel motor are compared with those obtained by a spring controlled indicator.

Eight references.

Photography

Photogrammetry of Landing Speeds. (V. C. Finch, *Aeron. Eng.*, Vol. 5, No. 1, Jan.-March, 1933, pp. 23-27.) (14.28/14.40/27118 U.S.A.)

Cinematograph records of an aeroplane landing are reduced by the usual methods of projective geometry. Details of the apparatus are given and the somewhat elaborate precautions and corrections are discussed. The error is estimated at about 1 per cent. Specimen films are reproduced.

Nine references.

Determination of Aeroplane Path by Photogrammetric Methods and by Cinematograph Records. (W. Schnittger, *Z.F.M.*, Vol. 24, No. 9, 15/5/33, pp. 241-249.) (14.28/14.40/27119 Germany.)

Two types of apparatus are described. The first consists of a camera with a fixed plate and an orientable lens. The circular image formed by each exposure is about 1/150th of the plate surface, and with some overlapping about 20 images in the breadth and 30 in the length of the plate could be formed, each showing the position of the aeroplane. The angular position is determined from the position of the focus with respect to the plate, and the distance by the size of the image of the aeroplane, so that the aeroplane must fly approximately overhead. For rolling and looping the use of two such cameras is suggested.

The second type consists of a cinematograph camera mounted on a theodolite. The focal axis is parallel to that of the telescope. One instrument is mounted at each end of a base line. The film records the position of the aeroplane and the altitude and azimuth vernier readings. A correction is readily made for the distance of the aeroplane image from the cross wires. The two altitudes and two azimuths give a redundant reading, which may be used as a check.

In a variant of the second method the times are determined separately. An elementary account is given of the geometry involved and method of reducing observations.

Errors of observation are discussed, particularly with reference to high speed determination. A technical description of the equipment of a suitable base line is illustrated by sketches.

The Film in Engineering. (H. Wimperis, Engineer, Vol. 156, No. 4053, 15/9/33, p. 255. British Association—Section G (Engineering), 8/9/33.) (14.28/27120 Great Britain.)

Three methods of applying cinematograph records to technical measurements were discussed, the recording of simultaneous readings of a battery of indicating instruments, the recording of the motion of any object on films afterwards subjected to measurement, and the use of slow motion films to study motions which were too rapid for the eye to analyse.

Cinematic Studies of the Compass in an Aeroplane, 1931. (A. Ritscher and W. Immler, Z.F.M., Vol. 24, No. 7, 13/4/33, pp. 185-193, and No. 8, 28/4/33, pp. 213-221.) (14.28/6.501/27121 Germany.)

Four compasses were installed on the compass board and their indications were recorded by cinematograph, while another cinematograph recorded the topography of the ground below the aeroplane. A careful analysis is given of the difficulties of mounting, synchronising and reducing the film records. A specimen table of entries of readings is given and readings are plotted in seven charts with reduced relative readings and with straight lines representing the true bearing. The compass errors are plotted separately on the same diagram and show average values of less than 4° with jumps and nearly 10° after sudden changes of course.

Damped oscillations about the principal axis with an initial displacement of 90° are shown graphically for four types of compass, the period varying from 9-16 seconds. The figure also shows damped oscillations about E.-W. and N.-S. areas. The lower figure was obtained by using a needle of small mass, with a large restoring moment. Further curves show lags in steady turns of specified angular velocity, 2° per sec., and oscillations under arbitrary disturbance. Numerical tables contain the detailed readings. Applications to compass design are discussed and rules are given for designers. Experiments with aperiodic compasses are in view and needles with two bearings are receiving attention.

Acoustics, Noise Reduction, Etc.

Determination of Altitude. (P. Léglise, L'Aéron., No. 169, June, 1933, pp. 128-134, and No. 170, July, 1933, pp. 160-170.) (15.0/27122 France.)

A survey is given of methods and apparatus and includes variations in electric capacity, interference of radio waves, reflection of directional radio waves and reflection of infra red rays. Acoustical methods are discussed at some length. The principal causes of error are variations in temperature, aeroplane and wind velocities, control of times of emission and reception, interference between emitter and receiver, and irrelevant noises.

A photograph shows an elaborate sound equipment with multiple emitters, apparently as an example to be avoided. Technical descriptions are given of representative installations and are illustrated by numerous figures and extracts from patent specifications, and examples of records are reproduced.

The paper is a useful review of the present position of altitude determination below, say, 300 metres above the immediate ground level, and has an obvious importance in reference to blind landings.

Meteorological Acoustics. (W. S. Tucker, Jrnl. Met. Soc., Vol. 59, No. 250, July, 1933, pp. 203-216.) (15.2/27123 Great Britain.)

The problem of sound transmission through the atmosphere is discussed in terms of the physical relations involved.

With a normal lapse rate, in still air sound is refracted upwards from a source on the ground in catenary curves, the envelope of such curves constituting

an acoustical bowl outside which no sound penetrates. Conversely, no sound produced at a point lying outside the acoustic bowl through the observer's position can reach him.

Wind gradients and changes in the lapse rate distort the bowl from the catenary form. An inversion of the lapse rate may refract the sound range back to the earth, leaving intermediate "deaf" regions.

Elementary mathematical expressions for these effects are formed and tables of numerical values are given. Water vapour content has very sensible effects on the acoustical properties of the atmosphere.

Knowledge of the meteorological conditions is necessary for sound ranging of unknown sources such as guns and aeroplanes. Conversely, sound ranging observations between known points contribute to knowledge of the state of the atmosphere.

Measurement of Acoustical Impedance. (P. B. Flanders, Bell Tele. B.678, 1932.) (15.26/27124 U.S.A.)

The electro-magnetic analogy is applied and expressions and equations are formed in complex algebra. Numerical solutions are shown graphically. The observed impedance characteristics are in general oscillatory about the calculated values as means.

Nine references.

Noise in Aircraft. (S. Capon, Engineer, Vol. 156, No. 4053, 15/9/33, p. 255. British Association—Section G (Engineering), 8/9/33.) (15.26/27125 Great Britain.)

Reference was made to investigations in progress at the National Physical Laboratory, the Royal Aircraft Establishment and the Air Defence Establishment. The reduction of noise in aircraft cabins was specially considered and a reduction had been obtained from 80 decibels to 70 decibels, approximately the intensity in a railway carriage with open windows. Instrumental equipment was described in some detail.

Mr. Wimperis (Director of Scientific Research, Air Ministry) gave acknowledgment of the work done. The reduction of noise on air liners had rendered the use of cotton wool in the ears unnecessary to passengers in civil aircraft and he considered that the growth in passenger air traffic was largely due to this improvement in comfort. The silencing of wireless cabins in naval and military aircraft was an important application. In the campaign for abatement of noise attention might well be directed to pneumatic drills and motor cycles, which were more objectionable than the maligned aeroplane.

Dr. Tucker discussed the imperfection of the ear in comparison with instrumental measurements and the difficulty of forming quantitative judgments of auditory sensations.

Propagation of Sound Along Airscrew Wake. (E. T. Paris, Phil. Mag., Vol. 16, No. 103, July, 1933, pp. 61-64.) (15.26/27126 Great Britain.)

The intensity of the exhaust of a Rolls-Royce 12-cylinder Condor exhausting in banks of six cylinders through two exhaust pipes was explored by the same method as in the previous paper (see Abstract 26030). M. P. Hart's theory is applied to give a polar curve of intensity along different directions of the second harmonic.

Two sets of observed values are plotted on a separate polar diagram and show heavy divergence from the calculated diagram, in particular smaller intensity down stream and higher intensity transversely. This is attributed to acoustical refraction in the wake.

Seven references.

Accidents and Precautions

Lightning. (A. O. Austin, *Aeron. Eng.*, Vol. 5, No. 1, Jan.-March, 1933, pp. 13-21.) (16.30/27127 U.S.A.)

A high voltage installation was set up by the Ohio Insulation Company, capable of discharging at 1,500,000 volts. Photographs show discharges passing through balloon, airship and aeroplane models and full size aeroplanes and balloon cars. The types of damage are classified and discussed.

Aircraft—Unorthodox

Tendencies in Aeroplane Development. (M. Schrenk, *Z.F.M.*, Vol. 24, No. 10, 29/5/33, pp. 273-279.) (17.0/27128 Germany.)

A descriptive survey is given of tendencies in design, including tail-less aeroplanes, autogyros and helicopters.

Twenty references.

Rocket Propulsion. (H. Chatley, *J.R. Aer. Soc.*, Vol. 37, No. 272, Aug., 1933, pp. 723-728.) (17.20/27129 Great Britain.)

The elementary thermodynamics and dynamics are worked out and numerical examples are computed.

Twenty-four references.

Test Performance of the Focke-Wulf "Ente" (Canard)—Introduction by H. Focke. (W. Hubner, *Z.F.M.*, Vol. 24, No. 8, 28/4/33, pp. 223-230, and No. 9, 13/5/33, pp. 255-258. Test Report No. 317 Report of D.V.L.) (17.30/27130 Germany.)

The designer gives a brief account of the advantages of the tail-first type, particularly freedom from stalling and from pitching over on the ground. The report gives a full technical specification of the aircraft and a mass of performance data in graphical form.

A descriptive analysis summarises the behaviour of the aeroplane under a wide variety of air conditions. The total flight distance was about 6,000 km.

The report is an important guide to the somewhat controversial subject of relative merits as compared with the more usual type with tail plane.

Cloud Formation and Gliding. (G. T. Walker, *J.R. Aer. Soc.*, Vol. 37, No. 272, Aug., 1933, pp. 657-680.) (17.40/27131 Great Britain.)

A number of photographs are reproduced showing resemblances between cell formations in the laboratory and cloud formations in the sky. The analogy is now generally accepted as based on the possible modes of instability of a top-heavy layer, but the discussion indicated a considerable diversity of opinion on details. The condensed vapour of clouds acts as an imperfect indicator since the condensed vapour may not fill the whole field of motion.

Applications to gliding are of aeronautical interest and gliding pilots will look to meteorology for information as to these convection currents and will in turn supply valuable meteorological data.

Sir George Cayley's Note-Book, Edited by J. E. Hodgson. (*J.R. Aer. Soc.*, Vol. 37, No. 270, June, 1933, pp. 547-568.) (17.50/27132 Great Britain.)

This is an historical document of first rate importance. Systematic observations of bird flight led to a belief in the possibility of human flight and thence to investigations with a whirling arm, with flapping wings and with gliders. The author was the first to state the proportionality of lift to incidence and carried out experiments at small angles of incidence which give an approximately linear relation with lift.

Outside aerodynamical subjects the most interesting item is the development of a wheel with spokes in tension attached to a central hub. The author adds, "These wheels were patented by Jones just as Mr. Donkin and I were engaged in preparing to do so."

Numerous original sketches are reproduced in illustration of the author's versatile activity.

Meteorology and Physiology

Effect of Gusts on High Structures. (E. Rausch, Z.V.D.I., Vol. 77, No. 17, 29/4/33, pp. 433-436.) (19.10/27133 Germany.)

Various representations of assumed variation in wind velocity are given graphically. The natural period of the structure is introduced and numerical values of a dynamical stress coefficient are tabulated for different values of these variables. The principal numerical result is that gusts may increase the stresses due to wind by 100 per cent. over those produced by a steady wind.

Physiological Limitations of Flying. (G. S. Marshall, J.R. Aer. Soc., Vol. 37, No. 269, May, 1933, pp. 389-410.) (19.2/27134 Great Britain.)

The effects of altitude and rate of climb are considered in physical and physiological respects, primarily due to lack of oxygen. The necessary distinction is made between high speeds and high acceleration in considering the hydrostatic effects of the latter on blood pressures. The discussion ranged to possible heights of 50,000 feet and to accelerations of five or six times gravity. Numerous individual experiences are cited.

Two references.

Catapults

Heinkel Catapult. (Z.F.M., Vol. 24, No. 9, 13/5/33, pp. 264-265.) (20.14/27135 Germany.)

A manufacturer's specification is given of the Heinkel catapult as fitted to the s.s. Westfalen, the base ship for the South Atlantic Service of the Luft Hansa.

Three photographs show the bows of the steamer, the catapult carrying an aeroplane and details of the compressed air drive. A flying boat of 14 tons can be accelerated at 3.5 g. up to 150 km./hrs.

Aerodynamics and Hydrodynamics

Direct Determination of Velocity Field and pressure distribution on a Given Rudder Section. (F. Weinig, Werft-Reederei-Hafen, Vol. 14, No. 9, 1/5/33, pp. 117-118.) (22.0/27136 Germany.)

The problem is stated in two-dimensional form, and the methods of complex algebra are used. A distribution of sources is sought which will make the profile a streamline.

A method of graphical integration is indicated. The results of a numerical example are shown graphically for 0° , 5° , 10° , 15° incidence and resemble typical pressure distributions over a wing profile.

The moments are not evaluated, but the shift of the centre of pressure is of little importance in relation to the length of a ship.

Excitation of Waves in a Channel by a Moving End Boundary. (T. M. Burgers, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 67-71.) (22.0/27137 Germany.)

A velocity potential function is defined by linear differential equations involving x , y and t . Periodic expressions in time and space are found, each of

which satisfies the equation of continuity, and a solution is built up satisfying the variable and fixed boundary conditions.

Experimental work indicates certain restrictions as to periodicity in time and space, but no general confirmation was obtained of the general applicability of the method to numerical predeterminations.

Ocean Currents Produced by Evaporation and Precipitation. (G. R. Goldsbrough, Proc. Roy. Soc., Vol. 141, No. A.845, 1/9/33, pp. 512-517.) (22.10/27138 Great Britain.)

When evaporation and precipitation are functions of latitude only, they cannot produce steady ocean currents. When they are functions of longitude, *e.g.*, as determined by meridional coast lines, a definite field of velocity can be set up.

The equations of motion are solved and the stream lines plotted for an ocean roughly representing the Atlantic north of the equator. The observed precipitation is quite inadequate to account for the observed ocean currents.

Rounding and Sharpening of Edges in Stream Boundaries. (F. Weinig, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 224-235.) (22.10/27139 Germany.)

The methods of conformal transformation are applied to obtaining boundaries with sharp corners, in two-dimensional flow.

Seven references.

Super-Critical Decompression of Compressible Fluids. (W. Schiller, F.G.I., Vol. 4, No. 3, May-June, 1933, pp. 128-137.) (22.10/27140 Germany.)

The equation of St. Vénant is quoted and the critical value of the expansion ratio is found in terms of the exponent in the equation of adiabatic expansion. Applications are made to the results of the German researches on steam nozzles, and the total flow is plotted against the pressure ratio in a series of characteristic nozzle delivery curves. German standard nozzles show the expected constant delivery for all velocities above the critical value, but diaphragms show increasing flow up to zero ratio of expansion.

Twenty-five references.

Resistance of a Cylinder Due to Normal and Tangential Stress Distribution. (L. Schiller and W. Linke, Z.F.M., Vol. 24, No. 7, 13/4/33, pp. 193-198.) (22.10/27141 Germany.)

The separation of the partial resistance by direct measurement is difficult owing to the relatively small contribution of the tangential stresses at moderately high Reynolds numbers. Favourable reference is made to A. Thom's solution of the equations of motion in the boundary layer.

The tangential forces are calculated up to the branching points at which the stream, initially following the surface, is diverted therefrom and an empirical expression is formed for the relatively small contribution of the tangential stresses in the unstable sector beyond the branching points. The semi-empirical expression is shown to be in substantial agreement with careful measurements over a range of Reynolds numbers for 5,000 to 40,000.

Measurement of Apparent Mass of Ship Models. (C. von den Steinen, Werft-Reederei-Hafen, Vol. 14, No. 7, 1/4/33, pp. 89-91.) (22.10/27142 Germany.)

The rate of acceleration of the model is measured by a pen vibrating with constant period $1/100$ sec., transverse to a record strip moving with the model. The arrangement is shown in sketches and a record is reproduced with calibration. The acceleration curve is drawn and the additional mass acceleration is

found as the difference between the applied force and the model's mass acceleration.

Empirical expressions are fitted to the experimental results.

Dynamics of Ship's Motion in Seaway. (W. Späth, Werft-Reederei-Hafen, Vol. 14, No. 8, 15/4/33, pp. 104-106.) (22.10/27143 Germany.)

A study of rolling is based on vector diagrams giving point to point values of the resultant rolling couple produced by the restoring couple, moment of inertia, and friction.

Values of the resultant couple are shown graphically as functions of the angle of roll; for different frequencies of the impressed forces the maximum rolling angle is shown as a function of the ratio of natural period to frequencies of impressed forces.

Influence of Viscosity of Water on Turbine Performance. (Roe, Z.V.D.I., Vol. 77, No. 13, 1/4/33, p. 355.) (22.10/27144 Germany.)

Performance tests were carried out at water temperatures from 1°C. to 70°C. For fixed blade setting and constant r.p.m. the efficiency increased with increasing temperature in a nearly linear relation. The maximum improvement was +3 per cent. efficiency with a concomitant increase of 0.3 per cent. in the quantity of water per second.

Potential Flow Round a Biplane. (E. Pistolesi, L'Aerotecnica, Vol. 13, No. 3, March, 1933, pp. 185-193.) (22.10/27145 Italy.)

Following Millikan, general transformations are simplified by placing a concentrated vortex at the centre of vorticity along with a doublet of appropriate strength and direction. The resulting analysis is shortened and simplified in the present paper.

Research on Mechanics of Fluids. (P. L'église, L'Aéron., No. 169, June, 1933, pp. 136-138.) (22.15/27146 France.)

A review is given of research work carried out by Martinot-Lagarde and Guillemet on visual observation of fluid motion. Numerous photographic records are reproduced of fluid motion in a wind channel rendered visible by filaments of hot air, and illustrating flow past a wing below and above stalling incidence and flow past a cylinder; and of flow of relatively highly viscous oils with free surface past cylinders rendered visible by powdered aluminium on the surface. The latter are particularly rich in detail and show the progressive differences with Reynolds numbers from 9 to 360.

Fluids in Turbulent Motion. (A. Fage, J.R. Aer. Soc., Vol. 37, No. 271, July, 1933, pp. 573-600.) (22.15/27148 Great Britain.)

The paper describes visual observations by microscope of motions of minute mineral particles contained in ordinary tap water which, by reason of their small size, do not disturb sensibly the flow which carries them along. Unfortunately, a square or slightly rectangular section is imposed by the requirements of microscopic observation, and this introduces complications avoidable only by using a circular section or a long, narrow rectangular section.

Nevertheless, an important body of experimental observations on the velocity field is presented. As a contribution to the interpretation thereof the writer gives a useful summary of the attempts made to resolve the formidable difficulties presented by the differential equation of viscous fluid motion. From his quoting of Reynolds' remarks on the need for visual observation and his own experimental contributions, it may be inferred that he is of Reynolds' persuasion. A discussion

followed to which Professor Taylor and Professor Prandtl contribute. The subject is too extensive and the interpretation of the results too obscure for concise abstracting, but the methods and results described will influence deeply subsequent investigations.

Experimental Investigation of the Generation of Turbulence. (J. Nikuradse, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 174-176.) (22.15/27149 Germany.)

For comparison with Schlichting's results (see Abstract 27160) experiments were carried out in a water channel. A description is given of the channel and of elaborate devices for maintaining steady flow and for introducing disturbances of prescribed frequencies.

The experimental points at which the disturbance increases are plotted, along with Schlichting's boundary curve of neutral equilibrium, and lie on a narrow vertical belt which is bounded by the lower branch of the neutral curve but extends far beyond the upper branch. The interpretation is not immediately obvious.

The critical value without artificial disturbance is $R=655,000$.

Four references.

Dynamical View of Turbulence. (F. Noetner, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 115-120.) (22.15/27150 Germany.)

The distribution of velocity across a two-dimensional flow is represented approximately by the field velocity due to superposition of Karman rows of vortex pairs.

A condition of minimum instability is sought by the usual methods, and leads to a number of conditions analogous to those found in the simple case of one double row. It appears that any such arrangement is unstable for a perfect fluid.

Nine references.

The Mean Square Value of Axial Oscillations in Turbulent Flow in a Pipe. (H. Reichardt, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 177-180.) (22.15/27151 Germany.)

A hot wire instrument was used, the length of the wire being kept down to 2 mm. to localise the effects in space, the diameter being 0.007 mm. The small variations in potential drop were increased 10^5 times by a direct current amplifier. A sensitive deadbeat electro-dynamometer measured the mean square of the current variations, a galvanometer needle, maintained at zero deflection, indicating the maintenance of zero mean direct current.

The electromagnetic and thermal characteristics are discussed and expressions are obtained for electric current and velocity relations. The numerical results are shown graphically and in tables. The root mean square values approximately fall off inversely as the square root of distance from the walls.

Three references.

Calculation of Katzmayr Effect. (A. Lafay, Pub. Sc. et Tech., No. 24, 1933, pp. 1-16.) (22.15/27152 France.)

Periodic variation of incidence is imposed, and the time mean coefficients are expressed as integrals taken over a complete cycle. The results show general agreement with measurements.

Autorotation.—The case where the axis of rotation is parallel to the wind is immediately explained by elementary airscrew theory. Autorotation of a lamina about an axis parallel to its length and to the wind involves a variable angle of incidence passing from 0° to 360° in each cycle. The characteristics of the section of the lamina being known experimentally, the existence of a time-mean couple is readily deduced by graphical or numerical methods.

Stability of a Local Vortex Moving Round a Corner. (A. Miyadzu, *Phil. Mag.*, Vol. 16, No. 106, Sept., 1933, pp. 553-562.) (22.15/27153 Great Britain.)

Methods of conformal transformation are used to derive the flow potential near an angle from the potential flow near an infinite plane. The vortex is found to be in neutral equilibrium on a line bisecting the angle when a certain relation exists between the intensity of the vortex and the velocity parameter of the main flow.

Only a summary is given of the analysis, but a comprehensive graphical representation makes clear the general nature of the solutions.

Motion of an Eddy Round the End of a Barrier. (G. Hamel, *Z.A.M.M.*, Vol. 13, No. 2, April, 1933, pp. 98-101.) (22.15/27154 Germany.)

Methods of conformal representation are applied and a velocity potential variable in time is defined by a linear differential equation.

The solution is found and applied to determine the paths of an eddy round a plane barrier and through a gap in a plane. Infinite velocity at an edge can be avoided in the latter case by superposition of eddies at the edges of the gap, but in the former case the potential function and the pressure become many valued and the solution must be rejected.

Two references.

Flow Past Circular Cylinders at Low Speeds. (A. Thom, *Proc. Roy. Soc.*, Vol. 141, No. A.845, 1/9/33, pp. 651-669.) (22.15/27155 Great Britain.)

A method of numerical solution of the equations of two-dimensional viscous steady flow was developed in a previous paper. The field is ruled into squares. Initial values of stream function and vorticity are assumed at the corner, and the resultant values at the centres are found by interpolation and so on. If the initial assumptions are sufficiently near the true values and the squares are small enough, the results are true solutions.

The stream function and vorticity iso-curves are plotted graphically on an intermediate t -plane. The stream lines are finally plotted in the w -plane and exhibit two symmetrical stationary vortices behind the cylinder. The similarity of the calculated field at Reynolds number 20, with the experimental field at $R=29$, shows that the approximations bring out the observed phenomena. At higher speeds instability sets in.

Nine references.

Fall of a Strip of Paper. (J. G. Baker, *Phil. Mag.*, Vol. 16, No. 103, July, 1933, pp. 175-178.) (22.15/27156 Great Britain.)

Experiments were made with autorotation of a pivoted strip in an air current and with a falling strip. A qualitative description of the variation of the turbulent wake is outlined, as an explanation of the general nature of the phenomenon.

Experimental Study of Vortex Rings at Low Velocities. (C. Sadron, *Pub. Sc. et Tech.*, No. 22, 1933.) (22.15/27157 France.)

A descriptive account is given of the formation and propagation of vortex rings, with photographs and numerical results, with a brief discussion of different suggestions as to the qualitative mechanism. The author's experimental apparatus is described and photographs are reproduced. No mathematical physical interpretation is attempted.

Eleven references.

Instability of Liquid Jets. (E. Tyler, *Phil. Mag.*, Vol. 16, No. 105, Aug., 1933, pp. 504-518.) (22.2/27158 Great Britain.)

Experimental determinations of the wave-length of drop formations were carried out by spark photographs, by photo-electric records, and by stroboscopic

methods. Thirty-four photographs are reproduced and show considerable irregularities.

Numerical results are given in tables according to the method employed, and the mean values are in substantial agreement with Rayleigh's theory. The arrangement of the apparatus in the three methods is of general interest.

Thirteen references.

Effect of Jets of Air Emitted Parallel to the Surface of Bodies. (A. Lafay, Pub. Sc. et Tech., No. 24, 1933, p. 31.) (22.3/27159 France.)

The method is applied to circular cylinders and to wing profiles. Four polar characteristics of wings are reproduced and show the improvement thus obtained, particularly for incidence above normal stalling values.

Calculation of Time Increments of Small Disturbances in Laminar Flow Along a Plate. (H. Schlichting, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 172-174.) (22.3/27160 Germany.)

By an extension of Tollmien's work on critical instability, time increments of small disturbances are calculated, neglecting squares of increments, for different values of Reynolds numbers, $R = \text{max. velocity} \times \text{depth of boundary layer} / \text{kinematic viscosity}$.

A family of iso-increment curves is obtained with Reynolds numbers and reciprocals of wave-lengths as co-ordinates, all as non-dimensional parameters. The curves are closed on the left-hand side of the diagram, and the limiting curve of zero increment separating the stable and unstable regions of the diagram, corresponds to Tollmien's solution.

In the generalised solution a disturbance of given frequency, carried downstream along the plate, first passes through a region of stability and then enters a region of instability, the total increment being obtained by integration with respect to time.

Numerical results are shown graphically and give stability below $R \hat{=} 10^5$

The experimental limits of stability found by Burgers and Hansen and by Blasius and Gebers are at values $R = 2.5 \times 10^5$ and $R = 5 \times 10^5$ respectively, with time increments of 4 and 9 for the most sensitive disturbance according to the results of the present paper.

Ten references.

Sucking Away the Boundary Layer. (O. Schrenk, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 180-182.) (22.3/27161 Germany.)

It is pointed out that the orifice acts as a sink and sets up velocity and pressure fields which are superposed on the undisturbed field. Prandtl's explanation is restricted to the removal of the ultimately unstable boundary layer fluid, which would in itself be sufficient to maintain steady flow. The writer considers that experimental measurements show a stabilising effect of the superposed pressure field when the boundary layer is not completely removed.

Skin Friction of Flat Plates. (N. A. V. Piercy and H. F. Winny, Proc. Roy. Soc., Vol. 140, No. A.842, 1/6/33, pp. 547-561.) (22.3/27162 Great Britain.)

The approximate equation of slow viscous motion in Oseen's form was solved by Bairstow in the form of an integral equation as a distribution of doublets along the plate.

In the present paper the core is expanded in series and first and second approximations are discussed and an asymptotic solution is obtained in a simple form. Fields of velocity and vorticity are shown graphically.

The results are compared graphically with the solution given by Blasius and with Hansen's experimental values.

Resistance of Impact of a Cone on a Water Surface. (S. Watanabe, Inst. of Phys. and Chem. Research, Tokyo, Scientific Paper No. 268, 20/9/30, pp. 153-168. See Phys. Zeit., No. 12, 15/6/33, pp. 494-495.) (22.35/27163 Japan.)

The piezo-electric effect of pressure on a quartz plate was recorded by a cathode ray oscillograph. A number of oscillograms show the rise of pressure to a maximum followed by a fall to a steady value. Elementary approximate expressions for impact are constructed and confirm the general run of the experiments. Interesting relations between maximum, height of fall, cone angle and position of maximum instantaneous pressure are established.

Materials—Elasticity and Plasticity

Forced Oscillation of Two Systems with Friction Coupling. (E. Hahnkamm, Z.A.M.M., Vol. 13, No. 3, June, 1933, pp. 183-202.) (23.0/27164 Germany.)

Linear differential equations are formed and solved in the usual way. Resonance and phase changes are discussed, numerical results are shown graphically for a variety of conditions. Two numerical examples are worked out in application to the Anschütz gyroscopic compass and the artificial gyroscopic horizon. An apparatus was made up, to check the theory, in the form of a fluid pendulum coupled to a spiral spring. The numerical data are given and the characteristics determined experimentally. Rules are given for selection of the most suitable characteristics.

Seven references.

Oscillation in Buildings. (G. Scharrer and O. Brötz, Forschungsheft, No. 359, March-April, 1933.) (23.0/27165 Germany.)

Vibration of ceiling and walls of rooms was investigated under conditions of resonance, and a simplified mathematical expression was formed from which it is possible to predict response to impulses of known frequency. A mathematical investigation of the longitudinal and transverse vibration of brick pillars is attempted.

Thirty-nine references.

Working Charts for the Stress Analysis of Elliptic Rings. (W. F. Burke, N.A.C.A. Tech. Note No. 444.) (23.10/27166 U.S.A.)

Reference is made to a paper by A. R. Miller on stresses in circular frame rings for monocoque aeroplane bodies. The work is extended in the present paper to elliptic rings of uniform cross-section under steady concentrated loads symmetrical about the major axis. Elementary linear relations are written down between loading and stresses and moment with coefficients which are functions of the eccentric angle. Graphical charts give numerical values of the coefficients in terms of the eccentric angle and of the latter in terms of the angular position.

Three numerical examples are worked out. The calculations, making use of the minimum energy principle, involve elliptic integrals and are not reproduced as they are not new.

Creep Phenomena—a New Group of Problems of Technical Importance in the Theory of Elasticity. (A. Stodola, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 143-146.) (23.10/27167 Germany.)

Reference is made to data given by R. W. Bailey (in a paper read at the Tokyo World Power Conference, 1929, and reproduced in *Engineering*, February,

1930, pp. 265, etc.). In the creep phenomena there is no limiting state of equilibrium, and the time variable does not ultimately disappear from the differential equations, as in the equations of plastic-elastic strain. This fact gives novelty, interest and importance to the new group of problems.

Elementary cases of bent beams are discussed and the solution is made to depend on graphic integrations, of which numerical examples are given.

One reference.

Buckling Load of Rectangular Plate with Four Clamped Edges. (G. I. Taylor, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 147-152.) (23.10/27168 Germany.)

The problem has been solved for other boundary conditions which lead to comparatively simple solutions, since the displacement is a simple harmonic function of one of the co-ordinates. With all four edges clamped, this type of displacement is not possible and no previous complete solution has been offered.

In the present paper the solution is made to depend on an infinite determinant. The numerical values of the roots of successive minors, about the diagonal, of increasing order, were found by slide rule work and converge to a final value taken as 5.30. Values of 5.61 and 5.33 were found by Sezawa and Ritz by approximate methods; but the close agreement of the latter is considered to be probably fortuitous.

Four references.

Photo-Elastic Effect in Phenolite. (J. Kuno, Phil. Mag., Vol. 16, No. 105, Aug., 1933, pp. 353-362.) (23.15/27169 Great Britain.)

The characteristics of the material were investigated, taking into account heat treatment, temperature and duration. Numerical values of Young's modulus and the coefficient of extinction are tabulated for five materials. Empirical time relations suggested by Filon and Jessop are quoted. It is considered that the optical effect is more directly connected with strain than with stress.

Seven references.

Thin Tubes Under Combined Stresses. (C. P. Casiraghi, L'Aerotecnica, Vol. 13, No. 6, June, 1933, pp. 757-766.) (23.30/27170 Italy.)

Results of American experimental data are expressed in simple forms suitable for calculation, with a semi-empirical coefficient determined from a graphical chart.

Five references.

Strains and Stresses in a Thin Cylindrical Sheet Lying Freely on its Edges and Loaded Arbitrarily. (H. Reissner, Z.A.M.M., Vol. 13, No. 2, April, 1933, pp. 133-138.) (23.41/27171 Germany.)

Navier's method of integration is extended and more general boundary conditions are considered than those previously introduced by v. Mises.

Appropriate solutions of the differential equations of elasticity are developed in series and the expressions employed are tabulated numerically and applied to numerical examples.

Three references.

Torsional Stability of Monocoque Fuselage. (K. Sezawa, J.R. Aer. Soc., Vol. 37, No. 269, May, 1933, pp. 411-422.) (23.41/27172 Great Britain.)

The elastic equations for a cylinder are quoted and simplified for thin walls. Solutions are assumed as simple sine functions of axial and angular co-ordinates, and the resulting determinantal equation of compatibility is solved for an assumed

value of Poisson's ratio, one half, and for particular numerical values of the parameter involved. The results are tabulated and plotted and minimum critical values are derived.

An experimental mounting is described and two photographs show the cylinders in torsional strain with spiral corrugations.

Experimental values are compared with calculation values and show considerable disagreement, particularly in the number of nodes. None the less, they are held to confirm the mathematical method in principle, and divergences are explained by details in the mounting.

Miscellaneous

Form and Structure of Lead Shot. (G. Tammann and K. L. Dreyer, *Z. Metallk.*, Vol. 25, No. 3, March, 1933, p. 64.) (27173 Germany.)

Arsenic or antimony is added to the melt to obtain accurately spherical shot. These substances react with lead oxide and form a film of arsenide or antimonide which remains liquid at relatively low temperatures. Possible change in the surface tension is not an effective factor.

Short Circuit Arcs. (W. Ende, *Ann. d. Phys.*, Vol. 17, No. 4, June, 1933, pp. 460-464.) (27174 Germany.)

Three cinematograph records show the rupture of a silver conducting wire with formation of the arc.

After the brief duration of the arc, roughly $1/1,000$ sec., the records show the wire collapsing into small spherical globules, groups of which may unite to form larger globules. The rate was from 3,100 to 6,730 exposures per second.

PART II.—AIRCRAFT AND ENGINES : PERFORMANCE

Dornier Do.Y Freight Machine (and Heavy-Load Carrier). (Flugsport, Nov. 8th, 1933, No. 23.) (4.44/47 Germany.)

The "Do.Y," constructed by the "A.G. für Dornier-Flugzeuge," Altenrhein (Switzerland), is a cantilever high-wing machine.

The three-spar wing is fabric-covered, except near the engine where it is covered with sheet-metal. The fuselage is covered with duralumin.

Three air-cooled Bristol-Jupiter VI engines without gearing are fitted, two in the leading edge of the wing on either side of the fuselage, the third on an engine bracket above the wing.

Span.—92 ft.

Length.—60 ft.

Height (with stationary airscrews).—20 ft.

Wing area.—1,196 sq. ft.

Engine power.— $3 \times 350/500$ h.p. Bristol-Jupiter VI engines.

Fuel capacity.—3,539 lbs. in wing tanks.

Oil capacity.—403 lbs. in tanks in leading edge of wing for the two lateral engines, and in tank in engine nacelle for the central engine.

Weight equipped.—11,000 lbs.

Useful load.—7,700 lbs.

Total loaded weight.—18,700 lbs.

Wing loading.—15.65 lb./sq. ft.

Power loading.—11.9 lbs./h.p.

Maximum speed.—161.6 m.p.h.

Cruising speed.—136.7 m.p.h.

Landing speed.—55.9 m.p.h.

Ceiling.—19,500 ft.

Range.—931 miles.

Stipa "Flying Tube." (L'Ala d'Italia, October, 1933.) (4.68/11 Italy.)

The fuselage is of hollow tubular form.

Total loaded weight.—1,870 lbs.

Wing area.—205 sq. ft.

Wing loading.—9 lbs./sq. ft.

Performance :—

Maximum speed.—82.66 m.p.h.

Minimum speed.—42.2 m.p.h.

Time of climb to 10,000 ft.—40 mins.

Landing and taking-off run, without wheel brakes.—590 ft.

The Dewoitine D.332. (Interavia, No. 41, 24/8/33.) (4.37/46 France.)

Three "9 V" Hispano-Suiza engines (575 h.p.) air-cooled, with true N.A.C.A. cowlings; two-blade all-metal Levasseur airscrews; emitting and receiving wireless equipment; the three fuel tanks with a total capacity of 704.3 imp. gals.

Span.—95.15 ft.

Length.—62.15 ft.

Height.—17.88 ft.

Wing area.—1,033 sq. ft.

Gross weight.—20,513 lbs.

Useful load.—8,973 lbs. (of which 4,850 lbs. is fuel).

Maximum speed.—186.4 m.p.h.

Cruising speed.—155.3 m.p.h.

Ceiling (with two engines running).—9,843 ft.

Range.—1,245 miles.

Crew.—Two pilots and assistant.

The World Record F.I.A.T. Macchi M.C. 72. (Luftwacht, No. 4, April, 1933, pp. 140-141.) (4.67/12 Italy.)

In its general form the Macchi resembles the British Supermarine which was the previous record holder.

The construction is mainly in duralumin, and wing and float surfaces are used to cool water and oil. The engine consists of two independent 12-cylinder V's of 25 litres stroke volume each. A reduction gear between the engines operates two tandem airscrews rotating in opposite direction. The engines are stated to give a total of 2,800 h.p. at 3,200 r.p.m. for a weight of 920 kg. (2,024 lbs.).

Jumo Two-Stroke Diesel Engine for Aircraft, Series 5. (Automotive Industries, 2/9/33, p. 280.) (3.43/1 Germany.)

Characteristics.—Bore 105 mm., stroke 2 x 160 mm., six cylinders, 420/540 h.p. at 2,100 r.p.m.; dry weight 2,000 lbs., including vibration damper and fuel pump.

The German Airworthiness Certificate has been obtained.