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Aircraft—Design, Performance, etc.

Comparison between Douglas DC2 and a Projected French Aircraft. (L. Breguet, L'Aéron., No. 181, June, 1934, pp. 127-130.) (5.10/29301 France.)

The high performance of the Douglas aeroplane (manufactured under licence by Fokker) is attributed to careful design on well-known lines, with freedom from restrictions imposed by external authority.

Modern Fighting Aircraft. (H. Ritter, Z.V.D.I., Vol. 78, No. 15, 14/4/34, pp. 455-458.) (5.10/29302 Germany.)

Leading types of French fighting aircraft are described and illustrated, ranging in weight from one to four tons, with a corresponding h.p. range from 500 to 1,800 h.p.

Great attention is given to cone of fire and protection of gunner from wind and weather, which is essential at high speeds. The author expresses the opinion that defensive armament has been unduly developed at the expense of offensive capacity.

Coupe Deutsch de la Meurthe, 1934. (Flugsport, Vol. 26, No. 12, 13/6/34, pp. 241-242.) (5.10/29303 France.)

The winning machine reached 240 m.p.h. with a six-cylinder 315 h.p. in-line Renault engine. The average fuel consumption was $6\frac{1}{2}$ miles per gallon. At these high speeds the smaller resistance gives a definite advantage over the single bank air-cooled radial engine of equal power. This advantage might be reduced by the development of the two-bank radial, with reduction of the over-all diameter and head resistance.

Temperature measurements in flight indicate the need of equalisation of cylinder air-cooling. The rear cylinder of the in-line engine tends to overheat and there are always one or two cylinders in a radial engine which are appreciably hotter than the others. (See Abstract 29346.)

The Aerodynamic Effects of Wing Cut-away. (A. Sherman, N.A.C.A. Report No. 480, 1934.) (5.20/29304 U.S.A.)

A method is developed for estimating the effect of wing cut-outs, which gives a reasonably good fit with tests in the variable density wind channel.

Increase of the dimensions of the cut-out parallel to the chord has much greater effect than increase along the span. Fairing is necessary along the edge of a cut-out.

Nine references.

Influence of Cut-away in Elevator on Longitudinal Stability and Elevator Control. (C. Biechteler, L.F.F., Vol. 11, No. 1, 15/5/34, pp. 1-4. D.V.L. Report No. 33/01.) (5.20/29305 Germany.)

The yawing moment of the rudder of a light aeroplane required to be increased and this was effected by cutting away a sector in the elevator to allow of increase in the rudder depth, reducing the area by 12.5 per cent. Photographs and sketches show the modification.

The aeroplane was equipped with measuring instruments and put through a series of tests in steady flight at different speeds with four different positions of the C.G., first with the standard elevator and rudder, then with the modification. The relations between indicated speed control, lift, moments, incidence and position of C.G. at full power and in glide are shown graphically for those of parameters taken in pairs.

The stable range of the centre of pressure was reduced by 1.8 per cent. at full throttle and by 1.3 per cent. for gliding. The control forces could not be measured. The static control of the elevator was decreased by 22 per cent. at full power and 10 per cent. running light.

Two references.

Caretta System of Rigid Transmission Controls. (L'Aéron., No. 179, April, 1934, p. 70.) (5.356/29306 France.)

A small cylindrical gear box of circular section is divided into two equal cylindrical parts which abut and are clamped in position by an axial bolt and end plates. The two halves of the gear box can be rotated relatively to each other before clamping so that two inter-gear control rods may be set at any angle to each other. A complete transmission gear weighs about $\frac{1}{2}$ lb. and transmits a thrust of 70 lb. weight.

Aircraft—Landing Gear, Hulls, etc.

Semi-Automatic Brakes for Aeroplanes. (G. A. Boggio, Riv. Aeron., Vol. 10, No. 5, May, 1934, pp. 258-267.) (5.53/29307 Italy.)

The brakes are operated by oil pressure, governed by the contact pressure between tail skid wheel and ground.

Retractable Undercarriage "Charlestop." (L'Aéron., No. 182, July, 1934, pp. 172-174.) (5.555/29308 France.)

A mechanism, actuated by oil pressure, swings back a leg and folds it towards the centre. Each leg is handled separately on account of the complicated motion. The gear weighs about 30 lb. Sluggish action of the oil and deformation of the landing gear have caused defective working.

Air screws

Working Charts for Determination of Airscrew Thrust. (E. P. Hartman, N.A.C.A. Report No. 481, 1934.) (5.60/29309 U.S.A.)

A "torque speed" coefficient is defined as the quotient of the V/nD ratio by the square root of usual torque coefficient, and is plotted against the ratio

thrust coefficient/torque coefficient. On the assumption that the engine torque is constant, the charts enable the thrust to be read off for any value of V/nD .

Twenty-four tables of airscrew data are reprinted from Technical Report No. 350 and exhibit airscrew characteristics for mean blade pitches from 10° to 28° .

Three references.

Some Dynamical Characteristics of Propellers. (J. Morris, J.R. Aer. Soc., Vol. 38, No. 288, Dec., 1934, pp. 987-997.) (5.63/29310 Great Britain.)

General expressions are written down for forces and moments of inertia of blades. A simplified blade form is assumed, the solution of the differential equation of bending vibration is developed in series for first and third approximations. Numerical values are found for the blade form assumed. Alternatively, Rayleigh's approximate method is applied and numerical results are given.

Torsional vibrations are discussed for a simple case and the results are extended to a crankshaft with many throws.

Variable Pitch Airscrews. (L'Aéron., No. 182, July, 1934, pp. 175-182.) (5.64/29311 France.)

Details and method of operation of the Ratier and Levasseur propeller are given, with illustrations. There are two working pitches, coarse and fine. In the Ratier the change of pitch is governed automatically by air pressure increasing with flying speed. In the Levasseur, the change of pitch is governed partly by engine speed and partly by hand control.

Reduction of Energy Losses in Channels by Guide Vanes. (K. Frey, F.G.I., Vol. 5, No. 3, May/June, 1934, pp. 105-117.) (5.644/29312 Germany.)

Twenty-one forms of channels with sharp turns are shown in sketches, with principal dimensions, and the losses in the bends with and without guide vanes are tabulated.

Fifteen photographs show the fundamental differences in the configurations of flow with and without guides and general principles are deduced for the disposition of the vanes.

Twelve references.

Two-Spar Wing Structure with Ribs. (C. Minelli, L'Aerotecnica, Vol. 14, No. 5, May, 1934, pp. 493-531.) (5.660/29313 Italy.)

The author investigates the stiffness of two spar wings, both when unsupported (cantilever) and when fitted with external supports. The critical speed is calculated.

Instruments

A New Oscillograph. (E. S. Shire, J. Sci. Inst., Vol. 11, No. 12, Dec., 1934, pp. 379-384.) (6.0/29314 Great Britain.)

Author's Abstract.—This paper describes a new type of oscillograph in which the moving part consists of a very light single turn coil suspended without torsional control in a constant magnetic field. No leads are attached to the coil, but energy is supplied to it by making it the secondary winding of a transformer, the primary of which carries the current to be recorded. The instrument is rapid, dead beat and of high sensitivity.

Four references.

Airscrew Vibration Indicator. (H. L. Dryden and L. B. Tuckerman, Bur. Stan. J. Res., Vol. 12, No. 5, May, 1934, pp. 537-542.) (6.0/29315 U.S.A.)

Failure of airscrews is attributed to fatigue under alternating forces.

An electro-magnetic indicator was designed for direct record of vibrations of any working combination of engine and airscrew. In principle two coils

carrying a direct current maintain a fixed relative position in steady rotation, but are periodically displaced when harmonics are present. An alternating current is superposed in the direct current and may be separated by a transformer.

A diagram shows a record from 20 to 150 cycles per second. The indication in milliamperes is plotted and shows well defined peaks at synchronism, with the fundamental and with the first harmonic.

An Electric Manometer for Pressure up to 3,000 Atmospheres. (A. Michels and M. Lenssen, *J. Sci. Inst.*, Vol. 11, No. 11, Nov., 1934, pp. 345-347.) (6.251/29316 Great Britain.)

Authors' Abstract.—The construction of a differential electric manometer depending upon the variation of resistance of manganin coils with pressure is described. A special form of plug resistance is employed in the bridge circuit, whereby the number of plugs in use is always the same, thus decreasing variation due to contact resistance.

Six references.

Measurement of Gas Quantities in Standard Cubic Metres. (J. F. Schutz, *Z.V.D.I.*, Vol. 78, No. 29, 21/7/34, pp. 875-877.) (6.252/29317 Germany.)

For measurement of large quantities of gas the rotary meter of the Roots type is receiving increasing attention. The number of revolutions is a measure of the volume of gas passing. An aneroid controls the revolution counter and the volume is recorded at standard temperature and pressure.

Automatic Pressure Regulator. (W. Pontow, *Z.V.D.I.*, Vol. 78, No. 28, 14/7/34, pp. 848-850.) (6.252/29318 Germany.)

The regulator is intended to keep the gas pressure in a supply system constant. It consists essentially of a pressure gauge, the pointer of which makes electrical contacts when the pressure exceeds or falls below a certain amount. Freedom from hunting is maintained by a linkage which moves the contacts relatively to the pointer.

One reference.

The Time Balance—An Instrument for Comparing Time Rates of Watches. (R. Tamm, *Z.V.D.I.*, Vol. 78, No. 18, 5/5/34, pp. 556-558.) (6.3/29319 Germany.)

The rates are compared acoustically by arranging two microphones with amplifiers in a bridge circuit with the grids of two relay valves. The microphones respond to the ticks of the two watches and the relay valve produces an out of balance current depending on the phasing of the ticks. The instrument will detect a difference in time rate of the order of 10 seconds in 24 hours.

One reference.

High Vacuum Ballistic Galvanometer. (W. B. Ellwood, Bell Tele. B-808, 1934.) (6.35/29320 U.S.A.)

By suspension in a high vacuum and by various modifications a sensitivity of one millimetre deflection is obtained for one metre scale distance and four Maxwell turns, which is above 125 greater than commercial galvanometers.

Details of construction are given and the performance characteristic is discussed.

Fourteen references.

Aerodynamic Investigation of a Cup Anemometer. (J. D. Hubbard and G. P. Brescoll, *N.A.C.A. Tech. Note No. 502*, July, 1934.) (6.40/29321 U.S.A.)

The normal force coefficients were determined statically for:—

- (1) Single cup with no interference.
- (2) Single cup with interference from three cups.
- (3) Four cups.

The coefficients of a single cup with three-cup interference are nearly all greater than without interference, indicating that the coefficient of resistance increases in turbulent flow.

Seven references.

Modern Drift and Ground Speed Indicators. (Lt. Aussenac, L'Aéron., No. 179, April, 1934, pp. 77-82.) (6.51/29322 France.)

The development of drift and ground speed indicators is treated chronologically. The Wimperis and Zeiss instruments are described in detail. As altitudes increase an optical sighting system becomes more necessary. The development of suitable instruments is influenced by artillery requirements.

Haya Control Instrument for Blind Flying. (L'Aérophile, Vol. 42, No. 5, May, 1934, p. 151.) (6.52/29323 France.)

A mechanism controlled by two air driven gyrostats indicates the position of the aircraft relatively to the ground, by the position of a model relatively to the cockpit.

Suction Driven Gyroscopes for Aircraft Instruments. (C. S. Draper and A. F. Spilhaus, Trans. A.S.M.E., Vol. 56, No. 5, May, 1934, pp. 289-294.) (6.52/29324 U.S.A.)

The elementary theory of venturi tube arrangements for providing air drive is discussed and diagrammatic sketches show the general disposition of the details of a double venturi tube with pipe connections for flight tests. Experimental relations between venturi dimensions, pitot pressure, air speed, air flow, altitude and effective orifice, taken in pairs, are shown graphically as characteristic curves.

Pump characteristics are also shown. The pump is considered as superior to the venturi tube. The low efficiency, poor flight-speed characteristic and liability to ice formation of the latter offset its simplicity, reliability and cheapness.

Three references.

Peak Accelerometer. (Z.V.D.I., Vol. 78, No. 27, 7/7/34, pp. 835-836.) (6.73/29325 Germany.)

A rod, free to move axially, is placed against the vibrating body, and transmits the motion to a mass mounted eccentrically on the axis of a flywheel and carrying a sliding electrical contact. A pointer, set on the common axis, is controlled by a spring. An initial tension can be found for which the pointer is not deflected by the vibration and this is a measure of the maximum acceleration of the rod. Maximum acceleration up to 1000 sec.^{-2} can be measured.

For extensive bibliography on this and similar instruments, see Z.V.D.I., Vol. 76 (1932), p. 1065.

Aircraft Flight

Flying Boats for Ocean Transport. (W. W. Webster and W. D. Clark, J. Aer. Sci., Vol. 1, No. 2, April, 1934, pp. 55-65.) (7.15/29326 U.S.A.)

A general descriptive account is given of the problem. Typical seaplane and flying boat types are shown in outline.

Tables of comparative weights and graphical representations of the relation between loads, total weights and range are reproduced.

General conclusions are drawn of a familiar nature.

Estimation of the Variation of Thrust Horse-Power with Air Speed. (S. Ober, N.A.C.A. Tech. Note No. 446 (Appendix), July, 1934.) (7.15/29327 U.S.A.)

The method of Technical Note 446 is extended to the case where the brake horse-power of the engine varies non-linearly with the speed. (See Abstract 28018.)

Separation of Roots in Stability Problems. (K. Th. Vahlen, Z.A.M.M., Vol. 14, No. 2, April, 1934, pp. 65-70.) (7.20/29328 Germany.)

References are given to various steps in the generalisation of Sturm's method for separating real roots along an axis and to separation of complex roots in the Argand plane.

Contour integrals of the complementary functions along the circumference and vertical axis of a sufficiently large circle give the number of roots in the right and left hand semi-circles.

Parallel shifts of the vertical axis determine the number of roots in a strip of the Argand plane. If the conditions of the problem are modified so that the corresponding shift of the y -axis places all the roots in the left hand semi-circle, the real parts of all the roots are negative and satisfy a condition of stability.

The quotient of the complementary functions is expressed as a continuous fraction, each successive partial quotient being one degree lower than the preceding. These lead to new criteria; in particular, if the continued fraction terminates before the last partial quotient is of zero degree, there must be equal roots. New formal criteria are obtained for the distribution of roots.

A simple formal illustration is given for a quadratic with complex roots.

(In the absence of numerical examples with equations of higher degree, it is difficult to assess the practical value of the method. No reference is made to Graeffe's method and subsequent developments. See Abstract 7973 *re* Brodetsky and Smeal, Proc. Camb. Phil. Soc., XXII, Part II, 1924.)

Four references.

Further Measurements of Longitudinal Stability. (W. Hübner, L.F.F., Vol. 11, No. 1, 15/5/34, pp. 5-15. D.V.L. Report 33/02.) (7.25/29329 Germany.)

A. A Junkers F.13 ge, shown in outline sketches, was flown with different positions of c.g., and the elevator incidence, indicated flying speed, wing incidence, height and span were measured in steady flight at seven throttle positions, including full power and light running. At full power useful readings were obtained up to a lift coefficient of $C_a=1.2$ ($k_L=0.6$) and in gliding flight only up to $C_a=0.6$ ($k_L=0.3$), between which limits active rudder control was necessary.

The relations between elevator angle, lift, control moment, flying speed and span are exhibited graphically between pairs of variables. The induced velocity is also shown as a function of lift at full throttle and running light. The effects on stability are shown in a more comprehensive figure (10). At full throttle small changes in the elevator angle gave large changes in the lift. Running light, the elevator moment is much less sensitive to angular changes. With fixed elevator position the lift increases very rapidly with opening throttle and this should be considered in elucidating certain accidents.

Other conclusions are drawn. Six references.

B. The influence of the hinge inertia moment of the elevator on longitudinal stability is discussed. Earlier measurements show that the longitudinal stability increases with the weight moment of the elevators left free. Blenk has given a mathematical demonstration of this result.

An extension of the experimental work was carried out to confirm the results and to bring out the underlying principles. The same aeroplane as in "A" was tested with three different values of the elevator hinge inertia moment, at full throttle and running light.

The elevator control mechanism is shown in dimensioned sketches, with specification of weights and c.g. position. The relations between control lever and elevator displacements, elevator weight moment and force on lever, lift and incidence pitching moment, are shown in diagrams for three weight moments.

The restoring moments are plotted for full and light throttle for the three cases and show a systematic increase of longitudinal restoring force with weight moment.

Three references.

Seaplane Take-off Weights. (E. T. Jones, *Airc. Eng.*, Vol. 6, No. 70, Dec., 1934, pp. 330-332, and No. 71, Jan., 1935, pp. 8-10.) (7.30/29330 Great Britain.)

Typical characteristic curves of resistance and incidence as functions of flying speed are given. Resistance attitude and moment attitude characteristics are also given.

A discussion is given of the effects on performance of varying the characteristics separately.

Finally, characteristic curves near the limiting weight are discussed and methods of decreasing the peak value are considered.

Motion of Flying Boats during Take-off and Landing Run. (T. Ogawa and J. Murata, *Aer. Res. Institute, Tokyo*, Report No. 105 (Vol. 8, No. 9), April, 1934.) (7.30/29331 Japan.)

From English Abstract.—Data are presented from full-scale experiments on the "N" and "Dornier Wal" flying boats.

Coefficients of water resistance, trim and heaving are given graphically and in tables, for landing and starting runs, and model data are given graphically for comparison. The maximum values of water resistance agree fairly well for model and full-scale, but beyond the hump the full-scale figures are much lower. The resistance curves for starting and landing runs differ considerably. The hump speed is less for a flat bottom (Wal) than for a wedge bottom (N).

The text is in Japanese, but most of the data and figures have headings in English.

Landing Shock Recorder. (M. J. Brevoort, *N.A.C.A. Tech. Note No. 501*, July, 1934.) (7.30/29332 U.S.A.)

A weight slides freely in a cylinder and actuates a mirror. The restoring force is supplied by a spring, the natural frequency being of the order of 1.5 cycles per sec. A beam of light reflected from the mirror gives a record of the decelerations, which are smaller than had been assumed.

A Criticism of the Term "Landing Speed." (E. Everling, *Luftwissen*, Vol. 1, No. 4, 15/4/34, p. 106.) (7.30/29333 Germany.)

Landing shocks from irregularities on the ground are proportional to the square of the landing speed. The ratio between maximum horizontal flying speed and minimum landing speed gives no indication of landing shocks or the length required to pull up. Elementary mathematical relations are written down to illustrate the argument.

One reference.

Slotted Wings. (W. Pleines, *Luftwissen*, Vol. 1, No. 6, 15/6/34, pp. 152-157, and No. 7, 15/7/34, pp. 190-197.) (7.72/29334 Germany.)

A summary is given of the present state of model wings alone and test characteristics of complete aeroplanes are tabulated. A direct comparison between full-scale and model of the Bristol Fighter is also quoted.

The effective incidence and lift distributed along the span are shown graphically, with unslotted wings and with slotted wings, the latter from Lachmann's calculations. English measurements of the coefficient of rolling moment are shown as functions of incidence for ordinary wings, wings with slots and wings with end slots. The lift coefficient is also shown as a function of incidence for the wing, as a whole and for the slotted part only, with slots opened and closed. American measurements of lift and rolling moment coefficients are shown graphically as fractions of incidence.

A tabular form shows the qualitative relation between roll angle, angular velocity and angular accelerator and time, according as the lift coefficient is below maximum, at maximum and above maximum.

Expert opinion on the value of slots is contradictory and interpretations of their action is ambiguous.

Nineteen references.

Wind Tunnel Measurements of Air Loads on Split Flaps. (C. J. Wenzinger, N.A.C.A. Tech. Note No. 498, May, 1934.) (7.72/29335 U.S.A.)

Measurements of control forces necessary to operate split flaps show hinge moment coefficients more than twenty times that of a normal aileron. Possible reduction of the hinge moment is under investigation.

Five references.

Zap Flaps and Ailerons. (T. N. Joyce, Trans. A.S.M.E., Vol. 56; No. 4, April, 1934, pp. 193-201.) (7.72/29336 U.S.A.)

The Zap wing flap designed by Mr. E. F. Zaparka is hinged in front of the trailing edge and extends over the full span of the wing. On opening, the hinge travels forward and the average V-shaped space between wing and flap is filled with substantially "dead" air. The ailerons are set above the wing. The advantage is claimed of rapid operation with small effort. The increase in lift is over 80 per cent.

With ordinary aeroplanes skilled judgment is required in flattening out for landing. In certain types of lightly loaded sport machines it is claimed that the Zap flap enables the pilot to set the machine in an altitude in which it glides with engine off on to the ground, without any manœuvring of the controls.

Automatic Control of Aeroplanes. (Sci. Am., Vol. 151, No. 1, July, 1934, p. 36.) (7.50/29337 U.S.A.)

A photograph shows the principal parts of a G.E.C. steering installation controlled by external wireless. Corrections are made for drift and course error. The effective range is given as 150 miles.

Observations on Spins. (J. M. Gwinn, Trans. A.S.M.E., Vol. 56, No. 6, June, 1934, pp. 393-400.) (7.62/29338 U.S.A.)

The aerodynamical causes of spin are discussed and some test figures are quoted giving number of turns required to come out of a spin.

The concise summary of the mathematical theory is given.

Eight references.

Engines—Thermodynamics

The Process of Combustion in the High Speed Engine. (W. Kann and P. Rickert, Z.V.D.I., Vol. 78, No. 28, 14/7/34, pp. 851-855.) (8.13/29339 Germany.)

A brief review is given of methods of investigating processes of combustion in an engine cylinder, e.g., ionisation, photographic flame and pressure records and chemical analysis of samples from a sampling valve.

Special attention is given to the two stage ignition engine and diagrams taken with a quartz indicator show pressure differences between the precombustion chamber and the main cylinder.

Nine references.

Heats of Combustion and of Formation of Paraffin Hydrocarbons. (F. D. Rossini, Bur. Stan. J. Res., Vol. 13, No. 1, July, 1934, pp. 21-35.) (8.13/29340 U.S.A.)

The heats of combustion of normal hydrocarbons in the gaseous state are calculated. The addition of the CH_2 group to the normal alkyl group results in an increase in the heat of combustion of 157 kcal (gaseous state, 25°C ., and one atmosphere), provided the original alkyl group contained more than five carbon atoms.

Twenty-six references.

Determination of the Specific Heat of Gases at High Temperatures by the Sound Velocity Method. I. Carbon-monoxide. (G. G. Sherratt and E. Griffith, Proc. Roy. Soc., Vol. 147, No. 861, 15/11/34, pp. 292-308.) (8.13/29341 Great Britain.)

Experiments on the velocity of sound for frequencies 7,908 and 27,422 respectively show an increase of approximately 2 per cent. at the high frequency at temperatures between $1,000^\circ\text{C}$. and $1,800^\circ\text{C}$. On the assumption that the difference is due to partial failure of the vibrational energy to follow the acoustic cycle, a true specific heat value can be calculated which is in good agreement with spectroscopic data.

Fifteen references.

Specific Heat of Gases and Vapours at High Temperatures. (E. Justi, F.G.I., Vol. 5, No. 3, May/June, 1934, pp. 130-137.) (8.13/29342 Germany.)

A survey is made of available methods, including explosion, adiabatic flow, velocity of sound and spectroscopic methods. Collected results are tabulated.

The problem of dissociation is discussed and the relevant chemico-thermal equations with numerical coefficients are given for thirteen gases and vapours.

The work of compilation was undertaken for the German Standards Committee.

Forty-three references.

On the Composition of Exhaust Gases from Petrol and Petrol/Alcohol Mixtures. (J. Formánek, Autom. Tech. Zeit., Vol. 37, No. 9, 10/5/34, pp. 234-238.) (8.15/29343 Germany.)

On light load and low speeds the engine exhaust contains appreciable quantities of oxides of nitrogen.

One reference.

Engines—Design and Performance

Aero Engine Installation. (R. G. Pettit-Herriot, Airc. Eng., Vol. 6, No. 69, Nov., 1934, pp. 285-290, and No. 70, Dec., 1934, p. 332.) (8.20/29344 Great Britain.)

Statistics show that the majority of engine failures resulting in forced landings are due to faulty engine installation. The article gives examples of satisfactory installation of water-cooled and air-cooled engines, with excellent illustrations.

Aero Engine Design in 1934. (M. Lagarde, Rev. Gen. L'Aéron., No. 17, pp. 85-129, and No. 18, pp. 55-88.) (8.20/29345 France.)

Superchargers are becoming standard equipment and details are given of Continental practice. Castor oil is generally used in French aero engines as a home product of consistent quality. Its deterioration can be controlled and methods have been devised for rapid determination of ageing of samples. Castor

oil withstands high temperatures for a short time, but under continuous high temperature operation carbon deposits, gummed rings, etc., entail shorter periods between overhauls.

It is of interest to note that most of the French engine firms design both water and air-cooled models. The two banked 14-cylinder radial is receiving special attention.

Renault Six-Cylinder Coupe Deutsch Engine. (Flugsport, Vol. 26, No. 13, 27/6/34, pp. 277-278.) (8.20/29346 Germany.)

The inverted six-cylinder, in-line, air-cooled engine (110×140) of 8 litre capacity is rated at 300 h.p. at 3,000 r.p.m. A centrifugal fan delivers compressed air to a Stromberg down-draught carburettor.

Analysis of Motion of Master and Auxiliary Connecting Rod Assembly. (K. Schlaefke, Z.V.D.I., Vol. 78, No. 27, 7/7/34, pp. 831-834.) (8.20/29347 Germany.)

The auxiliary rod assembly involves a displacement of the dead centre position and a change in stroke of the corresponding auxiliary piston, which may affect the torsional vibration characteristics of the complete engine.

One reference.

Engine Installation of SS. "Konigin Luise." (B. Bleicken, Z.V.D.I., Vol. 78, No. 20, 19/5/34, pp. 603-606.) (8.21/29348 Germany.)

The engine is single acting two-stroke, with direct injection. Quiet running is obtained by fitting a silencer to the air intake of the scavenge blower, which is of the Roots type, and a two stage silencer to the engine exhaust. The blowers take air directly from the engine-room as a long intake pipe produces vibration and noise. Part of the engine silencer consists of concentric tubes. The inner tube is perforated and the sound waves enter the annular space and are damped by a packing of copper turnings.

The piston is very long, the gudgeon pin being placed abnormally low. Canting of the piston is prevented by fitting special rings of silumium.

Three references.

Investigation on the Scavenging Process of Two-Stroke Engines. (C. Zublin, W.R.H., Vol. 15, No. 13, 1/7/34, pp. 175-177.) (8.21/29349 Germany.)

The scavenging process is investigated in two and three-dimensional flow models. The direction of the air motion is indicated by means of small flags and the velocity is measured with a pitot tube. The results are not directly applicable to design as they do not take into account piston motion and differences in temperature between exhaust gas and fresh charge.

To some extent differences in density can be allowed for by filling the model with coal gas and scavenging with air. An analysis of the charge in the model after the scavenging is complete gives an indication of the effectiveness of the process. An obvious development is to take samples on the engine itself, with a special sampling valve, during the compression strokes. The problem is extremely complex, the type of gas flow and the resultant exhaust dilution varying considerably between successive explosions.

Tests on an Internal Combustion Engine with Variable Piston Stroke. (J. Schmitt, Autom. Tech. Zeit., Vol. 37, No. 13, 10/7/34, pp. 336-340.) (8.22/29350 Germany.)

The crank throw and big end are in the form of an eccentric and strap with roller bearings. Axial movement of a concentric lay shaft actuates a screw drive which alters the eccentricity and stroke and, at the same time, raises or lowers the cylinder so that the compression ratio is kept constant for all strokes.

The experimental engine had a single air-cooled cylinder of 60 mm. bore. The stroke could be varied between 28 and 84 mm. A slight gain in thermal efficiency was obtained at low power (reduced stroke and full throttle) in comparison with a normal engine throttled down (full stroke and reduced charge).

The Volumetric Efficiency of High Speed Four-Stroke Engines. (E. Drucker, Autom. Tech. Zeit., Vol. 37, No. 14, 25/7/34, pp. 350-363.) (8.22/29351 Germany.)

An attempt is made to calculate volumetric efficiency, taking into account heat exchange and pressure changes in the engine. The figures show an appreciable decrease of volumetric efficiency with increase in compression ratio. Twenty-six references.

External Compression Process for Diesel Engines Intended for Locomotive Drive. (S. Grantz and P. Rieppel, Z.V.D.I., Vol. 78, No. 14, 7/4/34, pp. 436-438.) (8.252/29352 Germany.)

The authors propose that the compression for a two-stroke cycle engine be completed in a separate compressor driven by an auxiliary engine. The compressed air is exhaust-heated and supplied to the main engine at T.D.C. The old compression stroke becomes available for scavenging and no separate scavenge blower is required. It is claimed that this will enable the main engine to be coupled direct to the driving wheels of the locomotive. No details of the method of starting are given. (In this connection see Forschungsheft, No. 363, Abstract No. 28063, on the Deutz Diesel locomotive.)

Two references.

Deschamps 1,200 h.p. Diesel Aero Engine. (Flugsport, Vol. 26, No. 12, 13/6/34, pp. 249-250.) (8.252/29353 France.)

The engine has 12 cylinders in V of 6in. bore and 9in. stroke. It operates on the two-stroke cycle and is rated 1,200 h.p. at 1,600 r.p.m. for a weight of 2,400lb. Each cylinder is fitted with two injection pumps, operating during alternate cycles. In this way the pump speeds are halved and low speed engine operation is obtained by cutting out one pump and operating the engine on the four-stroke cycle.

Spark Plugs and Their Improvement. (H. Navratiel, Autom. Tech. Zeit., Vol. 37, No. 9, 10/5/34, pp. 238-240.) (8.283/29354 Germany.)

Attention is paid to the possible catalytic effect of the hot plug surface on the combustion. The aim should be to improve ionisation at the gap and reduce tendency to form carbon deposits on the plug. The author hopes to achieve this by suitable choice of insulation and electrode materials.

The Coal Dust Engine. (Dr. Ing. Wahl, W.R.H., Vol. 15, No. 14, 15/7/34, p. 200.) (8.290/29355 Germany.)

Coal dust engines are mainly of the injection type. The greatest difficulty is the rapid wear of cylinder liner and piston by abrasive material in the ash.

Special design of piston rings and grooves is required to prevent gas pressures from building up behind the rings. The pipe lines feeding the coal dust from the bunker to the injection valve must be designed to minimise the risk of premature explosions.

Steam Turbine for Aircraft. (O. R. Thomson, Luftwissen, Vol. 1, No. 4, 15/4/34, pp. 97-101.) (8.296/29356 Germany.)

The Huttner turbine works on the axial contrary flow principle, the steam nozzle rotating in the opposite direction to the blades. The nozzles are actually

the boiler elements and form a rotary boiler. Each element consists of a U-tube, one open end forming the steam nozzle, whilst the other open end takes in the water supply like a centrifugal pump. The hub attached to the steam nozzle is heated by blow pipe flame, the steam pressure generated depending on the pressure set up by centrifugal action on the water. Most of the exhaust steam is condensed by the inlet water and a relatively small condenser deals with the balance.

In the discussion following the lecture the heavy fuel consumption due to the absence of an exhaust vacuum is stressed. Mechanical difficulties are considerable. A model is stated to have given promising results.

Engines—Design and Strength of Components

Lubricated Journal Bearings with Dimensions of Roller Bearings. (A. Riebe, Z.V.D.I., Vol. 78, No. 14, 7/4/34, pp. 444-445.) (8.31/29357 Germany.)

A housing, clamped in the bearing, carries a press-fitted caro-bronze liner.

A hardened steel liner, locked on the shaft, runs in the caro-bronze liner. Lubricant is supplied by wick through the housing. The bearing surfaces may be cylindrical or have double curvature.

The steel liner can be unlocked from the shaft and the housing from the bearing, and the whole drawn out exactly like a ball bearing, a matter of importance for assembly and repair.

The selection of materials is stated to allow of loads equalling or exceeding those permissible on ball bearings of equal dimensions. The cost is presumably much less. (See Abstract 28773.)

Three references.

Contribution to the Question of Cylinder Wear of Internal Combustion Engines. (W. Ostwald, Autom. Tech. Zeit., Vol. 37, No. 9, 10/5/34, pp. 246-247.) (8.32/29358 Germany.)

The researches of Ricardo and the Institution of Automobile Engineers are reviewed. As an alternative to the corrosion explanation, the possibility of the steam condensing in the cylinder walls at low temperatures and forming an emulsion with the oil is put forward. Such emulsion may not be capable of producing an adequate lubricating film.

Three references.

Torsional Oscillations of Engines with Cylinders in Line. (R. Grammel, Ing. Arch., Vol. 5, No. 2, April, 1934, pp. 83-91.) (8.36/29359 Germany.)

The usual recursion formula is obtained by a simplified method and applied to a variety of cases with additional rotating masses.

The frequency formulæ are established in simple forms with sufficient accuracy for design calculations. Further extended applications are indicated.

Two references.

Measurement of the Bending Oscillation of a Two-Bearing Crankshaft Running Under Power. (W. Riede, Autom. Tech. Zeit., Vol. 37, No. 14, 25/7/34, pp. 366-368.) (8.36/29360 Germany.)

The oscillations were recorded optically by reflecting a beam of light from a mirror attached to the free end of the shaft. Under inertia forces only, the bending moment had three maxima per revolution. The vibrations were modified by the explosive forces. The only feasible cure was the provision of an extra (central) bearing.

Theory of the Resonance Vibration Damper. (L. Geislinger, Ing. Arch., Vol. 5, No. 2, April, 1934, pp. 146-155.) (8.36/29361 Germany.)

The mass of a vibration damper working on the resonance principle need only be 2 per cent. of the mass of the damped system or less if the timing is accurate.

The mathematical investigation shows that bad tuning of the damper is less harmful in defect than in excess of the natural period of the damped system.

Eight references.

Progress in Design of Air Engine Bearings. (A. Füssenhauser, Luftwissen, Vol. 1, No. 6, 15/6/34, pp. 158-161.) (8.37/29362 Germany.)

Improvements in fuels allow increased supercharger pressures, imposing higher bearing pressures. A brief survey is given of the literature of bearing lubrication from 1930-1934.

The non-dimensional parameter, viscosity \times r.p.m./bearing pressure is proportional to the resistance torque down to the value 2.1 with 1 kg. weight as unit of force.

(Transformed to c.g.s. units,

$$\mu\omega/p = 2.1 \times 9.81 \times 10^5 / 2\pi \times 60 = 8.2 \times 10^4.)$$

Below this value lubrication, in the ordinary sense, fails.

Recommendations are made for the selection of bearing metals, the design of bearings and the selection and application of lubricants.

Forty references.

Engines—Cooling

Heat Transmission to Pipes when Coated with Dew and Rime. (W. Piening, Z.V.D.I., Vol. 78, No. 26, 30/6/34, pp. 813-814.) (8.40/29363 Germany.)

The experimental pipe was filled with liquid CO₂. The rate of evaporation of CO₂ determined the heat transfer. At low temperatures the pipe became coated with a layer of rime surrounded on the outside by a layer of ice. From the thickness of these layers concordant values of the heat transfer were obtained.

It appears that the coefficient of heat transfer thus obtained is related in a simple manner to the coefficient for dry air, obtained in a previous paper.

Five references.

Cowling of Air-Cooled Engines. (S. Hesse, Luftwissen, Vol. 1, No. 6, 15/6/34, pp. 162-165.) (29364 Germany.)

A summary is given of work in U.S.A. and in this country.

Nineteen references.

Cowlings for Radial Engines. (M. Giqueaux, Pub. Sc. et Tech., No. 42, 1934.) (8.426/29365 France.)

Reference is made to early use of cowlings, and to the systematic investigations recently carried out in this country and U.S.A. A description is given of work done in France and dimension sketches give full details of the combinations of cowlings and baffle plates tested.

Ten photographs show air flow round various models rendered visible by smoke jets. The numerical results are tabulated and shown graphically.

The best result obtained was a reduction of the drag to about 11 per cent. of the uncowled model engine. The question of cooling is passed over.

Theory of Townend Ring. (G. Otten, J.R. Aer. Soc., Vol. 38, No. 287, Nov., 1934, pp. 885-935.) (8.426/29366 Great Britain.)

The velocity field in the neighbourhood of a gauze wire obstruction is discussed by the methods of Froude, the obstruction being considered as a negative

actuator. Aerofoils are placed above and below the gauze (in mirror image relation to the centre line) and give a two-dimensional analogue of the Townend ring. The reaction on the aerofoils is measured and the effective circulation is deduced from the lift on the circulation theory.

An elementary consequence is the possibility of an upstream component of reaction on the aerofoils for a small range of effective incidence. Further, the circulation field of the aerofoils reduces the effective velocity through the gauze and hence the loss of total head in the wake.

Apart from the empirical determination of the drag coefficient of the gauze and the lift and drag coefficient of the aerofoil, the analysis is developed as for a perfect fluid and the various expressions are worked out approximately in a comprehensive manner.

The two-dimensional theory thus developed is transformed conformally to the field round a circular sheet of gauze surrounded by an annular aerofoil and the corresponding analysis is developed.

Applications to a multi-cylinder engine surrounded by polygonal aerofoils are considered and corrections in relation to the ideal case are estimated.

Numerous test results are tabulated and shown.

Seven references.

Theory of Cooling Through Evaporation. (G. Ackermann, *Ing. Arch.*, Vol. 5, No. 2, April, 1934, pp. 124-146.) (8.460/29367 Germany.)

Cooling water by evaporation is common practice in large power plants. Recently the method has been applied to steam locomotives. By having the air in direct contact with the water, the plant is simplified and the cooling rate increased, but there is loss of water carried away as vapour in the air. This loss can be kept within reasonable limits. The warm water flows in a thin film down the surface of vertical plates and is met by an upward current of cold air. The process is investigated mathematically and the correlation between the heat transfer coefficient and diffusion is developed. With a suitable temperature range the loss of water is less than 1 per cent. (Application to oil cooling might be of interest.)

Seventeen references.

Engines—Fuels

The German Oil Fields. (R. v. Zwerger, *Z.V.D.I.*, Vol. 78, No. 17, 28/4/34, pp. 525-531.) (8.60/29368 Germany.)

Germany consumes two million tons of liquid fuel per year. The home production from all sources is about 600,000 tons, out of which oil wells account for 200,000 tons. The most important oil fields are near Hanover. There are minor fields in Thuringia, Bavaria and the upper Rhine basins. A grant of 5 million marks has been made for trial borings in new districts.

Twelve references.

Hydrogenation of Coal. (H. Koppers, *W.R.H.*, Vol. 15, No. 9, 1/5/34, pp. 108-110.) (8.602/29369 Germany.)

Statistics are given of German imports and internal production of coal spirit and of fuel alcohol. Imports for 1930 were about 1,000,000 tons and internal production of all kinds of motor fuel about 500,000 tons.

Fuel Investigations—Paper Read at the Meeting of the German Society for Fuel Oil Research. (A. v. Philippovitch, *Z.V.D.I.*, Vol. 78, No. 26, 30/6/34, p. 792.) (8.640/29370 Germany.)

The papers deal mainly with the testing of fuels. For carburettor fuels the C.F.R. method is employed. For heavy oils a special Diesel test engine has been designed, in which the ignition lag is measured electrically.

Three references.

Equilibrium Volatility of Motor Fuels. (O. C. Bridgeman, Bur. Stan. J. Res., Vol. 13, No. 1, July, 1934, pp. 53-109.) (8.640/29371 U.S.A.)

An approximate equation connects equilibrium volatility of commercial fuels with standard A.S.T.M. distillation curves.

Researches on the Constitution of Paraffins and Gas Oils. (E. Carrière and H. Bonnet, Pub. Sc. et Tech., No. 43, 1934.) (8.640/29372 France.)

In publication No. 7 methods are described for determining the constitution of petrols from physical data, density, viscosity and refractive index of the original fuel or its products. These methods are extended in the present paper to cover the heavier fuels. The difficulties of analysis increase with molecular complexity, but the above methods, applied to a mixture of cumene, cymene, naphthalene and diphenylmethane give satisfactory results, which are quoted.

The Thermal Properties of Benzene/Air and Methyl Alcohol/Air Mixture. (J. Small, Phil. Mag., Vol. 18, No. 120, Oct., 1934, pp. 554-560.) (8.640/29373 Great Britain.)

The total heat of the fuel mixture is plotted against mixture strength for various temperatures and pressures, from the data given in the International critical tables.

In a complete combustion mixture of benzene/air there is no separation of fuel at atmospheric pressure for a temperature range extending below 30°C. With a complete combustion mixture of methyl alcohol/air, initially at 15°C., the air has to be preheated to 200°C. to ensure complete vapourisation.

Three references.

Fuels for Aero Engines. (E. L. Bass, Airc. Eng., Vol. 6, No. 70, Dec., 1934, pp. 320-325.) (8.645/29374 Great Britain.)

A review is given of the methods of measurement and relative importance of anti-knock rating, boiling point and vapour pressure. At present high anti-knock rating is the principal requirement and correlation between laboratory and full-scale experiments is needed. An easy method of detecting early stages of detonation in flight is especially required. The appearance of black smoke in the exhaust or abnormal temperature rise of the cylinder is not sufficiently sensitive.

Three references.

Causes of Detonation in Petrol and Diesel Engines. (G. D. Boerlage and W. J. D. Van Dyck, J.R. Aer. Soc., Vol. 38, No. 288, Dec., 1934, pp. 953-986.) (8.645/29375 Great Britain.)

In the petrol engine detonation is caused by the sudden inflammation of the "end gas" left unburnt after the greater part of the charge has been ignited by normal flame propagation. In the Diesel engine detonation is caused by sudden inflammation of the charge present in the cylinder at the conclusion of the "delay period." In each case part of the charge has become "activated" by reason of its previous history in the engine.

The authors take the view that the activation is primarily due to the presence of cracked fuel products, together with unstable oxygen molecules (not to be confused with so-called fuel peroxides, which only play a secondary part).

Defining ignition lag in reference to adiabatic compression under specified conditions, a small lag is desirable in an ignition engine, while a large lag renders detonation more difficult in the petrol engine. The authors have established a method of rating Diesel fuels in terms of cetene numbers. This number denotes the volumetric percentage of cetene in a mixture of cetene and methylnaphthalene which has the same ignition lag as the fuel. A high cetene number denotes a

good fuel with short ignition lag. In the case of the petrol engine a different method of rating, based on the suddenness of the explosion, has been in use for some time. Here a high octane number denotes a smooth running engine. If in each case ignition lag is the principal factor cetene and octane numbers should be related. The authors establish this relationship for a series of fuels and further demonstrate that both numbers are related to the reaction constant with which the fuel undergoes cracking.

Thirteen references.

The Causes of Detonation in the Carburettor and Injection Engine. (O. Holfelder, Z.V.D.I., Vol. 78, No. 27, 7/7/34, pp. 836-837.) (8.645/29376 Germany.)

This is a review of the work of Messrs. Boerlage and Van Dyck, reported fully in Abstract 29375.

True detonation is associated with gaseous vibration of the burning charge, knocking is due to mechanical vibration of the cylinder walls and "rough running" is due to crankshaft vibration. In each case auto-ignition takes place and disturbs smooth ignition by flame travel.

Four references.

Engines—Injection and Exhaust Systems

On the Effect of Pipe Bores on the Cut-off of Fuel Spray in Injection Systems with Open Nozzles. (F. Nakanishi, M. Ito and R. Kitamura, Aer. Research Institute, Tokyo, Report No. 108 (Vol. 8, No. 12), June, 1934.) (8.705/29377 Japan.)

The falling pressure/time curve of the oil in the pipe fluctuates about the mean slope for very low and very high oil speeds. Sharp cut-off is thus only possible over a range of pipe diameters.

Three references.

Silencing Arrangement for Aircraft Engines—French Patent No. 746961. (L'Aéron., No. 179 (Bulletin), April, 1934, p. 47.) (8.721/29378 France.)

Two exhaust valves, a smaller and a larger, are fitted. The small valve opens with the usual lead and closes about 40° A.B.D.C. The second, larger, valve then opens and discharges into atmosphere till the end of the stroke. It is claimed that a small silencer on the small valve is effective without serious loss of power.

Engines—Transmission

The Dynamics of the Differential Gear. (T. Pöschl, Z.V.D.I., Vol. 78, No. 26, 30/6/34, pp. 799-800.) (8.761/29379 Germany.)

The kinematics of differential gears in motor cars has been investigated more fully than the dynamics. The author develops energy equations, taking into account the inertia of the intermediate wheel.

In this case the pinion reactions on the left and right hand driving shafts are no longer equal.

Elastic Couplings in Torsional Oscillations. (V. Rembold and J. Jehlicka, F.G.I., Vol. 5, No. 3, May/June, 1934, pp. 146-154.) (8.765/29380 Germany.)

Sectional sketches show details of the four elastic couplings used and the general layout of the experiments. Characteristics of steel spring and rubber couplings are given in elaborate numerical tables and graphically, the area of the hysteresis loops being large in the rubber couplings.

An expression is given for the rate of loss of energy by damping.

Three references.

Behaviour of Threaded Connection on Tightening and Loosening. (E. Bock, Z.V.D.I., Vol. 78, No. 25; 23/6/34, pp. 780-781.) (8.769/29381 Germany.)

The experiments were carried out mostly on 1in. bolts and nuts. The loading reproduced practical conditions of hand tightening by 10in. spanner. Under these conditions the material is never dangerously strained, even if considerable tolerance is given to the accuracy of workmanship.

Four references.

Armament

Hispano-Suiza Large Calibre Machine Gun. (Flugsport, Vol. 26, No. 10, 16/5/34, pp. 210-211.) (9.11/29382 Germany.)

The calibre is 20 mm. The machine gun is mounted in the V of the engine and fires through a hollow airscrew shaft. The rate of fire of the cannon is stated to be equal to that of the machine gun. Explosive and tracer ammunition is used. The gun weighs 116lb., the magazine with 60 rounds weighs 55lb., total 171lb. Two additional machine guns of normal calibre fire through the airscrew disc.

Machine Gun Operation at High Altitude. German Patent No. 598251 (1932). (Flugsport, Vol. 26, No. 13, 27/6/34, pp. 85-86.) (9.11/29383 Germany.)

The operator in a pressure sealed chamber manipulates the machine gun, which is placed in the open. Troublesome pressure seals are thus avoided.

Improvements in Machine Gun Mounting in Aircraft. French Patent 718964. (K. G. Ostberg, Rev. de l'Armée de l'Air, No. 58, May, 1934, pp. 613-617.) (9.14/29384 France.)

An epicycloidal transmission gear transforms rotary motion of the engine into a rectilinear reciprocation which is applied to the interrupter gear.

History of Explosive Bullet in Aerial Combat. (P. Barjot, Rev. de l'Armée de l'Air, No. 59, June, 1934, pp. 687-700.) (9.15/29385 France.)

A description is given of English and German explosive, incendiary and tracer ammunition used in the late war. A light shell of this type has been developed, which would probably put any aircraft out of action by a single hit. On this account the author strongly recommends a reduction in the size of bombing aircraft to reduce the size of target.

Reference is made to the Madsen and Oerlikon machine guns, which handle ammunition of this type of 20 mm. calibre. The Oerlikon is a development of the Becker gun used by the Germans towards the end of the war.

Eight references.

Construction of a Firing Table for Bombs Dropped from Aircraft. (N. Cavicchioli and U. Ricca, L'Aerotecnica, Vol. 14, No. 6, June, 1934, p. 716.) (9.16/29386 Italy.)

A relation is obtained between a form coefficient and the observed time of fall from a kite balloon at known height.

Corrections for a Trajectory. (A. Wertheimer, J. Frank. Inst., Vol. 217, No. 6, June, 1934, pp. 729-742.) (9.16/29387 U.S.A.)

A method of computing trajectories was developed in F. R. Moulton's "New Methods in Exterior Ballistics," 1926.

The present paper gives a routine for calculating correction from Moulton's standard trajectories required by changes in initial conditions.

Approximate differential relations are developed and a numerical example is computed.

Vulnerability of Warship Structures. (H. Evers, W.R.H., Vol. 15, No. 11, 1/6/34, pp. 142-3, and No. 12, 8/6/34, pp. 163-164.) (9.53/29388 Germany.)

A fundamental distinction is drawn between the effect of shells and bombs hitting above water and under water. The latter resembles the effect of under water mines and torpedoes. Detonation in an enclosed space naturally increases the effect of the explosion.

Examples are given from research trials and from naval actions.
Seven references.

Calculating Machine for Directing Anti-Aircraft Fire. French Patent 706020. (P. Algrain, Rev. de l'Armée de l'Air, No. 58, May, 1934, pp. 608-613.) (9.61/29389 France.)

The altitudes and azimuths of an aircraft, observed continuously from two or more bases, are differentiated with respect to time by the mechanism, and their values, after a further time corresponding to the time of flight of the projectile, are given by extrapolation of the aircraft's trajectory.

The mechanism is necessarily somewhat complicated.

Estoppey Bomb Sight. French Patent. (P. Légglise, Rev. de l'Armée de l'Air, No. 59, June, 1934, pp. 713-736.) (9.62/29390 France.)

This bomb sight (Type D.4) is in use by the American authorities. A specimen sight has been purchased by the French Government. The article gives a full illustrated review of the French covering patent.

Materials—Characteristics, Defects and Treatment

Brinell Hardness of Bearing Metals. (A. Vãth, Z. Metallk., Vol. 26, No. 4, April, 1934, pp. 83-86.) (10.101/29391 Germany.)

Tables are given correlating the hardness figure with the load and time of contact. In testing bearing metals the load and time should be adjusted so that the diameter of the impression is about half the diameter of the ball.

Five references.

Stainless Steel. (F. Flader, Trans. A.S.M.E., Vol. 56, No. 5, May, 1934, pp. 295-300.) (10.102/29392 U.S.A.)

A particular specification is recommended as suitable for U.S.A. aircraft construction and the strain-stress characteristic is shown graphically. Its general behaviour, during manufacturing processes and in service, is discussed.

Comparison is made with aluminium alloys and the final recommendation gives preference to stainless steel on the ground of rate of production, welding properties, treatment, cost, etc.

Photographs show examples of welds and a micro-photograph shows a section of one of the welds.

The Internal Mechanism of Metals. (W. Kuntze, Z. Metallk., Vol. 26, No. 5, May, 1934, pp. 106-112.) (10.104/29393 Germany.)

The behaviour of a substance under deformation is largely determined by internal molecular cohesion and resistance to slip. The field of stress in a body is affected by heterogeneity and local peaks of stress may produce slip in a metal before general flow sets in. A minute slip will generally produce a new configuration of greater inherent strength. There is a momentary stiffening up of the material, to be followed by a further slip if the load is increased. This accounts for the "crackling" noise emitted by many metals under tensile tests.

In the case of certain light alloys under tensile tests, the vibration of the loading line is well marked, although noise is generally absent. A substance will

fail under fatigue sooner than under static load, since there is no time for internal rearrangement producing local stiffening.

The article is illustrated by wood models demonstrating the mechanism of cohesion and slip.

Twenty-three references.

Cold Press Test of Sheet Metals. (H. Fournier, Pub. Sc. et Tech., No. 44, 1934.) (10.104/29394 France.)

The sheet under test is clamped between annular plates and a die presses the free metal into a dish form. Two variants are used, in one of which the metal sheet is bored centrally, in the other is left intact.

The load of final rupture is taken as the test figure. The first method is standardised in Germany and in either form the test is considered by the author as entitled to high consideration by reason of the uniformity of results.

Extensive tables of test figures by both methods are given, with tensile strength and elongation test figures for comparison. Photographs show examples of the dished form produced during test and microphotographs show the grain of various specimens.

Seven references.

Strength Calculation of Vehicle Axles. (A. Thum and F. Wunderlich, Z.V.D.I., Vol. 78, No. 27, 7/7/34, pp. 823-824.) (10.104/29395 Germany.)

Axles may fail under fatigue or under shock. In rail car construction the temperature of the axle is important. Surface treatment by pressing, polishing or hardening extends the fatigue limits.

Eleven references.

Fatigue Limits and Notch Tests of Steels at Low Temperatures. (H. Wontrup, Z.V.D.I., Vol. 78, No. 18, 5/5/34, p. 565.) (10.104/29396 Germany.)

A reduction in temperature to -20°C . increases the fatigue limits of crankshaft and chrome nickel steels about 10 per cent. Ultimate tensile is also increased, but the resistance to notch impact is sensibly reduced.

Three references.

Recent Development of Permanent Magnet Steels. (W. Steinhaus and A. Kussman, Phys. Zeit., Vol. 35, No. 9, 1/5/34, pp. 377-382.) (10.105/29397 Germany.)

The recent development of permanent magnet steels is based on the relation between heterogeneity of crystalline structure associated with internal stresses. The metallurgical physical problem is discussed briefly.

A graphical chart shows the properties of two Fe. Co. Mo. magnet steels quenched at $1,300^{\circ}$ and annealed at 700° , showing a residual magnetic indication of 10,000 C.G.S. units and a coercive force of 300 gauss.

The change in micro-structure on annealing is shown by microphotographs. A chart and table show in comparative form the properties of seven modern magnet steels.

Twelve references.

The Recovery of Metals from the Results of Cold Working. (G. Tammann, Z. Metallk., Vol. 26, No. 5, May, 1934, pp. 97-105.) (10.12/29398 Germany.)

When metals are cold worked many properties, such as electrical resistance, thermo-E.M.F., etc., are changed concomitantly with the mechanical properties. A subsequent heat treatment will generally restore the metal to its original condition.

The minimum temperature rise required varies for different properties. The change of electrical resistance with temperature is especially sensitive and, from the type of recovery curve obtained, the author suggests that the process of cold working modifies the individual metallic molecules very unevenly. Maximum temperature effect occurs when the largest number of atoms returns to the normal condition.

Twenty-five references.

Temperature Recording Paints. (Airc. Eng., Vol. 6, No. 69, Nov., 1934, p. 305.) (10.12/29399 Great Britain.)

The colour changes of recording paints containing metallic iodides are not reliable under prolonged heating and cooling. Mixtures of clays and metallic oxides behave more consistently, but further research is required.

An Accelerated Nitriding Process. (Autom. Tech. Zeit., Vol. 37, No. 14, 25/7/34, p. 372.) (10.12/29400 Germany.)

The usual nitriding process requires about 16 hours in an atmosphere of NH_3 at temperatures between 460-580°C. Both time and temperature are reduced considerably by gaseous accelerators—pyridine, nitric oxide, etc.

A covering of copper gauze over the part to be nitrated reduced the time to four hours at 460°C.

Corrosion of Ferrous Metals in Acid Soils. (I. A. Denison and R. B. Hobbs, Bur. Stan. J. Res., Vol. 13, No. 1, July, 1934, pp. 125-150.) (10.125/29401 U.S.A.)

Correlations were obtained between acidity of soil and rate of pitting, under both practical and laboratory conditions.

Photographs show corrosion on pipe lines in soil and on discs in laboratory tests.

Tables of numerical data are given for thirty soils.

Eighteen references.

Durability of Protective Coatings on Steel. (M. Komers, Z.V.D.I., Vol. 78, No. 26, 30/6/34, p. 813.) (10.125/29402 Germany.)

The effectiveness of the coating depends on the composition of the steel and its surface treatment prior to painting. Burnishing with oil or a mixture of oil and red lead is very effective and accounts for the well-known resistance shown by old iron work made by the puddling process.

Three references.

Aluminium Alloys as Piston Material. (R. Sterner-Rainer, Z. Metallk., Vol. 26, No. 6, June, 1934, pp. 141-142.) (10.231/29403 Germany.)

Aluminium silicon alloys, with their low coefficient of expansion and good wearing properties, are receiving increasing attention as piston material, since improvements in casting technique have reduced the grain of any silicon which comes out of solution.

Alloy pistons are suitable for high speed steam engines, but have received limited application so far.

Tests on Duralplatt. (K. L. Meissner, W.R.H., Vol. 15, No. 9, 1/5/34, pp. 107-108.) (10.231/29404 Germany.)

A descriptive summary is given of the patent situation with brief reference to tests in comparison with magnesium alloys.

Light Alloy Rivets. (K. Guler, Z. Metallk., Vol. 26, No. 4, April, 1934, pp. 90-91.) (10.29/29405 Germany.)

Details are given of manufacture and of testing. The effect of heat treatment and temperature control on the subsequent age hardening is fundamental.

Safety Glass for Vehicles. (M. Heckter, Z.V.D.I., Vol. 78, No. 24, 16/6/34, pp. 757-758.) (10.406/29406 Germany.)

Most of the safety glass in use consists of two thin sheets of plate glass which are held together with some transparent cement. This cement may be derived from

- (1) Celluloid.
- (2) Cellon.
- (3) Certain condensation and polymerisation products of organic esters.

The celluloid cements at present are the cheapest and in most general use. The cements of groups (3) are more stable than those of groups (1) and (2) as judged by discolouration and patches, but are affected more adversely by heat and cold.

Three references.

Extending the Life of Wooden Masts. (W. Mühlau, Z.V.D.I., Vol. 78, No. 14, 7/4/34, pp. 434-436.) (10.420/29407 Germany.)

Wooden masts chemically treated rot near the ground after about eight years, whilst the rest of the mast is still comparatively sound. In the new methods here described chemically treated pads are wrapped round the vulnerable parts of the mast. Differences in osmotic pressure cause the salts to impregnate the wood and prolong the life of the mast. A saving of between one and two marks per mast is claimed.

Three references.

Grain of Coats of Paint. (W. Toeldte, F.G.I., Vol. 5, No. 3, May/June, 1934, pp. 121-126.) (10.603/29408 Germany.)

Fourteen photographs are reproduced and show the surface formation and sections of protective coats. Specifications are given of the varnishes and solvents and methods of application are discussed in a practical manner.

Testing Apparatus and Methods of Testing

Turin Aeronautical Laboratory. (L'Aerotecnica, Vol. 14, No. 4, April, 1934, pp. 359-434.) (11.10/29409 Italy.)

A description is given of the mounting of aerofoils, etc., on wire suspensions and the reduction of the readings to force and moments impressed. Airscrews are mounted on a torsion balance, the details of which are shown in a section sketch.

Numerous examples of experimental work are described and international comparisons are given. Numerical results are given graphically in fifty diagrams.

Twelve references.

The Froude Tank of the Hydrodynamical Laboratory of the Italian Ministry of Aeronautics. (L'Aerotecnica, Vol. 12, No. 4, April, 1932, pp. 447-472.) (11.20/29410 Italy.)

The dimensions are given in sketches and the more important items of equipment in sketches and photographs. The total length is 176 metres, depth 2.3 metres, width 3 metres. The maximum velocity of the travelling carriage is 10 m./s.

There are two small subsidiary tanks with continuous flow, maintained by a circulation pump absorbing 25 h.p. Typical curves of air and water resistance of a hull are reproduced and a combined diagram of characteristics is constructed in non-dimensional co-ordinates.

Tank Experiments on Model Seaplane Floats (1st Series)—Directorate of Research and Experiment, Ministry of Aeronautics, Report No. 3. (A. Eula, L'Aerotecnica, Vol. 14, Nos. 8-9, 1934, pp. 947-990.) (11.20/29411 Italy.)

(The equipment of the laboratory was described in L'Aerotecnica, April, 1932. See Abstract 29410.)

Measurements were made with 17 models, eight of type A, six of type B, two of type C, one of type D. The float lift, trim angle, resistance/total lift, and resistance/float lift, are plotted in non-dimensional co-ordinates, formed on the basis of Froude's theory.

The float lines and dimensions are given in separate diagrams. The departures of the principal dimensions, e.g., length of beam, from geometrical similitude are within moderate ranges and are shown in a table.

Approximate numerical values may be taken from the curves for any hull or float design not departing much from the nearest type in the present series.

100th Report of the Hamburg Naval Research Institute—Model Measurements in a Current of Water. (K. Holm, W.R.H., Vol. 15, No. 12, 8/6/34, pp. 146-148.) (11.20/29412 Germany.)

The level in the service tanks is 1.5 metres higher than the mean channel level and the sink tank 0.5 metres lower. A delivery of 900 cub. metres per hour is available for nearly three minutes, with a maximum current of 0.25 m. per sec. Measurements of resistance power and efficiency, trim angle and steerability are transformed to full-scale in open water and in a channel 3 m. deep \times 37.7 m. wide for relative speeds from 7 to 17 km./hrs. and for currents zero and ± 7 km./hrs. There is a correction of -2 per cent. to -4 per cent. from model to full-scale in the required power. Detailed consideration is given to numerous factors affecting dynamical similitude.

In Report 113, which follows immediately, a full technical description is given of the installation.

The Resistance of a Ship in a Channel. (Dr. J. Kreitner, W.R.H., Vol. 15, No. 7, 1/4/34, pp. 77-82.) (11.22/29413 Germany.)

The velocity field near the hull is modified by the constriction of the channel by the hull itself and the characteristic velocity of waves is modified by the depth of water. Expressions for these well-known effects are written down and discussed numerically.

The computed values are compared with measurements in graphical form and show satisfactory agreement.

Three references.

Static Wing Rib Tests. (A. W. Clegg, Airc. Eng., Vol. 6, No. 69, Nov., 1934, pp. 301-302.) (11.32/29414 Great Britain.)

The labour of calculating the correct load distribution at 16 or more stations along the chord is much reduced by the use of sixteen typical curves of percentage partial loads, one at each station, plotted against the fraction of the chord defining the centre of pressure.

Physical Relation between the X-Ray Unit and the Radium Unit. (R. Jaeger, Phys. Zeit., Vol. 35, No. 7, 1/4/34, pp. 273-275.) (11.47/29415 Germany.)

The definition of international unit of X-ray radiation is based on the production of unit electrostatic change in an ionisation chamber. The unit is called the

Röntgen. The radium unit is based on the intensity of radiation from 1 milligramme of radium at 1 centimetre from the radium preparation. Both may be reduced to a count of electrons and by this method the numerical ratio is approximately:—

$$1 \text{ radium unit} = 7.35 \text{ Röntgen units.}$$

Fourteen references.

Relation between Thermal and Mechanical Rupture of Molecular Bonds. (F. Regler, *Ann. d. Phys.*, Vol. 19, No. 6, April, 1934, pp. 637-664.) (11.47/29416 Germany.)

X-rays, refracted by the molecular structure, exhibit characteristic interference lines. These lines broaden under mechanical stresses and under temperature increase. A maximum breadth is observed just before yield or rupture and corresponds to a maximum absorbable strain energy. The same broadening effect under increase of temperature and the same maximum value precedes melting.

The author's method of obtaining photographic records is described and four photographs are reproduced. The numerical results are exhibited graphically.

Twelve references.

Optical Indicator. (*J. Sci. Inst.*, Vol. 11, No. 12, Dec., 1934, pp. 396-399.) (11.55/29417 Great Britain.)

In this new form of the Perry indicator the deflection of the diaphragm is measured by the tilt of a mirror fastened to it. A reciprocating stroke mechanism operating with steel tape and rollers is provided.

Magnetic Pressure Indicator for Internal Combustion Engines. (T. Kobayasi and S. Sakuma, *Aer. Res. Institute, Tokyo, Report No. 109* (Vol. 9, No. 1), July, 1934.) (11.55/29418 Japan.)

Authors' Abstract.—The applications of the inverse Wiedemann effect to torque measurements and to torque variation recordings were devised by the writer and the details of the experiments were published in the Reports, Vol. 4, No. 52, and Vol. 5, No. 54. If a ferro-magnetic bar is furnished with a twisting arm, a force, or variations of a force, can be measured in the same way. The writer constructed a pressure indicator for an internal combustion engine and obtained satisfactory results.

The Isotta-Fraschini High Altitude Test House for Aero Engines. (O. Kurtz, *Luftwissen*, Vol. 1, No. 5, 15/5/34, pp. 135-138.) (11.55/29419 Germany.)

The plant is designed to deal with water-cooled engines up to 800 h.p. under altitude conditions corresponding to 33,000 feet (0.26 atmospheres absolute, -50°C . intake temperature). During the test the engine is exposed to a stream of air at low temperature and pressure to reproduce actual cooling conditions. The air is circulated at about 60 m.p.h. and brine cooling keeps the temperature down to -18°C .

(In the American and English plant the external surface of the engine is kept under normal atmospheric conditions in still air.) The combustion air is drawn from the channel and undergoes a second cooling (down to -50°C .) before it enters the engine. A turbo pump removes the engine exhaust and any leakage air and maintains the low pressure in the channel. To make good the air consumption of the engine fresh air is drawn from the external atmosphere and is cooled before it enters the channel.

The engine power is measured by a water brake situated outside the channel. The power consumption of the test house includes 160 h.p. for the NH_3 cooling

plant of 250,000 cal./h. capacity and 60 h.p. for the wind channel (70 m. 3/sec. at 0.26 atmospheres and $-18^{\circ}\text{C}.$).

A considerable extension of the plant will be necessary before it can deal with air-cooled engines.

Four references.

High Altitude Tests of Aero Engines. (P. Ragazzi and F. Righetti, Riv. Aeron., Vol. 10, No. 5, May, 1934, pp. 268-325.) (11.55/29420 Italy.)

High altitude tests in flight are restricted by lack of consistent and reliable instruments for measuring power. Tests on mountains are restricted in altitude and temperature.

The authors describe fully the Fiat Italian high altitude test plant, which resembles in some respects the Isotta-Fraschini installation. (See Abstract 29419.) The whole engine is placed in a low density high speed air current at low temperature, with a closer approach to flight conditions. The whole cooling of air-cooled engines is effected by the air stream and this limits the test range to 500 h.p. at 15,000 feet.

With water-cooled engines, the jacket cooling can be effected by radiators outside the air stream and the test range is extended to 500 h.p. at 30,000 feet.

Precautions against explosion are described.

Fifteen references.

Airships and Balloons

Disaster to Russian Stratosphere Balloon. (Luftwissen, Vol. 1, No. 4, 15/4/34, p. 105.) (12.0/29421 Germany.)

According to Russian accounts the disaster was due to insufficient ballast reserve for the prolonged stay at high altitudes. At sunset the rapid cooling of the gas reduced the residual lift so far (presumably below the net weight without ballast) that a catastrophic fall resulted.

Design of Rigid Airships. (K. Arnstein, Trans. A.S.M.E., Vol. 56, No. 6, June, 1934, pp. 385-392.) (12.10/29422 U.S.A.)

The author is in charge of the engineering activities of the Goodyear Zeppelin Corporation.

The weight analysis of various types is considered and some comparative figures are tabulated. The importance of power plant output per unit weight is referred to, and the overweight of the R.101 is attributed to the high specific weight of the Diesel engines.

Frame design and stress calculations are briefly discussed, and a photograph shows a model frame section under static test. Performance is discussed as a function of useful load, fuel consumption, drag and speed.

Six references.

Airship Performance. (G. Fulton, Trans. A.S.M.E., Vol. 56, No. 5, May, 1934, pp. 301-303.) (12.30/29423 U.S.A.)

Methods of improving performance of airships as long range carriers are discussed in general terms, which include water recovery as ballast, power plant improvements, use of excess hydrogen as fuel, and fire hazards, with the inevitable comparison of the advantages and disadvantages of helium.

Wireless

Microphone Noise in Vacuum Tubes. (D. P. Penick, Bell Tele. B-814, 1934.) (13.2/29424 U.S.A.)

Measurements of microphonic noise level are shown graphically. Methods of reducing noise are discussed and recommendations are made.

Seven references.

Fluctuation Noise in Vacuum Tubes. (G. L. Pearson, Bell Tele. B-813, 1934.) (13.2/29425 U.S.A.)

Sources of fluctuating noise are enumerated and their relative magnitude indicated.

Quantitative measurements in typical tubes are tabulated and recommendations are given.

Nineteen references.

Extension of Theory of Three-Electrode Vacuum Tube Circuits. (S. A. Levin and L. C. Peterson, Bell Tele. B-812, 1934.) (13.2/29426 U.S.A.)

The effects of feed-back between input and output circuits is considered to second and higher approximations, on the assumption that the amplification factor is constant and that the conductive grid current is zero.

The analysis is in terms of complex algebra and illustrative numerical constants are given.

Seven references.

Resistance Tuning. (S. Cabot, Proc. Inst. Rad. Eng., Vol. 22, No. 6, June, 1934, pp. 709-731.) (13.2/29427 U.S.A.)

The theory of resistance and reactance tuning is discussed mathematically. The variation in amplification by the latter may be as high as 10 to 1, while resistance tuning keeps the variation within practicable limits, about 3 to 1.

Five references.

Distributed Capacity of Single Layer Coils. (A. J. Palermo, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 897-905.) (13.2/29428 U.S.A.)

Previous experiment and theory are in disagreement, which is largely removed by introducing two new parameters, the diameter of the conductor and the pitch of the windings, the ratio of which affects the capacity sensibly.

Nine references.

Suppression of Interlocking in Detector Circuits. (P. W. Klipsch, Proc. Inst. Rad. Eng., Vol. 22, No. 6, June, 1934, pp. 699-708.) (13.2/29429 U.S.A.)

The pentagrid converter has solved many problems, but may be subject to excessive interlocking with short waves or high frequency beats.

A modification of the usual circuit was devised which reduced the forced change in frequency from 0.15 per cent. to 0.005 per cent. Modifications of the tube construction are discussed with the same object.

Three references.

Free Oscillations of a Condenser Circuit with a Periodically Variable Capacity. (A. Erdelyi, Ann. d. Phys., Vol. 19, No. 6, April, 1934, pp. 585-622.) (13.2/29430 Germany.)

The problem arises in telephone circuits where the sound vibrations produce modulations in the capacity.

A differential equation of Hill's type is found and discussed by various methods for stable and unstable conditions. The solutions, involving elementary transcendentals, Bessel and Neumann functions, etc., are not susceptible of abstracting.

Nineteen references.

Influence of Stray Capacitance on Antenna Measurements. (E. A. Laport, Proc. Inst. Rad. Eng., Vol. 22, No. 5, May, 1934, pp. 657-669.) (13.2/29431 U.S.A.)

Diagrams of circuits are shown for typical cases and the corresponding vector diagrams of voltage and current are drawn, giving numerical values which agree with measurement.

High Frequency Models in Antenna Investigation. (G. H. Brown and R. King, Proc. Inst. Rad. Eng., Vol. 22, No. 4, April, 1934, pp. 457-480.) (13.2/29432 U.S.A.)

The feasibility is considered of setting up of models with sufficient approach to electro-magnetic similitude with full-scale work.

Most of the paper is given to discussion of distortion by wireless masts or towers in resonance with the field. A guarded conclusion is given that the method may be useful as a check on the assumption underlying theoretical developments and in suggesting generalisation of theory.

Nine references.

Frequency Transformations by Rectifier with Capacity Load. (J. Kluge, Phys. Zeit., Vol. 35, No. 7, 1/4/34, pp. 275-278.) (13.2/29433 Germany.)

Diagrams show the fundamental elements of a rectifier circuit with capacity load and the complete installation discussed in the present paper. The products of large values of the resistance and capacity give a large time of decay, which maintains a voltage superposed on the rectified voltage.

A diagram shows the superposed voltage maintained over four peaks of the rectifier voltage at a sufficient level to prevent sparking.

Oscillograph records for specified values of capacity, resistance, reactance, etc., show 2:1 and 4:1 transformations. Specifications are given for applications to marking time intervals and to illumination of lamps for stroboscopic observations.

Two references.

Practical Measurement of Degree of Amplitude Modulation. (L. F. Gaudenack, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 819-846.) (13.2/29434 U.S.A.)

A critical review of existing methods is given. The requirements for a direct reading modulation are specified and an instrument designed on these lines is shown in photographs. Two diagrams of connections and calibration curves for three ranges are given.

Sixteen references.

Echoes of Radio Waves. (N. Janco, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 923-925.) (13.30/29435 U.S.A.)

Ordinary waves may have right-handed polarisation or left-handed polarisation. The former may penetrate the E layer of ionisation and undergo repeated reflections between E and F layers, with final escape through gaps in the E layer which would account for long delay echoes and suggests that they occur more frequently than actual observation records.

Six references.

Echoes from the Ionosphere. (L. C. Verman, S. T. Char and A. Mohammed, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 906-922.) (13.30/29436 U.S.A.)

A description is given of apparatus for making film records of time and intensity of reflected impulses. Repeated reflections between E and F layers account for long retardation.

Twenty-seven references.

High Quality Radio Broadcasting. (S. Ballantine, Proc. Inst. Rad. Eng., Vol. 22, No. 5, May, 1934, pp. 564-629.) (13.31/29437 U.S.A.)

A comprehensive review is given of the underlying problems. The wave band separation of stations is 10 kc. and the range of modulation frequencies

required is about 8 kc. for orchestral music. This produces an overlap of side bands by 3 kc. which sets up chattering.

Disc microphone characteristics are shown as functions of incidence, frequency and temperature. To eliminate the incidence effect a crystal piezo electric has been designed with cylindrical symmetry, about a vertical axis, so that the reception from sources of sound grouped round it are uniformly effective. Volume control, antenna characteristics and ground effect are discussed.

Thirty-six references.

League of Nations Wireless Station. (G. F. Van Dissel, Proc. Inst. Rad. Eng., Vol. 22, No. 4, April, 1934, pp. 430-448.) (13.31/29438 U.S.A.)

An account is given of the political compromise whereby a wireless transmitting station is available for international announcements by the League.

A descriptive technical account is given of the equipment of the station, which began partial operations in 1932.

Wireless Equipment on Federal Airways System, U.S.A. (L'Aéron., No. 181, June, 1934, pp. 141-142.) (13.30/29439 France.)

A general description of the system is given and a journey from Cleveland to Chicago entirely by wireless soundings is described in detail.

Wireless Beacons on the U.S.A. Air Lines. ((L'Aéron., No. 181, June, 1934, p. 137.) (13.4/29440 France.)

The article describes the experiences of and gives an entirely favourable account by a French pilot who used the system over the transcontinental route.

Gliding-in Beacons. (C. Jung-Zaeper and E. Kramar, Luftwissen, Vol. 1, No. 4, 15/4/34, pp. 92-95.) (13.4/13.6/29441 Germany.)

In the well-known American method of Diamond and Dunmore, a long wave beacon gives distant direction and the gliding-in course is directed by short waves from a complicated system of antennæ.

The German method patented by Lorenz, directs both distance and gliding courses by signals from a simple short wave framework. The method is awaiting trials.

Seven references.

Blind Landing by Means of Electrical Devices. (P. Handel, Luftwissen, Vol. 1, No. 7, 15/7/34, pp. 186-189.) (13.4/29442 Germany.)

The D.V.L., in conjunction with Messrs. Lorenz, have developed a polarised radio beacon system suitable both for horizontal and vertical navigation. The wave length is of the order of 9 metres and a special antenna of low air resistance has been developed for fitting to the aircraft.

Six references.

Landing in Fog. (R. Stüssel, J.R. Aer. Soc., Vol. 38, No. 286, Oct., 1934, pp. 807-836.) (13.4/29443 Great Britain.)

A descriptive technical account is given of the wireless beacon system used by Luft Hansa, and of the required aeroplane equipment, the latter weighing 8 kg. Photographs and diagrams of connections exhibit the details. A typical landing is described.

Statistics are given of the numbers of bearings given in Luft Hansa operations, increasing from 1,610 in 1929 to 32,500 in 1933. Failures to maintain night services show heavy seasonal increases in mid-winter and successful landings show a corresponding increase in the occasions when the beacon system was required.

Reference is made to short wave developments (9 metres), but the problem is not yet fully solved and further research and development is required. The discussion brought out a wide range of experiences and opinions relating to work in this country.

Problem of "Bad Weather" Landing of Aeroplanes. (R. Stüssel, Luftwissen, Vol. 1, No. 5, 15/5/34, pp. 128-134.) (13.4/29444 Germany.)

Bad weather flying through a limited zone, in particular bad weather starts from an aerodrome, are made reasonably safe by reliable instruments which have been evolved for "blind flying." Bad weather landings require special instruments, both on the ground and in the machine. Progress has been made in landings on aerodromes where a ground organisation is available.

The direction of flight and the horizontal distance from the landing ground are generally obtainable by wireless methods, the apparatus described here conforming closely to American practice. Height above ground is generally estimated by some type of static pressure gauge which, though imperfect, is more practicable than wireless transmission of instantaneous distance and direction. The concentrated efforts of specialist firms have not yet solved these instrumental problems.

Forced landings in bad weather in unknown territory, where the pilot can rely only on his own instruments, still involve serious risks.

Compensation of Distortion by Space Charge in Gas-Filled Cathode Ray Oscillograph Tubes. (M. v. Ardenne, Proc. Inst. Rad. Eng., Vol. 22, No. 4, April, 1934, pp. 423-429.) (13.5/29445 U.S.A.)

The non-linear characteristic of an uncompensated tube is shown by oscillograph records. The use of the linear part of the characteristic by bias on the deflecting plate involves either restoration of symmetry by an independent magnetic field or the use of asymmetrical tubes with attendant difficulties of manufacture.

In the present paper a method is described in which one or both of the deflecting plates is divided and equal and opposite bias voltages are applied to both parts. Two pairs of deflecting plates, the pairs being mutually at right angles, are employed. The beam passes the pairs of plates successively and the final direction of the cathode ray after the two successive deflections is axial.

Records are shown of a distorted sine curve and of the pure sine wave obtained by this method of correction.

Four references.

Seventy-five Centimetre Radio Communication Tests. (W. D. Hershberger, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 870-877.) (13.6/29446 U.S.A.)

The sender was 200 feet above sea level, the receiver 20 feet above sea level, giving a straight line range of $16\frac{1}{2}$ miles tangent to the earth's surface. Telephonic communication was good up to 20 miles and telegraphic communication up to 88 miles, about five times the horizon range.

Nine references.

Maintaining Directivity of Antenna Arrays. (F. G. Kear, Proc. Inst. Rad. Eng., Vol. 22, No. 7, July, 1934, pp. 847-869.) (13.6/29447 U.S.A.)

Slight changes in phase and magnitude of the antenna currents seriously alter the directional intensity.

Constancy of line current ratios is obtained by building out the transmission lines to 90° in parallel or 180° in series. Numerical characteristics of the current lines are given and the circuits are shown diagrammatically. The theory is

worked out mathematically and the characteristics shown graphically. The system has been applied successfully.

Five references.

Ultra Short Wave Generators. (E. W. B. Gill, *Phil. Mag.*, Vol. 18, No. 121, Nov., 1934, pp. 832-838.) (13.6/29448 Great Britain.)

In the usual arrangement the Lecher wires are connected to anode and grid and to extension plates. In an alternative arrangement the wire attached to the grid is split, the two ends connected to the filament, and two to a split condenser plate. In this arrangement the oscillations are maintained by the current to the anode alone.

It appears that the assumption of damping by the anode current and of independent internal oscillations in the valve are untenable.

Six references.

Television with Cathode Ray Tubes. (V. K. Zworykin, *H.F. Technik*, Vol. 43, No. 4, April, 1934, pp. 109-121.) (13.7/29449 Germany.)

A detailed description is given of operation with the instruments known as the "Ikonscope" and the "Kinescope." (See Abstract No. 28848.)

Ten references.

Theory of Scanning. (P. Mertz and F. Gray, *Bell Tele.* B-799, 1934.) (13.7/29450 U.S.A.)

Blurring is due to the discrete division of the field and extraneous patterns are due to the original and scanning system. Extraneous patterns can be eliminated at the cost of increased blurring.

A comprehensive Fourier analysis of intensity distribution along the frequency spectrum is worked out, Bessel functions of both kinds and of various orders appearing in the analysis. The results are exhibited graphically.

Constancy of Selenium Layer Photocells. (L. Bergmann, *Phys. Zeit.*, Vol. 35, No. 11, 1/6/34, pp. 450-452.) (13.7/29451 Germany.)

The characteristics of four cells are given in numerical tables. Provided that the cells are not overloaded they maintain a reasonably constant characteristic for over 100 hours of continuous load.

Photography

Cinematograph Record of Aeroplane Motions During Start. (W. Pleines, L.F.F., Vol. 11, No. 1, 15/5/34, pp. 16-25. D.V.L. Report, No. 33/03.) (14.28/29452 Germany.)

A sketch shows the position of a cinematograph camera on the ground; the region of observation was limited by the field of the apparatus, which was fixed and not rotatable. A photograph shows two other cinematograph cameras fixed on the aeroplane.

Three flare lights were arranged on the wing. The distance between parallel wires in the field of one of the aeroplane cameras measured the movements of the elevator and was calibrated for this purpose.

Stop watches were placed in the field of both cameras and the beginning of the flare was co-ordinated within 1/30th second, with the aeroplane altitude and position. A detailed account is given of the method of controlling and reducing the observations.

Flights were observed with four different positions of the c.g. The results are given in graphical form and in tables and show the aeroplane position and

altitude and the elevator control angle as functions of time. A more extensive analysis of the test results is to be published later.

Eight references.

Blackening of Photographic Films by Electrons and by Induced Fluorescence. (B. v. Borries and M. Knoll, Phys. Zeit., Vol. 35, No. 7, 1/4/34, pp. 279-289.) (14.60/29453 Germany.)

Recent investigations of quantitative relations between the density of emitted electrons (coulombs/cm.) and the blackening of films for comparatively long time intervals (10^{-2} sec.) are extended to short intervals (10^{-5} sec. to 10^{-8} sec.).

Numerical tables and graphical charts give a mass of data for photographic plates and papers.

Twenty-one references.

Acoustics, Noise Reduction, etc.

Perception of Change in Intensity of Pure Tones. (B. G. Churcher, A. J. King and H. Davies, Phil. Mag., Vol. 18, No. 122, Supplmt., Nov., 1934, pp. 927-939.) (15.20/29454 Great Britain.)

A description is given of the methods of changing intensity and of precautions taken in presenting these changes to selected observers for personal judgment.

The numerical results are tabulated and shown graphically for a frequency of 800 cycles per second and indicate that Fechner's law of logarithmic increment of sensation is a rough approximation.

Five references.

Minimum Perceptible Changes of Intensity. (H. Davies, Phil. Mag., Vol. 18, No. 122, Supplmt., Nov., 1934, pp. 940-949.) (15.26/29455 Great Britain.)

The methods of the previous paper are used. More or less established results of other workers are shown graphically for a range of pitches from 50 cycles per second to 800 cycles per second.

Further data are shown graphically. Both the method of minimum change of intensity and of direct comparison were used and lead to closely similar curves.

The inadequacy of Fechner's law is confirmed.

Eight references.

The Measurement of Altitude and Inclination of Aircraft by Echo Method. (L. P. Delsasso, J. Acoustical Soc. of America, Vol. 6, No. 1, 1934, pp. 1-15; see Phys. Berichte, No. 22, 15/11/34, p. 1844.) (15.26/29456 U.S.A.)

Height and inclination of airship are estimated from time of reflection and flight speed and difference of frequency between emitted and reflected sounds.

Noise in Aeroplanes and its Suppression. (F. Gutsche, Z.V.D.I., Vol. 78, No. 27, 7/7/34, pp. 825-827.) (15.38/29457 Germany.)

The principal sources of noise in aeroplanes are the engine, the exhaust and the airscrew. The exhaust noise can be reduced to the level of engine noise by suitable silencers.

Air-cooled engines emit more noise than water-cooled engines and sleeve valves emit appreciably less noise than poppet valves. Airscrew noise measured in decibels increases linearly with tip speed, the noise also increases with blade thickness and pitch. The difficulties of silencing are increased by the width of the acoustical spectrum.

It is an immediate consequence of the approximate logarithmic scale of noise that the most intense source of sound must be reduced before less intense sources can be usefully attacked.

Sound insulation of passenger cabins is only a palliative and involves serious additions to weight.

Fourteen references.

Measurement of Absorption and Reflection of Sound by Materials. (F. Spandock, Ann. d. Phys., Vol. 20, No. 3, June, 1934, pp. 328-344.) (15.38/29458 Germany.)

A short sharp sound is emitted from a loud speaker and sets up a short wave train, part of which meets a microphone; the remainder passes on to a plate or board of the material under examination, placed at right angles to the line joining loud speaker and microphone. The wave train must be shorter than twice the distance between microphone and board, in order to avoid interference. Oscillograms are recorded and the different amplitudes measured.

The proportion of sound energy reflected is readily calculated from knowledge of the distances between loud speaker, microphone and board. Examples of oscillograms are reproduced.

The experiment may also be arranged to measure oblique reflection and to measure direct transmission through the specimen.

Eleven references.

Acoustics of Small Concert Halls. (G. V. Békésy, Ann. d. Phys., Vol. 19, No. 6, April, 1934, pp. 665-679.) (15.38/29459 Germany.)

A diagrammatic sketch shows the circuit of the installation used for establishing slowly increasing and decreasing notes. Oscillograph records are reproduced, which show examples of growth and decay.

A diagram reproduced the record of pressure distributed after three time intervals, for two different durations of the initial note and for ten points in a room of 180 m.³. The frequency of occurrence of notes and of intervals is shown for the first violin in Beethoven's fifth symphony.

Proceeding to the determination of the acoustics of the room, the reverberation time was altered by changing the damping value of the hangings until the most pleasing effect was obtained by ear. The corresponding reverberation times for different tone pitches was measured at the same time. The distribution of reverberation times is shown graphically for the most pleasing effect and for other damping values.

Ten references.

A Method of Comparing Acoustical Impedances. (K. Schuster, Phys. Zeit., Vol. 35, No. 10, 15/5/34, pp. 408-409.) (15.38/29460 Germany.)

A telephone produces a pure tone in the straight main tube. Two auxiliary tubes have a junction at their mid-points. One of them, having fixed reactance, forms a loop between two points equidistant from the mid-point of the main tube; the other has variable reactance controlled by a double piston fitting into the two open ends. The pistons in turn have adjustable reflecting intensities.

Applications can be made to determination of absorption and reflection of various materials.

Acoustic Measurements on Models. (F. Spandöck, Ann. d. Phys., Vol. 20, No. 4, July, 1934, pp. 345-360.) (15.38/29461 Germany.)

The wave length must be reduced on the same scale as the dimensions of the model. Hence for one-fifth scale model the pitch of the corresponding note must be increased by two octaves and a major third.

A gramophone record and loud speaker run at five times normal speed supplies the source. The sound arriving at a fixed point is recorded on a record also run at five times normal speed. The latter record, run at normal speed, gives the full-scale effect, including any disturbance effects.

Precautions must be taken in selecting and damping the wall material. A number of records are reproduced and it is stated that the results are in agreement with full-scale measurements.

Twenty references.

Methods of Astronomical Air Navigation. (A. Bastide, Rev. de l'Armée de l'Air, No. 59, June, 1934, pp. 653-672.) (15.5/29462 France.)

Italian experts are paying attention to problems of night flying. If a schedule of corresponding times and positions can be prepared beforehand, close check on the accuracy of navigation is obtained by single star observations.

Accidents and Precautions

Contribution to Parachute Research. (R. Alkan, L'Aéron., No. 179 (Bulletin), April, 1934, pp. 37-43.) (16.20/29463 France.)

The porosity of the parachute material is measured by comparing the air flow through the material with that of a standard calibrated orifice. It appears that increase in air pressure increases the porosity by separating the fibres. Resistance to tearing is tested by an impact of a falling weight on a stretched strip of material (much as in tests on a length of chain). The maximum pull during the descent of the parachute is recorded by inserting a steel ball resting on a copper plate between the parachute and the load. This indication is rough because the time of contact is short. The temperature effect may be marked.

A simple type of magazine camera is described, which records the descent of full-scale parachutes.

Analysis of Parachute Emergency Descents and Accidents in Germany during 1933. (H. von Stryk, Flugsport, Vol. 26, No. 13, 27/6/34, pp. 278-279.) (16.20/29464 Germany.)

Three pilots saved their lives by emergency parachute descents, two from aeroplanes in a spin and one from a glider which broke up in the air.

There were four accidents, one fatal, in pre-arranged descents; two were caused by bad weather, one by faulty construction of parachute and one by careless operation.

Measurement of Lightning Currents. (Z.V.D.I., Vol. 78, No. 28, 14/7/34, pp. 862-863.) (16.30/29465 Germany.)

A bundle of highly remanent steel wire sealed in a glass tube is placed in close proximity to the lightning discharge and the intensity and direction of the current is estimated from the intensity and polarity of the remanent magnetic field induced in the wire.

More than 10,000 of these elements were placed on electrical pylons in 1933. The lightning is usually a negative discharge from cloud to earth with a duration of the order of 100×10^{-6} seconds and peak values of 60,000 amps.

Two references.

Aviation Rescue Boats. (Sci. Am., Vol. 151, No. 1, July, 1934, p. 38.) (20.34/29466 U.S.A.)

An illustration shows a high speed motor boat for salvage work in connection with naval aircraft forced down at sea; overall length 45 feet, two converted aircraft engines of 650 h.p. each, speed 45 m.p.h. The crew of six includes doctor, hospital attendant and aviation carpenter's mate.

Aircraft—Unorthodox

The Problem of Vertical Flight. (J. H. Crowe, *Airc. Eng.*, Vol. 6, No. 69, Nov., 1934, and No. 70, Dec., 1934, pp. 315-318.) (17.05/29467 Great Britain.)

The principles of the autogiro and cyclogiro are discussed in terms of aerodynamical elements.

Photographs show an autogiro in flight and two types of cyclogiro on the ground. The helicopter is considered to be fundamentally unstable in gusts.

Variable Incidence Gyroplane. (*Flight*, Vol. 26, No. 1357, 27/12/34, pp. 1377-1378.) (17.05/29468 Great Britain.)

In the Kay gyroplane the rotating wings do not flap but operate at a fixed incidence which, however, is controllable by hand. The hub can be tilted to maintain trim.

It is claimed that by reducing the incidence at high speed, the cone angle and drag of the rotating wing can be reduced. An increase in incidence reduces landing impact; a negative incidence on the ground steadies the aircraft in a gusty wind.

Flying trials are awaited.

Rotating Wings. (M. Schrenk, *Luftwissen*, Vol. 1, No. 5, 15/5/34, pp. 121-127.) (17.05/29469 Germany.)

A descriptive technical account is given of the relation between the aeroplane wing and the autogiro and helicopter blade. The elementary aerodynamical conditions for autorotation are shown in a diagram of forces on a wing element.

An interesting variant of the autogiro is the so-called "gyroplane" in which variable incidence is obtained by rotating mechanically pairs of blades about a common axis (which is a diameter of the blade disc). Clearly increase of incidence of one blade is accompanied by equal decrease of incidence of the opposite blade.

The Florinne and Asboth machines are helicopters, in the usual sense of the name, with blades rigidly attached to the shaft. An English report on the latter is cited, in which it is stated that the machine is stable in calm air, with a sensible vertical climb (1.5 m./s.) and light landing.

Photographs show a Cierva autogiro, a Rieseler gyroplane and a Florinne helicopter in flight.

Ten references.

The Technical Value of the Rotating Wing Aircraft. (M. Schrenk, *Z.V.D.I.*, Vol. 78, No. 25, 23/6/34, pp. 776-777.) (17.05/29470 Germany.)

The low landing speed of the autogiro facilitates taking up and dropping messages and even personnel. It should replace the vulnerable captive balloon for artillery and is more likely to survive a forced landing in fog than an aeroplane.

Seven references.

Choice of Aerofoils for Rotating-Wing Aircraft. (J. B. Wheatley, *J. Aer. Sci.*, Vol. 1, No. 2, April, 1934, pp. 88-90.) (17.05/29471 U.S.A.)

A brief account is given of the aerodynamic basis of the autogiro and a semi-empirical expression is quoted from R. & M. 1127. The rule is given that the drag coefficient be small up to three-fourths of maximum lift.

The outstanding difficulties of the physical theory are considered intractable.

The Autogiro Fitted with Publicity Streamers. (*L'Aéronautique*, No. 181, June, 1934, pp. 135-136.) (17.05/29472 France.)

Extensive use is made of the autogiro in U.S.A. for trailing publicity banners. The messages are made of individual letters (up to 35) about seven feet high

strung on a wire frame and kept taut by two air cones at the ends. The conditions for stability of the streamer have been found empirically.

Rocket Flight. (G. E. Pendray, *Sci. Am.*, Vol. 151, No. 1, July, 1934, pp. 10-12.) (17.20/29473 U.S.A.)

A useful account is given of the relative weights of fuel consumption and pay load for a rocket design. The so-called speed of escape from the earth's attraction is 7 m.p.s. and about 25 m.p.s. from the sun's attraction.

The trial design of a rocket shows that to attain the former speed the total weight (mostly combustible) is about 500 times the pay load. Modest experimental results are described and a photograph shows a rocket at the moment of departure.

Reference is made to German, U.S.A. and British Rocket Societies, each with its own publications.

Aircraft Carriers

Seaplane Carriers. (*Sci. Am.*, Vol: 151, No. 1, July, 1934, p. 42.) (18.01/29474 U.S.A.)

A photograph shows U.S. "Saratoga" with about twenty large and fifty small aircraft on the flying deck.

Seaplane Tender-Ship "Westfalen." (F. W. Hammer, *Z.V.D.I.*, Vol. 78, No. 22, 2/6/34, pp. 649-656.) (18.04/29475 Germany.)

A detailed descriptive account is given of the seaplane and flying boat hoisting and catapulting equipment. The trailing canvas is shown in operation. Four references.

Meteorology and Physiology

Determination of Dust Content in the Free Atmosphere. (R. Meldau, *Z.V.D.I.*, Vol. 78, No. 20, 19/5/34, pp. 614-615.) (19.10/29476 Germany.)

Respiration troubles are caused by quartz dust and a determination of quartz content of atmospheric dust is effected as follows.

A filter passes particles below a certain size, which are deposited on a glass plate for examination under a microscope. A count is made of the particles visible under the microscope. The plate is then moistened with tetralin, the quartz particles disappearing, since the refractive index of quartz is near that of tetralin, and a second count is made of the particles remaining visible.

Atmospheric Dust Recorder. (W. G. Hazard, *J. Frank. Inst.*, Vol. 217, No. 5, May, 1934, pp. 571-590.) (19.10/29477 U.S.A.)

Dust collected from the atmosphere is deposited on a film in a beam. The diminution of a beam of light passing through the film and deposited dust is recorded by photocell, and the current is amplified in the usual way. The light reduction may be proportional to area multiplied by number, *i.e.*, $N \cdot V^{2/3}$ when N is the number, V the mean volume of the particles. In any case it is not a measure of number or size independently.

Fourteen references.

Determination of the Variation of Suspended Soot in the Atmosphere. (A. Heller, *Z.V.D.I.*, Vol. 78, No. 18, 5/5/34, pp. 565-567.) (19.10/29478 Germany.)

The experiments were carried out in Berlin and neighbourhood using an Owen filter apparatus. The variation of soot content with the hour of the day and the season is similar to that observed in English tests, but the absolute

quantities are considerably less. Wind and rain and vertical temperature gradient have pronounced effect.

The marked increase in soot content after sunset is due to the evening temperature inversion preventing the influx of fresh air into the contaminated ground layer.

(Possibly gas attacks will be more effective two hours after sunset.)

Three references.

Prevention of Ice Formation on Wings in the U.S.A. (L'Aéronautique, No. 181, June, 1934, p. 138.) (19.15/29479 France.)

A hollow rubber band is periodically inflated and deflated and causes the ice to crack off. Failure to act under severe conditions caused the wreck of an air liner and the frequency has been increased from 40 to 80 per minute to meet this danger. The device is apparently standard on all postal aeroplanes.

Reference is made to fitting a rubber sheet over the airscrew hub and half way along the blades. The surface is treated with castor oil before every flight and prevents ice formation on the airscrew.

Physical Aptitude Tests for Pilots. (Dr. Flamme, Revue de l'Armée de l'Air, No. 60, July, 1934, pp. 761-786.) (19.29/29480 France.)

The expansion of the French Air Force will mitigate the present severe regulations governing the acceptance of pilots and the high proportion of rejections. The medical officer should be in sympathetic relations with the pilots and frequent rest periods should be granted to prevent staleness.

Lighting

Drag of Landing Lamp. (C. H. Dearborn, N.A.C.A. Tech. Note No. 497, May, 1934.) (21.07/29481 U.S.A.)

Dimensioned sketches and photographs show details of landing lamps mounted in the leading edge and below the wing, with and without fairing.

Full-scale drag measurements are given graphically for six arrangements. Faired lamps in the leading edge show the lowest drag curve, with a minimum at -5° incidence.

Six references.

Advances in the Technique of Illumination. (H. Lux, Z.V.D.I., Vol. 78, No. 15, 14/4/34, pp. 451-454.) (21.07/29482 Germany.)

Modern illuminators are of the high temperature type (solid radiator) or low temperature type (gas radiator). In the former the problem is to increase the temperature of the filament and the effective illumination while maintaining reasonable life. In the second type the problem is to control the colour without undue loss of illumination. Outputs of the order of 36 lumens per watt have been obtained with high temperature filament lamps for films. Experiments are being conducted with filaments of tantalum carbide, with a melting point about 500°C . higher than that of tungsten (about $3,000^\circ\text{C}$.).

With low temperature vapour lamps the type of radiation emitted is controlled by fitting fluorescent containers. Vapour pressure influences the spectral lines and a mixture of vapours of the rare earths give an approach to white light.

A new photometric apparatus is described, which takes account of differences in wave length or colour.

Twenty-four references.

High Class Products of the German Electro-Ceramic Industry. (J. Wallich, Z.V.D.I., Vol. 78, No. 17, 28/4/34, pp. 522-524.) (21.08/29483 Germany.)

Successful results have been obtained both in construction of large scale ceramic insulation with mechanical strength as a predominant requirement and in insulating materials for special purposes.

An insulator with a magnesium base has a dielectric loss factor approaching that of quartz and is specially suited for short wave wireless sets. A material with a dielectric constant of about 100 has been produced with which a disc condenser of 1 cm. diameter and 20 cm. capacity has been constructed.

Seven references.

Use of Phosphorescent Substance for Aeronautical Purposes. (M. Roulleau, Pub. Sc. et Tech., No. 48, 1934.) (21.12/29484 France.)

A list is given of common phosphorescent substances and a simple photometer is described for measuring feeble illumination.

Aerodynamics and Hydrodynamics

Diffusion of Heat and Vorticity with (Initial) Circular Cylindrical Symmetry (of Distribution). (W. Muller, Ann. d. Phys., Vol. 19, No. 8, May, 1934, pp. 809-828.) (22.0/29485 Germany.)

The present paper is restricted to problems analogous to the diffusion of heat by thermal conductivity. Following Kelvin (Collected Papers, Vol. II, pp. 41-60), a number of Fourier's integrals are constructed and evaluated, involving Bessel functions.

The results are shown graphically for initial distribution along a line over a circular cylindrical surface and through a circular cylindrical volume.

Nine references.

Contribution to the Study of Lubrication. (M. Briault, Pub. Sc. et Tech., No. 46, 1934.) (22.0/29486 France.)

The author has measured by torsion balance the coefficient of sliding friction at very low speeds with a number of oils. With vegetable oils increase in temperature has small effect up to a certain critical value, beyond which there is a sudden drop in the friction. The drop is roughly the same for all the oils examined, but the critical temperature varies considerably for different oils.

It appears that the change is due to the action of certain organic acids normally present in the oil and addition of such substances to mineral oils reduces the coefficient of sliding friction.

Flow Through Blade Grids. (F. Weinig, Z.V.D.I., Vol. 78, No. 24, 16/6/34, pp. 742-746.) (22.0/29487 Germany.)

In the old turbine theory the space between consecutive blades is considered as a channel through which the fluid is guided. The modern tendency is to increase the spacing, in which case each blade tends to become an aerofoil, the foil now becoming affected by interference.

The author develops simple expressions for the hydrodynamical reaction on the blades.

Seventeen references.

Wind Structure on Evaporation in a Turbulent Atmosphere. (O. G. Sutton, Proc. Roy. Soc., Vol. 146, No. 858, 1/10/34, pp. 701-722.) (22.0/29488 Great Britain.)

The equations of motion are first considered and a summary is given of the methods of Taylor, Prandtl, v. Kármán and others.

Empirical expressions are formed for various statistical mean values with appropriate physical dimensions, integrated and differentiated.

In view of the complete failure of mathematical physical analysis it is difficult to consider the results otherwise than as empirical formulæ of the correct dimensions.

Similar methods are applied to the problem of evaporation and integral expressions are formed. Fits are obtained between a variety of empirical forms on observed values.

Twenty-seven references.

Kinetic Theory of Viscosity of Liquids. (R. O. Herzog and H. Kudar, Phys. Zeit., Vol. 35, No. 11, 1/6/34, pp. 437-445.) (22.10/29489 Germany.)

The methods of molecular theory are applied and expressions are formed for the coefficient of models represented by a sphere, an ellipsoid of rotation (axes 1, 1, 2), an elongated cylinder and a tetrahedron.

The results are applied to fluids with molecules of different type.

Six references.

Effect of Electrostatic Field on Viscosity. (R. O. Herzog, H. Kudar and E. Paersch, Phys. Zeit., Vol. 35, No. 11, 1/6/34, p. 446.) (22.10/29490 Germany.)

An electrical field of 100 volts orients asymmetrical molecules so as to increase the time of flow in a viscosimeter and the results are given in a table.

Times are unaltered for molecules with approximately spherical symmetry and are increased where there is pronounced asymmetry.

Flow of Perfect Fluid Through a Lattice of Aerofoils. (E. Weinel, Ing. Arch., Vol. 5, No. 2, April, 1934, pp. 91-105.) (22.10/29491 Germany.)

The problem is two-dimensional throughout. Expressions can be written down for conformal representation, on a circle, of a lattice of flat thin blades regarded as segments of a straight line, and give the potential function of the velocity field.

The extension to blades of the form of a circular arc has been worked out numerically by other authors, and involves three numerical coefficients, the values of which are given graphically as functions of gap and angle of stagger of the lattice.

An approximate extension is made to blades of other forms, with restrictions to thin aerofoils of small curvature. One blade only is given aerofoil shape, the others are replaced by thin flat blades. The blade is transformed into a slightly distorted circle, called here an "ovaloid." Taking distance along the blade as variable, the velocity is expressed by an integral equation, the integral being taken over the ovaloid. The integral equation can be solved by successive numerical approximations.

Extensive numerical comparisons between the values given by the solution for flat blades and measurements with blades of usual shapes are shown in 24 diagrams of lift as a function of incidence and 27 diagrams of pressure distributions. Three diagrams show lift as a function of gap in a Kaplan turbine. The agreements are close, apart from a moderate scattering in some of the examples.

Thirteen references.

Motion of an Eddy Near Rectilinear Boundaries. (E. Paul, Z.A.M.M., Vol. 14, No. 2, April, 1934, pp. 105-116.) (22.10/29492 Germany.)

The methods of complex algebra are applied and examples are worked out for semi-infinite and finite plane boundaries and for a finite gap in an infinite plane.

The calculated paths are shown graphically for different initial paths in relation to different types of boundary.

Nine references.

A Numerical Method of Conformal Representation to a Doubly Connected Region. (K. Zarankiewicz, Z.A.M.M., Vol. 14, No. 2, April, 1934, pp. 97-104.) (22.10/29493 Germany.)

The problem of transforming a rectangular transformer stamping with two rectangular windows into a region by concentric circles is considered.

The solution of an integral equation is required and is obtained by expansion in power series to the fourth positive and negative powers of the complex variable.

Numerical coefficients are worked out for the expansion, but no application is made to a complete numerical example. The method has application to irrotational flow of a fluid.

Eight references.

Disturbance of Steady Inviscid Flow Between Parallel Planes. (J. L. Synge, Phil. Trans. Roy. Soc., Vol. 234, No. 732, 31/12/34, pp. 43-78.) (22.15/29494 Great Britain.)

The problem is restricted to two-dimensional cases and has therefore restricted relation to physical phenomena. The author examines the so-called velocity-characteristic value method, applied by Kelvin and Rayleigh to the problem of instability and shows that it is not valid for the present problem. In particular, he challenges Rayleigh's result that the flow is stable if the velocity profile has curvature of the same sign throughout.

The vorticity is introduced as a parameter and the vector of velocity (expressed as a double integral of vorticity through the fluid) is used to define the resultant velocity of the fluid at any part.

The integro-differential equation is expanded in series which involve new functions. The expressions are generalisations of those used by Rosenhead for a single sheet of vorticity replaced by a discrete row of point vortices.

Special forms are obtained for an initial parabolic velocity distribution between the plane boundaries.

The author hopes that the results contain the correct solution of the problem. Eighteen references.

Turbulence. (H. L. Dryden, J. Aer. Sci., Vol. 1, No. 2, April, 1934, pp. 67-75.) (22.15/29495 U.S.A.)

The questions are raised of defining turbulence and of measuring the quantity so defined. Wind channel experiences are referred to and compared with full-scale experience of the atmosphere.

The effects of turbulence on the resistance of spheres and aerofoils are referred to. The relations between turbulence and the Reynolds number are mentioned. Unsolved problems are stated.

Twenty references.

Divergent Flow of Fluid. (W. R. Dean, Phil. Mag., Vol. 18, No. 121, Nov., 1934, pp. 759-777.) (22.2/29496 Great Britain.)

Hamel found a solution of the problem of radial flow of a viscous fluid for steady conditions and demonstrated the existence of particular steady motion differing slightly from radial flow.

A more general investigation is given in the present paper and in the course of numerical computations solutions are obtained, some of which are identified with Hamel's, others appear to be new.

A discussion is given of the difficult problem of stability in the presence of small disturbances imposed at entry. The periods are given by the vanishing of an infinite determinant, of which the first diagonal minor of the fourth order is taken as an approximation and the zeros shown numerically and graphically for four assumed values of the greatest root in the cubic of the Weierstrass elliptic integral.

It is stated as a qualitative result that certain types of disturbance produce instability in radial flow.

Five references.

Flow in Curved Pipes. (H. Nippert, Forschungsarbeiten, No. 320, 1929.) (22.2/29497 Germany.)

In an historical note curves of loss and configuration of flow are reproduced graphically from previous papers by other experimenters.

A detailed description of the author's elaborate installation is illustrated with photographs and diagrams. The pitot-mean velocity distribution is measured at the outlet of the channel, where a free jet is discharged. Bends of 90° and 180° were set up in channels of various sections, one circular and six rectangular, with different side ratios. The cross sectional areas were between 5 cm.^2 and 15 cm.^2 , the radius of curvature of the order of twice the channel depth. The curve and cross section of minimum loss for this type of flow is sought experimentally.

Twenty-three photographs are reproduced and show lines of flow, in some cases laminar, in some with local eddy regions, and in some with more extensive turbulence. Over fifty diagrams of transverse flow are reproduced.

Fifty references.

Pressure Fall in Smooth Curved Pipes. (H. Richter, Forschungsarbeiten, No. 338, 1930.) (22.2/29498 Germany.)

Measurement of pressure drop was made in a smooth circular pipe of about 4 cm. diam. fitted successively with twenty-one bends of radii 3.4 cm. to 1 metre, subtending from 10° to 180° .

Two diagrammatic sketches show typical streamlines in side elevation and projected on a transverse cross section. Extensive numerical results are tabulated and shown graphically as functions of the Reynolds number. Smooth transition is shown from laminar to turbulent motion between $R=1660$ and $R=2400$ (Fig. 25).

Forty-five references.

Steady Laminar Flow of Viscous Fluid in a Rectangular Pipe. (J. Allen, Phil. Mag., Vol. 18, No. 119, Sept., 1934, pp. 488-495.) (22.2/29499 Great Britain.)

The equations of motion have been solved by Cornish and some numerical consequences are discussed.

The ratio of axial velocities is shown to be a maximum (2.10) for a square section and falls off to 1.5, the limiting ratio, for parabolic distribution between indefinitely wide planes as a limiting case.

Contours of mean velocity are plotted graphically for a square and for the aspect ratio $10/\pi$.

Two references.

Surface Friction of Ships. (W. Schmidt, W.R.H., Vol. 15, No. 9, 1/5/34, pp. 101-105.) (22.3/29500 Germany.)

The paper cites the rational expression of Blasius for laminar flow and the empirical expression of Nikuradse for turbulent flow, both giving a coefficient of

surface friction in terms of the Reynolds number. Numerical values are given graphically. These expressions are elaborated along the lines of the Göttingen Laboratory and numerical values are given graphically and in tables for wide ranges of the variables.

Numerical data for warships from the Vienna and Hamburg Laboratories are tabulated and compared.

Four references.

Wave Patterns and Wave Resistance. (T. H. Havelock, Engineering, Vol. 138, No. 3577, 3/8/34, pp. 125-126. Summer Meeting of Institution of Naval Architects.) (22.35/29501 Great Britain.)

A summary is given of the development of wave theory and applications are made to ship form. The solution involves the use of a function which has been determined only for limiting forms and appears to give results 15 to 20 per cent. low in approximate applications.

Consideration of the energy of the wave field at a distance gives a measure of the wave resistance.

Toepler's Refraction Method. (H. Schardin, Forschungsheft, No. 367, July/Aug., 1934.) (22.36/29502 Germany.)

A beam of light passing through air, with a variable field of density, is refracted differentially and projects on a screen a field of variable light density, which may be interpreted in terms of variable density qualitatively and in some cases quantitatively.

In particular, photographs of bullets in flight and of currents of air near heated wires show well-defined light and dark bands which may be interpreted as wave fronts or as fluid lines in the respective cases.

A useful exposition is given of the physical and geometrical optical relations involved, with a critical discussion of the accuracy of the methods of reduction and interpretation of the observations with methods of numerical application.

Many photographs are reproduced in illustration of the methods, including the indication of fluid lines in wind channels. The isoclinic lines round a heated tube yield two remarkable photographs and their interpretation in terms of the temperature field is worked out numerically.

Seventy-six references.

"Diruttore" Turbulence Wing. (Flugsport, Vol. 26, No. 13, 27/6/34, pp. 31-32.) (22.45/29503 Germany.)

At stalling incidence the flow of air is diverted from the upper wing surface near the leading edge while still in a laminar state. The branching off can be delayed if turbulence is introduced into the layer.

In the Italian construction described the "spoiler" consists of an aluminium tube of oval section (10 x 20 mm.) placed about 20 mm. in front of the nose of the wing. The exact orientation of the tube is important and this has to be determined experimentally. The weight of the contrivance is less than 3 lb. per wing for a Caproni light aeroplane. The maximum speed is slightly reduced (3 km. per hr.). On the other hand, the machine so fitted will glide at 60 km. per hr. at 17° with full aileron control.

(The above does not appear to be quite concordant with Prandtl's explanation that stalling is postponed by removing the accumulation of retarded fluid in the boundary layer.)

Experimental and Mathematical Researches on Flow Stability. (W. Margoulis, Tech. Aeron., No. 132, 1934, pp. 65-148.) (22.45/29504 France.)

The researches covered date from those of Fliegner (1898) to recent work of Nikuradse (1929). A review is given mainly of work on stability of flow in

expanding channels (diffusers). In the experiments the air stream pressure, slightly above atmospheric, evacuates the boundary layer through slots in the diffusor wall and nearly uniform velocity distribution is obtained even in short diffusors. The air loss was about 2 per cent. of the flow. Steadiness of flow was indicated by silk threads.

Six references.

Propulsion by Reaction. (I. Raffaelli, Riv. Aeron., Vol. 10, No. 6, June, 1934, pp. 463-472.) (22.5/29505 Italy.)

An elementary discussion is given of the propulsive efficiency of "closed" and "open" circuits. In the former the gas is at rest relatively to the explosion chamber before combustion, in the latter it is in relative motion.

Investigation of the Transition Layer at the Surface of a Wing in Flight. (J. Stuper, L.F.F., Vol. 11, No. 1, 15/5/34, pp. 26-32.) (22.6/29606 Germany.)

A sketch shows the mounting of a pitot head with position adjustable along the chord and above the wing surface. Extensive explorations are plotted graphically for four different flying speeds and for eleven stations along the chord on the suction side and eight on the pressure side. Static pressure readings were obtained from orifices in the surface of the wing.

The point of change from laminar flow to turbulent flow is well marked by the change in the velocity profile from one station to another, both in the velocity profiles and in the pressure distribution. The results are concordant with model tests.

Twelve references.

Effect of the Surface Condition of a Wing on the Aerodynamic Characteristics of an Aeroplane. (S. J. de France, N.A.C.A. Tech. Note No. 495, April, 1934.) (22.6/29507 U.S.A.)

Experiments carried on in the full-scale channel show that polishing the wing surface has a negligible effect on the lift, but reduces the drag. The effect is not great and at 200 m.p.h. would produce a speed increase of say, 1.5 per cent., corresponding to about $4\frac{1}{2}$ per cent. in power.

Materials—Elasticity and Plasticity

Electrically-Maintained Vibrating Reed and Determination of Young's Modulus. (R. M. Davies and E. G. James, Phil. Mag., Vol. 18, No. 122, Nov. (Supplmt.), pp. 1023-1052, and No. 123, Dec., 1934, pp. 1053-1086.) (23.10/29508 Great Britain.)

Small reeds of phosphor bronze with strips of "Stalloy" transformer iron attached at the tips were maintained in vibration by an alternating magnetic field. The mathematical theory is worked out and the relations between resistance, impedance, frequency and amplitude of reed vibration are obtained. The value of Young's modulus was obtained from three reeds and showed a variation of about 1 in 1,000.

The value of Young's modulus deduced is nearly 12×10^{11} dynes/cm.², in closer agreement with Kay and Laby than could be expected from an alloy subject to variation in composition and treatment.

Method for Determination of Torsional Stresses by Means of a Diaphragm Model. (E. Kopf and E. Weber, Z.V.D.I., Vol. 78, No. 30, 28/7/34, pp. 913-914.) (23.10/29509 Germany.)

In applying the well-known analogy of Prandtl the author prepares a mould of the strained diaphragm in a suitable plastic material and makes the measurements from the mould.

Three references.

Plastic Materials. (H. Bürgel, Z.V.D.I., Vol. 78, No. 17, 28/4/34, pp. 519-522.) (23.10/29510 Germany.)

Plastic materials cover a very wide range. Artificial resins with a phenolic base such as Bakelite are well known. Products with cellulose and albumen as bases are now being developed. The polymerisation and condensation of certain carbohydrates furnish new bases.

Four references.

Plastic Behaviour in the Light of Creep Elastic Recovery Phenomena. (M. F. Sayre, Trans. A.S.M.E., Vol. 56, No. 7, July, 1934, pp. 559-561.) (23.10/29511 U.S.A.)

The amount of creep and hysteresis seem to be definitely related to the temperature of the metal and to its state of internal stress. Very mild heat treatment may greatly decrease hysteresis, whilst overloads beyond the elastic limit greatly increase it.

The author put forward several hypotheses in tentative explanation.

Elastic Bending of Curved Bar. (E. Jones and R. J. Cornish, Phil. Mag., Vol. 18, No. 119, Sept., 1934, pp. 456-458.) (23.10/29512 Great Britain.)

The strain energy is usually calculated without taking into account the change in the depth of the bar. An additive term is given as a (formally simple) integral.

A Membrane Analogy Supplementing Photo-Elasticity. (J. G. McGivern and H. L. Supper, J. Frank. Inst., Vol. 217, No. 4, April, 1934, pp. 491-504.) (23.15/29513 U.S.A.)

From Authors' Abstract.—A description is given of a method suggested by J. P. Den Hartog for finding the sum of the principal stresses in a two-dimensioned model by ordinate measurements on a stretched rubber membrane.

The method is applied to a bar with a central circular hole in tension. It is easy in operation and sufficiently accurate.

Field of Stress in Rectangular Plates. (F. Tölke, Ing. Arch., Vol. 5, No. 3, June, 1934, pp. 187-237.) (23.30/29514 Germany.)

The elastic equations are formed in rectangular and polar co-ordinates. General solutions in rectangular co-ordinates are given in the form of series integral equations, involving trigonometrical and hyperbolic functions.

In polar co-ordinates Bessel functions are not introduced explicitly, but solutions in series are formed and numerical coefficients are computed. The membrane analogy is introduced and the assumption of rectangular nodal lines leads to solutions in Jacobi elliptic functions, numerical results being computed for an aspect ratio of 2/1. Theta functions are also applied and a numerical case worked out for the aspect ratio 4/3.

There are 240 numbered equations in the paper.

Eight references.

Strength of Tubular Struts. (J. Morris, Airc. Eng., Vol. 6, No. 69, Nov., 1934, pp. 303-304.) (23.30/29515 Great Britain.)

The approximate (Southwell) formula for buckling load gives values slightly in excess for very thick struts and in defect for thin struts.

A family of modified curves is computed to cover the whole range of diameter/gauge ratios more accurately.

Distribution of Moment in Continuous Beams. (H. A. Williams, Trans. A.S.M.E., Vol. 56, No. 5, May, 1934, pp. 305-319.) (23.30/29516 U.S.A.)

A method, due to Prof. Hardy Cross, is given for finding the moments at joints of a continuous beam without end thrust. Step by step approximations are made from joint to joint by simple arithmetic. Numerical examples are worked out in detail.

(Similar elementary methods may possibly be applicable to the more general case where there are end thrusts.)

Five references.

Design of Compression Members in Aircraft. (W. R. Osgood, Bur. Stan. J. Res., Vol. 13, No. 1, July, 1934, pp. 157-160.) (23.40/29517 U.S.A.)

A particular case of Berry's analysis is applied successfully to joints of a framework giving a sufficient number of linear homogeneous equations. The elimination of the unknown quantities gives a determinantal equation which is the condition for buckling.

Two references.

Vibration of Engine Mountings. (B. v. Schlippe, L.F.F., Vol. 11, No. 2, 3/7/34, pp. 57-63.) (23.40/29518 Germany.)

The elastic coefficients of a symmetrical lattice structure are investigated with applications to engine frame mountings.

One reference.

The Torsional Stiffness of Thin Duralumin Shells subjected to Large Torques. (P. Kuhn, N.A.C.A. Tech. Note No. 500, July, 1934.) (23.41/29519 U.S.A.)

A simple method is given of estimating the torsional stiffness of box beams or stressed skin wings. By means of charts the torsional deflections of eight beams and a complete wing are calculated in satisfactory agreement with experimental results.

Six references.

Rubber Spring Mounting for Machinery. (D. Thum and K. Oeser, Z.V.D.I., Vol. 78, No. 19, 12/5/34, pp. 587-589.) (23.46/29520 Germany.)

Experiments furnished the elastic and damping coefficients of rubber for the calculation of rubber cylinders, which are used successfully to damp the transmission of vibration and noise from machines through their foundations. The life of a cylinder depends on the quality of the rubber and the temperature rise.

Four references.

A Method Utilising Coupling Between Two Oscillating Systems for the Determination of Mechanical Strength of Structures. (P. Rolland and P. Sorin, Pub. Sc. et Tech., No. 47, 1934.) (23.46/29521 France.)

The transfer of energy between two vibrating systems depends on the elastic properties of the connecting structure. An elastic "deterioration" of the structure affects the transfer characteristic.

The authors hope to apply the method to a complicated structure such as an aircraft fuselage.

Lateral Vibration of Ring-Shaped Frames. (F. H. Brown, J. Frank. Inst., Vol. 218, No. 1, July, 1934, pp. 41-48.) (23.46/29522 U.S.A.)

The frame is regarded as a circular segment of about 320° with encastré ends.

An expression is formed for the potential energy of strain and the kinetic energy of vibration, and an approximate result is obtained for the frequency of vibration, which is within 3 per cent. of the observed values.

Four references.

Motor Car Vibrations and Their Insulation from the Frame. (K. Oeser, *Autom. Tech. Zeit.*, Vol. 37, No. 10, 25/5/34, pp. 277-279.) (23.46/29523 Germany.)

A popular exposition of the advantages accruing from the extensive use of rubber in mounting engine and back axle in the frame.

Miscellaneous

The German Silent Typewriter. (W. Kniehahn, *Z.V.D.I.*, Vol. 78, No. 18, 5/5/34, pp. 547-555.) (29524 Germany.)

A complicated system of linkages, regulated by the inertia of a flywheel, imposes a reciprocating motion on the type. An analysis of the sound spectrum shows a marked reduction of sound intensity, especially in the higher frequency range. The average sound intensity at a distance of 1 m. is 38 phones.

Nine references.

A Free Cutting Spade. (G. Lehmann, *Z.V.D.I.*, Vol. 78, No. 16, 21/4/34, pp. 504-5.) (29525 Germany.)

The section of the blade is arrow-shaped so that the main shovelling surface is narrower than the cutting surface. The effort of digging is considerably reduced, since the material to be handled does not cling to the shovelling surface.

The Activities of the Reichanstalt during 1933. (S. Erk, *Z.V.D.I.*, Vol. 78, No. 26, 30/6/34, pp. 296-299.) (29526 Germany.)

The following are among the items mentioned:—

1. Influence of short sound waves on chemical processes.
2. Laws of similarity (hydrodynamics) investigated down to low air pressures, covering the range Re 10^{-5} to 10^5 .
3. Fog penetration—Development of infra red spectrum apparatus, enabling investigation of narrow spectral lines by means of a vacuum thermo element.
4. Stroboscopic investigation of roller bearings and measurement of creep of cage.

Nine references.

Tests of Uniformity in Series Manufacture. (Fr. A. Willers, *Z.A.M.M.*, Vol. 14, No. 2, April, 1934, pp. 77-84.) (29527 Germany.)

The so-called Lexis number is defined for one and two variables in terms of mean square deviation from a mean zero.

Formal expressions are developed for correlation of deviations in selected sets of specimens for different production series.

The method has applications to correlation of deviations in different series of target records in which there are two main sources of error.

Four references.

Pressure of Saturated Water Vapour from 0° to 374°C. (N. S. Osborne and C. H. Meyers, Bur. Stan. J. Res., Vol. 13, No. 1, July, 1934, pp. 1-20.) (29528 U.S.A.)

German, British and American experimental values are compared with various empirical formulæ. The formula giving the closest mean fit is used for the preparation of numerical tables.

Five references.

The Specific Heat of Water from 0° to 350°C. and from Saturation Pressure to 260 kg./cm. (≈ 26 Atmospheres). (W. Koch, F.G.I., Vol. 5, No. 3, May/June, 1934, pp. 138-145.) (29529 Germany.)

Nineteen measurements of specific heat were made and 43 determinations of temperature change under adiabatic flow. Three empirical equations are fitted to three different ranges of temperature.

Numerical values are tabulated and some comparisons are made with other results. Above 270° the international tables gave higher values.

Twelve references.

Numerical Calculations of Ships' Gyros. (E. Hahnkamm, Ing. Arch., Vol. 5, No. 3, June, 1934, pp. 169-178.) (29530 Germany.)

The equations of motion are given and a numerical example shows that a gyro installation, with a mass only 1 per cent. of that of the ship, reduces the rolling angle from 30° to 1°.

Seven references.