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*Aircraft Design, etc.*

*Vertical Dive in Variable Air Density.* (F. Becker, Z.F.M., No. 22, 28/11/32, pp. 659-663.) (306 D.V.L. Report.) (5.10/26001 Germany.)

The motion in a prolonged dive is sensibly modified by the variation in atmospheric density. The modified differential equations are integrable in terms of elementary functions. The atmospheric characteristics are taken as those of the international standard day and a numerical example is worked out.

A graphical chart gives families of curves from which numerical values can be read off.

*Limits of Aeroplane Speeds.* (E. P. Warner, Aviation, Vol. 31, No. 11, Nov., 1932, pp. 432-433.) (5.13/26002 U.S.A.)

Coefficients of structural and engine weights and of aerodynamical characteristics are taken from the most successful designs.

The possibilities of improving the characteristics are considered in detail and the requirements for speeds up to six hundred miles per hour are plotted graphically.

Without committing himself to prophecy, the author finds that the technical difficulties are very great.

*Aeroplane Types Taking Part in the European Circuit, 1932.* (W. Pleines, Z.F.M., Vol. 23, No. 19, 14/10/32, pp. 563-577.) (5.14/26003 Germany.)

Forty-three aeroplanes of seventeen different types took part in the competition (sixteen German, no British, two biplanes). In 1930 twenty-nine monoplanes and thirteen biplanes were entered.

The following figures are the average of all the entries:—

Weight empty ... ..	=1,000 lb.
Weight full ... ..	=1,700 lb.
Weight/sq. ft. ... ..	=10 lb./sq. ft.
Weight/h.p. ... ..	=12 lb./h.p.

*The Adjudication of Marks during the European Circuit, 1932.* (Leander, Z.F.M., Vol. 23, No. 19, 14/10/32, pp. 582-588.) (5.14/26004 Germany.)

Sixteen out of twenty-four competitors completed the circuit and received over four hundred marks out of a possible 515 marks under ten headings. The

highest marks were allotted to high cruising speed, followed by equipment, minimum flying speed, regularity, fuel consumption, starting and landing distances. Few marks were given for maximum flying speed, but maximum speeds of about 150 m.p.h. were attained by several competitors in conjunction with minimum speeds of about 40 m.p.h.

*Economic Aspects of Transport Aeroplane Design.* (R. S. Damon, G. A. Page and K. Perkins, S.A.E. Journal, Vol. 31, No. 6, Dec., 1932, pp. 475-484.) (5.14/26005 U.S.A.)

A lengthy descriptive analysis is given of the factors affecting the economics of design, the list containing 114 headings and sub-headings.

The types of aeroplane are tabulated with details of pay load, power, area and maximum speed with comparative figures of merit varying from 121 to 161, the latter being for an aeroplane with retractable carriage.

Numerous statistical data of costs are tabulated.

*Vibration of Aeroplane Instrument Boards.* (S. J. Zand, S.A.E. Journal, Vol. 31, No. 5, Nov., 1932, pp. 445-456.) (5.17/26006 U.S.A.)

The design and construction of a three-component vibrograph are described and illustrated by sketches and a photograph. The effect of vibration on calibration is discussed quantitatively.

A table of instruments shows undesirable consequences such as vibration of the indicating pointer, erroneous readings and deterioration. A method of testing shock absorbing qualities of materials for washers, etc., is described and anti-shock mountings are discussed.

The sources of aeroplane vibration are listed and oscillograms are reproduced.

*Calculation of Profiles Free from Cavitation.* (C. Schmieden, Z.A.M.M., Vol. 12, No. 5, Oct., 1932, pp. 288-310.) (5.20/26007 Germany.)

The methods of conformal transformation are applied to determine the limits of velocity beyond which cavitation sets in. Expressions are employed in Fourier series and the coefficients are determined by the boundary conditions, including the conditions for non-cavitation.

A numerical example is worked out and results are given graphically and in tables for practical ranges of the parameters.

Eight profiles are shown graphically.

Twelve references.

*High Lift and Autostability Device in Caudron "Superphalène" monoplane.* (L'Aéronautique, No. 163, Dec., 1932, pp. 380-381.) (5.254/26008 France.)

The rear portion of the central wing section is hinged so as to produce variable camber and linked permanently with the tail plane so as to maintain stability. It can also be linked to the ailerons at will so as to produce maximum lift over the whole wing section, while maintaining differential aileron control. The linkages appear complicated. Test figures are given.

*Possibility of Increasing Wing Lift.* (E. Gruschwitz and O. Schrenk, Z.F.M., Vol. 23, No. 20, 28/10/32, pp. 597-601.) (5.254/26009 Germany.)

Wing flaps were fitted on hinges so that the trailing edge of the closed flap coincided with the trailing edge of the wing. Three flap widths were used, 5, 10 and 20 per cent. of the wing chord.

Drag and moment as functions of lift are shown graphically. The stalling lift is roughly doubled in an extreme case while the corresponding resistance is about four times larger.

Further investigation is required in respect of interference with rudder and aileron control.

*Design Formula for Ailerons.* (Traitiro Ogawa, Rep. of Aer. Res. Inst., Tokyo, Vol. 7, No. 7, Nov., 1932, pp. 179-194.) (5.30/26010 Japan.)

Approximate formulæ are quoted for the rolling moment imposed by an aileron (W. Schmeidler) and the damping moment (G. Lachmann).

The calculated angle, angular displacement and angular velocity are plotted against time and show close agreement with test results.

A formula is constructed for use of designers and a graphical chart enables values to be read off and at the same time give comparisons with existing designs.

Relevant data are tabulated for over fifty existing aeroplanes.

*Pneumatic Tyres.* (B. Darrow, S.A.E. Journal, Vol. 31, No. 5, Nov., 1932, pp. 438-444.) (5.50/26011 U.S.A.)

An account is given of the development of pneumatic tyres, with special notice of balloon tyres.

Two types of aeroplane balloon tyres are shown, a 3in. tyre on a 3in. hub and a 1½in. tyre on a 6in. hub. The pressure is from 12½lb. per sq. in. as compared with over 50lb. per sq. in. in old style pneumatic tyres.

*Aerodynamic Brake.* (L'Aéronautique, No. 163, December, 1932, p. 383.) (5.53/26012 France.)

On the Couzinet 100 low wing monoplane the centre sections on either side of the fuselage are hinged and the flaps act as air brakes. Movement of the brake lever first depresses the flaps and then puts on the wheel brake. The aileron control is interconnected with the brake lever and the aerodynamic braking can be increased by the ailerons.

*Retractable Undercarriage.* (L'Aéronautique, No. 163, Dec., 1932, p. 393.) (5.55/26013 France.)

The wheels of the Blériot 111/5 are retractable to a horizontal position coinciding with the c.g. while the wheel shields act as fairing to the recess.

### Airscrews

*Take-off and Propeller Thrust.* (M. Schrenk, Z.F.M., Vol. 23, No. 21, 14/11/32, pp. 629-638.) D.V.L. Report No. 305. (5.610/26014 Germany.)

The take-off is divided into three sections, taxiing, intermediate air-borne state, and lift. The total distance is a minimum when the intermediate portion is flown at maximum lift coefficient. The analysis is illustrated by a numerical example. The agreement with experiments is satisfactory only for taxiing. Further data on the variation of airscrew thrust with advance are required.

*Design of Airscrews.* (D. L. H. Williams, Airc. Eng., Vol. 4, No. 46, Dec., 1932, pp. 310-314.) (5.63/26015 Great Britain.)

A useful summary is given on the elementary principles of aerodynamic theory and design and illustrated by typical characteristic curves.

Applications are made to design for extreme range and to the effects of supercharging the engine and of using variable pitch airscrews.

*Formulae for the Design of Variable Pitch Airscrews.* (H. B. Helmbold, Z.F.M., Vol. 23, No. 14, 28/7/32, p. 413.) (5.64/26016 Germany.)

Independent metal blades screwed to a central hub have the advantage over fixed wooden blades of a moderate range of pitch adjustable on the ground. The subsequent discussion shows considerable differences of opinion on the feasible accuracy of setting.

*Variable Pitch Airscrew.* (Aero Digest, No. 5, Nov., 1932, p. 39.) (5.658/26017 U.S.A.)

A description is given of the "Smith" controllable pitch airscrew with worm gear control giving slow continuous variations at the rate of one degree in two seconds at 1,700 r.p.m. while in operation. The control handle has direct and reverse drive and neutral positions.

Four photographs show details.

### Instruments

*Measuring Instruments Relying on Electric and Pneumatic Devices and their Employment in Aircraft.* (L. Heck, Z.F.M., Vol. 23, No. 14, 28/7/32, p. 416.) (6.0/26018 Germany.)

Electrical devices are suited for measuring deflections and pneumatic devices for measuring forces. The latter may have restoring and operating forces from 100 to 1,000 times greater than the former. Examples of both types are described.

Reference is made to electrical devices for measuring deflection operating on the so-called "quotient" principles (Siemens and G.E.C.).

*New Harmonic Analyser.* (B. G. Gates, J. Sci. Inst., Vol. 9, No. 12, Dec., 1932, pp. 380-386.) (6.0 (Misc.)/26019 Great Britain.)

Commutator rings in concentric strips are made up in a circular disc with the annular commutator elements separated by annular insulative strips. The inner commutator ring has one contact in its periphery and the succeeding rings have 3, 5, 7- $n$  commutator segments ( $n$  odd).

The collecting brush of the segment is connected to a valve voltmeter with a reservoir condenser which indicates a voltage expressible as a series in terms of the  $n$ th, 3 $n$ th, 5 $n$ th, etc., voltage harmonics, the coefficient, in general, decreasing fairly rapidly. A plate with eight annular commutator rings will analyse the wave up to the 17th harmonic.

The elementary analysis is developed and a numerical example is worked out for a rectangular voltage wave.

*Navigation Influence of the Wind in Distance Records.* (L'Aéronautique, No. 160, Sept., 1932, pp. 277-279, and No. 162, Nov., 1932, pp. 351-354.) (6.51/26020 France.)

The influence of the wind both on open and closed distance records is considered. A simple apparatus is described for determining the effect of wind on fuel consumption. Examples are worked out.

*Hoffman Gyro Vertical Indicator.* (Z.F.M., Vol. 23, No. 20, 28/10/32, p. 618.) (6.52/26021 Germany.)

The gyroscope is mounted on roller bearings which stand the conditions on aircraft better than pivot bearings. The drive is by Venturi nozzle.

*Power Steering.* (P. M. Heldt, Autom. Ind., Vol. 67, No. 24, 10/12/32, pp. 738-743, No. 25, 17/12/32, pp. 774-777.) (6.552/26022 U.S.A.)

The muscular effort demanded by the steering of heavy trucks has led to the design of mechanical drives.

Technical description of several makes is illustrated by sketches and sectional drawings.

In particular a full description is given of the Bosch vacuum control with electro-magnetic control, illustrated by perspective sketch and sectional drawing of the steering column attachment and general arrangement sketch.

*Reduction of Platinum Resistance Thermometers.* (G. S. Callendar, *Phil. Mag.*, Vol. 14, No. 93, Nov., 1932, pp. 729-742.) (6.71/26023 Great Britain.)

Elementary interpolation formulæ are developed at considerable length for a variety of reductions.

*Heat Transfer of Viscous Fluids in Tubes.* (H. Kraussold, *Forschungsheft*, No. 351, 1932—abstracted in *Z.V.D.I.*, Vol. 76, No. 9, 27/2/32, p. 215.) (6.72/26024 Germany.)

The experiments were carried out with warm oil in vertical tubes between 10 and 40 mm. diameter for Reynolds numbers between 20 and 10,000. The results are tabulated in a convenient form for the design of oil coolers. There is fair numerical agreement with a formula given by Prandtl, but the effect of tube length is larger.

In America it appeared that reversal of the direction of heat flow affected the result and this is confirmed and explained.

*Evaporation and Heat Transfer at the Surface of a Vertical Plate in Still Air.* (R. Hilpert, *Forschungsheft*, No. 355, July/Aug., 1932.) (6.72/26025 Germany.)

The research is an extension of the work of Lewis, who found (*Mech. Eng.*, Vol. 44, 1922, p. 445) on theoretical grounds that the quotient of the heat transfer coefficients by the evaporation coefficients should be equal to the specific heat of the mixture into which evaporation takes place. The measurements were carried out by noting the loss in weight of clay plates saturated with various liquids. The plates were heated electrically and evaporation was measured in air, hydrogen and CO<sub>2</sub>. The results are in approximate agreement with Lewis for the evaporation of water, but a number of hydrocarbons tested exhibited a quotient equal approximately to twice the specific heat of the mixture.

Thirty-three references.

*The Prandtl-Taylor Equation.* (A. E. Lawrence and J. J. Hogan, *Ind. and Eng. Chem.*, Vol. 24, No. 11, Nov., 1932, pp. 1,318-1,321.) (6.72/26026 U.S.A.)

An empirical equation of heat transfer to water in turbulent motion is given in a form attributed to Prandtl (1910) and Taylor (independently 1916).

Stender's experimental results are reduced to graphical form and lie on a discrete family of unicursal curves. A non-dimensional form places the same results on single unicursal curves. An alternative empirical equation shows smaller scattering of the observed points.

Sixteen references.

*Photographs of Caustics Produced by the Temperature Field near a Warm Body.* (E. Schmidt, *Forschung*, Vol. 3, No. 4, July/Aug., 1932, pp. 181-189.) (6.72/26027 Germany.)

Elementary geometrical optical principles are discussed and the formation of caustics is shown graphically.

Refraction takes place in the boundary layer, the depth of which determines the displacement of the caustic curve outwards from the boundary.

Numerous photographs are reproduced and curves show the thickness of the boundary layer for various positions.

*Surface Temperature of Bodies of Simple Geometrical Form and Low Thermometric Conductivities.* (G. Poschl, *Z.A.M.M.*, Vol. 12, No. 5, Oct., 1932, pp. 280-287.) (6.72/26028 Germany.)

Grober's solutions for plates, spheres and circular cylinders of high conductivity became very slowly convergent for low coefficients of conductivity. His

solutions are therefore transformed into more tractable forms and the computed results are tabulated numerically and plotted graphically.

Seven references.

### **Aircraft Flight**

*Longitudinal Stability of Gliders.* (M. A. Lapresle, *Revue Générale de l'Aéronautique*, No. 14, 1932, pp. 105-147.) (7.21/26029 France.)

The model is mounted on gymbals and the pitching moment is balanced against the calibrated moment of a plate.

The restoring couples thus determined are plotted graphically for a variety of dispositions of wings, control surfaces, etc., and conditions for positive restoring couples are determined.

### **Engines, Thermodynamics**

*Propagation of Explosion Waves.* (D. B. Gawthrop, *J. Franklin Inst.*, Vol. 214, No. 6, Dec., 1932, pp. 647-664.) (8.13/26030 U.S.A.)

A detailed survey is made of methods of photographing rapidly moving particles and waves of expansion sent out by commercial detonators fired electrically.

Twenty-five photographs are reproduced and interpretations are given.

Velocities of explosion waves and of particles of the case are shown for four mixtures, mercury fulminate chlorate, tetryl lead azide, picric acid, mercury fulminate and lead styphnate, the latter of comparatively small intensity.

A table gives results for 12 detonator mixtures. A containing tube increased velocities and effectiveness. The most effective type of mixture is specified.

Nineteen references.

*Process of Combustion in Carburettor Engines.* (W. Endres, *Forschung*, Vol. 3, No. 2, March/April, 1932, pp. 78-83.) (8.13/26031 Germany.)

The rate of combustion depends very markedly on the shape of the combustion chamber.

From experimental results empirical curves are established for eight types of combustion chambers and are applied to pre-determination of combustion velocities. Reasonable agreement is shown with experimental results.

Sixteen references.

*High Temperature Furnace with Flameless Combustion.* (R. Schnabel, *Z.V.D.I.*, Vol. 76, No. 9, 27/2/32, p. 213-214.) (8.13/26032 Germany.)

The high temperatures of flameless combustion are due not only to catalytic effects of porous materials, but also to explosion waves in the hollow spaces.

Interposition of a perforated clay cylinder provides an air space between the crucible and the "contact mass" and increases the effectiveness of the process.

*Ionisation During Flameless Combustion Below the Ignition Point.* (J. Tausz, H. Gorlacher and H. Draxl, *Forschung*, Vol. 3, No. 5, Sept./Oct., 1932, pp. 247-251.) (8.13/26033 Germany.)

A fuel was maintained at gradually increasing temperatures in a modified Moore ignition pot. An electroscopes was connected to an insulated electrode inserted into the pot and ionisation of the fuel was determined by the rate of loss of charge. Fuels liable to knock produced no measurable ionisation while fuel of high knock rating produced a considerable amount. By adding a dope, iron carbonyl, ionisation was produced in knocking fuels. It is concluded that in all cases ultimate ignition is due to the prior formation of unstable "atomic" combinations, the presence of which produces the observed ionisation. In



“knocking” fuels below the ignition point the unstable products are used up as fast as they are produced and no ionisation is observed. With anti-knock fuel the ionised oxygen is produced faster than it is used up and an ionisation current is observed.

*Photographic Methods of Measuring Explosion Velocities.* (W. Payman and D. W. Woodhead, *Fuel*, Vol. 11, No. 12, Dec., 1932, pp. 435-440.) (8.13/26034 Great Britain.)

A description is given of the mechanical details of revolving mirrors and moving films. A small single mirror can be rotated safely up to 500 revs. per sec. giving a speed of image of 500 m. per sec. The speed of a film revolving on a drum is limited by centrifugal forces to the order of 200 m. per sec.

Different systems are shown in eleven diagrammatic sketches.

Twenty-two references.

*Internal Energy of Gases after Explosions.* (W. T. David, J. R. Brown and A. H. El. Din, *Phil. Mag.*, Vol. 14, No. 93, Nov., 1932, pp. 764-777.) (8.13/26035 Great Britain.)

Comparative tests were carried out in spherical vessels of 6in. dia. and 17.45in. dia., both for fast burning and slow burning mixtures.

The results negative a suggestion put forward that differences of pressures observed in different vessels are due to differences of cooling surface. The explanation put forward here is that incomplete combustion is responsible.

*Piston Temperature of a Crossley Solid Injection Engine.* (*The Engineer*, Vol. 154, No. 4015, 23/12/32, p. 644.) (8.14/26036 Great Britain.)

The piston dimensions are 14in. dia. by 30in. overall length, including the crown knob 2½in. dia. by 2in. high. The temperature was measured by 14 distributed thermocouples and varied from max. 650° at the knob, where the combustion is concentrated, to 50°C. at the skirt. It appears that the greater part of the heat is transferred to the jacket through the skirt rings.

*Bad Effects of Exhaust Gases.* (H. Gorlacher, *Autom. Tech. Zeit.*, No. 20, 25/10/32, p. 495.) (8.15/26037 Germany.)

A summary is given of a report by W. Liesegang. The dangerous concentration of CO ranges from 0.02 per cent. upwards and may be fatal at 0.2 or 0.35 per cent.

Methods of rendering engine exhaust gases innocuous are discussed briefly. Reference is made to a reassuring official report.

*Investigating Mixture Distribution.* (H. Rabazzana and S. Kalmar, *Autom. Eng.*, Vol. 22, No. 301, Dec., 1932, pp. 587-593.) (8.15/26038 Great Britain.)

Fuel distribution may be measured on a motored engine, but bears little relation to actual performance under running conditions. Exhaust flame colours and sparking voltage contribute further information.

Reliable information can be obtained by means of exhaust gas analysis, provided the exhaust of each cylinder can be analysed separately.

Extensive data collected on these lines are given in tables and charts.

Six photographs show the elaborate equipment required for carrying out tests.

### *Engines, Design and Performance*

*Experiences obtained with German Civil Aviation Aero Engines.* (B. Bruckmann, *Z.F.M.*, Vol. 23, No. 14, 28/7/32, p. 423.) (8.20/26039 Germany.)

The D.V.L. published statistics of performance of 1,100 civil aviation engines over 700,000 running hours. Ninety per cent. are water-cooled and of these

seventy per cent. are below 500 h.p. All the air-cooled engines are from 500-700 h.p. The average running period between complete overhauls was 180 hours.

Generally, the modern German 6 and 12-cylinder water-cooled engine follows closely the war product of 1918, having practically identical cylinder construction, with modifications in valve seats and crankcase webs.

Since the war English, Continental and American engines have undergone considerable changes in design to meet military requirements and are more compact and lighter.

German civil aviation has a high reputation on the continent, but the question of relative reliability will be settled only if and when equally authoritative statistics such as these become available in other countries. (See Abstract 26040.)

*Experiences Gained in the Construction of Aero Engines.* (O. Kurtz, Z.F.M., Vol. 23, No. 23, 14/12/32, pp. 691-701, and No. 24, 21/12/32, pp. 721-730.) (8.20/26040 Germany.)

The article deals with constructional features of engines at present employed in German civil aviation and with possible lines of development and is a supplement to D.V.L. Report No. 302 (see Abstract 26039).

Higher flying speeds require a reduction in the air resistance of the engine and a departure from German standard methods of construction. Lack of funds and absence of military orders direct the attention of the German engine builders to development in other countries and lead to the incorporation of the best features in their own designs.

*"Universal" Radial Engine.* (Aero Digest, No. 5, Nov., 1932, p. 40.) (8.20/26041 U.S.A.)

A brief descriptive account is given of the "Universal" four-cylinder radial engines, showing many novel features of construction. No details are given of the variable pitch control to which brief reference is made.

*The Engines used during the European Circuit, 1932.* (O. Kurtz, Z.F.M., Vol. 23, No. 19, 14/10/32, pp. 577-581.) (8.225/26042 Germany.)

Particulars are given of the size, weight and method of mounting of ten different makes of light aero engines in 40 aircraft. All were air-cooled and one half had cylinders in line. The average figures for all the engines are:—

H.P.	...	...	135
R.P.M.	...	...	2,130
Lb./h.p.	...	...	2.25

The competition was won by the Polish light aeroplane RWD6, fitted with the English Genet Major engine. Second, third and fourth place and the highest speeds were obtained by planes fitted with the German Argus engines.

*Supercharged Aero Engines.* (C. Brooks, Airc. Eng., Vol. 4, No. 46, Dec., 1932, pp. 303-309.) (8.235/26043 Great Britain.)

A summary is given with extensive technical detail of the principles of supercharging and controlling the supercharging of engines at different altitudes.

Diagrams obtained with the Farnborough electric indicator are reproduced with curves of power absorbed by the supercharger. A number of mechanical accessories are described with photographs and diagrams, and rules for setting and maintenance are given.

Typical performance figures of supercharged engines are given in tables.



*Scavenging Two-stroke Cycle Diesel Engine.* (O. P. van Steewen, *Autom. Tech. Zeit.*, No. 19, Oct., 1932, pp. 464-467. See also *Werft-Reederei-Hafen*, No. 5, 1/3/33, pp. 66-69.) (8.25/26044 Germany.)

The air supply must first scavenge the burnt gases from the cylinder, then refill it with air for combustion and mix with the guttulated (pulverised) fuel.

The paper is largely concerned with accelerating the mixing of air and fuel through turbulence set up by guide vanes.

A large glass cylinder about 1 m. high by 1.7 m. diam. was used to investigate air flow. The air was supplied by a centrifugal fan and sparks from fireworks preparations were used as indicators, the trail of the sparks being recorded on a photographic plate.

It is stated that the time of combustion is reduced to one-fifth or one-sixth by the increased turbulence set up artificially.

Photographs showing spark trails are reproduced and three photographs of three-dimensional models show the result more clearly.

The general layout of the installation is shown in photographs and sectioned sketches give details of valves.

The angular velocities obtained are plotted as nearly linear functions of the r.p.m.

140-h.p. *M.A.N. Diesel for Motor Lorries.* (*Autom. Ind.*, Vol. 67, No. 21, 19/11/32, pp. 647-648.) (8.25/26045 U.S.A.)

Details are given of principal dimensions and performance.

Sketches show the installation in a rail car; a photograph shows the complete engine and a section drawing shows the end view.

The weight of 14.5lbs. per h.p. suggests possible future development for aircraft.

*Diesel Bus Test.* (J. Geschelin, *Autom. Ind.*, Vol. 67, No. 25, 17/12/32, pp. 771-773.) (8.26/26046 U.S.A.)

Details are given of a 91-hour 3,220-mile run, from New York to Los Angeles.

The engine was a Cummins Diesel six-cylinder ( $4\frac{1}{8}$  in. by 6 in.) rated at 125 h.p. at 1,800 r.p.m.

The consumption was 365 gallons of low grade fuel at 6 cents per gallon.

*Thermal and Electrical Theories of Ignition.* (J. D. Morgan, *Fuel*, Vol. 11, No. 12, Dec., 1932, pp. 452-456.) (8.28/26047 Great Britain.)

The results of experimental work on the effectiveness of different types of electrode in promoting spark ignition are reviewed.

The author holds, on the evidence, that heating a sufficient volume of the mixture to explosion point is a process of purely thermal conduction from spark to gas.

The spark energy required depends on the shape and duration of the spark and therefore on the shape of the electrodes. The required energy decreases with increase of spark length and decrease of electrode radius up to feasible limits.

After ignition has been started ionisation takes place and electro-chemical relations must be considered.

Fifteen references.

*Electrical Accessories for Aircraft.* (W. Brintzinger and B. Bruckmann, *Z.F.M.*, Vol. 23, No. 18, 28/9/32, pp. 541-549.) (8.28/26048 Germany.)

In the new Bosch induction magneto the rotating part carries no windings and has small inertia. Two mechanical interruptors displaced relatively, one of which is shorted, give a large range of timing. With coil ignition reliability depends on the battery. The large increase in weight offsets any small advan-

tages. The high tension cable system with its shield should form a rigid unit capable of installation as a whole.

Modern ceramic materials based on  $Al_2O_3$  combine greater thermal conductivity than mica with satisfactory dielectric properties and make cooler plugs which are urgently needed.

To meet wireless requirements the Bosch shield can be fitted to any plug without serious increase of temperature. Generators should be direct driven by the engine and not wind driven.

Nine references.

*The Michel Engine.* (S. J. Davies, *Engineering*, No. 3478, 9/9/32, pp. 290-293; No. 3479, 16/9/32, pp. 333-336; No. 3480, 23/9/32, pp. 353-354.) (8.292/26049 Great Britain.)

This report covers the tests published by Prof. Nagel in Z.V.D.I. (Abstract 24856). (Abstractor's Note.—The high litre performance is due to supercharging and not to suitability for richer mixtures than a normal injection engine. The presentation of the material in both reports unduly stresses the unorthodox mechanical feature in this connection.)

*Michel Compression Ignition Engine.* (P. Schmaljohann, *Autom. Tech. Zeit.*, Vol. 35, No. 19, 10/10/32, pp. 467-472.) (8.292/26050 Germany.)

Constructional details are given and illustrated by six sectional drawings and three photographs, one of a sectioned engine, one of the engine complete and one of the whole test installation.

Characteristic curves are given of effective piston volume as a function of angular position of crank pin, fuel consumption as a function of speed and power, volumetric efficiency and pressure of pump, and relative contributions of the pistons. (See Abstracts 24856 and 26049.)

### *Engines, Accessories*

*Bending Moments in Master Rod of Radial Aircraft Engine.* (C. F. Taylor, S.A.E. Journal, Vol. 31, No. 6, Dec., 1932, pp. 488-492.) (8.35/26051 U.S.A.)

A dimensioned sketch of the master rod is given with numerical details specified and a diagram shows the application of these principal forces. Gas pressures are taken from an indicator diagram and the partial and resultant turning moments are shown in elaborate torque diagrams.

*Ball versus Tapered Roller Bearings.* (J. E. Hamilton, *J. Amer. Soc. Nav. Engrs.*, Vol. 44, No. 4, Nov., 1932, pp. 407-429.) (8.37/26052.)

A comprehensive comparison is made of dimensions and weights for specified bearing loads and end thrusts—between standard ball bearings and tapered roller bearings.

The comparison is in favour of the roller bearing in two-thirds of the cases considered.

### *Engines, Cooling*

*Heat Transferred from a Wire to a Transverse Stream.* (J. Ulsamer, *Forschung*, Vol. 3, No. 2, Mar./Apr., 1932, pp. 94-98.) (8.40/26053 Germany.)

By the introduction of four non-dimensional parameters, not all independent, numerous experimental data from various sources are reduced to unicursal curves. Numerical tables and graphical diagrams are given.

Thirteen references.

*Research in Heat Transmission.* (E. Schmidt, Z.V.D.I., Vol. 76, No. 42, 15/10/32, pp. 1,025-1,032.) (8.40/26054 Germany.)

In the differential equations of heat flow the condition of dynamical similitude suggests parameters of zero dimensions, *e.g.*, Reynolds, Peclet, Prandtl, Grashof and Nusselt numbers.

The representation of results is reduced to a unicursal curve and various analogies are suggested.

*Thermal Conductivity of Air Between Co-axial Circular Cylinders.* (W. Beckmann, Forschung, Vol. 2, No. 5, May, 1931, pp. 165, 213 and 407.) (8.40/26055 Germany.)

A separation is made of the total transfer of heat measured by subtraction of the part transferred by radiation, as calculated by Stefan's relation, leaving the difference as due to conduction and convection. For dynamic similitude there must be equality of the ratio of diameters and of "Grashof's number," the latter being a non-dimensional parameter involving kinematic viscosity, temperature difference, mean absolute temperature and cube of inner diameter.

The results give a family of smooth curves, as functions of these two parameters.

*Thermal Conductivity of a Layer of Air between Co-axial Circular Cylinders.* (H. Voigt and O. Krischer, Forschung, Vol. 3, No. 6, Nov./Dec., 1932, pp. 303-306.) (8.40/26056 Germany.)

Reference is made to Beckmann's experiments which are substantially repeated and confirmed, with extension to a higher range of temperatures.

*Heat Transference by Condensation of Steam in a Vertical Pipe.* (M. Jakob, S. Erk and H. Eck, Forschung, Vol. 3, No. 4, July/Aug., 1932, pp. 161-170.) (8.40/26057 Germany.)

In previous experiments the apparatus dealt with 40 kg. per hr., the present apparatus deals with 400 kg. per hr. Full details are given of the mounting of the apparatus.

The results are shown graphically in comparison with Nusselt's formula.

The distributions of temperature and velocity across the pipe show suggestive analogies.

### *Engines, Lubricants and Lubrication*

*Lubricating Properties of Oil.* (R. O. King, Proc. Roy. Soc., Vol. 139, No. A.838, Feb., 1933, pp. 447-459.) (8.540/26058 Great Britain.)

Measurements of torque resistance of a journal were carried out on a Jakeman apparatus, which provides for the heating of the shaft internally, the temperature being measured by thermo-couple. Nine litres of oil (two gallons) were passed through the bearings in an average time of about  $7\frac{1}{2}$  minutes and a stream of air heated to 160°C. was fed into the oil return pipe to promote oxidation. The bearing load was kept constant at 1,000lb. per sq. in. (70 kg./cm.) projected area, or 2,000lb. per sq. in. on projected arc of wear. The measurements were begun when the arc of wear was from 80° to 100° and the bush was scrapped when the arc exceeded 120°. The same oil was passed through the apparatus for  $7\frac{1}{2}$  hours per day and for one to two weeks. The whole series of experiments lasted nearly four years. A selection of the tests is given in the form of graphs showing the coefficient of friction against temperature of bearing.

A well defined minimum is reached at a corresponding temperature and is followed by a rise to seizing temperature. The curve is a function of the total running time and a family of curves is obtained which shows marked lowering

of the minimum coefficient of friction to about half and increase of seizing temperature to about double. The lower value recorded is 0.00045.

The beneficial results are attributed to increasing oxidation of the lubricating oil. Molecular theories are suggested on the lines of Hardy's so-called "boundary" lubrication which goes beyond the scope of the experimental data as recorded.

Fuller details in respect of the experimental conditions, in particular accurate measurements of the eccentricity of the shaft, are desirable in considering physical interpretation.

*Lubrication.* (H. N. Bassett, *Autom. Eng.*, Vol. 22, No. 301, Dec., 1932, pp. 575-6.) (8.540/26059 Great Britain.)

The article deals with "oiliness" and "boundary" lubrication, but no physical definition of either term is attempted.

From the context it appears that "oiliness" is a measure of the bearing loading at which seizing occurs and that "boundary" lubrication denotes the, no doubt, complex, physical conditions prevailing just before lubrication breaks down and the bearing seizes.

A more physical explanation is offered in the suggestion that when roughnesses on both shaft and bearing coincide on a radial line, the lubricating film is pierced locally and direct rubbing occurs between shaft and bush over a small but finite area.

Running in of bearings would smooth such projections by the flow of metal according to Beilby and improve the performance in agreement with experience. Viscosity appears to be confounded with surface tension. Practical devices for postponing the breakdown of lubrication are considered.

Three references.

*The Viscosity of Lubricating Oils for High Velocity Gradients in the Film.* (S. Kyropoulos, *Forschung*, Vol. 3, No. 6, Nov./Dec., 1932, pp. 287-296.) (8.540/26060 Germany.)

Rate of shear in bearings may be of the order of 5.5 by  $10^4$  radians per second, while in viscosimetry it is usually less than 100 radians per second.

A vertical, slightly conical bearing, designed to Prandtl's specification, enables the clearance to be measured accurately and eliminates the complication of eccentricity. Up to 3,000 radians per second the values of  $\mu$  are consistent with viscosimetric measurements, but at higher rates of shear, with certain lubricating oils, bearing friction may fall as much as 17 per cent. below the calculated value, allowing for temperature effects.

It is remarked that one of the lubricating oils which gives a sensible decrease in observed bearing friction, gives evidence of anisotropy in shear by its relatively high double refraction. This appears to suggest a correlation between molecular orientation and coefficient of viscosity which becomes sensible at rates of shear exceeding 3,000 radians per second.

*High Pressure Lubricants.* (*Autom. Ind.*, Vol. 67, No. 21, 19/11/32, pp. 650-653.) (8.540/26061 U.S.A.)

An account is given of systematic tests on 16 lubricants. Of the many substances proposed for addition to ordinary lubricants, the most successful are sulphur and chlorine compounds.

It is somewhat obscurely suggested that the chlorine and sulphur liberated at high bearing temperatures combine with the surface metal to form films of iron sulphide or iron chloride which prevent local metallic contact between bearing surfaces.

Details of test apparatus are given, with two photographs and a diagrammatic sketch.

The amount of the additive substance and the viscosity of the mixture is given in a numerical table.

Grouped photographs of experimental journals show the results of running at 200, 400 and 600 r.p.m. The doping of the oil appears to be most effective at the higher speeds.

*Contact Effects in Lubrication.* (Autom. Tech. Zeit., No. 10, 25/5/32, pp. 258-259.) (8.540/26062 Germany.)

The incipient failure of lubrication is discussed in terms of so-called boundary lubrication with its crude conception of chains of polarised molecules acting as roller bearings.

*Bearing Bronzes.* (Z.V.D.I., Vol. 76, No. 9, 27/2/32, p. 215.) (8.540/26063 Germany.)

Reference is made to a claim that certain American bearing bronzes absorb oil, in fine pores, up to 40 per cent. of the volume of the metal, without affecting normal lubrication; that the absorbed oil comes into action under overloading; and that a lubricating film is maintained even at low starting torques.

*Lubrication Research.* (O. Walger, Z.V.D.I., Vol. 76, No. 9, 27/2/32, pp. 205-208.) (8.540/26064 Germany.)

Determinations of friction in a cylindrical bearing with a number of oils under various conditions of load and speed confirm the hydrodynamical theory for a complete oil film of sensible thickness. When surface tension is insufficient to maintain the film the conditions become complicated and obscure until seizing occurs.

Explanations are sought in various physical properties. The transition range between normal lubrication and seizure may be maintained over a considerable range of speed and load. The bearing undergoes a certain amount of wear, suggesting partial or intermittent contact.

The somewhat indeterminate friction torque fluctuates widely and may be heavily affected by the admixture of graphite and other substances. In some cases the minimum observed coefficient of friction lies apparently in the transition range.

Nine references.

*Regeneration Method for Used Lubricating Oil.* (R. Ascher, Autom. Tech. Zeit., Vol. 35, No. 9, 10/5/32, p. 230.) (See Abst. 25042.) (8.586/26065 Germany.)

During use the oil undergoes oxidation and improves in lubricating quality (oiliness).

Accumulated sludge, acid and foreign matter are detrimental and must be removed. Simple regeneration by filtering through certain clays removes solid impurities and neutralises the free acids. The so-called "crack-smell" (characteristic of used oils) is much reduced. After prolonged use a centrifugal process should precede clay filtration.

Regenerated oils are in every way as good as, and in many respects better than, fresh oils, but their use is restricted by commercial interest in the sale of fresh oil.

### **Engines, Fuels**

*Knock Rating Tests in Germany.* (O. Enoch, Autom. Tech. Zeit., Vol. 35, No. 8, 25/4/32, pp. 205-207.) (8.645/26066 Germany.)

Four fuels were matched against a benzol petrol mixture by 18 laboratories

using various engines. The matching was done either by ear or by bouncing pin. The results varied by about  $\pm 3$  per cent. from the average, expressed as per cent. benzol in a benzol petrol mixture supplied as sub-standard. The agreement was satisfactory for general practice, but the discrepancies justify further research. A new standard to replace the expensive octane/heptane is desirable.

*“ Motor Method ” of Determining Anti-knock Values.* (C.F.R. Committee, Autom. Ind., Vol. 67, No. 22, 26/11/32, pp. 682-684.) (8.645/26067 U.S.A.)

The intake valve is shrouded to produce turbulence in the entering charge, particularly in the neighbourhood of the bouncing pin. An improved vapour condenser is fitted and the circulating water pump is removed.

The engine speed is increased from 600 r.p.m. to 900 r.p.m.

The testing routine is fully specified and results by the new method show closer agreement with road tests.

### *Engines, Injection Systems*

*Guttulation (Atomisation) of Jets in Diesel Engines.* (O. Holfelder, Forschung, Vol. 3, No. 5, Sept./Oct., 1932, pp. 229-240.) (8.705/22.2/26068 Germany.)

A full description is given of the experimental installation with dimensioned sketches and tables of 11 types of jet.

Forty-five instantaneous photographs of jets show variety of types breaking up into waves, drops and clouds.

Seventeen references.

*The Injection Process of the Diesel Engine.* (O. Holfelder, Z.V.D.I., Vol. 76, No. 51, 17/12/32, pp. 1,241-1,244.) (8.705/26069 Germany.)

The distribution of the injected fuel in time and space depends on the fuel pump, the connecting tube and the injection valve. A cylindrical bomb was fitted with windows and shadow photographs were made with short-time spark illuminations of the form of the jet and the ignition lag with open and closed injection valves, needle and pinhole types. The pipe line between pump and valve influences the whole process. The break up of the jet is influenced mainly by the density of the air and this may account for beneficial effects of supercharging.

Three references, thirteen photographs.

### *Engines, Exhaust Systems*

*Acoustic Filters as Silencers for Internal Combustion Engines.* (A. Kauffman, Autom. Tech. Zeit., Vol. 35, No. 22, 25/11/32, pp. 545-546.) (8.721/26070 Germany.)

Comparative tests were carried out at the Technical High School, Berlin, on a silencer in two sections designed to deal with the high and low frequency sounds in the engine exhaust. The high notes are absorbed by so-called absorption filters, obtained by lining the exhaust pipe with a porous material. The low notes are dealt with by a straight pipe communicating with closed chambers. The straight through passage of the gases produces comparatively little back pressure, while the noise reduction is greater than with baffles.

*Silencing Arrangement on Blériot 111/5.* (L'Aéronautique, No. 163, Dec., 1932, p. 393.) (8.721/26071 France.)

The heavily ribbed exhaust collector of the Hispano 12 Mor engine projects outside the cowling into the slipstream, following the contour of the nose of the aircraft. The silencer is of the double wall type fitted with external fins and a central passage for cooling air, part of which, when heated, can be deflected to warm the cabin. The pipe connecting the collector and the silencer is also air-cooled. Cooler cylinder heads and substantial reduction of noise are claimed.



*Flow through Conical Valves.* (L. Richter, *Autom. Tech. Zeit.*, Vol. 35, No. 24, 25/12/32, pp. 591-593.) (8.725/22.2/26072 Germany.)

In reviewing Reports Nos. 50, 51 and 67 of the Aeronautical Research Institute, Tokyo, it is noted that rounding off certain parts of the seating and valve reduced the resistance to steady flow and improved the volumetric efficiency of a Hispano Suiza engine by 3 to 4 per cent. The Curtis D.12 engine has been fitted with chamfered valve seats as standard design.

### **Engines, Pumps**

*The Vaudet-Guitant Compressor.* (*L'Aéronautique*, No. 161, Oct., 1932, pp. 321-322.) (8.745/26073 France.)

The blower is of the type in which the rotor is mounted eccentrically on a shaft which is central to the casing. A single vane slides in a radial guide fixed externally to the casing.

Instead of sealing by rubbing contact, under spring pressure, of the end of the vane on the surface of the rotor, a small clearance is maintained by mechanical gearing to the rotor. This eliminates surface friction and allows higher speeds at the price of mechanical complications.

The volumetric delivery of the eccentric rotor type is about half that of the more usual alternative type with rotor mounted centrally on a shaft which is eccentric to the casing.

The eccentricity introduces high inertia stresses and balance is obtained by employing the units in opposition.

### **Engines, Starting Systems**

*Use of Tractor for Engine Starting Device.* (*Aero. Digest*, No. 5, Nov., 1932, p. 27.) (8.780/26074 U.S.A.)

A photograph shows a tractor with an attachment improvised out of an old "Ford" transmission for starting an aeroplane engine.

### **Armament**

*Smoke Screens Developed by Aircraft.* (M. Auriol, *Rev. d. F. Aer.*, No. 41, Dec., 1932, pp. 1,392-1,415.) (9.45/26075 France.)

The application of smoke screens in offensive and defensive has been the object of development work in America and Italy. On land the smoke is produced by stationary apparatus or by smoke shells. At sea, the smoke curtain is produced by the ships themselves. The production of smoke screens by aircraft on land or sea requires accurate co-ordination with land or sea forces. Vapourised chemicals as used for sky writing are too thin. The use of smoke bombs is limited. A coarse spray of liquid tin tetrachloride emitted by the screening aircraft forms a vertical slowly settling screen of a suitable type.

### **Materials, Characteristics**

*Nitrided Nickel Steels.* (*Autom. Ind.*, Vol. 67, No. 21, 19/11/32, pp. 640-643.) (10.10/26076 U.S.A.)

The addition of nickel to nitrided steel gives marked improvements in tensile strength and yield points, but decreases its elongation and impact resistance.

Specifications of steels and the results of systematic tests are given graphically and in tables.

*New Experiments on the Functioning of the Cutting Tool.* (F. Schwerd, *Z.V.D.I.*, Vol. 76, No. 52, 24/12/32, pp. 1,257-1,265.) (10.10/26077 Germany.)

A cinematograph record of the shearing of the material at various cutting

speeds shows the periodic blocking of the cutter by the adhesion of the material and the subsequent clearing process. The record is not complete and the value of the partial results justifies further investigation by this method, since the process of plastic deformation underlies all cutting and is of fundamental importance in research on the strength of materials.

*Fatigue Strength of Round Struts with Holes Drilled Transversely.* (A. Thum and H. Oschatz, *Forschung*, Vol. 3, No. 2, Mar./Apl., 1932, pp. 87-93.) (10.104/26078 Germany.)

The fatigue strength is unavoidably reduced by transverse drilling, but the effect may be mitigated by several devices, (a) cross-drilling to equalise moments of resistance, (b) by fitting collars to relieve local concentration of stress, (c) by imposing initial stresses round the drilled holes.

The reduction of strength is shown graphically, and an empirical formula is given. A suitable type of collar is shown by photograph and sketch. The resultant stress field (c) is shown graphically. A substantial recuperation of lost strength is shown.

*Surface Pressure and Fatigue Fractures in Roller Bearings.* (R. Mundt, *Z.V.D.I.*, Vol. 76, No. 25, 18/6/32, p. 618, also *Forschung*, Vol. 3, May/June, 1932, p. 127.) (10.104/26079 Germany.)

Previous attempts to correlate the life of ball and roller bearings with the equations of Hertz had failed. It appears that the important stresses are not the normal surface pressures as assumed by Hertz, but tangential stresses in the direction of rotation. The author has amended the equation and obtained satisfactory agreement with experiment.

*Magnet Steels and Permanent Magnets.* (K. L. Scott, *Bell Tele.* B.682.) (10.105/26080 U.S.A.)

The permanent magnetism of a large number of specimens of cobalt, tungsten, chromium and carbon-manganese steels is plotted as a function of parameters such as length of magnet, cross section area, saturation, induction, hardening temperature, etc.

Evershed's criterion taking  $(BH)_{max}$  as the controlling parameter is verified experimentally and on this basis an abac (nomogram) is given which determines the highest permanent external magnetic energy per unit volume of magnet steel. Seven references.

*Re-crystallization and Crystal Recovery of Pure Aluminium and Certain Improvable Cu-Al Alloys after Cold Deformation.* (H. Bohner and R. Vogel, *Z. Metallk.*, No. 8, Aug., 1932, pp. 169-175.) (10.231/26081 Germany.)

The primary as well as the secondary crystalline structure of aluminium and aluminium alloy rollings, pressings and stampings depends on the temperature, velocity, form and amount of strain, as well as on the temperature of previous and subsequent heat treatment.

Small changes in the original structure, *e.g.*, size and orientation of grains have considerable influence on the final structure.

A chemical analysis is given of four alloys and the elongation is shown as a function of mean size of grains and of temperature of annealing.

Forty-five photographs of grain structures illustrate discussions of the changes produced by various processes and heat treatments.

Much closer control of composition, mechanical processes and heat treatment is required than at present practised in order to maintain a uniformly high standard of mechanical properties.

Twenty-two references.

*Mechanical Properties of some Light Alloys.* (K. Matthaes, Z. Metallk., No. 8, Aug., 1932, pp. 176-180.) (10.231-2/26082 Germany.)

Chemical specifications are given of six aluminium and two magnesium alloys and the following test results are tabulated for tensile, cubic and shear strains:—

- Modulus of elasticity.
- Elastic limit.
- Ultimate strength.
- Strain at point of rupture.
- Bending test data and Brinell hardness.

Impact tests and fatigue tests are discussed and test results are shown graphically and in tables. Photographs of eleven fractures of rods are given and one of failure under impact.

Corrosion, fatigue and surface protection are briefly discussed and failure loads are plotted as a function of the number of alternations of stress and the time of exposure to corrosion concurrently.

Five references.

*Bending-torsional Tests of Duralumin Tubes.* (G. Gabrielli, L'Aerotecnica, Vol. 12, No. 12, Dec., 1932, pp. 1,594-1,605.) (10.231/23.30/26083 Italy.)

The results of combined flexion and torsion failing loads are shown graphically.

Ten photographs show buckled tubes. An application to wing construction is discussed.

*Safety Glass.* (Autom. Tech. Zeit., No. 20, 25/10/32, pp. 502-504.) (10.406/26084 Germany.)

A single sheet of plate glass is brought to annealing temperature and cooled rapidly so that there are internal stresses in the finished plate. The glass thus treated has higher rupture strength than annealed glass and when ruptured at a point breaks into particles too small to inflict serious injuries.

Internal stress diagrams and strength test diagrams are given.

Three photographs of a ruptured sheet show the nature of the breaking up.

### *Materials, Defects and Treatment*

*Internal Stresses in Large Forgings.* (G. Kirchberg, Forschungsheft, No. 357, 1932, pp. 1-29.) (10.12/26085 Germany.)

The forgings were circular cylinders, and after forging and heat treatment, successive rings were cut from the forging at different axial positions.

The overall dimensions of the rings before and after cutting were measured accurately.

The rings were then cut radially and further strain measurements were obtained. The mathematical theory of elasticity is applied and appropriate developments are worked out in cylindrical co-ordinates; the results are shown graphically and in tables. The maximum internal stresses were found near the axis.

Twelve references.

*Camshaft of Alloy Steels by Electric Furnace.* (J. Geschelin, Autom. Ind., Vol. 67, No. 20, 12/11/32, pp. 620-622.) (10.12/26086 U.S.A.)

The chemical composition and test properties of an alloy produced by electric furnace are specified.

The moulds are combined metal and sand with chilling for cam roses and eccentric surfaces. No further heat treatment is required.

Cost, speed and flexibility of design and production are improved.

*New Method of Steel Hardening.* (O. Gassner, *Autom. Tech. Zeit.*, Vol. 35, No. 22, 25/11/32, pp. 552-553.) (10.12/26087 Germany.)

A new case hardening process—known as the Durapid high speed hardening process—now in operation at several works depends on heating the specimen above its upper transformation temperature and quenching it in a bath at normal temperature with accurate temperature control. Subsequent hardening follows on normal lines. The superior close grain of the steel produced is attributed to the short duration of the high temperature and the elimination of packing boxes and case hardening powders which render the process slow and expensive and productive of warping.

*Surface Corrosion.* (L. Tronstad, *Z. Metallk.*, No. 8, Aug., 1932, pp. 185-188.) (10.125/26088 Germany.)

The corrosive agent is prepared in the form of a solution with added gelatine to increase the viscosity and with coloured indicators, such as bromocresol purple, bromothymal blue and phenol red to indicate electrical polarity. Copper sulphate solution (5 per cent.) was also used as an indicator and gave well marked yellow colouring to cathodic areas.

A layer is applied to the surface of the metal under investigation and the reactions are studied by microscope.

The indicating colours at anode and cathode are diffused more slowly on account of the increased viscosity and are observable by microscope after the lapse of days.

Bubbles of hydrogen given off at the anode are also held in position. Four micro-photographs of such bubbles are reproduced.

The observations indicate that local anode centres are formed at which hydrogen is given off and cathode centres at which metal is dissolved, with pitting of the surface.

*Welded Aircraft Structures.* (*Autom. Ind.*, Vol. 67, No. 22, 26/11/32, pp. 669 and 697.) (10.140/26089 U.S.A.)

A summary is given of a paper and discussion at the 33rd meeting of the International Acetylené Association, 16th-18th November.

Prohibition of welds in tension excludes plain butt joint welding.

Exclusion of sea water from tubes by welding sealing plates is essential.

Aluminium and its alloys lose strength after welding and complete cleansing from remnants of welding flux is necessary, while stainless steel loses its corrosion resisting properties.

Chrome molybdenum steel has good welding properties.

*Effect of Alcohol Fuels on Aluminium and Aluminium Alloys.* (O. Bauer and G. Schikoer, *Autom. Tech. Zeit.*, Vol. 35, No. 24, 25/1/32, pp. 583-589.) (10.262/26090 Germany.)

In view of new laws increasing the obligatory addition of alcohol to petrol fuels experiments were carried out by the official Material Testing Station at Berlin on possible corrosion effects. The corrosion effect was studied by immersing samples of aluminium and its alloys in various types of commercial petrol and benzol fuel containing up to 20 per cent. of alcohol. The corrosion of aluminium tanks and pipe was found to be negligible with as much as  $\frac{1}{2}$  per cent. water in the mixtures.

### *Wind Tunnels*

*New Methods of Research in Aeronautics—Wilbur Wright Lecture, 1932.* (H. E. Wimperis, *J. Roy. Aer. Soc.*, Vol. 36, No. 264, Dec., 1932, pp. 991-1,012.) (11.0/26091 Great Britain.)

The Wright brothers founded their practical success on thousands of experiments on model wings in a 16in. by 16in. wind channel.

The first N.P.L. channel (1910) had a square section, 4ft. by 4ft., while the new R.A.E. channel has a jet of circular section, 20ft. diameter, a motor drive of 2,000 h.p. and a jet velocity of 176 f.p.s.

The great N.A.C.A. channel has a jet of rectangular section, 60ft. by 30ft., and the test chamber is large enough to take a full size aeroplane. The Diesel engine power is 6,500 h.p. and the jet velocity is 169 f.p.s., giving of course a full-scale Reynolds number.

The R.A.E. test chamber is large enough to take the central section of an aeroplane with engine, and can be used for different engine installations, giving the full-scale Reynolds number for the included part of the aeroplane. For wing tests, it is comparatively easy to fit different wings to the same body for comparative tests at full scale, and it is considered that the great additional expense of a wind channel taking a complete aeroplane is not immediately justified.

An alternative method of obtaining a high Reynolds number is the use of compressed air as medium. The pioneer U.S.A. compressed air channel gives a full-scale Reynolds number in a 5ft. diam. jet at 70ft. per sec. wind velocity and 20 atmospheres pressure. The experience thus gained was applied in the design of the N.P.L. compressed air channel which gives nearly twice full-scale Reynolds number with a 6ft. diam. jet at 90ft. per sec. and 25 atmospheres.

The use of water with a density 800 times that of air and much smaller kinematic viscosity has inconveniences arising from the robust supports required by the high pressure with consequent disturbance of the flow.

The field of starting and landing stresses on floats and hulls is explored by means of the R.A.E. tank. When the motion is steady, measurements are accumulated with comparative ease. Unsteady motion, due to waves or to oscillations of the float or hull, lead to much greater difficulties of obtaining and analysing measurements.

The vertical air channel for the investigation of spin has a circular section of 12ft. diam.

The injection of indicators such as the fumes of titanium tetrachloride or filaments of heated air, has much improved the technique of visual observation of flow, and phenomena of fundamental importance are in course of exploration by this powerful means of research.

The suppression of noise is of great importance notably in encouraging air travel. The psychological laws of intensity of sound perception are entirely different from mechanical measurements of intensity. An appropriate scale of intensity of sound perception has to be laid down before the problem of sound reduction can be attacked systematically. The chief sources of noise are airscrew, engine clatter and engine exhaust, and progress in direct reduction of noise from these sources is slow. The alternative method of shielding the passenger in a well-designed cabin has been more successful, and the interior noise has been reduced to the level of intensity in a railway carriage.

Accelerometers are of vital importance in recording the stresses imposed on aeroplanes by external gusts or by aerobatic manœuvres. Under these conditions aeroplane structures tend to become heavier and controls more complicated in defiance of the American precept to "simplify and add more lightness."

Finally, the objects and achievements of research are "morally neutral." Their direction, beneficial or otherwise, must depend on the character of the users.

*The New Göttingen Wind Channel for Airscrew Research.* (Z.V.D.I., Vol. 76, No. 52, 24/12/32, p. 1,274.) (11.10/26092 Germany.)

The channel has an octagonal closed circuit 1 m. 85 cm. diameter, with equipment for airscrew research. A motor of 165 h.p. gives speeds up to 120 m./s. Airscrew models up to 50 cm. diameter can be mounted. The density of the air can be reduced.

*Tanks, Hydroplanes, etc.*

*Hydromechanical Problems of Ship Propulsion.* (W. Schmidt, Z.V.D.I., Vol. 76, No. 37, 10/9/32, p. 877.) (11.20/26093 Germany.)

Frictional wave and form resistance are considered in terms of modern theory. Particular cases are the Voith-Schneider rotary paddle propeller and ship propeller working in a closed funnel with considerable increase of traction, equivalent in a small tug to an increase in engine power from 120 h.p. to 160 h.p.

*Installation for High Speed Towing of Models.* (H. M. Weitbrecht, Z.V.D.I., Vol. 76, No. 46, 12/11/32, pp. 1,119-1,122.) (11.20/26094 Germany.)

A full technical description is given of the mechanical and electrical details of a new towing carriage designed to run on the rails alongside the existing tank. The speed has been increased from 8 m./s. to 21 m./s. to meet aeronautical requirements.

Two photographs show the carriage and cable towing gear. A general arrangement sketch shows tank and equipment as a whole.

*Experiments with Hydroplanes.* (W. Sottorf, Werft-Reederei-Hafen, No. 19, 1/10/32, pp. 286-290, No. 4, 15/2/33, pp. 43-47 and No. 5, 1/3/33, pp. 59-61.) (Reports 106 and 107, Hamburg Shipbuilding Co.) (11.22/26095 Germany.)

In a previous paper a report was made on a systematic research programme and certain fundamental results obtained with a plane surface were given. In the present paper the transformation of results from model to full scale is discussed. The formulæ used for comparison of ships' models with full scale fail for hydroplanes. The boundary layer largely determines the resistance and the type of flow is subject to rapid changes from small models to large models. From large models to full scale the rate of change falls to tractable magnitude.

The results of systematic tests are recorded graphically and in tables for six models over a range of incidences from  $0^\circ$  to  $10^\circ$ . The transition from laminar to turbulent motion is discussed. Moments and resistances are plotted against incidence and velocity. Two photographs show models of different dimensions (4:1), towed at corresponding speeds.

In continuation, the influence of keel angle was studied and the shock on impact is shown graphically as a function of keel angle. The shock falls off rather faster than on the D.V.L. assumption, but the friction increases with the wetted surface and spray water is thrown up laterally in greater volume. The gliding ratio and coefficients of moment and aspect ratio of bearing surface are tabulated and shown graphically for a number of tests.

The formation of the sheet of water thrown off is considered hydrodynamically. Measurements of shape were made. Elaborate graphical representations and reductions are used in an attempt to establish systematic relations. Five photographs of the sheet of water are reproduced.

Similar methods are extended to curved surfaces. The geometrical surface curves of five models are given in figured sketches, coefficients are tabulated and shown graphically. Graphical representations of velocity distribution and spray wave formation are given for curved surfaces and seven photographs of spray wave formations are reproduced.

*On the Scale Effect of Aeroplane Model Float Tests.* (W. Sottorf, Z.F.M., Vol. 23, No. 24, 28/12/32, pp. 713-719.) (11.22/26096 Germany.)

In aeroplane float tests the reduction of model tests to full scale is difficult. The wetted surface depends both on the speed and incidence, whilst the mean velocity of the water in contact with the float may differ appreciably from the towing speed.



In small scale models the friction coefficient for the same Reynolds' number depends on the preliminary run conditions and their effect on the boundary layer.

The author carried out experiments both with flat plates and model floats and concludes that the results can only be applied to full scale work if large models are used (scale  $\frac{1}{4}$ ). This applies especially to the point of max. resistance before the float rises on the step.

(It has since been stated by Pabst that model results on the comparatively large scale of the Hamburg tank can be applied without correcting factor.)

### *Aircraft Components*

*Tests on Wire Cables.* (F. List, Z.V.D.I., Vol. 76, No. 53, 31/12/32, pp. 1,297-1,298.) (11.43/26097 Germany.)

Experiments were carried out on lift cables of various patterns and show the importance of the proper fit of the cable in the pulley.

### *Airships*

*Dynamics of the Dirigible.* (Revue Générale de l'Aéronautique, No. 14, 1932, pp. 1-103.) (12.30/26098 France.)

A description is given of paradoxical effects of increasing or decreasing the buoyancy of a dirigible.

A discussion of the general problem is based on consideration of the meta-centric curves derived from tests on models.

Various ranges are found to exist and the character of dynamical equilibrium changes in passing from one range to another.

A number of problems are worked out graphically and applications are made to analyses of various incidents and accidents in airship operation including the cases of R. 33, the Dixmude and the Shenandoah.

*Mission of Naval Airships.* (Lt.-Comdr. T. G. W. Settle, U.S. Nav. Inst. Proc., Vol. 58, No. 11, Nov., 1932, pp. 1,621-1,626.) (12.30/26099 U.S.A.)

A favourable view is taken of possible naval application of airships. A descriptive account is given of U.S. equipment with seven photographs showing balloons, kite balloon and shed, small and large airships and aeroplane hooking-on gear.

*Air Services—the Akron and Macon.* (Aero Digest, Vol. 21, No. 6, Dec., 1932, p. 40.) (12.30/26100 U.S.A.)

The Akron (since destroyed) completed the first year of service with a flying time of 1,131 hours in 51 flights—total distance covered 55,000 miles; total of passengers carried 4,058.

The aeroplane fighter squadron attached to the Akron carried out 401 hook-on operations.

A travelling elevator carrying 1,500lbs. at 175 feet per minute up to 220 feet above the ground will be used for inspection and local repairs of airship hulls.

*Economic Airship Construction.* (J. Schwengler, Z.F.M., Vol. 23, No. 14, 28/7/32, p. 419.) (12.44-5/26101 Germany.)

The densities of air, helium and hydrogen are in the ratios 1 : 0.14 : 0.07 in round numbers. The use of helium instead of hydrogen involves a loss of 7 per cent. on the gross lift or 35 per cent. on a disposable load taken as 20 per cent. of the gross weight. This is considered a decisive factor against the use of helium in commercial airships, in view of the extreme demands already made on the structural design and materials. Mixed use of hydrogen and helium might reduce fire risks without excessive sacrifice of lift, but preventive methods and careful training of the crew are held to be the effective solution.

With further knowledge of aerodynamical and structural problems the use of helium may become feasible.

**Wireless**

*Frequency Distribution of Atmospheric Noise.* (R. K. Potter, Bell Tele. B.697.) (13.1/26102 U.S.A.)

Author's Abstract.—A relation between atmosphere noise intensity and frequency is estimated upon the basis of noise measurement data covering the frequency range between 15 and 60 kilocycles, and 2 and 20 megacycles.

*Transformer Coupling Circuits for High-frequency Amplifiers.* (A. J. Cristopher, Bell Tele. B.699.) (13.2/26103 U.S.A.)

Characteristics of transformer coupling circuits are discussed and exhibited graphically for five numerical examples.

Transformer circuits show characteristics similar to those of band pass filters and may replace the latter on satisfying certain conditions.

*Electro-magnetic Oscillations of Coupled Systems.* (M. Stone, J. Franklin Inst., Vol. 214, No. 6, Dec., 1932, pp. 633-646.) (13.2/26104 U.S.A.)

Oscillations of purely electro-magnetic coupled systems lead in general to a system of equations with a symmetrical determinantal eliminant or characteristic.

The author specifies a system in which a prime mover with a centrifugal governor is mechanically coupled to an electro-magnetic generator and load.

This leads to a symmetrical determinantal eliminant. The equations are discussed after Routh's method.

A numerical example is worked out and the ranges of stability are shown for different numerical data.

The term non-unilateral is used by the author to denote the asymmetry of the characteristic determinant.

*Kennelly-Heaviside Layer Studies Employing a Rapid Method of Virtual-height Determination.* (J. P. Schafer and W. M. Goodall, Bell Tele. B.688.) (13.30/26105 U.S.A.)

From Authors' Abstract.—The virtual height of the ionized regions was determined by visual observations of the received pulse pattern on a cathode ray oscillograph tube, both for single frequencies and for two frequencies simultaneously. A résumé of the data obtained during observations of some three hundred hours is given.

Ten references.

*Effects of Topography and Ground on Short-wave Reception.* (R. K. Potter and H. T. Friis, Proc. Inst. Rad. Eng., Vol. 20, No. 4, April, 1932, pp. 699-721.) (13.32/26106 U.S.A.)

From Authors' Abstract.—This paper contains some results of an experimental study of the effects which ground and ground irregularities have upon short-wave signal reception. The results illustrate the signal strength advantage to be gained in the selection of suitable ground or topographical conditions and show the influence of antenna types, and vertical angle of signal arrival upon such an advantage.

The agreement between measurement data and theory seems to justify the application of plane wave optical theory to the calculation of vertical plane directivity of antennæ.

*Application of Cathode Ray Oscillograph.* (R. R. Batcher, Proc. Inst. Rad. Eng., Vol. 20, No. 12, Dec., 1932, pp. 1,878-1,891.) (13.5/26107 U.S.A.)

A concise account is given of the elementary characteristics, calibration and use of cathode ray oscillographs.

Electrostatic and electro-magnetic methods of deflection are compared, the latter requiring considerably more power but at low voltage.

Two photographs of commercial apparatus are reproduced.  
Twenty-nine references.

*Pressure Record by Pentode Valve.* (W. D. Oliphant, J. Sci. Inst., Vol. 9, No. 12, Dec., 1932, pp. 386-388.) (13.5/26108 Great Britain.)

A circuit containing a capacity variable under pressure, a triode, oscillator and a valve voltmeter is replaced by a circuit containing capacity and pentode, the latter acting both as oscillator and valve voltmeter.

A diagram of connections is given and the relation between anode current and capacity charge is shown graphically as a straight line along which experimental points lie closely.

*Principles of the Light Valve.* (T. E. Shea, W. Herriott and W. R. Goehner, Bell Tele. B.675.) (13.5/26109 U.S.A.)

The mechanism of single and double ribbon shutter valves is described and illustrated by sketches and the frequency impedance characteristic is shown graphically with high peaks at resonance between magnetic field and natural period of ribbon. The instantaneous light received is expressible in Fourier series and the total light, by integration, in Bessel and Fourier series.

The amplitudes of fundamental first, second and third harmonics are shown graphically as functions of frequency.

The elastic characteristics of ten metals used for ribbons are given in a table. Applications are discussed and twelve examples of wave distortion produced by overloading are shown graphically.

A description is given of a new type of valve with permanent magnets and high field intensity.

Nine references.

*Electrode Structures of Cathode Ray Tubes for Television Reception.* (A. B. Du Mont, Proc. Inst. Rad. Eng., Vol. 20, No. 12, Dec., 1932, pp. 1863-1877.) (13.5/26110 U.S.A.)

An essential element of design is a focussing electrode by which the size of the spot on the screen is maintained while the intensity varies.

Seven diagrams show the relation between voltage of accelerating current and focussing electrode voltage, the size of the spot being sketched in for five or six points on the curve.

Rules for design are given and a satisfactory solution is obtained.

*Cathode Ray Compass.* (W. Ende and M. H. Gloeckner, Z.F.M., Vol. 23, No. 20, 28/10/32, pp. 603-609.) (13.5/6.50/26111 Germany.)

An elementary account is given of the physical principles. The stream of electrons has no sensible inertia in relation to the gravitational field and is affected only by the earth's magnetic field (see Abstract 22536).

Some constructional details are given of the cathode ray tube produced in the laboratories of the A.E.G. A photograph shows the tube as mounted with contacts, connections and compass rose exposed to view.

Small angular movements of the compass give deflections which depend on its mean orientation in the earth's magnetic field and systematic interpretation of the varying indications is discussed. Calibration curves are shown before and after flight with maximum deviations of about 3 or 4 degrees.

The influence of proximity to the magneto is discussed and the deflection of the ray is shown as a function of distance and of thickness of magnetic shielding.

A test calibration is shown in comparison with that of a magnetic compass, the errors being of much the same general order.

*Locating Radio Beacon Stations.* (H. C. Stark, *Aero Digest*, Vol. 21, No. 6, Dec., 1932, p. 39.) (13.6/26112 U.S.A.)

The author, who is instructor in instrument flying for an air transport company, gives a routine for locating an aerodrome beacon and landing in a fog. On p. 38 a map shows chains of beacons in U.S.A.

There are two continuous trans-continental routes and a third is under construction.

*Technique of the Sound Film.* (H. Kotte, *Z.V.D.I.*, Vol. 76, No. 23, 4/6/32, pp. 545-550.) (13.7/26113 Germany.)

Methods of sound reproduction are discussed concisely. Progress in research and development in Germany have successfully met American film competition and built up an export business. Dialogues in different languages can be synchronised with the same film.

*Vacuum Tube and Photoelectric Tube Developments for Sound Picture Systems.* (M. J. Kelly, *Bell Tele. B.694.*) (13.7/26114 U.S.A.)

From Author's Abstract.—An indirectly heated cathode triode is described which makes it possible to use an a.c. supply in amplifiers having flat frequency characteristics with over-all gains of the order of 100 decibels. A measuring system for evaluating the microphonic noise currents is described and the characteristics of a filamentary cathode tube of low microphonic noise level are given. The characteristics of a double anode, thermionic, gas-filled, rectifier tube for use in a d.c. power supply unit for the sound lamp and vacuum tube filaments of reproducing systems are given. A photoelectric cell of high sensitivity for use in sound reproduction work is described.

*Photoelectric Cells.* (N. R. Campbell, *J. Sci. Inst.*, Vol. 9, No. 12, Dec., 1932, pp. 369-373.) (13.7/26115 Great Britain.)

A lucid exposition is given of the physical elements as a preliminary to discussion of applications in the light of recent improvements in technical detail.

Rectifier cells have usually cuprous oxide or selenium as the element sensitive to light and have the qualities of high emission, cheapness and robustness.

Their constitution is illustrated by a sketch and an equivalent circuit diagram and their current voltage characteristic is shown graphically.

Emission cells produced by the reaction of caesium with oxidised silver are the most sensitive known and approach the gas filled cell which they will probably displace.

The emission curve is very similar to the visibility curve and the agreement may be brought closer by the use of suitable filters, preferably solutions, to admit of adjustment to variations in the emission curves of different cells.

Conductive cells are excluded from uses requiring exact synchronisation by hysteresis but where a time lag is unimportant they offer the simplest solution of photoelectric control requirement.

Twelve references.

*The Caesium-oxygen-silver Photoelectric Cell.* (C. H. Prescott, and M. J. Kelly, *Bell Tele. B.681.*) (13.7/26116 U.S.A.)

From Authors' Abstract.—Technique is described of forming caesium-oxygen-silver photoelectric cells under controlled conditions. The essential conditions are a quantitative control of the degree of oxidation of the silver cathode base and the amount of caesium generated, together with a regulation of the amount of chemical interaction by a control of the time and temperature of the heat treatment.

The active surface of the cathode appears to be a film of free caesium of atomic dimensions absorbed upon a matrix of caesium oxide and silver containing

free caesium and a small amount of silver oxide. The spectral characteristics of the photoelectric response appear to depend largely upon the thickness of the surface film of free caesium. This film thickness is determined by the caesium concentration in the underlying matrix and is maintained by a diffusion equilibrium.

Twelve references.

*Application of Selenium Cells to Physical Measurement.* (L. Bergman, Phys. Zeit., Vol. 33, No. 21, 1/11/32, pp. 824-826.) (13.7/26117 Germany.)

The difficulty arising from variation in the light source is overcome by splitting the beam into two parts by partial reflection from a glass plate set at  $4^{\circ}$ .

One of the beams is reflected by the moving mirror of an instrument and illuminates an area of the photo cell, proportional to the rotation of the mirror.

The other beam is reflected by a mirror rotatable by a micrometer screw, and falls on a second photo cell. An iris diagram controls the intensity of the second beam.

The two photoelectric effects are calibrated so that equal deflections of the instrument mirror and of the controllable mirror produce equal e.m.f.'s, which are opposed to a galvanometer circuit.

In this way the method becomes a null method and is independent of variations in the original light source.

*Interference in Motor Car Receivers.* (L. F. Curtis, Proc. Inst. Rad. Eng., Vol. 20, No. 4, April, 1932, pp. 674-688.) (13.9/26118 U.S.A.)

Sources of interference are the sparking plugs, distributor, interruptor and collecting brushes.

Their relative importance is discussed and methods of shielding are recommended.

Six references.

### Photography

*Photographic Apparatus for Recording the Profile of Model Airscrews.* (Z.V.D.I., Vol. 76, No. 51, 17/12/32, p. 1,255.) (14.0/26119 Germany.)

Reference is made to part 4 of the "Aerodynamic Research publications of Göttingen" in which Muttay describes a special camera.

A new apparatus is being developed for photographing wing profiles in a similar manner.

*Photogrammetric Equipment of "Graf Zeppelin."* (O. v. Gruber, Bildmessung und Luftbildwesen, No. 6, 1931, p. 146—see Z. Instrum., No. 12, Dec., 1932, p. 557.) (14.40/26120 Germany.)

A hand surveying camera with films 18 by 13 cm. and a double series camera with films 13.5 by 12 cm. were provided.

Problems of fixing the orientation and reducing to a common network are discussed.

### External Craft Location

*A New Stroboscopic Radio-compass for Blind Flying.* (R. Hardy, L'Aeron., No. 161, Oct., 1932, pp. 309-315.) (15.05/26121 France.)

The receiving installation has a rectangular rotating frame aerial, a fixed aerial and a 7 valve amplifier. The tuning is recorded by means of Neon tubes either rotating with the frame aerial or driven by a synchronous motor. In the latter case several recorders can be installed in the cabin and the rotating aerial can be housed in the tail. The commutator brush of the rotating aerial and the device for synchronising lamps and aerial are of interest.

Seventeen illustrations.

*Sound, Noise Reduction, etc.*

*Distribution of Sound Intensity.* (N. W. McLachlan, Phil. Mag., Vol. 14, No. 93, Nov., 1932, pp. 747-758.) (15.20/26122 Great Britain.)

Expressions in Legendre functions are obtained for the distribution of sound intensity at a distance from various distributions of sound sources on spheres. Numerical results are given in tables and graphically.

Applications are made to hornless loud speakers.

*Measurement of Noises.* (J. Geschelin, Autom. Ind., Vol. 67, No. 22, 26/11/32, pp. 676-681.) (15.3/26123 U.S.A.)

An elementary account is given of sources of sound, methods of analysis and instrumental equipment.

Two photographs of a three dimensional model show intensity as a function of engine speed and of frequency. As the engine speed rises a chain of peaks spreads upward along the frequency ordinates.

Of some ten peaks only one was found to indicate resonance with natural periods in the car and its suppression met practical requirements.

Seven references.

*Interception of Sound Waves by Partition Walls.* (R. Berger, Forschung, Vol. 3, No. 4, July/Aug., 1932, pp. 193-202.) (15.38/26124 Germany.)

The material, density and sand or water loading of 16 experimental plates of 4 sq. metres and 13 plates of 1 sq. metre are specified in tabular form. The details of the mounting of an experimental plate and its position separating two closed chambers are shown to scale in four sketches.

The results are collected in 18 graphical charts and include the effects of resonance and of the size and distribution of orifices in the partition.

Elementary physical relations are stated and simplified expressions suffice for comparison of the results of different experimenters.

(The use of a variety of inconsistent units from different international sources is confusing.)

*Accidents and Precautions*

*Safety Explosives in Mines.* (Z.V.D.I., Vol. 76, No. 53, 31/12/32, p. 1,294.) (16.05/26125 Germany.)

The range of safe applications of explosives in mines is considerably widened by preventing the ejection of burning fragments of explosive from bore holes, which may produce explosions in gaseous mixtures.

*Aircraft, Unorthodox*

*Autogiro.* (Aero Digest, No. 5, Nov., 1932, p. 56.) (17.05/26126 U.S.A.)

A brief specification is given of a Pitcairn autogiro P.A.19.

A photograph shows details of interest—closed cabin, streamlined pylon, engine ring and wings of appreciable area (30½ft. span).

*The Clinogyro.* (L'Aéron., No. 160, Sept., 1932, pp. 274-276.) (17.05/26127 France.)

The rotating wings are not hinged at the centre as in the autogiro, but oscillate as a whole about the axis of rotation. The device is covered by patents. A full-scale "clinogyro" has been built with rotating wings of 18-foot span, speed of rotation 400 r.p.m., lowest flying speed 30 m.p.h. It is stated that successful flights have been made.



*Tail-less Aeroplanes.* (A. Lippisch, Z.F.M., Vol. 23, No. 22, 28/11/32, pp. 653-658.) (17.30/26128 Germany.)

A diagram shows three plan forms of wings with wing tips forward of the centre section (sweep forward), in line with the centre section and aft of the centre section (sweep back). In parallel columns are shown the distributions of lift imposed by considerations of stability.

A wing profile with stationary centre of pressure is desirable, but has the disadvantage of negative loadings on the swept back wing tips, which are hinged and used for pitching and rolling control. The flaps must accordingly have balanced moments.

Göttingen profile No. 716 was found suitable and the polar curves are given for three different flap positions. The polar characteristic is also given graphically when a slot is formed between wing and flap.

A tail-less aeroplane constructed on the result of this preliminary work is shown in photographs, along with models and sketches of projected large scale aeroplanes.

Reference is made to the Junkers large aeroplanes or "flying wings," as well as to the G.38 (18 tons-24 tons), Jn.52 (5 tons-9 tons), J.48 (1.5 tons-2 tons).

### *Meteorology*

*Wire (Telegraph) Communications in Air Transport.* (H. H. Nance, Bell Tele. B.680.) (19.10/26129 U.S.A.)

The organisation of U.S.A. telegraphic weather services is based on teletypewriter equipment. A map shows the ground telegraph system for airport service and the radio service. A weather map shows the nature of the information circulated.

Eleven references.

### *Aircraft Apparatus*

*Oxygen Face Masks.* (Aero Digest, No. 5, Nov., 1932, p. 42.) (19.32/26130 U.S.A.)

A brief descriptive account is given of a face mask, tested in the low temperature chamber at Wright Field. The oxygen stream is diverted by a baffle plate to produce mixing before inhalation.

Rubber pads separate the eyes and goggles from the breathing space to prevent internal fogging.

### *Seaplanes, Handling Accessories*

*Flotation Gear.* (U.S. Air Services, Vol. 17, No. 11, Nov., 1932, p. 38.) (20.34/26131 U.S.A.)

Low cloud and poor visibility caused six two-seater bombing aeroplanes launched from U.S.S. Lexington, to lose the mother ship. Two aeroplanes landed on an island and four in the sea. Emergency flotation gear and rafts were inflated with CO<sub>2</sub>, all eight occupants were rescued and two of the four aeroplanes were salvaged. The two lost aeroplanes sank while being towed, on account of leaks caused by chafing.

*Air Rafts.* (Aero Digest, No. 5, Nov., 1932, p. 42.) (20.34/26132 U.S.A.)

A brief description is given of a new design of raft with duplicate concentric inflation tubes, either of which may be inflated to the full designed volume from a cylinder of carbon dioxide gas. The raft is canoe shaped and provided with oars and rowlocks. The largest size, designed for four passengers, will carry six or seven, with additional five men holding on to life lines.

*Aerodynamics and Hydrodynamics*

*Experiments with Capillary Jets.* (E. Tyler, *Phil. Mag.*, Vol. 14, No. 94, Supplement, Nov., 1932, pp. 849-881.) (22.10/26133 Great Britain.)

The break up of capillary jets into globules is investigated experimentally with a number of different combinations of fluids in the jet and in the surrounding medium.

An attempt is made to generalise Rayleigh's results for an inviscid fluid by adding a non-dimensional empirical factor.

Experimental results are tabulated and plotted and about fifty photographs are reproduced.

*Plane Potential Flow of an Inviscid Compressible Fluid.* (G. Braun, *Ann. d. Phys.*, Vol. 15, No. 6, Dec., 1932, pp. 645-676.) (22.10/26134 Germany.)

A potential function is assumed and substituted in the equations of state, motion and continuity, yielding a partial differential equation of the second order with variable coefficients containing squares and products of the first order derivatives.

Solutions are classified and a discussion is given of particular solutions given by Prandtl, Taylor, Bateman and others, by assuming special forms of the boundary conditions or by approximations.

In discussing the general problem the methods of the calculus of variations are applied. The variation of a certain double integral is equated to zero. The integrand is expressed in derivatives of the potential function expressed as a sum of two functions and reduced to linearity by suitable approximations.

Particular values of a parameter corresponding to wave lengths in the motion yield particular solutions.

Numerical applications are worked out for flow past a cylinder and the results are given in tables and curves.

Numerical comparisons are made with G. I. Taylor's work and show fair numerical agreement.

*The Modification of a Vortex by Dissipation.* (G. Serragli, *L'Aerotecnica*, Vol. 12, No. 10, Oct., 1932, pp. 1,311-1,321.) (22.10/26135 Italy.)

The author finds expression in Bessel functions of zero order for the redistribution of velocity as a function of radial distance from the axis and of time.

Experiments with a rotating cylinder of small diameter in a cylindrical vessel illustrate qualitatively the increase of the radius at which maximum velocity exists.

*Two Dimensional Flow of a Compressible Fluid.* (L. Poggi, *L'Aerotecnica*, Vol. 12, No. 12, Dec., 1932, pp. 1,579-1,593.) (22.10/26136 Italy.)

The equation of continuity for a compressible fluid is formed. Rayleigh's method of solution is discussed and a modification is applied to a circular cylinder. The results are compared with Rayleigh's and G. I. Taylor's experimental results.

An application to a Joukowsky profile is suggested.

*Flow in Annular Pipes.* (Forschung, Vol. 3, No. 5, Sept./Oct., 1932, pp. 258-259.) (22.2/26137 Germany.)

Measurements are given for a pipe of 19 cm. dia. without core and with cores of 1, 3, 5 and 10 cm. dia.

The results are plotted against Reynolds parameter, in comparison with the results of other experimenters.

The question of roughness of walls is discussed as possibly affecting the conditions of dynamic similitude even when they are "commercially smooth."

*Empirical Formulae for Flow in Smooth Pipes.* (J. Nikuradse, Forschungsheft, No. 356, Sept./Oct., 1932.) (22.2/26138 Germany.)

A historical summary is given of recent literature. A full technical description is given, with photographs and sectioned drawings, of the elaborate installation set up at the Göttingen laboratory for observation and measurement of flow in pipes. Measurement of the velocity is discussed and a method of reduction by extrapolation up to the wall of the pipe is given, but the results are in contradiction with the equation of hydrodynamics of a viscous fluid. Extensively observed and transformed data are collected in nine tables and shown graphically in numerous diagrams.

The mean velocity curve as a function of radial distance from the walls of the pipe varies with increasing Reynolds number and approaches a limit asymptotically.

The analogy between turbulent motions and the kinetic theory of gases is discussed, and a parameter is introduced as a function of shear forces and radial gradient of mean velocity, which gives considerable unity to the empirical treatment and is closely related to Taylor's coefficient of eddy viscosity.

V. Kármán's and Prandtl's applications of the principles of dynamical similitude are summarised and discussed in reference to various transformations of the form of the experimental results.

The general aim of the methods is the placing of the observed values thus transformed upon unicursal curves of a simple form, in particular on straight lines, by introducing Reynolds number as a parameter in the manner suggested by the particular assumption made.

*Pressure Loss in Smooth Straight Pipe.* (H. Richter, Z.V.D.I., Vol. 76, No. 52, 24/12/32, pp. 1,269-1,271.) (22.2/26139 Germany.)

Experiments were carried out on commercial brass tubing 20 mm. diameter and  $\frac{1}{4}$  in. long at Reynolds numbers from 22,000 to 1,200,000. Compressed air at various pressures give more uniform results than water containing dissolved air. The latter affects the viscosity and may introduce complications by its liberation under reduced pressure. The resistance coefficients are applied to the graduation of a straight pipe air meter which possesses the advantages of extreme simplicity for accurate reproduction.

*Measurement of Critical Velocity by Pitot Tube.* (E. Tyler, Phil. Mag., Vol. 14, No. 94, Supplement, Nov., 1932, pp. 990-1,003.) (22.3/26140 Great Britain.)

The formation of eddies at the nozzle of a pitot produced audible notes. The appearance of the note indicates the breakdown of flow at the critical speed. The pitch of the note determined the frequency of the eddies. A large number of observed values is given graphically and in tables.

*Calculation of Wind Stresses in Cylindrical Containers under Wind Pressure.* (K. Girkmann, Sitzungberichts des W. Akad, Vol. 141, No. 9/10, 1932, pp. 651-672.) (22.4/26141 Austria.)

The distribution of wind pressure is taken from aerodynamical laboratory results.

The equations of elastic equilibrium are formed and solutions found which satisfy the boundary conditions expressed in Fourier series.

Some numerical results are tabulated.

Seven references.

*Rotary Oscillations of a Cylinder in a Viscous Fluid.* (H. F. Winny, *Phil. Mag.*, Vol. 14, No. 94, Supplement, Nov., 1932, pp. 1,026-1,032.) (22.45/26142 Great Britain.)

A long circular cylinder was oscillated in nearly harmonic motion with an amplitude of 2.54 cm. and a frequency of 0.2 to 0.5 per sec. The flow was observed by the motion of aluminium powder.

The observed motions lie fairly well on a curve drawn from Kelvin's solution in Bessel functions. A boundary layer is defined by the surface at which the amplitude falls to 1 per cent. of the maximum value, and is of the same order as that given by Blasius for a flat plate.

*Boundary Layer Round Airship Model.* (H. B. Freeman, N.A.C.A. Report No. 430.) (22.6/26143 U.S.A.)

A 1/40 scale model of the Akron was used, 19.62ft. overall length.

The boundary layer increased from 0.08in. depth at 15in. from the nose of the model to 10in. depth at the tail.

The velocity distribution is plotted for nine stations and various empirical formulæ are fitted to the experimental curves.

The loss of momentum in the boundary layer accounts substantially for the drag. The transition from laminar to turbulent flow is marked by changes in velocity distribution and in rate of change of depth of boundary layer.

### *Materials, Elasticity and Plasticity*

*Plastic Strength of Soft Materials.* (R. K. Schofield and G. W. S. Blair, *Proc. Roy. Soc.*, Vol. 138, No. A.836, 1/12/32, pp. 707-718.) (23.10/26144 Great Britain.)

Maxwell's time of relaxation is defined mathematically for a viscous fluid, and the conception is generalised for application to a plastic body.

Experiments on baker's dough yielded figures which were reproducible with some accuracy, and these are shown graphically in seven diagrams.

The authors consider that light is thrown on the phenomena of the hardening of metals under mechanical working.

Sixteen references.

*Theory of Resonance Dampers.* (O. Föppl, *Z.A.M.M.*, Vol. 12, No. 5, Oct., 1932, pp. 257-260.) (23.10/26145 Germany.)

An elementary example is constructed in which the damping term is linear and the solution is obtained in the usual way.

*Solid Viscosities of Metals.* (K. Sezawa and K. Kubo, *Aer. Res. Institute, Tokyo*, Report No. 89, Dec., 1932.) (23.10/26146 Japan.)

Dealing first with the experimental part, bending vibrations of strips of various metals and alloys were observed at pressures of one atmosphere,  $\frac{1}{2}$  atmosphere and in high vacua (of the order of 1/1,000,000 atm.) with some intermediate pressures.

The test pieces were of 10 mm. by 1 mm. section with a free length of 150 mm. or 180 mm. and a maximum end deflection of 2 mm. to 5 mm. Logarithmic damping was assumed and the coefficients determined by experiment are shown graphically. These curves are all approximately linear and are extrapolated to meet in a point at zero amplitude. The point of intersection is, however, not one of zero damping coefficient, but of the order of half the maximum damping coefficient observed.

This negatives the assumption made in Part I that Young's modulus  $E$ , in the simplified equation of bending vibrations can be replaced by  $(E + \xi\partial/\partial t)$ .

The simplest mathematical hypothesis is that the shearing stress has two additive components, one proportional to the shearing strain and one to the time rate of shearing strain. The general equations formed on this assumption are given in Ibbetson's *Elasticity*, Chap. X.

In deriving the authors' equation a further linear relation must be assumed connecting hydrostatic pressure with viscous shearing stress, with the introduction of another constant (see Filon and Jessop, *Trans. of the Royal Society, Series A*, Vol. 223, 1923, p. 95, "stress optical effects in solids strained beyond the elastic limit") and reductions and further approximations are required.

In view of the general disagreement of a mass of experimental observations with values given by such hypotheses the mathematical part merely provides exercise in the solution of linear differential equations with constant coefficients.

See Abstracts 26147 and 26148.

*Effect of End Pressure on Bending Oscillations with Internal Damping.* (K. Sezawa, *Z.A.M.M.*, Vol. 12, No. 5, Oct., 1932, pp. 275-279.) (23.10/26147 Germany.)

The equations are formed with a term proportional to rate of shear. The approximate methods of solution are of interest, but the numerical values for the coefficient of viscosity which is assumed to exist can only be regarded as mean values. (See Abstract No. 26146.)

Seven references.

*Theory of Visco-Elasticity.* (J. H. C. Thompson, *Phil. Trans. Roy. Soc.*, Vol. 231, No. A.703, 13/3/33, pp. 339-407.) (23.10/26148 Great Britain.)

The assumption that resistance to strain is a linear function of rate of strain as well as of strain involves 36 coefficients of rate of strain corresponding to the 36 coefficients of elastic strain. In practice isotropy is assumed and two new coefficients are introduced.

The author gives a historical account of the development of the subject and proceeds to discuss a number of mathematical consequences. In application to isotropic cylinders two strain coefficients and two rate of strain coefficients are assumed.

(Experimental results do not support this assumption. See Abstract 26146.)

*Photo-Elasticity.* (D. L. Pellett, *S.A.E. Journal*, Vol. 31, No. 6, Dec., 1932, pp. 469-474.) (23.15/26149 U.S.A.)

Reference is made to the work of Filon and Coker in the development of the physical principles and technical applications.

An interesting example of a celluloid model wing rib is shown in photograph and dimensioned sketch.

A table of stresses is given with a diagram of stress distribution round a triangular bay.

*Stress Optical Photographs of Angles and Double Hooks.* (L. Kettenacker, *Forschung*, Vol. 3, No. 2, March/April, 1932, pp. 71-78.) (23.15/26150 Germany.)

Eleven graphical stress fields are drawn from stress optical observations. An empirical formula is constructed which gives useful approximations for a wide range of practical applications.

Sixteen references.

*Secondary Bending Stress in Double Channel Sections.* (B. v. Schlippe, *Z.F.M.*, Vol. 23, No. 21, 14/11/32, pp. 625-627.) (23.30/26151 Germany.)

The report is an abstract of an extensive series of investigations carried out in Junker's research department.

A test span is shown in photograph and in sketches lettered in accordance with the symbols used in a mathematical investigation.

Approximate formulæ are developed and a numerical example is worked out and is stated to differ from the test result by about 7 per cent.

*Elastic Stability.* (A. F. Cornock, Phil. Mag., Vol. 14, No. 94, Supplement, Nov., 1932, pp. 881-896.) (23.30/26152 Great Britain.)

A method of calculating crippling loads of struts and whirling speed of shafts from an initial "reasonable" assumption by successive approximations is developed from Picard's method for solving a linear differential equation with coefficients which are functions of the independent variable.

Numerical examples are worked out and a great saving in computation is claimed in comparison with previous methods.

Reference is made to the work of Rayleigh, Southwell and others.

*Elastic Oscillations of a Mass Supported by a Cantilever Spring.* (M. Rossiger, Ann. d. Phys., Vol. 15, No. 6, Dec., 1932, pp. 735-740.) (23.46/26153 Germany.)

The motion is compounded of the angular and linear velocities superposed. The equations are formed in the usual way and solved for several cases of interest. Twenty-four references.

*Mechanical Vibrations.* (B. E. Eisenhour and F. G. Tytzer, J. Franklin Inst., Vol. 214, No. 6, Dec., 1932, pp. 691-707.) (23.46/26154 U.S.A.)

Elementary equations are formed for the forced vibration of a simple elastic system with and without damping. A sketch shows simple apparatus for measuring the elastic properties of various materials in the form of pads for reducing the mechanical transmission of vibrations.

Numerical tables are given of natural frequencies of 1 in. sheets of various materials in comparison with a helical spring for different loads per unit surface.

Variation of thickness and elastic stiffness with pressure is shown graphically for cork, felt and wood fibre board.

Four references.

*Damping of Oscillations by Internal Friction.* (G. Bock, Z.A.M.M., Vol. 12, No. 5, Oct., 1932, pp. 261-274.) (23.46/26155 Germany.)

The hysteresis loop is replaced by an ellipse of the same area and approximately the same maximum and minimum diameters.

This substitution renders the differential equations of motion soluble in elementary functions, neglecting the variation in the loop with varying amplitude. Examples are worked out on these lines and resonance curves are plotted with and without damping.

Ten references.

### Miscellaneous

*Saturation Pressures of Steam.* (A. Egerton and G. S. Callendar, Phil. Trans. Roy. Soc., Vol. 231, A.698, 1/12/32, pp. 147-205.) (0/26156 Great Britain.)

The main object of the paper is to compare the properties of steam in motion with determination of steam at rest in equilibrium, with water in a closed vessel. No appreciable differences were found.

Extensive data are given in tables and compared with the results of other workers. It is considered that tables can be constructed in which the condition of thermodynamical consistency is satisfied, and the permissible limits of error are reducible within small limits. The fit of empirical equations is discussed and



the hope is expressed that a physical relation may finally be established, on the lines of Van der Waal's equation. The experimental installation and methods are fully described.

(The use of pounds and inches seems an unnecessary complication in physical tables of international significance.)

*Technical Research in Germany—Index of work in hand at Universities and High Schools.* (Z.V.D.I., Vol. 76, No. 42, 15/10/32, pp. 998-1,024.) (0/26157 Germany.)

An index of 1,500 entries exhibits the wide range of active research in German Laboratories. An introductory note urges the importance of maintaining outstanding quality in German products if the present difficulties and tariff walls are to be overcome. Quality can only be maintained if the manufacturer is in touch with the latest research developments. The V.D.I. will foster such intercourse by a series of meetings where technical processes can be discussed.

*Sixth International Cold Storage Congress at Buenos Aires.* (Z.V.D.I., Vol. 76, No. 53, 31/12/32, p. 1,300.) (0/26158 Germany.)

By inserting conical blocks of solid dry  $\text{CO}_2$  in refrigerator chambers the temperature of the chamber is kept between  $-10^\circ\text{C}$ . and  $+8^\circ\text{C}$ . For the smallest refrigerator (clear space 100 by 50 by 30 cm.) the consumption is about 20lb. of  $\text{CO}_2$  in a fortnight. Carbonic acid gas is manufactured in conjunction with alcohol, which is mixed with petrol to form a "national" fuel.

*The Future of Technical Publications.* (Z.V.D.I., Vol. 76, No. 53, 31/12/32, p. 1,303.) (0/26159 Germany.)

The engineer should be conversant with recent development. Technical abstracts should be sufficiently full to give useful information. Rigid sub-division is required, each sub-division being edited by an expert in the particular branch of engineering. The research worker would know what has been already done and the high cost would be recovered by elimination of the present overlap.

*Unification of Symbols in German Aeronautics.* (H. Blenk and G. Mathias, Z.F.M., No. 22, 28/11/32, pp. 663-669.) (0/26160 Germany.)

The principal German sources are collated with British and U.S.A. terminology. The large number of letters with suffixes in the German list is a symptom of the pressure on the letters of the alphabet (including borrowings from German and Greek characters).

There is in general more disagreement than agreement with British and American symbols, the two latter being closely related.

(A sort of "metric slug" is introduced as one kg. mass  $\times$  local acceleration of gravity. It is of different dimensions from the British "slug" which is a mass of one lb. multiplied by the numerical value of local gravity. The object of both units is no doubt to make rational mechanics easier for engineers.)