ABSTRACTS AND NOTICES

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PHYSICS AND ENGINEERING SCIENCE

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PART I.—PHYSICS AND ENGINEERING SCIENCE

Aircraft Design

Influence of Weight of Spar on the Span and Performance of Large Aeroplanes. (E. V. Lossl, Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, p. 1548, Rept. of W.G.L.) (5.154/20251 Germany.)

The conclusion is reached that an economic limit to the size of giant aeroplanes is in the neighbourhood of 100 tons.

Wing Profiles—Catalogue, Nos. 201-225. (Services des Recherches de l'Aéronautique, Nov., 1930.) (5.20/20252 France.)

Twenty-five profiles, mostly French, but some American, are drawn accurately to scale on squared paper, and their aerodynamical qualities are given in tables and graphically.

Pressure Distribution over a Symmetrical Aerofoil Section with Trailing Edge Flap. (E. N. Jacobs and R. M. Pinkerton, N.A.C.A. Rept., No. 360, 18 pp.) (5.206/20253 U.S.A.)

A photograph shows the arrangement whereby the trailing edge flap can be set by means of graduated end flanges to a series of angles. Profile diagrams show two models, one with the flap 10 per cent. of the chord and the other 20 per cent. of the chord. The pressures were observed by manometer, led to holes pierced in the surface. The observed distributions are applied for different settings and Reynolds numbers. Thirty diagrams are given.

Besides pressure distribution, normal forces, pitching moments, flap lead and hinge moments were measured and plotted graphically. The normal force increases up to as much as 40° flap setting. Further investigation is recommended. Ten references are given.

Vibration of Cantilever Wings. (M. R. Bouchenot, Rev. S.G.A., Oct., 1930, pp. 16-20.) (5.26/20254 France.)

The author gives an elementary theory of vibration of wings and concludes that the torsional rigidity is the most important factor in determining the lowest critical speed. A photograph is given of monoplane cantilever construction with internal bracing mounted for the determination of the torsional rigidity, and the critical speed is shown graphically as a function of the torsional rigidity.

Metal Monocoque Fuselage Construction. (R. W. Mossman and R. G. Robinson, N.A.C.A. Tech. Note, No. 357, Nov., 1930, 44 pp.) (5.45/20255 U.S.A.)

Dimensioned drawings and photographs give full details of the mounting of the experiment, including typical failures by local buckling. An elementary mathematical theory is given and numerous test results are tabulated. Deflections are tabulated and plotted against loads.

Seaplane Floats. (Report of the 19th W.G.L. Gen. Mtg., Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, pp. 1548-1549.) (5.51/20256 Germany.)

The impact of a long prism on the surface of water displaces an effective mass of fluid and sets up a pressure distribution which has a mathematical solution in the two-dimensional problem. A sharp wedge keel does not set up impulsive reactions such as are produced by a flat bottom float. Measurements of the pressure on the hulls and stress measurements on the supporting members of floats show that the forces on striking the water may be six times the weight of the machine, in agreement with calculated results.

Seaplanes. (Report of the 19th W.G.L. General Meeting. P. Schröder, Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, pp. 1548-1549.) (5.51/20257 Germany.)

Hydrodynamic similarity shows that towing experiments on seaplane floats are only comparable when the ratio of the load carried to the square of the towing velocity is constant.

Airscrews

Aerofoils of Circular Arc Section for Use at High Speeds. (L. J. Briggs and H. L. Dryden, Phys. Rev. (2) 35, 1416-1417, 1930, No. 11 (Berichte, No. 21, 1930, p. 2203).) (5.60/20258 U.S.A.)

As the speed of sound is approached the aerodynamical properties of blade profiles suitable for airscrews change, the resistance coefficient increases rapidly and the normal reaction falls off. It has been found that crescent-shaped profiles are suitable for high velocities of the wing tip. The investigation shows that slight rounding of the sharp edges brings further small advantages. At 95 per cent. of the velocity of sound thin profiles which are segments of circles are decidedly better than the usual forms. On the other hand at 50 per cent. of the speed of sound the usual profiles, well rounded at the leading edge, are better.

For airscrews with tip speeds approaching that of sound a circular segment profile should be used at the tips, slightly rounded profiles near the tips and the usual type of profile for the rest of the blade.

Airscrews, Effect of Cutting off the Tips, Wind Tunnel Tests. (D. H. Wood, N.A.C.A. Rept., No. 351, Oct., 1930, 25 pp.) (5.610/20259 U.S.A.)

A standard metal airscrew of 10 feet diameter, running to a fairly sharp tip, was diminished successively to $9\frac{1}{2}$, 9, $8\frac{1}{2}$ and 8 feet diameter by cutting off the tips. It was tested for each diameter at four pitch settings. The results are

given in extensive tables and graphically; they are in conformity with airscrew theory and show a small decrease of efficiency with diameter. The data are useful to the designer who wishes to adapt an existing airscrew by change of diameter.

Influence of Aeroplane Surfaces on the Propulsive Efficiency of the Airscrew. (F. Weinig, Z.F.M., Vol. XXI, No. 8, 28/4/30, pp. 196-200.) (5.614/20260 Germany.)

Efficiencies are given graphically for an ideal airscrew with an infinite number of blades.

The disturbance of the relative streamlines by a surface of revolution is considered and the correction for a finite number of blades is introduced.

A numerical example is worked out by the new method and by an older method, the figures being 0.530 for the former and 0.612 for the latter.

Metal Airscrew Construction Methods. (L. D. Webb, Aviation, Vol. XXIX, No. 5, Nov., 1930, pp. 299-301.) (5.654/20261 U.S.A.)

A survey is given of the practicable methods of design of airscrews in light alloys with solid blades or in high tensile steel with hollow blades. Methods of design and manufacture employed by various U.S.A. firms are briefly described.

U.S. Government whirling tests for new types of airscrews are described with application to a magnesium alloy airscrew. Corrosion by salt water is troublesome, and anti-corrosion precautions are specified. The manufacture of hollow steel blades is described and illustrated by photographs. Apparently tests were made with hollow steel airscrew blades as exhaust mufflers, the exhaust gases passing through a collector-ring near the hub, but were not completed owing to failure of the collector-ring assembly.

Instruments, etc.

The Cluzel Calculator as an Aircraft Instrument. (L'Aeron., No. 138, Nov., 1930, pp. 401-402.) (6.53/20262 France.)

By this apparatus the path of an aircraft may be determined without calculation or plotting, as a function of three sightings of any point on the ground taken at constant time intervals.

(The ground velocity is assumed to be known in magnitude and direction. Neglect of the height is equivalent to shifting the course parallel to itself.)

Course Deviometer. (Aviation News, 25/10/30.) (6.55/20263 U.S.A.)

The relative sensitivity of two reeds of a vibrating reed indicator is made unequal. The course of equal amplitudes of vibration is therefore off the course indicated by reeds of equal sensitivity.

A variable resistance inserted in either reed circuit may be calibrated in degrees to right or left of the equi-signal plane, the effective angular range being $\pm 15°$.

Various applications are suggested.

Application of Navigation to Aircraft. (H. P. McLean Connor, U.S.N. Inst. Proc., Vol. LVI, No. 12, Dec., 1930, pp. 1065-1073.) (6.9/20264 U.S.A.)

A monoplane named the "Columbia" with an airspeed of 90 to 100 m.p.h., was fitted with a small navigator's compartment and equipped with navigating instruments as follows:—

Earth inductor compass.
Cowling magnetic compass.
Cabin magnetic compass.

(These compasses were checked for deviation and remained accurate throughout).

Octant, with bubble attachment.
Aero-chronometer.
Three watches.
Nautical almanac and tables.
Aircraft plotting sheet.
Celluloid plotters.
Parallel rulers.
Dividers.
Chart table, 2ft. by 3ft.
Sperry artificial horizon and the usual flying equipment of instruments.
Fuel 333 gallons, 15 gallons lubricating oil.
Total flying weight 4768 lbs. at start.
Ground speed of engine 1600 r.p.m.

A descriptive account, tabular logs and charts of the flight by dead reckoning and astronomical observation are given. The course was from New York to Bermuda and back non-stop. The maximum deviation from course appears to have been about fifteen miles. The average ground speed was 83 m.p.h. with fuel consumption 12 gallons per hour running south; and 108 m.p.h. and fuel consumption 14 gallons per hour running north. The total flying time was seventeen hours.

A New Consistometer. (R. Bulkley and F. G. Bitner, B. Stan. Jrnl., Vol. V, No. 1, July, 1930, pp. 83-96.) (6.225/20265 U.S.A.)

Author's abstract:—A consistometer is described which is suitable for determining the consistency of viscous and plastic materials in general, but which is more particularly advantageous in obtaining flow-pressure diagrams for materials which change rapidly in consistency with time or which show a breakdown of structure with mechanical working. The limitations of some commonly used instruments are discussed, and the sources of error in the present instrument are pointed out. Flow-pressure graphs of a cup grease at different temperatures and of various plastic oils at 0°C. are shown.

The importance and the significance of the unworked consistency of the undisturbed material and of the thoroughly worked consistency of the completely broken down material are discussed. The methods of measuring these properties of the material with the new instrument are described in detail.

Viscosimeter for Small Quantities of Fluid. (E. Madelung, Z. Inst., Vol. L, No. 11, Nov., 1930, pp. 647-649.) (6.225/20266 Germany.)

The rate of descent of a sinker in a vertical glass tube measures the viscosity. Rotation of the tube keeps the sinker centralised and prevents contact with the walls.

Instrument for Determination of Thermal Expansion of Solid Bodies at High Temperatures. (H. Gerdien and W. Jubitz, Z. Inst., Vol. L, No. 11, Nov., 1930, pp. 653-655.) (6.10/20267 Germany.)

The apparatus measures the expansion of solids up to temperatures at which softening of fire resisting material takes place. The sample is heated in an electric oven and its length recorded by two invar pointers which touch the specimen at each end. The pointers are cooled and interlinked so that their separation can be accurately recorded. In order not to cool the specimen the actual time of contact

is reduced to one-tenth of a second whilst the contact pressure can be reduced to a few grams.

Measurement of Small Electrical Currents. (Inst. World, Vol. III, No. 31, Nov., 1930, p. 156.) (20268 Great Britain.)

It is claimed for a valve developed by the G.E.C. of America that 10^{-17} ampere may be measured. The grid current is reduced to a low value by careful attention to the following sources:—

(1) Electrons from the filament.
(2) Exhaustion of the tube.
(3) Temperature of the grid.
(4) Leakage of positive ions from the filament.
(5) Effect of light from the filament.
(6) Soft X-rays from the plate.

Photo-Elastic Dispersion of Vitreous Silica. (L. N. G. Filon and F. C. Harris, Proc. Roy. Soc., Vol. CXXX, No. A.813, 1/1/31, pp. 410-431.) (6.86/20269 Great Britain.)

Anomalies in the photo-elastic dispersion of pure silica glass previously noted by Filon are now examined in more detail, and certain periodicities are brought out, possibly connected with the natural periodicities of the element silicon. This affects the interpretations of photo-elastic phenomena, but fortunately not beyond a small fraction of the mean numerical values, so that their usefulness for engineering purposes is unimpaired.

Lag of Aircraft Thermometers, Thermographs and Barographs. (H. B. Henrickson, B. Stan. Jrnl., Vol. V, No. 3, Sept., 1930, pp. 695-709.) (6.71/20270 U.S.A.)

Photographs exhibit a strut thermometer, a distant indicating thermometer, a minimum temperature strut thermometer, an electrical resistance thermometer, a combined temperature, pressure and humidity meteorograph, and a combined barograph and thermograph. Descriptive specifications are given of twenty-one thermographs and of four barographs tested, and the time lags are tabulated for an air stream of 17 miles per hour, for the case of the thermographs, and of 10 miles per hour for the barographs. Sketches show the temperature elements for each of the 21 thermometers and thermographs tested.

The thermometer lags vary from 72 seconds for a thermometer with a liquid in a metal tube to 3 seconds for a wire electrical resistance element. In the case of the barographs the lag in still air varies from 74 minutes to 22 minutes, and in a current of 10 miles per hour from 14 minutes to 5 minutes.

An elementary theory of cooling is given and the results are recorded graphically.

Stability and Control

Manœuvrability and Spin, Flight Research. (J. W. Crowley, S.A.E., Vol. XXXVII, No. 6, Dec., 1930, pp. 665-670.) (7.40/20271 U.S.A.)

From author's abstract:—Descriptions of instruments and test methods used and some of the results obtained in the research on manœuvrability and spins are given. The instruments described include a recording accelerometer, a recording turn-meter, and a recording air-speed meter, for measuring accelerations and angular velocities in any manœuvre and speed of flight.

Methods of integrating the records obtained in order to plot the flight path of an aeroplane in any manœuvre, as in a loop, are described. Some of the results obtained are given.

An accurate method for determining the flight path and motion of an aeroplane during a spin and the forces and moments acting on it has been evolved, which permits the investigation of the effect of changes to the aeroplane on the spin characteristics.

Aeroplane Spin; A Symposium of Papers. (S.A.E., Vol. XXVII, No. 5, Nov., 1930, pp. 560-582.) (7.62/20272 U.S.A.)

(1) Lieut. C. B. Harper, p. 560. The control experiences of the pilot in going into and coming out of various types of spin are given in considerable detail. Spins are divided into three types, normal, controlled and " vicious." " Vicious " spins are classified as flat, either slow or fast, and finally as " peculiar." Pilots with sufficient experience to interpret spin experiences do not care to put an aeroplane into a well developed vicious spin, from which it appears that recovery is impossible and chances of escape by parachute slight. Confidence is expressed in the effective action of slots in helping to bring an aeroplane out of a vicious spin.

(2) T. N. Joyce. The author was taught in 1918 by a French instructor as a professional secret how to come out of a flat spin. In 1928 after two fatal accidents he had to carry out type tests, and he gives a descriptive account of the manœuvres employed in going into and coming out of a spin. Thereafter 50 per cent. increase in elevator area and 20 per cent. in rudder area were applied, and gave additional control. Further experiments are described on different types, which lead to the impression that no satisfactory solution of the general problem was reached, from the variety of the unexpected effects experienced. The existing nomenclature is considered inadequate for descriptive purposes.

(3) G. P. Reed, p. 566. The author considers the flat uncontrolled spin as the limit of a stalled spiral. Elementary mathematical considerations are introduced for a particular type. Various modifications were applied by trial and error and finally the cure of vicious spin was effected in a low wing monoplane by shifting the centre of gravity backwards and placing it higher. This was contrary to the opinion previously held by the designer.

(4) P. E. Hovgard, p. 571. A series of spinning experiments was carried out with ballast applied at different positions, including the wing tips. The conclusion was reached that an increase of 50 per cent. to the horizontal tail surface was the most effective modification.

(5) H. A. Sutton, p. 573. Experiments were carried out with different distributions of a ballast. Increased moments of inertia about rolling and yawing axes were found detrimental. The single definite conclusion is reached that the quickest method of recovery is to put the control lever full forward and the rudder full against the direction, in which positions they are held until the rotation stops.

(6) F. E. Weick, p. 578. An account is given of the origin of the problem of spinning with an elementary mathematical statement of the quantities involved. It appears that N.A.C.A. have completed a vertical wind tunnel for auto-rotation and spinning tests in which the conditions as to radius, angular velocity, vertical velocity, and attitude in the full scale spin will be reproduced by a complete model.

Flat Spin. (R. Fuchs and W. Schmidt, Z.F.M., Vol. XXI, No. 13, 14/7/30, pp. 325-333, No. 14, 28/7/30, pp. 359-364.) (7.62/20273 Germany.)

Three different sets of axes used are defined. The equations of motion are formed with respect to moving axes about which the coefficients of lift, drag and moments are shown as functions of incidence and of the spin angular velocity. The calculated path velocity, angular velocity about the vertical axis in space and angle of bank are shown graphically as functions of incidence for a path angle of $-87°$. The moments about the rolling and pitching axes, along with coefficients of the couple imposed by the air forces and the gyroscopic couple, are shown separately.

In the course of the computations it was found that the angle of incidence and the angular rotation about the path axis are the principal variables. Neither of these can be measured in a wind channel nor inferred from full scale measurements of resistance, lift and moment in steady flight. The latter quantities are so heavily altered that they cannot be taken as independent of the spin rotation, as has been done by some authors. The cross force can be neglected. The only rolling moment to be considered arises from the air forces on the wing set up by the spin. The moment about the normal axis depends on the wing forces and the forces on the tail unit and the latter always have a damping effect. These forces are only in equilibrium at definite limiting value of the ratio:

$$\frac{\text{Span} \times \text{angular velocity of spin}}{\text{twice airspeed.}}$$

Given the angles of bank and yaw the incidence is determined by equating moments and the conditions of spin are determined. In a full scale experiment the values were:—

Angle of path $-87°$.
Path speed 25 metres per second.
Angular velocity of spin 5 radians per second.
Incidence 60°.
Angle of bank, small.

The investigation of disturbances from a steady flat spin depends on the integration of the fundamental equations corresponding to equilibrium of the forces and moments. These may be transformed and simplified so that the variables can be separated, and a solution obtained for the all-important incidence. Information is thus obtained as to the manœuvres which will bring the aeroplane out of the spin.

One of the methods considered of coming out of a spin is a sudden increase in the fixed horizontal tail surface, shown diagrammatically in a sketch without any mechanical description.

Another method is to apply periodic pitch moments by means of the rudder in synchronism with the natural period of pitching in a flat spin. The increasing oscillations will finally bring the machine into a nose-dive.

A preventive measure is to leave the spars of the horizontal tail surface exposed without ribs or cover for some distance on either side of the body. Seven references are given.

Moments of Inertia of Aeroplanes, Accurate Measurement. (M. P. Miller, N.A.C.A. Tech. Note, No. 351, Oct., 1930, 26 pp.) (7.62/20274 U.S.A.)

Diagrams show the method of mounting and swinging the aeroplane so as to obtain experimentally its principal moments of inertia. Full discussion of the elementary mathematics is given, a numerical example is worked out, and the section of the ellipsoid of inertia by the plane of symmetry is given graphically, the principal axes nearly coinciding with yawing and rolling axes.

Flying in Fog. (H. Koppe, Luftwacht, No. 10, Oct., 1930, pp. 465-470.) (7.80/20275 Germany.)

Fog flying requires suitable instruments and a pilot who is used to following their indications. Once the instruments are available, it is an easy step to make them take control of the aircraft and maintain aerodynamic and mechanical stability. The pilot is thus relieved of much strain and enabled to give his attention to the navigation of the craft.

Engines, Fuel, etc.

Development and Progress of the Aero Engine. (H. R. Ricardo, J.R. Aer. Soc., Vol. XXXIV, No. 240, Dec., 1930, pp. 1000-1015.) (8.20/20276 Great Britain.)

A brief account is given of the development of the aero engine, indicating the difficulties that have arisen in detail and the methods by which they have been overcome. The question of air versus water cooling is put on a strictly comparative basis. Methods of supercharging are analysed briefly, and different types of valves are discussed. The possibilities of the compression ignition engine are considered from the point of view of further development.

The Author's position gives special weight to his conclusions.

Development of the Oil Engine. (P. H. Schweitzer, Autom. Ind., Vol. LXIII, No. 23, 6/12/30, pp. 820-822.) (8.291/20277 U.S.A.)

The low speed of the oil engine involving large weight per h.p. is due to ignition lag. Compensation of lag by earlier injection requires restriction of the amount of fuel injected by the use of a special pilot sprayer, a method which offers interesting developments. Uncontrolled early injection produces rough running and incomplete combustion. Very high compression ratios of the order of 20 : 1 reduce the ignition lag. Ignition may be by spark plugs or hot surfaces.

Sleeve Valve Engine Developed with Super-Expansion Feature. (Autom. Ind., Vol. LXIII, No. 2, 12/7/30, pp. 49-50.) (8.235/20278 U.S.A.)

The engine is of the opposed piston type, the upper piston making only one stroke to two of the lower one. In this way the expansion ratio is made considerably bigger than the compression ratio whilst a certain proportion of exhaust residue is retained during the compression stroke. The engine has been built as a carburettor engine, and tests show that a mean indicated effective pressure of 150 lbs. per sq. in., could be maintained together with a fuel consumption of .4 lbs. per indicated h.p./hr.

The Fiat Oil Engine. (Luftwacht, No. 10, Oct., 1930, pp. 477-479.) (8.291/20279 Germany.)

Six-cylinder vertical water-cooled engine; stroke volume 16.6 litres; 180 h.p. at 1600 r.p.m.; maximum pressure 1150 lb. per sq. in. The injection system has been supplied by the German firm of Bosch.

Hollow Valve Stem Used in Engine Endurance Record. (Autom. Ind., Vol LXIII, No. 24, 13/12/30, pp. 867-868.) (8.725-20280 U.S.A.)

The Curtiss engine in a record endurance flight of 647 hours was fitted with exhaust valves with hollow stems nearly twice the usual diameter, for good heat conducting area, ample bearing surface and a strong neck section. The stem of the valve is drilled and closed by extruding the end and nitrided with ammonia.

Oil Engine Motor Cars in the Sahara. (Autom. Ind., Vol. LXIII, No. 25, 6/12/30, p. 847.) (8.291/20281 U.S.A.)

The French Government is carrying out experiments with a Junkers type heavy oil 45 h.p. engine (built under licence by the Peugeot firm), fitted to trucks using routes in the Sahara desert. There is no loss by evaporation of heavy oil fuel compared with as much as 50 per cent. loss of petrol carried in the tanks of the trucks.

The "Praga Es-550" Engine. (M. Aero. Tchec., No. 7/8/9, 1930, p. 63.) (8.292/20282 Tchecoslovakia.)

The engine is a 12-cylinder Vee developed from the Breitfield engine shown at the Prague Aeronautical Exhibition several years ago. Following German practice the cylinders are independent, each with a welded-on water jacket. Two carburettors placed inside the Vee have a common air intake. Cylinder volume 31.4 litres, compression ratio 7.5, normal rating 550 h.p. at 10,000 feet, with a 50 per cent. Benzol mixture.

Geared Centrifugal Superchargers for Aeroplane Engines. (S. A. Moss, S.A.E., Vol. XXVII, No. 2, Aug., 1930, pp. 148-153.) (8.235/20283 U.S.A.)

Air-cooled cylinders of small dimensions will stand a considerable amount of overheating, and in conjunction with a simple high pressure supercharger at sea level would be considerably cheaper, lighter, and smaller than a large bore air-cooled engine of an equivalent power output.

Testing Supercharged Engines. (J. Pettitt-Herriot, Airc. Eng., Vol. II, No. 22, Dec., 1930, pp. 300-304.) (8.235 Great Britain.)

A Rolls Royce "F" supercharger is shown in perspective photographs and briefly discussed. The arrangement of the engine-testing apparatus is discussed in considerable detail and various practical precautions are given. The question of rating is considered fully and the terminology is defined carefully. Rules and tables are given for reduction to standard conditions.

Reduction charts and abbreviated methods of reduction are given for rapid calculation.

The Starting of Combustion Engines. (Z.V.D.L., Vol. LXXIV, No. 50, pp. 1703-1710.) (8.291/20285 Germany.)

Oil engines using indirect injection (two-stage ignition) do not start cold, but require a hot spiral (electrically heated) or a "glow paper," an absorbent paper impregnated with a mixture of copper and potassium nitrate. With correct concentration auto-ignition is obtained in the engine without lighting the glow paper, which is hygroscopic and must be kept dried. Direct injection engines are generally started on the two-stroke cycle and have been successfully started under load. In the Hesselman engine starting is facilitated by throttling the air. By the construction of the cylinder head a small portion of the oil mist is isolated and ignited by means of a sparking plug. The flame is spread by high turbulence from this burning nucleus.

Combustion Chambers for High Speed Diesel Engines. (Autom. Tech. Zeit., Vol. XXXIII, No. 30, 31/10/30, p. 728.) (8.291/20286 Germany.)

A short review of the characteristics of high speed injection engines shows a diversity of opinion as to the best means of achieving high output with economy. The shape of the combustion chamber differs widely between the Beardmore and the Deutz and the design of fuel pump and control is different for every engine. The difficulty of the problem arises from ignorance as to the controlling factors.

Needle Bearings. (Autom. Ind., Vol. LXIII, No. 24, 13/12/30, pp. 869-870.) (8.31/20287 U.S.A.)

Roller bearings, developed in Germany, with diameters from .08 to .16in., length about 1in., are called "needle" bearings. They are suitable for connecting rod bearings and valve rockers. Such a bearing acts as a floating bush, the needles rolling only for a short time after changes of load. The space between the needles retains the oil and thus dispenses with lubricating oil feed.

Determination of the Period of Natural Frequency of Crankshafts. (K. Schlaefke, Autom. Tech. Zeit., Vol. XXXIII, No. 30, 31/10/30, pp. 725-727.) (8.36/20288 Germany.)

A discrepancy between the calculated and observed resonance period of a six-throw crankshaft was traced to the gearing of the valve gear, water pump and dynamo from the end of the crankshaft which reduced the free period by 20 per cent.

Pyrilysis of Methane. (R. V. Wheeler and W. L. Wood, Fuel, Vol. IX, No. 12, Dec., 1930, pp. 567-574.) (8.10/20289 Great Britain.)

Methane on coming in contact with a hot surface undergoes a rapid initial decomposition leading to the liberation of hydrogen. In certain cases the hydrogen may be absorbed by the surface and act as a protective layer. The further chemical actions are then forced to take place inside the mass of the gas, a series of higher hydro-carbons being formed.

Automatic Gas Analysis Dependent on the Thermal Conductivity of Gases. (P. Jarrier, Fuel, Vol. IX, No. 10, Oct., 1930, pp. 458-462.) (8.15/20290 Great Britain.)

Apparatus for gas analysis by thermal conductivity facilitates distant reading, but only with clean dry gases, constant attention to the filters and connections and periodical calibration being required.

Influence of Radiation in Combustion in Closed Vessels of Colloidal Powders. (H. Muraour, C.R., Vol. CXCI, No. 17, 27/10/30, pp. 713-715.) (8.10/20291 France.)

For low densities of the charge there is a considerable diminution in the area of the pressure-time curve which cannot be explained by a reduction in the gas radiation.

A New Formula for the Transmission of Heat through a Cross-Current. (W. Nusselt, T.M.T., Vol. I, No. 12, Dec., 1930, pp. 417-422.) (8.10/20292 Germany.)

The author forms a differential equation of the temperature field and transforms it to an integral equation, which he solves. The numerical results are plotted and tabulated. The results are obtained for an opposing current by comparatively simple transformations and again a table of numerical results is given.

Transference of Heat from a Warmed Plate to a Surrounding Stream of Air. (F. Elias, Z.A.M.M., Vol. IX, No. 6, Dec., 1929, pp. 434-453, and Vol. X, No. 1, Feb., 1930, pp. 1-14.) (6.72/20293 Germany.)

A thin hollow casing with ogival nose and with sheet copper sides was kept heated to constant temperature internally by ether or alcohol vapour. The quantity of heat transferred was attempted to be measured by the volume of vapour condensed. Curves of temperature difference between air and plate at varying distances from the plate are plotted in twenty-three diagrams and velocity distribution for different temperatures in twenty diagrams, the effect of temperature on velocity being only 2 or 3 per cent. The main numerical results are tabulated. The air velocity varied from 3 m/s. to 35 m/s., the temperature differences from 16° to 20°C., but in special experiments reached 37.5°C. Comparative results with rough plates show greater turbulence and velocity differences.

An integral is formed for the flow of heat in the boundary layer. Inserting the empirical values found for temperature and pressure which appear as factors under the sign of integration, the flow of heat is obtained as a function of Reynolds

number and Peclet's number which follow v. Karman's and Latzko's results closely. The results given by Jürges are not very different. The temperature distribution is compared with the velocity distribution, and shows a close resemblance in the proportional increase.

The analogy between transference of heat and vorticity is not in general exact, and the resulting discrepancies are discussed and appear to be small in the cases considered.

Heat of Evaporation of Fuels and a Method of its Determination. (Wawrziniok, Autom. Tech. Zeit., Vol. XXXIII, No. 31, 10/11/30, pp. 764-766.) (8.640/20294 Germany.)

An apparatus is described which determines the total heat of evaporation of fuels electrically in a rapid manner to an accuracy of 10 per cent. It is pointed out that by blending fuels of different latent heat the carburation system can be simplified.

Fuel Requirements of the Gasoline Aircraft Engine. (S. D. Heron, S.A.E., Vol. XXVII, No. 6, Dec., 1930, pp. 694-699.) (8.291/20295 U.S.A.)

The relative anti-knock comparison of fuels depends on cylinder pressure and other test engine conditions, particularly as between benzol fuels and aromatic petrol doped with lead. The method of rating by the heating of the cylinder unit may be better than by audible knock or by rate of pressure rise measured with the bouncing pin.

Overheating may be due to pre-ignition and auto-ignition as well as to incipient detonation. Lead dope reduces overheating far more than audible knock, hence benzol may be liable to some form of pre-ignition accompanied by overheating.

Fuel Requirements for Large Air-Cooled Engines. (W. A. Parkins, S.A.E., Vol. XXVII, No. 6, Dec., 1930, pp. 679-682.) (8.291/20296 U.S.A.)

The addition of considerable quantities of benzol is required to reduce incipient detonation in air-cooled cylinders accompanied by relatively high temperatures. If the fuel is thereby rendered unsuitable for aircraft small quantities of tetraethyl lead give a cooler running.

Sulphur Content in American Fuel Specification. (G. Egloff, Natl. Petroleum News, Vol. XXII, No. 24, 41-3 (1930). Chem. Absts., Vol. XXIV, No. 21, 10/11/30, p. 5473.) (8.640/20297 U.S.A.)

In the United States a limit of 0.1 per cent. on the sulphur content of motor fuels increases the cost of production. There is no evidence that so low a limit is required to prevent corrosion of the engine.

An Electrical Differential Method for Measuring C_v of Gases. (M. Trantz and F. Kaufmann, Ann. d. Phys., Vol. V, Part 5, 1930, p. 581.) (8.15/20298 Germany.)

An electrical circuit supplies equal quantities of heat to the two gases which are to be compared. The C_v ratio of the gases is estimated by the volume ratio of the gases necessary to produce equal rise of pressure. The instrument has been calibrated by using argon and values are given for C_v of methane and air at 20°C. with an error less than $\frac{1}{2}$ of 1 per cent. The estimation of heat loss in these experiments is of interest.

Effects of Anti-Knock Material on the Speed of Flame in a Closed Tube. (Y. Nagai, Jrnl. Soc. Chem. Ind., Japan, Vol. XXXIII, pp. 296-299. Chem. Absts., Vol. XXIV, No. 22, 20/11/30, p. 2994.) (8.13/20299 U.S.A.)

Experiments were carried out on hydrocarbons with tetra methyls of tin and lead and diethyl selenide in closed glass tubes 1in. in diameter and 3ft. long. Additions of 0.1 per cent. dope reduced the speed of flame propagation in hydrocarbon vapours. With high concentrations of dope the flame speed increased.

Water as an Anti-Detonant. (G. W. Hobbs and M. L. Fast, Mich. Eng. Expt. Sta. Bull., No. 31, 1930. Chemical Abstracts, Vol. XXIV, No. 22, 20/11/30, p. 5994.) (8.645/20300 U.S.A.)

The injection of water requires a proportional increase in the spark setting in order to prevent loss of power. Whilst the liquid acts as an anti-knock agent, the injection of water vapour produces no effect on the detonation.

Listening-in to the Combustion in the Engine Cylinders. (Rev. Soc. Gen. Aeron., Dec., 1930, p. 25.) (8.645/20301 France.)

The earth terminal of a small wireless receiving set is joined to the cylinder wall whilst the aerial terminal is joined to an insulated electrode projecting into the combustion space. On listening through a telephone receiver with the engine running a characteristic crackle is heard, the intensity of the noise increasing with the amount of throttle opening. With the engine detonating the quality of the note changes. The apparatus is suggested as a sensitive method of testing knock rating fuels.

Standard Knock-Rating Test. (G. G. Brown, H.A. Zuck, Oil and Gas J., Vol. XXVIII, No. 34, 1930. Chem. Absts., Vol. XXIV, No. 18, 20/9/30, p. 4620.) (8.645/20302 U.S.A.)

The fuel is matched against a mixture of normal heptane and iso-octane. Instead of a carburettor a metering pump is used. In making the comparison two points are determined—

(1) The first audible detonation
(2) The compression ratio giving maximum power.

Analysis of the Gradual Oxidation Prior to Ignition of Fuels in Internal Combustion Engines and its Relation to Detonation. (W. M. Zaikowsky, H. B. Holroyd and V. M. Sokoloff, Phys. Rev., Vol. XXXIII, p. 264 (1929). Chem Absts., Vol. XXIV, No. 18, p. 4620.) (8.645/20303 U.S.A.)

Anti-knock compounds act by temporarily eliminating active oxygen. From experiments in heated tubes it is concluded that the dopes are only active in the vapour phase for a short time whilst the oxides condensed on the walls of the tube act as effective anti-detonants.

Resin Formation in Benzols. (W. H. Hoffert and G. Claxton, Fuel, Vol. IX, No. 10, Oct., 1930, pp. 476-481.) (8.640/20304 Great Britain.)

Discrepancies between oxidation and storage tests on benzols from distillation of coke-oven spirits have been traced to the presence of sulphur. At an atmospheric temperature sulphur acts as a mild inhibitor and prevents the deposition of gum. At higher temperatures, as in oxidation tests, the sulphur reacts with unsaturated compounds to form non-volatile pitches which increase the apparent gum content. From extensive road tests gasworks and coke-oven benzols give equal results when stabilised with tricresol.

Fuel Requirements of Aircraft Engines. (S. D. Heron, Oil and Gas J., Vol. XXIX, No. 17. Chem. Absts., Vol. XXIV, No. 22, 20/11/30, p. 5993.) (8.645/20305 U.S.A.)

The amount of overheating in a cylinder operating with detonation depends on the nature of the fuel, so that cylinder temperatures afford a convenient method of rating fuels.

Vapour-Locking Tendency of Aviation Fuels. (O. C. Bridgeman and H. S. White, S.A.E., Vol. XXVII, No. 2, Aug., 1930, pp. 218-223.) (8.68/20306 U.S.A.)

The vapour-locking tendency of a fuel can be predicted from distillation data in the case of gravity feed systems. Discrepancies occur on the suction side of the fuel pump, vapour-locking occurring below predicted values.

Production of Alcohol Fuel Mixtures. (Dr. K. R. Reitrich, Autom. Tech. Zeit., Vol. XXXIII, No. 33, 30/11/30, pp. 792-793.) (8.606/20307 Germany.)

The German Government is exerting pressure on fuel retailers to use home-produced fuels such as mixtures of benzol, alcohol and petrol in various concentrations. The chief difficulty is the separation of water, especially in aircraft at altitude. On the ground the variations in temperature are less and the separation of water can usually be prevented within certain proportions of mixture.

Oil Fuels for Diesel Engines. (Autom. Ind., Vol. LXIII, No. 25, 20/12/30, pp. 892-894.) (8.640/20308 U.S.A.)

The " pour point " is an important quality of aircraft Diesel fuel oils, which must pass freely from the tanks at temperatures of $-50°$F. Vaporisation, gumming and detonation characteristics are much less important that in petrol fuels. Recent tests show that anti-knock heavy oil fuels may allow shorter injection periods with improved thermal efficiency in certain engines with early timing.

Crash Fire Tests with Diesel Oil. (C. F. and E. S. Taylor, Aviation, Vol. LXII, No. 5, Nov., 1930, pp. 283-285.) (8.640/20309 U.S.A.)

To stimulate the conditions of a wrecked aeroplane with burst tanks fuel was poured over a short section of two-inch pipe heated to a cherry red, fuel oil igniting almost as readily as petrol. With petrol the fire spread with extreme rapidity and was difficult to extinguish, but with fuel oil the fire was readily extinguished by pouring excess of oil on to the flames.

Lead-Base Lubricants. (J. A. Edwards, S.A.E., Vol. XXVIII, No. 1, Jan., 1931, pp. 50-52.) (8.50/20310 U.S.A.)

A qualitative specification and a description of the process of chemical manufacture are given. Alternative metal-base greases such as aluminium stearate greases are mentioned as probably inferior. Three partial specifications of lead soap lubricants by different manufacturers are given. They are stated to be particularly suitable for gear cases.

Importance of Lubricity of Lubricants. (B. E. Sibley, A.S.M.E. Paper, May, 1930.) (8.540/20311 U.S.A.)

Lubricity is defined as the property of keeping the working surfaces wet with oil, thereby protecting working parts and reducing wear. A number of figures of wear per hundred hours are given for principal working parts. Comparative figures of merit are given for three types of lubricating oil.

Evaluation of Lubricating Oils by the Work Factor Method. (J. G. O'Neil, Nat. Pet. News, Vol. XXII, No. 24. Chem. Absts., Vol. XXIV, No. 22, 20/11/30, p. 5996.) (8.540/20312 U.S.A.)

A lubricating oil is evaluated by changes under working conditions over a period in viscosity, neutralisation number, precipitation number and carbon residue. The tests show in general no difference between well refined paraffin and naphthene-base oils.

Recent Research in Lubrication. (S. Kyropoulos, Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, pp. 1551-1553.) (8.540/20313 Germany.)

There are different requirements for bearing lubrication and engine lubrication. In a bearing the properties of the oil may be affected by the proximity of metallic surfaces and the magnitude of hydraulic pressure. Where safety at low speeds is the main consideration naphthenic or asphaltic base oils give the thickest oil film for the same viscosity. In gear lubrication the adhesion of the oil is important and can be improved by small quantities of so-called active or dipole oils such as castor oil.

The requirements of engine lubrication are :—

(1) Constancy of composition during use.
(2) Small proportion of residue.
(3) Soft non-volatile residue.

Naphthenic base oil meets the above requirements best, but in high duty engines admixture with castor oil is recommended, this increasing the carbon residue slightly but giving a higher factor of safety against local seizure. At points of high loading the mineral oil evaporates leaving a protective film of castor behind. A bibliography is given.

Flame, Combustion and Ignition Point of Lubricating Oils Under Pressure. (H. Hassenbach, Warme, 53, 444-8 (1930). Chem. Absts., Vol. XXIV, No. 2, 10/11/30, p. 5474.) (8.540/20314 Germany.)

Flame, ignition and combustion points are no criterion for the behaviour of oils under pressure. Cheap oils often give as good results as expensive ones in practice.

Ballistics, etc.

Exterior Ballistics of the Arrow. (F. L. English, J. Franklin Inst., Vol. CCX, No. 6, Dec., 1930, pp. 805-819.) (9.16/20315 U.S.A.)

Careful specifications are given of longbow and arrows and shooting machine. Semi-empirical equations of the flight are formed. The velocities were determined by ballistic pendulum at various distances, from 10 yards upwards. The extreme range approached 200 yards with an initial angle of 40°. Tables of striking velocities, trajectories, ranges and times are given.

The S.T.Aé. Bombsight Used with Drift when Bombing a Fixed Target. (Guyomar, Rev. F. Aer., No. 15, Oct., 1930, pp. 1214-1225.) (9.62/20316 France.)

The French Service Bombsight is primarily intended for bombing into the wind. A new method of mounting permits accurate sighting across the wind. The new combination is no makeshift but will meet all requirements till the ideal universal bombsight is designed.

Detonation of Solid Explosives. (P. Lafitte and M. Patry, C.R., Vol. CXCI, No. 25, 22/12/30, pp. 1335-1337.) (9.01/20317 France.)

Photographic records were obtained of the rate of propagation of luminous waves, and waves of shock travelling in the glass container and rendering it more or less opaque. The velocities were 7,000 m/s. for both, near the explosive, and 1,750 m/s. for the former, 2,300 m/s. for the latter, at 60 cm. from the surface of the explosive.

A photograph is reproduced and is used to illustrate the argument.

Askania Cine-Theodolite for Measuring Speed of Aircraft. (L'Aeron., No. 138, Nov., 1930, p. 406-407.) (9.65/20318 France.)

Three theodolites are arranged to follow the aircraft from the ground, simultaneous measurements being assured by means of a special chronographic device. Each theodolite carries a cinema camera and two parallel reflecting telescopes with opposed eye pieces at right angles to the line of vision. One observer controls altitude and one controls azimuth. The results are stated to have a high order of accuracy. The velocity of an aircraft undergoing any manœuvre can be measured to within plus or minus half a metre per second. By following the motion of pilot balloons accurate information as to air turbulence can be obtained.

A photograph shows an instrument in operation. Three film exposures are reproduced.

Materials

High Heat Expansion Cast Iron for Cylinder Linings. (Autom. Ind., Vol. LXIII, No. 18, 1/11/30, pp. 656-657.) (10.103/20319 U.S.A.)

The International Nickel Co. specifies a new casting iron alloy, 13 per cent. Ni., 6 per cent. Cu., 3 per cent. Cr., 3 per cent. C., 15 per cent. Si., which is free from growth, corrosion resisting and easily machined. It has a thermal expansion about 50 per cent. greater than ordinary cast iron, and cylinders of this material with pistons of low expansion Al.-Si. do not require abnormal clearances.

Non-Ferrous Metals for Aircraft. (D. Hanson, Airc. Eng., Vol. II, 1930, No. 21, Nov., pp. 290-291, and No. 22, Dec., pp. 308-310.) (10.230/20320 Great Britain.)

A survey is given of the properties of aluminium and magnesium alloys. The principle of dimensions in more or less similar structures is discussed in an instructive manner and the different incidence of the penalties of increasing size of aircraft and engines is well brought out. The limited number of aluminium alloys suitable for aircraft is simply classified.

Copper has the same importance in aluminium alloys as carbon in steels, since $CuAl_2$ is soluble in aluminium permitting beneficial heat treatment.

Silicon and aluminium yield good casting alloys, magnesium along with silicon and copper furnishes good case and wrought alloys, susceptible of heat treatment. Nickel-copper and copper alloys of aluminium have good mechanical properties. Manganese is of less importance. The addition of iron has a good effect on wearing properties. No other constituents are yet known which yield useful alloys.

The constitutions of some thirty alloys of aluminium and magnesium in use in aeroplane practice are given, with reference to their suitability for casting, forging, drawing, rolling, pressing, etc. The rise of magnesium as a competitor of aluminium is remarkable, and its use in aeroplane design is certain to increase.

Alloys of heavier non-ferrous metals are briefly referred to in connection with special applications.

The great importance of corrosion problems is referred to, but their discussion lies outside the scope of this paper.

Casting Quality of Aluminium Alloys. Influence of Chemical Composition. (A. Courtz, C.R., Vol. CXCI, No. 23, 8/12/30, p. 1128-1130.) 10.231/20321 France.)

Experiments were carried out with aluminium alloys containing various proportions of silicon, copper and zinc. In each case the pouring quality increased with the content of added metal. The silicon alloys possessed the best casting quality.

Light Alloys. (Sci. Am., Vol. CXLIII, No. 2, Aug., 1930, p. 140.) (10.234/20322 U.S.A.)

Reference is made to a Beryllium-Lithium alloy, Be.-Li., containing 75 per cent. Be. and 25 per cent. Li., sp. gr. 1.5, with corrosion in the presence of water equal to that of iron; and to another alloy, Be. 35 per cent. and Li. 65 per cent., sp. gr. 1, requiring special protection against corrosion in the presence of water. Other alloys contain small quantities of aluminium and zinc.

Plating Nickel on Aluminium. (Chem. and Met. Engineering, Vol. XXXVII, No. 11, Nov., 1930, p. 694.) (10.262/20323 U.S.A.)

The polished aluminium is immersed in boiling solutions of ferric chloride and hydrochloric acid. A pasty iron deposit is secured which will subsequently take a closely adhering deposit of nickel.

Improvements in Electro-Plating Quality. (E. B. Neil, Autom. Ind., Vol. LXIII, No. 16, 18/10/30, pp. 560-564.) (10.264/20324 U.S.A.)

A descriptive account is given with a number of technical recommendations for improving the technique and reliability of electro-plating with nickel and chronium. Electro-deposition of iron on worn parts is also considered briefly.

Rolled Aluminium Alloys, Protection from Corrosion. (P. Brenner, Zeit. Metallk., Vol. XXII, No. 10, Oct., 1930, pp. 348-356.) (10.262/20325 Germany.)

With proper care in the heat treatment and composition of the metal intercrystalline corrosion can be completely avoided. Corrosion between rivet and plate is caused by differences in chemical composition. Protective coatings of paint, anodic treatment and a protective sheet of pure aluminium (alclad) are compared.

Sea Water, Electrolytic Effect on Dissimilar Metals Immersed. (G. B. Vroom, J. Am. Soc. Naval Eng., Vol. XLII, No. 41, Nov., 1930, pp. 549-554.) (10.12520326 U.S.A.)

The author gives briefly some of the results of naval experience of the corrosion of different metals in contact under the influence of sea water. To gain insight experiments were carried out on the voltage drop between dissimilar metals in sea water and in sea water plus NaCl., sat. sol. The temperature and turbulence of the solution were varied during the tests. The apparatus used is shown diagrammatically and a number of results are plotted graphically against temperature and turbulence.

Influence of High Frequency Oscillations on Treatment of Metals. (M. G. Mahoux, C.R., Vol. CXCI, No. 25, 22/12/30, pp. 1328-1332.) (10.125/20327 France.)

Experiments on nitrogen hardening and chromium plating a nickel-chrome-molybdenum steel showed remarkable increases in the depth of penetration of the treatment when the test pieces were subjected to high frequency (mechanical) oscillations.

The hardening and protective qualities obtained showed corresponding increases.

High Temperature Creep of Metals: Flow Characteristics of Special Alloys. (H. J. French, W. Kahlbaum and A. A. Peterson, B. Stan. Jrnl., Vol. V, No. 1, July, 1930, pp. 125-183.) (10.100/20328 U.S.A.)

Author's summary:—The results of "creep" tests at different temperatures are given for three groups of alloys. The 11 metals in the first group included commercial alloys of nickel, chromium and iron, both with and without tungsten, and low chromium steels containing also tungsten, vanadium or molybdenum. The second group comprised two carbon steels, a 3½ per cent. nickel steel and two low nickel chromium steels which were tested at 700°F.; the 12 alloys of the third group were melted in a high frequency induction furnace, and their compositions were selected to show the general trends at 1,000°F. in the load-carrying ability of castings of the nickel-chromium-iron system. A metallographic study of the creep-test specimens revealed inter-crystalline weakness in some of the wrought nickel-chromium iron alloys especially at temperatures between 1,160° and 1,390°F. A study was also made of the effect of deformation in the creep tests at different temperatures on the hardness and impact resistance of a chromium vanadium steel at atmospheric temperatures.

Internal Damping of Materials under Alternating normal and Shearing Stresses. (O. Föppl, Z.V.D.I., Vol. LXXIV, No. 40, 4/10/30, pp. 1391-1394.) (10.100/20329 Germany.)

The author considers principally shearing stresses and strains. The somewhat current supposition that the area of the hysteresis loop depends on the frequency of the alternations of stress is rejected. Relative damping is defined as the area of the hysteresis loop divided by the maximum strain energy at an instant of maximum stress, thus establishing a non-dimensional measure. It is remarked that when the frequency of the forced strain corresponds to a natural frequency of a test specimen, or more generally of a constructional part, the internal damping may be an important factor in keeping down the maximum strain and stress. In particular it is suggested that high quality steel with an ultimate load of 35 megabars (35 kg. wt./mm.^{2}) may not withstand a certain type of forced alternating stress so well as a mild steel of 20 megabars ultimate load, the result being attributed to the low internal damping of the former and the high internal damping of the latter.

A number of results are given graphically with the relative damping plotted against shearing strain. For timbers, cork, and rubber relative damping appears to be nearly constant for all strains within the rupture limit. For structural steels a parabola of the 8th to the 10th degree is obtained. For copper the rise in relative damping is considerably less rapid, and for electron after a rapid rise at low values of shear strain, following a parobolic type, the rate of increase of the curve falls off and shows an inflection.

The results obtained under bending and torsion are compared. In bending, the concomitant shear stresses reach 50 per cent. of the normal stresses. On multiplying the damping relative to the normal stresses by 2 the resulting curve approximates fairly closely to the curves of damping relative to shear stress

for steels and for copper. It is inferred that the shearing strains are the principal cause of internal damping.

The behaviour of electron is again abnormal and the damping relative to normal stress must be divided by 3 instead of 2 in order to bring it into approximate agreement with the damping relative to shear stress.

Rockwell-Brinnell Relationships. (S. N. Petrenko, B. Stan. Jrnl., Vol. V, No. 1, July. 1930, pp. 19-50.) (10.100/20330 U.S.A.)

A photograph shows the Brinnell and Rockwell testing machines side by side. Specifications are given of about 200 ferrous and non-ferrous alloys from which Rockwell and Brinnell tests were made and compared. The results are plotted grahically as Brinnell number against Rockwell number and various empirical formulæ are fitted from which the Rockwell number may be predicted from the Brinnell number, and *vice versa*. It is stated that the discrepancy seldom exceeded 10 per cent.

Cemented Tungsten Carbide Steel Tools. (J. Geschelin, Autom. Ind., Vol. LXIII, No. 16, 18/10/30, pp. 544-549.) (10.101/20331 U.S.A.)

Notable economies in production are claimed both in special operations on hard materials and in general machine shop work. Illustrative comparative costs are given and tables and diagrams of recommended settings. Seven references are given.

Tungsten Carbide Tools at the White Motor Co. (Autom. Abst., Vol. VIII, No. 10, Oct., 1930, p. 227.) (10.101/20332 U.S.A.)

The White Motor Company record the use of cemented Tungsten carbide tools over a period of nearly two years with an average production increase at from 30 to 40 per cent. and a material saving in costs.

Wires and Cables in Aircraft: Summary of Paper. (M. Abraham, Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, pp. 1549-1550, 177 D.V.L. Report.) (10.162/20333 Germany.)

From fatigue tests on cables passing over rollers the effective diameter of the roller at the bottom of the groove should be at least twenty times the diameter of the cable. Rollers of compressed fabric mixed with artificial linen, mounted on ball bearings, wear the cable less rapidly than metal rollers. Corrosion can only be avoided by the use of stainless steels. A new type of splice, formed by a tubular fitting pressed over the cable ends, is as strong as the cable itself.

Testing Gear and Methods

Characteristics of Two-Blade Propeller Fans. (H. L. Dryden and P. S. Ballif, B. Stan. Jrnl., Vol. V, No. 1, July, 1930, pp. 185-211.) (11.10/20334 U.S.A.)

From author's summary:—Seven two-blade propeller fans, eight feet in diameter and of pitch-diameter ratios 0.250, 0.375, 0.500, 0.625, 0.750, 0.938, and 1.063, respectively, were tested in a duct especially constructed to stimulate the operating conditions encountered in cooling towers. Each fan was tested for two operating conditions: (1) with the fan operating as a blower, and (2) with the fan exhausting air from the duct. Each fan was operated at constant speed of rotation against resistance conditions which were varied by steps, from a completely blocked passage to as nearly an open passage as the conditions in the duct permitted. The relation between the volume of air moved in unit time, the head developed, and the power absorbed by the fan was determined for each resistance condition. The results are expressed in

the form of coefficients and are plotted so as to facilitate their use in estimating the performance of fans of other diameters and rotational speeds.

Jet Boundary Corrections for Aerofoil Tests in Wind Tunnels. (M. Knight and T. A. Harris, N.A.C.A. Rept., No. 361, Nov., 1930.) (11.16/20335 U.S.A.)

The open jet type of wind tunnel was fitted with three nozzles :—

(1) Circular, 17 3/16 in. radius.
(2) Parallel top and bottom, joined by semi-circles 12 5/16 in. radius, maximum horizontal diameter as before.
(3) Parallel top and bottom, joined by 8 27/32 in. radius semi-circles, horizontal diameter as before.

Prandtl's theoretical correction for the circular tunnel was found in agreement with experiment. Experimental corrections were then obtained for the other two jet forms. Results are given graphically and in tables for the standard aerofoil of different dimensions and constant 5 : 1 aspect ratio. Measurements were also made on a complete aeroplane model.

A cross-sectional arrangement of the wind channel is shown with separate sketches and photographs of the three types of jet nozzle.

Effect of Wind Tunnel Interference on the Characteristics of an Aerofoil. (L. Rosenhead, Proc. Roy. Soc., Vol. CXXIX, No. A.809, 3/9/30, pp. 135-145.) (11.16/20336 Great Britain.)

Reference is made to Prandtl's investigation for a circular tunnel, Glauert's approximate result for rectangular tunnels and Terazawa's accurate solution of the latter problem. The author extends and completes the discussion of the whole problem and gives all the formulæ arising in a convenient form. In particular it is shown that the expressions obtained by Glauert are useful first approximations.

See abstract No. 14/12866.

Experiments with a Model Water Tunnel. (E. N. Jacobs and J. H. Abbott, N.A.C.A. Tech. Note, No. 358, Dec., 1930, 13 pp.) (11.20/20337 U.S.A.)

From author's summary :—Results are given of tests of the tunnel and also of some observations made with model aerofoils in the tunnel to study the phenomena of cavitation. It is concluded that a water tunnel does not offer a convenient method of making aerodynamic investigations at large scales. A large water tunnel would be of value chiefly for use in the study of cavitation.

The installation is shown in sectional drawing and photographed, and velocity pressure characteristics and distribution of velocity are plotted.

The Lateral Bending of Bars. (A. N. Dinnik and A. S. Lokshin, Phil. Mag., Vol. X, No. 66, Nov., 1930, pp. 785-808.) (11.34/20338 Great Britain.)

A series of examples is considered in which the cross section of the bar is a curve of the second degree. The differential equation is formed for each particular case and solved for the critical buckling force for different proportions of the bar. Every case is covered by a simple formula of the same type as Euler's buckling formula, but multiplied by a coefficient of K, which is a function of the dimensions of the bar.

The value of K is tabulated for a large variety of numerical cases from which a designer can select values approximating to many cases occurring in practice.

Test Bench with Single-Cylinder Experimental Motor at D.V.L. (K. F. Nägele, Z.V.D.I., Vol. LXXIV, No. 40, Oct., 1930, pp. 1387-1389.) (11.50/20339 Germany.)

Any ordinary cylinder can be tested. The base of the cylinder is raised or lowered to alter the compression ratio from 3 : 1 to 15 : 1, and the timing adjusted accordingly. An airmeter and a supercharger are fitted, the latter for detonation experiments.

Airships

New Rigid Airship LZ-128. (Luftwacht, No. 11, Nov., 1930, p. 528.) (12.10/20340 Germany.)

Following on the accident to the R.101 certain radical alterations have been made in the design of the German airship which will delay the completion of this ship till 1932. Helium will be the lifting gas, but for manœuvring purposes a certain quantity of hydrogen will still be carried. To reduce the fire danger the hydrogen bags are placed inside the helium. At the same time eight oil engines of Maybach construction will be fitted.

Modern Dirigibles Operated at Sea. (D. S. Ingalls, Air Services Mag., Sept., p. 35, 2 pp. Automotive Absts., Oct., 1930, p. 242.) (12.30/20341 U.S.A.)

The following points are claimed in favour of the airship :—

With average visibility an airship can patrol 20 times the area covered by a cruiser, and can launch and take on board during flight five or six aeroplanes. The airship can be constructed in less than a year as compared with three to five years for a warship.

Points against the airship are ignored, *e.g.*, extreme vulnerability to enemy action, fragility in handling and in stormy weather and slow speed compared with aeroplanes, etc.

The R.101 Disaster. (Airc. Eng., Vol. II, No. 21, Nov., 1930, pp. 278-280.) (12.30/20342 Great Britain.)

Photographs are given of the R.101 as originally launched, as lengthened, and after the accident, from three points of view.

Trans-Atlantic Flight of R.100. (Airc. Eng., Vol. II, No. 21, Nov., 1930, pp. 287-289. Posthumous article by Sq. Leader E. L. Johnston.) (12.30/20343 Great Britain.)

Notes are given on navigational and meteorological conditions. Photographs are given of the compass, drift sight, bubble sextant and periscopic drift sight used. A descriptive log is given of the double voyage with a number of meteorological details.

Goodyear Zeppelin Shed at Akron, U.S.A. (H. Schwegler, Z.F.M., Vol. XXI, No. 14, 28/7/30, pp. 357-8.) (12.33/20344 Germany.)

The Goodyear Zeppelin Shed at Akron, U.S.A., the largest airship shed in the world, is capable of taking an airship of 186,000 m^3 volume. A number of technical details of construction and equipment are given and are illustrated by three photographs, one during construction and two after completion.

Wireless

Kennelly-Heaviside Layer Studies. (P. A. de Mars, T. R. Gilliland and G. W. Kenrick, Proc. Inst. Rad. Eng., Vol. XIX, No. 1, Jan., 1931, pp. 106-119.) (13.1/20345 U.S.A.)

Chronograph records of measurement of the height of the Heaviside layer by the echo method are reproduced and interpretations are attempted. Layers were observed at heights of about 300, 400 and 500 km., and it is inferred that several layers exist at different heights.

Kennelly-Heaviside Layer Height Observations. (T. R. Gilliland, B. Stan. J. Rec., Vol. V, No. 5, Nov., 1930, pp. 1057-1061.) (13.31/20346 U.S.A.)

Specimen strips of recording film are shown with time marks about 24 mm. apart for an interval of 1/120 second. The distances between the ground signal and the echo over a ground distance of 21 km. are of the order of 458 km. Diurnal periods and monthly means of morning and evening heights are given graphically. The latter show great irregularities.

Attempted correlation with sunspot intensity gives apparent results which are considered to be based on too short duration of the available observations.

Ionized High Altitude Layers between Paris and the Sahara. (J. Lugeon, C.R., Vol. CXCI, No. 16, 20/10/30, pp. 676-678.) (13.1/20347 France.)

Short-wave signals were sent from El Golea, in Morocco, 2,000 km. south and 56 km. east of Paris, from October 26th to November 2nd, 1929.

A diagram shows a vertical section of the earth's shadow and of the ionised layers observed, and the assumed path of a short-wave beam with eight reflections from four distinct ionised layers and seven reflections from the earth's surface.

The anomalies can be explained in a satisfactory manner by the assumptions made as to the number and height of the effective layers, under the action of the rays of sunlight.

See Abstract No. 13252, Issue No. 15.

Short Wave (Half Metre) Wireless. (Shintaro Uda. Sendai, Japan, Z.H.F.T., Vol. XXXV, No. 4, April, 1930, pp. 129-135.) (13.31/20348 Germany.)

In Part I. brief reference is made to previous work.

In Part II. a receiver is described suitable for 50 c.m. wave length. The variable condenser is connected across the Lecher parallel conductors. The numerical values of voltage, resistance, etc., are given. The capacity-current characteristic is given graphically. The current and sound-intensity characteristics are plotted against the length of the Lecher leads. Photographs and diagrams illustrate two alternative arrangements.

In Part III. the sender is described. Two or more valves oscillating in a tuned circuit give steadier and stronger oscillations approximately in proportion to the number of valves with suitable distribution of the latter in respect to the antennæ. A diagram of the connections and a photograph of the complete sending set are shown along with two photographs of a portable form of apparatus.

In Part IV. a diagram gives the arrangement of the antennæ on which the calculation of the intensity along a given direction is based. The intensity falls off to a half in $\pm 12\frac{1}{2}^\circ$ as measured at 10 km. distance.

A sound intensity of 120 units was obtained at 30 km. By superimposing a voltage on the anode or grid potential, the sensitivity of the receiver was much increased and a good reception for wave lengths of 40 to 50 cm. was obtained.

High Frequency Radio Long Distance Transmission. (M. L. Prescott, Proc. Inst., Rad. Eng., Vol. XVIII, No. 11, Nov., 1930. pp. 1797-1900.) (13.31/20349 U.S.A.)

The diurnal variation of intensity of signals received for different wave lengths is plotted in 190 charts covering 19 radio circuits radiating from Schenectady, New York, in different directions. The length of the circuits varies from 2,300 to 11,400 miles. The daylight and darkness distribution of reception intensity for each path largely determines the diurnal and seasonal performance for a given wave-length. It is stated that the data assembled will determine the appropriate frequency for commercial circuits from 6,000 kc. upwards, *i.e.*, from wave lengths of 50 metres downwards.

Aviation Communications. (J. S. Richardson, Proc. Inst. Rad. Eng., Vol. XVIII, No. 12, Dec., 1930, pp. 2143-2157.) (13.31/20350 U.S.A.)

A general description illustrated by eleven photographs is given of radio aeroplane equipment as developed in Canada.

Power Equipment for Aircraft Radio Transmitters. (J. D. Miner, Proc. Inst. Rad. Eng., Vol. XIX, No. 1, Jan., 1931, pp. 59-77.) (13.31/20351 U.S.A.)

Author's summary :—The paper covers all the systems of power equipment for aircraft radio transmitters now used or contemplated. The various types are described and advantages and disadvantages discussed.

The types discussed are :—

(1) Wind driven generator.
(2) Dynamotor.
(3) Main engine driven generator.
(4) Auxiliary engine generator set.
(5) Combination wind-driven and dynamotor.
(6) Constant speed main engine-driven alternator.

Acoustic Distortion. (R. L. Hanson, Bell Tele. Lab., B.517, Nov., 1930, 10 pp.) (13.32/20352 U.S.A.)

Although the application is considered with respect to sound picture sets, the interest is more general. Analysis of microphone records shows very clearly the unfavourable results of interference between the direct wave and one or more reflected waves over the range of aural frequencies.

Reduction of Distortion and "Cross-Talk" in Radio Receivers by Variable Mu Tetrodes. (S. Ballantine and H. A. Snow, Proc. Inst. Rad. Eng., Vol. XVIII, No. 12, Dec., 1930, pp. 2102-2127.) (13.32/20353 U.S.A.)

From authors' summary :—In attempting to control the audio output of a radio receiver employing the present types of tubes by varying the control-grid bias or screen-grid voltage, distortion, due to non-linearity of the output-input voltage relation for the tube, and "cross-talk" are encountered at the higher signal voltages. Both effects are largely due to the rapid increase in the higher order curvature parameters of the tube characteristic which occurs as the grid bias increases negatively, or screen voltage decreases.

Two tubes have been developed to reduce these effects. They are shielded tetrodes of which the characteristic has been specially shaped to reduce the higher-order curvature in relation to the trans-conductance. The desired shape of characteristic is attained by a composite structure by virtue of which the tube acts as a high-mu tube at normal grid biases and automatically changes into a device of low-mu as the grid bias increases negatively.

Graphical Determination of Characteristic Frequencies of Undamped Oscillating Systems of Several Terms. (H. Deutler, T.M.T., Vol. I, No. 12, Dec., 1930, pp. 434-438.) (13.2/20354 Germany.)

The ordinary method depends on the convergence of a determinant with the terms grouped about the principal diagonal. In the present paper the numerical calculations are replaced by a graphical construction which converges to the same final value within the limits of drawing accuracy. A number of examples are given.

Accurate Method of Measuring Transmitted Wave Frequencies at 5,000 and 20,000 Kc. per Second. (E. L. Hall, B. Stan. Jrnl., Vol. V, No. 3, Sept., 1930, pp. 647-652.) (13.31/20355 U.S.A.)

An installation is described for testing transmitted waves of 5,000 kc. and 20,000 kc. *i.e.*, of 60 m. and 15 m. respectively.

A generator of frequency 10 kc. is used, and harmonics up to the 290th have been employed in setting up beat frequencies between this and the radio frequency generator which are matched with a tuning fork.

The errors are of the order of ± 1.25 in 10^6 and agreement of results is usually within 2×10^6.

International Comparison of Frequency by Means of a Luminous Quartz Resonator. (S. Jimbo, Proc. Inst. Rad. Eng., Vol. XVIII, No. 11, Nov., 1930, pp. 1930-1934.) (13.80/20356 U.S.A.)

Author's summary:—The international comparison of frequency standards made with the luminous quartz resonator shows the different laboratories—Physikalisch-technische Reichsanstalt, National Physical Laboratory, Bureau of Standards and Electro-technical Laboratory—to be in agreement to one part in 10^5 when used to calibrate the resonator at its flexural fundamental of about 10 kc., due allowance being made for the temperature coefficient of the resonator in this mode, namely, about 1 part in 10^5 and negative. The observed agreement seems limited by the luminous glow resonator used rather than by any difference between the laboratory standards compared.

Temperature Control for Frequency Standards. (J. K. Clapp, Proc. Inst. Rad. Eng., Vol. XVIII, No. 12, Dec., 1930, pp. 2003-2010.) (13.80/20357 U.S.A.)

From Author's summary:—The factors influencing the stability of temperature-control include the degree of insulation; rate of application and method of distribution of heat; sensitivity, regularity of operation, and position of thermostat; degree of " ripple " attenuation; and the operating temperature. Examples of three types of control units regulating to within approximately ± 0.5 deg., ± 0.1 deg., and ± 0.01 deg. C. respectively at 50 deg. C. are given, with heating rates and details of construction. Diagrams and photographs are included.

Characteristics of Piezo-Electric Quartz Oscillators. (I. Koga, Proc. Inst. Rad. Eng., Vol. XVIII, No. 11, Nov., 1930, pp. 1935-1959.) (13.81/20358 U.S.A.)

Author's summary:—Piezo-electric quartz oscillators are very satisfactory in their stability of frequency, but their frequencies are obviously somewhat influenced by several factors associated with the circuits. Starting from the Barkhausen equation their behaviour could be almost completely explained together with their amplitudes of oscillations.

A New Type of Wireless Valve. (F. Noack, Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, pp. 1550-1551.) (13.5/20359 Germany.)

In a new wireless valve by the Telefunken Company of Germany the electron stream is governed by means of an external electro-static device with no internal grid. The valves are long and narrow, and the anode presents a sharp edge to the heating filament. Being less affected by disturbances they are suitable for circuits run off mains.

Development of Visual Type of Radio Range Transmitter. (W. E. Jackson and S. L. Bailey, Proc. Inst. Rad. Eng., Vol. XVIII, No. 12, Dec., 1930, pp. 2059-2101.) (13.6/20360 U.S.A.)

From Author's summary:—The paper deals with the development of a visual type of radio range transmitter which has universal application to the civil airways of the United States. Following a discussion of the relative merits of the aural and visual systems of course indication the theory of the production of twelve courses by utilizing a three-phase radio-frequency source is presented, followed by a general description of the transmitter.

Polar space patterns of reed amplitude show the characteristics of the courses obtained with the two, four and twelve-course ranges.

Blind Landing, Radio Beacon and Receiving System. (H. Diamond and F. W. Dunmore, Bur. St. J. Res., Vol. V, No. 4, Oct., 1930, pp. 897-931.) (13.6/20361 U.S.A.)

The equipment requires the following types of beacon:—

A. Directive beacon, 2 kw.	...	150 miles	range.
B. Runway ,, ...	...	15 ,,	,,
C. Boundary marker beacon	...	3 ,,	,,

A marks the general direction from aerodrome to aerodrome, and its exact location is marked by drop of signal strength to zero as the aeroplane passes over it.

B is then picked up and gives the line of the landing runway, while *C* gives the instant at which the boundary of the aerodrome is passed.

A diagram shows the phase difference of two vibratory reeds for different angular deviations from the axis of the runway course marker beam.

The problem of height above the ground remains to be dealt with. Sensitive altimeters with correction for local changes of pressure were found inadequate. The landing beam was therefore replaced by a short wave directional beam directed upward at about 10°. (10^8 kc., 3 m. wave length).

The signal current in the receiver is rectified and passed through a micro-ammeter. The pilot, once he is below the axis of the beam is instructed to keep the pointer of the instrument steady on a reference line. This leads the aeroplane along a curved path of constant reception strength flattening out near the ground, the falling off in reception strength near the ground with distance from the axis of the beam being compensated by approach to the source. In fog flying there is usually little wind, but in a blizzard visibility may be as low as in fog. In an installation with three runways, giving six landing directions at 60° angular interval, one course-beam, three runway beacons, three boundary markers, and six landing beams are required, thirteen beacons in all.

Photographs of apparatus, diagrams of connections, and graphical curves are shown in thirty-five figures, and give a large number of details of the installation and instrument.

Wireless Direction Finding. (C. B. Carr, Airc. Eng., Vol. II, No. 22, Dec., 1930, pp. 305-307.) (13.6/20362 Great Britain.)

The ground installations are in two classes, one providing fixed sectors of equal strength, the other rotating beams (both involving equipment much too massive for installation in an aeroplane).

The requirements for reception installations are discussed briefly.

Fairly detailed descriptive accounts are given of three systems, the Marconi-Bellini-Tosi, Marconi-Adcock and Marconi-Robinson, and a short reference is made to other systems. The object of the paper is to guide the choice of the system most suitable for given conditions.

Infra-Red Sensitivity of Cæsium Oxide Photo-Electric Cells. (J. W. Ballard, J. Opt. Soc., Vol. XX, No. 11, Nov., 1930, pp. 618-623.) (13.7/20363 U.S.A.)

Author's Abstract:—Measurements have been made of the relative spectral sensitivities of a number of cæsium oxide photo-electric cells to visible and infra-red radiations. For the region 5,000 A to 8,000 A where the results now reported overlap those of Koller and of Vedder, the sensitivities were found to confirm those previously reported. The infra-red response has been found to decrease gradually from the maximum at about 7,750 A to approximately zero at 12,000 A.

Photo-Electric Cells. (Trans. Opt. Soc., Vol. XXXI, No. 4, 1929-30, pp. 233-240.) (13.7/20364 Great Britain.)

Abstracts are given of thirty-one papers, presented at a joint meeting of the Physical and Optical Societies, June, 1930.

A New Type of Photo Cell. (B. Lange, Phys. Zeit., Vol. XXXI, No. 21, 1/11/30, pp. 964-969.) (13.7/20365 Germany.)

The cells resemble the crystal detector in wireless. In one form a very thin layer of Cu is sputtered by an electron discharge tube on to a Cu_2o plate.

They are constant, sensitive, and specially suited for photo-micrometer work.

The "Cäsopress" Photo Cell for Television. (F. Noack, Z.V.D.I., Vol. LXXIV, No. 42, 18/10/30, p. 1460.) (13.7/20366 Germany.)

A new kind of photo-electric cell utilises a very thin layer of cæsium instead of the normal potassium. Such cells respond to yellow and red rays and are considerably more sensitive than the normal potassium cells. The cæsium vacuum cell becomes saturated at 50 volts and will pass a current of 200×10^{-10} amperes per Lux.

Comparison of Selenium and Photo Cells. (F. Schroter and W. Ilberg, Z. Inst., Vol. L, No. 11, Nov., 1930, p. 657.) (13.7/20367 Germany.)

No general conclusions can be drawn as to the relative advantages of selenium and photo cells, which depend on the special circumstances and the electrical circuits available.

Noise Reduction

Noise Created by Resonance Harmonics in a Free Jet Wind Channel. (O. Schrenk, Tech. Mech. Therm., Vol. I, Nos. 4 and 5, 1930, pp. 158-164 and 197-201. Thys. Berichte, No. 21, 1930, p. 2200.) (15.20/20368 Germany.)

Measurements in a large free-jet wind channel present difficulties in explaining the noise, owing to the complicated elastic system coupled with the jet. In a small

channel the harmonics were explained by resonator action of the receiving funnel with a special configuration of eddies at the upper surface of the free jet, a result confirmed by varied experiments. In the question of suppressing the noise the coupling between the harmonics of the model arrangements and the natural period of the wind channel has not been sufficiently explained.

Causes of Noise in Aircraft. (A. H. Davis, Airc. Eng., No. 21, Vol. II, Nov., 1930, pp. 273-274.) (15.20/20369 Great Britain.)

Using the decibel scale a table is given of the intensity of noises varying from 10 decibels, about the threshold for a quiet whisper at five feet, to 80 for a tube train and 110 for a noisy aeroplane cabin. The sources of sound are principally the airscrew, engine clatter and exhausts. In the case of the airscrew the only means of improvement is by gearing down the speed, with the disadvantage of possibly noisy gearing. Engine clatter may be reduced by enclosing the engine, which is possible only with water cooling. With regard to exhaust noises, proper design of the exhaust manifold should reduce the sound to reasonable intensity without serious loss of power.

In addition to reducing intensity at the source a properly designed cabin may reduce intensity of air-borne noise at the passenger's ear. Tables of panel weights per sq. foot and reduction of sound in decibels are taken from N.P.L. tests. Finally, the reverberation in the cabin may be reduced by lining the walls with suitable absorbent.

Scale of Sound Sensation. (P. A. Macdonald and D. M. Robertson, Phil. Mag., Vol. X, No. 67, Dec., 1930, pp. 1063-1073.) (15.20/20370 Great Britain.)

The accuracy of the Weber-Fechner law $dI/I=C$ by which the minimum sensible increase in sensation is proportional to the logarithm of the intensity, is accepted for sight but rejected for sound and touch sensations. For the latter a new relation is proposed, $dI \times \log I = C$. This appears to imply a serious departure from the decibel scale of sound intensity within the range of the experiments. Extensive experimental data are quoted for touch sensation, but none are given for sound.

Reduction of Aeroplane Noise. (Aero. Bulletin, No. 25, Dept. Commerce, 1/10/30, 21 pp.) (15.30/20371 U.S.A.)

A sketch is given of the development of the logarithmic scale of intensity with the decibel as a unit. A diagram exhibits the noise in an aeroplane as lying between 90 and 100 units. In comparison the noise in a New York subway is 80, in a typewriting room 70, in a busy street 60. An average whisper is given as 20, and the rustle of leaves 10.

A brief account is given of the instruments available for measuring sound.

The two principal sources of aeroplane noise are the airscrew and the engine. The intensity of airscrew noise can only be reduced by gearing down the angular velocity. Silencing of engines is briefly considered.

In addition to reducing the intensity of the sound source, passengers may be protected by a closed cabin which reduces the intensity of the sound reaching the ear. Tables are given of the damping properties of fifty-four commonly used materials. The results of measurements on cabins built up in the laboratory are given, with further results of measurements made on four aeroplanes in flight. The reduction of noise in an aeroplane to the level of that in a railway carriage in motion is considered to be an attainable object. The additional weight is estimated at ten to fifteen pounds per passenger.

Design of Broadcast Studios. (O. B. Hanson and R. M. Morris, Proc. Inst. Rad. Eng., Vol. XIX, No. 1, Jan., 1931, pp. 17-34.) (15.38/20372 U.S.A.)

The application of modern methods of acoustics to the design of broadcast studios is discussed. These applications are of interest in the problem of noise insulation. In particular detailed drawings and a photograph are given of a sound-proof window.

Safety

Safety and Multi-Engined Machines. (W. L. Cowley, Airc. Eng., Vol. II, No. 22, Dec., 1930, pp. 299 and 304.) (16.15/20373 Great Britain.)

An elementary discussion of probabilities of partial and complete failure and of consequent accidents, taking into account the most important factors, and weighting them appropriately.

Helicopters

The Curtiss-Bleeker Helicopter. (Sci. Am., Vol. CXLIII, No. 3, Sept., 1930, pp. 214-215.) (17.00/20374 U.S.A.)

A descriptive account with some technical data is given of the Curtiss-Bleeker helicopter, illustrated by four photographs, three showing the complete machine from different points of view and the fourth showing the connection between engine and body. The engine is a Pratt and Whitney Wasp air-cooled, geared to four horizontal shafts driving four 4-bladed tractor airscrews which in turn pull the four radiating wings in the direction of rotation. Each lifting wing has a trailing auxiliary plane surface which controls the incidence and produces an oscillating moment about the wing axis which alters the effective incidence inversely as the relative air speed, thereby maintaining uniform lift through the cycle.

Total weight 3,200 lbs. Horse power at 2,100 r.p.m. 420. The useful load is small.

Ascanio Helicopter. (Luftwacht, No. 11, Nov., 1930, p. 529.) (17.00/20375 Germany.)

This single seater machine weighs 800 kg. and has carried out a closed circuit flight of over 1 kilometre. It has also hovered for several minutes at an altitude of about 12 feet. The two vertical lifting screws are rotated in opposite directions by means of a 95 h.p. Fiat engine. The two blades of each airscrew are articulated on the vertical shaft and the angle of incidence of the blades can be altered by means of small elevator planes attached to the tips. Stability is ensured by three small auxiliary airscrews attached to the fuselage. These auxiliary airscrews are driven from the same engine and by varying their thrust it is possible to tilt the axis of rotation of the lifting airscrews and in this way produce forward motion in any desired direction.

The Autogiro: Paper Read before the Society, 13/2/30. (J. de la Cierva, J.R. Aero. Soc., Vol. XXXIV, No. 239, Nov., 1930, pp. 902-921.) (17.05/20376 Great Britain.)

The designer gave a summary of his latest developments of the autogiro along accepted lines, but did not present much in the way of numerical tests results. With regard to the slow rate of vertical descent, for which a test value is claimed of about half that indicated by airscrew theory, he suggested that the boundary of the trailing vortex widened out very rapidly, and that the effective column of air to which downward momentum was imparted was twice the volume of the column standing on the autogiro disc.

Gliders

Rocket Propulsion: Tailless Glider with Rocket Propulsion. (Flugsport, Vol. XXII, No. 21, 15/10/30.) (17.20/20377 Germany.)

In successful glides with an Espenlaub glider the absence of a tail renders the fitting of rockets much easier. The pilot is in an enclosed cabin. A rocket weight of 150 lbs. can be carried and a speed of 60 miles an hour is anticipated.

Safety and Serviceability in Primary Gliders. (W. J. Perfield, S.A.E., Vol. XXVII, No. 5, Nov., 1930, pp. 583-590.) (17.40/20378 U.S.A.)

Many glider clubs have been formed in the United States, some equipped by purchase of standard types and others with home-made machines. For the benefit of the latter, brief technical details of successful gliders are given illustrated by photographs of complete machines and details. Provisions for launching, handling and transportation are suggested. The load factor of a glider manufactured by an American Company is given as 4.15 with forward c.p. and 6.5 at best gliding angle, the computed speed being 43 m.p.h.

Meteorological

The Structure of the Wind. (W. Schmidt, Z. Inst., Vol. L, No. 11, Nov., 1930, pp. 649-650.) (19.10/20379 Germany.)

Wind structure is recorded kinematographically by studying the motion of a set of wire hoops 18 in. in diameter covered with muslin, controlled by steel wires and kept normal to the wind.

Transfer of Heat by Radiation and Turbulence in the Lower Atmosphere. (D. Brunt, Proc. Roy. Soc., Vol. CXXX, No. A.812, 2/12/30, pp. 89-104.) (19.10/20380 Great Britain.)

It is stated by Helmholtz that the atmosphere is comparatively transparent to short waves from the sun. At the surface of the earth the energy of these waves is transformed and radiated back chiefly as longer heat waves to which the atmosphere, particularly when it contains moisture, is more opaque. In this way the greater temperature of the atmosphere at the ground level is accounted for.

The author introduces an effective co-effcient (K_R) of thermo-metric conductivity, particularly for air containing a known proportion of water vapour. This new coefficient may be applied in determining the vertical temperature distribution in the atmosphere whether it acts alone or in conjunction with G. I. Taylor's coefficient of eddy diffusion (K_E). The greatest observed values being of the order $K_R = 10^3$, and $K_E = 10^5$, it is seen that the eddy coefficient at its maximum swamps the radiation coefficients in transferring heat. Under certain conditions near the ground, an absence of sensible eddy motion is accompanied by the establishment of relatively enormous lapse rates which are accounted for by introducing the new radiation coefficient. The stability of such a layer heated from below is discussed (using the above results) in a paper by A. R. Low at the International Congress for Applied Mechanics at Stockholm, 1930, to which reference is made.

Weather Problems on the New York—Chicago Airway. (W. L. Smith, Monthly Weather Review, U.S.A., Dec., 1929, pp. 503-506.) (19.15/20381 U.S.A.)

A summary is given of adverse weather conditions, of which No. 2, the coating of 'planes with ice, is considered as probably the worst. Dry snow offers no serious hindrance to flying otherwise than by reducing visibility, but north-west winds blowing over the relatively warm region of the Great Lakes and then again over colder land, may produce serious accumulations of wet snow re-

freezing into ice. The belt of country over which these conditions are met has sharp geographical definitions. In flying through autumn storms at high altitudes ice formation again appears. On the other hand, it is not safe to fly at low levels, under the concomitant cloud and fog conditions. In winter so-called "freezing rain storms" form ice so rapidly that the aircraft may be weighted down to the ground within five minutes. In a sleet storm the ice forms much less rapidly and it may be possible to climb to the warm regions usually existing above, and thereby avoiding the ice danger. With such temperature inversions any ice formed in the lower regions is evaporated or melted in the higher altitude. In flying still higher a new danger zone may be reached to avoid which it may be necessary to fly through the clouds. The most suitable flying zone is to some extent indicated by hygrometers and air thermometers indicating temperature and humidity outside the ice forming conditions. Incidentally the formation of ice on the thermometer itself, indicating freezing point, acts as a warning. The ice hazard is greatest at freezing point, and occurs most frequently in the transition from winter to spring.

Reference is made to the research proposed at the Guggenheim foundation.

Ice Formation on Aircraft and its Prevention. (Merit Scott, Guggenheim Research Physicist, J. Franklin Inst., Vol. CCX, No. 5, Nov., 1930, pp. 537-586.) (19.15/20382 U.S.A.)

The present paper is a continuation of N.A.C.A. Technical Note No. 345 (see Abstract No. 15/13226). A comprehensive investigation of the physics problem is carried out.

In Part I. the presence of water as vapour only is considered. The equation of diffusion is solved in a suitable form and the maximum possible deposit of ice near the leading edge is found to be of the order of 5 mm. in depth per hour, which is not considered dangerous. A diagrammatic sketch shows the wind channel equipped for producing the required conditions of temperature, humidity and air velocity.

In Part II. the problem is considered when water is present in liquid form. The inertia forces in the curved streamlines near the nose separate out the water particles and deposit them on the surface. Using Stoke's expression for the viscous resistance of the air to a small drop a quantitative expression is obtained for the resultant acceleration. These considerations account for the shape of the ice cap near the stem point. The conditions for the freezing of the water so deposited are investigated. The most dangerous condition is that of a temperature inversion with a stratum slightly above freezing point lying above a colder stratum in contact with the earth and below the colder upper regions. In the case of a snow storm in the upper regions the flakes may melt as they pass through the warm stratum of inversion and re-freeze on the aeroplane in the lower cold stratum.

The problems of the exchanges of heat between waterdrops and aeroplane are considered mathematically and numerical results are tabulated indicating with reasonable accuracy the limiting conditions for dangerous ice formation.

Finally the question of heating the wing artificially is considered. With a wing area of 275 sq. ft. and an airspeed of 180 m.p.h., the figure of 144 h.p. is obtained as representing the expenditure of energy necessary to prevent ice formation under possible conditions. The power required by such an aeroplane would be about 450 h.p. The exhaust gases carry off energy at a rate roughly equivalent to the torque horse-power, so that the exhaust gases should contain amply sufficient heat energy to prevent ice formation.

A number of subsidiary physical details are discussed mathematically.

Altitude Flying

Kinematographic Study of the Size of the Heart in an Atmosphere of Low Oxygen Content. (Dr. H. Strughuld, Report of 19th W.G.L. Gen. M., Z.V.D.I., Vol. LXXIV, No. 45, 8/11/30, p. 1548-1549.) (19.29/20383 Germany.)

Experiments on animals show reduction of stroke volume at constant blood pressure and pulse, with a reduction of oxygen content. An altitude of 16,000 feet corresponds to an increase of 7 per cent. in the quantity of blood circulated per heart beat. It is of great importance that the seat and the straps holding the pilot should be designed to allow for the greater heart action at altitude.

Aerodynamics and Hydrodynamics

New Rudder Construction for Ships. (W. Scholz, Z.V.D.I., Vol. LXXIV, No. 47, 22/11/30, pp. 1609-1613.) (22.10/20384 Germany.)

Balanced rudders of streamline profile have greater turning moment than flat plate rudders, since the flow diverges less from the surface, affecting beneficially the backwash of the propeller and the propulsive effort required.

Pressure Distribution Round Quadratic Cylinders. (F. F. Parsons and J. A. Wallen, N.A.C.A. Tech Note, No. 354, Nov., 1930, 48 pp.) (22.10/20385 U.S.A.)

The dimensions of three cylinders tested were :—

A. Circular, 6 ins. diameter.
B. Elliptical major axis 7.128 ins.
minor axis 4.752 ins.
C. Elliptical major axis 8.792 ins.
minor axis 2.198 ins.

The mounting of the experiment is described in detail and the results are given in tables and graphically.

The line at which the flow ceases to be laminar and diverges from the surface of the model, with periodic formation of vortices, is separately plotted for each model against the velocity. The distance from the nose is found to increase with speed and from 40 feet per second to 90 feet per second.

A number of empirical relations are given.

Resistance to Propulsive Force in Fishes. (A. Magnan and A. Sainte-Laguë, Bull. Tech., No. 71, Oct., 1930.) (22.10/20386 France.)

Dead fishes, with weights in the nose, were allowed to fall freely in water, and a cinematograph record was taken showing the position of the fish and of a timing pendulum. The square root of the distance travelled is plotted against the time, generally speaking, giving times of the order of one second up to displacements of the order of one metre. In a number of cases the graph rectilineal indicating constant acceleration and hence constant resistance.

See A. & N. No. 12/11616.

The Eddy System in the Wake of Flat Circular Plates in Three-Dimensional Flow. (Dorothy Marshall and T. E. Stanton, Proc. Roy. Soc., Vol. CXXX, No. A.813, 1/1/31, pp. 295-301.) (22.10/20387 Great Britain.)

To avoid asymmetrical gravitational effects a vertical water tunnel was erected and is shown in diagram, the flow being downwards. The cross-section is square, 1.5 in. × 1.5 in. Various difficulties in the injection of coloured indicator are discussed. In the experiments selected for photographic reproduction a disc of 3 mm. diameter (in one case of 5 mm. diameter) is mounted at the top of a vertical

spindle apparently of about 1 mm. diameter. At the very slow velocity of 1 mm. per second permanent vortices were formed below the disc. At higher velocities the photographs show detachment of vortices, asymmetrical with respect to a vertical plane through the axis of the rod and the camera, but in the last two photographs symmetrical with respect to the axial plane at right angles.

The suggestion that the wake consists of a helical vortex was put forward in the first place, but is considered to be disproved by the symmetry in such cases as are shown in last two photographs referred to above. Certainly there appears to be no *à priori* reason for helical motion if the symmetry of the apparatus is given. No reference is made to the effect of the rod on the velocity distribution in the wake. As the velocity is certainly zero at the surface of the rod the influence may be considerable.

The following table is given of Reynolds number for discs of different diameters :—

d	3	4	5	6
vd/ν	200	197	191	199

Experiments on Auto-Oscillation and Auto-Rotation of Plates in a Stream. (J. Courregelongue and H. Maugein, C.R. 191, No. 2, 16/7/30, pp. 90-92.) (22.10/20388 France.)

The problem is approximately a two-dimensional one and the axes referred to are vertical to the stream.

An inclined plane plate was shown to throw off a series of small eddies coalescing into larger eddies in a characteristic way. (See Abstract No. 12775 of issue 14).

In the present experiments the plate was free to turn about its principal axis or about an axis in a vertical edge. The axis in turn was free to move in a circular arc. The plate had thus two degree of freedom, the same as those of a compound pendulum.

A number of interesting eddy formations are sketched and motions of auto-rotation and oscillations are described. These experimental facts are bound to modify and throw light on the rotary derivatives of aerofoils, the theory of which is being developed independently. (See Abstract No. 13116 of issue No. 15).

Distribution of Velocity in a Rectangular Water Channel with a Free Surface. (T. B. Abell and J. H. Lamble, Proc. Roy. Soc., Vol. CXXX, No. A.812, 2/12/30, pp. 90-97.) (22.10/20389 Great Britain.)

Dimensioned general arrangements are accompanied by numerical specifications. The method of measurement is by pitot tube, the reading of which became unreliable near the surface, at which visual observations were made of floating marks.

The results of twelve hundred observations are plotted and show the vertical and transverse distribution of velocity. There is considerable asymmetry as between right and left-hand sides. The maximum velocity occurs in two areas, one on each side at about one-fourth of the depth from the bottom. From the maximum value the velocity falls off rather rapidly towards the bottom and sides and more slowly towards the surface. There is a sensible reduction of velocity on the centre line as compared with the right and left-handed region of maximum velocity.

Bessel Functions in Cylindrical Wind Tunnel Problems. (G. N. Watson, Proc. Roy. Soc., Vol. CXXX, No. A.812, 2/12/30, pp. 29-37.) (22.10/20390 Great Britain.)

Certain series involving Bessel functions of the order zero and 1 occur in solutions of hydrodynamical problems in steady laminar motion with boundaries

which are surfaces of revolution. These series are rapidly convergent for large values of the independent variable, but become poor for small values with which, in practice, published tables are found to be useless for computation. The problem of transferring these series to a more convenient form was suggested by Mr. C. N. H. Lock in connection with a cylindrical wind tunnel problem, and has been carried out by the author. Numerical values of new coefficients expressed as definite integrals are worked out for four cases and may be applied to evaluating the first three terms of the new and sufficiently convergent series.

Boundary Problems in Hydrodynamics. (C. W. Oseen, Z.A.M.M., Vol. X, No. 4, Aug., 1930, pp. 314-326.) (22.3/20391 Germany.)

The author considers Stokes' approximations for viscous fluid motion past a cylinder and proposes solutions involving integral equations some of which have been solved by Odqvist and Faxen. Reference is made to Filon's solution in a series of Bessel functions, and also to papers by Bairstow. No reference is made to Filon's conclusion that the type of approximation is inappropriate. All the cases concerned are essentially slow motion and are of no direct practical interest in aeronautics. The treatment is purely formal and no numerical examples are given.

A Hot Wire Amplifier Method for Measuring Critical Velocity of Flow Past Aerofoils and Cylinders of Small Section. (E. Tyler, J. Sc. Instr., Vol. VII, No. 11, Nov$_t$, 1930, pp. 349-354.) (22.4/20392 Great Britain.)

In application of the method previously described in Phil. Mag., No. 61, June, 1930, p. 1113 (see A. & N. No. 15/13118), critical velocities of square prisms (rubber cord), circular cylinders, and aerofoils, with axes at right angles to the stream were determined by the appearance of eddies. The values were found to be 40, 48 and 60 in c.g.s. units, the cambered aerofoil being at zero chord incidence. A diagram of connections is given and the numerical results are plotted graphically showing frequency against velocity. Empirical formulæ are given for the results as linear functions of the reciprocal of Reynolds numbers.

Wind Pressure on Circular Cylinders and Chimneys. (H. L. Dryden and G. C. Hill, B. Stan. Jrnl., Vol. V, No. 3, Sept., 1930, pp. 653-693.) (22.4/20393 U.S.A.)

Extensive tests on model cylinders at different Reynolds numbers are recorded graphically. Further experiments were carried out on a 10 × 30 foot experimental cylinder in the open air, and the results recorded numerically and graphically in both cases. Finally experiments were carried out on the power plant chimney of the Bureau of Standards, 142 ft. high by 11 ft. 3 in. diameter, of which about 120 ft. rises above the building. Photographs show the chimney and building and the battery of manometers installed at the base of the chimney for rapid recording. The results are compared graphically with the previous experiments and show a strong general resemblance with considerable detail differences, which are attributed to the different Reynolds number.

A New Aerodynamical Phenomenon. (G. A. E. Raimondi, Not. Technico, Vol. VI, No. 10, Oct., 1930, pp. 1-19.) (22.4/20394 Italy.)

If an elongated body symmetrical bilaterally, etc., polylaterally, about an axis, in limit a circular cylinder, is rotated in the vicinity of a parallel plane, a force is set up with a component directed towards the plane. This force appears to increase more rapidly than the angular velocity and less rapidly than the square. With diameters varying from 225 to 300 mm. and with different forms of rotor, the force increases to a well defined maximum between 10 and

30 mm. distance from the plane. As a variation the rotor was enclosed in a cylindrical case with parallel axis, but eccentrically disposed. The maximum resultant force was least in the case of a cylinder rotated near a plane, and greatest with an eight-bladed rotor enclosed in a cylindrical case.

The author concludes, without suggesting any physical basis, that in the limiting case of two planes in relative parallel displacement a force of attraction will exist.

Photography of Waves and Vortices Produced by Discharge of an Explosive. (D. B. Gawthrop, W. C. F. Shepherd and G. St. J. Perrott, J. Franklin Inst., Vol. CCXI, No. 1, Jan., 1931, pp. 67-86.) (22.4/20395 U.S.A.)

The Schlieren method of photographing disturbances of the air by explosion is described in elementary technical terms and a number of photographs so obtained of waves and vortices are reproduced.

Miscellaneous

Navigation Methods Employed by Costes and Bellonte. (L. Kahn, C.R., Vol. CXCI, No. 17, 27/10/30, pp. 706-708.) (20396 France.)

Co-operation with the surface vessel during the New York flight gave greater accuracy of navigation than astronomical observation on the flight to Siberia.

Flight Instruction. (W. F. Gerhardt, Aviation, Vol. XXIX, No. 5, Nov., 1930, pp. 269-272, and No. 6, Dec., 1930, pp. 349-352.) (20397 U.S.A.)

Some useful elementary principles are laid down. A photograph shows an instructional apparatus which consists of a model aeroplane fixed on a universal joint in a wind stream and connected with full size controls. The pupil, sitting with his head in the wind stream behind the model, can cause it to roll, pitch and yaw by movements of the controls. A cockpit is mounted on gymbals which allow pitching, rolling and yawing motion. An airscrew driven by an electric motor is mounted. The c.g. is fixed, but all the angular movements of an aeroplane are possible.

Apparatus for Obtaining High Speeds of Rotation. (J. W. Beams, Rev. Sc. Instr., Vol. I, No. 11, Nov. 1930, pp. 667-671.) (20398 U.S.A.)

By employing a cone-shaped rotor floating on a film of air in the hollow cone of the stator, extremely steady angular velocities of 3,000 revolutions per second with a mirror and of 7,000 revolutions per second without a mirror were obtained. The construction is exhibited in diagrams.

Activities of the Phys. Tech. Reichsanstalt in 1929. (Z.f. Inst., Vol. L, No. 5, May, 1930, pp. 286-308.) (20399 Germany.)

A survey is given of the testing and experimental activities of the Institute, covering a wide range of physical investigation.

Naval Aviation. (D. S. Ingalls, Asst. Sec. Navy for Aeronautics, U.S. Naval Inst. Proc., Vol. LVI, No. 332, Oct., 1930, pp. 891-894.) (20400 U.S.A.)

A brief descriptive account is given of American Naval Air Policy illustrated by eight photographs showing aircraft on the landing deck of a carrier, and in squadron formation, the Curtiss Hawk, torpedo dropping, inverted flight, formation flying, the lost Shenandoah, and seaplanes taxying on the water.

Navy Air Organisation, 1931. (U.S. Naval Inst. Proc., Vol. LVI, No. 332, Oct., 1930, pp. 934-948.) (20401 U.S.A.)

Elaborate statistics are given of air equipment and syllabus of training. Accidents are classified for nine years by causes and results. The number and cost of aeroplanes and engines is tabulated by types. The main characteristics of aircraft carriers and tenders are also tabulated. Brief statistics of civil air transport in the United States are added.