ABSTRACTS AND NOTICES

Pressure Losses for Fluid Flow in Curved Pipes. (G. H. Keulegan and K. H. Beij, Bur. Stan. J. Res., Vol. 18, No. 1, Jan., 1937, pp. 89-114.) (42/1 4909 U.S.A.)

This paper presents the results of a study of the flow of water in smooth-walled large radius curved pipes for the viscous and turbulent régimes over a range of Reynolds numbers from 500 to 60,000. The discussion is based on data obtained with $\frac{3}{8}$-inch brass tubing. Two series of tests were made. In the first series pressure losses were measured on ten bends, and simultaneous measurements were made on the downstream portion of the straight pipe. In the second series pressure losses were measured on four equal segments on each of four bends. Critical numbers for bends of different curvature ratios when the entering flow is laminar are briefly discussed. Average values for the relative increase in resistance in a bend as compared with straight pipe in the régime of turbulent flow are given for the range of Reynolds numbers from 40,000 to 60,000. The results show that the relative increase in resistance is approximately proportional to the curvature ratio.

On the Relative Motion of a Solid in a Viscous Fluid. (V. Valcovici, Comp. Rend., Vol. 203, No. 21, 23/11/36, pp. 1054-1056.) (42/2 5300 France.)

The author demonstrates the following theorem. The system of hydrodynamic forces acting on a solid moving in a viscous fluid (which is at rest at infinity) augmented by the inertia forces of the displaced fluid is equivalent to the system of forces which the same fluid would exert on the body, if the whole material system (body and fluid) moved so as to bring the body to rest.

Tank Tests of Two Models of Flying Boat Hulls to Determine the Effect of Ventilating the Step. (J. R. Dawson, N.A.C.A. Tech. Note, No. 594, Feb., 1937.) (42/3 5308 U.S.A.)

The results of tests made in the N.A.C.A. tank on two models of flying boat hulls to determine the effect of ventilating the step are given graphically. The step of N.A.C.A. model 11-C was ventilated in several different ways and it was found that the resistance of the normal form is not appreciably affected by artificial ventilation in any of the forms tried. Further tests were made with the

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depth of the step of model 11-C reduced and likewise show no appreciable effect on the resistance from ventilation of the step. Tests were made on a model of the hull of the Navy P3M-1 flying boat hull both with and without ventilation of the step. It was found that the discontinuity which is obtained in the resistance curves of this model is eliminated by ventilating the step.

The Thermal Scale of Turbulence (English Text). (L. Witzianski and B. Schwab, Technical Physics, U.S.S.R., Vol. 2, No. 5, 1935, pp. 414-430.) (42/4 5341 U.S.S.R.)

Following the work of Knethe and Dryden, the turbulence in an airstream can be estimated by the value of the Reynolds number for which the resistance coefficient of a sphere becomes equal to 0.3.

It has since been found, however, that the results also depend on the absolute diameter of the sphere and this renders the method rather inconvenient. For this reason, one of the authors suggested as far back as 1931 an alternative method of estimating turbulence depending on the change of the heat transfer coefficient of a sphere immersed in the turbulent air. The procedure when using a thermal scale of turbulence is simple and more exact than the resistance method which depends on taking measurements in a critical stage of flow, when the latter is necessarily unstable and responsive to small influences.

It is possible to use relatively small spheres (7 cm. diameter) and the work is at present being extended to other shapes (streamline, etc.) with a view to investigating their suitability for similar measurements.

A New Stream Function for the Investigation of Rotational Gaseous Motion. (L. Crocco, Z.A.M.M., Vol. 17, No. 1, Feb., 1937, pp. 1-7.) (42/5 5364 Italy.)

The usual methods for the investigation of the motion of gases break down when the velocity of sound is exceeded. In this case, surfaces of discontinuity may form which are associated with changes in entropy, the motion now being no longer irrotational. The usual potential and stream functions now being no longer available, the author proposes a new type of stream function which is defined solely by velocity components. This new function is applicable to the equation of motions of general two-dimensional flow and to those special cases of three-dimensional flow which possess axial symmetry.

The Instability of the Boundary Layer in a Slightly Divergent Channel. (G. Rosenbrook, Z.A.M.M., Vol. 17, No. 1, Feb., 1937, pp. 8-24.) (42/6 5381 Germany.)

The velocity distribution in a divergent channel was obtained experimentally for the two-dimensional case. The method consisted in towing a pair of parallel divergent plates through stationary water sprinkled with metallic powder, the camera moving with the plate. The resultant velocity profile was approximately expressed by a polynomial of the sixth degree and the disturbance differential equation established following the methods of Tollmien (see Translation No. 244) from which it follows that the wave velocity of the neutral disturbance is equal to the fundamental velocity at the point of inflexion of the velocity profile. The author also attempted to determine the critical Reynolds number by means of the equation of dissipation. The attempt failed on account of the approximations introduced when solving the disturbance equations becoming untenable for the relatively small Reynolds numbers in question.

The Effect of a Periodic Source in Water with a Free Surface. (H. Holstein, Z.A.M.M., Vol. 17, No. 1, Feb., 1937, pp. 38-47.) (42/7 5382 Germany.)

The author considers the form of free surface as a function of the strength and period of the source and its distance below the surface in the two-dimensional case

of an incompressible fluid (irrotational motion). At a finite distance from the source, the main constitution of the solution is a complex experimental integral which is solved approximately in series form.

Centrifugal Pumps and Blowers. (British Patent No. 460,489.) (Messrs. Escher Wyss, Switzerland.) (Engineer, Vol. 163, No. 4238, 2/4/37, p. 406.) (42/8 5399 Great Britain.)

It is claimed that in this design of centrifugal multi-stage pump the losses in the passages from one stage to another are materially reduced. The diffusor chambers are so proportioned that their cross-section decreases by at least 10 per cent. in the direction of the flow, so as to increase the velocity and check turbulence. The passages are then provided with streamlined vanes to guide the fluid into the next stage. It is stipulated that the distance apart of the vanes should not be greater than the radial depth of the shortest vane.

A Study of the Factors Affecting the Range of Aeroplanes. (D. Biermann, N.A.C.A. Tech. Note No. 592, Feb., 1937.) (42/9 4925 U.S.A.)

A study has been made of the most important factors affecting the range of aeroplanes. In the first of three parts of the paper the various factors are individually analysed and evaluated relative to each other in order to establish a basis for compromise in design. In the second part the effect of varying a number of the most important factors is determined for a sample aeroplane. In the third part the problem of take-off is investigated for the most critical design conditions encountered in Part II and means for improving the take-off are analysed. The following general conclusions are drawn:—(1) Reduction in overall weight may be of more importance than aerodynamic cleanness. (2) Flight at constant speed or constant power is preferable to flight at constant L/D. (3) A large gain in speed with but little loss in range can be obtained by supercharging the engine to high altitudes. (4) For a given geometric size the gross weight should be the limit fixed by the take-off conditions. (5) Variable pitch props and flaps are of importance in making possible take-offs with greater loads.

The Effect of Lateral Controls in Producing Motion of an Aeroplane as Computed from Wind Tunnel Data. (F. E. Weick and R. T. Jones, N.A.C.A. Report No. 570, 1936.) (42/10 4926 U.S.A.)

Lateral control at low speed and high angles of attack not only depends on the rolling moment introduced but also on secondary forces due to yawing moments introduced by the controls and their effect on the damping in rolling, the other lateral stability derivatives and the moments of inertia of the aircraft. The present report deals with computations which take these additional factors into account and the agreement of the calculation with results of flight tests shows the utility of the method. It appears that for satisfactory control at high angles of attack the damping in both rolling and yawing must be maintained above a definite minimum to avoid an uncontrollable form of instability arising from the interaction of these motions.

The Rolling Friction on Several Airplane Wheels and Tyres and the Effect of Rolling Friction on the Take-off. (J. W. Wetmore, N.A.C.A. Report No. 583, 1937.) (42/11 5231 U.S.A.)

The rolling coefficient of friction varied between 0.009 to 0.077 depending mainly on the type of ground surface, although the type of tyre (high pressure, low pressure and extra low pressure) and the wheel bearing (plain or roller) have also some effect. Speaking generally, the standard type of wheel with high pressure tyres gave the lowest friction. In rough calculation of take-off performance only the type of ground need be considered.

Dollar Values in Airplane Design. (K. Perkins, J. Aer. Sci., Vol. 4, No. 4, Feb., 1937, pp. 139-148.) (42/12 5243 U.S.A.)

This paper explains the application of a partially rationalised method of reaching decisions relating to the general and detail design of an airplane. The method consists basically of assigning, by means which are explained and illustrated, dollar values to differences of weight, differences of speed, etc., which influence design, in order that all such factors may be reduced to common terms. It is shown how this method permits relatively accurate determination of ideal characteristics needed to meet given requirements, and an example is given showing how a typical design problem, involving the determination of the ideal wing span, may be solved.

Muscular Help to Gliding Flights. (Flugsport, Vol. 29, No. 6, 17/3/37, pp. 152-155.) (42/13 5281 Germany.)

From the known performance of a series of high performance gliders, it is estimated that the rate of descent can be halved by the muscular action of the arms and legs of the pilot. The corresponding increase in range will depend on the distribution and magnitude of the vertical air currents. Muscular effort may thus be of use in enabling a pilot to make use of vertical currents which, normally, he would have been unable to reach. Without the help of such currents, none of the existing gliders can be maintained in the air by muscular effort alone.

A Study of the Two-Control Operation of an Aeroplane. (R. T. Jones, N.A.C.A. Report No. 579, 1936.) (42/14 5311 U.S.A.)

The two-control operation of a conventional aeroplane is treated by means of the theory of disturbed motions. The consequences of this method of control are studied with regard to the stability of the aeroplane in its unconstrained components of motion and the movements set up during turn manœuvres. It is found that the motion of a conventional aeroplane is more stable when an arbitrary kinematic constraint is imposed in banking than when such constraint is imposed in yawing. Different means of two-control operation are also discussed and it is concluded that a reliable rolling moment control that does not give the usual adverse secondary yawing moment should be most satisfactory. Several special modifications intended to make the aeroplanes more suitable for two-control operation are also discussed, and it is found that relatively great weathercock stability (N_v) would be desirable.

Carburation for Long Range Flying. (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 471.) (42/15 5330 U.S.A.)

For long range work it is essential that the rate of fuel consumption of the engine be regulated within narrow limits. Moreover, it is advisable to maintain either constant air speed or determine a compromise of increased air speed and decreased power. This necessitates control of engine r.p.m. (variable pitch propeller) and induction pressure (boost regulator) as well as mixture strength. The Wright Aeronautical Corporation have designed an automatic carburettor in which the float mechanism is replaced by a diaphragm. This provides automatic compensation to within 10-15 per cent. at altitudes up to 15,000 feet. Ice formation in the carburettor caused by fuel evaporation has been eliminated by providing a clear path for the mixture (no throttle obstruction).

Wibault 25 Tons Civil Aircraft. (Les Ailes, No. 824, 1/4/37, p. 7.) (42/16 5434 France.)

A scale model of this machine fitted with four 20 b.h.p. engines is nearly completed at Villacoublay and will be tested in the full-scale tunnel at Chalais

Meudon.   The model will fly under its own power in the tunnel and it is claimed that this method of experimentation has, so far, not been carried out in any other country.

Giant Hydroplane.   (Les Ailes, No. 824, 1/4/37, p. 7.)   (42/17 5436 U.S.S.R.)

A twin-float gliding boat intended for passenger work on the Black Sea is under construction.   It is propelled by four engines (total b.h.p. 2,700) driving airscrews and two auxiliary engines operate water screws for manœuvring in harbours.   The machine can carry 150 passengers and a maximum surface speed of 60 m.p.h. is aimed at.

Pre-Chamber Compression Ignition Engine Performance.   (C. S. Moore and J. H. Collins, N.A.C.A. Report No. 577, 1937.)   (42/18 5310 U.S.A.)

Results of the investigation indicate that for maximum performance of this 5- by 7-inch single cylinder engine at speeds up to 1,500 r.p.m. the compression ratio should be between 15.5 and 17.5 and the pre-chamber should be as large as possible, disc-shaped and connected to the cylinder by a single passage.   A strong rotational air flow should be created in the pre-chamber by introducing the passage tangentially.   Flaring should be employed on the cylinder end of the passage to spread the issuing gases over the flat piston crown.   The fuel spray should be directed across the disc chamber toward the mouth of the connecting passage.   Boosting the inlet air pressure effectively raises the power output.   As the pre-chamber is inaccessible for scavenging and the lack of clearance under the valves prohibits the use of proper valve timing, the pre-chamber type of cylinder head is judged to be incapable of developing the high specific output required of aircraft engines.

Viscosity Type Oil Cooler, Designed by U.S. Air Corps.   (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 466.)   (42/19 5325 U.S.A.)

A viscosity control valve is illustrated which is directly secured to the cooler and requires no external " plumbing."   The operation of the valve is controlled by the pressure in a set of bellows, which in turn is controlled by the throat pressure of a small venturi which by-passes a very small quantity of oil from the inlet to the low pressure side of the relief valve.   In order to facilitate engine starting in cold weather, the U.S.A. Air Corps have been experimenting with an oil dilution system, in which the viscosity of the engine oil is reduced by petrol admixture prior to shutting down.   The admixture is restricted to the oil in circulation in the engine and the main oil is not affected.   Details of the circuit are given.

Aircraft Engine Ratings—Design of Metal Fins.   (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 468.)   (42/20 5326 U.S.A.)

From tests on a single cylinder the following conclusions are drawn :—(1) A considerable improvement in the heat transfer of conventional aluminium fin designs is possible by correctly proportioning the fin dimensions.   (2) The optimum thickness of fin decreases as the thermal conductivity of the material increases.   (3) Correctly proportioned aluminium fins will transfer more than $2\frac{1}{4}$ times as much heat as steel fins for the same weight and pressure drop.   (4) The best fin proportions for maximum heat transfer for a given pressure drop also give a high heat transfer for a given power expenditure.

French Engine Design.   (Autom. Ind., Vol. 76, No. 12, 20/3/37, pp. 470-471.)   (42/21 5328 France.)

The following tendencies are noted :—*Under* 30 *b.h.p.*—high speed air-cooled two-stroke (geared).   70-100 *b.p.h.*—radial air-cooled.   100-250 *b.h.p.*—in-line four- or six-cylinder ungeared (air-cooled).   300-500 *b.h.p.*—in-line six-cylinder

ungeared (air-cooled), 12-cylinder V geared (air-cooled). 600-1,000 *b.h.p.*—12-cylinder water-cooled predominate. 1,000-1,600 *b.h.p.*—air-cooled two-row radial largely predominates. On fighting aircraft, spur reduction gear is in favour, since it facilitates the use of the automatic cannon firing through the propeller shaft. Recent experience in Spain has shown that the ordinary machine gun is practically useless against high speed aircraft. The cannon, on the other hand, cannot be easily synchronised to fire through the propeller.

Flexible Valve Seats. (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 471.) (42/22 5329 U.S.A.)

The insert material for the valve seat is austenitic nickel chrome valve steel in the form of a ring of inverted U section. The outer member of the ring is sprung into the cylinder wall, whilst the stellited edge of the inner member forms the valve seat. It is stated that this modification enabled continuous runs under detonating conditions to be carried out on a Cyclone (6⅛in. bore) which had previously given trouble due to valve seat distortion.

Reduction Gears for Aircraft Engines. (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 476.) (42/23 5332 U.S.A.)

In single reduction gears of the spur type, herring-bone gears are now general. Reduction gears of the interplanetary type require careful design so as to equalise the loads on the subsidiary members. At the present time 1,000 b.h.p. engines can be run ungeared (1,000-1,500 r.p.m.). Engines of higher output will have to operate at higher r.p.m. (up to 3,000 r.p.m.). In this case a double reduction gear (ratio 3.5 or 3 to 1) will be required which will be of the spur wheel type.

Factors Influencing the Wear of Valve Seats in Internal Combustion Engines. (C. G. Williams, Engineering, Vol. 143, No. 3715, 26/3/37, pp. 357-358.) (42/24 5335 Great Britain.)

The experiments were carried out on a special machine, in which the exhaust valve could be subjected to the combustion product of a gas flame. Besides varying the nature of the products (oxidising or reducing) the effect of tappet clearance and spring closing pressure were investigated. It appears that wear only becomes appreciable if the valve and seat temperatures exceed a certain limit (approximately 600°C. and 240°C. respectively). Above this temperature, the wear increases rapidly in an oxidising flame, but only slowly in a reducing flame. As was to be expected, at constant speed, the wear is roughly proportional to the spring pressure and the square of the tappet clearance. (To be continued.)

Piston Ring Grooves. (British Patent No. 460,420.) (Engineer, Vol. 163, No. 4237, 26/3/37, p. 377.) (42/25 5339 Great Britain.)

This patent taken out by the Brandenburg Motor Works, Berlin, aims at overcoming wear of ring grooves in light alloy pistons by lining the top groove with a fixed channel-shaped ring in which the normal piston ring operates. Several alternative designs are illustrated.

Fuel Injection Pump. (British Patent No. 461,521.) (Scintilla, Ltd., Switzerland.) (Engineer, Vol. 163, No. 4238, 2/4/37, p. 405.) (42/26 5398 Great Britain.)

This pump is equipped with an accumulator piston acting in opposition to a spring. The downward stroke of the accumulator piston, and consequently the capacity of the pump barrel, can be regulated by a wedge controlled by the governor. The discharge of the oil takes place through a port in the piston, which terminates in a tangential gash. The piston can be rotated by a rack and

pinion gear. In this way the edge of the gash can be used to throttle the discharge and the fuel will be injected into the cylinder at comparatively low loads by the nozzle in a series of puffs, none of which is sufficient to cool the compressed air in the cylinder seriously. When the engine warms up the throttling action is reduced and continuous injection takes place.

Motor Spirit—Total Consumption and Home Production in Great Britain. (Fuel, Vol. 16, No. 3, March, 1937, p. 63.) (42/27 4938 Great Britain.)

The yearly imports of motor spirit in Great Britain amount to approximately $1,200 \times 10^6$ gallons, the yearly increase being of the order of 40×10^6 gallons. The hydrogenation plant at Billingham produced 34×10^6 gallons, or less than 3 per cent. of the total requirements. Assuming a possible production of 350 gallons per ton of treated coal, the total requirements of Great Britain could be met by treating 3.5×10^6 tons of coal. Ancillary operations would consume approximately 11.5×10^6 tons, so that out of a total annual coal production of approximately 230×10^6 tons, approximately 7 per cent. would have to be set apart to make Great Britain self-supporting.

Composition for Preventing Vapour Lock in Internal Combustion Engines. (J. E. Essick, Chem. Absts., Vol. 31, No. 5, 10/3/37, p. 1590.) (U.S. Patent No. 2,067,384.) (42/28 5278 U.S.A.)

A composition, to be added in small amounts to hydrocarbon fuel for internal combustion engines to eliminate vapour lock conditions, is formed by mixing kerosene $27\frac{1}{4}$ gal., nitrobenzene $5\frac{1}{2}$ gal., oil of creosote $10\frac{3}{4}$ gal., turpentine $2\frac{1}{4}$ gal., oil of cedar wood $2\frac{1}{4}$ gal., and camphorated oil $1\frac{1}{2}$ gal.

Anti-Knock Motor Fuel. (I. G. Farb, A.G., Chem. Absts., Vol. 31, No. 5, 10/3/37, p. 1603.) (U.S. Patent No. 2,067,331.) (B.P. No. 459,270.) (42/29 5279 U.S.A.)

Et_4Pb is used as an anti-knock agent together with a small amount of a water soluble (alkali) fluoride such as NH_4F to stabilise the Et_4Pb against light and water. A small proportion of methyl alcohol may be added.

Recent Research Work in Lubrication. (G. B. Karelitz, J. App. Mech., Vol. 4, No. 1, March, 1937, pp. A.31–A.32.) (42/30 5297 U.S.A.)

The work is reviewed under the following headings:—(1) Hydrodynamic theory. (2) Viscosity. (3) Boundary lubrication. (4) Bearing design (including piston rings).

(1) In the case of fluid friction, theory and experiment are in satisfactory agreement. (2) In certain cases the absolute viscosity and the slope of the viscosity temperature curve throw light on the constitution of the lubricant. There is a tendency to replace the commercial type of viscometers (which only give relative values) with instruments of a different type which give absolute readings. (3) Stability film strength, capillary attraction and oiliness all become of importance as soon as the film becomes so thin that the hydrodynamic laws of fluid motion no longer apply. The use of hypoid gears in motor cars has given added importance to this subject and had led to the development of extreme pressure lubricants. Apart from special methods of testing (Timken machine, Adheroscope, etc.), X-ray research has been carried out on the molecular orientation of thin films with a view to determining the effect of various oil admixtures. (4) A considerable amount of work has been carried out on the fatigue of bearing metals (tin base, lead base, bronze, etc.). A new cadmium silver alloy has been investigated. In the I.C. engine, the lubrication of the piston and rings becomes

increasingly difficult as loads increase (supercharging). As shown by several investigations, the increase of friction due to gas pressure may become appreciable. An extensive bibliography (31 items) covering recent work (1935-1936) adds considerable value to the review.

Value of High Octane Number Fuels. (Autom. Ind., Vol. 76, No. 12, 20/3/37, pp. 475-476.) (42/31 5331 U.S.A.)

(1) The revenue earning power of one gallon of petrol is increased from 2 to 5 cents per octane number improvement (for same calorific value). (2) High octane number fuels are of special importance in long range flights. (3) Within practical limits increase in cost of fuel cannot influence trend towards higher octane numbers.

Pressure Drop in Tubing in Aircraft Instrument Installations. (W. A. Wildhack, N.A.C.A. Tech. Note No. 593, Feb., 1937.) (42/32 5232 U.S.A.)

The theoretical basis for the calculation of the pressure drop in tubing is reviewed briefly. The effect of pressure drop in connecting tubing upon the operation and indication of aircraft instruments is discussed. Approximate equations are developed, and charts and tables based upon them are presented for use in designing installations of altimeters, air speed indicators, rate of climb indicators, and air-driven gyroscopic instruments.

The Duration of Spark Discharges Through a Gas Tube. (M. Laporte, Comp. Rend., Vol. 201, No. 23, 2/12/35, p. 1108.) (42/33 5318 France.)

A rotating mirror device is described, the image of the spark being registered on a stationary photographic plate. The speed of rotation is measured in a simple manner by combining the mirror with a siren, the pitch of the sound being measured by means of a tuning fork. The gas tube contained a mixture of argon and mercury vapour at a pressure of approximately 1 mm., and the duration of the spark was of the order of 10^{-5} seconds.

New Instrument for Recording Vibration in Flight. (Autom. Ind., Vol. 76, No. 12, 20/3/37, p. 469.) (42/34 5327 U.S.A.)

The vibrations are recorded electrically, a number of pick-up units operating a single central amplifying and recording unit. Each pick-up is specially adapted to the type of vibration it is intended to measure and is so small that it does not affect the vibration characteristic of the member to which it is attached. By recording the relative motion of two points, the vibration recorder can give information as to the straining of a particular part. An interesting application of the strain pick-up is the recording of engine detonation. For this purpose the gauge is connected between a cylinder stud and the spark plug shell, the detonation producing an electrical output which can be measured on a long period galvanometer.

Anodic Coating of Magnesium Alloys. (R. W. Buzzard and J. H. Wilson, Bur. Stan. J. Res., Vol. 18, No. 1, Jan., 1937, pp. 83-87.) (42/35 4908 U.S.A.)

Magnesium alloys may be anodised in a bath of sodium phosphate and sodium dichromate. The film obtained combines both corrosion-resistance and paint-holding properties, without serious change of dimensions of the treated piece, even on machined surfaces. (Eleven references.)

Aircraft Materials in the U.S.S.R. (Metals). (L'Aerophite, Vol. 45, No. 2, Feb., 1937, p. 38. See also Vol. 44, No. 12, Dec., 1936, pp. 278-280.) (42/36 4944 U.S.S.R.)

In the manufacture of special steels, there is a growing tendency to replace Ni and Tungsten, wherever possible, by Vanadium, Chromium or Cobalt. This

tendency is probably mainly governed by economic reasons which also account for the intense research into bearing metals free from tin. In the production of copper and aluminium, U.S.S.R. hopes to become self-supporting in the near future. The use of Titanium (a native product) in aluminium alloys is stated to have given good results.

Experimental Studies of the Effective Width of Buckled Sheets. (R. Lahde and H. Wagner, L.F.F., Vol. 13, No. 7, 20/7/36. N.A.C.A. Tech Memo. No. 814, Dec., 1936.) (42/37 2637 5062 Germany.)

Aeroplane design makes frequent use of thin sheet metal or plywood shells which buckle under shear and compression stresses, although some support is given at the point where sheet and angles join. So far as it deals with the absorption of compressive stresses this fact is allowed for in the calculation by introducing a participating stress bearing or " effective width," *i.e.*, a part of the sheet section of certain width is allocated to the section of the edge stiffener. The object of the present experiments is a more exact determination of the effective width for the case of pure compression and of the sheet clamped at the angle section. From the experimental data on the effective width the calculation of the buckling load of an angle joined to a thin sheet is then deduced. The experimental results for simultaneous appearance of transverse forces in the buckled sheet (tension fields) are reserved for a continuation of this article in a subsequent issue.

Thermal Stress. (J. N. Goodier, J. App. Mech., Vol. 4, No. 1, March, 1937, pp. A.33-A.36.) (42/38 5298 U.S.A.)

The paper gives a list of formulæ for the thermal stress arising in a number of fundamental cases (rods, plates and tubes). In all cases when the thermal stress is appreciable but still within the elastic limit, the expression for its value is of the form $KE\alpha T$ where $E =$ Young's modulus, $\alpha =$ coefficient of expansion, $T =$ temperature difference measured in a way depending on the particular problem, $K =$ a numerical factor ranging from 0.5 to 2.5. Holes, flaws, notches, and other source of stress concentration are not considered in the article. Taking $E\alpha T$ as representing the order of magnitude of the thermal stress, we obtain a value of 200 lb./sq. in. per degree F. for steel. The yield point is thus reached for this material when temperature differences of the order of 200°F. exist within the material. If the material is mechanically loaded in addition, much smaller internal temperature differences may have to be considered.

Increasing the Fatigue Strength of Press-Fitted Axle Assemblies by Surface Rolling. (O. J. Horger and J. L. Maulbetsch, discussion of paper, J. App. Mech., Vol. 4, No. 1, March, 1937, pp. A.37-A.39.) (42/39 5301 U.S.A.)

According to Föppl, engineering metals are heterogeneous, the constituent crystals being arranged at random and exhibiting very different amounts of cohesion. The stress distribution under load is thus far from uniform and the maximum stress may exceed the average stress ten or even a hundred times. The first breakdown of the material will then occur in small isolated regions and provided the load keeps within certain limits, the damage will not spread. The preliminary loading may even be considered as strengthening the material, since the stressing becomes more equalised. These remarks, however, only apply if the regions of breakdown are surrounded by sound material. If situated near the free surface of the metal, stress equalisation is rendered more difficult and the presence of any flaws in the surface becomes of great importance. Unless special precautions are taken, machined surfaces generally show microscopic cracks, but by subjecting the surface to mechanical treatment (rolling, etc.) the small fissures can be eliminated and the fatigue strength very considerably increased.

A New Alloy of High Density. (C. J. Smithells, Nature, Vol. 139, No. 3516,
    20/3/37, pp. 490-491.) (42/40 5314 Great Britain.)

A mixture of 95 per cent. tungsten and 5 per cent. copper powders is heated
to 1,450°C. for one hour in a steel die in an atmosphere of hydrogen. The
resultant alloy has a density of the order of 17 gm./cc. The alloy is readily
machined, using a tungsten carbide tool, and although primarily intended for
radium containers, it has been used for balancing crankshafts of racing car
engines and similar applications in aircraft engines appear possible.

Chemical Exploration of the Stratosphere. (F. A. Paneth, Nature, No. 3509,
    30/1/37, pp. 180-182, and No. 3510, 6/2/37, pp. 220-223.) (42/41 4676,
    4932, Great Britain.)

If the stratosphere is free from air currents the constituent gases of the atmos-
phere should sort themselves out on a density basis. The most suitable gas for
testing this appears to be helium and the author has developed a micro method
for measuring quantities of a few millionths of a cubic centimetre with an accuracy
of 1 per cent. The automatic sounding balloon used at Kew Observatory is
described. When the envelope bursts at the ceiling, a previously evacuated
glass bulb (500 cc.) is put in communication with the surrounding atmosphere
and resealed electrically after 15 seconds whilst the instrument descends by
parachute. Altitudes of 23,000 metres have been reached whilst 31,000 m. has
been recorded in Germany, using a slightly larger balloon. The He content of
the atmosphere shows a definite increase at about 18,000 m. (5 per cent. at
23,000 m.). The rate of increase is, however, much less than would be expected
if the quiescent atmosphere existed at these altitudes (13 per cent. per km.).
There is thus no evidence of a sudden change in condition of the stratosphere at
20 km., the influence of air currents persisting even at this altitude and depending
on general weather conditions.

Natural and Artificial Clouds. (D. Brunt, Nature, Vol. 139, No. 3517, 27/3/37,
    p. 541.) (42/42 5316 Great Britain.)

When an unstable layer of fluid breaks down, the resultant motion is in the
form of prismatic cells. In the case of air, the motion of a relatively shallow
layer rendered unstable by heating from below consists of a large number of
ascending currents surrounded by much slower descending currents. If the
heated air is contained in a glass box, motion of the upper plate will produce a
variety of phenomena closely resembling cloud phenomena. Typical examples
are small cloudlets on a background of blue sky, cloud sheets which show a series
of clear holes and clouds in rolls which correspond to the longitudinal or trans-
verse rolls obtained in the model with rapid or slow shearing of the upper plate.

The Albedo of Clouds and the Earth's Surface. (K. Stuchtey and A. Wagener,
    Nachrichten der Königlichen Gesellschaft der Wissenschaften zu Göttingen,
    Mathematical Physical Series, 1911, No. 1, pp. 209-235.) (42/43 5406
    Germany.)

The experiments were carried out from a balloon, the albedo of the cloud or
earth below the balloon being compared with that of a plaster of Paris plate using
the Marten's polarisation photometer. Since the construction of the instrument
necessary shields the plaster plate from some of the sky light, the value of the
cloud or earth albedo has to be reduced in order to obtain a fair comparison.
Independent experiments led to a correction of approximately 7 per cent. for this
effect. The absolute value of the albedo for the plaster plate was determined
subsequently in the laboratory as being equal to unity. Altogether four balloon

flights were carried out and over 200 measurements were taken. The following are average values for the *albedo of clouds* :—

Stratus clouds	...	...	600 m.	0.54
,, ,,	...	...	1,600 m.	0.76
Cumulus clouds	...	...	1,600-3,000 m.	0.67

Average values for *albedo of earth's surface* :—

Fields	...	...	...	...	0.15
Forests	...	...	...	...	0.06

(Altitude 600-1,600 m.)

Heat Transfer to Fuel Sprays Injected into Heated Gases. (R. F. Selden and R. C. Spencer, N.A.C.A. Report No. 580, 1937.) (42/44 4927 U.S.A.)

A study has been made of the influence of several variables on the pressure decrease accompanying injections of a relatively cool liquid into a heated compressed gas. Indirectly, this pressure decrease and the time rate of change of it are indicative of the total heat transferred as well as of the rate of heat transfer between the gas and the injected liquid. Air, nitrogen, and carbon dioxide were used as ambient gases; Diesel fuel and benzene were the injected liquids. The gas densities and gas fuel ratios covered approximately the range used in compression ignition engines. The gas temperature ranged from 150°C. to 350°C. Several general conclusions may be drawn from the experimental results :— Vaporisation begins immediately after start of injection; the initial rate of heat transfer is a direct function of the initial temperature difference between the gas and the fuel; and the heat transfer is less efficient the greater the injected fuel quantity, even though the total heat transferred is greater.

The Laws of Heat Transmission in a Flowing Medium. (M. Lang, Ann. d. Phys., Vol. 24, No. 5, Nov., 1935, pp. 393/408.) (42/45 5307 Germany.)

If the classical theory of Fourier is applied to the temperature distribution in a hydrodynamic field of flow, heat transfer takes place up to infinity even if the direction is opposed to the velocity of the medium. This is contrary to experience, the optical investigation of the field of flow round a heated tube showing a discontinuity beyond which the temperature field does not extend.

The author attributes this to the fact that heat conduction is a molecular phenomenon, the medium not being continuous as required by the Fourier analysis. Making allowance for this fact, new equations of heat transfer are derived by the author which show that heat transfer cannot take place into a medium if the latter is moving against the temperature gradient at a velocity approximately double the mean molecular velocity.

The Heat Transfer of a Gas Moving at Very High Speeds in a Cylindrical Tube. (German text.) (A. Guchmann and others, Technical Physics, U.S.S.R., Vol. 2, No. 5, 1935, pp. 375-413.) (42/46 5340 U.S.S.R.)

Considerable difficulties arise in the theoretical treatment of heat transfer problems as soon as the velocity of the gas is such that compressibility can no longer be neglected. The authors carried out experiments at air speeds ranging from 100 to 300 m./sec., the temperature of the air entering the tube being approximately 300°C. whilst the tube itself was immersed in boiling water. The pressure of the air at entry was of the order of 3-4 atmospheres, the exit being atmospheric. The heat transfer coefficient a increased over the speed range employed from app. 150 to 400 cal./m.²/h./°C. In calculating the above results, the gas temperatures used are those recorded when the air is brought to rest at

the thermometer.   The experiments give the following simple relationship for the Nusselt and Peclet numbers :—

$$Nu = 0.017 \, Pe^{0.82}$$

and from this it is concluded that under the condition of the experiments the compressibility phenomena are restricted to comparatively small regions near the exit of the tube.

Ultra High Frequency Wave Propagation over Plane Earth and Fresh Water. (R. C. Colwell and A. W. Friend, Proc. Inst. Rad. Eng., Vol. 25, No. 1, Jan., 1937, pp. 32-37.)   (42/47 4895 U.S.A.)

The propagation of 59 to 98 megacycle waves over the plane earth and fresh water was measured and a simple equation for the field strength was developed. Propagation over very deep fresh water was found to be no better than that over plane dry earth.

Directional Antennæ. (G. H. Brown, Proc. Inst. Rad. Eng., Vol. 25, No. 1, January, 1937, pp. 78-145.)   (42/48 4898 U.S.A.)

The object of this paper is to develop analytical methods which are readily applicable to the general problems that arise in array design and to provide design curves that may be used without reference to the field theory underlying the problem.   The cases of both driven and parasitic arrays have been treated. Where possible, the results have been by comparison with experimental results. In the case of a single parasitic reflector, it is found that spacings less than a quarter wave length are desirable both for transmitting and receiving.   It is seen that the parasitic antenna functions equally well as a director or a reflector. The case of an antenna parallel to an infinite sheet acting as a reflector is treated. It is shown that it is desirable to space the antenna very much less than a quarter wave length from the sheet.   Other appendices give the derivation of the expressions for the electro-magnetic field in the vicinity of a straight wire, end-loaded, and of arbitrary length, and the extension of these expressions to yield the vertical radiation characteristics at great distances.

Klein Accumulator with Small Self-Discharge.   (G. Nehlep and K. H. Koepernik, J. Soc. Chem. Ind (Abstracts B), Vol. 56, February, 1937, p. 149.)   (42/49 4952 Germany.)

The cell has a rod anode of PbO_2 surrounded by a cylidrical Cd plate as cathode. in 32 per cent. H_2SO_4 the reactions being $Cd + PbO_2 + 2H_2SO_4 \rightleftharpoons CdSO_4 + PbSO_4 + 2H_2O$, and the e.m.f. 2.24 volts with no load.   Charge and discharge curves are given for 100 milliamp.   The self-discharge is only 1 per cent. in one month, 2-3 per cent. in two months, and 7 per cent. in three months.   The cell is lighter than a Pb accumulator, and is suitable for use in high tension batteries.

Ultra Short Wave Refraction and Diffraction. (T. L. Eckersley, J. Inst. Elec. Eng., Vol. 80, No. 483, March, 1937, pp. 286-304.)   (42/50 5215 Great Britain.)

The work of G. N. Watson on the propagation of electric waves over a spherical earth has been extended by the author to take account of the finite resistivity of the earth, the effect of which is of great importance in ultra short wave transmission.   The work is in such a form that the field intensities above the earth can be computed numerically.   The effect of refraction in the earth's atmosphere can also be taken into account.   The results for a range of wave length between 2 and 10 m. and for heights up to 4,000 m. and distances up to

400 km. are published in the paper in a set of curves, the general properties of which are discussed. The effect of atmospheric refraction is considered, and a comparison between observation and theory is made, in which good agreement is obtained, on the average, when neglecting refraction. Major changes may, however, be produced occasionally by refraction.

The Performance of Coil Ignition Systems, with Particular Reference to Double Contact-Breakers and the Effects of Variation of the Period of Open Circuit. (W. R. Debenham, J. Inst. Elec. Eng., Vol. 80, No. 483, March, 1937, pp. 329-341.) (42/51 5216 Great Britain.)

The paper deals with experimental results obtained on a modern coil ignition system operated by a double contact-breaker with a small angle of open circuit. At high speeds the contact-breaker closes before the spark discharge ceases. A theoretical investigation, based on the results, is carried out to determine the approximate increase in sparking frequency with a given output, due to the effect of the persistence of the spark discharge, for various periods of open circuit. Under certain conditions, the estimated increase is 35 per cent. for 0.4 millisecond and 63 per cent for 0.1 millisecond. The maximum sparking frequency of 12-volt coil systems, capable of meeting the output requirements of the service specification for ignition apparatus, is estimated for various values of the open circuit period. It is shown that the probable limit for reliable operation with a double contact-breaker is about 300 sparks per sec. per coil.

REVIEWS.

AIRMAN FRIDAY.

William Courtenay. Hutchinson and Co. Price 12s. 6d.

William Courtenay is well-known in aviation as a brilliant publicity expert. Much of the fame which has come to certain pilots would, despite their often remarkable flights, have died away, a nine days' wonder, if it had not been for the skill of the author in keeping them before the public. How far this is a good or bad thing for those concerned, or for aviation in general, it is not within the competence of the reviewer to express an opinion. But it is certain that from a purely publicity point of view Mr. Courtenay has done his work extremely efficiently and in this book he gives some account of his methods and of the many famous people in aviation with whom he has come in close contact.

The author, himself a fully qualified pilot, went to sea at 15, joined the army at 17, took part in the landing at Suvla Bay, invalided home, returned to the Holy Land to win the Military Medal, returned to Cairo where he became an officer in the Royal Air Force, gaining an experience of sea, land and air which was to prove invaluable.

In the years which followed he helped to organise the tours of Sir Alan Cobham in the famous " Youth of Britain," the reception to Amy Johnson following her amazing solo flight to Australia, and afterwards the outstanding series of flights made by Miss Johnson and James Mollison. In 1932 the author, as an accredited newspaper correspondent, made a flight to India and back with Captain Stack. That year Courtenay met, and helped to make known to the public, Edward Hillman, whose dynamic personality built up a road transport service from nothing, to sell to the London Passenger Transport Board for £145,000 in four years, began Hillman's air services, and died at the early age of 45, a definite loss to air transport.