

ABSTRACTS AND NOTICES
FROM THE
SCIENTIFIC AND TECHNICAL PRESS.

Issued by the
Directorates of Scientific Research and Technical Development, Air Ministry.

(Prepared by R.T.P.)

No. 43. MAY, 1937.

Behaviour of Turbulent Boundary Layers on Curved Convex Walls. (H. Schmidbauer, N.A.C.A. Tech. Memo. No. 791, April, 1936.) (43/1 1987 U.S.A.)

In an approximate method for calculating the friction layer at a plane plate when the former is simultaneously subjected to a pressure gradient parallel to the plate, E. Gruschwitz (Ing.-Arch., II, 1931) developed a system of linear differential equations for a suitably chosen form parameter which indicated the approach of separation and the so-called "boundary layer thickness."

This system of equations is extended here to the case where the friction layer is subject to centrifugal forces. Measurements were made of the total pressure in the friction layer during flow of an air current along the upper curved surface of an upwardly curved channel between two parallel, perpendicular walls, the curvature of which was constant. Experiments were made for three different radii of curvature, $r=25, 75$ and 150 cms. Evaluation of the data showed that change in momentum and wall drag are functions of the ratio boundary layer thickness/radius of curvature of the wall. Transition from laminar to turbulent flow occurs at somewhat higher Reynolds numbers at the convex wall than at the flat plate, due to the stabilising effect of the centrifugal forces.

The extended system of equations is applied to several boundary layers. For comparison, two examples for friction layers without curvature were also calculated. It was found in each case that for a level plate the friction layer was about 25 per cent. thicker than that for a wall with convex curvature.

New American Wind Tunnel. (Engineer, Vol. 163, No. 4239, 9/4/37, p. 419.) (43/2 5506 U.S.A.)

The United States Government has placed a contract valued at about 1,000,000 dollars for the construction of a high-pressure wind tunnel for aeronautical experimental work. The tunnel will be 280ft. long with a diameter varying from 19ft. to 54ft. at its widest point. A wind velocity of 200 miles an hour will be created within the tunnel by a 30ft. diameter multi-blade propeller, driven by an 8,000 b.h.p. electric motor. About 2,000 tons of steel will be used for the tunnel, which will be built up by welding steel plates of varying thicknesses between $\frac{3}{8}$ in. and 2in.

The Interference Effect of the Surface of the Sea on the Lift of a Seaplane. (S. Tomotika and I. Imai, Aer. Res. Inst. Tokio Rept., Vol. 12, No. 145, Feb., 1937, pp. 71-128.) (43/3 5532 Japan.)

The appreciable interference effect on the lift of a seaplane produced by flying near the surface of the sea, and which according to experiments carried out at Felixstowe may produce a 10 per cent. increase in the maximum lift cannot be satisfactorily explained by the ordinary vortex theory. In this paper a mathematical analysis is made of the problem of calculating the lift of a flat plate placed in a two-dimensional continuous stream of fluid which is bounded by a free surface on the lower side of the plate, assuming various values for the angle of attack of the plate and for the distance of the plate from the free surface. It is shown that for practically important angles of attack, such as 10° or 15° , the lift is increased by a few per cent. due to the presence of the free surface when the distance of the plate from it is of the same order of magnitude as the breadth of the plate. The surface of the sea being considered as a free surface, by assuming the water at rest and neglecting gravity, the theoretical results are applied to the case of a seaplane taxiing over the sea surface, and it is shown that for an angle of attack of about 15° the maximum lift may be expected to be increased by about 6 per cent. when the distance of the wing from the surface is of the order of the breadth of the wing.

Sphere Tests in the N.A.C.A. 8-foot High-Speed Tunnel. (R. G. Robinson, J. Aeron. Sci., Vol. 4, No. 5, March, 1937, pp. 199-201.) (43/4 5632 U.S.A.)

Tests with a 4in. sphere indicate that this high speed channel possesses practically free air turbulence. Tests with a 12in. sphere in the entrance cone (low speed) showed a critical Reynolds number of the order of 200,000, so that the 9/1 entrance cone fitted to this channel has reduced the turbulence from 1 per cent. at entry to less than 0.3 per cent. in the working section. Compressibility effects affect turbulence measurement of this type at speed in excess of 270 m.p.h.

Measurements of Intensity and Scale of Wind Tunnel Turbulence and their Relation to the Critical Reynolds Number of Spheres. (H. L. Dryden, G. B. Schubauer, W. C. Mock, and H. K. Skramstad, N.A.C.A. Report No. 581, 1937.) (43/5 5823 U.S.A.)

By the use of a modification of the usual hot wire apparatus incorporating two hot wires suitably connected and mounted so that the cross-stream distance between them may be varied, it has been found possible to determine the correlation between the speed fluctuations existing at the two wires. If u_1 and u_2 are the velocity fluctuations in the direction of the mean speed at the first and second wires respectively, a correlation coefficient $R(y)$, equal to $\overline{(u_1 u_2)} / \{ \sqrt{\overline{(u_1^2)}} \sqrt{\overline{(u_2^2)}} \}$ may be found as a function of the separation y . A length characterising the scale of the turbulence may then be defined by the relation—

$$L = \int_0^{\infty} R(y) dy.$$

It was found that the critical Reynolds number depended on D/L , where D is the diameter of the sphere, as well as on $\{ \sqrt{\overline{(u^2)}} \} / U$. It is shown that the effect of the size of the sphere already observed by other investigators is but a particular manifestation of the foregoing more general relation.

Notes on the Construction of Integral Fuel Tanks for Aeroplanes. (H. J. Alter, J. Aer. Sci., Vol. 4, No. 3, Jan., 1937, pp. 100/106.) (43/6 5238 U.S.A.)

The integral or built-in tank saves weight and space in aeroplane structures and thus makes for efficiency. Low rivet stresses, careful workmanship and

above all an efficient sealing medium such as bakelite varnish or a synthetic rubber compound (Thiokol or Duprene) are required. Several ways of making the seams and joints are illustrated, the best type of seam being one which is securely fastened at the ends and has a flexing portion between. Corners and structural members going through the tank present the most difficulty. These should be fastened on with properly shaped castings, stamped or welded fittings. Standard dural tanks weigh approximately 0.47 to 0.38lb. per gallon, depending on size (150 gallons to 500 gallons). The integral tank weights for various installations come out as follows:—

100 gallons	...	...	0.32 lb./gallon.
300 "	...	...	0.18 "
500 "	...	...	0.10 "
1,000 "	...	...	0.06 "

The possible saving in weight is thus considerable.

Variable Pitch Propeller. (British Patent No. 460,921.) (G. Schwarz, Engineer, Vol. 163, No. 4239, 9/4/37, p. 436.) (43/7 5508 Great Britain.)

This variable pitch propeller is automatically adjusted according to the temperature, not the pressure, of the atmosphere in which it is working. Fixed to the blade of the propeller there is an arm loaded with an eccentric weight, which tends to turn the blade anti-clockwise on account of centrifugal force. Between the arm and an abutment on the propeller boss there is a telescopic link. The casing of this link is filled with a liquid, such as oil, which, expanding and contracting under the influence of changes of temperature, acts on the plunger and adjusts the pitch of the propeller in opposition to the action of the weight. The temperature of the casing may be under the control of the pilot through the diversion of part of the engine exhaust.

Stinson Reliant Wing Structure. (Aero Digest, Vol. 30, No. 4, April, 1937, p. 72.) (43/8 5607 U.S.A.)

Due to the airfoil section and plan form of the wing, which is a Clark Y section, tapered and modified, each wing rib must be constructed in a separate jig. These ribs are built of square dural tubing, riveted together. The Y, or inboard, section of the spar (fuel tank in middle of Y) is also built in a separate jig, as is the outer portion of the spar. These are constructed of chrome molybdenum steel. The false spar to the rear, together with the aileron and flap, are built of dural and are individually jugged so as to be interchangeable on any wing. Both sections of the spar, together with ribs, torque vees and false spar, are assembled in another jig. The dural leading edge, false wing tip, heavy gauge aluminium tank, cables and wiring, are installed after the wing has been removed from the assembly jig.

Full-Scale Wind Tunnel and Flight Tests of a Fairchild 22 Aeroplane Equipped with a Zap Flap and Zap Ailerons. (C. H. Dearborn and H. A. Soulé, N.A.C.A. Tech. Note No. 596, March, 1937.) (43/9 5625 U.S.A.)

A wing equipped with Zap flaps and Zap ailerons was tested on a Fairchild 22 aeroplane in the full-scale wind tunnel and in flight. The Zap flap is a split flap characterised by the fact that its leading edge is moved aft as the flap angle increases, so that the trailing edge of the flap remains approximately under the trailing edge of the wing. The Zap ailerons are small chord aerofoils fitted with leading edge slats, the aileron being mounted above and slightly forward of the trailing edge of the wing. Both tunnel and flight experiments showed that the flaps and ailerons functioned satisfactorily. The Zap ailerons require, however, relatively large stick forces for their operation.

High Altitude Aeroplane Compartments. (J. S. McDonnell, *J. Aeron. Sci.*, Vol. 4, No. 5, March, 1937, pp. 177-182.) (43/10 5626 U.S.A.)

Experiments were carried out in the Bureau of Standards decompression chamber on the effect of rapid evacuation on the human organism (puncture of aeroplane compartment at high altitude). Structural tests were also carried out on various types of compartments (fixed and floating skin) with the object of getting information on weight of skin to withstand the pressure difference. The author concludes that sealed pressure compartments can be successfully constructed for altitudes up to 30,000 feet and that the sudden decrease in pressure due to a puncture will not prove dangerous to the passengers.

Strength of Welded Aircraft Joints. (W. C. Brueggeman, N.A.C.A. Report No. 584, 1937.) (43/11 5822 U.S.A.)

In welding thin-walled tubing, the recently developed "carburising flux" process was found to be the only method capable of producing joints free from cracks. The "magnetic powder" inspection was used to detect cracks in the joints and flaws in the tubing. The strengths of chromium-molybdenum T, lattice, and butt joints were materially increased by heat treatment. Butt joints in chromium-molybdenum sheet and tubing welded with low carbon and chromium-molybdenum welding rod and those welded by the "carburising flux" process had about the same strength in the "as welded" condition. The chromium-molybdenum and carburising flux welds were the strongest after heat treatment.

U.S.A. New Method for Wing Load Calculation. (Inter Avia., No. 422, 13/4/37, p. 6.) (43/12 5847 U.S.A.)

The Army-Navy-Commerce Committee on Aircraft Requirements recently published their first bulletin (A.-N.-C. Structures Bulletin No. 1), in which a method for obtaining a spanwise load distribution on wings is described. The spanwise distribution of CL (lift coefficient) and CD (drag coefficient) are obtained by the solution of a Fourier series with a correction at the tip for the value of CL . Charts are set up for the analytical solution of the problem, with an example worked out. Curves are included for the ready solution of the Fourier series for untwisted tapered monoplane wings, having a straight trailing and leading edge. The report was prepared by the Navy Department, Bureau of Aeronautics, and has been approved by the military and commercial departments.

Down Gusts. (J. H. Crowe, *Airc. Eng.*, Vol. 9, No. 99, May, 1937, pp. 119-122.) (43/13 5954 Great Britain.)

It is shown that the down gust requirement in the strength specification is open to the objection that heavier loads may be taken by the front spar at lightly loaded weight than those for which the spar was designed. This is normally covered by the factor of safety of 2, but the method of calculating the loads on a basis of all-up weight is not very rational. Some available data concerning the magnitudes of down gusts are reviewed and the sharp-edged gust hypothesis briefly examined. The British requirement is compared with those of the I.C.A.N. and the U.S.A. The conclusions are that there are no very practical alternatives to sharp-edged theory and while the estimate of the magnitudes of normal down gusts at 25 f.p.s. appears satisfactory and British standards of strength in this respect need not be tightened up, a modification to the requirement to meet the above objection is desirable. A suggested alternative is put forward.

Aerial Fighting in Spain. (Les Ailes, No. 824, 1/4/37, p. 12.) (43/14 5446 Spain.)

Retractable undercarriages have led to a number of casualties since the mechanism is very vulnerable to gun fire. A pancake landing generally leads to the loss of the aircraft, even if the crew escape serious injury. The French

observer also is of the opinion that the bombers in use suffer from blind spots and lack centralised fire control. Wing guns are generally inaccurate, since the barrel is short and the mounting too flexible. In addition, the time lag of 0.2 to 0.3 seconds in the firing control mechanism introduces serious errors.

Lessons of the War in Spain. (A. Langeron, *Les Ailes*, No. 825, 8/4/37, p. 12.) (43/15 5536 France.)

The following conclusions are drawn:—

- (1) The handling of modern single-seater fighter is much too complicated. In addition to the enemy, "the pilot has to fight his own plane."
- (2) The principal aim of aircraft should be to inflict damage to the enemy on the ground (either against troops or buildings). For this purpose the raider must be fast. Douglas civil aircraft have been used practically without any modification, their superior speed enabling them to execute their mission whilst avoiding aerial combat.
- (3) French military aircraft taking part in the fighting is definitely inferior to that of Italy and U.S.S.R.
- (4) The tactics to be adopted in future aerial warfare are not yet settled. Large scale experiments are urgently required so that construction is concentrated on those types which are of use.

The Next Five Years in Spark Ignition Aviation Engines. (C. F. Taylor, *J. Aer. Sci.*, Vol. 4, No. 3, Jan., 1937, pp. 113/116.) (43/16 5240 U.S.A.)

The following general predictions are made:—

1. Weight per b.h.p. should diminish to 0.75.
2. Cruising fuel consumption of the order of 0.35 lb./b.h.p. hr.
3. For high altitude work the liquid-cooled engine will come into favour.
4. Active development of the exhaust driven supercharger.
5. Special propeller designs for high altitude work will be investigated.

Measurement of Air Movement in the Interior of Diesel Engine Cylinders. (J. Geiger, *Mitt. Forsch-Anst. Gutehoffmingshutte-Konzern*, Vol. 4, No. 9, Nov., 1936, pp. 213-220.) (43/17 5495 Germany.)

A spindle carrying on the inside a radial blade with a pressure disc, and on the outside a mirror, movement of which is optically recorded, was inserted through the cylinder head. In the motored engine, without fuel, the air speed was measured for different positions of the induction valve mask and compared with that obtained by tangential induction channel without a mask. A graph shows the relationship between mask position, air speed at 80 mm. from the cylinder axis and fuel consumption. The latter is increased considerably (30 per cent.) at low air speeds, is approximately constant at average speeds (10-22 m./sec.) and increases somewhat at higher speeds (22-25 m./sec.).

Experimental Investigation on the Combustion in a Diesel Engine II. The Study of Combustion by Means of a Photo-Electric Cell and Emission Spectra. (G. Hamabe, F. Nagao and T. Watanabe, *Trans. Soc. Mech. Eng., Japan*, Vol. 2, No. 6, 1936, pp. 50-55. In Japanese-English Abstract, *Phys. Ber.*, Vol. 18, No. 6, 15/3/1937, p. 484.) (43/18 5650 Japan.)

The combustion process in a two-cylinder Junker's Diesel engine has been investigated spectroscopically. A quartz window of 15 mm. diameter was inserted opposite the injection nozzle, and the light from it was allowed to fall on a photo-cell and the photo-current amplified. The result was registered on the same film as the pressure record obtained from the oscillograph of an electrical indicator. Examples of typical records (which are given in the paper) show that, during the course of a stroke, brightness and pressure curves rise similarly, the

curve of brightness rising more quickly at first than that of the pressure. From this the authors conclude that the combustion is at first localised in certain regions of the cylinder. It was also possible to determine that emission of light begins 15 mm. in front of the injection nozzle and spreads out suddenly from there. Changes in speed of revolution and load showed that light intensity increases with the load and that the commencement of light emission is delayed with decreasing load. Investigations with oils of different ignition quality showed that, when the ignition lag is great, combustion begins simultaneously in all parts of the cylinder, and is generally accompanied by knocking. By means of a quartz spectrograph and a rotating sector, the light emitted over 5° of crank angle was analysed. It was found that the bands associated with $-\text{OH}$ and $\text{CH}-$ radicals and $\text{C}-$ atoms and present during combustion in a free atmosphere were missing.

Investigations on Knock Ratings I, II and III. (R. Kobayasi and S. Kajimoto, J. Soc. Chem. Ind., Japan, Vol. 38, No. 11, Nov., 1935, pp. 654-657B, and Vol. 39, No. 9, Sept., 1936, pp. 304-311B.) (43/19 5437 5472 Japan.)

Part I deals with the effect of tetraethyl lead on the knock rating of straight run and cracked petrols. In Part II, knock ratings were determined for two straight run petrols and their blends with alcohol, benzene and benzol, together with various amounts of lead. Part III extends the work to the lead susceptibility of mixtures of various pure hydrocarbons with straight run petrol. The work was carried out throughout on the C.F.R. engine.

The main conclusions were:—

1. The ethyl effect is much greater for straight run petrol than for cracked spirit using alcohol and benzol as blending agents instead of lead, the straight run petrol was again more susceptible in each case.
2. The lead susceptibility of straight run petrol is reduced by the addition of alcohol, benzene or benzol.
3. Experiments with pure hydrocarbons show that paraffins and naphthenes are more responsible to lead than aromatics and unsaturateds.

Evaluation of Motor Fuels. (A. W. Schmidt, Braunkohle, 1936, 35, pp. 535-48; J. Soc. Chem. Ind. Abstr. B., Vol. 56, March, 1937, p. 205.) (43/20 5438 Germany.)

By means of a microphone and oscillograph, knocking of motor fuels can be made visible on a screen. Diagrams show the average knock deflections of petrol and various fuel mixtures. If injected into the engine, fuels of low octane number can be used at considerably higher compression ratios than is possible when employing a carburettor. The phenomenon of vapour lock is discussed. Tables show the times taken for formation of 10 cc. of vapour from various fuel mixtures when passed through a narrow tube 1in. in length heated to $40-50^\circ$. Addition of 2 per cent. of various organic peroxides reduced the ignition lag of brown coal and bituminous coal tar Diesel oils.

Evaporation and Knock (of Motor Fuels). (O. Herstadt, Oel v. Kohle, 1936, 12, pp. 1014-5, 1111-4; J. Soc. Chem. Ind. Abstr., B, Vol. 56, March, 1937, p. 205.) (43/21 5439 Germany.)

Apparatus for measuring the rate of evaporation of motor fuels at various temperatures is described and results are given for 17 fuels and pure substances. The evaporation times of mixtures of benzol, alcohol and petrol at temperatures up to 198° are plotted on triangular diagrams which enable the evaporation times of any ternary mixture to be read off. At low temperatures mixtures rich in benzol show the longest evaporation times, but at 184° and 198° mixtures rich in alcohol show a very much increased time, due to the formation of liquid drops surrounded by blankets of vapour. The effect of probable presence of liquid

drops during the combustion stroke on knocking is discussed. The abnormalities of evaporation shown experimentally are considered in relation to Callendar's theory of detonation and abnormal lead susceptibility at different temperatures.

The Mechanism of Formation of Engine Carbon in Internal Combustion Engines. (A. Maillard and W. Edelberg, *Ann. Combustibles Liquides*, 11, 1936, pp. 1117-1126; *Chem. Absts.*, Vol. 31, No. 6, 20/3/37, p. 1981.) (43/22 5455 U.S.A.)

In order to eliminate the possible effect of the fuel on carbon deposition, an engine was operated on H_2 as a fuel, and the exhaust gas analysed to measure the combustion of the oil. Combustion accounts for only a small fraction of the total oil consumption, and used oil gave the same amount of engine deposit as fresh oil. With petrol as a fuel, the amount of deposit found was not very reproducible, and appeared to decrease when rich mixtures were used.

Conversion of Coal into Liquid Fuels by the Fischer Process. (F. Fischer, *Petroleum Times*, 36, 1936, pp. 613-614; *Chem. Absts.*, Vol. 31, No. 6, 20/3/37, p. 1983.) (43/23 5456 U.S.A.)

Tropsch and Fischer (*cf.* C.A. 20, 2814) found that $(CO + H_2)$ at 400° and 100 atm. with alk. Fe catalyst produced oxygenated hydrocarbons. At lower pressures less O_2 combines. A catalyst was developed, active at 190° and 1 atm., producing the paraffinic hydrocarbons "Kogasin." Steam + CH_4 produce water gas containing one part CO to $2H_2$. The gas is caused to react over the catalyst with dispersion of heat, and the products are recovered by condensation and adsorption. The weight per cent. of products are: Gasol (light fractions) 8, motor spirit 62, Diesel fuel 24, paraffin wax 2 and ceresin 4, varying with operating conditions. The higher boiling motor spirit requires treatment to improve anti-knock properties; the Diesel fuel is of the best type.

The Ignition of Gaseous Mixtures by Hot Particles. (R. Silver, *Phil. Mag.*, Vol. 7, No. 156, April, 1937, pp. 633-57.) (43/24 5527 Great Britain.)

Apparatus for measuring the lowest temperature at which a hot sphere will instantaneously ignite a gaseous mixture of known composition is described. The particle, heated in a furnace to the required temperature, is blown into an explosion chamber containing the mixture at normal temperature, the speed of the particle being kept as nearly as possible constant at about 4 m./sec. Attempts with methane air mixtures were abandoned on account of the high temperatures required, but a series of experiments was carried out with coal gas pentane and hydrogen air mixtures using a range of sizes of platinum and quartz spheres (0.109 to 0.500 cm.). Over this range the ignition point of a 10 per cent. coal gas air mixture fell from $1,140-855^\circ C.$ with increasing particle size. For both coal gas and pentane air mixtures platinum and quartz spheres produced approximately similar results, but gave slightly differing results in the case of hydrogen air mixtures. In every case the minimum ignition point diminished rapidly with increasing size of particle, but even with the largest spheres used it still greatly exceeded the known ignition point of the mixture. The problem is discussed theoretically and an approximate form of theory suggested on the assumption that extinction is due to cooling by conduction to the unburnt parts of the gas. A relationship is worked out between sphere radius and sphere temperature which is satisfied when explosion only just takes place. The theory can only be used at present to predict qualitative results. It is discussed with reference to chain reactions.

Home Produced Motor Spirit. (*Engineer*, Vol. 163, No. 4240, 16/4/37, p. 449.) (43/25 5611 Great Britain.)

Replying to a question in the House of Commons, the Secretary for Mines recently said that the production of motor spirit by low temperature carbonisation was nearly 750,000 gallons in each of the years 1934 and 1935. In addition, the

production of tar and tar oils amounted to nearly 4,500,000 gallons in 1934 and over 5,000,000 gallons in 1935. Particulars for 1936 are not yet available. The production in 1935 by the hydrogenation of coal and tar oils (including some low temperature tar) was nearly 21,000,000 gallons of motor spirit, and in 1936 rather more than 33,000,000 gallons. No heavy oil was produced.

The Heat and Time Factors in Vapourisation in the Engine. (J. Small, J. Inst. Petrol. Techn., Vol. 22, Oct., 1936, pp. 706-25.) (43/26 5670 (G) Great Britain.)

An investigation of the vapourisation of petrol in air, on the basis of a diagram corresponding to the Mollier diagram for water, is described. Results in the form of formulæ, tables and diagrams, show that a high degree of vapourisation during induction is not necessary for ignition. Pre-heating of the air is probably much less effective in promoting vapourisation than heating the walls of the induction system, on which the petrol settles as a liquid film.

Factors Influencing Wear of Valve Seats in Internal Combustion Engines. (C. G. Williams, Engineer, Vol. 143, No. 3719, 23/4/37, pp. 475-476. Contd. from No. 3715, 26/3/37, p. 358—Abstract, A. and N., No. 42.) (43/27 5723 Great Britain.)

Probably the most promising method for reducing seat wear is by the use of appropriate materials, of which there is a fairly wide choice. Heat-treated high-speed steel has much to recommend it, as it is machinable before heat treatment and is of reasonable cost. Stellite also gives excellent results and is widely used, though it is somewhat expensive. There are other materials almost as good. Monel metal is probably the best material for use in conjunction with aluminium cylinder heads. Measurements of exhaust valve temperatures at full load were taken on various car and lorry engines and show an appreciable effect of cylinder bore. Alcohol fuels give a reduction of exhaust valve temperature of the order of 50°C. on 800°C.

Motor Fuel. (Hungary Pat. 115,320, 2nd November, 1936.) (F. Timar, Chemical Abstracts, Vol. 31, No. 7, 10th April, 1937, p. 2410.) (43/28 5817 Hungary.)

Heavy hydrocarbons are saturated with a series of gases which respectively reduce knocking, accelerate combustion and improve ignition.

Examples are methane, acetylene and hydrogen. The absorption process may be carried out in the presence of Ni-Pd catalysts, MnO₂ and active carbon.

Preventing Separation of Solids and Semi-Solids from Liquid Lubricants in Internal Combustion Engines. (Siemens and Halske, A.G.B.P. 455, 790, 28th October, 1936; Chemical Abstracts, Vol. 31, No. 7, April, 1937, p. 2412.) (43/29 5818 Great Britain.)

Deposition of solid or semi-solid substances, e.g., C, from organic lubricants is prevented by modifying the inner walls of I.C. engine cylinders by contacting them with S at 100-350°. Sulphur may be deposited by electrolysis of solutions (sulphides, polysulphides, thiocyanates, etc.) on to the surface, which is then subjected to high temperature; or the treatment may consist in contact with an organic lubricant containing free sulphur, with the walls at high temperature.

Operation of Internal Combustion Engines and Production and Supply of Fuel Thereto. (Ammonia Casale Soc. Anon., B.P. 460, 498, 15th July, 1936, J. Soc. Chem. Ind., Abstracts B, Volume 56, April, 1937, p. 322.) (43/30 5885 Great Britain.)

An ammonia-hydrogen mixture (NH₃/H₂ = 3/19) is used as fuel, the hydrogen being obtained by catalytic decomposition of 3 to 18 per cent. of the NH₃ in an apparatus connected to the engine and utilising the waste heat from the latter to heat the catalyst.

Automatic Power and Mixture Control (Pratt and Whitney). (Aeroplane, Vol. 52, No. 1354, 5/5/37, pp. 540-1.) (43/31 5952 U.S.A.)

The device described (known as the Eclipse Regulator) attempts to keep the density of the intake air at the carburettor jets constant and equal to its value at some predetermined altitude. For lower altitudes the intake air is throttled by a subsidiary device and the proportion of heated air adjusted so that although the main carburettor throttle is left fully open, both power and mixture strength remain constant at cruising value. For take-off and emergency, provision is made to strengthen the mixture by opening up additional jets. These jets are placed in parallel with the normal cruising jets and the fuel flow to them is controlled by oil operated poppet valves placed in the pipe line. Neither needle valves nor sealed float chambers are employed and the mechanism which operates the intake throttle through an oil servo motor is very robust.

Fuel of High Octane Number. (Inter. Avia., No. 425, 24/4/37, p. 4.) (43/32 5958 U.S.A.)

It is reported that Pan-American Airways are now using anilol to increase octane rating of their fuel from 87 to 94. Anilol is a mixture of alcohol, aniline and neutralising acids, the quantity required being about 6 cc./gallon. Anilol cannot be mixed with the fuel in the tank but is injected by means of a special automatic valve at the carburettor. An important characteristic of anilol is that it prevents icing up in the carburettor.

No detrimental effect on engine parts was observed after extended use.

A New Cathode Ray Oscillograph (Polar Co-ordinate and Uniform Time Scale). M. Ardenne, H.F. Technik, No. 4, April, 1937, p. 140.) (43/33 5868 Germany.)

The circular time scale is obtained by a combined electro-static and magnetic deflection. The time for one period can be regulated between 1×10^3 and 0.5×10^5 seconds, the accuracy being of the order of 0.5 per cent. The radial deflection is of the order of 0.4 mm. per volt. Details of the circuit are given.

Rotoroid Scales for Measuring Instruments. (H.F. Technik, No. 4, April, 1937, pp. 141-142.) (43/44 5869 Germany.)

The cylindrical scale is mounted on a flexible metallic tube, bent in the form of an arc over which the pointer moves. The flexible tube can be rotated about a stationary support and in this way different parts of the scale utilised. By inter-connecting the scale moving mechanism with the measuring instrument in such a way that changes in sensitivity and scale go together, troublesome magnification factors are avoided and at the same time the risks of damaging the instrument are considerably reduced.

Bending Tests of Circular Cylinders of Corrugated Aluminium Alloy Sheet. (A. S. Miles and others, N.A.C.A. Tech. Note No. 595, March, 1937.) (43/35 5590 U.S.A.)

Bending tests were made of two circular cylinders of corrugated aluminium alloy sheet. In each test failure occurred by bending of the corrugations in a plane normal to the skin. It was found, after analysis of the effect of short end bays, that the computed stress on the extreme fibre of a corrugated cylinder is in excess of that for a flat panel of the same basic pattern and panel length tested as a pin-ended column. It is concluded from the tests that light bulkheads closely spaced strengthen corrugated cylinders very materially. The section properties of corrugated sheet are summarised in an appendix.

A Theory for Primary Failure of Straight Centrally Loaded Columns. (E. E. Lunkguist and C. M. Fligg, N.A.C.A. Report No. 582, 1937.) (43/36 5591 U.S.A.)

Primary failure is defined as any type of failure in which the cross-sections are translated, rotated, or translated and rotated, but not distorted in their own

planes. For illustration, the theory is applied to a column of I section. The conclusions, however, are generalised to include any column with a cross-section symmetrical about its principal axes. When a column is attached to a skin, the great stiffness of the skin in its own plane causes the axis of rotation to lie in the plane of the skin. It is shown how the effective width of skin that may be considered to act with the column and how the bending stiffness of the skin resists twisting of the column and raises the critical stress. An illustrative example shows how the theory for a primary failure may be used to construct the column curve for a skin-stiffener panel.

The Hypothesis of the Secondary Structure Applied to the Mechanical Properties of Metals. (Dr. P. Duwez, Engineering, Vol. 143, No. 3719, 23/4/37, p. 461.) (43/37 5718 Great Britain.)

Numerous properties of crystals cannot be explained on the conception of a perfect geometrical network in which all the planes of the atoms of the same family are identical. The anomalies can, however, be explained if the existence of a secondary structure, such as defined by Zwicky, are admitted. The author considers that in a family of reticular planes of a crystal there exists a certain number of planes having properties different from those of the other planes and distributed at sensibly equal distances. The mechanical properties are directly influenced by the presence of these planes, and they can be used to explain the phenomena of work hardening and fatigue failure. The hypothesis of the secondary structure is still very controversial, but in the author's opinion it may render great service in increasing our knowledge of the properties of metals.

New Developments in the Flame-Proofing of Fabrics. (N. L. Deutsch, Rayon Textile Monthly, Vol. 17, No. 10, October, 1936, pp. 689-690, and No. 11, November, 1936, pp. 747-748.) (43/38 5827 U.S.A.)

After reviewing the various inorganic salts which have been in common use for the last 50 years, a new flame-proofing agent (trade name "Abopon") is described. This substance is a complex inorganic boro-phosphate, in the form of a water-white liquid "resin." It is claimed that "Abopon" is superior to the common flame-proofers in that it does not develop acidity in the fabric nor does it lose its effectiveness in time due to crystallisation. Details of the strength of solution of "Abopon" required for the treatment of various fabrics are given and the tests for flame-proofness of the National Bureau of Standards (U.S.A.) are described. (Seven references.)

Theories of Age-Hardening. (The Metallurgist, 30/4/37, pp. 18-19.) (43/39 5870 Great Britain.)

In order to exhibit the phenomenon of age-hardening, the alloy must be originally in a state of thermodynamic instability. The resultant hardening is either due to a modification of the distribution of the solute atoms in the solute lattice (knot hardening) or actual precipitation may occur (precipitation hardening). In the case of knot hardening, the rearranged electrons, if suitably grouped, may cause an increase in electric resistance somewhat like light is scattered by particles, if the latter are of suitable size. In this way, ageing and changes in electrical resistance may go together. This is not, however, always the case and the theory has still to account for the great specific effect of small additions of certain elements on the age hardening of the resultary alloy.

Polished Surfaces. (The Metallurgist, 30/4/37, pp. 17-18.) (43/40 5871 Great Britain.)

The method of electron diffraction applied to the surface of liquid mercury shows the latter to be in an amorphous condition. Similar results are obtained when highly polished metal surfaces are examined (Beilby Layer), although in certain cases recrystallisation under the influence of the underlying material may occur.

It is hoped to extend the method of electron diffraction to the study of the initial stages of electron deposits and thus obtain new light on the problem of adhesion.

Ice Formation in the Atmosphere. (Don. McNeal, *J. Aer. Sci.*, Vol. 4, No. 3, Jan., 1937, pp. 117/123.) (43/41 5241 U.S.A.)

The following general conclusions are drawn:—

1. Icing conditions may be expected in any form of cloud at a temperature of 2°C. or below.
2. The danger of icing conditions in regions above clouds is not great.
3. Ice may form in rain below a warm front provided the lower cold air has cooled the aircraft surfaces below 0°C.
4. Clear ice may be expected in clouds at suitable temperature where vertical currents sufficiently strong to support larger droplets are found.
5. Rime may be expected under similar conditions if the vertical currents are insufficient to support large drops.
6. It is misleading to attempt any correlation between icing conditions and type of cloud. This results from the difficulty of classifying and identifying the various types.

Study of the Light Diffused by Particles in the Air. (H. Grisolle, *Comp. Rend.*, Vol. 202, No. 22, 2/6/36, pp. 1872-1874.) (43/42 5415 France.)

Diffusion of light by the dust in Paris air has been investigated at night by allowing a prismatic beam of parallel light to illuminate simultaneously a known thickness of air and a mat white diffuser, the latter receiving the light at a fixed angle of incidence of 45°. Photometric comparison of the relative brightness gives a ratio R characteristic of the diffusion. R was determined for values of the angle between the incident ray and the line of sight of 45°, 90° and 135°. Finally the proportion of polarised light in the diffused light and the number of dust particles were determined. The quantities $R(45)/R(90)$, $R(135)/R(90)$, and $R(45)/R(135)$, varied between 9 and 27, 0.2 and 0.7, and 13 and 90 respectively, results in sufficiently good agreement with Y. Rocard's theory. Between 0.12 and 0.42 of the light was partly polarised in the plane defined by the incident ray and the diffused ray. In general, diffusion increased with the number of dust particles present.

Theoretical and Experimental Studies of Convective Circulation and its Relation to Land and Sea Breezes. (T. Kobayast and others, *Aer. Res. Inst.*, Tokio, Vol. 12, No. 145, Feb., 1937, 67 pp. in English.) (43/43 5497 Japan.)

The motion developed in a fluid when one half of its base is heated has been solved mathematically, and the solution compared with some experimental results and with observed data on sea breezes.

Experiments were carried out on water in a tank, to which was given a temperature gradient corresponding to the potential temperature gradient of the atmosphere. The temperature of one half of the bottom of the tank was then raised a few degrees. Powdered aluminium was dusted into the water and photographic records were made of the elliptical circulation developed above the boundary of the warm and cold portions. Velocities of the water and the speed of growth of the circulation were measured. Experimental and mathematical results agree well provided that the effect of viscosity is taken into account and a suitable value given to the vertical variation in temperature. In the case of a sea breeze the mathematical solution gives the relationships between the rate of rise in temperature of the earth's surface by solar radiation and the wind velocities at various points and times, the height of the limit of the breeze and the speed of extension inland of the region covered by the breeze.

The Measurement of the Albedo of Artificial Fogs. (E. Regener, *Zeitschrift f. Physik. Chemie., Abt. A*, Vol. 139, 1928, pp. 416-424.) (43/44 5533 Germany.)

The albedo of a body is defined as the ratio of the light diffusively reflected (in all directions) to the incident light. The albedo of natural clouds has been extensively studied by Stuchtey and Wegener (see A. and N. No. 42, item 43). In order to carry out successful albedo measurements, with artificial fogs, the latter have to be very dense and the present paper deals primarily with the experimental production of such fogs. Three types of fogs were employed, the principal constituents being sulphur trioxide, ammonium chloride and paraffin oil respectively. In each case the density of the fog was artificially increased by using CO₂ instead of air. The fog formed a sharply demarcated layer at the bottom of a glass tank (1.2 × 1.4 × 1.1 m.). Above the layer was suspended a plaster of Paris plate and the whole illuminated by sunlight (altitude 30 to 60°). Comparative albedo measurements were carried out by means of a Marten's photometer placed vertically above the box, the results being in close proximity to unity for all the fogs tested. In all the albedo measurements it was noted that maximum readings could only be obtained if the air above the fog was clear of any diffuse fog layers. Such layers always tend to form in time, either by diffusion and on account of small thermal disturbances. A very dense fog is formed if ether is poured on a layer of liquid air. Unfortunately the resultant white fog is too unstable for accurate measurements, but the arrangement forms a most effective lecture experiment.

The Measurement of Upper Winds by Means of Pilot Balloons. (M.O. 396, Air Ministry, published by H.M.S.O.) (43/45 5703 Great Britain.)

At British meteorological stations, the ascent of the balloon is usually followed by one theodolite, the height of the balloon being obtained by assuming a constant rate of ascent (calculated from the starting lift). The results of many observations show that this method gives reasonably correct values of the upper winds in the majority of cases. The paper describes in detail how observations of this kind are carried out and reduced. At the same time a modification of the single theodolite method, the so-called tail method, is described, which consists in measuring the apparent length of a tail attached to the balloon as seen through the telescope of the theodolite. From the known dimensions of the tail the height can be calculated without making any assumption as to the rate of ascent.

Radio Meteorograph System. (Inter Avia, No. 420, 6/4/37, pp. 3-4.) (43/46 5942 U.S.A.)

A balloon 5ft. diameter carries a miniature radio transmitting set, batteries and a meteorograph in a balsa wood box 6 × 6 × 4½ inches.

The decreasing air pressure as the balloon rises causes a small switch arm to move over a set of contacts and operate the radio transmitter. Predetermined audio notes put an automatic recording gear on the ground into action. Other signals are sent out controlled by air temperature, humidity, and light intensity (clouds). The angle of elevation is estimated by a special wireless method and from the known height, the path of the balloon can be mapped.

Visit of French Aeronautical Engineers to the U.S.A. (Les Ailes, No. 827, 22/4/37, p. 8.) (43/47 5740 France.)

The following points struck the French observers:—

- (1) The New York aeronautical exhibition was primarily a civil aviation show—only four military exhibits.
- (2) Government laboratories carry out researches up to the point where the manufacturers can take over. New ideas, new materials and new methods of construction receive equal support.

- (3) Constant speed propellers are favoured against independent (electrical) control of pitch.
- (4) Direct injection of petrol for spark ignition engines is receiving considerable attention.
- (5) In engine design, questions of reliability and mass production outweigh all others (maximum diameter or weight).

Long-Span Self-Supporting Steel Aeroplane Shed Roofs. (Houel, Sci. et Ind. (Travaux), Vol. 20, 1936, pp. 549-53. Engineering Abstracts, No. 73, April, 1937, pp. 32-3.) (43/48 5776 France.)

Steel aeroplane sheds ordered by the French Air Ministry and suitable for rapid construction, removal and re-erection are described. They are of 70 m. clear span, 66 or 55 m. depth with a height of clear opening of 10 m., and the principle adopted in their roof construction is that of the thin sheet of double curvature. The roof covering consists of self-supporting steel sheeting 1.4 mm. in thickness, in panels 10.2 m. by 4.7 m., stiffened at the edges by welded stiffeners. Full details are given of the supporting structure, the whole of which is assembled by bolting. The main framework for six sheds can be erected in 24 days. Three sides of the shed are closed by reinforced concrete walls 1.5 m. in height surmounted by steel sheets having large corrugations, the remaining side being closed by sliding doors manipulated by hand. The total weight of the shed including doors is 541 tons, or about 115 kg./sq. m. (23.5 lb./sq. ft.) of covered area.

Report of the N.A.C.A. for 1936. (Inter Avia, No. 413, 13/3/37, pp. 1-3.) (43/49 5777 U.S.A.)

Investigations regarding boundary layer control are only shortly alluded to in this year's report. Whereas the year before reference was made to the planned investigations into boundary layer suction to increase the maximum lift coefficient as well as to the adaptation of the same method to the reduction of drag, recent investigations were more especially concerned with boundary layer characteristics and various control methods. Investigation into effectiveness of chemical solutions to prevent ice formation on aeroplanes showed that the most effective ice inhibitor is a 7:1 mixture of alcohol and glycerine. An arrangement by which the liquid is fed through tubes to a porous leather covering enveloping the parts concerned means an additional gross weight of less than 0.5 lb./ft. of span, or about 50 lb. for a transport aeroplane. The amount of liquid required varies with the type of ice formation; in wet clouds at low temperature, which constitute about 95 per cent. of the icing conditions, the formation of ice on a modern transport aeroplane can be prevented by about 1 gallon per hour; more severe conditions in ice storm regions may require as much as 5 gallons per hour.

Pacific Air Service. (Inter Avia, No. 420, 6/4/37, pp. 5-6.) (43/50 5943 U.S.A.)

The Pan-American Airways have so far carried out 94 successful crossings of the Pacific. The following procedure is adopted:—

The all-out power available (four Pratt-Whitney twin-row engines) is 3,800 b.h.p. On taking off, 90 per cent. or 3,420 b.h.p. are taken for 60 seconds. For the next six minutes, to gain altitude, 2,660 b.h.p. (70 per cent.) are developed. Following this initial climb, the engines are throttled to 2,090 b.h.p. (55 per cent.) to gain the flying height and the balance of the flight is carried out at 1,820 b.h.p. (48 per cent.).

The large amount of reserve power enables the aircraft to fly on three and even on two engines.

During the last two years, about 100 hours' practice flying were done on three engines and about 50 hours on two engines.

Air Traffic Regulations. (Inter Avia, No. 423, 17/4/37, p. 6.) (43/51 5947 U.S.A.)

The Department of Commerce has made the fitting of approved radio antenna compulsory on transport planes as from November 1st, 1937.

The design of this antenna has to be such as to eliminate as far as possible the static interference of rain and snow. So far four types have been developed: (a) Streamline body above nose of machine; (b) "ring in the nose" projecting from nose of machine; (c) rotatable ring below fuselage; (d) a type mounted inside fuselage.

As from January 1, 1938, all transport planes will have to be fitted with radio direction finders.

Short Wave Wireless Detector of Obstacles by Reflection (fitted to ss. "Normandie"). (U.S. Nav. Inst. Proc., Vol. 63, No. 409, March, 1937, pp. 439-442.) (43/52 5254 France.)

A special micro valve with antenna incorporated in the glass bulb is used to generate 16 cm. waves modulated at 7,500 cycles.

The valve is placed inside a parabolic reflector of 75 cm. aperture. A similar valve placed in a second reflector is used as receiver. The distance between emitter and receiver is 6 metres and when the wireless beam is reflected by an obstacle, the current detected is carried to an amplifier and is received on ear-phones or on a visual indicator. As soon as signals are detected, the two reflectors, which are normally revolving automatically through about 40° are stopped and precisely directed for maximum signal strength. From the known bearings and base line, the distance of the obstacle follows. It is stated that reflections from passing ships could be obtained up to distances of the order of 7 km. and that under favourable conditions readings can be obtained up to 20 km.

Modern Receiver Valves: Design and Manufacture (with Discussion). (M. Benjamin and others, J. Inst. Elec. Eng., Vol. 80, No. 484, April, 1937, pp. 401-439.) (43/53 5596 Great Britain.)

The authors discuss the main features in the geometrical design of the types of valve in common use to-day and the various factors, mechanical and chemical, which impose limitations in manufacture. The minimum tolerances to which it is possible to reproduce characteristics are indicated. The paper includes a brief historical survey of the recent improvements in thermionic emitters and gives details of the precautions necessary in the production of modern highly efficient oxide-coated cathodes and insulated heaters. Pumping and activation processes are described, and the main factors affecting the life of a valve are discussed. The last section of the paper deals with some of the limitations encountered in the use of valves, such as hum, microphony, noise, and frequency limitation, and the methods of minimising these factors are given. The authors conclude with some observations on possible future developments. Valves depending on secondary emission are being studied as well as valves depending on the deflection of an electron beam rather than on the control of electron density. (40 references.)

Ultra-Short Wave Propagation Along the Curved Earth's Surface. (P. von Handel and W. Pfister, Proc. Inst. Rad. Eng., No. 3, Part I, March, 1937, pp. 346-363.) (43/54 5704 U.S.A.)

The penetration of ultra-short wave radiation beyond the range of optical sight is dependent on the diffraction and refraction of the rays. Proceeding from an analogy to optics the diffraction is calculated by various methods. It is found that calculation of the ray distribution beyond the line of sight yields the best agreement with measurement. The practical application of the results of calculation is represented by curves which give the decrease of field intensity with distance for various elevations in the whole range of wave lengths at present of interest. The curves are substantiated by aeroplane measurements. Measurements of the influence of refraction are appended.