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Note.—As far as possible, the country of origin quoted in the items refers to the original source.

List of Abbreviations of Titles and Journals.

A.	Abstracts from the Scientific and Technical Press.
Aeron. Eng.	Aeronautical Engineering (U.S.S.R.)
Aer. Res. Inst. Tokyo	Aeronautical Research Institute of Tokyo.
A.C.I.C.	Air Corps Information Circular.
Ann. d. Phys.	Annalen der Physik
Army Ord.	Army Ordnance.
Autom. Eng.	Automobile Engineer
Autom. Ind.	Automotive Industries.
Autom. Tech. Zeit. ...	Automobile Technische Zeitschrift.
Bell Tele. Pubs. ...	Bell Telephone Publications.
Bur. Stan. J. Res. ...	Bureau of Standards (U.S.A.) Journal of Research.
Chem. Absts.	Chemical Abstracts.
Chem. and Ind. ...	Chemistry and Industry.
Comp. Rend.	Comptes Rendus de L'Académie des Sciences.
Eng. Absts.	Engineering Abstracts.
E.N.S.A.	Revenue Technique de l'Association des Ingénieurs de l'Ecole Nationale Supérieure de L'Aéronautique.
Forschung	Forschung auf dem Gebiete des Ingenieurwesens.
Fuel	Fuel in Science and Practice.
H.F. Technik.	Hochfrequenztechnik und Electroakustik.
Ind. and Eng. Chem. ...	Industrial and Engineering Chemistry.
Ing.-Arch.	Ingenieur-Archiv.
Inst. Autom. Eng. ...	Institute of Automobile Engineers (Research and Standardisation Committee).
J. Aeron. Sci.	Journal of the Aeronautical Sciences.
J. App. Mech.	Journal of Applied Mechanics.
J. Am. Soc. Nav. Engs.	Journal of American Society of Naval Engineers.
J. Roy. Aero. Soc. ...	Journal of Royal Aeronautical Society.
J. Frank. Inst.	Journal of Franklin Institute.
J. Inst. Civ. Engs. ...	Journal of Institute of Civil Engineers.
J. Inst. Elec. Engs. ...	Journal of Institute of Electrical Engineers.
J. Inst. Petrol.	Journal of the Institute of Petroleum.
J. Met. Soc.	Journal of Meteorological Society.
J. Sci. Inst.	Journal of Scientific Instruments.
J.S.A.E.	Journal of Society of Automotive Engineers.
J. Soc. Chem. Ind. (Abstracts B)	Journal of the Society of Chemical Industry (British Chemical Abstracts B)
L'Aéron.	L'Aéronautique.

L.F.F.	Luftfahrt-Forschung.
Luschau.	Luftfahrt-Schrifttum des Auslandes.
Met. Mag.	Meteorological Magazine.
Met. Prog.	Metal Progress.
N.A.C.A.	National Advisory Committee for Aeronautics (U.S.A.).
Phil. Mag.	Philosophical Magazine.
Phil. Trans. Roy. Soc.	Philosophical Transactions of the Royal Society.
Phys. Berichte. ...	Physikalische Berichte.
Phys. Zeit.	Physikalische Zeitschrift.
Proc. Camb. Phil. Soc.	Proceedings of Cambridge Philosophical Society.
Proc. Inst. Rad. Engs.	Proceedings of Institute of Radio Engineers.
Proc. Roy. Soc. ...	Proceedings of Royal Society.
Pub. Sci. et Tech. ...	Publications Scientifiques et Techniques du Ministère de l'Air.
Q.J. Roy. Met. Soc. ...	Quarterly Journal of the Royal Meteorological Society.
R. and M.	Reports and Memoranda of the Aeronautical Research Committee.
Rev. de l'Arm. de l'Air	Revue de l'Armée de l'Air.
Riv. Aeron.	Rivista Aeronautica.
Sci. Absts. (A. or B.)	Science Abstracts (A. or B.).
Sci. Am.	Scientific American.
Sci. Proc. Roy. Dublin Soc.	Scientific Proceedings of Royal Dublin Society.
Tech. Aéron.	La Technique Aéronautique.
Trans. A.S.M.E. ...	Transactions of the American Society of Mechanical Engineers.
Trans. C.A.H.I. ...	Transactions of the Central Aero-Hydrodynamical Institute, Moscow.
U.S. Nav. Inst. Proc.	U.S. Naval Institute Proceedings.
Verroffent (Siemens)	Veröffentlichungen aus dem Gebtete der Nachrichtentecgnik (Siemens).
W.R.H.	Werft Reederei Hafen.
W.T.M.	Wehrtechnische Monatschefte.
Z.A.M.M.	Zeitschrift für Angewandte Mathematik und Mechanik.
Z.G.S.S.	Zeitschrift für Das Gesamte Schiess und Sprengstoffwessen mit der Sonderabteilung Gasschutz.
Z. Instrum.	Zeitschrift für Instrumentenkunde.
Z. Mech.	Zentralblatt für Mechanik.
Z. Metallk.	Zeitschrift für Metallkunde.
Z.V.D.I.	Zeitschrift des Vereines Deutscher Ingenieure.

Variation in Velocity Profile with Change in Surface Roughness of Boundary. (W. Jacobs, Z.A.M.M., Vol. 19, No. 2, April, 1940, pp. 87-100. Translation available, No. T.M. 951.) (89/1 Germany.)

The present report deals with a variation of a turbulent velocity profile in flow from rough to smooth wall and vice-versa. Expressions obtained for the shear-stress distribution with respect to the distance from the point of junction of the different roughnesses and from the wall distance, are utilised to ascertain the developing velocity distributions. Under simplified assumptions, the use of these formulæ renders possible the integration of the motion equations for the shear stress. This calculation is carried out and compared with the experiments. Despite the fact that the assumptions in this particular case do not prove to be wholly correct, comparatively good agreement is achieved in the most important region.

Standard Aeronautical Symbols approved by N.A.C.A., May 28th, 1940. (89/2 U.S.A.)

The symbols listed are arranged under the following headings:—

1. General scientific.
2. Aeroplane dimensions.
3. General and applied aerodynamics.
4. Aeroplane dynamics—
   Axes, forces, force coefficients, moments, moment coefficients, velocities, angles, moments of inertia, factors, stability derivatives, stability derivative coefficients.
5. Seaplanes.
6. Airships.
7. Engines and propellers.

8. Rotor planes.
9. Miscellaneous (factors and subscripts).

Abbreviations :—

1. Aeronautical abbreviations used in N.A.C.A. Reports.
2. Laboratory rules about abbreviations.

Review of Researches on the Statistical Theory of Turbulence. (K. Wieghardt, L.F.F., Vol. 18, No. 1, 28/2/41, pp. 1-7.) (89/3 Germany.)

The statistical theory of turbulence has been mainly developed in England and the U.S.A. The author reviews the investigations of Taylor, Karman, Goldstein and others, and concludes that the theory is well adapted to deal with the kinematics of turbulent flow and also furnishes a valuable means for co-ordinating experimental investigations. Dynamic processes, however, cannot as yet be evaluated in a satisfactory manner. Even in the simplest case of isotropic turbulence, the calculation of the so-called correlation curve depends ultimately on fundamental assumptions, such as neglect of inertia terms, or the introduction of equivalent mixing paths, etc. Since, however, the differential equations are derived entirely from the Navier-Stokes and continuity equations, the required solution must be contained amongst the number of possible solutions. What is still wanted is some physical principle by means of which the true solution can be selected.

Two-Dimensional Lift Distribution for Arbitrary Unsteady Motion. (H. Sohngen, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 401-420.) (89/4 Germany.)

Previous investigations on the lift distribution along the chord during unsteady motion are limited to cases of pure vibration, with the special proviso that the motion has been in existence for a considerable period. For the case of an arbitrary unsteady motion, only expressions for the total lift and moment are known. The author considers the lift distribution along the chord in this more general case and his method is applicable to thin aerofoils of small curvature operating at small angles of incidence. Any deformation of the wing with time is assumed to have no effect on the length of the chord. The author also assumes that the wing moves to a first approximation in a straight line with an almost constant velocity V so that the velocities of various points of the wing perpendicular to this direction can be neglected. Special attention is given to the definition of critical velocity and the effect of a free aileron. The same problem has been attacked by a different method by Kussner. L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 355-361, see Abstract 89/21.)

General Aerofoil Theory. (H. G. Kussner, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 370-378.) (89/5 Germany.)

The author establishes a very general integral equation for the aerofoil theory, on the assumption that the disturbances are infinitely small. This equation applies to any type of motion and also holds for compressible fluids. Step by step specialisation of this equation leads to simpler forms such as the Possio, Birnbaum and Prandtl type of integral equation. Special equations are also deduced applicable to the two-dimensional wing with a periodic downwash distribution and to the vibrating wing of large span. The method is finally extended to cover the case of the biplane or the wing with slotted flap.

Calculation of the Pressure Distribution of a Two-Dimensional Aerofoil Undergoing Harmonic Deformations. (L. Schwarz, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 379-386.) (89/6 Germany.)

The method of attacking this problem was first given by Birnbaum in 1924, and extended by Kussner and Cicala in 1936. In the present paper the solution of the Birnbaum integral equation is referred to the known solution by Munk of the steady Prandtl equation of the vortex sheet. The calculation of pressure, lift and moment for a given downwash distribution (wing distortion) can now be carried out by simple integration without requiring the help of harmonic analysis.

The theory of non-steady motion has thus reached the same stage of development as that of the corresponding steady problem (theory of thin aerofoils).

The Potential Theory of the Vibrating Circular Aerofoil, Part I—Analytical Considerations. (T. Schade, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 387-400.) (89/7 Germany.)

The paper is an extension of a previous investigation carried out by Kinner on the stationary circular aerofoil (Ing. Arch., Vol. 8, p. 47). In the present case, the circular plate, immersed in a uniform airstream, undergoes small vibration, the amplitudes of which are complete function of the second order in x and y. The author determines the pressure distribution on the plate with the help of the Prandtl acceleration potential. A system of linear differential equations is obtained of which the coefficients can be calculated in terms of exponential and Hankel functions. All the necessary equations are given in this analytical part. Numerical calculations will be published subsequently.

The Calculation of Wing Vibrations by the Use of Special Replacement Systems. (W. Biermann and W. Dissecker, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 314-9.) (89/8 Germany.)

Before calculation on wing flutter can be carried out, the behaviour of the wing as regards natural frequencies and vibration forms with the aircraft stationary must be known. Although in most cases actual experiments will be required to settle these points, it is important to be able to predict such results as accurately as possible. The author develops an approximate method for this purpose, in which the wing is replaced as regards its mechanical properties by a special system amenable to simple treatment. It is assumed that the elastic axis is straight and that rotation about the axis under condition of pure twist is not accompanied by any distortion. The equations of motion are then established by means of the following replacement systems:—

1. *Pure bending*, the wing is replaced by a series of rigid links which are coupled statically, additional loads being concentrated at the elastic joints.
2. *Pure torsion*, the wing is considered as made up of a series of sections, each of which has a constant moment of inertia and rigidity. The angle of twist thus varies linearly in each section. Additional masses are again concentrated at the junction of the sections.

The frequency determinants for pure bending and torsion are then obtained from the expressions for kinetic and potential energy in the well known manner from the Lagrange equation. If the wing under consideration has constant bending stiffness EJ and torsional rigidity GJ_d, the equivalent spring constant K at the joints (bending) or equivalent rigidity C of the sections (torsion) is given approximately by $K=EJ/l$ and $C=GJD/l$ respectively, where l=length of link or section, provided the numbers of sections per semi-span exceed 4.

If mass and stiffeners distribution vary along the wing the corresponding expression becomes:—

$$K=1 \Big/ \int_0^l \frac{dx}{EJ} \text{ and } C=1 \Big/ \int_0^l \frac{dx}{GJ_d}$$

respectively.

Coupled vibration (bending and torsion) are investigated by the Ritz method.

The author points out that the method is specially applicable to cases of variable mass and stiffness distribution, since it entails considerable less labour than the usual iteration and integrations method, besides being of sufficient accuracy for most practical purposes. In the case of the wing of a multi-engined aircraft, the authors' method predicted the various experimental "static" frequencies to within 5 per cent. (symmetrical vibration) and 2 per cent. (anti-symmetrical vibrations) respectively.

The Symmetrical Potential Flow of a Compressible Gas about a Circular Cylinder in a Straight Channel (Subcritical Region of Flow). (E. Lamla, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 329-331. Addendum, L.F.F., Vol. 18, No. 1, 28/2/41, p. 37.) (89/9 Germany.)

The corresponding problem for incompressible flow has already been solved by the method of images, *i.e.*, the dipole placed at the centre of the circle is reflected at the walls of the channel and the resultant effect of all images is obtained by summation. The solution is exact, but the profile is not a true circle, although the difference is generally very small. Regarding this solution as a first approximation the author investigates the effect of compressibility to a second approximation, making use of the method of Janzen and Rayleigh. It

U = velocity of incident flow.
a_0 = velocity of sound (medium at rest).
H = width of channel.
R = radius of cylinder.
W_k = maximum velocity at channel wall.
W_p = maximum velocity at cylinder ($\theta = 90$),

the following expressions are obtained :—

$$\frac{W_k}{U} = 1 + \tfrac{1}{4} q^2 + \left[\tfrac{11}{24} q^2 + \tfrac{19}{192} q^4 + \ldots\right] \alpha^2$$

$$\frac{W_p}{U} = 2 + \tfrac{1}{6} q^2 + \tfrac{1}{180} q^4 + \ldots + \left[\tfrac{7}{6} + \tfrac{43}{72} q^2 + \tfrac{47}{432} q^4 + \ldots\right] \alpha^2$$

$$\text{where } q = \frac{2\pi R}{H}$$

$$\text{and } \alpha = \frac{U}{a_0}$$

= Mach number M for very wide channels.

The method only holds for the subcritical region of flow, *i.e.*, the local velocity of sound must not be exceeded at any point.

Experimental Research on Undercarriage Loads and the Efficiency of Shock Absorbers. (V. P. Toulyakov, Aeron. Eng., U.S.S.R., Vol. 15, No. 1, Jan., 1941, pp. 44-52.) (89/11 U.S.S.R.)

Problems investigated are :—

1. Value and direction of the forces acting on the undercarriage wheel during take-off, landing and running.
2. Forces acting on the undercarriage struts.
3. Relationship between the force on the shock absorber and the piston stroke.
4. Analysis of the work done in the shock absorber.

The investigation mainly concerns the single-seat fighter type, of weight 1,500 kg., for conditions corresponding to summer and winter landings. In addition a series of tests were made on medium and heavy aircraft.

Results are given in tables and graphs.

Longitudinal Dynamic Stability of an Aeroplane with an Automatic Pilot. (V. A. Kotelnikov, Aeron. Eng., U.S.S.R., Vol. 15, No. 1, Jan., 1941, pp. 27-31.) (89/10 U.S.S.R.)

Theoretical and experimental investigations have been carried out to attempt to explain the effect of the various parameters of the automatic pilot and of the aircraft on the dynamic stability, automatic oscillations and behaviour of the aircraft in a disturbed atmosphere.

A flight test using the automatic pilot A.V.P.-12 comprised determination of longitudinal and lateral dynamic stability and the mean angular deviation of the aircraft from the stable position set by the automatic pilot. In addition an experiment was carried out on a specially constructed test stand to study the natural oscillations of a system stabilised by a course stabiliser A.V.P.-12.

The theoretical investigation consisted in solving the system of linear differential equations for the motion of the stand or of the aeroplane and the simplified non-linear equations for the motion of the automatic pilot. In the case of the non-linear equations the regimes of auto-oscillation were determined by assuming that the system moves according to a sine law. In establishing the equations of motion of the auto-pilot, the operation was assumed to be imperfect on account of the finite velocity of the control surfaces and the delay in the air effect.

Airscrew Development for Maximum Speeds. (Inter. Avia., No. 750, 13/2/41, pp. 1-3.) (89/15 Switzerland.)

An increase in the number of airscrew blades would seem to be the easiest means at present to increase the performance of airscrews. No general rule can be established for the number of blades to be employed; the number must be determined in each individual case for each aeroplane or engine. The reduction gear ratio of the engine must be carefully adapted to the number of airscrew blades; it can be calculated that the 2,000 h.p. engine of an aeroplane having a speed of more than 385 m.p.h. at 20,000 ft. must be reduced to 800 r.p.m. for a three-blade airscrew to 925 r.p.m. for one with four blades, and to 1,150 r.p.m. for one with six blades, in order to obtain the optimum propulsive efficiency. The three-blade airscrew is still retained to-day in most cases even though the six-blade propeller has two important advantages: Smaller diameter and lower weight. The four-blade airscrew, such as the Curtiss Electric design fitted to the American Martin B-26 twin-engined bomber, is an excellent compromise between the three- and six-blade versions.

By extensive isolation of the airscrew from the vibrations created by the engine it is hoped to attain a considerable saving in building material and weight. A minor improvement in the static thrust is obtained by the fitting of cuffs to the blade shanks to give the latter an airfoil shape, and it seems probable that the future airscrews designed for high engine powers will have to abandon the present narrow blades in favour of airscrew blades of greater width.

U.S.A. Airport Statistics. (Inter. Avia., No. 750, 13/2/41, p. 16.) (89/17 U.S.A.)

On January 1st, 1941, there were 2,656 airports, landing fields and seaplane bases in the United States and Alaska compared with 2,451 at the beginning of 1940. These included 788 municipal and 496 commercial airports, 289 Civil Aeronautics Administration Intermediate Fields, 507 Auxiliary Fields, 21 Naval Air Stations, 69 Air Corps Fields, and 161 Miscellaneous Government private and state airports and landing areas. Of these 2,331 fields, 776 were either fully or partly equipped for night flying. In addition, there were 325 seaplane bases and anchorages on January 1st, including 15 equipped for night operation, compared with 171 at the beginning of 1940. This number is composed of Army, Navy, Coast Guard and Marine Corps bases, as well as commercial installations. Six states and the territory of Alaska have more than 100 fields and airports, as follows:—California 174, Texas 146, Pennsylvania 107, Florida 122, Michigan 116, Ohio 105, Alaska 129.

Fletcher Trainer in Plastic Plywood. (Inter. Avia., No. 750, 13/2/41, p. 6.) (89/16 U.S.A.)

The machine is a two-seater cantilever low wing monoplane of plastics plywood construction and has the following characteristics: The fuselage is of conventional semi-monocoque construction, the stressed skin consists of a new two-ply

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birch plywood, the sheets of which are laid up in such sizes that a single sheet goes completely around one half each of the fuselage shell which is divided along a horizontal plane. A feature of the birch plywood is that the angle of the plies is developed precisely to meet most efficiently the normal loads imposed on the structure, so that a kind of geodetic design results. The two wing halves are covered by the plywood skin in a similar manner; a single sheet goes completely around either wing panel from root to tip and from trailing edge around the leading edge back to the trailing edge; the skin is attached to the wing structure by a secret bonding process using pressure and heat.

Characteristics and Performance.—Span, 30 ft.; length, 21.5 ft.; with a power plant of 130 h.p.; gross weight, 2,100 lb.; fuel capacity, 30 U.S. gals.; maximum speed, 135 m.p.h.; landing speed, 58 m.p.h.; rate of climb, 730 ft./min. with 285 h.p.; engine gross weight, 2,500 lb.; fuel capacity, 50 U.S. gals.; maximum speed, 175 m.p.h.; landing speed, 65 m.p.h.; rate of climb, 1,350 ft./min.

Photo Lofting in the U.S.A. (Inter. Avia., No. 747, 30/1/4, pp. 9-10.) (89/18 U.S.A.)

For the manufacture and assembly of individual construction elements of mainly irregular curvatures, such as ribs, transverse frames and bulkheads, which in the finished aircraft determine the curved surfaces, the aircraft industry has for a long time employed a method it borrowed from the shipbuilding industry. For these parts full-size drawings were made and traced on metal sheets by hand which afterwards were cut out and used as templates. In order to simplify this complicated and lengthy operation which caused a great loss of time between the design and the quantity production of the aeroplane, an engineer of the Lockheed Aircraft Corporation has developed a method which has already been adopted by several aircraft firms. The engineering drawings are photographed on 14 by 17 in. plates and subsequently projected to the full size of the aircraft parts on sensitised template metal sheets by means of a projector camera. Immediately afterwards the drawing is again projected in full size on a sensitised tracing cloth which is used for the preparation of the blueprints; in the meantime the template is cut out and can immediately be employed in the shop. In addition to a great saving of time, the photoloft process has the advantage of eliminating a whole series of possible sources of error.

The Effect of Centrifugal Force on the High Order Bending Vibrations of Airscrews at Various Angles of Blade Incidence. (J. Meyer, L.F.F., Vol. 18, No. 1, 18/2/41, pp. 24-5.) (89/19 Germany.)

On the assumption that bending vibrations occur only transversely to the plane of rotation the author has shown in a previous paper (L.F.F., Vol. 16 (1939), p. 429) that the natural frequencies λ can be represented by the equation

$$\lambda^2 = \lambda_0^2 + CW^2$$

where λ_0 = bending frequency of stationary blade.
W = angular velocity of blade.
C = constant.

The values of C for the first and second harmonic were calculated by the author for zero blade setting and various mass distributions along the blade, utilising the analogy of a rope undergoing vibrations in a centrifugal field of force. Modern airscrews have, however, considerable blade setting and in the present paper the author investigates the effect of this. It appears that the variation of C with blade setting is given by the equation:—

$$C_d = C - \sin^2 d, \text{ where } d = \text{blade setting angle.}$$

The relationship, however, only holds for the higher harmonics for which the vibration form of the blade approximates to that of a rope vibrating in a centrifugal field of force, which analogy forms the basis of the calculations.

The Vibration of a Wing Fitted with an Aerodynamically Balanced Aileron. (H. G. Kussner and L. Schwerz, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 337-354.) (89/20 Germany.)

In a previous contribution (L.F.F., Vol. 13, pp. 410-427) the principal author of the present paper has already dealt with the two-dimensional problem of the vibrating wing fitted with an aileron swinging about its leading edge. In the practical case the aileron axis of rotation is placed farther back (aerodynamic balance) or tabs are fitted to the trailing edge of the control surface. The latter problem is relatively simple (since it merely entails providing the equivalent flat plate of the previous investigation with two sharp bends instead of one) and has been solved by Dietze (L.F.F., Vol. 16, pp. 84-96). The case of the aerodynamically balanced aileron (axis of rotation behind leading edge) presents, however, some difficulties, since now we have two plates vibrating independently. The author shows how the practical case can be reduced to an equivalent system with 6 degrees of freedom for each of which he determines the forces, moments, pressure distribution and aerodynamic co-efficients. The final results for the complete wing are then obtained by superposition, the requisite constant being given in numerous tables.

The Two-Dimensional Problem of a Wing Undergoing Arbitrary Displacement in "Gusty" Air. (H. G. Kussner, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 355-361.) *The Evaluation of U (s) and U2 (s) Functions for Large Values of s.* (L. Schwarz, L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 362-9.) (89/21 Germany.)

Classical aerofoil theory deals with the case of uniform motion of the wing in a fluid at rest. The theory was later extended to cover non-steady motion (vibration) the surrounding fluid being still at rest. This problem is of interest (wing flutter) and the two-dimensional case may be considered as solved.

In practice the air is not generally at rest but may be turbulent or gusty, and this may effect the wing loading appreciably if the speed or size of the wing is considerable.

In a previous paper (L.F.F., Vol. 13, pp. 410-424) the author has shown that the most general two-dimensional solution can be converted by means of the Laplace Transformation into the special case of harmonic vibration and represented by known functions. The integral expression for the pressure jump at the wing hold for any arbitrary motion or deformation of the wing surface in either quiescent or "gusty" air. In the original paper mentioned above, the author considered the case of a wing entering the confines of a jet. As was pointed out subsequently by Karman and Sears (J. Aeron. Sci., Vol 5, pp. 379-390) there are several errors in this first paper which have been corrected in the present investigation. At the same time the function entering into the pressure jump integrals have been re-calculated and tabulated. Details of this calculation are given by Schwarz in an addendum to this paper (L.F.F., Vol. 17, No. 11-12, 10/12/40, pp. 362-369).

Oil Engine Design—The Combined Effect of Swirl and "Squish" (Radial Flow) on Combustion. (Automobile Engineer, Vol. 31, No. 407, Feb., 1941, pp. 63-64.) (89/22 Great Britain.)

It is well known that efficient combustion in a compression ignition engine is largely a question of proper control of the motion of the air in the cylinder with respect to the fuel spray. Rotary motion is termed swirl and can be produced in a variety of ways, such as tangential air inlets, masked valves or control of air flow from cylinder into the combustion space proper by appropriate design of transfer passages.

In the majority of injection engines the combustion chamber is in the form of a recess in the cylinder head or piston crown. The clearance between the piston in its T.D.C. position and the annular space surrounding the recess is very small and as a result there is a pronounced radial flow of air into the combustion space as the air is "squeezed" out during the last portion of the stroke. This secondary air movement may influence the rotary motion or swirl produced previously and the term "squish" has been coined by Ricardo to denote this effect. The radial streams from opposite sides of the annulus will meet and be deflected upwards into the combustion space, producing a kind of toroidal motion. The problem has been analysed by C. B. Dicksee in his book "The High Speed Compression Ignition Engine," and it appears that the "squish" velocity towards the end of the stroke may be of the order of 50-100 feet/sec., depending on engine r.p.m., ratio of diameter of opening into the combustion space to that of the cylinder, compression ratio and clearance. The last factor has a very pronounced effect and quite a small change in the cylinder head gasket will alter the nature of the "squish" completely. In conclusion, it must not be overlooked that although the "squish" velocity may not appear to be very high, the corresponding pressure head may be of the order of 70 lb./sq. in. on account of the high density of the air during this portion of the cycle.

Comparison of Direct Injection Engine (Ju 211D) and Carburettor Engine (Rolls-Royce Merlin X) as regards Performance at Altitude. (Aeroplane, Vol. 60, No. 1,554, 7/3/41, pp. 289-92.) (89/23 Great Britain.)

Tests have been made on two Junkers Jumo 211D engines having direct petrol injection equipment, the nearest British equivalent, the Rolls-Royce Merlin X, being used for comparative tests. Fuel consumption curves were obtained at three different speeds. In view of the difference in dimensions of the two motors the consumption tests on the Merlin were not made at the same crankshaft speeds as the Jumo engine, but at speeds which gave the same piston speeds. Thus the Merlin had to be run 8.25 per cent. faster and therefore at a slight disadvantage. Maximum powers available in level flight were also compared. Specific fuel consumptions of the two types of engine were practically the same except at the lowest speed and power conditions, at which that of the Merlin was 4 per cent. inferior. However, the consumptions given by the automatic mixture regulator are lower for the Merlin over the whole range of speeds than the comparable consumptions for the Jumo, the advantage over the whole speed range being about 7 per cent. Power curves show that at heights above 16,000 feet the Merlin has advantages in power. The system of fuel injection requires a much more complicated mechanism than is required by a carburettor engine. The Jumo injection system comprises some 1,576 parts and weighs approx. 60 lbs (excluding the supply pump) compared with 433 parts and a weight of only 25 lb. for the Merlin carburettor (including Amal valve and fuel pipes). It is concluded that the simplification of the controls made possible by fuel injection pumps is nullified by this increased complication of the complete system, and no greater fuel economy is shown. Good distribution of air to the individual cylinders, which is possibly more important than fuel metering in obtaining low level consumption, cannot be controlled by injection pumps. With fully supercharged carburettor engines the fuel distribution is known to be good and defects such as liability to freezing and cut out during aerobatics can be rectified by suitable design. It is concluded that in engines of conventional design nothing would be gained by use of injection pumps.

Investigation of the Effect of Excess Air Coefficient on the Indicated Efficiency of a Diesel Engine. (T. M. Melkumov, Aeron. Eng., U.S.S.R., Vol. 15, No. 1, Jan., 1941, pp. 53-64.) (89/24 U.S.S.R.)

Diesels of different construction may have different indicated efficiencies at equal values of the excess air coefficient. Consequently curves of the type $\eta_i = f(\alpha)$, where η_i values are given as percentages and α in absolute units cannot be applied universally and may be used only for narrow ranges for one type of engine. In particular, the N.A.C.A. graph for aero Diesels is not satisfactory. A universal characteristic for all Diesels of any type or speed may be obtained by expressing the relationship between the relative value of η_i to the corresponding relative value of α. To do this we may take any value of α for one engine and for other engines the values of α which give an identical value for $d\eta_i/d\alpha$. In practice fully satisfactory results are obtained by plotting graphs for

$$\frac{\eta_i}{\eta_{iE}} \% = f\left(\frac{\alpha}{\alpha_E}\right)$$

where α and η_i are the prevailing values of excess air coefficient and corresponding indicated efficiency, α_E is the value of the excess air coefficient giving minimum fuel consumption and η_{iE} the corresponding value of the indicated efficiency.

The analysis given does not permit practical calculation of the characteristics of a new engine since for the latter α_E is unknown. Accurate determination of α_E for different working conditions and evaluation of the practical application of the method will be a subject for further research.

Pressure and Temperature Measurement in Supercharger Investigations. (A. Franz, Jahrbuch der Deutschen L.F.F., Vol. 2, 1938, pp. 215-8.) (Available as M.A.P. Trans. 1,095.) (89/27 Germany.)

With the further development of the supercharger requirements with regard to measuring accuracy increase while at the same time the conditions under which the measurements must be carried out become more difficult. The present paper is a contribution toward the improvement and refinement of the measuring methods. For pressure measurements some suggestions are made with regard to design and location of the measuring stations. The question of temperature measurement in rapid air flow is discussed, new instruments for the direct measurement of the temperature in the rapid air stream are described and the results obtained with the various instruments presented.

The more nearly the attainable limits are reached in the development of the supercharger the higher become the requirements that must be satisfied by the measurement procedure. At the same time the conditions under which the measurements must be carried out become much less favourable as, for example, in pressure and temperature measurements for which the rise in the flow velocities have considerably increased these difficulties.

Supercharged Aircraft Ignition Harnesses (Ventilation of Contaminated Air) (with discussion). (C. E. Swanson, J.S.A.E., Vol. 48, No. 3, March, 1941, pp. 107-116.) (89/28 U.S.A.)

The supercharged aircraft ignition distribution system is a system which supplies air free from harmful ingredients and at pressure maintained in considerable excess of that of the surrounding atmosphere to the space within the spark plug shield chambers, and is a system which provides ways and means by which the contaminated air may be removed from these regions. It is a feature of the system to utilise for the conduction of this air the type of ignition harness which already constitutes a conduit system to the spark plugs because, through such a type of harness clean air can be transmitted to and into all the spark plug shield chambers and adjacent spaces without adding tubing or additional conduit of any sort. The very important consideration of providing means for the escape of contaminated air from within is accomplished by utilising for this purpose the inherent leaks of the harness or, if these prove insufficient, to provide such leaks purposely by drilling holes or otherwise making openings in the shielding.

After describing the system in detail, a summary is made of various other designs of harnesses which have been set forth in an effort to eliminate the ignition distribution problem and it is pointed out wherein each has its weaknesses.

In support of the contention that supercharged harness makes possible complete relief from the troubles associated with harness contamination a perfect service record of 5,000,000 engine miles is cited.

Problems relating to the Control of Flow in Engine and Cabin Superchargers. (N. C. Price, J.S.A.E., Vol. 48, No. 3, March, 1941, pp. 118-124.) (89/29 U.S.A.)

Comparisons are drawn between engine supercharger flow-control problems. Some new methods of obtaining efficient flow control are discussed. Interdependent factors existing between flow control and impeller speed control must be recognised.

It is pointed out that design features in the supercharger should be correlated closely with the type of control applied.

Effects arising from the connection of superchargers to receivers of large volume are presented. Necessity for regulation of flow for pressure cabins requires the solution of numerous new problems. The advantage of simultaneous design of the supercharger and controls, and the desirability of integral supercharger and control units, are stressed. It has been necessary to overcome many mechanical problems in order to produce units of a type suited for pressure cabin operation. Typical control constructions are described.

A New Method of Determining the Gas Temperature Cycle in a Four-Stroke Spark Ignition Engine. (H. Graff, L.F.F., Vol. 18, No. 1, 28/2/41, pp. 8-17.) (89/30 Germany.)

The method depends on the measurement of the radiation of the resonance line of potassium, obtained by adding a small proportion of potassium alcoholate to the engine fuel (leaded petrol). The radiation is measured by means of a gas-filled infra red photocell, the current being amplified sufficiently for direct recording by means of a cathode ray oscillograph. Details are given of the experimental arrangement and the means adopted for co-ordinating current and gas temperature values. Direct comparison of the temperatures obtained by the photocell with those obtained by the well known spectrum line reversal method shows very good agreement and furnishes proof that neither variation in gas composition nor changes in pressure have any material effect on the intensity of the radiation of the resonance line. The method appears to have an accuracy of about 1 per cent. for temperature in the neighbourhood of 1,800°C. abs. The main difficulty is due to deposits accumulating on the quartz windows fitted in the engine combustion space. An extension of the method which does not suffer from this defect is being investigated.

Damping of Torsional Vibrations by Means of Electrically Coupled Masses with Non-Linear Spring Constants. (K. Maier, L.F.F., Vol. 18, No. 1, 28/2/41, pp. 18-23.) (89/31 Germany.)

It has been observed in practice that dampers with non-linear elastic constants do not experience an increase in temperature comparable with the vibrational energy destroyed. Hence the common explanation that such fittings work mainly by internal friction has to be discarded and a close study of the system appeared to be justified. The analytical solution of a single oscillating mass with non-linear elastic constants undergoing either damped or undamped forced vibrations is already known. An extension of the problem to multi-mass systems leads, however, to great mathematical difficulties. For this reason the authors investigated the problem experimentally and showed that the damping effect is mainly a question of tuning. The best results are obtained if both mass and elastic constant of damper are chosen so as to produce maximum changes in the natural frequencies of the whole system with change in "equivalent" stiffness due to deflection of damper. If the tuning is, however, such that an increase in the "equivalent" stiffness produces only a slight increase in the natural frequency of the system, the damper works mainly by internal friction of the spring system.

Graphical Determination of the Discharge Process of a Gas from a Container. (O. Lutz, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 332-5.) (89/33 Germany.)

The author investigates the discharge process of hot exhaust gas from an engine cylinder, taking into account the motion of the piston and the variable section of the discharge passage (exhaust valve). Intensive use is made of $J-S$ tables (J=enthalpy, S=entropy) recently published by the author.

The calculation is carried out step by step, at approximately 10-crank angle intervals in the critical and five intervals in the sub-critical flow region. The values for the contraction coefficients at the valves are taken from experiments carried out under steady flow conditions. The effect of unsteadiness of flow on these coefficients will be discussed in a subsequent report. The method is illustrated by a worked out example.

The Development of Direct Fuel Injection for Spark and Compression Ignition Engines by the Junkers Works during the Period 1916-1924. (A. Lichte, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 291-296.) (89/32 Germany.)

Experiments on direct fuel injection for c.i. engines were initiated by the late Prof. Junkers as early as 1913, and interesting abstracts from the note-book of his assistant, Dr. Mader, are given. It is worthy of note that the so-called " fish tail " jet (a flat fanwise distribution of the fuel) already dates from this period. During the 1914-1918 war considerable work was done on spark ignition two-stroke engines operating with fuel injection. Lubrication troubles due to the nature of the fuel (petrol) were overcome by utilising a stepped pump cylinder and oil seal. In a later form, the pump piston was given rotary as well as reciprocating motion. The experiment gave promising results, but all work of this nature had to be stopped after the armistice. Subsequent work was concentrated on the compression ignition engine and by 1924 the pump element with slanting piston crown and control by rotation (as now generally adopted) had been evolved. In 1933, petrol injection for spark ignition was once more taken up, and it is stated that the rapid development of the German aircraft engines using this method of fuel supply must be largely credited to the valuable experience gained by the Junkers works in their early researches.

Some Notes on the Engine Airscrew Combination. (W. Hoff, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 299-305.) (89/34 Germany.)

It has been customary for some time to express both the power absorbed by an airscrew and the thrust produced in terms of certain non-dimensional coefficients. The work output of the engine, on the other hand, is usually expressed in dimensional form. Now both these constituents of the aircraft power plant obey different laws. Provided, however, the performance of the airscrew and engine is known at different altitudes and r.p.m. it is possible to correlate these two components by expressing the engine output also in non-dimensional form. In this case neither the absolute power of the engine nor that of the screw need be known. The following cases are treated in detail:—

1. Airscrew with fixed pitch.
2. Airscrew with pitch adjusted for maximum airscrew efficiency.
3. Constant speed V.P. airscrew.
4. V.P. airscrew, r.p.m. of screw diminishing as flight speed increases.

By means of tables and curves, it is possible to select optimum operating conditions in each case.

Lubricating Oils for Internal Combustion Engines. (L. H. Mulit, F. W. Kavanagh, J.S.A.E., Vol. 48, No. 3, March, 1941, pp. 98-106.) (89/35 U.S.A.)

Some of the performance characteristics of lubricating oils, such as limiting cranking temperatures, oil mileages, and gear shifting temperatures, can be predicted from viscosity determinations, but the other items of interest to the users, such as stability, ring sticking, gumming and wear, cannot be predicted from inspections. The trend of engine design, in both the petrol and diesel fields, has resulted in an increase in the mechanical and thermal loads imposed on the lubricating oil and, in some services, such as diesels and aviation engines, satisfactory operation can be obtained only by the use of compounded oils.

Such oils cannot be judged by simple laboratory tests and should therefore be selected on a basis of their performance in full-scale engines.

Compounded oils cannot be reclaimed successfully. This is due to the fact that, in reducing gummy deposits, the compounding materials are consumed and, since the reclaiming operation cannot supply additional compounding, the reclaimed oils are always inferior to the fresh oils. Compounded oils also tend to form a more stable foam than ordinary mineral oils, and the presence of the foam is more noticeable because of its persistence, although the actual amount of foam may be only slightly greater than with an uncompounded oil.

It should be emphasised that the addition of small percentages of compounding material to an oil has a large influence on its service performance; yet it causes almost no change in the normal inspections, and these values are therefore meaningless with respect to the performance characteristics of the lubricant.

Oxidation of Lubricating Oils (Apparatus and Analytical Methods). (M. R. Fenske, Ind. and Eng. Chem. (Analytical Ed.), Vol. 13, No. 1, Jan., 1941, pp. 51-60.) (89/36 U.S.A.)

An apparatus and procedure are described which permit determination of the rate of lubricating oil oxidation. Studies are usually made over the range 130° to 180°C. using oxygen in a circulatory system. Methods have been developed for the determination of substantially all the volatile and non-volatile end products of the reaction.

Ninety to 100 per cent. of the oxygen absorbed by various oils has been accounted for in the products determined. The chief product is water, which accounts for 40-60 per cent. of the reacting oxygen. Soluble saponifiable materials represent another considerable portion, while carbon dioxide, carbon monoxide, volatile acids, fixed acids, and precipitable products account for the remainder.

The analysis of insoluble materials produced by laboratory and engine oxidation indicates these to be relatively highly oxygenated materials (14-24 per cent. oxygen) produced by polymerisation or condensation of the oxidised oil. Molecular weights and elementary analyses suggest certain empirical formulas for the insoluble bodies.

The oxidation of several commercial light oils shows that rates of oxidation vary widely and that induction-type oxidation curves may be common. In general, these results show the widely different oxidation characteristics existing in oils, and that much of the oxidation mechanism remains to be understood before corrective measures are generally applicable.

Standards for Discharge Measurement with Standardised Nozzles and Orifices (German Industrial Standard 1952—4th edition). (V.D.I.-Verlag, G.m.b.H., Berlin, 1937. Translation available as T.M. 952.) (89/37 Germany.)

EXTRACTS FROM PREFACE TO 3RD EDITION (1935).

The constructions of the standards is now clearly divided into definitions of standardised designs of throttling devices and their standardised installations, and guiding information which is to be considered when deviations from the standardised manufacture or the standardised installation occur. Through this division the application of the standards in practice should be simplified and, at the same time, their range of use is extended to those cases that are to be handled with low requirements for accuracy.

The discharge coefficient of the standard nozzle has been newly investigated for ratios of areas $m>0.5$ up to $m=0.64$. These investigations have shown that the discharge coefficient for $m>0.35$ are lower than given in the first and second editions, and that the basic tolerance for m is to be increased for high values of m.

The international standards of the I.S.A. (International Federation of National Standardising Association), suggested by the I.E.C. (International Electrotechnical Commission), adopted at the last meeting at Stockholm, September, 1934, are based principally on the same German investigations as those underlying the VDI Standards. In this way, agreement of the VDI Standard with all essential provisions of the I.S.A. Standards is guaranteed at the start. In particular, the designs of the German standard nozzle and standard orifice and also the discharge coefficients are the same as those of the I.S.A. nozzle and the I.S.A. orifice.

PREFACE TO 4TH EDITION (1937).

In the fourth edition of the Standards, the equations and make-up used in the third edition are essentially unchanged. From experience and on the basis of new tests, a few but quite important changes, as well as several corrections and additions, have been made. These are concerned principally with the dimension of the cylindrical parts s' of the standard orifice and the displacement of the tolerance limit in the direction of higher Reynolds numbers.

A short section on the permanent pressure loss is given again, as in the second edition. Also the section on the conditions when using non-standard pressure taps is treated more fully as compared with the second edition, in order to enable correlation with foreign investigations, which are frequently conducted with non-standard pressure taps.

Corrections on the Thermometer Readings in an Air Stream. (E. J. Vanden Maas and S. Wynia, National Luchtvaart Laboratorium, Amsterdam, No. 8, 1939, Report V. 834, pp. 28-33. Translation available as T.M. 956.) (89/38 Netherlands.)

The reading of a thermometer exposed to an air stream is affected by adiabatic compression, friction in boundary layer and time lag. If the thermometer is small enough, stagnation temperature can be measured directly and friction is negligible.

In the case of the distant reading mercury thermometer employed by the N.L.I. both friction and compression are operative and the total correction $\Delta\theta_a$ in degrees Centigrade is given by the equation:—

$$\Delta\theta_a = -3.86 \times 10^{-5} (\rho_0/\rho_H) V_q^2$$

where V_q=dynamic velocity in km./h.
ρ_0=standard ground density.
ρ_H=density at altitude corresponding to V_q.

Some values are given in the table below.

Dynamic Velocity Km./h.	$\Delta\theta_a$ 100	200	300	400
Altitude 0 ...	−0.39	−1.54	−3.48	−6.17
3,000 m. ...	−0.52	−2.08	−4.68	−8.32
6,000 m. ...	−0.72	−2.87	−6.45	−11.5
9,000 m. ...	−1.01	−4.06	−9.12	−16.2

Corrections for lag will vary from case to case and must be determined separately.

Gas Carburising by the Hypercarb Process. (W. A. Darrah, Ind. and Eng. Chem. (Ind. Ed.), Vol. 33, No. 1, Jan., 1941, pp. 54-9.) (89/40 U.S.A.)

The Hypercarb process serves to apply a controlled high-carbon case on steel articles, which greatly increases the hardness and wear resistance of the surface. The process depends on treating steel articles at controlled temperatures for a controlled time by an atmosphere containing hydrocarbons and carbon monoxide in definite percentages.

The articles leave the furnace clean and free from carbon scale or soot so that no cleaning is necessary. The process is controllable and economical, and has a wide commercial application.

Modern Aircraft Materials and Their Testing. (K. R. Jackman, J.S.A.E., Vol. 47, No. 5, Nov., 1940, pp. 461-73 and 496.) (89/39 U.S.A.)

The commonest steels used for the highly stressed parts of aircraft (landing gears, engine supports, etc.) are as follows:

MATERIAL. No.	Specifications. Army.	Specifications. Navy.	Form	Specific Gravity. D	Weight lbs. cu. in.	TENSION. Ultimate T	TENSION. Ultimate T/D	TENSION. Yield. Y (÷ 10³)	TENSION. Yield. Y/D (÷ 10³)	TENSION. Mod. of Elas. E (÷ 10⁶)	TENSION. Mod. of Elas. E/D (÷ 10⁶)	Elong. % in 2in.	SHEAR. Ultimate S (÷ 10³)	SHEAR. Ultimate S/D (÷ 10³)	SHEAR. Modulus of Rigidity. G ÷ 10⁸	Fatigue Limit, ÷10³	Cost. $/lb.
STEEL	ALLOYS																
1025	57-107-9B	46-S-22	Bar	7.8	.28	55	7.1	36	4.6	28	3.6	22	—	—	—	—	—
2330	57-107 17b	46-S-21b	Bar	7.8	.28	125	16 0	100	12.8	29	3.7	17	—	—	—	—	.15
X4130	57-107-19b	46-S-23E	Bar	7.8	.28	150	19.2	135	17.3	29	3.7	18	100	12.8	11	78	.15
4345	11062	46-S-28	Sheet	7.8	.28	230	29.5	220	28.2	30	3.9	4	—	—	11	95	—
STAINLESS	STEEL	ALLOYS															
18-8	57-136-9	47-S-19	Sheet	7.8	.28	80	10.2	35	4.5	26	3.3	40	70	9.0	—	30	70
18-8	11068	47-S-21-½H	Sheet	7.8	.28	150	19.1	110	14.0	26	3.3	10	100	12.8	—	35	70
18-8	10079	46-S-18-1C	Bar	7.8	.28	120	15.3	60	7.7	30	3.9	15	—	—	—	—	55
18-8	10079	46-S-18-7E	Bar	7.8	.28	100	12.8	50	6.4	29	3.7	28	—	—	—	—	55
16-2		M-286	Bar	7.8	.28	175	22.4	135	17.2	30	3.9	13	—	—	—	—	50

S.A.E. 4345, a Ni-Cr-Mo steel, suitable as substitute for the usual Cr-Mo steel, has good depth-hardening qualities, making it suitable for high-strength forged fittings. It may be heat-treated to over 200,000 lb./sq. in., and the excessive hardness produced by welding can also be neutralised by heat treatment. Scaling during heat- treatment is now largely overcome by use of an anti-scaling compound " Galvo."

Stainless steels are divisible into two groups:—1, Those not suitable for heat-treatment but which obtain their qualities from cold-working; and 2, those that can be heat-treated. The first group, which includes the " 18-8 " types, contain low carbon, 17-25 per cent. Cr. and 7-13 per cent. Ni. and are usually non-magnetic. The second heat-treatable group consists of magnetic steels containing 12-18 per cent., approximately 2 per cent. Ni. and up to 1 per cent. C.

The conventional heat resisting steel for aero-engine exhaust collectors is a titanium stabilised 18-8 product, Navy designation " 47S19."

Particular uses and treatments of the various grades of aircraft steels are briefly mentioned.

Increasing the Ductility of Welds. (Dawson and Lytle, Steel, 20/1/41, pp. 62-4.) (89/41 Great Britain.)

A study has been made of the effect of heat treatment on the physical properties of oxyacetylene welds. The results recorded indicate that the ductility of the weld metal, as indicated by elongation and reduction of area under tensile load, can be improved 30 to 50 per cent. by treatment at lower temperatures than are ordinarily employed for stress-relieving treatment. According to the authors this improvement takes place in low alloy steels as well as in carbon steels.

(Absract supplied by Metropolitan-Vickers Research Department.)

Electromagnetic Stirring Action in a Spot Weld. (Unger, Matis and Knocke, Welding Journal, Jan., 1941, pp. 42-7.) (89/42 Great Britain.)

The authors maintain that when the metal in a spot weld becomes molten, electromagnetic forces acting on the liquid create a violent stirring action. Macro-photographs taken from welds made between a low alloy high tensile steel and stainless steel are produced in support of this statement. A method is also described by which satisfactory welds can be made without the melting and mixing action. The physical properties of the two types of welds are compared.

(Abstract supplied by Metropolitan-Vickers Research Department.)

Creep Strength of Stabilised Wrought Aluminium Alloys. (W. Muller, Aluminium Industry A.G., Neuhausen, Rept. 536, Dec., 1939. Translation available as T.M. 960.) (89/46 Switzerland.)

The tests were carried out on the following alloys: Anticorodal, Avional D, Peralumin 2, Peralumin 7. For comparison Aluminium (99.5 per cent. pure) was also included. In each case, the original extrusions were redrawn cold to app. 20 mm. diameter and stabilised. The reason for utilising such soft materials in the preliminary tests was to simplify the problem and obtain limiting values which might occur in practice after prolonged periods of reheating.

Further tests on age hardened and cold formed alloys are in hand.

The creep strength was investigated both by the Rohn method (600-700 hours under steady load, the temperature being automatically controlled by the yield so that the total plastic flow does not exceed admissible bounds) and by the shortened V.D.M. method (strain rate between 25th and 35th hour 1/1000 per cent. per hour, total strain after 45 hours not exceeding 2 per cent). The values obtained by the two methods were found to be in reasonable agreement, the V.D.M. method giving slightly higher values in all cases with the exception of anticorodal.

The hot yield point (.2 per cent. permanent set) as obtained from the machine diagram in the normal tensile test (period 2-5 minutes) is appreciably above the creep strength at all temperatures in excess of 100°C. Below this temperature, however, the creep strength tends to exceed the yield point, probably due to strain hardening of the material during the creep tests.

The most interesting point brought out in the present tests is the great importance of ground vibrations in lowering creep strength values. Such vibrations may easily lower the creep strength by as much as 50 per cent. and the specifications for such tests should, therefore, be redrawn to ensure proper insulation of the test machines (rubber blocks, etc.)

The following table gives the creep strength (C.S.) and (static yield) points (Y.P.) of the materials tested (Kg./mm.^{2}).

	20°C.		100°C.		200°C.		400°C.	
	YP.	CS.	YP.	CS.	YP.	CS.	YP.	CS.
Aluminium ...	1.5	3.3	1.4	1.5	1.2	0.9	0.3	0.2
Anticorodal ...	6.5	(8.0)	5.1	4.3	3.3	2.3	1.3	0.5
Avional ...	9.8	(12.0)	9.0	9.3	6.3	4.8	1.8	0.9
Peralumin 2 ...	7.9	(9.0)	7.7	7.4	6.8	2.8	0.8	0.2
Peralumin 7 ...	12.9	(14.0)	12.6	13.4	10.7	1.2	0.4	0.1

Effect of Low Temperature on the Properties of Aircraft Metals. (S. J. Rosenberg, Bur. Stan. J. Res., Vol. 25, No. 6, Dec., 1940, pp. 673-701.) (89/43 U.S.A.)

The effect of sub-zero temperatures down to −78C. was determined upon the tensile, hardness, and impact properties of metals commonly used in aircraft construction. These materials were divided into three general groups: (1) Ferritic steels, (2) austenitic stainless steels and nickel alloys, and (3) light-metal alloys.

The tensile properties and the hardness of all materials were generally improved at low temperatures. The resistance to impact of the ferritic steels decreased generally as the test temperature was lowered, the rate and nature of the decrease being dependent upon the type of steel and its treatment. The impact resistance of the austenitic stainless steels and the nickel alloys was not deleteriously affected and they were considered best adapted for service at low temperatures. The impact resistance of the aluminium-base alloys was not decreased; the impact resistance of the wrought magnesium-base alloys was adversely affected by the low temperatures, while that of the cast magnesium-base alloys was not. These last-named materials were, however, extremely brittle even at room temperature.

Arc Welding of High Tensile Alloy Steels. (Rollason and Others, Transactions of the Institute of Welding, Jan., 1941, p. 21.) (89/47 Great Britain.)

It is stated that the problem of welding high tensile steels lies in preventing hot cracks in the weld and cold cracks in the hardened base plates. The report is divided into three parts dealing with the cracking problem with special reference to thermal characteristics, base metal cracking and the effect of delayed cooling on the properties of martensite. Details are given of a magnetic test for determining the transformation temperature.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Effect of Grain Size on Creep Strength. (Weaver, Steel, 24/2/41, pp. 80-85 and 92.) (89/48 Great Britain.)

The author states that the creep strength of a steel is correlated to the grain size. Special creep tests were devised to determine the optimum grain size when the creep temperature is above the " lowest temperature of recrystallisation " and also to determine the optimum grain size for differently alloyed steels at the same creep temperature. Other tests show variation in optimum grain size in the same steel at different creep temperatures. These data are united to produce a creep-strength-temperature-grain-size characteristic for carbon-molybdenum steel.

(Abstracts supplied by Research Department, Metropolitan-Vickers.)

Technical Developments on Metal Finishing during 1940. (Hall, Hogaboom, Metal Finishing, Jan., 1941, pp. 2-7, 10.) (89/49 U.S.A.)

Summaries of papers on metal finishing published during the year 1940 are presented in a form designed for ease of reference. The abstracts are classified in sections according to the purpose and type of the finish and contain details of many U.S. patents on electroplating.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Surface Treatment of Magnesium Alloy. (Schmidt and Others, Foundry Trade Journal, 13/3/41, pp. 175-7.) (89/50 Great Britain.)

This paper discusses the various methods of protecting magnesium alloys against corrosion by the atmosphere, salt water or other corrosive environments. It is stated that numerous tests and industrial uses of magnesium have proved that this metal is remarkably resistant to arduous atmospheric corrosion conditions. Details of some nine different processes for protective chemical coatings are given.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Age Hardening of Al-Zn-Mg Wrought Alloys. (W. Bungardt and G. Schaitberger, L.F.F., Vol. 18, No. 1, 28/2/41, pp. 26-31.) (89/51 Germany.)

The object of the authors research was to obtain a high tensile wrought alloy of Al-Zn-Mg possessing good corrosive resistance after quenching in water from 450°C. and subsequent age hardening at room temperature. The most suitable alloy was found to have the following basic composition:—

Zn	4.5%
Mg	.3%
Mn	.3%
Fe and Si	.2%

In order to improve both the strength and corrosion resistance under conditions of surface/stress (DVL cold rolled strip method), the addition of vanadium (.1 per cent.) and copper (up to 1 per cent.) has proved beneficial. The general corrosion resistance of such alloys is however reduced if the copper content exceeds .1 per cent.

The Creep Strength of Laminated Synthetic Pressed Resins. (H. Perkuhn, L.F.F., Vol. 18, No. 1, 28/2/41, pp. 32-37.) (89/52 Germany.)

The resins used in these experiments were of the phenol formaldehyde type, the laminations consisting either of cellulose (paper) or cotton tissue which constituted between 50 and 90 per cent. of the weight of the finished product. The pressing was carried out at 145°C. at pressures varying between 60 and 600 kg./cm.^{2}. The test rods had an overall length of 170 mm., of which 60 mm. constituted the working sectors (diameter 10 mm.). All the measurements were carried out at 20°C. at a relative humidity of 70 per cent. The following strength characteristics were determined:—

(1) Ultimate tensile (rate of loading 800 kg./cm.^{2}/min.).

(2) Static strength, *i.e.*, maximum stress which can be supported for at least 30 days without fracture.

(3) Creep strength, *i.e.*, stress which will produce a rate of extension of 5×10^{-4} per cent. per hour during the 10-hour period between the 100th and 110th hour of loading. After unloading and resting for 24 hours, the permanent stretch of the material must not exceed 2 per cent.

The ultimate tensile of the various samples varied between 1,000 and 2,000 kg./cm.^{2} (approx. 6-12 tons/sq. in.). The static strength varies between 50 per cent. and 75 per cent. of the ultimate, whilst the creep strength (as defined above) is generally less than 28 per cent. of the ultimate.

Speaking generally, it appears that a resin content of not more than 40 per cent. will give the best strength qualities. No improvement in quality is noted by exceeding a compression pressure of about 250 kg./cm.^{2} (1.5 tons/sq. in.) during manufacture.

Single Sampling and Double Sampling Inspection Tables. (Bell System Tech. J., Jan., 1941, p. 1-61.) (89/54 U.S.A.)

Whether sampling may be employed to advantage in place of 100 per cent. inspection usually depends on the purpose for which inspection is made. The sampling tables provide definite procedures for conducting inspections that have certain immediate purposes which are described in some detail. Through their provision for instituting a " screening " inspection whenever quality falls below an acceptable level, it is claimed that the procedures have been found in practice to enforce a programme of controlling quality in process as the alternative to high inspection costs. The paper includes an appendix of 32 pages of tables.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

A Micro Hardness Testing Machine. (Hanemann, Engineers Digest, Feb., 1941, pp. 42-44.) (89/53 U.S.A.)

Hardness testing by Brinell, Rockwell and Vickers methods affect a large number of crystals and hence the distribution, magnitude and quantity of the crystals influence the result. Previous microscopic hardness measuring tests have been limited to scratch and abrasive methods which, however, measure rather the resistance to wear than the plastic deformation. This new micro hardness testing device has the indentor unified with the lens and is claimed to be very simple to handle. The surface of the sample is brought into focus and the sample so arranged that the crystal to be tested comes in the correct position. The objective is then lowered on to the specimen until the test load is reached. Measurement of the impression follows.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Experiment on Buckling Under Bending. (J. Casseus, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 306-13.) (89/55 Germany.)

The author gives expressions for the buckling load of a strut loaded eccentrically at both ends, the investigation being extended into the non-elastic region. The results are presented in three different ways, two of which are independent of the material of the strut, at any rate in the elastic region. The third method of presentation depends on the material and is mainly utilised for the easier comparison with experimental results.

A comparison of the buckling load of an open section loaded eccentrically (bending failure) with that obtained under conditions of central loading with no restriction against torsion shows that in the case of slender struts the former method of loading gives the higher critical value.

Some Notes on the Endurance and Fatigue Strength of Materials. (F. Bollenrath, L.F.F., Vol. 17, No. 10, 26/10/40, pp. 320-328.) (89/56 Germany.)

Laboratory tests on fatigue or endurance limits are often carried out under conditions which do not represent those occurring in practice. Broadly speaking, we have to differentiate between two kinds of practical loading:—

1. The structural element may be subjected throughout its life to a large number of periodic load cycles operating between definite limits.
2. The element is subjected to widely varying loads, the number of peak loads over a period of time being limited.

In the first case fatigue test of the usual kind over a series of constant stress limits (Wohler curves) should provide the necessary information, provided due attention is given to the order, type and frequency of the limits. In the second case, it is necessary to express the loading on a statistical basis with special reference to the possible effect of rest periods. Such a method of treatment applies principally to aircraft structures, but occurs also in certain forms of crankshaft and propeller loads.

In conclusion, the author calls attention to some factors other than the applied load which may affect the fatigue strength (surface pressing, method of clamping, fretting corrosion, etc.).

There appears to be no doubt that a further important saving in the weight of aircraft structure should be possible without reduction in safety if care is taken that the laboratory tests correspond more closely to the working conditions.

On the Space Attenuation of Impact Sounds in a Brick Building. (A. E. Knowler, Phil. Mag., Vol. 31, No. 206, March, 1941, pp. 240-6.) (89/57 Great Britain.)

A study of impact noises on concrete floors, as heard in the different rooms of a brick building, leads to the following conclusions:—

(1) The relation between the equivalent loudness heard in a room from the source of the impact noise is roughly linear.

(2) The space rate of attenuation of the loudness of dull blows is substantially more than that of sharp ones, the mean values for a concrete floor or uninterrupted brickwork being about 0.3 phon per ft. for the type of sharp blows used and about 0.5 phon per ft. for the dull blows.

(3) For the same type of blow, the space rate of attenuation down a longitudinal wall interrupted by windows may be 50 per cent. greater than that down an equally heavy unbroken transverse wall.

TITLES AND REFERENCES OF ARTICLES AND PAPERS SELECTED FROM PUBLICATIONS RECEIVED IN R.T.P.3 DURING FEBRUARY, 1941.

Theory and Practice of Warfare.

ITEM NO.		TITLE AND JOURNAL.
74/1	U.S.A. ...	*Chemical Warfare since* 1918. (A. L. Kibler, Ind. and Eng. Chem. (News Ed.), Vol. 18, No. 24, 25/12/40, pp. 1,122-25.)
74/2	Great Britain	*High Flying Military Aircraft.* (W. O. Manning, Flight, Vol. 39, No. 1,673, 16/1/41, pp. g-50.)
74/3	Germany ...	*Ju. 88 Dive Bomber (Photograph).* Flyning, No. 18, Sept., 1940, p. 4.)
74/4	Germany ...	*Focke-Wulf F.W.* 187 *Twin-Engine Fighter.* (Flyning, No. 18, Sept., 1940, p. 13.)
74/5	Great Britain	*Consolidated Model* 32 *(Liberator) Photograph.* (Aeroplane, Vol. 60, No. 1,547, 17/1/41, p. 63.)
74/6	Italy ...	*Macchi C.* 200 *Single-Seat Fighter.* (Aeroplane, Vol. 60, No. 1,547, 17/1/41, p. 74.)
74/7	U.S.A. ...	*Consolidated Model* 29 *Flying Boat, Photograph.* (Aeroplane, Vol. 60, No. 1,547, 17/1/41, p. 67.)
74/8	U.S.A. ...	*Table of Aeroplanes Supplied by the U.S.A. to the R.A.F., Fleet Air Arm and Civil Lines.* (Aeroplane, Vol. 60, No. 1,547, 17/1/41, pp. 79-96.)
74/9	U.S.A. ...	*Martin B.* 26 *Bomber.* (Flight, Vol. 39, No. 1,674, 23/1/41, pp. c-d.)
74/10	Italy ...	*Italian S.M.* 82 *Canguru Bomber transporting Fiat C.R.* 42 *Single-Seat Fighter.* (Aeroplane, Vol. 59, No. 1,549, 31/1/41, pp. 142-4.)
74/11	Great Britain	*Blackburn Botha I Torpedo Bomber.* (Aeroplane, Vol. 59, No. 1,549, 31/1/41, p. 145.)
74/12	Germany ...	*Focke-Wulf F.W.* 187 *Two-Engine Fighter (Photographs).* (Aeroplane, Vol. 59, No. 1,549, 31/1/41, p. 146.)
74/13	Italy ...	*New Names for Italian Military Aircraft.* (Aeroplane, Vol. 59, No. 1,548, 24/1/41, p. 104.)
74/14	Great Britain	*Some New Types of British Military Aircraft (Hawker Tornado, Short Stirling, Spitfire Mark III, Westland Whirlwind).* (Aeroplane, Vol. 59, No. 1,548, 24/1/41, p. 110.)
74/15	Italy ...	*S.M.* 81 *"Pipistrello" Bomber.* (Aeroplane, Vol. 59, No. 1,548, 24/1/41, p. 120.)
74/16	U.S.A. ...	*Possibilities of Large Flying Boats for National Defence.* (H. Alfaro, Aero Digest, Vol. 37, No. 4, Oct., 1940, pp. 43-5.)
74/17	Great Britain	*Blackburn "Botha" Torpedo Bomber.* (Engineer, Vol. 170, No. 4,438, 31/1/41, pp. 84-5.)

ITEM NO.		TITLE AND JOURNAL.
74/18	Great Britain	*The Low Countries and France. Lessons of the Tactical Employment of Fighters and Bombers in the Present War.* (N. Macmillan, Flight, Vol. 39, No. 1,676, 6/2/41, pp. e-113.)
74/19	Great Britain	*The Chances of Invasion: Prospects of Airborne Troops: Key Position of Fighters.* (F. A. deV. Robertson, Flight, Vol. 39, No. 1,676, 6/2/41, pp. 114-5.)
74/20	Great Britain	*Blackburn "Botha" I General Reconnaissance and Torpedo Bombing Aircraft.* (Engineering, Vol. 151, No. 3,917, 7/2/41, pp. 107-8.)
74/21	Germany ...	*Air Force Targets in Germany, No. XVI. The City and Port of Mannheim.* (Engineer, Vol. 171, No. 4,440, 14/2/41, pp. 110-1.)
74/22	U.S.A. ...	*Martin B-26 Medium Bomber (Photograph).* (American Aviation, Vol. 4, No. 14, 15/12/40, p. 6.)
74/23	Sweden ...	*Swedish Self-Sufficiency Hopes (Expansion of Aircraft Industry and Air Force.* (Inter. Avia., No. 739, 12/12/40, pp. 1-2.)
74/24	U.S.A. ...	*Vought-Sikorsky XF 4 U-1 Single Engine Fighter.* (Inter. Avia., No. 739, 12/12/40, pp. 7-8.)
74/25	U.S.A. ...	*Republic "Guardsman" Dive Bomber.* (Inter. Avia., No. 739, 12/12/40, p. 8.)
74/26	Great Britain	*Blast Tests on Glass.* (Plastics, Vol. 5, No. 45, Feb., 1941, pp. 23-5.) (Abstract available.)
74/27	Great Britain	*Douglas B-19 Bomber.* (Inter. Avia., No. 738, 4/12/40, pp. 8-9.)
74/28	U.S.A. ...	*North American NA-68 Single Seat Fighter.* (Inter. Avia., No. 738, 4/12/40, p. 9.)
74/29	U.S.A. ...	*U.S.A. Aircraft Production. Review of Progress in Defence Programme and with Aircraft Orders for Britain.* (Inter. Avia., No. 738, 4/12/40, pp. 10-13.)
74/30	U.S.A. ...	*U.S.A.: Reorganisation of Army Air Force Command.* (Inter. Avia., No. 738, 4/12/40, p. 14.)
74/31	Germany ...	*German Military Equipment described from British Sources (Ju 87, Ju 88-A1, Me 110, He 111K).* (Inter. Avia., No. 740-1, 23/12/40, pp. 5-9.)
74/32	U.S.A. ...	*Colour-Blind Flyers can See Through Camouflage.* (Sci. Am., Vol. 164, No. 2, Feb., 1941, pp. 102-3.)
74/33	Great Britain	*The Dive-Bomber versus the Navy (Editorial).* (Engineer, Vol. 171, No. 4,439, 7/2/41, pp. 96-7.) (Abstract available.)
74/34	Germany ...	*Rapid Method for Calculating the Progress of Internal Ballistic Processes (to be cont.).* F. Gabriel, Z.G.S.S., Vol. 36, No. 1, Jan., 1941, pp. 1-3.)
74/35	Germany ...	*The Explosive Properties of Mixtures of Tetranitromethane and Nitrobenzol: a Confirmation of the Hydrodynamic Theory of Detonation (to be cont.).* (J. F. Roth, Z.G.S.S., Vol. 36, No. 1, Jan., 1941, pp. 4-6.)
74/36	Italy ...	*Treatment of Parachutists according to International Military and Civil Law.* (M. Mazzanti, Riv. Aeron., Vol. 16, No. 9, Sept., 1940, pp. 377-86.)
74/37	Italy ...	*General Principles for the Design of a Fighter Aircraft.* (A. Robotti, Riv. Aeron., Vol. 16, No. 9, Sept., 1940, pp. 419-26.)

ITEM NO.		TITLE AND JOURNAL.
74/38	Italy ...	*Considerations on the Use of Ordinary Bombers for Diving Operations.* (G. Salvadori, Riv. Aeron., Vol. 16, No. 9, Sept., 1940, pp. 427-31.)
74/39	U.S.A. ...	*Rapid Determination of Anti-Aircraft Tactical Requirements.* (R. T. Sharpe, Coast Artillery Journal, Vol. 83, No. 3, May-June, 1940, pp. 258-60.)
74/40	U.S.A. ...	*Hasty Camouflage for A.A. Guns.* (P. Rodyenko, Coast Artillery Journal, Vol. 83, No. 3, May-June, 1940, pp. 269-71.)
74/41	U.S.A. ...	*New 90 mm. A.A. Gun.* (Coast Artillery Journal, Vol. 83, No. 3, May-June, 1940, pp. 279-80.)
74/42	U.S.A. ...	*Air Raid Warning Service Tests.* (W. H. Dunham, Coast Artillery Journal, Vol. 83, No. 6, Nov.-Dec., 1940, pp. 531-6.)
74/43	U.S.A. ...	*Bofors 40 mm. A.A. Gun.* (Coast Artillery Journal, Vol. 83, No. 6, Nov.-Dec., 1940, pp. 554-5.)
74/44	U.S.A. ...	*Production for Defence. A Report on Re-armament Progress.* (W. S. Knudsen, Army Ordnance, Vol. 21, No. 124, Jan--Feb., 1941, pp. 333-5.)
74/45	U.S.A. ...	*Anti-Tank and Anti-Aircraft Guns. Trends in the Development and Use of Intermediate Artillery.* (R. H. Somers, Army Ordnance, Vol. 21, No. 124, Jan.-Feb., 1941, pp. 345-6.)
74/46	U.S.A. ...	*The H. and R.—Reising Sub-machine Gun.* (Army Ordnance, Vol. 21, No. 124, Jan.-Feb., 1941, p. 381.)
74/47	U.S.A. ...	*Tactical Aspects of Flexible Aeroplane Cannon.* (K. Sagendorph, U.S. Air Services, Vol. 26, No. 1, Jan., 1941, p. 15.)
74/48	Italy ...	*Cant Z506 B "Airone" Seaplane.* (Aeroplane, Vol. 59, No. 1,550, 7/2/41, p. 166.)
74/49	Germany ...	*Man Power for the Luftwaffe: Estimate of the Number of Recruits Available per Annum.* (Aeroplane, Vol. 59, No. 1,550, 7/2/41, p. 168.)
74/50	Great Britain	*Avro Anson and Focke-Wulf FW 187: Comparison of Features which Disclose Identity.* (Flight, Vol. 39, No. 1,677, 13/2/41, p. 133.)
74/51	Great Britain	*Evolution of the Fighter Aeroplane.* (Flight, Vol. 39, No. 1,677, 13/2/41, pp. a-136.)
74/52	Great Britain	*Lessons of the Tactical Employment of Fighters and Bombers in the Present War. Part III.* (N. Macmillan, Flight, Vol. 39, No. 1,677, 13/2/41, pp. 137-9.)
74/53	U.S.A. ...	*U.S. Aircraft Arrivals (Curtiss, Douglas).* (Flight, Vol. 39, No. 1,677, 13/2/41, pp. 140-1.)
74/54	Germany ...	*Air Force Targets in Germany. XVII. Ludwigshafen-em-Rhein.* (Engineer, Vol. 171, No. 4,441, 21/2/41, pp. 127-8.)
74/55	Italy ...	*Meridionali RO 37bis Army Co-operation Biplane.* (Aeroplane, Vol. 59, No. 1,551, 14/2/41, p. 200.)
74/56	U.S.A. ...	*The First Machines from the U.S.A. (Curtiss "Tomahawk" and "Mohawk," Douglas "Boston," Brewster "Buffalo" and Grumman "Martlet").* (Aeroplane, Vol. 59, No. 1,551, 14/2/41, pp. 205-7.)
74/57	Great Britain	*Aircraft of the Fighting Powers (Book Review).* (H. J. Cooper and O. G. Thetford, Harborough Publishing Co., 1941, price 10/6, 174 pp.) (Aeroplane, Vol. 59, No. 1,551, 14/2/41, p. 204.)

AERO- AND HYDRODYNAMICS.

ITEM NO.		TITLE AND JOURNAL.
74/58	Great Britain	*On the Turbulence of a Tidal Current.* (J. Proudman, Proc. Roy. Soc., Vol. 176, No. 967, Nov., 1940, pp. 449-68.)
74/59	Japan ...	*On the Turbulent Boundary Layers at the Surface of Two Rotating Co-axial Cylinders.* (T. Okaya and M. Hasegawa, Japanese Journal of Physics, Vol. 13, No. 2, 1939-40, pp. 29-49.) (Sci. Absts. "A," Vol. 43, No. 513, 25/9/40, p. 652.)
74/60	U.S.A. ...	*Experimental Determination of Hydrodynamic Stability.* (E. G. Stout, J. Aeron. Sci., Vol .8, No. 2, Dec., 1940, pp. 55-61.)
74/61	U.S.A. ...	*An Experimental Verification of the Isotropy of Turbulence Produced by a Grid.* (D. C. Macphail, J. Aeron. Sci., Vol. 8, No. 2, Dec., 1940, pp. 73-5.)
74/62	U.S.A. ...	*Development of Pipe-Line Charts by Dimensional Analysis.* (L. H. Cherry, Proc. Petrol. Fluid Metering Conf., 11/4/40, pp. 58-64.) (J. Inst. Petrol., Vol. 27, No. 207, Jan., 1941, p. 20A.)
74/63	U.S.A. ...	*A Theory of Cavitation Flow in Centrifugal-Pump Impellers (with discussion).* (C. A. Gongwer, Trans. A.S.M.E., Vol. 63, No. 1, Jan., 1941, pp. 29-40.)
74/64	U.S.A. ...	*Turbulence and Energy Dissipation (with discussion).* (A. A. Kalinske, Trans. A.S.M.E., Vol. 63, No. 1, Jan., 1941, pp. 41-8.) (Abstract available.)
74/65	U.S.A. ...	*Some Aspects of Non-Stationary Airfoil Theory and its Practical Application.* (W. R. Sears, J. Aeron. Sci., Vol. 8, No. 3, Jan., 1941, pp. 104-8.) (Abstract available.)

AIRCRAFT AND AIRSCREWS.

74/66	U.S.A. ...	*Lockheed Lodestar Commercial Transport (Model 18).* (Flight, Vol. 39, No. 1,673, 16/1/41, pp. e-f.)
74/69	U.S.A. ...	*Flight Test Inspection Procedure.* (N. J. Clark, Aero Digest, Vol. 37, No. 3, Sept., 1940, pp. 60-3, 116.)
74/70	U.S.A. ...	*Designing for Serviceability.* (J. E. Thompson, Aero Digest, Vol. 37, No. 3, Sept., 1940, pp. 68-72, 116.)
74/71	U.S.A. ...	*Pitcairn Model PA-36 Direct Control Autogiro.* (D. Rose, Aero Digest, Vol. 37, No. 3, Sept., 1940, pp. 104, 115.)
74/72	U.S.A. ...	*Grumman "Widgeon" 4-5 Place Amphibian.* (Aero Digest, Vol. 37, No. 3, Sept., 1940, pp. 107-8.)
74/73	Germany ...	*Arado AR-96 B. Germany's Standard Military Trainer.* (Aero Digest, Vol. 37, No. 3, Sept., 1940, pp. 111-2.)
74/74	U.S.A. ...	*Engineering for Higher Altitudes (Cabin Supercharging, Ventilation, etc.).* (W. E. Beall, Aero Digest, Vol. 37, No. 4, Oct., 1940, pp. 52-6.)
74/75	U.S.A. ...	*"Swallow" Low Wing Trainer (Swallow Airplace Co. Inc.).* (Aero Digest, Vol. 36, No. 4, Oct., 1940, p. 113.)
74/76	U.S.A. ...	*Schweizer Two-Place All-Metal Sailplane.* (Aero Digest, Vol. 37, No. 4, Oct., 1940, pp. 114, 128.)
74/77	U.S.A. ...	*Design of the Fairchild PT-19 Trainer.* (A. Thieblot, Aero Digest, Vol. 37, No. 4, Oct., 1940, pp. 130-2, 134, 137.)

ITEM NO.		TITLE AND JOURNAL.
74/78	U.S.A. ...	*The Howard Trainer.* (Aviation, Vol. 39, No. 12, Dec., 1940, p. 68.)
74/79	U.S.A. ...	*Undercarriage Shock Absorbing Systems.* (W. A. Semion, Aviation, Vol. 39, No. 12, Dec., 1940, pp. 80-1, 136.)
74/80	U.S.A. ...	*Lockheed's New Photo-Loft-Template Process.* (Aviation, Vol. 39, No. 12, Dec., 1940, p. 111.)
74/81	Great Britain	*Production of Aircraft Components in Alclad.* (P. S. Houghton, Light Metals, Vol. 3, No. 34, Nov., 1940, pp. 278-80.)
74/82	Germany ...	*Tricycle Undercarriages.* (W. Wernitz, Luftwissen, Vol. 7, No. 3, March, 1940, pp. 73-82. (Airc. Eng., Vol. 13, No. 143, Jan., 1941, pp. 6-12.)
74/83	Great Britain	*Oscillations of Castoring Wheels.* (J. L. Taylor, Airc. Eng., Vol. 13, No. 143, Jan., 1941, p. 13.) (Abstract available.)
74/84	U.S.A. ...	*Load Factors in Gusts.* (U.S. Civil Aeronautics Board, Airworthiness Section, Report No. 7.) (F. R. Shanley, Flight, Vol. 39, No. 1,676, 6/2/41, pp. 111-2.)
74/85	Great Britain	*Limits of Aircraft Speeds: Their Relationship to the Speed of Sound.* (W. O. Manning, Flight, Vol. 39, No. 1,676, 6/2/41, p. 116.)
74/86	U.S.A. ...	*Two New American Trainers (Ryan ST-3 and Howard DGA-125).* (Flight, Vol. 39, No. 1,676, 6/2/41, pp. 118-120.)
74/87	U.S.A. ...	*Wing Loading, Icing and Associated Aspects of Modern Transport Design.* (C. L. Johnson, J. Aeron. Sci., Vol. 8, No. 2, Dec., 1940, pp. 43-54.) (Abstract available.)
74/88	U.S.A. ...	*Safety Factor in Metal Wings.* (H. W. Sibert, J. Aeron. Sci., Vol. 8, No. 2, Dec., 1940, pp. 76-7.)
74/89	Germany ...	*Nordische Aluminium A.G. (Particulars of New Company closely associated with Junkers Flugzeug-und Motorenwerke A.G.).* (Inter. Avia., No. 739, 12/12/40, p. 4.)
74/90	Brazil ...	*Brazil: H.L. "El Boyero" Trainer.* (Inter. Avia., No. 739, 12/12/40, p. 7.)
74/91	U.S.A. ...	*Pan-American Airways Trans-Oceanic Services.* (Inter. Avia., No. 739, 12/12/40, pp. 15-16.)
74/92	U.S.A. ...	*Altitude Conditioning of Aircraft Cabins (Paper to S.A.E. National Aircraft Production Meeting).* (J. B. Cooper, Inter. Avia., No. 738, 4/12/40, pp. 1-5.)
74/93	Sweden ...	*Swedish Aircraft Industry Organisation.* (Inter. Avia., No. 738, 4/12/40, pp. 7-8.)
74/94	U.S.A. ...	*Ryan ST Two-Seat Primary Trainer—Seaplane Version.* (Inter. Avia., No. 738, 4/12/40, p. 9.)
74/95	France ...	*Bloch 161 Four-Engined Airliners for French Civil Aviation.* (Inter. Avia., No. 738, 4/12/40, p. 17.)
74/96	U.S.A. ...	*U.S.A. Accident Reports: Douglas DC 3 Crash due to Lightning.* (Inter. Avia., No. 738, 4/12/40, p. 18.)
74/97	U.S.A. ...	*Vultee "Valiant 54" Basic Trainer.* (Inter. Avia., No. 740-1, 23/12/40, p. 11.)
74/98	U.S.A. ...	*Fairchild M-62 Primary Trainer.* (Inter. Avia., No. 740-1, 23/12/40, p. 12.)

ITEM NO.		TITLE AND JOURNAL.
74/99	U.S.A. ...	*U.S.A. Details of Aircraft Companies' Expansion and Finance.* (Inter. Avia., No. 740-1, 23/12/40, pp. 12-15.)
74/100	U.S.A. ...	*Test Tower for Studying the Aerodynamics and Functioning of Parachutes.* (Sci. Am., Vol. 164, No. 2, Feb., 1941, p. 85.)
74/101	Italy ...	*General Discussion on Blind Flying.* (P. Magini, Riv. Aeron., Vol. 16, No. 9, Sept., 1940, pp. 387-418.)
74/102	Italy ...	*Review of Modern Variable Pitch Airscrews.* (E. Pistolesi, L'Aerotecnica, Vol. 20, No. 10, Oct., 1940, pp. 747-60.)
74/103	U.S.A. ...	*The Trend of Air Transportation.* (E. T. Allen, Trans. A.S.M.E., Vol. 63, No. 1, Jan., 1941, pp. 1-11.)
74/104	U.S.A. ...	*Detection of Supercooled Fog Droplets (Proposed Method of Detecting Incipient Wing Icing).* (R. L. Ives, J. Aeron. Sci., Vol. 8, No. 3, Jan., 1941, pp. 120-2.) (Abstract available.)
74/105	U.S.A. ...	*Charts for Minimum Turning Radius and Minimum Time of Turn.* (H. W. Sibert, J. Aeron. Sci., Vol. 8, No. 3, Jan., 1941, pp. 123-4.)
74/106	Great Britain	*Ice Accretion on Aircraft Notes for Pilots.* (G. C. Simpson, M.O. Professional Note, No. 82, 1939.)
74/107	Great Britain	*Aeroplane Landing Lights.* (Aeroplane, Vol. 59, No. 1,550, 7/2/41, pp. 179-81.)
74/108	Great Britain	*The Observer's Book on Astro-Navigation Parts I and II (Book Review).* (F. Chichester, George Allen and Unwin, 1941, 103 and 83 pp., price 2/6 each.) (Aeroplane, Vol. 59, No. 1,551, 14/2/41, p. 204.)

ENGINES AND ACCESSORIES.

74/109	Great Britain	*Rotary Vacuum Pump for Aircraft (Fenton Smith Bros.).* (Engineer, Vol. 170, No. 4,436, 17/1/41, p. 52.)
74/110	Great Britain	*Steam Turbine Nozzle and Blading Efficiency.* (F. Dollin, Engineer, Vol. 170, No. 4,436, 17/1/41, pp. 53-4.)
74/111	U.S.A. ...	48 *Ordinate Harmonic Analysis and the Harmonic Spectrum of Two-Cycle Diesel Torque.* (N. Klook, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 158-60.) (Abstract available.)
74/112	U.S.A. ...	*Turbine Blade Vibration Due to Partial Admission.* (R. P. Kroon, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 161-5.) (Abstract available.)
74/113	U.S.A. ...	*The Strength of Marine Engine Shafting (Review).* (C. F. Doney, J. App. Mech., Vol. 7, No. 4, Dec., 1940, p. 175.)
74/114	U.S.A. ...	*Field Strength of Motor Car Ignition between* 40 *and* 450 *Megacycles.* (R. W. George, Proc. I.R.E., Vol. 28, No. 9, Sept., 1940, pp. 409-12.) (Abstract available.)
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