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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.

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| 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. ... | Automobiltechnische 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. ... ... | Revue 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 Elektroakustik. |
| 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. |

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| 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. Soc. Chem. Ind. (Abstracts B) | Journal of the Society of Chemical Industry (British Chemical Abstracts B) |
| J.S.A.E. ... ... | Journal of Society of Automotive Engineers. |
| 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. |
| Veröffent (Siemens) | Veröffentlichungen aus dem Gebiete der Nachrichtentechnik (Siemens). |
| W.R.H. ... ... ... | Werft Reederei Hafen. |
| W.T.M. ... ... ... | Wehrtechnische Monatshefte. |
| Z.A.M.M. ... ... | Zeitschrift für Angewandte Mathematik und Mechanik. |
| Z.G.S.S. ... ... | Zeitschrift für das gesamte Schiess- und Sprengstoffwesen 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. |

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*New Solution of the First Main Problem of External Ballistics.* (K. Eggers, Wiss. Abh. Reichsamt f. Wetterdienst, Vol. 5, No. 11, 1939, pp. 11-16.) (96/1 Germany.)

The paper is a development of Popoff's investigations as laid down in "The Main Problem of External Ballistics," Leipzig, 1932. The motion of the projectile is related to a system of co-ordinate axes $\bar{x}$, $\bar{z}$, intersecting at an acute angle, and adapting itself step by step (by partial arcs), to the development of the trajectory. Calculation is based on a zone law for the air resistance $F(v)$, which is developed into a series $F(v)/v = f(v) = f(w) + \ldots$, with $w = \bar{x} + \bar{z}$. If this series is interrupted after the first term the variables in the equations of motion can be separated. It is then possible to find the time of flight $t$ and the horizontal velocity $\bar{x}$, in terms of $w$. The error in each individual step arising out of this approximation, and the propagation of the error into the final values are exhaustively investigated.

The method can be improved either by selecting the limits of the stages of the calculation so as to cause the error arising from the neglect of the second term in $F(v)/v$ to assume partly positive and partly negative values within the stages (in this case the total error at the end of the stage is practically zero);

or by substituting a mean value (constant over the stage) for the variable factor in the neglected second term of the expansion. A check of the method by Cranz's standard trajectory gave good results.

To enable convenient calculation of an entire family of trajectories for setting up a range table, a number of basic integrals must first be calculated, of which the simplest has the form :—

$$A(\tilde{g}_0, w) = \int_{w_0}^{w} dw / \{ \tilde{g}_0 - c_0 F(w) \} \ ; \ \tilde{g}_0 = \text{const.} ; \ c_0 = \text{const.}$$

No information on the time taken by the new method is given. According to the abstracter, it is considerably more than the time required to calculate a range table by existing methods (Runge-Kutta, Cranz-Rothe). One disadvantage is that these integrals need evaluation, not only for each type of air resistance $F(w)$, but also for each projectile ($c_0$).

The variation of gravity, air density, and temperature with altitude, is to be allowed for by replacing these variables at each stage of the calculation by their corresponding, constant "ballistic" equivalents. Finally, a method for including the diurnal influences of air density, longitudinal and lateral winds, is indicated, entirely new formulæ being developed for the wind effect. The opinion of the author, that the methods hitherto current in ballistic practice for calculation of the relative wind effect are erroneous, is not shared by the abstracter.

(Abstract from Zent. B, Vol. 10, No. 4, 11/11/40, pp. 151-152.)

*Ballistics of Anti-Aircraft Gunnery.* (I. Lintes, C.R. Inst. Sci., Roum., Vol. 3, 1939, pp. 263-268, 549-558, 683-690.) (96/2 Roumania.)

1. The Calculation of Ballistic and Atmospheric Corrections for Anti-Aircraft Fire.

The starting point is the solution of the ballistic problem derived from the approximate principal ballistic equation (C. Cranz, "External Ballistics," Berlin, 1925, pp. 151 and 153). The author assumes an exponential law $[F(w) = Cw^n]$ for the air-drag function. On this assumption, he develops equations for variation of the horizontal distance $dx/x$, height $dz/z$, and time of flight $dt/t$, which are linked with variation of the muzzle velocity, angle of departure, and ballistic coefficient. These equations include as a special case, the familiar difference formulæ of Stübler (C. Cranz, supra, p. 282), and are applied to determine the effects of wind and rain on the trajectory.

2. Anti-Aircraft Ballistics (Nadiral Ballistics).

A method is developed, subject to certain limiting conditions, for the calculation in a self-contained form of the ascending limb of a trajectory. The assumptions are equivalent to making the ratio $\gamma = w/v$ ($w$ = retardation due to air drag; $v$ = projectile velocity) a function of the time of flight $t$, of the form $\gamma(t) = \gamma(0)/[1 + \gamma(0) \cdot t]$.

By means of this method, calculations are made for the envelope of the family of trajectories, the lines of equal inclination to the horizontal, equal times of flight, equal elevation and of equal fuse-setting. In the opinion of the abstracter, the equation for $\gamma(t)$ is only a rough approximation to the actual conditions.

3. Aerial Ballistics (Zenithal Ballistics).

For notation, see preceding abstract. On the assumption that from the vertex $S$ onwards, the ratio $\gamma = w/v$ takes the form $\gamma(t) = \gamma_s/(1 + \gamma_s \cdot t)$, the ($x$, $z$)—co-ordinates of the descending limb of the trajectory of a projectile or an aerial bomb are calculated in a self-contained form as functions of the time $t$. In the opinion of the abstracter, the equation for $\gamma(t)$ is inapplicable to the descending part of the trajectory.

(Abstracts from Zent. B., Vol. 10, No. 4, 11/11/40.)

*On Tactical Requirements in the Design of Fighter Aircraft.* (J. P. Nikolaef, Aeronautical Engineering, U.S.S.R., Vol. 15, No. 3, March, 1941, pp. 56-58.) (96/3 U.S.S.R.)

A rejoinder to an article under the same title by M. P. Stroyev in "Aeronautical Engineering," U.S.S.R., No. 12, of 1940 (R.T.P. Abstract No. 28,109), specifically dealing with the contention of the original author that the twin-engined single-seater fighter type presents no advantages by comparison with the "Standard" single-engined fighter (*i.e.*, with a tractor airscrew).

As against this, the development of the latest fighter types as twin-engined models—*cf*. Grumman "Skyrocket," Lockheed "P.38," Westland "Whirlwind"—appears to prove that the twin-engine arrangement does have certain advantages, which are accordingly examined.

Treating manœuvrability as a function of the power loading ($G/Ne$ in kg./h.p.), it is found that single engined types have power loadings between 2.6-2.7 kg./h.p., and twin-engined types between 2.2 and 2.3 kg./h.p.

Calculating the "coefficient of manœuvrability" $(G/N)\sqrt{(G/lS)}$—where $G$=all-up weight, $N$=engine h.p., $l$=wing span, $S$=wing area) the following values are obtained:—

| | |
|---|---|
| Single-engined fighters:— | |
| Curtiss "Hawk" ... | 20 |
| "Spitfire" ... | 19.5 |
| "Me. 109" ... | 18.5 |
| Twin-engined fighters:— | |
| Grumman "Skyrocket" ... | 17 |
| Lockheed "P.38" ... | 20 |

Manœuvrability and power loading being approximately the same in both groups, the conclusion is justified that the efficiency is also the same. Stability and controllability (with suitable design!) will be no worse for the twin-engined than the single-engined type. Top speeds are at least 5-6 per cent. better. The arrangement of two engines admits better provision for armament and fuel (longer range!), and avoids "blind spots" for the pilot.

The following conclusions are arrived at:—

1. The design of the twin-engined single-seater fighter, particularly with air-cooled engines, affords considerable tactical advantages in flight by comparison with the single-engine design.
2. In aerial combat the twin-engined fighter will be better by reason of higher speed, vertical manœuvrability, service ceiling, armament and visibility for the pilot.
3. Operations against bomber aircraft will be easier for the twin-engined fighter by reason of its greater fire power. This will also be useful for anti-tank operations.
4. The additional operational scope of the twin-engined fighter will be far greater.

*The Oerlikon "Oblique Pin" Impact Fuse for 20 mm. Aircraft Cannon.* (Flugwehr and Technik, Vol. 3, No. 6, June, 1941, pp. 161-162.) (96/4 Switzerland.)

Aircraft cannon ammunition must be safe during transport and whilst in the gun. This is usually achieved by providing a locking pin which is ejected by centrifugal action (spin) when the shell leaves the barrel. Cases having arisen when the ejected pin caused damage to the aircraft, the Oerlikon firm have developed an alternative safety device, still operated by centrifugal action, but retained in the shell and not ejected. The device consists of two inclined cylindrical members, pressed inward by a retaining spring and gripping the striking pin of the shell. The angle of inclination is so chosen that the inertia forces due to longitudinal acceleration overbalance the centrifugal forces due to spin as long as the shell is still moving along the barrel. In free flight, however, the longitudinal acceleration stops and the cylindrical members now move outward under centrifugal force and free the striking pin. It is stated that the new type of fuse is perfectly safe during transport (dropping, shaking, blows, etc.), and has been designed specially to take into account present day difficulties in obtaining materials. Thus no copper is required in its manufacture.

*Some Notes on Repair and Maintenance at an Advance German Air Base in Sicily.* (Junkers Journal, Vol. 12, No. 5-6, May-June, 1941, pp. 70-72.) (96/5 Germany.)

Repair and maintenance units of the German Air Force are known by the initials F.B.K. and are provided with a number of lorries carrying the necessary tools and equipment so that a change of base can be carried out quickly. A mobile power plant supplies the necessary electric current. Photographs illustrate work being carried out on Ju. 88 bombers and include welding operations, engine overhaul (dust proof tent) and replacement of complete power plant.

*Some Properties of the Hodograph and Their Application in the Construction of the Hodograph in the Problem of External Ballistics.* (T. Lewis, Phil. Mag., Vol. 32, No. 214, Nov., 1941, pp. 427-435.) (96/6 Great Britain.)

The equations of motion of a projectile in a resisting medium can be integrated analytically only for special forms of the law of resistance and, except for the case in which the resistance is proportional to the velocity, the analysis is very complicated and great labour is involved before numerical results are obtained. The equations for an arbitrary law of resistance can be solved numerically with any degree of precision required. But all the calculations have to be repeated for every set of initial conditions and for each value of the ballistic coefficient. The labour of integration would be greatly reduced if the hodograph were known beforehand, or if a quick method of constructing the hodograph were known. Knowledge of the hodograph is equivalent to the knowledge of a first integral of the equations of motion.

The author shows that the tangents to all hodographs at the points corresponding to the velocity $v$ pass through a fixed point on the $y'$ axis provided $c$, the ballistic coefficient, remains constant. This property leads to a quick method of constructing the hodograph, which is described. It can be extended so as to allow for the variation of density and it does not require the construction of a different set of curves for each value of $c$; all that is needed is polar graph paper and tables of values of $\eta$, which can be calculated from the tables for $f(v)$.

Owing to the uncertainty in the value of the ballistic constant, it is of greater importance to be able to calculate accurately the difference in the elements of two trajectories due to a change in the initial conditions. If the difference in the initial conditions is a small quantity of order $\Delta v$, it follows that the error in the difference at any stage, due to the method of constructing the hodograph alone, is of the third order. So considered as a graphical method it appears to be highly satisfactory.

*The Design of High Speed Military Aeroplanes.* (C. L. Johnson, J. Aeron. Sci., Vol. 8, No. 12, Oct., 1941, pp. 467-474.) (96/7 U.S.A.)

The hardest problem which the designer of military aeroplanes must face is the proper evaluation of the following fundamental factors in their relative importance, one to the other:—

(*a*) Performance.
(*b*) Armament.
(*c*) Ease of production.

(*d*) Manœuvrability.
(*e*) Time required for development.
(*f*) Flight qualities.
(*g*) Cost.

All aircraft design is made up of compromises between these considerations and the success of the basic design depends on which of the above factors have been favoured without too great a loss in the other items. The element of time is of paramount importance under wartime conditions because the manufacturer, or, more properly, the nation, cannot afford to gamble too far on new and untried design features for fear that trouble experienced in their development may make the aeroplane obsolete and waste the production facilities at a time when the greatest output is required. It is better to have 1,000 four hundred m.p.h. aeroplanes in service than to have the finest four hundred and fifty m.p.h. design in the world on paper struggling with problems of design and production. Only after sound fundamental research and the highest type of engineering can the manufacturer afford to use some of the newer developments now on the horizon of progress.

A gross weight analysis of a typical twin-engine fighter is given below.

| I. | | II. | |
|---|---|---|---|
| Useful load, pilot, fuel, armour, guns ... ... | 23.61% | Pilot, fuel, oil ... ... | 14.5% |
| Wings ... ... ... | 12.30 | Stressed material ... ... | 28.0 |
| Tail unit ... ... ... | 2.82 | Miscellaneous material ... | 12.5 |
| Landing gear... ... ... | 5.67 | Purchased equipment (engine, prop., etc.) ... ... ... | 45.0 |
| Fuselage and fixed equipment ... ... ... | 11.00 | | |
| Nacelles ... ... ... | 8.30 | | |
| Power plant, propellers, fuel, and cooling systems ... | 36.30 | | |

The designer thus has direct control over only 40 per cent. of the gross weight.

As aeroplane speeds increase, the percentage of weight in the power plant increases also. Developments in the present war have shown the need for increased equipment rather than a reduction of what is now used. It can be seen that future military aeroplanes tend to become larger and more expensive as the performance is pushed up.

In spite of the fact that the pusher propeller has many problems, it seems fairly certain on the basis of present data that it should be used. Before they can be widely used, the problem of the pilot leaving the aeroplane with parachute must be considered. With a rotating propeller behind him, it is absolutely impossible to leave the aeroplane safely, so means for stopping it in a given position, dropping it or throwing the pilot clear, must be incorporated.

*Visual Experimentation with Centrifugal Pumps (American Society of Naval Engineers).* (H. L. Cooper, Engineer, Vol. 172, No. 4,476, 24/10/41, pp. 278-281.) (96/8 U.S.A.)

The tests were carried out on a 1 : 6 model of a 28 in. dredger pump. The model was of composite construction (transparent plastic and light alloy). Velocity and pressure distribution were obtained by means of pitot tubes and flow conditions were examined by means of silk threads.

Outstanding phenomena, brought to light as a result of this visual investigation, are the existence of large dead water areas within the impeller and the consequent existence of extremely high velocities over a small percentage of the cross-sectional area within the impeller. The magnitude of these velocities is often six times the average for the entire area. On account of these extreme velocities, considerable energy losses occur as a result of the transformation from potential to kinetic energy, and vice versa. It is believed that these losses may be materially reduced by changes in design after further experimental effort.

The phenomena of dead water areas and maldistribution of velocities are also existent in conjunction with fluid flow through bends in pipes and conduits resulting in extensive energy losses. These influences must be detrimental to the transfer of fluid through the various piping systems of naval vessels, where space is at a premium and elbows, manifolds, and bends are in abundance. The decrease in power requirements and improvement in efficiency of these systems could well offset the cost of further experimental effort in this field.

*Flow Properties of Lubricants Under High Pressure (with Discussion).* (A. E. Norton and others, Trans. A.S.M.E., Vol. 63, No. 7, Oct., 1941, pp. 631-643.) (96/10 U.S.A.)

In this paper, results are given of a preliminary study of the rate-of-shear versus shear-stress relationship for several oils known to undergo apparent solidification when subjected to high pressure. Lard, rapeseed, sperm, and one mineral oil were tested under a temperature range of $-5$ C. to 20 C. while subjected to pressures up to 50,000 psi. Experimental curves of flow versus pressure difference were obtained for capillary flow, and these curves were transformed mathematically to the desired curves of rate of shear versus shear stress. A brief discussion of some of the problems inherent in capillary testing of plastic materials is included in this report.

The consistency of an oil near apparent solidification is dependent upon time of application of pressure as well as upon the amount of pressure and the temperature. The consistency is very likely dependent upon the amount of shear as well.

*The Characteristics of the Aerofoil with Discontinuities Along the Span, with Special Reference to the Effects of Cut-out.* (T. Okamoto, Aero. Res. Inst., Tokyo, No. 208, May, 1941, pp. 207-263.) (96/11 Japan.)

The present paper deals theoretically with the aerofoil with discontinuities along the span (such as rectangular cut-out, flap or aileron) and consists of three parts. In the first part, the approximate method of calculating the lift distribution of the aerofoil with discontinuities is obtained, and it is shown that the method described may conveniently be used in practice with satisfactory accuracy. In the second part, the characteristics of the aerofoil with longitudinal slots are studied, and the special cases of the divided aerofoil and the aerofoil with cut-out are solved. The calculated results agree satisfactorily with the measured results. In the third part, the characteristics of the aerofoil with rectangular cut-out are calculated, showing that the calculated results agree satisfactorily with the experimental results. (Twelve references.)

*The Friction and Heat Transmission Coefficients of Rough Pipes.* (W. F. Cope, Procs. Inst. Mech. Engs., Vol. 145, No. 3, June, 1941, pp. 99-105.) (96/12 Great Britain.)

In a previous paper (Cope, Procs. I.Mech.E., Vol. 137, 1937, p. 165) an account was given of the simultaneous measurement of the heat transmission and friction coefficients of a series of smooth pipes of various shapes of cross section. The results formed the first part of a comprehensive research into the problem of heat transmission. The present paper, which describes the results of tests on rough pipes, forms the second section. Three pipes were tested, their internal surfaces being artificially roughened by a special knurling process which produced a series of pyramids geometrically similar in form but varying in absolute size from pipe to pipe. The roughness ratios (radius of pipe/height of pyramid) were approximately 8/1, 15/1, and 45/1. The apparatus used was basically the same as that used in the previous tests; the working fluid was water, and the Reynolds number ranged from 2,000 to 60,000. The results indicate that when fully turbulent conditions are established, the roughness has very little effect on the heat transmission coefficient, but that in the transition region between laminar and fully turbulent flow, the roughness may increase that coefficient to considerably more than its value for a smooth pipe; and that the heat transmission graphs for the three pipes are in better agreement if shearing force velocity is used instead of mean velocity, in forming the non-dimensional parameters used for plotting purposes. The broad conclusions from the practising engineer's standpoint are (1) for a given pressure drop across a heat transmission apparatus more heat will be transmitted if the pipes are smooth than if they are rough; (2) the velocity of the working fluid will, of course, be greater with smooth pipes; and (3) the smooth pipe is more efficient if the comparison is made on a basis of heat transmission for equal power.

*On the Statistical Theory of Turbulence.* (C. L. Pekeris, J. Aeron. Sci., Vol. 8, No. 12, Oct., 1941, pp. 475-476.) (97/13 U.S.A.)

A method is given of determining the distribution function of turbulent velocities. The distribution function $P(u)$ of a component turbulent velocity $u(t)$ is defined as the probability that $u$ shall have the value between $u$ and $u+du$. The part $P_e(u)$ of $P(u)$ which is an even function of $u$ can be determined by first measuring the mean with respect to time of $\cos zu(t)$ for all value of $z$. If this function be denoted by $\psi(z)$ the $P_e(u)$ is given by

$$P_e(u) = (1/\pi)\int_0^\infty \cos uz\psi(z)\,dz.$$

*Design and Production Procedure for Prototype Aircraft.* (N. N. Polikarpov, Aeronautical Engineering, U.S.S.R., Vol. 15, No. 5-6, May-June, 1941, pp. 1-8.) (96/14 U.S.S.R.)

The author examines the methods and procedure for the design and development of experimental (properly speaking—prototype) aircraft. The need for these is apparent from the tremendous scale of modern aerial warfare and the consequent imperative necessity of utilising materials and technical resources to the very best advantage. The modern military aircraft is becoming an increasingly complicated machine—comparable almost to a warship—and this, together with the large-scale production required, imposes the most stringent conditions on the designer.

Two methods of development are available—the design and construction of experimental machines and prototypes for series production as an ancillary activity of large construction plants; and the establishment of special "experimental" or "prototype" plants. Both have their advantages—the latter appears more efficient under conditions of high-pressure wartime production.

A full scheme of design and development, up to the stage of the "prototype series" capable of actual, operational testing, consists of the following steps:—

1. Examination of the problem and determination of the fundamental characteristics of the new design. Specialization and concentration on individual characteristics (speed etc.) should be avoided; the military aircraft should be an "all round" machine as far as possible. Scope for modification and "modernization" is essential.
2. Setting up the preliminary design (sketch plan).
3. Construction of the mock-up.
4. Preparation of the constructional drawings. For mass production this requires to be very carefully done.
5. Construction of the prototype series, followed by strength tests under both static and dynamic loads, vibration tests, etc.

6. *Flight tests, preliminary and operational.*
7. The type is passed into mass production.

Some design points to be watched:—

Durability of materials.

Rapid readiness for service.

Critical analysis of earlier designs which have failed in practice.

Control, take-off speed as well as landing speed; length of run in both cases.

Production methods and economy of materials.

*Weight Reduction in Aircraft Design.* (E. E. Roberts, Aero Digest, Vol. 39, No. 2, August, 1941, pp. 146-150, 232-233.) (96/15 U.S.A.)

As recently as ten years ago, the existence of a separate weight department as such was relatively unknown in aircraft plants. Necessary weight and balance calculation were made by personnel who could find the time to do them. Only within the last five years has the weight engineer elevated his function from that of estimating, calculating and recording, to one of actual control. The methods by means of which this has been achieved are described by the author with special reference to the Lockheed firm. Success can only be achieved if there exists the closest co-operation between the aerodynamic design and production departments. It is interesting to note that of the total (empty) weight of an aircraft, only about 50 per cent., covering the main structural parts such as wings, fuselage, etc., is controlled by the firm.

The remainder represents purchased equipment (power plant, etc.) or parts supplied by the Government (armament, etc.).

Excluding such items as ducts, fairings, pipe line and electric wiring, seats, flooring, etc., less than 30 per cent. of the empty weight remains in the form of stressed material under full control of the aircraft firm. It is evident that further progress is only possible if the firm or Government departments supplying the non-structural equipment are rendered as " weight conscious " as those responsible for the complete aircraft.

*Photo-Loft-Template Process Film Developed.* (Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 196-198.) (96/16 U.S.A.)

With the use of Matte Transfer Film, developed by Kodak, engineering drawings can be printed either by contact or by projection on photo-sensitive metal sheets and the processed plates bearing the photographic image are then sent directly to the Template Department to be cut out and used as a pattern. The templates are made by cutting around the photographic outline by a saw or mechanical shears. Other machining operations to which the photo-sensitised metal sheets are subjected are filing, drilling and punching. By this means the costly and time-consuming step of making the layouts on metal by hand from the blueprints or the necessity of duplicate inspection is avoided. Also, by this method, copies of a drawing can be produced for checking purposes, for blueprints, (by using photographic tracing cloth), or for use in re-designing a part.

In the contact method of making prints on photo-sensitised metal, the engineering drawings are made on metal plates which have been given a coating of a material which will fluoresce in the presence of X-rays. This coating is likewise of such a nature that it can be drawn upon satisfactorily. If positive prints on the metal are desired, a photo-sensitive glass plate is placed in contact with a treated surface of the plate bearing the mechanical drawing and the exposure is made by X-ray through the back of the metal plate. The processed glass negative is then printed on to a sheet of photo-sensitised metal in the usual way. If a mirror image negative on metal is used for the templates, the photo-sensitised metal sheet is placed in contact with the above treated metal drawing sheet and exposed through the back of the metal by X-ray.

The negative mirror images obtained may be made into " right " images by simply turning over the finished template.

Lockheed Aircraft Corp., a pioneer user of Eastman Matte Transfer Film, has made satisfactory use of enlargements of mechanical drawings on photo-sensitised metal plates. In this process the mechanical drawings are made directly upon lacquered metal sheets. The drawings are then photographed on glass plates in a special camera. The glass negatives are then enlarged on to the photo-sensitised metal sheets. By this method photo-templates as large as 4 ft. by 12 ft. have been made.

It has been found that the most simple and effective method of producing sheets of photo-sensitised metal consists of laminating Matte Transfer Film to lacquered metal sheets. The film consists of a sensitive emulsion coated on a thin film support, the latter backed by a paper base. When used, the sensitised strip is transferred (or stripped) from the supporting paper base to the lacquered metal plate. This film has a matte surface, so that it will take a pencil line in case changes or additional developments on the processed photographic image are desired.

At present, width of Matte Transfer Film is limited to a maximum of 34.5 in. If wider plates are desired, several strips of film are used to give the desired width and the plate is passed through the machine the required number of times for proper lamination of the film.

*Performance of Aircraft Wheels and Brakes.* (H. Burkhardt, Luftwissen, Vol. 8, No. 9, September, 1941, pp. 289-291.) (96/19 Germany.)

A typical German aircraft wheel is described and illustrated. The body of the wheel is made of Mg. alloy with cast iron inserts for the two brake drums. Two oil-operated band brakes are fitted (one on either side). The wheel without tyre weighs about .012 kg. per kg. of static load and has a factor of safety of 8. In spite of the low weight, the quantity of material is ample to absorb and subsequently radiate the heat generated during the braking. This energy is very considerable and amounts to about 500 K cal per wheel for the case of an aircraft weighing 9,000 kg. landing at 160 km./hour and pulled up in 300 m. It is interesting to note that the brake lining contains no asbestos but consists of a highly polished steel strip mounted on buna rubber. The friction generated between this strip and the cast iron brake drum is satisfactory, provided both surfaces are highly polished and all grease or oil is excluded. For this reason all the ball bearings are fitted with buna sealing washers and require no subsequent lubrication.

The great art in wheel design is to combine lightness and small bulk with adequate shock-absorbing capacity (size of tyre). With the advent of retractable undercarriages, the dimension of the wheel will to some extent determine the depth of the wing required to house it and this has a direct effect on aero-dynamics characteristics.

The possibility of rapid replacement of the wheel as a whole in case of damage is also of importance. According to the author, the German design of wheel satisfies all requirements, besides needing only home-produced materials for its manufacture.

*Range at Constant Speed.* (N. B. Moore, J. Aeron. Sci., Vol. 8, No. 12, Oct., 1941, pp. 456-466.) (96/22 U.S.A.)

The difference, at constant speed, between the thrust horse-power required at the average weight, as commonly used in range estimates, and the exact " mean effective thrust horse-power " required over the weight interval is investigated. Use of this m.e.t.hp. in estimates of range at constant speed for high-altitude, heavily loaded aeroplanes is facilitated by curves giving it as a function of t.hp.

required at the initial weight, of the ratio of final to initial weights, and of the basic performance parameter $\Delta_{v1}$ at the initial weight of the aeroplane.

*Cable Weights of Electrical Installations in Aircraft.* (E. Rühlemann, Flughafen, Vol. 9, No. 4, April, 1941, pp. 3-5.) (96/23 Germany.)

Details of the electric cable system on a Dornier aircraft (unspecified) are given. The cable range from multi-strand (5 mm.² cross section of each wire) to single wires of 25 mm.² cross section. On a basis of actual length of wire used (i.e. in the case of multi-strand, length of cable × number of strands) the smaller cross sections up to 1.5 mm.² account for over 90 per cent. of the total length installed. Of this 90 per cent., 60 per cent. are accounted for by wires up to .75 mm.² cross section. On a weight basis, however, sections up to 1.5 mm.² account for only 60 per cent. of the total, the remaining 40 per cent. being made up by sections of 2.5 mm.² and above. This weight basis of course refers to the complete cable, copper core plus insulation. It is interesting to note that the total weight of insulation of all the cable is roughly equal to the total weight of metal and from the point of view of weight reduction, both materials are thus equally important. The general substitution of Al. for Copper has not found favour in aircraft installations due to corrosion difficulties, especially for the smaller sections. Since, however, the larger sections (2.5 mm.² and upwards) account for 27 per cent. of the total metal weight, the utilisation of Al. for the heavier sections is well worth considering. It is stated that the substitution of synthetic materials for the normal rubber insulation would lead to a reduction in weight of the total installation by about 10 per cent.

*Flexible Couplings for Internal Combustion Engines (with Discussion).* (J. Ormondroyd, Trans. A.S.M.E., Vol. 63, No. 7, Oct., 1941, pp. 577-582.) (96/24 U.S.A.)

Four typical dynamical cases of torsionally flexible "linear" couplings are examined: (1) Instantaneous applications of the maximum engine torque; (2) instantaneous stoppage of the engine or the driven member; (3) dangerous torsional resonance; and (4) tooth chatter in geared drives.

In this paper only the effects of the elastic properties of the couplings have been considered. The ability of the flexible elements to withstand the twisting torques encountered in operation has been completely omitted. A great variety of couplings could be used to get the same flexibility. Each one considered would have to be analysed to ascertain its adequacy to meet the operating conditions at resonance. If it is strong enough to take the torques at resonance safely, it is more than safe at all other operating speeds. The most general remark that can be made in this connection is that safety in a flexible coupling is to be attained by using the largest possible volume of elastic material which gives the desired spring constant in the space available for the coupling. Also, the most efficient use of elastic materials in couplings is obtained by stressing the materials in pure tension, pure compression, or pure shear. This is usually only practical in couplings in which rubber is the elastic medium. Where metals form the elastic elements, reasonable deflections are obtained only by using the material in twist or bending. Under these modes of stressing, a fair percentage of the metal is not carrying large stresses, and either very high fatigue limits must be used or volumes of metal hard to pack into reasonable space limitations must be considered.

It is a popular misconception that flexible couplings which have torque-deflection curves that are not straight lines are cure-alls for torsional-vibration troubles. It is often imagined that torsional resonance cannot occur if such a coupling is introduced into the rotating systems. This belief may be based on the statements made by recognized authorities that no infinite amplitudes of motion are possible in a system which contains a non-linear coupling, even if frictional damping were completely absent. While this is true, and it is also a fact that very complicated relationships exist between torque, frequency, and amplitude of motion, it should be understood that conditions resembling resonance with linear couplings also exist with non-linear couplings. Amplitudes of motion large enough to cause trouble can exist at certain frequencies even if non-linear couplings are used. The reader is referred to a paper entitled " Steady Oscillations of Systems With Non-Linear and Unsymmetrical Elasticity," by Manfred Rauscher, Trans. A.S.M.E., vol. 60, 1938, p. A-169. This paper indicates methods by which such couplings can be analysed and also refers to numerous other papers on this subject that could be perused to get a complete picture of the situation existing when non-linear couplings are used.

*Rotating Boiler Turbine.* (Nott, Eng. and Boiler House Rev., Oct., 1941, pp. 114, 116, 118 and 120.) (96/25 Great Britain.)

The author discusses the principle of operation, construction and tests of a novel light-weight steam power plant of the rotating " U " tube type, which is entirely self-contained, combining within a single housing the burners, boiler, turbine and condenser. It is claimed that the machine works satisfactorily with no reciprocating mechanism whatsoever. Pressurising of water takes place wholly under the action of centrifugal force. Results obtained with two models were successful enough to warrant the building of a larger unit of 100 kw. capacity. Thermal efficiency and specific weights of the rotating surfaces are also discussed.

(Abstract supplied by Research Dept., Met. Vick.)

*Icing of Carburettor Air Induction Systems of Aeroplanes and Engines.* (V. J. Skoglund, J. Aeron. Sci., Vol. 8, No. 12, Oct., 1941, pp. 437-464.) (96/26 U.S.A.)

In conjunction with the development of a new commercial air-line power plant installation, laboratory tests were made of the icing of all critical parts of the carburettor air induction system, from the air scoop entrance to the supercharger impeller. Flight tests were made to establish a basis for the laboratory tests. The laboratory programme and apparatus were examined by all concerned and the results obtained were compared with actual operating experience to insure that they had a direct practical application. Laboratory tests included about 75 runs of full scale icing of the scoop in an 18 × 36 in. refrigerated wind tunnel and about 275 full scale runs of carburettor and engine induction system icing with a selected fuel in a complete running engine rear section. A laboratory was constructed for the latter tests, which included refrigeration, heating, and humidification equipment for producing cold and pre-heated carburettor air over a wide range of conditions.

The results of this investigation were: (1) A recommendation for radical changes in the original design of an air scoop which should make it possible to operate the scoop, without danger, under the most severe impact icing conditions; (2) the effect of a wide range of a large number of variables on the formation of ice on all parts of the induction system; (3) the extent of the induction system icing hazards, and effectiveness of pre-heat in preventing and removing ice formed with a conventional type and a new type of fuel discharge nozzles; (4) the relative effectiveness of pre-heat and alcohol in removing induction system ice.

An extensive bibliography completes the article.

*Engine Stresses Due to Rapid Rise of Combustion Pressure or Knock.* (J. Geiger, A.T.Z., Vol. 44, No. 13, 10/7/41, pp. 327-335.) (96/27 Germany.)

The piston, connecting rod, crank throw combination in an engine forms an elastic system capable of undergoing longitudinal vibrations. The author reduces this system to an equivalent 3 mass system which is subjected to the application of gas pressure varying according to some simple law. The response of the system, expressed in terms of the longitudinal force in the connecting rod, depends not only on the elasticity of the system and the gas pressure but also on the relation between natural frequency of the system and the periodicity of the applied force. Thus the rate of pressure rise, frequently put forward as the sole criterion, is not sufficient as a stress criterion of the engine transmission system. The force in the connecting rod may exceed the maximum explosion pressure by over 50 per cent. with quite moderate rate of pressure rise, provided the frequency of the gas cycle is of the order of .4 of the natural frequency of the system. The gas frequencies accompanying a knocking explosion are generally very high (8-10 times the natural frequency of the piston-rod-crank system) and the pressure accompanying knock are thus transmitted without amplification.

The author substantiates his conclusion by reference to piezo-electric records of the cylinder acceleration under various conditions of engine operation. For further confirmation, a previous paper by Le Mesurier & Stansfield is cited.

*Time and Distance Computor.* (Aero Digest, Vol. 39, No. 2, August, 1941, p. 198.) (96/30 U.S.A.)

The instrument enables a pilot to formulate accurately and quickly a flight plan based on actual visual indications directly from the flight chart.

The instrument is set to the ground speed of the aircraft and is then placed on the standard aeronautical chart along the route to be flown. It will then indicate the time the aircraft will pass over landmarks or radio check points along the route to be flown.

In flight, when time is established between two points shown on the chart the actual ground speed made good will be indicated and a corrected estimate for time required between other points ahead on the chart will be shown by the instrument.

Two models are manufactured which provide computations for all present type aircraft with speeds up to 400 m.p.h. and are operated in connection with Coast Geodetic Survey Charts (U.S.A.). The instrument is 13.5 in. long and 1.25 in. wide, with fixed distance scales conforming with the scale of the aeronautical charts, and movable and expanding time scale to provide time distance ratio.

The near edge of the computor is the miles scale, reading 8 miles per inch, like the chart. In the centre of the computor is an elastic band 5/16 in. wide, attached at left end of computor and imprinted with divisions representing minutes. The right end of the elastic terminates in a cylindrical knob which permits locking at any point for any degree of extension desired. In use the computor is laid on map, the elastic scale is extended until the number of minutes coincides with the number of miles indicated between desired points on map. If these points are the leg of flight just completed, the distance to next point, actual ground speed made good, minutes to next check point or destination, etc., are instantly readable from scale without further setting or intermediate figuring.

*Metal Rectifiers (with Discussion).* (A. L. Williams and L. E. Thompson, J. Inst. Elect. Eng., Vol. 88, No. 10, Pt. 1, Oct., 1941, pp. 353-383.) (96/31 Great Britain.)

The paper deals in detail only with the two types of metal rectifier which have found general application in industry, namely the copper-oxide and selenium rectifiers.

The history of these is given briefly, with particular reference to the main developments which have brought them to their present state of efficiency. This section leads up to modern methods of manufacture.

The fundamental direct-current electrical characteristics, upon which the performance depends, and the manner in which they are influenced by various factors, are described.

The simple basic theory which governs all types of rectifier is discussed with reference to metal rectifiers in relation to their chemical and physical forms.

Finally, the method by which the correct working conditions are deduced from the characteristics is described.

*Electrical Moisture Detector.* (Mech. World, 10/10/41, p. 250.) (96/32 Great Britain.)

The determination of moisture in wood, plaster, masonry, acoustical and other materials is often a tedious operation involving weighing, drying and calculation. It is claimed for the Delmhorst Instrument, which is briefly described, that the range covered is from 8 to 24 per cent. of moisture in woods, being accurate to within 1 per cent. No skill is necessary in its operation, the electrode needles being plunged into the material, a dial turned and a direct reading in percentage is obtained. Electric power is supplied to the instrument by a self-contained battery.

(Abstract supplied by Research Dept., Met. Vick.)

*Self Re-Winding Cable Reel.* (Colliery Guardian, 3/10/41, pp. 288-289.) (96/33 Great Britain.)

In certain mobile electrically-driven equipment there are often objections, due to damage, deterioration and entanglement, to using long lengths of trailing cable. A self re-winding reel is described which can take cable up to 1.5 in. in diameter. Essentially, it consists of a metal rotating reel (with enclosed slip-rings) carrying the cable, which, on unwinding, operates a spring mechanism, similar in principle to the spring roller blind. It is claimed that the cable is always maintained at a suitable tension, but when the latter decreases, the cable is automatically re-wound by the action of the spring.

(Abstract supplied by Research Dept., Met. Vick.)

*A Simple Method of Successive Approximations for Solving Equations of Elasticity.* (R. V. Halasz, Bautechnik, Vol. 18, 1940, pp. 233-235.) (96/34 Germany.)

The author gives a series approximation for the solution of a linear equation of the type

$$\Sigma\, a_{kh} x_h - a_{ko} = 0$$

allowing the unknowns $x_k$ contained in the principal diagonal to be calculated as functions of the remaining terms. Iteration commences with the approximation $x_k^{(1)} = a_{ko}$ and is conducted in separate steps, the improved results $x_1^{(\nu)} \ldots x_m^{(\nu)}$ of any iteration step $\nu$ being already used for the solution of $x_{m+1}^{(\nu)}$ of the same step.

As an aid to calculation a modification of the solution to enable use of the slide-rule is given.

(Abstract from Zentral B., Vol. 10, No. 3, 29/12/40, p. 103.)

*Solution of Equations of Elasticity.* (H. Borges, Beton u. Eisen, Vol. 39, 1940, pp. 120-124.) (96/35 Germany.)

The author deals with the solution of equations of condition for girder lattices and similar systems, having simple and double symmetry of the principal system. This leads to symmetry of the matrix about two or four main axes, and thus to subdivision of the calculation. By the addition and subtraction of equations of symmetrical order, two or four mutually independent partial groups are obtained equivalent statically to the introduction of redundant group loads. The conjugated coefficients appertaining to the principal matrix are calculated by recursion from the solutions of the partial groups.

(Abstract from Zent. B., Vol. 10, No. 3, 29/10/41, pp. 104/105.)

*Combustion Explosions in Pressure Vessels Protected with Rupture Disks.* (M. D. Creech, Trans. A.S.M.E., Vol. 63, No. 7, Oct., 1941, pp. 583-588.) (96/37 U.S.A.)

The object of this investigation was the determination of the effectiveness of a rupture disk for relieving the rapid pressure rise in a pressure vessel during a combustion explosion of its contents. The experimental data presented here are merely a first step toward the solution of this problem. This matter is quite complicated and much must yet be learned about combustion explosions in general before the problem can be called solved. Many of the variables which might affect the results were either disregarded or only crudely or partially controlled. However, the results thus far obtained do indicate that by using a higher factor of safety in designing the vessel together with a rupture disk of suitable size, every vessel containing an explosive combustible mixture can be protected. For many of the less violently explosive mixtures, a rupture disk alone will give absolute protection from a destructive explosion.

*The Permissible Stressing of Gears and its Calculation in Machine Tool Construction.* (H. Hofer, Friedrichshafen Gear Wheel Company, Werkstattstechnik, Vol. 25, No. 5, 1/3/31, pp. 128-131.) (96/38 Germany.)

The various types of possible gear loading are reviewed and, according to the author, the most important stress is that resulting from the normal contact pressure between the flanks (crushing of material). The loading due to bending of the blade root or slip during contact can generally be neglected in comparison.

According to the Hertz theory of cylindrical contact, the permissible contact pressure of two cylinders at rest varies as the square of the material strength (mainly surface hardness) and the mean radius of curvature at contact. This shows the great importance of case hardened gears. In the stationary case, the limiting stress is the same for either cylinder, irrespective of diameter. If, however, the cylinders are in relative motion, the contact zones of high pressure have a higher frequency on the cylinder of smaller diameter and for this reason the author suggests that in the case of gear wheels, the actual radius of curvature of each flank should be considered. In the case of involute teeth, this radius of curvature on the pitch circle $= z\ (m/2) \sin \epsilon$ where

$z$ = number of teeth.
$m$ = modulus.
$\epsilon$ = obliquity of action.
($mz$ = diameter of pitch circle).

If $P$ = maximum permissible circumferential force (kg.) (along pitch circle).
$b$ = width of tooth (mm.),

the normal force on flank surface $= P/(b \cos \epsilon)$ per unit width of tooth.

Inserting this in the Hertz formula, we have

$$\frac{P}{b \cos \epsilon} = KR^2 \,.\, z\left(\frac{m}{2}\right)\sin \epsilon$$

where $K$ = empirical factor.
$R$ = Rockwell hardness of material.

This can be rewritten in the form

$S\ nR^2zm \sin 2\epsilon$ = constant, which in the case of hardened ground gears with normal lubrication
$= 10^9$ for continuous operation and indefinite life
$= 10^8$ for very short life ($\simeq$ 50 hours) ($n$ = r.p.m.)

In the above

$$S_a = mzb/20N \quad (N = \text{h.p. transmitted})$$
$$= 1 \text{ to prevent excessive heating up of the gear.}$$

At very low and very high speeds, $S_a \approx 2$ since under these conditions lubrication is imperfect. Inertia stresses due to inaccuracy of manufacture (non-uniform angular velocities) also put an upper limit to the permissible r.p.m.

*Resistance Welding of Light Alloys.* (*Original in Japanese.*) (R.W. Research Committee, Aero. Res. Inst., Tokyo, No. 210, May, 1941, pp. 301-482.) (96/39 Japan.)

The following are the factors controlling resistance welding:—

(1) Magnitude of welding current,
(2) Time of current flow,
(3) Mechanical pressure between electrodes,
(4) Material of electrodes,
(5) Shape of electrode tips,
(6) Material of the metal sheets to be welded,
(7) Thickness of the sheets,
(8) Surface conditions of the sheets.

An investigation of the resistance welding of light alloys is being carried on since 1936 at the Aeronautical Research Institute, Japan, with the collaboration of its five departments (Aircraft, Electrical Engineering, Materials, Metallurgy and Central Work Shop).

This report gives a general account of the resistance welding of light metals and the results of the investigations on spot welding up to the present.

A good many of the authorities on the subject have reported that in producing satisfactory welds, three of the variables—welding current, time and pressure—must be accurately controlled. According to the experiments in the Aeronautical Research Institute, however, the shape of electrodes is considered to be one of the most critical variables and the proper values of current, time and pressure cannot be recommended without the specification of the shape of electrodes.

At present the static shear strength of welds is already satisfactory. Under shock, welds of 1.5 to 2.0 mm. thickness have shown equal or better results than with 5 mm. rivets.

Under fatigue, however, the weld is inferior to the riveted joint. Subsequent mechanical treatment, however, can improve the strength characteristics of the weld and this is being investigated further.

*New Gear-Tooth Flame Hardening Machine.* (Iron Age, 28/8/41, p. 57.) (Met. Vick.) (96/40 Great Britain.)

The article describes a new machine for flame hardening the surfaces of sprockets, bevel, spur and internal gears up to 33 in. pitch diameter. It is stated that both sides of the tooth are hardened simultaneously without distortion, and that each tooth on the wheel is hardened to exactly the same depth. A non-rusting coolant is used. The machine is fully automatic after starting, even to the extent of indexing, rolling, pre-heating and hardening, also stopping the motor and shutting off the gas supply when all the teeth have been hardened.

(Abstract supplied by Research Dept., Met. Vick.)

*Aircraft Spot Welding Problems* (*Digest*). (M. M. Rockwell, J.S.A.E., Vol. 49, No. 4, Oct., 1941, p. 441.) (96/41 U.S.A.)

Aluminium alloys have low electrical resistance and high heat conductivity; hence very welding heavy currents and pressures must be used. Even then, most of the generation of heat occurs at the surface of contact between the sheets being welded.

These conditions have imposed difficulties which have somewhat retarded the application of spot welding in the aircraft industry. However, of recent years, development has come very rapidly.

The increase in requirements for spot welding equipment in turn brought to the fore a very serious problem—the magnitude of the power supply necessary for such equipment.

At this point a saving factor appeared in the form of the " stored-energy " type spot welder first introduced into the U.S.A. two years ago by a French firm. The " stored-energy " spot welder introduces a new principle—that of charging the transformer up slowly with magnetic energy, then discharging it quickly to make the weld.

Consistent maintenance of the proper pressure is essential to successful spot welding because pressure controls the surface contact resistance. In many machines, pneumatic force is used to produce electrode pressure and, if the air lines to the welder are too small, the air pressure will drop when the machines are operated rapidly, and mysterious troubles will ensue. It was found necessary to install a large air receiver near the welder to overcome this trouble. Hydraulic pressure systems should be a helpful improvement.

Probably the greatest single cause of spot welding trouble is improper surface preparation. Oil, grease, or paint left on the surface to be welded produce cracked, burned, weak, or even " blown " spots. Careful cleaning is essential and, in most cases, it is also necessary to remove part of the oxide film which always covers the surface of aluminium alloys.

*Static Fatigue Life of Rubber.* (S. M. Cadwell and others, S.A.E.J., Vol. 49, No. 4, Oct., 1941, pp. 442-447.) (96/42 U.S.A.)

Static fatigue of rubber is defined by the authors as a progressive breakdown under the influence of a static load, whereas dynamic fatigue is defined as the progressive loss of strength due to successive cycles of stress. The static fatigue life is the time required for rupture under a static load.

Test data presented on the tension static fatigue of rubber indicate that the static fatigue lives of the samples are functions of the stresses acting on them; that the static fatigue lives fall off rapidly with increasing stresses; and that the dependents of static fatigue life on the stress is a function of the stock, among other things.

Curves of reduction of tensile due to static fatigue show that the tensiles of samples under load actually decrease and that the decrease is greater, the greater the time under load.

Referring to the effect of degree of cure, the data indicate that resistance to static fatigue decreases as degree of cure is increased beyond a certain optimum value which varies with the stock.

Other data show that large flow during cure in a particular region reduced the static fatigue resistance of that region in comparison with the remainder of the body of the stock; and that lateral pressure is highly beneficial in increasing the static fatigue lives of bonded rubber parts used in shear.

*Chafing (Fretting) Fatigue Strength of Some Metals and Alloys.* (G. Sachs and P. Stefan, Trans. of Am. Soc. Met., Vol. 29, No. 2, June, 1941, pp. 373-401.) (96/44 U.S.A.)

Endurance tests on cylindrical bars offer a simple method for determining the effect of stress raisers on the fatigue strength. The resulting chafing fatigue strength appears closely related to the notch fatigue strength obtained on specimens with very severe notches. The effects of cold work and heat treatments on the regular and on the chafing fatigue strength respectively are very different. Generally, annealed wrought metals have a higher chafing fatigue strength but a lower regular fatigue strength than the harder cold-worked and heat-treated conditions. Cast steels and aluminium alloys may have a higher chafing fatigue strength than wrought metals of the same type.

The trend curve for the chafing fatigue strength of the heat-treated cast al. alloys is located about 30 per cent. higher than that of the heat-treated wrought alloys. However, the actual differences are smaller, because the cast alloys have generally lower regular fatigue strength than the wrought alloys. The sand cast aluminium alloy, in particular, shows a lower chafing fatigue strength and even a lower regular fatigue strength than the chafing fatigue strength of the forged alloy.

It would appear, therefore, that suitably selected cast alloys may offer some advantage for applications where moving machinery parts are exposed to severe surface attacks by notches, corrosion and chafing.

*Correlation of High Temperature Creep and Rupture Tests Results.* (R. H. Thilemann, Trans. Am. Soc. Met., Vol. 29, No. 2, June, 1941, pp. 355-372.) (96/43 U.S.A.)

The tests were carried out on 4 in. specimen over periods up to 10,000 hrs. of exterpolated to 100,000 hrs. The results are given in table:—

| Material. | Temp. of Test °F. | (SR) 100,000 Hour Rupture Stress (lb. sq. in.). | (SC)* 100,000 Hour 1% Creep Stress (lb. sq. in.). | Ratio (SR/SC) |
|---|---|---|---|---|
| Ni-Cr-Mo ... | 900 | 20,000 | 13,500 | 1.48 |
| Cr-Mo-V ... | 1,000 | 22,000 | 22,000 | 1.00 |
| C-½ per cent. Mo | 1,000 | 9,000 | 7,300 | 1.23 |
| 7 per cent. Cr-Mo-Si | 1,200 | 3,750 | 1,700 | 2.20 |

*Indicates total creep and should not be confused with 1 per cent. creep rate per 100,000 hour commonly used.

It appears that both the creep and rupture properties of a material must be known before the behaviour over long periods of time at elevated temperatures can be predicted with any degree of certainty. A combined plot of creep and rupture test results, as presented, is found to be useful in correlating the creep and rupture properties. This method of plotting affords a convincing means of arriving at safe working stresses for design purposes.

With some materials there is good reason to believe that the amount of elongation accompanying long time fractures will be very small indeed. Usually, these materials possess high creep strengths and fail by a process of intergranular cracking. As indicated by the results, for materials of this type, long-time factors of safety against failure may be almost lacking if design stresses are based on the value that will produce 1 per cent. of creep in 100,000 hours. On the same basis, materials that do not fail by intergranular cracking in tests of long duration usually show much larger factors of safety against failure.

*The Vibration Damping Capacity of Mn-Cu. Alloys.* (R. S. Dean and others, Trans. Am. Soc. Metals, Vol. 29, No. 2, June, 1941, pp. 402-414.) (96/45 U.S.A.)

Preliminary measurements showed that certain manganese-copper alloys which possess a remarkable deadness or lack of metallic ring also have unusually high vibration damping capacity at low stresses.

An instrument for the determination of this property is described and the results obtained with manganese-copper alloys are discussed.

The results indicate that the high values obtained by certain heat treatments are due to the formation of ordered anti-phase nuclei in the mass of the alloy.

The vibration damping capacity appears to reach a maximum with some critical distribution of these anti-phase nuclei and decrease as a state of equilibrium order is approached. The effect of cold work is to decrease the vibration damping capacity of the alloys as would be expected from its disordering effect. The unusually high vibration damping capacity of the quenched alloys drops with time, and it is suggested that it is due to their failure to come to an equilibrium volume when quenched. There would thus seem to be simillarity in structure with regard to its effect on vibration damping capacity between an alloy in a super-cooled state and an alloy in a partly ordered state. In both instances, some of the atoms of the metal are not in the equilibrium positions required by the temperature. High vibration damping capacity appears to be an attribute of such metastable systems.

*Fatigue and Damping Studies of Aircraft Sheet Materials (Dural Alloy 24ST, Alclad 24ST and Several 18-8 Type Stainless Steels).* (R. M. Brick and A. Phillips, Trans. of Am. Soc. Metals, Vol. 29, No. 2, June, 1941, pp. 435-469.) (96/46 U.S.A.)

The strong wrought aluminium alloys, 24ST and Alclad 24ST, and nine 18-8 type commercial grades of stainless steels of low and moderate carbon contents, and in the annealed, cold-rolled, stabilized and aged conditions were fatigue tested under constant deflection conditions. The results are given in Tables 1 and 2:—

TABLE I.

| Material. | Fatigue Strength $5 \times 10$ Pounds sq. in. | Probable $5 \times 10^8$ Cycle Endurance Limit Pounds sq. in. | Tensile Pounds sq. in. |
|---|---|---|---|
| 24ST-L(1) | 20,500(3) | 18,000(4) | 66,000 |
| 24ST-T(2) | 18,500(4) | 16,500(4) | 65,000 |
| Alclad-L | 13,000(3) | 11,000(4) | 64,000 |
| Alclad-T | 11,500(3) | 10,000(4) | 63,000 |

(1) L-rolling direction parallel to specimen axis.
(2) T-rolling direction transverse to specimen axis.
(3) Error from stress measurement and extrapolation:
$= \pm 1{,}000$ pounds per square inch.
(4) Error; $\pm 2{,}000$ pounds per square inch.

TABLE II.

RESULTS OF FATIGUE TESTS OF STAINLESS STEELS.

| Alloy No. | Type and Condition. | Tensile Strength Pounds sq. in. | Indicated Endurance Limit Pounds sq. in. | % Ratio Endurance by Tensile Strength. | Surface Finish. |
|---|---|---|---|---|---|
| 1. | Annealed ... ... | 84,000 | 50-55,000 | 59-65 | No. 4 |
| 2. | Cold rolled 10 per cent. | 96,000 | 65-70,000 | 68-73 | No. 4 |
| 3. | Annealed ... ... | 75,000 | 22-24,000 | 29-32 | No. 2-B |
| 4. | Annealed ... ... | 89,000 | 32-34,000 | 36-38 | No. 2-B |
| 5. | Cold rolled 50 per cent. | 158,000 | 53-58,000 | 33-37 | No. 2-B |
| 6. | Cold rolled ... ... | 180,000 | 70-74,000 | 39-41 | Rolled |
| 7. | Cold rolled and aged | 194,000 | 75-81,000 | 39-42 | No. 2-B |
| 8. | Cold rolled 50 per cent. | 195,000 | 63-78,000 | 32-40 | No. 2-B |
| 9. | Aged ... ... ... | 243,000 | — | — | Rolled |

The S-N data so obtained indicate the probable endurance limits but are incomplete because of lack of time for aluminium alloys and the scatter of results for many of the stainless steels. The ratio of endurance limit to tensile strength of the stainless steels was found to be relatively constant for one type of surface condition but to change a maximum of from 30 to 70 per cent. with different commercial finishes. Errors considered were mechanical or inherent in the test method; i.e., increases of stress at constant deflection near the endurance limit accompanied by plastic behaviour resulted from work hardening or decreases in apparent stress from crack formation and propagation, particularly in Alclad. The effects of the two opposing factors, work hardening and cracking, were studied by means of damping and mechanical hysteresis (load-bending) tests on actual fatigue specimens at various intervals during stressing above and near the endurance limit. Very considerable changes took place in Alclad specimens but changes in the stainless steels were relatively slight although considerable differences were found among the various types studied

*Low Amperage Electronic Arc Welding.* (D. B. Scott, Welding Engineer, Vol. 26, No. 7, July, 1941, pp. 21-24.) (96/47 U.S.A.)

The electronic welder produces a direct current output at the welding terminals, though it is operated from a three-phase alternating current source. Output characteristics are such that a stable arc can be held at any setting to supply welding currents from 5 amperes to 75 amperes, thereby providing for the welding of materials from 32 gauge to 10 gauge with equal ease and success.

The following Table shows etectrode diameter versus welding current and material gauge:—

ELECTRODE SIZES FOR VARIOUS CURRENTS AND MATERIAL THICKNESSES.

| Electrode Diameier. | Welding Current Amperes. | Thickness Material to be Welded. |
|---|---|---|
| 1/32 in. | 5 to 10 | 32 to 26 gauge |
| 3/64 in. | 10 to 20 | 26 to 20 gauge |
| 1/16 in. | 20 to 40 | 20 to 14 gauge |
| 3/32 in. | 40 to 60 | 14 to 10 gauge |
| 1/8 in. | 60 to 75 | 10 to 1/4 in. |

Low current arc welding equipment has made possible the arc welding of all types of aircraft tubing and has been approved by the Army and Navy Air Corps and the Civil Aeronautics Administration, U.S.A., subject only to the qualification of the welding operators. It has cut the necessary welding time in certain cases to as much as one quarter of that required by previous methods.

Other products in the aircraft field which have been improved by the introduction of low current arc welding are the collector rings, exhaust manifolds, air to air heat exchangers for cabin heating, and exhaust manifold shrouds. These parts are usually made from Inconel or a heat-resisting stainless alloy such as 25 Cr-20 Ni, and are made from matching half sections that are welded together.

*The Stresses in and the Deflection of Circular Flat Plates, with a Central Hole Under Normal Force.* (S. Labrow, Procs. Inst. Mech. Engs., Vol. 145, No. 3, June, 1941, pp. 115-125.) (96/48 Great Britain.)

Solutions are given, and presented in graphical form, for the stresses in, and the deflection of, a thin circular plate when loaded by normal (transverse) forces only, with various prescribed conditions of supporting or fixing the edges.

The method used in deriving these results is an application of a general method for obtaining the direct and, or alternatively, the bending stresses in a thin circular plate under any type of loading. Because of the ease with which it can be applied to problems in which the loading on the plate is quite complex, this general method, due to Professor William Kerr, deserves to be more widely known, and a brief account of it is given by the author as an introduction to the special problem with which the paper is primarily concerned.

Kerr has shown that provided certain conventional forms are chosen to express the external forces on the disk—whether these are due to normal pressure (transverse) loading, to radial loading (as in a rotating disk), or to temperature differences giving rise to either transverse or radial temperature gradients and stresses, then the fundamental equations for the disk under the most general type of loading can be considerably simplified. Briefly, this simplification consists in a division of these equations into two groups, one of which contains only the " bending stress " terms, whilst the other group contains only the " direct " or " Membrane " stress terms. The feature of Kerr's method is that these two groups are absolutely identical in form, due to the conventional forms which are chosen to represent the external forces, and thus it is only necessary to obtain the solution of one group. As would be expected, the resulting general solution possesses a high degree of symmetry and is particularly well suited to presentation in tabular form, from which expressions for the stresses for simple and complex loading conditions can be written down immediately.

The author has applied Kerr's method to obtain the solution of one type of example which finds frequent application in many engineering problems. This is the case of a disk, with a central hole, and loaded by transverse forces. In all, twelve variations, representing different edge conditions and different loading have been investigated, each covering a range of disk proportions. The results of this analysis are presented in the form of tables and curves and illustrate the usefulness of Kerr's method in solving problems of this sort.

*The Relationship Between Stress and Strain in the Tensile Impact Test.* (A. F. C. Brown and N. D .G. Vincent, Proc. Inst. Mech. Eng., Vol. 145, No. 3, June, 1941, pp. 126-134.) (96/49 U.S.A.)

In impact testing, the notched bar test is that most frequently used and is valuable for the detection of brittleness; but the notch introduces an extremely complicated stress system and, despite frequent discussions, no universal agreement has been reached as to the method of test or form of specimen. The static tensile test, on the other hand, has been fully investigated and test bars of widely different sizes can be relied on to give comparable results.

Apparatus has been devised for the measurement of the relationship between stress and strain on metallic specimens broken in tensile impact. The stress was measured piezo-electrically and the strain photo-electrically.

Five ferrous materials have been examined at rates of extensional strain ranging up to 800 inches per inch per second, with the following results:—

With wrought iron there was an increase in tensile strength and considerable increase in yield point as the rate of strain was raised. With medium-carbon steel there was some increase in the yield point. With low-carbon manganese steel, nickel-chromium steel and " Vibrac " steel there was little difference between the impact and static stress-strain diagrams. The energy absorbed in fracture of the specimens in the impact tests was only slightly greater than that absorbed in the static tests.

On the whole, the measurements of impact stress bear out the results of earlier investigators. Some increase in ultimate stress had been expected with materials besides wrought iron but, after careful examination of the results, the authors cannot find any evidence for increase except for this one material.

*Spot Welding of Light Alloys.* (Junkers Journal, Vol. 12, No. 5-6, May-June, 1941, pp. 59-69.) (96/50 Germany.)

Spot welding of light alloy sheets has been successful, provided proper attention is paid to the preliminary treatment of the sheet and that the welding current and elecrode pressures are suitable. Pure Al, Al-Mg, and Al-Si-Mg Alloys are relatively easy to spot weld, although in the latter case, the heat treated material will lose some of its strength in the weld zone. Al-Cu-Mg alloy sheet require the greatest care in the control of the current characteristics. Loss of strength due to softening can be made good by a closer spacing of the spots.

A thorough cleaning of the sheets prior to welding is essential. This can be carried out either by immersion in a caustic soda bath or by mechanical brushing.

As already mentioned, control of the welding current is of the utmost importance Experiments were carried out with different types of current pulses and rest periods. An alteration of the wave form during the welding process was found to be beneficial.

Thus for example, a successful current control adopted consisted of 5 periods at maximum amplitude alternating with 5 periods at 50 per cent. amplitude with rest periods (zero current) of 5 periods between the changes (1 period = 1/50 sec.). In this case there are 2 pulses per spot weld. Alternatively, single pulse control can be adopted, the current rising to a maximum during 5 periods and diminishing to zero over the next 5 periods. No details of the electronic controls are given. By proper timing of the pulses, it is apparently possible to work four or more machines from a single 350 K V A transformer, leading to a considerable saving in the cost of the plant. Types of electrodes employed are described in some detail. Electrolytic copper appears to be the most suitable material. Means for rapid cleaning of the electrodes are essential. Interposition of a thin foil of brass between electrode and weld has been found very beneficial in this connection. The foil (in ribbon form) is moved automatically and carries away most of the impurities which would otherwise accumulate on the electrode.

*X-Ray Examination of Mg. Alloy Castings.* (H. T. Rupprecht, Luftwissen, Vol. 8, No. 9, Sept., 1941, pp. 283-286.) (96/51 Germany.)

X-Ray examination of Mg Alloys is rendered difficult by the small absorption coefficient of the material coupled with a considerable amount of scattering of the radiation. The latter becomes the more marked, the shorter the wave length of the incident radiation, i.e. the higher the tube voltage. For work of this kind, therefore, it becomes necessary to generate X-Ray at relatively low voltage and ensure sufficient penetration by increasing the tube current. Unfortunately commercial X-Ray apparatus are generally designed for voltages of the order of 250 K V (20 m. Amp.) and cease to generate if the voltage is reduced below 50 K V. At the same time the tubes normally employed will not pass an increased current to make up for the voltage reduction. According to the author, special apparatus has now become available which will generate X-Rays at 24 K V (4 m. Amp.) and pass 30 m. at 100 K V. With this equipment, examination of Mg alloys can be carried out with the same degree of accuracy as for Al. alloys. The new apparatus is, however, necessarily expensive and can only justify itself if exclusively and continuously employed on Mg alloys. As an alternative, quite good results can be obtained with standard equipment if a special photographic film of ultra fine grain and steep gradation is employed. The new film is relatively insensitive to scattered radiation and its superiority in detecting faults is illustrated by a number of sample photographs.

*Evidence on the State of Fatigue of Metals Obtained by Determination of Surface Stresses by Means of X-Rays.* (R. Glocker and others, Z.V.D.I., Vol. 85, No. 39-40, 4/10/41, pp. 793-800.) (96/53 Germany.)

The measurement of surface stresses by X-Ray methods depends on the fact that the dimensions of the Debye diffraction rings are directly related to the elastic deformation of the crystal structure of the materials. Up to now, such investigations have been mainly confined to the investigation of static stress. The authors describe a most ingenious camera in which the photographic film rotates in step with a tortion fatigue testing machine and which makes possible the measurement of the variation of surface stress during a complete load cycle. It appears that the proportion of the total stress taken up elastically by the surface layer of the metal diminishes progressively with total number of load cycles and by using X-Rays of different hardness the authors show that in the case of carbon steel, this plastic deformation is gradually penetrating into the material core. The authors were thus able to predict the state of fatigue of the material from X-Ray examination of samples subjected to static load. Of great importance is the fact that the appearance of the first cracks in the specimen is revealed by X-Ray examination at a relatively early state (60 per cent. of the ultimate life). Such small cracks cannot be detected by any other method. The magnetic powder method only reveals much larger cracks occurring when already 85 to 90 per cent of the load cycles required for ultimate failure have been reached.

*The Calculation of the Load Capacity of Ball and Roller Bearings.* (R. Mundt, Z.V.D.I., Vol. 85, No. 39-40, 4/10/41, pp. 801-806.) (96/54 Germany.)

The load capacity and life of ball and roller bearings are matters of great importance. The author reviews the data given by a number of leading German manufacturers for their products over the period 1903 to date. (D.W.F., F. & S., F.A.G. and S.K.F.) The theoretical basis of calculations on load capacity and life are next reviewed and the importance of standardisation in this field is stressed.

In modern engineering, indefinite life is scarcely an economic proposition. In most cases, the machine incorporating ball or roller bearings is scrapped for various reasons after a relatively short life. The load capacities of bearings as given by the different manufacturers for their products generally imply that most of the bearings will have a much longer life than the limits stated. A standard method of calculation would enable the user to select more readily the bearing satisfying his minimum demands.

*Aircraft Materials—German Specification Numbers.* (R. Liebig, Werkstoffkunde, pp. 94-98.) (96/55 Germany.)

All German specification numbers for aircraft materials consist of 4 figures followed by a decimal point and a fifth figure, e.g. 3,166.5.

In this code, the first figure denotes the principal group to which the material belongs, e.g. 1 = steel, 2 = non-ferrous heavy alloy, 3 = light alloy, etc.

The second figure in the code shows a sub-group in the principal group, whilst the last two figures before the decimal point are called the material numbers and designate the material more closely. The figure behind the decimal point so-called condition number, finally shows the treatment to which the semi-finished product has been subjected prior to delivery to the consumer.

The meaning of some of the code numbers is given in the tables below:—

| Principal Group. | Sub-Group. | Significance. |
|---|---|---|
| 1 = Steels | 0 | Carbon steels, not improved by heat treatment. |
| | 1 | Carbon steels, improved by heat treatment. |
| | 2 | Simple Alloy Steels. |
| | 3 | Multiple Alloy Steels. |
| | 4, 5, 6, 7 | Special Steels. |
| | 8 | Cast Steel. |
| | 9 | Cast Iron. |
| 2 = Heavy Alloys | 0 | Copper. |
| | 1 | Brass. |
| | 2 | Special Brass. |
| | 3 | Al/Pb Bronze. |
| | 4 | Special Bronze. |
| | 5 | White Metal. |

| Principal Group. | Sub-Group. | Significance. |
|---|---|---|
| 3 = Light Alloys | 0 | Pure Al. |
| | 1 | Dural. |
| | 2 | Al-Si (Silumin). |
| | 3 | Al-Mg (Hydronalium). |
| | | Al-Mg-Si (Legal) |
| | 4 | Other Al Alloy. |
| | 5 | Mg Alloy. |

| Sub-Group. | M.N. | Significance. |
|---|---|---|
| 0 | 00 | Al 99.5 per cent. |
| 1 | 15 | Dural (Normal). |
| 1 | 16 | Cladded Dural. |
| 1 | 30 | Alloy RR 53 (sand cast). |
| 1 | 31 | ,, die cast. |
| 1 | 35 | Y alloy, sand cast. |
| 1 | 36 | ,, die cast. |
| 1 | 37 | ,, extruded or forged. |
| 2 | 00 | Silumin, sand cast. |
| 2 | 01 | Copper Silumin, die cast. |
| 2 | 05 | Silumin—Beta, sand cast. |
| 2 | 10 | E.C. 124 die cast. |
| 2 | 11 | E.C. 124 pressed. |
| 2 | 15 | Alusil, KS 280 die cast. |
| 3 | 05 | Hydronalium Hy 5 |
| 3 | 10 | ,, Hy 7. |
| 3 | 15 | ,, Hy 9. |
| 3 | 55 | Legal. |
| 5 | 01 | Electron A.M. 503. |
| 5 | 10 | Electron A.2.M. |

Note: An increase in M.N. in any sub-group signifies improved mechanical properties.

Condition Numbers (after decimal point).

| Principal Group. | C.N. | Significance. |
|---|---|---|
| 1 Steels | 0 | No subsequent treatment. |
| | 1 | Annealed. |
| | 2 | ,, |
| | 3 | ,, |
| | 4 | ,, |
| | 5 | Hardened or heat treated. |
| | 6 | ,, ,, |
| | 7 | Cold worked. |
| | 8 | ,, |
| | 9 | Specially treated. |
| 2 Heavy Alloys | 0 | No subsequent treatment. |
| | 1 | Annealed. |
| | 2 | — |
| | 3 | — |
| | 4 | Heat treated. |
| | 5 | ,, and cold worked. |
| | 6 | ,, ,, |
| | 7 | Cold worked. |
| | 8 | ,, |
| | 9 | Specially treated. |

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| Principal Group. | C.N. | Significance. |
|---|---|---|
| 3 = Light Alloys | 0 | No subsequent treatment. |
| | 1 | Annealed. |
| | 2 | Annealed and straightened. |
| | 3 | — |
| | 4 | Age hardened. |
| | 5 | Age hardened and straightened. |
| | 6 | Age hardened and cold worked. |
| | 7 | Cold worked. |
| | 8 | ,, |
| | 9 | Specially treated. |

The code number 3116.5 given above thus refers to Cladded Dural (Al-Cu-Mg alloy with Al covering sheet) age hardened and straightened.

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## LIST OF SELECTED TRANSLATIONS.

No. 39.

NOTE.—Applications for the loan of copies of translations mentioned below should be addressed to the Secretary (R.T.P.3), Ministry of Aircraft production, and not to the Royal Aeronautical Society. Copies will be loaned as far as availability of stocks permits. Suggestions concerning new translations will be considered in relation to general interest and facilities available.

Lists of selected translations have appeared in this publication since September, 1938.

### ARMAMENT AND WARFARE.

| TRANSLATION NUMBER AND AUTHOR. | | TITLE AND JOURNAL. |
|---|---|---|
| 1289 | Tsaig, M. ... ... | *Barrage Balloons.* (Aeroplane, U.S.S.R., Vol. 17, No. 23-24, Dec., 1940, p. 22.) |
| 1293 | Pugatchev, V. S. ... Blinov, B. K. ... | *Calculation of Ballistic Elements for Firing in the Air.* (Air Fleet News, U.S.S.R., Vol. 23, No. 2, Feb., 1941, pp. 129-138.) |
| 1307 | Beseler, J. ... ... | *British Aircraft Armament Through German Eyes.* (Luftwissen, Vol. 8, No. 8, Aug., 1941, pp. 237-243.) |

### AERODYNAMICS AND FLIGHT DYNAMICS.

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| 1280 | Stiiper, J. ... ... | *The Measuring Technique of Flight Tests.* (Luftwissen, Vol. 8, No. 4, April, 1941, pp. 109-113.) |
| 1304 | Schmidt, R. ... | *Systematic Flight Tests on Dynamic Longitudinal Stability with Free Elevator.* (L.F.F., Vol. 18, No. 5, 28/5/41, pp. 169-173.) |
| 1311 | Eugen, J. ... ... | *Some Remarks on Statical and Dynamical Longitudinal Stability.* (Luftwissen, Vol. 8, No. 4, April, 1941, pp. 119-125.) |
| 1313 | Mathias, G. ... ... Schaaf, R. ... ... | *Landing Process (Length of Run, Braking Effort and Possibility of Tipping.* (L.F.F., Vol. 18, No. 2-3, 29/3/41, pp. 70-76.) |

## Aircraft and Accessories.

| Translation Number and Author. | | Title and Journal. |
|---|---|---|
| 1281 | Yegorov ... | *Oxygen Equipment of German Aircraft.* (Air Fleet News, U.S.S.R., Vol. 23, No. 5, May, 1941, pp. 448-455.) |
| 1282 | Podlubinaya, E. T. | *Cheap Solutions for Washing Aircraft.* (Civil Aviation, U.S.S.R., Vol. 11, No. 5, May, 1941, p. 15.) |
| 1288 | Shavrov, V.... ... | *The U.S.S.R. Amphibian "Sh. 7."* (Aeroplane, U.S.S.R., Vol. 17, No. 23-24, Dec., 1940, p. 22.) |
| 1290 | Bleich, H. S. ... | *On the Calculation of Variable Aperture Shock Absorbers.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 4, April, 1941, p. 57.) |
| 1291 | Pelix, N. A. ... | *Tolerances in Undercarriage Links.* (Aviation Industry, U.S.S.R., Vol. 1, No. 17, May, 1941, pp. 8-10.) |
| 1292 | Kostyuk, D. I. ... | *Kinematics of the Retractable Undercarriage.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 3, March, 1941, pp. 53-55.) |

## Engines and Accessories.

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| 1285 | Stepukhin, Z. A. ... | *Methods for Counteracting Corrosion of Pipes in Water-Cooled Aero Engines.* (Aviation Ind., U.S.S.R., Vol. 1, No. 6, Feb., 1941, pp. 7-11.) |
| 1295 | Ananiev and others | *Calculation of Resonance Vibrations of Elastically Supported Engine Mountings.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 4, April, 1941, pp. 21-40.) |
| 1306 | Preitz ... ... | *The Warming up of Aircraft Engines.* (Der Flieger, Vol. 20, No. 5-6, May-June, 1941, pp. 188-190.) |

## Materials and Elasticity.

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|---|---|---|
| 1294 | Erlinger, E. ... | *Fatigue Testing Machines for Large Specimens.* (Luftwissen, Vol. 18, No. 6, June, 1941, pp. 177-181.) |
| 1305 | — ... ... | *Weldability and Crack Sensitivity of Steel.* (Digest of Articles from Z. fur Mechanik, Vol. 10, No. 3, pp. 115-117.) |
| 1312 | Cornelius, R. ... | *On the Stability of Heat Resisting Materials for Internal Combustion Engines.* (L.F.F., Vol. 18, No. 8, 20/8/41, pp. 289-304.) |

## Miscellaneous.

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| 1283 | Rozhdestvin, N. P.... | *Aerial Photography in Colour.* (Air Fleet News, U.S.S.R., Vol. 23, No. 4, April, 1941, pp. 333-335.) |
| 1296 | Guglielmetti, A. ... | *Lines of Development of Italian Aircraft.* (Luftwissen, Vol. 8, No. 7, July, 1941, pp. 209-215.) |

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

Notices and abstracts from the Scientific and Technical Press are prepared primarily for the information of Scientific and Technical Staffs. Particular attention is paid to the work carried out in foreign countries, on the assumption that the more accessible British work (for example, that published by the Aeronautical Research Committee) is already known to these Staffs.



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### THEORY AND PRACTICE OF WARFARE.

| ITEM NO. | R.T.P. REF. | | TITLE AND JOURNAL. |
|---|---|---|---|
| 1 | 29222 | U.S.A. ... | *Barrage Balloon Organisation of the Coast Artillery Battalion, U.S.A.* (R. Arthur, Coast Artillery J., Vol. 84, No. 4, July-Aug., 1941, pp. 306-314.) |
| 2 | 29233 | U.S.A. ... | *Definition of Terms Relating to Power Tracking in Coast Artillery Fire Control.* (Coast Artillery J., Vol. 84, No. 4, July-Aug., 1941, pp. 370-372.) |
| 3 | 29224 | U.S.A. ... | *Shelters for Fire Control Equipment of Fixed Anti-Aircraft Batteries.* (Coast Artillery J., Vol. 84, No. 4, July-Aug., 1941, p. 373.) |
| 4 | 29225 | U.S.A. ... | 40 *mm. Anti-Aircraft Automatic Cannon.* (Coast Artillery J., Vol. 84, No. 4, July-Aug., 1941, p. 376.) |
| 5 | 29226 | U.S.A. ... | *Anti-Aircraft Searchlight Material.* (Coast Artillery J., Vol. 84, No. 4, July-Aug., 1941, pp. 378-380.) |
| 6 | 29227 | U.S.S.R. ... | *Russian Air Force.* (Flight, Vol. 40, No. 1,713, 23/10/41, pp. 274-276.) |
| 7 | 29228 | Great Britain | *Stirling Squadron.* (Flight, Vol. 40, No. 1,713, 23/10/41, pp. c-278.) |
| 8 | 29229 | Great Britain | *The History of the Eight-Gun Fighter.* (Flight, Vol. 40, No. 1,713, 23/10/41, pp. 279-280.) |

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| 9 | 29230 | Great Britain | *Paratroop Training in the R.A.F.* (Flight, Vol. 40, No. 1,714, 30/10/41, pp. 297-300.) |
| 10 | 29289 | U.S.A. ... | *Military Possibilities of Light Aircraft Engines.* (C. Caldwell, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 50-52.) |
| 11 | 29254 | U.S.A. ... | *Curtiss P40D "Kittyhawk" (Photograph).* (Aero Digest, Vol. 39, No. 2, Aug., 1941, p. 126.) |
| 12 | 29255 | U.S.A. ... | *Douglas A24 Dive-Bomber.* (Aero Digest, Vol. 39, No. 2, Aug., 1941, p. 126.) |
| 13 | 29261 | U.S.A. ... | *Invisible Light for Protection Against Sabotage.* (P. M. Farmer, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 171-172.) |
| 14 | 29271 | U.S.A. ... | *Curtiss XSB2C-1 Dive-Bomber (Photograph).* (Aero Digest, Vol. 38, No. 4, April, 1941, p. 86.) |
| 15 | 29272 | U.S.A. ... | *North American B-25 Twin-Engined Bomber (Photograph).* (Aero Digest, Vol. 38, No. 4, April, 1941, p. 86.) |
| 16 | 29282 | Germany ... | *He. 111K Mark V Torpedo Bomber (Photograph).* (Aeroplane, Vol. 61, No. 1,588, 31/10/41, p. 473.) |
| 17 | 29283 | U.S.A. ... | *The Development of the Airacobra (with Sectional Diagram).* (Aeroplane, Vol. 61, No. 1,588, 31/10/41, pp. 476-479.) |
| 18 | 29284 | Great Britain | *Parachute Troops in the R.A.F.* (Aeroplane, Vol. 61, No. 1,588, 31/10/41, pp.480-481.) |
| 19 | 29285 | Germany ... | *He. 115 K2 Bomber (Twin-Float Torpedo Carrier and Mine Layer).* (Aeroplane, Vol. 61, No. 1,588, 3/10/41, p. 482.) |
| 20 | 29286 | Germany ... | *German Aeroplanes in Service (Focke-Wulf and Gothe Series).* (Aeroplane, Vol. 61, No. 1,588, 31/10/41, p. 483.) |
| 21 | 29304 | Germany ... | *Engineering Officer Career in the Luftwaffe.* (Flugsport, Vol. 32, No. 13, 19/6/41, pp. 191-192.) |
| 22 | 29305 | Germany ... | *Ju. 52 Troop Transport (Photographs).* (Flugsport, Vol. 32, No. 13, 19/6/41, p. 191.) |
| 23 | 29306 | Germany ... | *Lysander II (Army Co-operation).* (Flugsport, Vol. 32, No. 18, 28/8/40, pp. 272-274.) |
| 24 | 29307 | Germany ... | *Morane 406 Fighter.* (Flugsport, Vol. 32, No. 18, 28/8/40, pp. 274-275.) |
| 25 | 29321 | U.S.A. ... | *The Bell Airacobra.* (Aeroplane, Vol. 61, No. 1,587, 24/10/41, pp. 448-449.) |
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| 27 | 29323 | Great Britain | *The Stirling as a Fighting Bomber.* (Aeroplane, Vol. 61, No. 1,587, 24/10/41, pp. 452-453.) |
| 28 | 29325 | U.S.A. ... | *U.S. Military Aircraft Deliveries.* (Aeroplane, Vol. 61, No. 1,587, 24/10/41, p. 457.) |
| 29 | 29330 | Germany ... | *Savoia Marchetti S.M. 79 Bomber (Photograph).* (Flugsport, Vol. 32, No. 16, 31/7/40, pp. 248-249.) |
| 30 | 29331 | Germany ... | *Breda 88 Twin-Engined Bomber (Photograph).* (Flugsport, Vol. 32, No. 16, 31/7/40, p. 250.) |
| 31 | 29336 | Great Britain | *Use of Paint in Camouflage.* (J. G. Kert, Nature, Vol. 148, No. 3,757, 1/11/41, p. 527.) |

| ITEM NO. | R.T.P. REF. | | TITLE AND JOURNAL. |
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| 32 | 29347 | U.S.A. ... | *The Military Pilot's Need for Instrument Flying Instruction.* (F. Smith, Aero Digest, Vol. 38, No. 3, March, 1941, pp. 62-66.) |
| 33 | 29349 | U.S.A. ... | *High Altitude Speed Test of Lockheed P38.* (Aero Digest, Vol. 38, No. 3, March, 1941, pp. 88-92.) |
| 34 | 29350 | U.S.A. ... | *Flight Training in the R.A.F.* (Aero Digest, Vol. 38, No. 3, March, 1941, pp. 108-113 and 274.) |
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| 37 | 29372 | U.S.A. ... | *Martin Maryland* (167), *Baltimore* (187) *and Marauder* (*B*26). (Flight, Vol. 40, No. 1,713, 23/10/41, p. 287.) |
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| 41 | 29376 | U.S.A. ... | *Vultee Two-Engined Single-Seater Fighter.* (Flugsport, Vol. 32, No. 10, 8/5/40, p. 141.) |
| 42 | 29377 | Germany ... | *The Lockheed EB-14 "Hudson" Bomber.* (Flugsport, Vol. 32, No. 10, 8/5/40, pp. 141-142.) |
| 43 | 29382 | Great Britain | *Space Heating by Means of Electrically Warmed Floors as Applied to Surface Type Air Raid Shelters* (*Digest*). (R. Grierson, J. Inst. Elect. Eng., Vol. 88, No. 10, Pt. 1, Oct., 1941, pp. 387-391.) |
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| 46 | 29405 | Great Britain | *The Russian Air Force.* (The Engineer, Vol. 172, No. 4,478, 7/11/41, p. 314.) |
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| 49 | 29413 | Germany ... | *Some British Patents on Remotely Controlled Aircraft Guns.* (Flugsport, Vol. 32, No. 26, 18/12/40, pp. 454-455.) |
| 50 | 29421 | Germany ... | *Cartridge Box for Wing Guns* (*Patent No.* 699,414). (Patent Collection, No. 39, Arado, Flugsport, Vol. 32, No. 26, 18/12/40, p. 60.) |
| 51 | 29424 | Germany ... | *Retractable Undercarriage Details of Heinkel He.* 111, *F.W.* 200 *and Ar.* 79. (Wissen und Fortachritt, Vol. 15, No. 8, Aug., 1941, pp. 418-419.) |

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| 53 | 29438 | U.S.A. ... | *Messerschmitt Me. 110C (Sectional Drawings).* (Aviation, Vol. 40, No. 9, Sept., 1941, p. 79.) |
| 54 | 29439 | U.S.A. ... | *Landing Gear Mechanism of Boeing Flying Fortress.* (Aviation, Vol. 40, No. 9, Sept., 1941, p. 81.) |
| 55 | 29441 | U.S.A. ... | *D.G.A.-160 Advance Trainer (Howard).* (Aviation, Vol. 40, No. 9, Sept., 1941, p. 91.) |
| 56 | 29464 | Great Britain | *Handley Page "Halifax" in Service.* (Flight, Vol. 40, No. 1,715, 6/11/41, pp. 322-324.) |
| 57 | 29466 | Great Britain | *Equivalent Ranks in Allied Air Forces.* (Flight, Vol. 40, No. 1,715, 6/11/41, p. 330.) |
| 58 | 29467 | U.S.A. ... | *Douglas Boston III (Photograph).* (Aeroplane, Vol. 61, No. 1,589, 7/11/41, p. 499.) |
| 59 | 29469 | Great Britain | *Northrop Experimental Tail-less Fighter (Photograph).* (Aeroplane, Vol. 61, No. 1,589, 7/11/41, p. 501.) |
| 60 | 29470 | Great Britain | *Handley Page "Halifax."* (Aeroplane, Vol. 61, No. 1,589, 7/11/41, pp. 506-507.) |
| 61 | 29471 | Germany ... | *German Aeroplanes in Service (XI) (Gotha and Heinkel Series).* (Aeroplane, Vol. 61, No. 1,589, 7/11/41, p. 509.) |
| 62 | 29484 | Germany ... | *Soviet Aircraft Types (J.15, J.153, J.16, S.B.2, S.B.3 and D.B.3).* (Flugsport, Vol. 33, No. 15, 23/7/41, pp. 293-298.) |
| 63 | 29485 | Italy ... ... | *Cant. Z. 1007 bis Bomber.* (Flugsport, Vol. 33, No. 16, 6/8/41, pp. 317-319.) |
| 64 | 29493 | Germany ... | *Aircraft Machine Gun Mounting (Patent No. 708,025).* (M.W.N. (Patent Collection, No. 10.) Flugsport, Vol. 33, No. 16, 6/8/41, pp. 38-39.) |
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| 66 | 29509 | Great Britain | *Avro "Manchester."* (Aeroplane, Vol. 61, No. 1,590, 14/11/41, p. 541.) |
| 67 | 29511 | Germany ... | *German Aeroplanes in Service (XII) (Heinkel Series).* (Aeroplane, Vol. 61, No. 1,590, 14/11/41, p. 549.) |
| 68 | 29513 | Germany ... | *Me. 109 Camouflaged for Desert Warfare (Photograph).* (Flight, Vol. 40, No. 1,716, 13/11/41, p. 333.) |
| 69 | 29517 | Great Britain | *Avro "Manchester" Heavy Bomber.* (Flight, Vol. 40, No. 1,716, 13/11/41, pp. 339-341.) |
| 70 | 29527 | Germany ... | *Photographic Reconnaissance (Illustrated).* (Luftwelt, Vol. 8, No. 19, 1/10/41, pp. 364-375.) |
| 71 | 29550 | Germany ... | *Arado AR96B (Trainer).* (Flugsport, Vol. 32, No. 12, 5/6/40, pp. 165-167.) |
| 72 | 29551 | U.S.A. ... | *U.S.A. Stearman X100 (XA-21) Bomber.* (Flugsport, Vol. 32, No. 12, 5/6/40, p. 167.) |
| 73 | 29552 | U.S.A. ... | *U.S.A. Grumman F3F-3.* (Flugsport, Vol. 32, No. 12, 5/6/40, p. 168.) |
| 74 | 29554 | Germany ... | *Ju. 52 Ambulance Plane.* (Flugsport, Vol. 32, No. 12, 5/6/40, p. 169.) |
| 75 | 29559 | Germany ... | *Container for Flares Carried on Aircraft* (689,843). (Henschel (Pat. Coll. No. 27), Flugsport, Vol. 32, No. 12, 5/6/40, p. 106.) |

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| 77 | 29562 | Germany ... | *Improvement in Smoke Signals* (689,791). (Ferstel (Pat. Coll. No. 27), Flugsport, Vol. 32, No. 12, 5/6/40, p. 108.) |
| 78 | 29564 | Italy ... ... | *Italian F.S. Single-Seat Fighter with Fiat A.*74, *R.C.* 38. (Flugsport, Vol. 32, No. 14, 3/7/40, pp. 201-202.) |
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| 80 | 29574 | Great Britain | *British Two-Seater Hawker "Hotspur" Fighter (Photograph).* (Flugsport, Vol. 32, No. 15, 17/7/40, pp. 222-223.) |
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| 86 | 29600 | Great Britain | *Bristol Hydraulically Operated Gun Turrets.* (Flight, Vol. 40, No. 1,717, 20/11/41, pp. 362-364.) |
| 88 | 29614 | Great Britain | *Spitfire V (Two Cannons and Four Machine Guns) (Photograph).* (Airc. Eng., Vol. 13, No. 153, Nov., 1941, pp. 306 and 318.) |
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| 92 | 29624 | Germany ... | *Personal Equipment of Air Crew Carrying Out Enemy Raids.* (Flugsport, Vol. 33, No. 22, 29/10/41, pp. 434-435.) |
| 93 | 29627 | Germany ... | *Anti-Dazzle Device for Glass Cockpits* (711,793). (Heinkel (Pat. Coll. No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 57.) |
| 94 | 29643 | Great Britain | *Vulnerability of Aircraft Carriers.* (Aeroplane, Vol. 61, No. 1,591, 21/11/41, pp. 554-555.) |
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| 97 | 29646 | Great Britain | *Avro "Manchester" I.* (Aeroplane, Vol. 61, No. 1,591, 21/11/41, pp. 564-565.) |
| 98 | 29647 | Germany ... | *German Aeroplanes in Service (XIII) (Heinkel Series).* (Aeroplane, Vol. 61, No. 1,591, 21/11/41, p. 573.) |
| 99 | 29651 | Great Britain | *Development of Bristol Aircraft Gun Turrets.* (Engineer, Vol. 172, No. 4,480, 21/11/41, pp. 357-358.) |
| 100 | 29661 | U.S.A. ... | *Gun Installation in Hurricane II (Photograph).* (Autom. Ind., Vol. 85, No. 8, 15/10/41, p. 44.) |
| 102 | 29674 | U.S.A. ... | *Bullet-Sealing Hose Pipe for Combat Planes.* (Sci. Amer., Vol. 165, No. 5, Nov., 1941, pp. 249-250.) |
| 103 | 29676 | U.S.A. ... | *Value of Black-Out as a Means of A.A. Defence Questioned.* (Sci. Amer., Vol. 165, No. 5, Nov., 1941, p. 250.) |

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| 105 | 29386 | Great Britain | *Characteristics of Fire Jets (Discussion and Errata).* (J. S. Blair, J. Inst. Civ. Engs., Vol. 16, No. 8, Oct., 1941, pp. 597-599.) |
| 108 | 29392 | Great Britain | *A Method for Making Streamlines Momentarily Visible by Means of Phosphorescent Zinc Sulphides.* (A. M. Binnie and E. J. Bowen, Procs. Camb. Phil. Soc., Vol. 37, Pt. 4, 1941, pp. 436-437.) |
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| 113 | 29592 | Germany ... | *The Aerodynamics of Animal Flight.* (D. Kuchemann and E. Holst, Luftwissen, Vol. 8, No. 9, Sept., 1941, pp. 277-282.) |
| 114 | 29609 | Great Britain | *The Shape of a Liquid Jet as a Graphical Solution of Bernoulli's Equation.* (J. M. A. Leniham, Phil. Mag., Vol. 32, No. 214, Nov., 1941, pp. 393-400.) |

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| 118 | 29667 | Germany ... | *The Development of the Cowled Propeller for Ship Propulsion.* (Z.V.D.I., Vol. 85, No. 39-40, 4/10/41, p. 812.) |
| 119 | 29689 | Germany ... | *A Method for Calculating the Theoretical Characteristics of Turbo Machines (Rotating Blade Systems).* (G. Klingemann, Ing. Arch., Vol. 11, No. 3, June, 1940, pp. 151-178.) |
| 120 | 29691 | Germany ... | *The Hydrodynamic Theory of Bearing Friction.* (R. Nature, Ing. Arch., Vol. 11, No. 3, June, 1940, pp. 191-209.) |

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| 123 | 29240 | U.S.A. ... | *Salvage Operation on Aeroplanes Embedded in Ice.* (Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 53, 223.) |
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| 126 | 29243 | U.S.A. ... | *Low Cost Bases for Seaplanes.* (Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 59 and 61.) |
| 127 | 29244 | U.S.A. ... | *Master Plan for Airport Development.* (Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 60-61.) |
| 128 | 29246 | U.S.A. ... | *Modern Hangar Door Design (Canopy Type).* (J. I. Byrne, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 80-82.) |
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| 130 | 29248 | U.S.A. ... | *Speed in Concrete Airport Paving.* (A. A. Anderson, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 88-90, 230-231.) |
| 131 | 29249 | U.S.A. ... | *A Design for the Airport of To-morrow.* (A. Andrews, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 92-94.) |
| 132 | 29250 | U.S.A. ... | *The Airport Programme of the C.A.A.* (D. H. Connolly, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 571-594.) |
| 133 | 29251 | U.S.A. ... | *The Dual Role of the Airport (Civil and Military).* (J. W. Wood, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 97-98, 224.) |

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| 140 | 29273 | U.S.A. ... | *Balancing Aircraft Propellers (III).* (M. C. Beebe, Aero Digest, Vol. 38, No. 4, April, 1941, pp. 102-109, 193-194.) |
| 141 | 29279 | U.S.A. ... | *Socket Head Cap Screw (Design Applications).* (W. C. Stauble, Aero Digest, Vol. 38, No. 4, April, 1941, pp. 136-139.) |
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| 143 | 29301 | Germany ... | *Block 161 Four-Engined Transport Plane (French).* (Flugsport, Vol. 32, No. 13, 19/6/40, pp. 183.) |
| 144 | 29302 | Germany ... | *Effect of Surface Roughness on Profile Characteristics (Mainly Based on N.A.C.A. Results).* (Profit Notes, No. 21, Flugsport, Vol. 32, No. 13, 19/6/41, pp. 81-84.) |
| 145 | 29309 | Germany ... | *Arrangement for Jettisoning Rear Portion of Fuselage for Quick Egress of Aircraft Crew (Patent* 694,019). (Patent Collection, No. 32, Messerschmitt, Flugsport, Vol. 32, No. 18, 28/8/40, p. 125.) |
| 146 | 29310 | Germany ... | *Boundary Layer Control by Suction (Patent* 693,398). (Patent Collection, No. 32, Junkers, Flugsport, Vol. 32, No. 18, 28/8/40, p. 125.) |
| 147 | 29311 | Germany ... | *Elastic Wing Root Fairings (Patent No.* 694,021). (Patent Collection, No. 32, Messerschmitt, Flugsport, Vol. 32, No. 18, 28/8/40, p. 126.) |
| 148 | 29312 | Germany ... | *Mass Balance of Control Surface (Patent No.* 693,900). (Patent Collection, No. 32, Heinkel, Flugsport, Vol. 32, No. 18, 28/8/40, p. 126.) |
| 149 | 29313 | Germany ... | *Pipe Joints with Conical Screw Threads (Patent No.* 692,061). (Patent Collection, No. 32, Junkers, Flugsport, Vol. 32, No. 18, 28/8/40, p. 127.) |
| 150 | 29315 | Germany ... | *Slotted Flaps (Patent No.* 693,899). (Patent Collection, No. 32, Focke-Wulf, Flugsport, Vol. 32, No. 18, 28/8/40, p. 125.) |
| 151 | 29320 | U.S.A. ... | *Cold Proof Neoprene Tyre F.R.* (Autom. Ind., Vol. 85, No. 6, 15/9/41, p. 39.) |
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| 154 | 29328 | Germany | ... | *Universal Joints of Ball and Socket Type* (*Eckelt*). (Flugsport, Vol. 32, No. 16, 31/7/40, p. 238.) |
| 155 | 29332 | Germany | ... | *Transparent Plastic Shells for Aircraft* (*Self-Supporting*) (*Patent No.* 693,159). (Patent Collection, No. 30, Junkers, Flugsport, Vol. 32, No. 16, 31/7/41, p. 117.) |
| 156 | 29333 | Germany | ... | *Reduction of Resistance at Supersonic Speeds by Boundary Layer Suction* (*Patent No.* 693,574). (Patent Collection, No. 30, Arado, Flugsport, Vol. 32, No. 16, 31/7/40, p. 118.) |
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| 158 | 29354 | U.S.A. | ... | *Private and Commercial Aircraft of the U.S.A.* (*Technical Digest*). (Aero Digest, Vol. 38, No. 3, March, 1941, pp. 139-162, 198-200.) |
| 159 | 29362 | U.S.A. | ... | *Balancing Aircraft Propellers, II.* (M. C. Beebe, Aero Digest, Vol. 38, No. 3, March, 1941, pp. 256-260 and 272.) |
| 160 | 29363 | U.S.A. | ... | *Automatic Cable Tension Regulator for Aircraft Installations.* (Aero Digest, Vol. 38, March, 1941, p. 264.) |
| 161 | 29364 | U.S.A. | ... | *Electrically-Controlled Landing Gear Tester.* (Aero Digest, Vol. 38, No. 3, March, 1941, p. 268.) |
| 162 | 29383 | U.S.A. | ... | *Loose Objects in Cabin a Source of Danger during Violent Manœuvres.* (Civil Aeronautics J., Vol. 2, No. 18, 15/9/41, p. 236.) |
| 164 | 29410 | Germany | ... | *Italian Sailplane Trainer Cat-15* (*with Photograph*). (Flugsport, Vol. 32, No. 26, 18/12/40, p. 448.) |
| 165 | 29414A | Germany | ... | *Multi-Engined Land Plane with Seaworthy Cabin which can be Jettisoned* (*Patent* 699,351). (Patent Collection, No. 39, Henschel, Flugsport, Vol. 32, No. 26, 18/12/40, p. 157.) |
| 166 | 29415 | Germany | ... | *Cockpit Covering-Constructional Features* (*Patent No.* 699,065). (Patent Collection, No. 39, Henschel, Flugsport, Vol. 32, No. 26, 18/12/40, p. 154.) |
| 167 | 29416 | Germany | ... | *Folding Seats for Aircraft* (*Patent No.* 699,106). (Patent Collection, No. 39, Henschel, Vol. 32, No. 26, 18/12/40, pp. 157-158.) |
| 168 | 29418 | Germany | ... | *Zigzag Wing with Engine Installed Inside Wing at the Vertices* (*Patent No.* 699,412). (Patent Collection, No. 39, Messerschmitt, Flugsport, Vol. 32, No. 26, 18/12/40, p. 158.) |
| 169 | 29419 | Germany | ... | *Reduction of Surface Friction of a Wing Surface by the Ejection of Air* (*Patent No.* 699,066). Patent Collection, No. 39, D.V.L., Flugsport, Vol. 32, No. 26, 18/12/40, p. 158.) |
| 170 | 29420 | Germany | ... | *Safety Device in Aircraft Structural Parts to Prevent Aerodynamic Overload* (*Air Leaks or Ripping Panel*) (*Patent No.* 699,067). (Patent Collection, No. 39, Focke-Wulf, Flugsport, Vol. 32, No. 26, 18/12/40, p. 159.) |

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| 172 | 29435 | U.S.A. ... | *Aeroplane Hydraulic Systems.* (E. M. Green, Aviation, Vol. 40, No. 9, Sept., 1941, pp. 70-71, 152-156 and 162.) |
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| 174 | 29463 | Great Britain | *Future of Civil Aviation.* (Flight, Vol. 40, No. 1,715, 6/11/41, pp. 318-321.) |
| 175 | 29468 | U.S.A. ... | *Fuselage Erection of the Fairey "Albacore" (Photograph).* (Aeroplane, Vol. 61, No. 1,589, 7/11/41, p. 500.) |
| 176 | 29474 | Germany ... | *Pressure Cabins for High Altitude Aircraft (Patent No. 707,313).* (Henschel (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 33.) |
| 177 | 29475 | Germany ... | *Tailless Aircraft Design (Patent No. 707,463).* (Messerschmitt (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 33.) |
| 178 | 29476 | Germany ... | *Slotted Flap Mechanism (Patent No. 706,959).* (Dornier (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 33.) |
| 179 | 29477 | Germany ... | *Slotted Flap Mechanism (Patent No. 707,147).* (Dornier (Patent Collection, No. 9), Vol. 33, No. 15, 23/7/41, p. 34.) |
| 180 | 29478 | Germany ... | *High Lift Flap (Patent No. 707,054).* (Messerschmitt (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 34.) |
| 181 | 29479 | Germany ... | *Elastic Member to Prevent Overload on Flap (Patent No. 707,401).* (Focke-Wulf (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 34.) |
| 182 | 29480 | Germany ... | *Slot Width Control on Flap Mechanism (Patent No. 707,402).* (Focke-Wulf (Patent Collection, No. 9), Flugsport, Vol. 33, No. 15, 23/7/41, p. 34.) |
| 183 | 29481 | Germany ... | *Combined Flap and Aileron Mechanism (Patent No. 707,424).* (Arado (Patent Collection, No. 9), Vol. 33, No. 15, 23/7/41, p. 35.) |
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| 185 | 29487 | Germany ... | *Aircraft Design Features—Some Simple Examples of Saving Weight (Dornier).* (Flugsport, Vol. 33, No. 16, 6/8/41, pp. 321-324.) |
| 186 | 29489 | Germany ... | *Collapsible Seat for Aircraft (Prone Position) (Patent No. 708,248).* (Heinkel (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 37.) |

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| 188 | 29491 | Germany ... | *Vibration Damper for Control Surface and Flaps (Patent No.* 707,678). (Henschel (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 38.) |
| 189 | 29492 | Germany ... | *Damping Control Surfaces (Patent No.* 708,228). (Messerschmitt (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 38.) |
| 190 | 29494 | Germany ... | *Method of Connecting Badly Fitting Plates on Aircraft by Means of Special Bolt Plates (Patent No.* 708,105). (Messerschmitt (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 39.) |
| 191 | 29495 | Germany ... | *Helicopter Blade Incidence Control (Patent No.* 707,982). (German Govt. (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 39.) |
| 192 | 29496 | Germany ... | *Spring Control for Castoring Aircraft Tail Wheel (Patent No.* 706,961). (Fieseler (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 39.) |
| 193 | 29497 | Germany ... | *Leaf Springs for Undercarriage Legs (Patent No.* 708,026). (Mahle (Patent Collection, No. 10), Flugsport, Vol. 33, No. 16, 6/8/41, p. 39.) |
| 194 | 29507 | U.S.A ... | *Martin* 170 *Flying Boat.* (Aeroplane, Vol. 61, No. 1,590, 14/11/41, p. 529.) |
| 195 | 29510 | Great Britain | *Tailless Aircraft.* (Aeroplane, Vol. 61, No. 1,590, 14/11/41, pp. 542-545.) |
| 196 | 29514 | Great Britain | *Northrop Tailless Aircraft.* (Flight, Vol. 40, No. 1,716, 13/11/41, pp. 337-338.) |
| 197 | 29525 | Germany ... | *The Historical Development of the Junkers Single and Multi-Engined Transport Plane.* (Junkers Journal, Vol. 12, No. 1 and 2, Jan.-Feb., 1941, pp. 11-20.) |
| 198 | 29548 | Germany ... | *Boundary Layer Control by Suction.* (Messerschmitt (Pat. Coll., No. 26), Flugsport, Vol. 32, No. 11, 22/5/40, p. 102.) |
| 199 | 29549 | Germany ... | *Aileron Spoiler Combination for Lateral Control.* (Messerschmitt (Pat. Coll., No. 26), Flugsport, Vol. 32, No. 11, 22/5/40, p. 104.) |
| 200 | 29553 | Germany ... | *Project for 100-t Transatlantic Douglas (Six Engines).* (Flugsport, Vol. 32, No. 12, 5/6/40, pp. 168-169.) |
| 201 | 29556 | Germany ... | *Retractable Cooler Installed in Nose Wing Slot* (689,840). (Siebel (Pat. Coll., No. 27), Flugsport, Vol. 32, No. 12, 5/6/40, p. 105.) |
| 202 | 29557 | Germany ... | *Fuel Drain for Sub-Divided Fuel Tanks, Operating Under all Conditions of Bank* (689,841). (Heinkel (Pat. Coll., No. 27), Flugsport, Vol. 32, No. 12, 5/6/40, p. 105.) |

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| 204 | 29563 | Germany ... | *Cable Arrester Gear for Aircraft* (687,927). (Arado (Pat. Coll., No. 27), Flugsport, Vol. 32, No. 12, 5/6/40, p. 108.) |
| 205 | 29567 | Germany ... | *Anti-Dazzle Devices for Cockpits* (691,758). (Heinkel (Pat. Coll., No. 28), Flugsport, Vol. 32, No. 14, 3/7/40, p. 109.) |
| 206 | 29568 | Germany ... | *Device for Jettisoning Cockpit Roof* (691,836). (Henschel (Pat. Coll., No. 28), Flugsport, Vol. 32, No. 14, 3/7/40, pp. 109-110.) |
| 207 | 29569 | Germany ... | *Rotatable Jig for the Construction of Flat Aircraft Parts* (691,513). (Dornier (Pat. Coll., No. 28), Flugsport, Vol. 32, No. 14, 3/7/40, p. 111.) |
| 208 | 29579 | Germany ... | *Mass Balance of Ailerons and Flaps* (691,395). (Heinkel (Pat. Coll., No. 28), Flugsport, Vol. 32, No. 14, 3/7/40, p. 112.) |
| 209 | 29571 | Germany ... | *ITS—8M Motor Sailplane.* (Flugsport, Vol. 32, No. 15, 17/7/40, pp. 219-221.) |
| 210 | 29572 | Germany ... | *Amphibian Flying Boat HA22.* (Flugsport, Vol. 32, No. 15, 17/7/40, p. 221.) |
| 211 | 29573 | Germany ... | *Amphibian Flying Yacht Ha 23.* (Flugsport, Vol. 32, No. 15, 17/7/40, p. 222.) |
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| 213 | 29576 | Germany ... | *Steerable Tail Wheel* (690,656). (Arado (Pat. Coll., No. 29), Flugsport, Vol. 32, No. 15, 17/7/40, pp. 114-115.) |
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| 215 | 29580 | Germany ... | *Variable Pitch Control Mechanism.* (Escher-Wyss (Pat. Coll., No. 34), Vol. 32, No. 20, 25/9/40, pp. 134-135.) |
| 216 | 29583 | Germany ... | *Pressure Surges in High Pressure Hydraulic Pipe Lines.* (G. Reid, Z.V.D.I., Vol. 85, No. 29, 19/7/41, pp. 639-643.) |
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| 223 | 29628 | Germany | ... | *High Speed Wing Profile (Pointed Nose and Suction Control Trailing Edge* (710,780). (D.V.L. (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 57.) |
| 224 | 29629 | Germany | ... | *Adjustable Incidence for Wing Elevator Combination (Maintaining Altitude at Low Speeds)* (711,216). (Rohrbach (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 58.) |
| 225 | 29630 | Germany | ... | *Method for Increasing Longitudinal Stability of Aircraft with Free Controls* (711,264). (Dornier (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, pp. 59-60.) |
| 226 | 29631 | Germany | ... | *Aircraft Wheels* (711,859). (V.D.M. (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 61.) |
| 227 | 29632 | Germany | ... | *Hot Air Control for Wing De-Icing* (709,354). (Focke-Wulf (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 63.) |
| 228 | 29633 | Germany | ... | *Device for Protecting the Aircraft Wing Structure Against Damage from Air Escaping at High Pressure in Case Wheel Tyre is Punctured whilst in the Retracted Position (Automatic Deflation and Re-inflation)* (710,738). (Blackmann (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, pp. 61-62.) |
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| 230 | 29635 | Germany | ... | *Brake Shoes for Aircraft Wheels* (712,010). (V.D.M. (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 62.) |
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| 233 | 29638 | Germany | ... | *Variable Pitch Propeller Mechanism* (710,739). (Argus (Pat. Coll., No. 15), Flugsport, Vol. 33, No. 22, 29/10/41, p. 64.) |
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| 243 | 29256 | U.S.A. ... | *Problems of Engines Enclosed in Wings.* (G. W. Tweeney, Aero Digest, Vol. 39, No. 2, Aug., 1941, pp. 142-144 and 224.) |
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| 248 | 29308 | Germany ... | *Guiberson Four-Stroke Diesel Aero Engine* (320 *h.p.*). (Flugsport, Vol. 32, No. 18, 28/8/40, pp. 275-277.) |
| 249 | 29314 | Germany ... | *Jet Propulsion* (*Patent No.* 692,163). (Patent Collection, Collection, No. 32, Stipa, Flugsport, Vol. 32, No. 18, 28/8/40, p. 128.) |
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