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

LIST OF ABBREVIATIONS OF TITLES AND JOURNALS.

A.	Abstracts from the Scientific and Technical Press.
Aeron. Eng.	Aeronautical Engineering (U.S.S.R.)
Aer. Res. Inst. Tokyo	Aeronautical Research Institute of Tokyo.
A.C.I.C.	Air Corps Information Circular.
Ann. d. Phys.	Annalen der Physik
Army Ord.	Army Ordnance:
Autom. Eng.	Automobile Engineer
Autom. Ind.	Automobile 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.
J. Inst. Civ. Engs. ...	Journal of Institute of Civil Engineers.

J. Inst. Elec. Engs. ...	Journal of Institute of Electrical Engineers.
J. Inst. Petrol.	Journal of the Institute of Petroleum.
J. Met. Soc.	Journal of Meteorological Society.
J. Sci. Inst.	Journal of Scientific Instruments.
J.S.A.E.	Journal of Society of Automotive Engineers.
J. Soc. Chem. Ind. (Abstracts B)	Journal of the Society of Chemical Industry (British Chemical Abstracts B)
L'Aéron.	L'Aéronautique.
L.F.F.	Luftfahrt-Forschung.
Luschau.	Luftfahrt-Schrifttum des Auslandes
Met. Mag.	Meteorological Magazine.
Met. Prog.	Metal Progress.
N.A.C.A.	National Advisory Committee for Aeronautics (U.S.A.).
Phil. Mag.	Philosophical Magazine.
Phil. Trans. Roy. Soc.	Philosophical Transactions of the Royal Society.
Phys. Berichte. ...	Physikalische Berichte.
Phys. Zeit.	Physikalische Zeitschrift.
Proc. Camb. Phil. Soc.	Proceedings of Cambridge Philosophical Society.
Proc. Inst. Rad. Engs.	Proceedings of Institute of Radio Engineers.
Proc. Roy. Soc. ...	Proceedings of Royal Society.
Pub. Sci. et Tech. ...	Publications Scientifiques et Techniques du Ministère de l'Air.
Q.J. Roy. Met. Soc. ...	Quarterly Journal of the Royal Meteorological Society.
R. and M.	Reports and Memoranda of the Aeronautical Research Committee.
Rev. de l'Arm. de l'Air	Revue de l'Armée de l'Air.
Riv. Aeron.	Rivista Aeronautica.
Sci. Absts. (A. or B.)	Science Abstracts (A or B.).
Sci. Am.	Scientific American.
Sci. Proc. Roy. Dublin Soc.	Scientific Proceedings of Royal Dublin Society.
Tech. Aéron.	La Technique Aéronautique.
Trans. A.S.M.E. ...	Transactions of the American Society of Mechanical Engineers.
Trans. C.A.H.I. ...	Transactions of the Central Aero-Hydrodynamical Institute, Moscow.
U.S. Nav. Inst. Proc.	U.S. Naval Institute Proceedings.
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.

Some Problems of Dive-Bombing. (M. P. Solovyev, Air Fleet News, U.S.S.R., Vol. 23, No. 4, April, 1941, pp. 317-322.) (94/1 U.S.S.R.)

Two methods are available for dive-bombing, known respectively as bombing by instruments and bombing by sight.

The first method calls for an instrument-controlled flight path up to the point of release. Since, however, considerable error is involved in the transition to the dive on the target, the method will still generally require correction by sights. Corrections are also necessary for the deviation of the actual conditions from those on which the calculated flight path is based. It would be possible to construct a cam mechanism performing the wind correction continuously during flight. Alternatively it is possible to construct a flight trajectory from any point of which the bomb is sure to hit the target, and construct the necessary instruments for controlling this path.

"Sight bombing" depends on determining the velocity vector of the bomb in relation to the target, the bomb being released when the vector is directed on the target. Dive-bombing sights with automatic wind correction already exist.

Ultimately a combination of the two methods appears to be likely, by which the aircraft is directed to the point of diving by instrumental means, and the point of release of the bomb determined by the sights. Detailed analysis of the requisite operations and the theory of the methods is given in the article.

German Shelter Buildings. (Inter. Avia., No. 676, 7/6/41, p. 14.) (94/2 Germany.)

From press illustrations, a new development trend in the German air raid precautionary measures can be recognized: The construction of underground air raid shelters is supplemented by the erection of entire air raid shelter buildings. These edifices appear to be characterized by especially solid roofs, the substitution of loophole-resembling slots for the windows, thick walls, and a multitude of exits. The impression is gained that such buildings are erected mainly in suburbs and smaller localities; they are several storeys high and serve exclusively to shelter the inhabitants of the surrounding districts in the event of air raids.

Electrical Operation of Time Fuses for Shells. (G. Grotsch, Z.G.S.S., Vol. 36, No. 7, July, 1941, pp. 135-137.) (94/3 Germany.)

Purely chemical time fuses for A.A. shells are not satisfactory, since the rate of burning is affected by atmospheric conditions, especially at high altitudes.

Clock-work fuses do not suffer from this defect but are complicated and expensive. The author describes a number of proposals for fuses, some of which operate partly electrically and partly mechanically, whilst the final proposed design is operated purely electrically without any moving parts.

In the "mixed" design, the acceleration of the shell causes a plunger to pass through a coil and generate a current which charges two condensers equally. These condensers are connected in opposition across a spark gap in vacuum, whilst one of the condensers is provided with a high resistance leak. A potential difference thus gradually builds up across the vacuum and the spark passes when the breakdown value is reached.

In the purely electrical version, the current for charging the condensers is provided externally by the passage of the shell through a coil surrounding the muzzle of the gun.

Some of the difficulties which will have to be overcome before electrically-operated fuses can compete with existing designs are briefly discussed by the author. The great simplicity of a purely electrical device for time fuse operation will deserve the close attention of armament research.

Aerial Barrages (Barrage Balloons, Aerial Mines and Kites). (L. Schuttel, published by Lehmann, 1939.) (94/4 Germany.)

According to the author, a balloon barrage was first employed by the Italians for the defence of Venice in 1916 and some account of the development by France and Great Britain during the concluding stages of 1914/18 war is given. The author's conclusions on the value of such barrages under modern conditions are mainly based on Air Commodore Hearson's lecture to the United Services Institution and the diagrams illustrating various arrangements of the individual balloons in order to protect targets of different types are all taken from this source. The aerial mine, *i.e.* a barrage balloon containing H.E. is also mentioned as a British proposal. It appears that Germany has made some experiments with kites as an alternative to balloons. At high wind speeds ($>$ 10 m./sec.) the tension on the balloon cable becomes excessive and at the same time the cable becomes inclined to such an extent that the value of the barrage suffers. Under these conditions kites give more satisfactory results. The launching of a kite presents certain difficulties which, according to the author, can be overcome by catapulting or utilising rocket propulsion.

Two photographs show the assembly of a German barrage kite whilst a series of ten photographs illustrate features of a German Mobile Balloon Unit. These are of possible interest.

At the time the book was written, it appears that aerial barrages in Germany were limited to the defence of small targets such as the Leuna Chemical Works.

Italian Verdict on the Soviet Air Force. (Inter. Avia., No. 772-773, 15/7/41, pp. 21-22.) (94/5 Italy.)

According to the Italian estimate, the Soviet had about 50 more or less uniformly organized Air Divisions ready for active service at the beginning of the hostilities; each of these divisions consists of from three to five Air Regiments, making a total of approximately 15,000 first-line aeroplanes, of which 30 per cent. are in the reserves. Divided by classes, the total is composed of 45 per cent. heavy and light bombers, 40 per cent. fighters and long-range interceptors, and 15 per cent. reconnaissance and naval air arm types. Before the outbreak of war, the Russian Air Force was divided into two sections, namely, two-thirds composing the Western Air Force, *i.e.* the air formations in European Russia, the remainder the Eastern Air Force, *i.e.* the Air Formations in Asia and the Far East.

The Naval Air Service is characterized by a special organization inasmuch as it is sub-divided into Brigades, Groups and Squadrons; this division varies according to the Naval Command, of which there are four, namely the Baltic, Black Sea, Arctic and Pacific Fleets. By careful calculation a Naval Air Arm strength of about 500 aeroplanes is reached. The Soviet Union possesses three aircraft carriers with displacements ranging from 10,000 to 15,000 tons, as well as three Naval Air Arm tenders.

Until a few months ago, the Russian Air Force had no dive bombers at its disposal at all, and the realization of the necessity to develop this weapon is stated to be of only very recent date.

According to the Italian source, Russia's fighters and long range interceptors are good, reconnaissance and naval air service mediocre, whilst the heavy bombers are unsatisfactory.

The Russian Aircraft Industry and Flying Equipment. (Inter. Avia., No. 770-771, 27/6/41, pp. 1-8.) (94/6 U.S.S.R.)

It goes without saying that the Russian aircraft industry is controlled by the State. From a Department of the Aircraft Industry, originally headed by a Director-General, a separate Soviet Commissariat has meanwhile been formed; its present connections with the Commisssariat of the Heavy Industry are not fully known. The technical sub-division of the administration of the aircraft industry was made on the following pattern: The ZAGI, the aero- and hydrodynamic central research institute, was created in 1918; the ZAIM, the corresponding research centre for the development of aircraft engines, created in 1930; the VIAM, which was organized in 1932 and is charged with testing and accepting the equipment.

It is not possible to state how many plants the Russian aircraft industry possesses at present. Estimates of its production capacity, too, differ greatly. A comparatively short while ago Swedish sources cautiously calculated a monthly output rate of 500 aeroplanes of different types and classes. The plants are scattered over the entire country.

Most of the Soviet Aircraft types which saw service in the Spanish Civil War and in the Russo-Finnish conflict are still among the first-line equipment of the U.S.S.R. Among the fighters operating in Spain and Finland, the I.15 and I.16 were the two best-known models; however, the former, a strutted biplane, strongly resembling earlier Breguet designs, can hardly be counted among first-line aeroplanes to-day. The I.16 (Rata) single-seater fighter is powered with an M-25 nine-cylinder radial engine of 750 h.p. (Wright Cyclone built under licence) and is credited with a maximum speed of 285 m.p.h. (460 km./h.), a ceiling of 31,500 ft. (9,600 m.), and is said to reach 16,400 ft. (5,000 m.) in 6½ mins. The stubby form of the fuselage strongly resembles certain American experimental designs and shows that American influence at that period had a marked effect on the products of the industry. The design of the engine cowling and the radial adjustable cooling air intakes in the frontal area, are the only proof of independent development work. The armament of the I.16 is variously given as four or even only two machine guns and was considered inadequate already at the time of the war in Spain. The latest Russian fighter aeroplane of which details have reached foreign circles is the I.17, for which the Russian designers sought and found a new pattern in the Vickers Supermarine "Spitfire." The I.17 is a cantilever all-metal low-wing monoplane; wing in three sections, centre portion sheet-covered. Outer panels as well as ailerons and tail surfaces fabric-covered; fuselage a metal monocoque. It is powered with the M-100 liquid-cooled twelve-cylinder in-line engine of 860 h.p. which was developed from the French Hispano 12Y. Judged by modern standards the armament is weak and consists of four wing machine guns firing clear of the airscrew circle. Small fragmentation bombs totalling 220 lbs. (100 kg.) can be carried on racks on the underside of the wing. No weight data of the I.17 is available, but the following characteristics are known: Span 33.1 ft. (10.1 m.); length 24.3 ft. (7.4 m.); wing area 190.5 sq. ft. (17.7 m.^{2}). Maximum speed 305 m.p.h. (490 km./h.); cruising speed 273 m.p.h. (440 km./h.); service ceiling 36,000 ft. (11,000 m.); range 500 miles (800 km.). The only known development of the I.17 is a single-seater fighter designated J.P., which has a more powerful armament than the original type, consisting of two cannon in the wing and two machine guns firing through the airscrew arc. The model J.P was also completed in 1937. It is quite likely, therefore, that the fighter formations of the U.S.S.R. have meanwhile been strengthened by later types resembling more or less the designs produced in the United States or European countries.

The initial development of the Russian *bombers* was influenced in a notable manner by the war doctrine of General Douhet which for some considerable time favoured the employment of multi-engined, heavily-armed giant bombers. The foundation stone of the Russian bomber formations was laid with the construction of the ANT-6 four-engined bomber re-named later *T.B.*3. The T.B.3 is a cantilever low-wing monoplane whose wings and fuselage consist of a metal frame with corrugated sheet skin. Power plant: Four M-17 liquid-cooled twelve-cylinder "Vee" engines of 600 h.p.; the armament consists of four twin machine guns; normal bomb load 3,300 lbs. (1,500 kg.), gross weight 33,000 lbs. (15,000 kg.); maximum speed 126 m.p.h. (200 km./h.); ceiling 16,400 ft. (5,000 m.). By the installation of more powerful engines of the type M-34 and by improving the shape of the fuselage, a development of the T.B.3 was produced in 1936 which, while retaining the same dimensions, had a considerably higher performance. This type was designated T.B.5 but was soon replaced by the T.B.6. The landing gear of the T.B.6 was semi-retractable into wheel fairings and moved backwards and upwards; normal bomb load 6,600 lbs (3,000 kg.). Fitted with four M-34 liquid-cooled engines of 950 h.p. each, the T.B.6 had a maximum speed somewhere between 220 m.p.h. and 250 m.p.h. (350 and 400 km./h.), a cruising speed of 186 m.p.h. (300 km./h.) and climbed to 13,000 ft. (4,000 m.) in 24 mins. Since 1935 the men responsible for the Russian bomber formations have been showing increasing interest for the twin-engined medium bomber. The first type of this class was developed by the well-known designer Tupoleff and proved its worth in the Spanish War. The Z.K.B.26 showed a considerable resemblance to the Martin 139 twin-engined bomber developed in the U.S.A. and is powered either with two M-100 liquid-cooled twelve-cylinder engines of 850 h.p. or two 750 h.p. Wright Cyclone nine-cylinder radials. The armament is composed of a machine gun station in the transparently-covered hemispherical fuselage nose, a machine gun station in the top of the fuselage, as well as a machine gun firing through the fuselage floor; normal bomb load of 1,400 lbs. (640 kg.). The same model was produced also with the M-85 14-cylinder twin-row radial of 1,000 h.p. (Gnome & Rhône 14K built under licence) and in this version had a somewhat higher speed and carried an increased bomb load of 2,200 lbs. (1,000 kg.). With the Z.K.B 26 there began a new phase in the tactical organization of the Soviet-Russian bomber formations: While the heavy multi-engined bombers of the period from 1932-1937 or their developments still represented the backbone of the Russian Air Force, the main weight of the Russian production shifted gradually to the construction of high-speed medium bombers first conceived by the Americans.

The Russian Air Force. (Luftwissen, Vol. 8, No. 7, July, 1941, pp. 206-208.) 94/7 Germany.)

The following types are referred to and partly illustrated:

FIGHTERS.

Biplanes: I.15, I.15 Cis, I.153.

Low-wing Monoplanes: I.16 (Rata), I.61 (I.200), I.17 (2KB.26), I.26.

The majority of the squadrons are composed of I.15, I.15 Cis and I.16. These may be regarded as obsolescent.

I.61, I.17 and I.26 are more modern, but only relatively few of these types have been encountered so far. I.61 fitted with a 12-cylinder V engine and is stated to have a good performance.

BOMBERS.

S.B.2, S.B.3, D.B.3, D.B.3A, P.2 (BB.22), TB.3 and TB.6.

The majority of the aircraft seem to consist of S.B.2, S.B.3 and D.B.3. S.B.2 is a copy of the original Martin (U.S.A) and S.B.3 represents an improved version of the same type (higher horse-power).

These machines are mid-wing monoplanes.

The D.B.3 is a low-wing monoplane fitted with two air-cooled twin radials, rated at 950 h.p. each at 10,000 ft. It has a crew of three or four and is fitted with three mobile machine guns. A range of 1,200 km. with a bomb load of 2,500 kg. is claimed (max. speed 270 m./h. at 10,000 ft., rate of climb to this altitude 1,000 ft./minute).

D.B.3A is the same machine fitted with a longer nose.

P.2 is a light twin-engined low-wing dive bomber, fitted with twin rudders.

T.B.3 is a four-engined heavy bomber which may be regarded as obsolete. A more modern version (T.B.6) is stated to be available only in small numbers.

NAVAL AIRCRAFT.

Single-engined flying boat M.B.R.2.

Twin-engined flying boat M.D.R.6.

Ship-borne K.O.R.1.

Long Distance Reconnaissance flying boat G.S.T. (Consolidated 28).

According to Soviet claims, a labour force of 500,000 produced 12,000 aircraft of all types during 1940.

At the outbreak of the war, between 6,000 and 10,000 aircraft are estimated to have been available on the Russian side.

Self-Catapulting Autogyros for the Protection of Cargo Vessels. (P. Thomas, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 69-70, 233.) (94/8 U.S.A.)

Present engineering knowledge indicates that it would be possible to build an autogyro carrying pilot and observer, two depth charges, two-way radio, smoke screen apparatus and have a reasonable cruising radius. The speed is estimated at 120 m.p.h., 14,000 ft. ceiling and 800 ft./min. rate of climb. Such a machine would only require a platform 50 ft. wide and 80 ft. long for landing and take-off, and such a structure could be provided on the stern of most cargo vessels. The new Pitcairn autogyro has manual control for pitch of rotor blades, so that quick descents from a height of 10 to 15 ft. can be made. This should allow safe deck landings even in a rough sea. It is stated that the firm has also developed a landing device for making the aircraft fast immediately it touches the deck. (An arresting gear is not needed as there is no forward run.) By means of such aircraft the seas could be patrolled at some distance from the convoy and submarines spotted. Depth charges could then be used or a smoke screen laid. It is stated that the feasibility of the scheme has been demonstrated by hill-top landings in very disturbed air.

Interstate Hydraulic Machine Gun Charger. (Aero Digest, Vol. 31, No. 1, July, 1941, pp. 206-209.) (94/9 U.S.A.)

This new unit is a compact device which not only charges the machine gun but also re-charges it when it has jammed, hit a dud shell, or stopped firing for other reasons. It is located so that the pilot or gunner can operate the bolt mechanism of the gun, ejecting the old shell in one direction of its movement and throwing in a new one at the end of the return stroke, the complete cycle of operation taking a fraction of a second. The charger is controlled merely by flicking a valve handle and will perform efficiently at temperatures as low as $-40°$.

The charger consists of a cylinder assembly and two supporting brackets which attach directly to the side of the gun. An electrical contactor box containing two sets of contact points is optional equipment and mounts on the rear support. One set of points makes contact each time the gun fires, causing a light to blink on the instrument panel as long as the gun is firing and indicating the position of the bolt while the gun is jammed or charging. The other set of points makes contact every tenth time the gun fires and is for the purpose of operating a rounds counter on the instrument panel, indicating at all times just how much ammunition is left.

The hydraulic connection can be made at either top or bottom of the forward end of the cylinder, the unused opening remaining plugged.

A conical pin, spring-mounted to the cylinder, engages in a socket on the front support, while the housing on the rear end of the cylinder assembly attaches on to the rear support. The cylinder assembly is easily and instantly removed from the gun by releasing the latch and safety and lifting it from the supports; thus the cylinder assembly can remain as part of the aeroplane's hydraulic system while the gun is removed for service or repair.

Operation is effected by hydraulic pressure pushing a piston and rider toward the rear against the pressure of springs. As the rider moves, it engages the gun bolt stud and moves it to the rear position, at which time a latch in the gun charger engages the rider. When the hydraulic pressure is released and the cylinder is open to discharge, the springs move the piston toward its forward position but the rider which holds the gun bolt stud remains latched in its rear position until the last $\frac{1}{4}$ in. of piston travel. This last part of the piston travel releases the latch allowing the gun bolt stud and rider to return rapidly to the forward position.

The charger is designed to stand extreme vibration and hammering and is suitable for operation on either 800 or 1,500 lb. pressure systems, yet will continue to operate when the hydraulic pressure drops as low as 250 lbs./sq. in. It has been tested to 3,000 lbs./sq. in. pressure and a fatigue test of 5,000 operations has been run with no indication of failure in either test.

All parts are interchangeable. The complete assembly including the contactor box weighs three lbs. It can be mounted on either side of the machine gun and is especially applicable to machine guns mounted in wings or other remote locations.

Remarks on the Analogy Between Heat Transfer and Momentum Transfer. (L. M. K. Boelter and others, Trans. of the A.S.M.E., Vol. 63, No. 5, July, 1941, pp. 447-454.) (94/10 U.S.A.)

This paper presents an extension of Von Kármán's analysis of heat transfer to fluids in closed conduits, based on the analogy between heat transfer and momentum transfer. For a particular ideal system, an expression for the temperature distribution in a fluid in turbulent motion being heated or cooled inside a circular pipe is derived and a relation is obtained between Nusselt's modulus and the pipe-friction factor for "isothermal" heat transfer. This equation is extended to apply in cases in which the physical properties of the fluid vary across the section of the pipe. The apparent variation of the dimensionless distance parameter y^+ with ratio of wall viscosity to laminar sub-layer viscosity and Reynolds' number is obtained. A comparison between the equation developed in the paper and the Nusselt empirical equation, including the constants evaluated by Dittus and Boelter, is made.

The Propagation of Pressure Fluctuations of Large Amplitude in Air Columns. (L. J. Kastner, Phil. Mag., Vol. 32, No. 212, September, 1941, pp. 206-224.) (94/11 Great Britain.)

The results of the investigation indicate, within the scope of the experiments described, that the velocity of propagation of pressure waves in air produced in a pipe excited by a piston is independent of the frequency, when the peak amplitude of the free vibration corresponds to a pressure of a few inches of mercury, and the number of vibrations varies betweeen 20 and 150 per second. Under the above conditions the velocity of propagation appears to diminish at a greater rate with decrease of pipe-diameter than for cases when the amplitude is very small.

The waves generated in the pipe are attenuated as they travel along the pipe, and are also reduced in amplitude on reflexion from the ends of the pipe. For pipe-lengths up to ten feet the attenuation constant appears to be unimportant compared with the open-end and closed-end reflexion coefficients, and the product of these latter coefficients does not vary greatly with changes of pipe diameter.

On Acoustically Effective Vortex Motion in Gaseous Jets. (P. Savie, Phil. Mag., Vol. 32, No. 212, September, 1941, pp. 245-252.) (94/12 Great Britain.)

Tollmien's general criterion of instability of one-dimensional fluid motion is applied to the problem of sound sensitive plane jets. Bickley's formula is inserted into Tollmien's disturbance equation and stream function, wave-velocity, and wave-length are found. The stream-line representation shows good qualitative agreement with G. B. Brown's photographs of smoke jets. Furthermore, a formula connecting the frequency of the sound with either of the two proper values of the disturbance equation is derived, which is in fair agreement with G. B. Brown's measurements on edge-tones. A brief explanation of the phenomenon of sensitive jets is given.

The Production of Waves by the Sudden Release of a Spherical Distribution of Compressed Air in the Atmosphere (Blast Waves). (J. J. Unwin, Procs. Roy. Soc., Vol. 178, No. 973, 12/6/41, pp. 153-170.) (94/13 Great Britain.)

An attempt has been made to develop a method for dealing with solutions of problems connected with the production of waves by spherical concentrations of compressed air. Starting from the general equations for three-dimensional spherically symmetrical flow in a homogeneous compressible medium having constant entropy everywhere, a process has been devised to apply step-by-step calculations over small intervals of time to investigate the general features of such a motion. A complete solution has been worked out in one particular case for a not very intense initial distribution of pressure, and various indirect checks have indicated that the results are reasonably accurate.

The method is applicable to any spherically symmetrical motion up to such a time as the formation of a shock wave takes place and then fails owing to the assumption of constant entropy.

Pitch Control for Co-axial Counter Rotating Airscrews (Fairey Patent 534,528). (Inter. Avia., No. 767, 7/6/41, p. 6.) (94/14 Great Britain.)

The British patent No. 534,528 has been granted to the Fairey Aviation Co., Ltd., of Hayes, Middlesex and covers an interesting arrangement for the automatic control of the angle of incidence of oppositely rotating co-axial controllable pitch airscrews mounted in close tandem. A vane, pivotal about a vertical axis in the vertical plane of the axis of the airscrews, is mounted on the fuselage forward of the cockpit and automaticallly adjusts itself to the direction of the airscrew slipstream. By means of sleeve valves in the mounting of the vane, two engine-driven pumps are controlled which change the blade angle until the twist component of the slipstream as measured by the vane disappears. The patent specifications cover electrical, hydraulical or mechanical control of the mechanism.

Reproduction of Work Templates by the Electrolytic Press. (Aviation, Vol. 40, No. 4, April, 1941, p. 113.) (94/15 U.S.A.)

Said to be faster and more economical than the photo-loft-template process, the new method is simple and the materials used are standard in most plants. A master layout is scribed from an Engineer's drawing on a galvanized iron sheet about .040 in. thick, one face of which has been prepared with a special coating of insulating paint. Layout thus formed is sprayed with a transfer solution and the wetted surface is pressed into firm and uniform contact with a copy plate in a specially built press. An electric current passing between the two plates results in the layout of the master plate being transferred instantly to the copy plate. Given a thin protective coating, the copy plate is then ready for immediate use by the template cutters. Total time required from the moment the copy plate is placed in the press with the master plate until it is washed, dried and ready for the template department is not more than 5 min.

Hamilton Standard Airscrew Laboratory. (Inter. Avia., No. 772-773, 15/7/41, pp. 10-12.) (94/16 Switzerland.)

The laboratory includes the following equipment:

A *cold room* affords facilities for testing airscrews at temperatures as low as 50 deg. F. below zero; a *whirl rig* serves for test runs at excess rotational speeds up to 4,000 r.p.m., the airscrew being driven by an 185 h.p. engine. The air is supplied to the test chamber by a blower at rates up to 7,000 cu. ft. per min. and can be heated to 150 deg. F. Besides the air inlet, an automatic stoker is mounted, which by means of compressed air projects sand, gravel, cinders, water or similar materials at the airscrew. This installation is used for the study of erosion of the airscrew or the control mechanism, which occurs chiefly in tropical regions.

To make possible the measuring of the dynamic unbalances resulting from differences in weight, axis positions and centre of gravity paths of the blades, the bearing system of the airscrew shaft is pivoted about an axis perpendicular to that of the shaft, so that it is oscillated by the dynamic unbalance of the airscrew. These oscillations are transmitted to the measuring device by pick-ups in the form of alternating current.

For the separation of the dynamic unbalance from the aerodynamic unbalance resulting from differences in the blade shapes or the angles of incidence, an entirely new course is adopted. At a small distance back of the airscrew there is a screen-mesh diaphragm mounted on a steel structure. This diaphragm, which is pivoted about a vertical axis, is made to oscillate by differences in the thrust moments of the individual airscrew blades; these oscillations are opposed by the inertia of the diaphragm structure.

The theoretical studies justified the expectation of a measuring accuracy that would correspond to blade pitch variations of 0.015 deg; however, due to disturbing interference of vibrations of the mounting base and unsteady airflow only angle differences of 0.1 deg. are revealed. By improving the airflow conditions and the installation of honeycomb straighteners and baffles efforts are made to eliminate these influences and to improve the measuring accuracy. However, the influence of a blade angle difference of 0.1 deg. is negligible in normal flight, compared with the dynamic unbalance considered as permissible where it results from inaccurate mounting of the airscrew on its shaft.

U.S. Army Air Corps New Wind Tunnel. (Inter. Avia., No. 772-773, 15/7/41, p. 14.) (94/17 U.S.A.)

The new 20 ft. tunnel is destined less for new development work than for studies of practical problems arising in air force operation. The test section will be housed in a reinforced concrete building measuring 108 ft. in length and 62 ft. in width and capable of withstanding a differential pressure of 400 lb./sq. ft. The model is connected with scales in the balance room at the top of the test building by means of three struts and can be regulated by remote control. The measuring values will be transmitted to the control room also by remote control. The control room is sealed off from the tunnel and is both air-tight and sound-proof; favourable working conditions are maintained by means of an air-conditioning plant. Windows enable the model to be observed from the control room. The two fans of 40 ft. diameter have 16 blades each. The driving motor, the biggest wound-rotor induction motor ever built, develops 40,000 h.p. and is housed in a separate building; it is connected to the two fans by 120 ft. of shafting. The speed of the motor can be regulated between 37 and 297 r.p.m. In order to reduce the waste of electrical energy when the motor is delivering only part of its full output, the current is led through a system of two motor-generator sets. The motor assembly was scheduled to be ready for operation by July 1st, 1941.

Synthetic Resins as Aircraft Construction Materials (Part II). (Inter. Avia., No. 774, 23/7/41, pp. 1-5. Part I, No. 772-773 Notice No. 28,502.) (94/18 Switzerland.)

(1) Properly selected synthetic resins have the following properties which make them suitable for the aircraft industry: Good mouldability, low specific weight, smooth surface, low inflammability, resistance to chemicals and bacterial growths, low hygroscopicity, great energy absorption for oscillation damping, manufacture from non-strategic raw materials.

(2) Synthetic materials suitable for the manufacture of entire airframes without stiffening additions are not known at present.

(3) The strengthening of synthetic resins to the values required for the manufacture of aircraft by means of fabric fillers is not excluded; however, materials of this class ready for use are not yet available.

(4) Wood improved by means of synthetic resins and plastics strengthened by means of wood layers are widely and advantageously adopted to-day.

(5) Methods and installations for the industrial manufacture of airframe components from compound wood/plastics materials are available.

(6) The "plastics aircraft" available to-day are made exclusively of wood improved by synthetic resins on the principles of conventional plywood construction under the application of the processes in question for the manufacture of shell components.

(7) The development of a method for the construction of wood/plastics aircraft in which the properties of the new compound materials are fully exploited with a view to reducing the manufacturing time, the quantity of material needed and the weight, and to adapting them to the static and aerodynamic requirements, is still in its infancy.

U.S.A. Altitude Equipment. (Inter. Avia., No. 774, 23/7/41, pp. 15-16.) (94/19 U.S.A.)

Particular value is attached to the improvement of altitude equipment for the single-seater and two-seater aircraft crews which for technical reasons cannot be provided with the advantages of the pressure cabin. For example, a newly developed electrically heatable underwear suit of latex which together with boots and gloves weighs only 7 lbs., can be heated by 12-volt current from the electrical system of the aeroplane, and is still comfortable at temperatures as low as 60 deg. F. below zero, is now being tested. The main advantage of this garment, besides its low weight, is the flexibility of the fabric which is stated not to handicap the movements of the crew in any way. Moreover, the B-L-B oxygen mask introduced as standard equipment in the U.S. Army Air Corps, has been improved by designing a lighter and smaller mask and replacing the rubber breather bag by a flat breathing reservoir. This reservoir is not directly connected with the mask but can be accommodated in a chest pocket of the flying suit, so that the crew is not encumbered by the flopping of the breather bag following each head movement. Other experiments are far advanced with bullet-proof low-pressure oxygen tanks; these tests appear to have been made on the basis of experience collected in the European war.

Line of Development of Italian Aircraft Design. (*Lecture to the Lilienthal Society, Berlin.*) (A. Guglielmetti, Luftwissen, Vol. 8, No. 7, July, 1941, pp. 209-215.) (94/22 Italy.)

High speed at high altitude is becoming of increasing importance and is receiving considerable attention by the Italian authorities. It is well-known that speed and wing loading are intimately connected. If the h.p. and propeller efficiency are independent of altitude, theory indicates that the optimum wing loading decreases with altitude. With increased power loading, however, the optimum wing loading at a given altitude increases with the power loading. Unfortunately, the h.p. per propeller blade which can be absorbed at optimum efficiency rapidly diminishes with altitude and flying speed. Thus, at 800 km./h. near the ground, a three-bladed propeller of 3.5 m. diameter can be built to absorb 3,000 h.p. at reasonable efficiency. At 40,000 ft., however, such a propeller will only absorb 450 h.p., without either an increase in Mach Number or in diameter. This shows the need at high altitude of sub-dividing the power plant or driving more than one propeller from one engine. In the latter case the use of contra propellers and gear boxes is receiving attention. At low altitudes on the other hand the construction of several engines driving one propeller is also worthy of consideration. The increasing difficulty of obtaining reasonable propulsive efficiency at high speeds with the orthodox power plant has led to increased attention being given to jet propulsion. The Campini aircraft utilizing the alternation method is stated to have flown successfully. At low altitudes, the air is compressed by the flight speed before entering the engine drive compressor and mixed with the engine exhaust before expulsions in the jet. At higher altitudes, additional heat is given to the air by an auxiliary burner.

As is well known, Italy still utilizes wood to a considerable extent in aircraft construction. Special reference is made to the Zappata method of building fuselage shells by glueing strips of thin veneers (40 m.m. wide, .6 to 2 m.m. thick) on a suitable framework of compressed wood. It is stated that the performance of wooden aircraft weighing up to 20 tons compares favourably with all-metal machines, whilst being much easier to produce. Of interest is reference to an experimental fighter (low-wing monoplane) fitted with a 12-cylinder air-cooled V engine (Isotta Fraschini Delta) of 800 h.p. The wing area is only 14 $m.^2$ and the total weight 2,000 kg. On account of its compact size, this machine is stated to have outstanding manœuvrability and requires only $\frac{1}{3}$ of the man-hours of a standard fighter for its production.

As regards equipment, an air intake filter for preventing sand getting into the engine is of interest. Two types have been developed. The first suitable for coarse-grained dry sand consists of a series of deflector plates which cause separation by inertia. These plates are placed in a box below the engine cowling. The second is a filter proper, consisting of two wire gauzes enclosing fine fabric and placed inside the cowling. Provision is made for easy cleaning of the filter before each flight. In the latest type of filter, a whirling chamber causes the heavier particles to separate before the airstream reaches the filter proper.

Problem of Weight Control. (L. R. Hackney, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 134-136, 237.) (94/23 U.S.A.)

The Society of American Weight Engineers was organized about two years ago with the object of a closer relationship between weight engineers and to correlate weight information. With its co-operation of every major aircraft form, a Master Weight book has been compiled and the Army and Navy Standard detail and group statements have been revised. The aircraft structure is sub-divided into seven main groups. The layout for the estimated weights of the wing group and one of its principal sub-divisions is illustrated below, the figures applying to a four engine transport of 40,000 lbs. gross weight.

	Weight.	Arm.	Horizontal Moment.
WING GROUP	3,964.0	453.5	1,798,055
Inner Wing Panel	2,905.0	450.4	1,308,602
Outer Wing Panel	642.0	435.4	—
Tips	25.0	428.0	—
Ailerons	109.0	474.0	etc.
Flaps	283.0	521.0	—
INNER WING PANEL	2,905.0	450.4	1,308,602
Front Beam	286.0	416.0	—
Intermediate Beam	—	—	—
Rear Beam	248.0	479.0	—
Auxiliary Beam...	—	—	—
Ribs	536.0	449.0	etc.
Stringers	—	—	—
Fittings	108.0	448.3	—
Corrugations	369.0	449.8	—
Gussets	—	—	—
Formers...	—	—	—
Channels	—	—	—
Stiffeners	115.0	453.5	—
Angles	—	—	—
Fillers	39.0	449.8	—
Fabric	—	—	—
Metal Covering	668.0	461.0	—
Paint	32.0	449.0	—
Inspection Doors	13.0	474.0	—
Fairing	18.0	434.0	—
Leading Edge	123.0	406.0	—
Hinge and Pins...	—	—	—

Weight control may be divided into:—

(1) Parts entirely within the Design groups control (wing, fuselage, tail, etc.).

(2) Parts partly controlled (fuel system, hydraulic and electrical equipment, armament provisions, etc.).

(3) Parts beyond immediate control (engines and purchased equipment, etc.).

Division (1) amounts to between 35 per cent. and 50 per cent. of the weight empty; (2) 10-15 per cent. and (3) 45-50 per cent. It thus appears that roughly half the estimated empty weight of the aircraft is subject to control by the Weight section. The saving of 1 lb. weight in an aircraft represents a saving of about $10 in manufacturing cost and is worth about $100 a year in pay load to the transport company. A 10 per cent. increase in gross weight means a 25 per cent. increase in power to reproduce the standard take-off, and a 13 per cent. increase in power to obtain the standard rate of climb.

Weight control is thus of the utmost importance. The stress department must be made "weight conscious," and allowance for "unknowns" must be done away with. Progress would be more rapid if detailed weight schedules of all successful models could become generally available.

Weight Economy. (J. E. Ayers, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 138-142, 238.) (94/24 U.S.A.)

The article is intended for new draughtsmen in the Aircraft Industry and he is urged, before the release of any drawings, to consider the following points, amongst others:—

Possible substitution of Al. Alloy for Steel.
,, ,, ,, Mg. Alloy for Al. Alloy.
,, ,, ,, Micarta for Light Alloys.
,, ,, ,, Moulded Plastic.
Can the part be simplified?
,, ,, spot-welded?
Can lightening holes be provided?
Relative advantages of formed and extruded sections and forgings.

Each of the above points are discussed in some detail with examples taken from current aircraft designs. It is interesting to note that due to wear of dies, extruded sections have generally about ten times the tolerance of rolled sheet and this is an argument in favour of formed sections. It is stated that in a recent 6,000 lbs. gross weight aircraft the weight penalty due to oversize of the extruded stringers (bulb sections) amounted to nearly 9 lbs.

Strengthening Aluminium for Aircraft Structures. (K. R. Jackman, Metal Progress, Vol. 40, No. 1, July, 1941, pp. 35-42 and 88.) (94/25 U.S.A.)

A typical modern aircraft weighing 50,000 lbs. gross will have a tare weight of about 27,000 lbs. of which 11,000 lbs. represent engines, propellers, accessories and non-structural furnishing. The remaining 16,000 lbs. of structure will be sub-divided as follows:—

Metal.	Form.	Wing.	Fuselage.	Tail.	Landing Gear.	Controls & Misc.	Total lbs.
Steel	CR-MO	300	200	20	1,000	80	1,600
	Stainless	500	50	—	—	50	600
Magnesium	Castings	—	—	—	—	50	50
Al. Alloy	Sheet	7,000	2,100	800	100	500	10,500
	Extrusions	150	100	50	25	175	500
	Drawn Parts	950	400	100	—	50	1,500
	Castings	—	—	—	—	100	100
	Forgings	150	50	25	100	25	350
	Rivets	250	100	50	—	50	450
Others	All	20	20	20	40	100	200
					Grand Total	...	15,850

Aluminium Alloys thus account for 13,400 lbs. out of the total of 15,850 lbs. The sheet metal covering wings, fuselage and tail represents the biggest item, *i.e.* 10,500 lbs. The present trend is to use 24S-T Al. Clad. which eliminates most of the corrosion troubles and very little can be done to strengthen this product still further so as to save weight. It has been known, however, for some time that extrusion and drawn shapes can be considerably strengthened by cold working and although the total weight of products of this type in the aircraft under consideration amount to only 2,000 lbs. this treatment would be worth while provided practical shop procedures can be developed.

The author describes the method adopted by Consolidated Aircraft for pre-stretching structural sections to 3½ per cent. permanent set on the straightening jig at very little extra cost. The gain in ultimate and yield strength of the material is such that a saving in weight of about 10 per cent. results. The reason for limiting the pre-stretching to 3½ per cent. permanent set is mainly the need for retaining sufficient residual elongation to accommodate stress concentration and dynamic load. Greater pre-stretching also increases the amount of rejected material.

Load Carrying Capacity Phenomena of Bearing Surface. (N. O. Tectov, J.S.A.E., Vol. 47, No. 6, Dec., 1940, pp. 497-503.) (94/26 U.S.A.)

The author confines himself to bearing surface under conditions of boundary lubrication or operating in the absence of lubricant. Failure will occur if the areas in contact reach the melting point of the material. Smooth surfaces have larger areas of contact and will therefore generate more heat, *i.e.* their load capacity is less. It has generally been noted that a bearing surface will acquire a high polish just before scuffling occurs, and that such a burnished surface will never carry as much load again as it did while acquiring the burnished finish. For his experiments the author used a so-called "scuffling" machine in which one of the bearing surfaces is stationary whilst its other reciprocates, oil being supplied to the latter at a definite rate. The load on the stationary sample is increased at a steady rate and a time record of its temperature is taken. Considerable benefits were found to result when the bearing area was provided with grove filled with iron oxide.

(It appears that the conditions of this test apply particularly to piston rings.)

Possibilities of Barrel Engines of Small Frontal Area for Aircraft. (E. S. Hall, J.S.A.E., Vol. 47, No. 6, Dec., 1940, pp. 497-503.) (94/27 U.S.A.)

The best engine form for high-speed flying is that having the lowest air drag. According to the author, the following table gives the drag h.p. at 20,000 ft. of various cylinder arrangements for a gross output of 2,000 h.p. in each case (air-speed 400 m.p.h.).

			Frontal Area (sq. ft.).	Drag (h.p.).
Twin row radial,	18 cylinders	...	16	373
V Tandem	24 ,,	...	12	280
H Type	24 ,,	...	10	233
Barrel Type	18 ,,	...	6	140

In the barrel engine, the piston displacement varies as (engine diameter)^3 and it is possible to crowd in as much as 25,000 cubic inches piston displacement into a cowling diameter of 50 in. normally housing a 1,000 h.p. radial of 2,000 cubic inch displacement.

Three type barrel engines are investigated by the author in greater detail:—

(1) Swash plate with slipper.
(2) Cylindrical cam mechanism with rollers in the piston.
(3) Wobble plate.

The Wobble plate mechanism is considered the most promising and an experimental unit with a floating wobbler designed by Almen was tested by the U.S.A. army authorities.

This design together with later improvements is illustrated.

It is estimated that an 18-cylinder two-stroke Diesel designed on these lines (displacement 5,500 ci) should develop about 1,700 b.h.p. without much development work 80 lb. per sq. in. b.m.e.p.). Ultimately 5,000 h.p. should be possible for a frontal area of not more than 7 sq. ft.

Application of Aluminium in Diesel Engine. (F. Jardine, J.S.A.E., Vol. 47, No. 6, Dec., 1940, pp. 520-525.) (94/28 U.S.A.)

Conventional high-speed Diesel engines for motor transport, weight about 20 lb. per h.p. By using aluminium for the cylinder heads, cylinder block, crankcase, piston, gear covers, flywheel housing, etc. the weight can be reduced to about 10 lb. per h.p. with practically no change in design or manufacturing practice. Further reduction in weight is possible by supercharging and the author describes in detail some design features of a 160 b.h.p. unit weighing as little as 7.8 lb. per h.p. (b.m.e.p. 160 lb. per sq. in. at 2,400 r.p.m.).

Experience in long distance haulage in the U.S.A. has shown that 1 lb. saved in dead weight of a truck is worth about 1 dollar a year (mileage 100,000). The extra cost of 1 lb. light alloy engine amounts to about 30 cents. per lb. of weight saved, the light-weight engine is then definitely an economic proposition under these conditions.

(In aerial transport 1 lb. saved corresponds to about 100 dollars in pay load.)

Effectiveness of the Burning Process in Non-Knocking Engine Explosions Based on an Analysis of Flame Picture and Pressure Data. (L. Withrow and W. Comclius, J.S.A.E., Vol. 47, No. 6, Dec., 1940, pp. 526-548.) (94/29 U.S.A.)

The author carried out experiments on a CFR engine fitted with a quartz window and carbon stack electric indicator. Flame motion pictures and pressure records were taken simultaneously and the author's attempt to estimate the heat loss by a careful analysis of five different engine explosions, in two of which benzene was the fuel, whilst in the other three the engine was operated with isooctane. The compression ratio was 4.8 and the piston speed 600 ft. per minute throughout (900 r.p.m.). The authors conclude that under the conditions of their experiments only 81 per cent. of the energy liberated according to thermo-dynamic data is accounted for by the pressure record. Theoretical rates of combustion (mass basis) required to produce the experimental pressure record are in agreement with the observed rates during the inflammation of the first 10 per cent. and the last 50 per cent. of the charge. Over the region of maximum rate of inflammation (corresponding to about 30 per cent. of the charge burnt) the theoretical rate is, however, only about half the practical rate as estimated from the flame photographs. From this it is concluded that most of the energy loss of the charge occurs over the period 5°-10° of crank angle after T.D.C. and before maximum pressure is reached. The complete elimination of the loss could raise the indicated m.e.p. by 20 per cent.

The most obvious explanation of the energy loss observed is that it is due to heat lost to the wells of the combustion chamber; other possible explanations are:—

(1) Incomplete combustion in the flame front, *i.e.* inflamed gases continue to liberate energy for some time after the flame has passed.

(2) Dissociation of CO_2 and H_2O to a greater extent than assumed on the basis of thermo-dynamic data.

In the discussion of this paper, reference is made to some indicator diagrams taken on a C.F.R. engine by the M.I.T. which show that the experimental indicated m.e.p. varied between 80 and 85 per cent. of the values calculated with the help of existing thermo-dynamic data. The effectiveness of combustion is thus of the same order as that estimated from the flame photographs.

Ford Aircraft Engine. (Inter. Avia., No. 774, 23/7/41, p. 14.) (94/30 U.S.A.)

The engine is a liquid-cooled Vee-12 type and is expected to have a take-off output of 1,800 h.p. at 3,000 r.p.m. and an altitude output of 1,500 h.p. at 30,000 ft. Its weight is estimated at 1,600 lb., working out at less than 1 lb./h.p.

The exhaust gases of the two cylinder banks are fed to a turbine through a horizontal collector each; they are exhausted centrally to the rear after passing through the turbine. The blower (two-stage ?) driven by the exhaust gas turbine is arranged beneath the crankcase and supplies the compressed air through a vertical duct to an intercooler located between the two cylinder banks and projecting somewhat above the latter at the rear; thence it is fed to the cylinder air inlets. The crankcase and the cylinder banks are an integral casting of aluminium alloy. The cylinder liners are not in contact with the coolant and are therefore of the " dry " type. They are of centrifugally cast steel and are free of any kind of flanges or bosses in order to avoid distortion by heat. Each cylinder head contains two inlet and two exhaust valves which open simultaneously at the top stroke position of the piston before the latter's compression stroke; the arrangement serves for the scavenging of the combustion chamber. Each cylinder bank has two overhead camshafts whose cams are directly on the valve stems. The engine is stated to be designed for fuel of 100 octane rating which is injected directly into the combustion chamber. The crankshaft is of the six-throw type and is made of centrifugally cast steel by the long-proven Ford method; each throw carries a floating big-end bearing to which are attached the connecting rods of an opposite pair of cylinders.

Spark Plug Threads in Light Metals. (Automotive Industries, Vol. 85, No. 3, 1/8/41, p. 48.) (94/31 U.S.A.)

When a spark plug has to be secured into the wall of a cylinder or cylinder head cast of a light alloy, it is customary to insert a bushing of some stronger material. To obviate the need for such a bushing, a German firm has patented a special thread for spark plugs and spark-plug holes. Both the spark plug and the hole for it are cut with a relatively coarse V thread, the thread in light metal has the top half removed, and the thread on the plug groove is filled up with metal to half its depth. Only the top half of a normal V thread is used on the plug and the bottom half in the light metal part. For a given radial depth of thread this gives a much stronger thread in the light metal part.

Spark Plug Indicator for Navy Planes. (Autom. Ind., Vol. 85, No. 3, 1/8/41, p. 41.) (94/32 U.S.A.)

The Bureau of Standards, which during the World War developed an improved grade of porcelain for use in spark plug insulators, has completed tests for the Navy on a dashboard indicator by which an aeroplane pilot can tell at a glance whether any particular one of the spark plugs of his engine is functioning properly. If the indicator shows the plug to be too hot, it may be due to the surface of the insulator being fouled with lead. This can be corrected by reducing the richness of the fuel mixture. If, on the other hand, a plug shows up too cold, it indicates the presence of carbon deposit on the insulator. This can be corrected by increasing the speed of the engine, thereby raising the temperature of the insulator and burning off the carbon.

The Brown Boveri Exhaust Driven Supercharger for Aero Engines. (E. Klingelfuss, Flugwehr and Technik, Vol. 1, No. 4, April, 1939, pp. 107-111.) (94/34 Switzerland.)

The Brown Boveri Company has had considerable experience in the supercharging of large four-stroke Diesel engines by exhaust-driven blowers (Buchi System). In such engines, the maximum exhaust temperature is of the order of 600°C. only, whilst considerable benefit arises from the fact that the engine can be scavenged with cold air without difficulty. The problem is much more difficult in the case of the spark-ignition aircraft engine since the exhaust temperature is much higher (900-1,000°C.) and the carburettor generally employed renders scavenging without loss of charge very difficult. Since no blade materials are available for exhaust temperatures of 1,000°C., Brown Boveri have adopted a method of air cooling for the blades, the latter being subjected alternately to exhaust and air streams. In this way the blade temperature can be kept at 600°C., but the bulk and weight of the unit naturally increases. A turbo installation suitable for one bank of an 800 h.p. V engine is illustrated. Two of these units, one on each bank, would be fitted and running at a maximum speed of 24,000 r.p.m. ground level pressure can be maintained up to 30,000 ft. Each turbo has two exhaust inlets, placed 180° apart and discharges axially into the atmosphere. The blower intake is on the opposite side to the exhaust discharge. It is stated that each turbo blower weighs approximately 90 lbs.

In developing the turbo blower, a special test stand was employed, the exhaust gases being produced by means of a special burner operating in the requisite air pressure.

The author is of the opinion that turbo supercharging for aircraft engines is only feasible if combined with scavenging and this entails the employment of petrol injection instead of a carburettor.

Two advantages of turbo blowers for aircraft are often overlooked. It is unaffected by the provision of constant-speed V.P. airscrews (the mechanically-driven blower requires a gear-box under these conditions) and the installation acts both as a flame damper and exhaust silencer.

Aero Engine Research and Development. (C. L. Lawrence, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 124-125 and 233.) (94/35 U.S.A.)

The N.A.C.A are building an 8½ million dollar research laboratory solely for engine research. Up to the present, most of the engine research in the U.S.A. has been carried out by the larger engine firms themselves, and whilst this led to the production of civil aviation engines second to none, the military side has been neglected. High speed at high altitude is very expensive, yet of paramount importance in war. The concensus of military opinion favour the water-cooled engines of small frontal area for this purpose. Engines of this type have only been developed comparatively recently in the U.S.A. and they lack as yet the horse-power of the more perfected air-cooled radials on which most of the money has been spent. The research funds set aside by the U.S.A. Government for such problems as the aircraft diesel, safety fuel, etc. were too small to ensure rapid progress. Thus the two-cycle diesel has been under investigation for over ten years at Langley Field. If the facilities had been sufficient so that all that was accomplished could have been completed in three years instead of ten, every one would have regarded the results as remarkable. In the words of the author: "If a project, either through lack of funds, lack of talent, or both, does not move fast enough, it does not move at all, for to fall behind in the procession is to accomplish nothing."

Apart from liquid-cooled engine development, the author lists the following problems as worthy of the attention of the new laboratory:—

(1) High pressure superchargers of the rotary type not requiring intercoolers.
(2) Exhaust-driven superchargers.
(According to the author, although superchargers are at present in production, they are not yet a proved article.)
(3) Safety fuels and fuel injection.
(4) Two-cycle aircraft engine, either compression or spark-ignition, fitted with exhaust-driven scavenge blower and gear-driven supercharger, B.M.E.P., of the order of 250 lb. per sq. in.
(According to the author, it should be possible to obtain about 4,500 h.p. from an engine of the size and weight of the D.B.601.)

On the Rate of Reaction in the System Mineral Oil Oxygen. (D. J. W. Krenlin and J. ter Horst, J. Inst. of Petroleum, Vol. 27, No. 213, July, 1941, pp. 275-292.) (94/36 Great Britain.)

The author employs the method of Luther and Plotinkow, both the liquid and gas phase being present during the reaction in a closed vessel. A constant pressure of oxygen is maintained (5 cn. Hg.), the gas being constantly stirred into the liquid (medicinal paraffin oil) maintained at a constant temperature of 100°C. The dielectric strength of the oil is measured by the high-frequency method and from this the average dipol moment is estimated at regular intervals. The reaction velocity is then proportional to the rate of change of dipol moment, provided the solution velocity of the oxygen is large compared with reaction velocity. It was found that after an induction period of about 35 hours, the average dipol moment increased linearly with time, showing that the subsequent reaction velocity was constant ($K \approx 1.3$) up to dipol moment of the order of $\mu = 7.5 \times 10^{-18}$ e.s.u.

If the oxidation is carried out in the presence of metallic copper or tin, the rate of reaction is unchanged but the induction period shortened considerably. The authors conclude that the metal exerts no catalytic effect but acts entirely by absorbing anti-oxygen compounds present in the oil. The first addition of the metal thus exerts the greatest effect and after passing the induction period, the metal is apparently completely inert. The authors consider that the reaction velocity and length of induction period are important oil characteristics which can be measured conveniently by the electrical method. Purely chemical (acid content) or physical methods (viscosity) are apt to give misleading results as regards oil stability.

The Blending Octane Numbers of Furan and Furfuryl Alcohol. (H. B. Nisbet, J. Inst. of Petrol., Vol. 27, No. 213, July, 1941, pp. 293-300.) (94/37 Great Britain.)

From the information which has been made available recently regarding the blending octane numbers of hydrocarbons and other compounds it has become apparent that this property is improved when (1) the molecule of an aliphatic hydrocarbon is highly centralized, (2) in addition to centralization in the open-chain hydrocarbon molecule there are also present one or more unsaturated linkages, (3) cyclic hydrocarbons contain unsaturated linkages and when the nature of the cyclic hydrocarbon becomes fully aromatic. It is also known that certain alcohols, particularly the lower aliphatic compounds, and also some ethers—*e.g.* isopropyl ether—possess high-blending octane numbers.

In the present investigation the effect of combining a ring structure containing conjugated double bonds with an ether linkage as found in the molecule of furan and the combination of this structure with an alcoholic group, as in furfuryl alcohol, on the octane blending number has been studied from various angles.

Furan.—Furan was added in various concentrations to motor spirit blends of different octane numbers, and it was found that in blends of low octane number the addition of small proportions of furan caused a big rise in octane number. This relative rise decreased with increasing proportions of furan, until when 30 per cent. was reached the rise became negligible.

The addition of furan to blends of high octane number caused only a slight increase in octane number, and when added to commercial iso-octane, a decrease in octane number was observed.

Furfuryl Alcohol.—Owing to the insolubility of furfuryl alcohol in motor spirit of an aliphatic nature, the investigation was limited to the comparison of the blending values of furfuryl and ethyl alcohols in 10 per cent. blends in spirit containing benzole. The blending octane number of furfuryl alcohol in these blends are not as high as those of ethyl alcohol.

The Viscosity of Russian and Rumanian Lubricating Oils at High Pressure. (R. B. Dow, J. S. McCartney and C. B. Fink, J. Inst. of Petroleum, Vol. 27, No. 213, July, 1941, pp. 301-309.) (94/38 Great Britain.)

The oils examined (four Russian and three Rumanian) were typical products of the respective sources of origin. The viscosities were measured over the pressure range 0-46,000 lb. per sq. in. with the Hersey Rolling Ball Viscometer at temperature of 100°F., 130°F. and 210°F. respectively. For a pressure rise of 14,000 lbs. per sq. in. the viscosity increases between ten and twenty times at 100°F. and between five and ten times at 210°F. The results at any given temperature can be represented by an equation of the type

$$\mu_p = \mu_0{}^{a\rho} \times C$$

where μ_p = viscosity at pressure p.
μ_0 = viscosity at atmospheric pressure.
ρ = density of oil at p.
a and C are constants.

From a comparison of similar experiments carried out on Pennsylvanian oil, it appears that the pressure effect on the viscosity of the Russian and Rumanian oils is considerably greater than in the case of typical paraffinic oils.

On a Relation Between Viscosity and Density of Liquids and Liquid Mixture. (M. K. Srinivasan, Phil. Mag., Vol. 32, No. 212, September, 1941, pp. 253-258.) (94/39 Great Britain.)

(1) An equation of the type $\log \eta = a + \beta (\rho_0 - \rho)$ (where η is viscosity, ρ density, and a, β and ρ_0 are constants) is proposed and is shown to represent the variation of viscosity of unassociated and associated, organic and inorganic liquids, with temperature.

(2) The same equation represents the viscosity variation with temperature of binary liquid mixtures at constant composition.

(3) It also represents at constant temperature the viscosity variation of ideal binary liquid mixtures with composition.

Lecithin as Stabiliser for Leaded Fuels. (Autom. Ind., Vol. 85, No. 4, 15/9/41, p. 25.) (94/40 U.S.A.)

Lecithin produced from Soya beans is said to have proved of value as a stabilizer for petrol, and especially leaded petrol. When leaded petrol is exposed to sunlight it may become cloudy, colour changes may take place, and the fuel tank may be subjected to corrosion in the presence of moisture. In one particular case the addition of 10 lb. of soyabean lecithin to 1,000 barrels of aviation gasoline is said to have prevented the formation of precipitates. The corrosion-inhibiting properties of lecithin are especially valuable in the case of aircraft, which usually have fuel tanks made of sheet aluminium.

The Behaviour of Lubricating Oils at Low Temperatures. (K. Siebald, Luftwissen, Vol. 8, No. 7, July, 1941, pp. 224-228.) (94/42 Germany.)

Investigations on the low temperature properties of complex mixture such as lubricating oils concern mainly their resistance to flow, both as regards the initiation of motion and the maintenance of the subsequent flow.

The low temperature starting resistance can be estimated in a special apparatus developed by the I. G. Farben, which records the force required to move a piston previously stuck by the cold oil crystallite. Viscosity determination at low temperature (*i.e.* actual flow) carried out by the usual methods are rendered inconsistent by the phenomena of plasticity exhibited by oils under these conditions. These difficulties have been overcome by the D.V.L. by carrying out the viscosity determination under pressure of the same order as occur in the engine circuit.

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Under these high pressures the oil crystals are broken up and consistent pseudo laminar flow is obtained. It is stated that by the use of the I.G. and D.V.L. instruments an accurate laboratory rating of the oils as regards their low temperature behaviour in an engine has been possible for the first time.

Electrolytic Hexane. (Autom. Ind., Vol. 85, No. 4, 15/9/41, p. 62.) (94/41 U.S.A.)

German investigations have shown that hexane, one of the principal constituents of petrol, can be obtained by electrolysing butyric acid, which is produced by fermentation. By subjecting butyric acid to thermal decomposition, di-n-propyl ketone is obtained, a compound having a freezing point of minus 29 deg. Fahr. and a boiling point of 289 deg. The octane number of this product ranges between 92 and 99. It will mix readily with either absolute or hydrated alcohol and in this form can be used as motor fuel.

Corrosion Resistance of Free-Machining Stainless Steel. (S. P. Watkins, Met. Prog., June, 1941, pp. 710-714.) (94/43 Great Britain.)

Whilst resistant to many corrosive media stainless steels may be affected by minute changes in exposure conditions or minor changes in metal composition. The addition of sulphur or selenium for free-machining properties for instance, reduces the corrosion resistance of stainless steels, especially under severe conditions. Results of comparative tests of the effects of acetic, hydrochloric, nitric and sulphuric acids, salt spray and tap water on free-machining and regular grades of stainless steel are tabulated. In general, hydrochloric and sulphuric acids and salt spray affect most grades, whilst free-machining grades are unsatisfactory with boiling concentrated solutions of nitric acid.

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

Non-Ferrous Physical Metallurgy. (R. M. Brick and A. Phillips, Metal Industry, 18/7/41, pp. 42-44.) (94/44 Great Britain.)

The present status of metallurgical thought on plastic deformation, strain hardening and re-crystallization is reviewed by the authors. Coppergas reactions are also discussed noting that recent investigations on the copper-oxygen system have been conspicuously successful in that many of the results are of immediate practical value. The question of internal oxidation in copper-base alloys is considered followed by an outline of recent work on fatigue. Finally the authors deal briefly with important developments in regard to the magnesium industry.

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

Weldability—Base Metal Cracks. (Spraragen, Claussen, Weld. J., 1941, pp. 201-219.) (94/45 Great Britain.)

This review deals with cracks which started in the base metal before the welded part was placed in service. The various aspects of the problem are dealt with in considerable detail and a bibliography of 147 references is appended.

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

Friction and Surface Finish (M.I.T. Symposium). (Various authors, Metal Industry, Vol. 59, No. 5, 1/8/41, p. 69.) (94/46 Great Britain.)

Almost any of the current methods of finishing moving internal-combustion engine parts as *e.g.* by turning, grinding or honing, results in the formation of a layer of excessively distorted metal, which is undesirable, since in "running-in" operations it leads to accelerated wear. A process for removing this layer of fragmented or "smear" metal has therefore been perfected which is known as "super-finishing."

The basic differences between super-finishing and other forms of abrasive finish are that the speeds of finishing are 3-50 ft./min. for the former, while

6,000-10,000 ft./min. is normal for grinding, and the corresponding pressures are 1-30 lb./in.^{2} as against 500-1,000 lb./in.^{2} for honing; it is evident that the high abrasive pressures and speed of honing and grinding cause local heating which develops defective fragmentary crystal surfaces. Super-finishing involves random motion of a vibratory order with strokes of 1/16 in. to 1/4 in. at 300-3,000 reversals/min., and light oil of the proper viscosity carries away the abraded particles. The process is obviously not a dimensional operation in the machine tool sense, but is essentially a finishing operation only, whereby the "smear" metal is removed.

Generators for Producing Gases of a Given Composition for Heat Treatment Furnace "Atmospheres." (E. E. Slowter and B. W. Gonser, Metal Industry, Vol. 59, No. 5, 1/8/41, pp. 71-75.) (94/47 Great Britain.)

The recent trend in the development of new equipment for the production of controlled atmospheres has been directed to the making of atmospheres which are as nearly as possible in equilibrium with the material to be protected. For high temperature heating of medium and high carbon steels this has usually meant the elimination of CO_2 as well as H_2O, either by avoiding their production or by removing them after formation. Removal after forming may be by wet methods—that is, scrubbing the gas through mono-ethanolamine or other CO_2 absorbent—or by dry means such as passing over hot carbon.

The fact that much steel is still hardened in a partly or completely burned gas atmosphere is not due to ignorance on the part of the heat treater. He is usually well aware of the advantages of an atmosphere free of O_2, CO_2, and H_2O (and which will not deposit carbon) but all too frequently the conditions of operation and scope of his work do not warrant expensive controlled-atmosphere equipment. Attempts to protect the work mechanically by a copper paint, non-metallic coatings or similar means have been reasonably successful only under special conditions. Although effective protective coatings would be greatly welcomed, most steel heat-treaters are willing to make a moderate investment in controlled-atmosphere equipment and are watching with great interest the new types of simple and relatively inexpensive atmosphere producers. Some of them are described by the author.

Surface Hardening by Induction. (Mechanical Engineer, Vol. 63, No. 8, Aug., 1941, pp. 602-603.) (94/48 U.S.A.)

The heating is accomplished by the use of high-frequency currents. Specifically chosen frequencies from 2,000 to 10,000 cycles per sec. and upward of 100,000 cycles are being used extensively at the present time. Current of this nature, when caused to flow through an inductor, will produce a high-frequency magnetic field within the region of the inductor. When a magnetic material such as steel is placed within this field there is a dissipation of energy in the steel both due to hysteresis and eddy currents. Due to the well known skin effect, the heating is limited to the outside layers.

When the temperature of an inductively-heated steel bar arrives at the critical, all heating due to hysteresis ceases and that due to eddy currents continues at a greatly reduced rate. Since the entire action goes on in the surface layers, only that portion is affected. The original core properties are maintained and the surface hardening is accomplished by quenching when complete carbide solution has been attained in the surface areas. Continued application of power causes an increase in depth of hardening, for as each layer of steel is brought to temperature the current density shifts to the layer beneath, which offers a lower resistance. It will at once be obvious that the selection of the proper frequency and control of power and heating time will make possible the fulfilment of any desired specifications of surface hardening.

Induction hardening produces a hardness which is maintained through 80 per cent. of its depth, and from there on toward the core a gradual decrease through a transition zone to the original hardness of the steel as found in the core which has not been affected. The bond is thus ideal, eliminating any chance of cracking.

In addition to the selective surface hardening of steels there have been other applications of induction heating of rather a unique nature. Hardening a piece of steel and brazing to copper and other metals may be done simultaneously. A small section of a previously hardened object can be drawn or softened to a condition possessing ready machinability. Heating for forging and upsetting has been found to be a particularly satisfactory use for induction heating. The speed with which this may be accomplished has made it readily adaptable to the high production requirements of forming equipment, and scale problems are reduced to a minimum. The corresponding increase in die life is of extreme importance. Tip annealing of brass cartridge shells at the rate 100,000 per hour is provided with a single induction-heating unit.

Friction and Surface Finish (M.I.T. Symposium). (Various authors, Metal Industry, Vol. 59, No. 6, 8/8/41, p. 89.) (94/49 Great Britain.)

The mechanism of wear is discussed and classified under the following headings: Cutting due to rough surfaces; abrasion by hard particles; corrosion by chemically active materials in the environment; galling due to molecular forces between metals as modified by surface films; and finally, pitting caused by the fatigue cracking of promontories on the surface, and the belief is expressed that all of these types of wear, except that of cutting wear, are important in service.

In the discussion which followed reference was made to the use of extreme pressure lubricants for "running in" operations, since these have a residual beneficial effect in reducing the wear of the metal parts, even when the lubricant is only plain mineral oil. References were also made to galling between mating surfaces, the formation of cocoa or fretting corrosion, and the actual welding of parts in service.

Fatigue Tests of Welded Joints (University of Illinois). (W. M. Wilson and others, Nature, Vol. 148, No. 3,748, 30/8/41, pp. 261-262.) (94/50 Great Britain.)

The primary object of this Progress Report by the Engineering Department of the University of Illinois was to obtain reliable information on which to base specifications governing the design of welded structural members subjected to reversed or pulsating stresses. The lack of knowledge of the fatigue strength of welded joints has been the principal deterrent to their adoption in the fabrication of bridges, and it was clear that tests on the largest practicable scale would have to be made before this method of construction could be placed on a satisfactory and reliable basis.

Three kinds of stress cycle were used: (1) from a tensile stress to an equal compressive stress; (2) from zero stress to a maximum tensile stress; (3) from a maximum tensile stress to a minimum tensile stress of half the value. These gave ratios r, of -1, 0 and $+0{:}5$ respectively, and for each value of r, seven identical specimens were tested; three so as to fail at 100,000 cycles, and three at 2,000,000 cycles, the seventh being a spare to be tested as desired after the other six tests had been completed.

It appears that the dependable strength of welded joints and plates weakened by transverse welds is quite moderate. But welds in $\frac{7}{8}$ in. carbon-steel plates in the as-welded condition failed after two million cycles, for maximum stresses of 14,400, 22,500, and 36,900 lb. per sq. in. in the three classes of cycles. The corresponding figures for machined-off specimens of classes two and three were 28,400 and 43,700 and for ground-off specimens of class two were 26,300. Stress-relief did not appear to affect fatigue strength and periods of rest showed no advantage. Carbon-steel plates with one transverse fillet weld gave an average of 18,900 and with two welds 13,000 lbs. per sq. in. The character of the bead had some effect on the figures, but for a given base metal the variation did not exceed five per cent.

A New Plastic Material. (Inter. Avia., No. 770/71, 27/6/41, p. 17.) (94/51 U.S.A.)

A construction material which apparently is particularly suitable for the aircraft industry has been developed under the designation *Fybr-Tech.* It consists of a single layer of wood with a layer of artificial fibre bonded by means of artificial resin to each side. The strength of this very light material is stated to be exceedingly satisfactory. Fybr-Tech can readily be sawn, drilled and stamped, immaterial of the direction of the grain, and can be formed under the application of heat without detrimental effect on the surface. Its resistance to meteorological influences is stated to be very good. The idea of using several laminated materials in the construction of aeroplanes is not new and has been adopted in France some considerable time ago. For example, the well-known "Plymax" skin, consisting of three-ply wood on which aluminium sheet was bonded by means of casein for the absorption of torsional stresses, was extensively used in the construction of the Morane 406 single-seater fighter.

A Thermodynamical Theory of the Tensile Strength of Isotropic Bodies. (R. Furth, Procs. Roy. Soc., Vol. 177, No. 969, 10/1/41, pp. 217-227.) (94/52 Great Britain.)

It is well known that attempts to calculate the tensile strength of crystals by means of the lattice theory have failed as yet: the tensile strength, calculated in this way, is about one hundred times larger than the actual value of this quantity, determined by experiments.

The lack of success of the former attempts to calculate the tensile strength from a pure atomistic theory has long ago led many physicists to believe that the usual experiments do not give the real values of the tensile strength because of the imperfections of the real crystals, such as small holes and cracks, which could considerably diminish their strength. Several attempts have been made to perform the experiments under such conditions as to compensate for these defects. But the results of these experiments are not very convincing, and the whole conception of the "apparent" and the "real" strength is very unsatisfactory and improbable.

In a recent paper M. Born (1939) has developed a theory of the melting of crystals based upon principles very similar to those which are used for the treatment of the breaking of crystals mentioned above.

The results of this theory are, however, in good agreement with the experimental facts as regards the absolute value of the melting temperature and its dependence on the pressure.

According to Born's theory melting is nothing else than a breaking due to the action of the heat movement of the atoms; or putting it the other way round, breaking is nothing else than melting enforced by the action of the external forces. So it might further be suggested that the tensile strength should rather be connected with the heat of melting than the heat of sublimation per unit of volume, as predicted by the lattice theory.

This fact was the starting point for the author's considerations which have led to a formula relating the tensile strength of an isotropic body with the heat of melting per unit of volume, in good agreement with the experiments.

Alternative Materials and Design. (G. F. Titterton, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 148 and 241.) (94/53 U.S.A.)

The author presents a number of suggestions for easing the current situation in the American Aircraft Industry, in which the best material for a given job is frequently not available.

AL. ALLOY.—Substitution of common alloy for the heat-treated variety requires the use of a heavier gauge and the insertion of alclad washers below the rivet heads. Extruded shapes may be replaced by fabricated sections. Formed shapes invariably entail an increase in bend radius and the consequent change in rivet position (to obtain a flat seat) requires careful consideration.

The possibility of obtaining the required extrusion from re-working one in stock must therefore not be lost sight of.

STEELS.—The difficulty of obtaining standard S.A.E. 2330 Nickel Steel commonly used for aircraft bolts has necessitated the use of chrome molydenum and modification of the bolt manufacturing equipment, unless the bolts are turned on a lathe.

Forgings of S.A.E. 4140 of electric furnace aircraft quality are also difficult to obtain. It is stated that open hearth steels to government specification can be substituted, provided a proper X-Ray or Magnaflux inspection is carried out. For the early planes of a production order the use of smith or hand forgings is recommended. The stocks of Cr. Mo. steel (almost exclusively used up to now in aircraft construction) can be conserved by restricting its present use to highly stressed parts and using mild carbon steel (S.A.E. 1020 or 1025) whenever possible.

The alternatives proposed do not necessitate any marked changes in design and for this reason plastics and plywood are not included. When the development of these materials is further advanced the metal procurement problem should be eased considerably, since complete sub-assemblies made of these materials should then become available.

Spot Weldability of Al. Alloys. (C. L. Hibert, Aero Digest, Vol. 31, No. 1, July, 1941, pp. 190-200.) (94/54 U.S.A.)

Conditions which are known to affect spot weldability of Al. Alloys are: chemical composition, surface condition, conditions under which welding is performed, type of service to which the product is put and the technical education and experience of the welding personnel. The main difficulty is the high thermal conductivity of Al. Alloys which, however, depends to some extent on composition and heat treatment. Soft material is generally more conducting and correspondingly more difficult to weld. Conditions under which welding takes place, such as machine settings, size and shape of electrodes, edge distance and accessibility play a large part on the success or failure of the operation. The author discusses some of these points in detail and describes modern form of equipment designed to rule out the personal element as much as possible. Of all the factors, the human element is the most difficult to control. Each operator has his own method and at least six months are required to train him to the point where consistent work can be expected. Quality, rather than speed, is to be aimed at.

At present most of the spot welding is restricted to secondary structures. A proper weld is, however, as strong as the rivetted job. The difficulty is to ensure consistency in large scale production and devise a method of non-destructive testing.

Internally Heated Electric Salt Bath. (Aero Digest, Vol. 31, No. 1, July, 1941, p. 214.) (94/55 U.S.A.)

Based on a design which is described as the "electrothermic-permeation" principle, an improved type of internally heated electric salt bath furnace is reported, capable of producing more uniform heat, reducing fuel costs, and eliminating excessive spoilage of carburizing salts; it also features a ceramic pot which can be guaranteed for at least one year's operation.

Range of operation available with the furnaces includes virtually any heating operation requiring temperatures of from 300° to 2,500°F. and the "proving" period for the furnaces is said to have covered almost every classification of temperature, composition and size of work. Furnaces are now available for carburizing, cyaniding, hardening of molybdenum and tungsten high-speed steels, selective hardening, brazing, heating for forging, treating aluminium alloys, tool tipping, etc. in a range of sizes suitable for either batch or continuous operation.

Advantages claimed for the new design are: greater efficiency due to generation and distribution of heating throughout entire pot with larger percentage of heat developed at the bottom; elimination of super-heated spots to destroy chemical balance of bath; spacing of electrodes to prevent possibility of shorting and burning the work; 20 per cent. greater working area.

The electrothermic-permeation principle takes its name from the fact that the heat for the bath is generated throughout the effective confined separate heating area. Distribution of current flow for working space rather than in a heating, the salt is by a unique arrangement of electrodes so that the greatest heat is at the bottom of the pot, with the balance decreasing in intensity as it approaches the surface of the liquid.

X-Ray Analysis in Industry. (J. Sc. Inst., July, 1941, pp. 126-158.) (94/56 Great Britain.)

The second part of this Symposium is reproduced in this issue and is devoted to the technique of X-Ray analysis methods and some recent developments. Thirteen papers are recorded and include the following:—Photometry of X-Ray Crystal Diffraction Diagrams; a simple photometer for the examination of X-Ray films; experimental technique in the study of alloy by X-Rays; X-Ray crystal photography at low temperatures; measurement of stress by X-Rays; some applications of X-Ray methods in the examination of organic crystals; the derivations of lattice spacings from Debye-Scherrer photographs; systematic determination of crystal orientation; some applications of X-Ray technique to the study of preferred orientation of crystals in metals; Supperlattices; X-Ray diffraction and the deformation of metals; precipitation in the solid state and particle size measurement by the X-Ray method.

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

Instrument Bearings. (Mechanical Engineer, Vol. 63, No. 8, Aug., 1941, pp. 601-602.) (94/57 U.S.A.)

Diamonds, rubies, sapphires, synthetic sapphires, garnets, chrysoberyl, spinels, zircons, topazes, rock crystal, and agates, are made into watch and chronometer jewels and bearings for meters and other scientific instruments.

The diamond, although superior to other gems, is not widely used due to the cost of the rough stone and the time and labour expended in shaping this, the hardest of all substances.

Sapphire and ruby jewels (mostly synthetic) serve as pivots and counter-pivots. Such jewels are not pierced but are cut into "cup jewels." Jewelled bearings are also used for bomb fuses and in the instruments for combat aeroplanes and bombers. A modern Curtiss pursuit plane has at least ninety instruments, dials, knobs, etc., and many of these require jewel bearings. Navigation watches alone have 21-jewel movements.

Quartz Membrane Manometers of Small Volume. (Kenty, Rev. Sci. Instrum., Nov., 1940, pp. 377-386.) (94/58 Great Britain.)

Fused quartz membrane manometers, used as null instruments, have been developed for measuring the pressures of vapours or gases from a few centimeters of mercury to 50 atmospheres, with an accuracy of the order of 0.1 per cent. It is stated that all-quartz manometers are remarkably constant in calibration, are operable at temperatures of 800°C. or higher, and are extremely rugged and free from explosion hazard at high pressure.

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

An Omni-directional Radio Range System. (D. G. C. Luck, R.C.A. Review, Vol. 6, No. 1, July, 1941, pp. 55-58.) (94/59 U.S.A.)

Radio navigation may be done with direction-finding receivers on mobile craft, with fixed direction-finders on the ground or with directional beacon transmitters on the ground. Each method has its unique merits and faults, but the last seems especially suited for aircraft guidance in the United States and has, in the form of four-course radio " range " beacons, rendered outstanding service. The disadvantages of limited choice of courses and of difficulty in definitely determining on which course a craft may be, inherent in the present four-course ranges, may be avoided by rotating a transmitted radio beam and timing its passage over the receiving craft to determine uniquely the bearing of that craft from the known location of the beacon transmitter.

A rotating beam, of figure-eight shape, may be produced without mechanical motion by setting up two fixed antenna systems having figure-eight directivity at right angles and feeding them with radio-frequency signals modulated at the desired rotation frequency, the modulation of the separate supplies to the two crossed antennas being in phase quadrature. Unmodulated carrier to resolve the ambiguity of the figure-eight beam, by changing its shape to a limaçon, is radiated from a non-directive antenna, and a timing reference is provided by interrupting all transmission momentarily just as the beam points north.

The audio output from a receiver tuned to this beacon comprises a sine wave produced by the sweep of the beam and a train of impulses produced by the reference keying. The sine component is filtered, split in phase and used to drive a cathode-ray beam in a circle, in step with the rotation of the transmitted beam. The impulses are used to slow up the beam electrons momentarily, marking the swept circle with an outward jog, and so indicating receiver bearing directly. The impulses also actuate a zero-centre meter, while the sine wave renders this meter insensitive at a certain moment of the cycle and oppositely sensitive just before and just after that moment. By adjusting the sine wave phase, the meter may be centred when the receiver is on any desired bearing, and thereafter will indicate any departure from that bearing. A special broadcast transmission may be used to check adjustments of receiving indicators.

Certain conditions as to modulation phases and amplitudes, antenna-current phases and amplitudes, antenna geometry and cathode-ray indicator voltage phases, amplitude and tube geometry must be fulfilled if accurate bearings are to be obtained. Study of these conditions shows all adjustment tolerances to be of reasonable magnitude, though considerable care in antenna construction is necessary to insure adequate symmetry of antenna-current phase.

On Starting an Electric Spark by Intense Ionisation of the Sparking Space. (T. Shimiza and M. Hirata, Scientific Papers of the Inst. of Phys. and Chem. Research, Tokyo, Vol. 38, No. 1,022.) (94/60 Japan.)

The sparking potential between spherical electrodes in air is somewhat variable and if such gaps are used for high-speed cinema exposures the fluctuation in the actual time of passage of the spark may introduce errors. In the author's arrangement of the gap, one of the sparking electrodes is hollow and provided with a thin metal foil window facing the second electrode. The hollow electrode forms part of a high vacuum grid type cathode-ray generator (triode) which ionises the gap and lowers its critical potential by about 30 per cent. The spark will now start with a time lag of less than 10^{-7}.

The new device will function either as:—

(1) An electric relay releasing considerable amount of energy almost instantaneously under very feeble stimulation,
(2) An arrangement for taking instantaneous photograph which is easy to control,
(3) A chonograph for measuring short time intervals with an accuracy of 10^{-7} sec.

The Effect of Rain and Fog on the Propagation of Very Short Radio Waves. (J. A. Stratton, Proc. I.R.E., Vol. 18, No. 6, June, 1930, pp. 1,064-1,074.) (94/61 U.S.A.)

The purpose of this paper is to investigate theoretically the effect of rain, fog, or clouds on the propagation of short radio waves. The theory of the propagation of electro-magnetic waves in a medium in which are suspended spherical particles of an arbitrary material is first reviewed. The available physical data on fog and rain is then referred to. The conclusions arrived at are that rain and fog have no effect on the propagation of radio waves of the frequencies now employed. Rain first begins to influence markedly the propagation of waves less than 5 cm. in length. Thereafter, the absorption increases very rapidly with decreasing wavelength, due both to scattering and the selective absorption of the water molecule. Infra-red radiation should not, therefore, prove satisfactory for communication purposes through heavy fog. The absorption coefficient for this case may be readily obtained from the formulas. For fog the formulas given in this paper are valid for wavelengths exceeding about 0.05 mm., provided the complex form of the index of refraction is used.

The CAA-MIT Microwave Instrument Landing System. (E. L. Bowles, W. L. Barrow and others, A.I.E.E. Trans., Vol. 59, 1940, pp. 859-864.) (94/62 U.S.A.)

This paper deals with the problem of developing an instrument landing system in which the pilot is kept informed as to both his location and orientation by the indications of a single instrument. The solution of this problem includes the application of centimetre waves, the development of a straight-line glide path, and the realization of a novel instrument combination. The apparatus was designed to demonstrate feasibility only. Commercial embodiment of the results is now within the reach of industry. In the course of the solution of the problem a landing system has been evolved embodying both a unique indicating instrument and landing path. The two elements, although used in combination in the system described, can also be applied independently. For example, the instrument may be used with constant intensity glide path and the straight-line glide path may be used with a conventional crossed pointer instrument. The landing path described in this paper marks a significant advance not simply because it is straight, and of an equi-signal nature, but because it demonstrates a means by which a path essentially free from the effects of ground and surrounding objects may be realized. The radio beam being thus substantially free from the effects of its surroundings makes the landing path reproducible and therefore makes the system truly portable. Although the 50-centimetre landing system was evolved it was felt that a 10-centimetre system would certainly be evolved in the near future.

Theoretical and Experimental Investigations of Electron Motions in Alternating Fields with the Aid of Ballistic Models. (H. C. Hollmann, Procs. of the I.R.E., Vol. 29, No. 2, Feb., 1941, p. 70.) (94/63 U.S.A.)

The motion of electrons and the exchange of energy in ultra-high-frequency transverse and longitudinal field is investigated theoretically and experimentally by means of ballistic models in which single balls or a beam of balls roll over potential slopes whose gradients change with time. In this way there are represented by models, first a cathode-ray tube, then the Heil two-field generator, and finally the Klystron.

Heretofore, such tube models have only been employed for illustrating and investigating stationary phenomena. The rubber membrane is stretched over stationary supports and its form remains unaltered while the balls roll. However, dynamic phenomena can also be imitated in this manner. For this purpose the height adjustments of the membrane must be periodically altered and in a rhythm whose period is comparable with the transit time of the balls. Fundamentally it is immaterial in which direction the balls roll over such a dynamic membrane, that is to say, whether in the same direction, or normal to the direction of the field lines which are altering with time, consequently the model may provide for a transverse or a longitudinal control or for a resultant of the two components.

The actual purpose of the models and researches which have been discussed is not only to derive the efficiency functions from the mechanical premises but especially to provide the exact insight into the excitation phenomena which is not so easy to obtain in the region of micro-waves with a 10^8 time refinement. Furthermore, by means of the ballistic model there can be obtained exact data for the suitable proportioning of the electrical apparatus initiated by the mechanical models.

Electro-Magnetic Horn Design. (L. J. Chu and W. L. Barrow, A.I.E.E. Trans., Vol. 58, July, 1939, pp. 333-338.) (94/64 U.S.A.)

The principles of designing electro-magnetic horn "antennas" to obtain beams of specified angular spread, smoothness of contour and power gain are disclosed. Although a wide variety of shapes is possible, a shape having a rectangular cross section perpendicular to the central axis of the horn is preferable because it is capable of producing a linearly polarized wave and also permits an independent control of the width of the radiated beam in the horizontal and vertical planes. Horns having straight sides in the longitudinal cross section have been most used because of the economy and ease of construction and because thorough analysis of this structure has been made. Quantitative curves are given from which the design of sectoral and pyramidal horns may be readily made. The material from which the horn is made may be any of the highly conducting metals. Galvanized iron sheeting and thin electrolytic copper foil cemented to plywood have both proved satisfactory. Screen or other semi-open construction may also be employed. Two general methods of exciting the horn are available: (1) the hollow-pipe feed, and (2) direct excitation.

Aircraft Radio, 1939. (Electronics, Jan., 1939, pp. 10-14, 43.) (94/65 U.S.A.)

A report of the technical background of recent developments of aircraft radio services. Recent achievements are reviewed in the use of radio for solving the problems of altimetering, course finding and course marking, blind landing and traffic control. One of them was the absolute altimeter developed jointly by United Airlines and the Bell Laboratories. Its significance lay in the use of the highest frequency yet applied to regular service, 500 Mc. Another was the development by the M.I.T. of a blind landing system, using "horn" radiators of the wave-guide type. A cathode-ray tube is used as indicator in this system. Yet another was the radio direction finder jointly announced by the Sperry Company and the R.C.A. Manufacturing Company operating on the 350-450 Kc. beacon band, which is completely automatic in operation, pointing toward the station being received without any attention from the pilot.

Theory of the Electro-magnetic Horn. (W. L. Barrow and L. J. Chu, Proc. I.R.E., Vol. 27, No. 1, Jan., 1939, pp. 51-64.) (94/66 U.S.A.)

This paper deals with the theory of the transmission of waves through the inside of the horn and into the outer free space. Although the analysis applies specifically to the sectoral horn, it provides a clear physical picture of the operation of electro-magnetic horns of any shape. The analysis applies directly to the transmission of waves in a hollow pipe-line with constants that change along its length, that is, to a " tapered " hollow-pipe line. The analysis also bears on the operation of a tapered section of hollow-pipe used as a connection between two uniform hollow-pipe lines of unequal cross sections. Such tapered sections may be used to reduce the electrical discontinuity when joining two pipes of unequal dimensions, for an aid in matching their impedances, and for other purposes. The analysis falls naturally into two parts. In the first part the boundary conditions for a horn of perfect conductivity and of infinite length is imposed on the appropriate solutions of Maxwell's equations to obtain the expressions for the electric and magnetic fields within the horn and to derive the more important transmission properties of these internal waves. In the second part Huygens' principle is invoked to calculate the shape of the radiation field at a great distance from the mouth of the horn by assuming the distribution across the mouth to be the same as would exist there if the sides of the horn extended to infinity. Certain transmission quantities, like the phase constant, attenuation constant, velocity of propagation, etc. are calculated for horns of any angle of flare and the field configuration within the horn is plotted. One result is a clear understanding of the propagation of waves within the horn. Another result is that design specifications for horns may be established. Calculations of radiation patterns made in this analysis agree satisfactorily with experiments reported in a companion paper.

Materials for Electrical Contacts. (J. C. Chaston, J. Inst. of Elect. Eng., Vol. 88, Pt. II, No. 4, Aug., 1941, pp. 216-301.) (94/67 Great Britain.)

The principal types of failure in light- and medium-duty electrical contacts are analysed in detail and an account is given of the characteristics of the commonly used contact materials.

The effects on contact resistance of the size, shape, surface finish and closing pressure of light-duty contacts are discussed; an account is given of the resistance of contact materials to the formation of tarnish films; and attention is directed to the effects of dust and grease films in causing failure.

In medium-duty contacts, when arching occurs, the most serious cause of failure is the action known as " material transfer " which takes place when direct currents are interrupted. As a result of transfer the contact gap may close and the contacts finally interlock. The factors which influence material transfer are discussed, and curves are reproduced to show the limiting current and the rate of build-up for a number of common contact materials under given test conditions.

A second cause of failure is the welding together of the contacts by the current surge at make. The inherent tendency of a number of contact materials to weld together has been measured.

In sliding contacts excessive wear is a frequent cause of troubles. A method of testing the wear of unlubricated surfaces is described, and the results of measurements on a number of combinations are tabulated.

Making Greater Use of Invention. (S. MacDonald, Engineer, Vol. 172, No. 4,468, 29/8/41, pp. 135-137.) (94/68 Great Britain.)

If an examiner has a definite dislike of some part of an invention he should be allowed to say that he belongs to another school of thought, and advise that the matter should be handed to someone else for consideration. In view of this natural attitude, the people to whom the report is made should not depend on the report of one man or even one group of men working together, unless minority statements are permitted.

This country gained its colonies and foreign connections through the venturesome spirit of its sailors; and it got its export trade through having the technicians, the factories, the raw materials, the internal and external transport facilities, and the financial power which other nations lacked, and it sold wealth-producing instruments, such as railways, on the hire-purchase system (foreign loans). It has lost that position, and the only way to hold at least some of the foreign trade seems to be for the manufacturers and customers here to display more of the venturesome spirit and take risks.

Inventions must be developed by ourselves. We can no longer afford to wait till they are proved a commercial success.

Our Unused Potentialities for Aeronautical Research and Development. (J. E. Younger, Mechanical Engineer, Vol. 63, No. 8, August, 1941, pp. 575-576.) (94/69 U.S.A.)

Funds have been provided for practically every phase of aviation except the most important phase of all, *i.e.* the training of engineers whose business it will be to design and superintend the construction of those marvels of mechanism, the aeroplanes of the future, and to make those aeroplanes better than they can be made anywhere else in the world.

If additional educational training for the aeronautical engineers who are to be the designers of the future air liners is to be provided for, and certainly this will be absolutely necessary, additional funds must come from some other source, *i.e.* personal endowment, endowment by the industry, or endowment by the National Government.

Other aeronautical sciences are so far behind the science of aerodynamics in development that practical use cannot be made of the new discoveries in aerodynamics. By all means the development of aerodynamics must not be slowed down, but other phases of the aeronautical sciences of equal importance should be given equal consideration for a balanced programme. The standard of aeronautical training and research in structures, materials, fabrications, and other phases of aeronautics must be brought up at least to the standard set for aerodynamics.

Electrical Machine Solves Heat Transfer Problems. (Swain Power, July, 1941, pp. 76-78.) (94/70 Great Britain.)

Details are given of a method of solving complicated heat-transfer problems by converting the thermal constants and variables to analogous electrical units. The machine described has fifteen sections and can be used to duplicate any heat-transfer structure that can be suitably represented by fifteen divisions.

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

LIST OF SELECTED TRANSLATIONS.

No. 37.

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.

WARFARE.

TRANSLATION NUMBER AND AUTHOR.		TITLE AND REFERENCE.
1255	Shaurov, N. ...	*The Use of Armour in Aircraft.* (Air Fleet News, U.S.S.R., Vol. 25, No. 3, March, 1941, pp. 243-247.)
1271	Yassin, E. Z. ...	*The Use of "Dummies" in the Camouflage of Operational Aerodromes.* (Air Fleet News, U.S.S.R., Vol. 25, No. 5, May, 1941, pp. 432-439.)

AERO-HYDRODYNAMICS.

1263	Flugge-Lotz, I. ... Ginzel, I	*Two-Dimensional Flow Round a Slotted Flap.* (Ing. Archiv., Vol. 11, No. 4, Aug., 1940, pp. 268-292.)
1245	Riegels, F. ... ... Weber, J.	*Contribution to the Design of Impellers Subjected to Shock at Entry.* (Ing. Arch., Vol. 12, No. 1, Feb., 1941, pp. 63-69.)

AIRCRAFT AND ACCESSORIES.

1247	Kronauer, E. von ...	*Dynamic Balance of Airscrews.* (Flugwehr und Technik, No. 6, June, 1941, pp. 141-144.)
1274	Horten, G.	*"Horten V" All-Wing Aircraft.* (Luftwissen, Vol. 8, No. 4, April, 1941, pp. 118-119.)

MATERIALS.

1253	Wiederholt, W. ...	*Surface Protection of Metals.* (Z.V.D.I., Vol. 85, No. 20, 17/4/41, pp. 451-459.)
1273	Eisele, K.	*Pilot Balloons Made from Transparent Plastic Film.* (L.F.F., Vol. 18, No. 4, 22/4/41, pp. 147-154.)

ENGINES AND FUELS.

1242	Weltin, C.	*Double Test Stands for Aero Engines.* (Z.V.D.I., Vol. 83, No. 47, 25/11/39, pp. 1,237-1,238.)
1265	Volkov, G. K. ...	*Some Peculiarities in the Working of Aircraft Fuel Systems.* (Air Fleet News, U.S.S.R., Vol. 23, No. 5, May, 1941, pp. 442-444.)
1266	Fokin, M. P. ...	*Operation of Aircraft Fuel Systems at High Altitudes.* (Air Fleet News, U.S.S.R., Vol. 23, No. 5, May, 1941, pp. 445-447.)
1248	Vokhmyanin ...	*Petrol Poisoning in Flight.* (Air Fleet News, U.S.S.R., Vol. 23, No. 3, March, 1941, pp. 265-267.)

TITLES AND REFERENCES OF ARTICLES AND PAPERS SELECTED FROM PUBLICATIONS RECEIVED IN R.T.P.3 DURING AUGUST, 1941, TOGETHER WITH LIST OF NEW TRANSLATIONS RENDERED AVAILABLE.

Notices and abstracts from the Scientific and Technical Press are prepared primarily for the information of the 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.

Theory and Practice of Warfare.

79/1	Germany ...	*The New German Mauser Cannons (15 mm. and 20 mm.).* Aeroplane, Vol. 61, No. 1,575, Aug. 1st, 1941, p. 113.)
79/2	Great Britain	*Short Stirling Heavy Bomber (Photograph).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, pp. 112-113.)
79/3	U.S.A. ...	*Glen Martin 187 Baltimore (Photograph).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 115.)
79/4	U.S.A. ...	*Brewster Bermuda Two-Seat Dive Bomber (Drawing).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 115.)
79/5	U.S.A. ...	*Boeing Fortress I (Photograph).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 116.)
79/6	U.S.S.R. ...	*Russian Aircraft Photographs (I. 187 and S.B. 2).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 117.)
79/7	Great Britain	*Douglas Havoc Night Fighter (Photograph).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 119.)
79/8	Germany ...	*Messerschmitt Me. 109F (Description of Captured Aircraft).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, pp. 120-122.)
79/9	Germany ...	*German High Command of Air Operation in 1941 up to the Conquest of Crete.* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, pp. 124-125.)
79/10	U.S.A. ...	*Consolidated Liberator (Photograph).* (Aeroplane, Vol. 61, No. 1,575, 1/8/41, p. 133.)
79/11	Great Britain	*Uses of Wood in Warfare.* (Nature, Vol. 148, No. 3,745, 9/8/41, p. 161.)
79/12	U.S.A. ...	*Will Bacteria be Used in War (Insurmountable Difficulties Explained).* (J. J. Kershaw, Scientific American, Vol. 165, No. 2, Aug., 1941, pp. 56-58.)
79/13	U.S.A./ Great Britain	*Vultee "Vanguard 48 D."* (Inter. Avia., No. 766, 27/5/41, p. 8.)
79/14	U.S.A. ...	*Vultee "Vengeance" 72.* (Inter. Avia., No. 766, 27/5/41, pp. 8-9.)
79/15	U.S.A. ...	*Douglas A. 20A Twin Engine Attack Bomber (Development of Boston DB-7).* (Inter. Avia., No. 766, 27/5/41, p. 9.)
79/16	U.S.A. ...	*Mass Production of Consolidated B-24 Heavy Bomber.* (Inter. Avia., No. 766, 27/5/41, p. 10.)
79/17	Great Britain	*Dinghies for British Fighters.* (Inter. Avia., No. 766, 27/5/41, p. 15.)

79/18	Great Britain	*Luminescent Materials and Their War Time Use.* (Nature, Vol. 148, No. 3,743, 26/7/41, pp. 118-119.)
79/19	Germany ...	*External Ballistics—Angle of Elevation and Range as Affected by Topographical Features (Elevation or Depression of Target with respect to the Horizontal).* (K. Stange, Z.G.S.S., Vol. 36, No. 6, June, 1941, pp. 115-120.)
79/20	Great Britain	*Bristol Beaufighter.* (The Engineer, Vol. 172, No 4,465, 8/8/41, pp. 92-93.)
79/21	U.S.A. ...	*Consolidated P.B. 27-2 Four-Engined Flying Boat Petrol Bomber.* (Scientific American, Vol. 165, No. 2, Aug., 1941, p. 94.)
79/22	U.S.A. ...	*Aircraft Armour—Production Speed-Up.* (Scientific American, Vol. 165, No. 2, Aug., 1941, p. 95.) (Abstract available.)
79/23	Germany ...	*Variation in Shell Trajectory by Change in One of the Principal External Characteristics (Ballistic Coefficients, Muzzle Velocity, Elevation, Air Density, Wind).* (H. Knobloch, Z.G.S.S., Vol. 36, No. 7, July, 1941, pp. 137-140.)
79/24	Germany ...	*Parachutes and Their Manufacture.* (G. Sedlmayer, Luftwissen, Vol. 8, No. 5, May, 1941, pp. 146-150,) (Abstract available.)
79/25	U.S.A./ Germany ...	*Tail Units of Lockheed Hudson and Me. 110.* (Flight, Vol. 40, No. 1,708, 18/9/41, p. c.)
79/26	Great Britain	*Short Stirling.* (Aeroplane, Vol. 61, No. 1,581, 12/9/41, p. 27.)
79/27	U.S.A. ...	*Black-Out Lighting on Army Vehicles.* (Autom. Ind., Vol. 84, No. 11, 1/6/41, pp. 582-583.)
79/28	U.S.A. ...	*Republic XP 47B Thunderbolt (Photograph).* (Autom. Ind., Vol. 84, No. 11, 1/6/41, p. 587.)
79/29	U.S.A. ...	*Boeing Fortress I High Altitude Bomber.* (Flight, Vol. 40, No. 1,704, 21/8/41, p. 106.)
79/30	U.S.A. ...	*Douglas B. 19 Giant Aircraft.* (Air Services, U.S., Vol. 26, No. 7, July, 1941, pp. 25-26 and 38.)
79/31	Great Britain	*Bristol Beaufighter (Photograph).* (Airc. Eng., Vol. 13, No. 150, Aug., 1941, p. 210.)
79/32	Germany ...	*Ha 139 Long Range Float Seaplane.* (Airc. Eng., Vol. 13, No. 150, Aug., 1941, pp. 218-220.)
79/33	Great Britain	*Black-Out in Factories.* (Airc. Eng., Vol. 13, No. 150, Aug., 1941, pp. 225-226.)
79/34	Great Britain	*Bristol Beaufighter.* (Engineering, Vol. 152, No. 3,943, 8/8/41, pp. 116-117.)
79/35	U.S.S.R. ...	*Armour on Aircraft.* (B. Ivanov, Aeroplane, U.S.S.R., No. 3, March, 1941, pp. 36-37.)
79/36	Great Britain	*Bristol Beaufighter.* (Flight, Vol. 40, No. 1,703, 14/8/41, pp. 90-d.)
79/37	Great Britain	*Wellington Mark II (Photograph).* Flight, Vol. 40, No. 1,703, 14/8/41, p. 86.)
79/38	U.S.A. ...	*Martin Baltimore and B. 26 (Silhouettes).* (Flight, Vol. 40, No. 1,703, 14/8/41, p. 90e.)
79/39	Great Britain	*Bristol Bolingbroke (Photograph).* (Flight, Vol. 40, No. 1,703, 14/8/41, p. 98.)
79/40	Germany ...	*Me. 109 F1/2 High Altitude Fighter.* (Flight, Vol. 40, No. 1,701, 31/7/41, p. 62.)
79/41	U.S.A. ...	*Curtiss Mohawk and Vultee Vanguard (Silhouette).* (Flight, Vol. 40, No. 1,701, 31/7/41, p. d.)

79/42	U.S.A. ...	*Developments in American Types (Fortress, Liberator, Catalina, Maryland, etc.).* (Flight, Vol. 40, No. 1,701, 31/7/41, p. f-63.)
79/43	Great Britain	*Short Stirling (Photograph).* (Flight, Vol. 40, No. 1,701, 31/7/41, p. 64.)
79/44	U.S.A. ...	*Martin 187, Baltimore and B-26 Marauder.* (Flight, Vol. 40, No. 1,701, 31/7/41, p. 64.)
79/45	U.S.A. ...	*Curtiss Tomahawk (Photograph).* (Flight, Vol. 40, No. 1,703, 14/8/41, p. 88.)
79/46	U.S.A. ...	*Vultee Vengeance Dive Bomber (Photograph).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 163.)
79/47	Great Britain	*Wellington II (Photograph).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 163.)
79/48	U.S.S.R. ...	*Russian Medium Bomber CKB-26 (Photograph).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 171.)
79/49	U.S.A. ...	*Consolidated Catalina (Silhouettes).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 172.)
79/50	Japan ...	*Japan's Air Power.* (V. L. Grubey, Aeroplane, Vol. 61, No. 1,577, 15/8/41, pp. 174-175.)
79/51	Great Britain	*Bristol Beaufighter (Photograph).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 181.)
79/52	U.S.A. ...	*Bell Airacobra (Photograph).* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 182.)
79/53	Great Britain	*History of Machine Gun Synchronisation.* (Aeroplane, Vol. 61, No. 1,577, 15/8/41, p. 188.)
79/54	U.S.A. ...	*Curtiss Dive Bomber SB2C-1.* (Inter. Avia., No. 767, 7/6/41, p. 9.)
79/55	U.S.A. ...	*Vultee Attack Bomber V-12C and D.* (Inter. Avia., No. 767, 7/6/41, pp. 9-10.)
79/56	U.S.A. ...	*Martin Patrol Bomber Flying Boat, PBM-1.* (Inter. Avia., No. 767, 7/6/41, p. 10.)
79/57	U.S.A. ...	*North American Single-Seat Fighter XP. 51 (NA-73 "Mustang" or "Apache").* (Inter. Avia., No. 767, 7/6/41, p. 10.)
79/58	U.S.A. ...	*Ballanca Plastic Trainer T-14-14.* (Inter. Avia., No. 767, 7/6/41, pp. 10-11.)
79/59	U.S.A. ...	*Fleetwings Basic Trainer XBT-12.* (Inter. Avia., No. 767, 7/6/41, pp. 11-12.)
79/60	Germany ...	*German Shelter Buildings.* (Inter. Avia., No. 767, 7/6/41, p. 14.) (Abstract available.)
79/61	Germany ...	*Electrical Operation of Time Fuses for Shells.* (G. Grotsch, Z.G.S.S., Vol. 36, No. 7, July, 1941, pp. 135-137.) (Abstract available.)
79/62	Germany ...	*Effect of Elevation of Target on Range.* (K. Strange, Z.G.S.S., Vol. 36, No. 7, July, 1941, pp. 140-141.)
79/63	U.S.S.R. ...	*Tactical Considerations in the Design of Fighter Aircraft (cont. from Vol. 14, No. 12, December, 1940).* (M. P. Stroyer, Aeron. Eng., U.S.S.R., Vol. 15, No. 5-6, May-June, 1941, pp. 8-13.)
79/64	Great Britain/ Germany ...	*Tail Unit Design in Hurricane and He. 113.* (Flight, Vol. 40, No. 1,705, 28/8/41, p. a.)
79/65	Great Britain	*Bristol Beaufighter.* (Flight, Vol. 40, No. 1,705, 28/8/41, pp. f-L.)
79/66	U.S.A. ...	*Catalina Taking Off (Photograph).* Flight, Vol. 40, No. 1,705, 28/8/41, p. 119.)

79/67	U.S.A. ...	*Testing Army Warplanes at Wright Field.* (Automotive Industries, Vol. 85, No. 2, 15/7/41, pp. 24-25 and 70.)
79/68	U.S.A. ...	*He. 115 Long Range Bomber (Photograph).* (Autom. Ind., Vol. 85, No. 2, 15/7/41, p. 49.)
79/69	Canada ...	*Martin Maryland (Cockpit Photograph).* (Canadian Aviation, Vol. 14, No. 7, July, 1941, p. 19.)
79/70	U.S.A. ...	*Catalina Gun Blister (Photograph).* (Canadian Aviation, Vol. 14, No. 7, July, 1941, p. 29.)
79/71	Canada ...	*Combat Experience of No. 1 Fighter Squadron (R.C.A.F.).* (Canadian Aviation, Vol. 14, No. 7, July, 1941, pp. 15-17 and 32.)
79/72	Great Britain	*Crop Damage by Air Attack.* (J. Russel, Nature, Vol. 148, No. 3,747, 25/8/41, pp. 215-217.)
79/73	U.S.A. ...	*Republic P. 47 Thunderbolt (Photograph).* (Aeroplane, Vol. 61, No. 1,572, 11/7/41, p. 32.)
79/74	U.S.A. ...	*Consolidated Liberator (B. 24).* (Aeroplane, Vol. 61, No. 1,572, 11/7/41, p. 40.)
79/75	U.S.A. ...	*Douglas Havoc Night Fighter (Photograph).* (Aeroplane, Vol. 61, No. 1,572, 11/7/41, p. 41.)
79/76	Great Britain	*Rapid Black-Out of a Factory.* (Nature, Vol. 148, No. 3,746, 16/8/41, p. 193.)
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79/78	Germany ...	*Aerial Barrages (Barrage Balloons, Aerial Mines and Kites).* (L. Schuttel, published by Lehmann,1939.) (Abstract available.)
79/79	Germany	*Split Trailing Edge Flaps on Me. 109 F 1/2 (Photograph).* (Flight, Vol. 40, No. 1,702, 7/8/41, p. 75.)
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79/81	U.S.A. ...	*Vought-Sikorsky Chesapeake Dive Bomber.* (Flight, Vol. 40, No. 1,702, 7/8/41, g.)
79/82	U.S.A. ...	*Northrop A.17-A Dive Bomber.* (Flight, Vol. 40, No. 1,702, 7/8/41, p. g.)
79/83	Great Britain	*Short Stirling.* (Flight, Vol. 40, No. 1,702, 7/8/41, p. 80.)
79/84	U.S.A. ...	*Lockheed Vega 37 (Ventura) (Photograph).* (Aeroplane, Vol. 61, No. 1,578, 22/8/41, p. 190.)
79/85	Great Britain	*Accidents to Liberators Engaged on Ferry Service.* (Aeroplane, Vol. 61, No. 1,578, 22/8/41, p. 190.)
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79/88	Great Britain	*Bristol Beaufighter Silhouette.* (Aeroplane, Vol. 61, No. 1,578, 22/8/41, p. 201.)
79/89	Great Britain	*Production of the Bristol Beaufighters.* (Aeroplane, Vol. 61, No. 1,578, 22/8/41, pp. 208-209.)
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79/94	Germany ...	*Heinkel Me. 115 Torpedo Plane (Photograph).* (Aeroplane, Vol. 61, No. 1,576, 8/8/41, p. 147.)
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79/98	U.S.S.R. ...	*Russian Aeroplane in Service (Silhouettes).* (Aeroplane, Vol. 61, No. 1,576, 8/8/41, pp. 154-155.)
79/99	Great Britain	*Bristol Beaufighter—Detail of Oil Cooler and Nose (Photographs).* (Aeroplane, Vol. 61, No. 1,579, 29/8/41, pp. 222.)
79/100	U.S.A. ...	*North American NA-40C Attack Bomber (Photograph).* (Aeroplane, Vol. 61, No. 1,579, 29/8/41, p. 223.)
79/101	Great Britain	*Early Types of Gun Synchronising Gears.* (Aeroplane, Vol. 61, No. 1,579, 29/8/41, pp. 224 and 240.)
79/102	Japan ...	*Japan's Air Force.* (Aeroplane, Vol. 61, No. 1,579, 29/8/41, p. 225.)
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