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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.	Automobile Technische Zeitschrift.
Bell Tele. Pubs.	Bell Telephone Publications.
Bur. Stan. J. Res.	Bureau of Standards (U.S.A.) Journal of Research.
Chem. Absts.	Chemical Abstracts.
Chem. and Ind.	Chemistry and Industry.
Comp. Rend.	Comptes Rendus de L'Académie des Sciences.
Eng. Absts.	Engineering Abstracts.
E.N.S.A.	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 Electroakustik.
Ind. and Eng. Chem.	Industrial and Engineering Chemistry.
Ing.-Arch.	Ingenieur-Archiv.
Inst. Autom. Eng.	Institute of Automobile Engineers (Research and Standardisation Committee).
J. Aeron. Sci.	Journal of the Aeronautical Sciences.
J. App. Mech.	Journal of Applied Mechanics.
J. Am. Soc. Nav. Engs.	Journal of American Society of Naval Engineers.
J. Roy. Aero. Soc.	Journal of Royal Aeronautical Society.
J. Frank. Inst.	Journal of Franklin Institute.
J. Inst. Civ. Engs.	Journal of Institute of Civil Engineers.
J. Inst. Elec. Engs.	Journal of Institute of Electrical Engineers.

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

Tactics of Photographic Reconnaissance in the Defence Zone. (P. I. Russ, Air Fleet News, U.S.S.R., Vol. 23, No. 2, Feb., 1941, pp. 117-119.) (93/1 U.S.S.R.)

The most valuable form of aerial reconnaissance is photography, with subsequent evaluation (interpretation) of the results.

During an advance, aerial (photographic) reconnaissance of the enemy defence zone is of the utmost importance. Photographic reconnaissance material will be required by all units down to the tank company and artillery battery. This will call for a great deal of hard and detailed work by the photographic reconnaissance units.

An aircraft on photographic reconnaissance must carry out its flight under pre-determined conditions, which may not be varied. The altitude is determined by the required scale of the reproduction, and the focal length of the camera used. The altitude can be calculated by $H=f.Mc$, wherein H=altitude, f=focal length of the camera, Mc=required scale.

Sharpness of definition depends on the time of exposure which must not produce a corresponding displacement of the target on the film by more than 0.1 mm., the maximum exposure time is thus given by

$$E_{\max}=\frac{M}{100\,W}$$

where W=aircraft speed in m./sec.

Enemy fighter aircraft may be standing ready for interception on the forward aerodromes, or in ambush. They must be driven off, or their attention distracted to another area. This curtails fighter support. Alternatively, the reconnaissance may be effected by surprise.

Enemy anti-aircraft artillery may be put out of action by dive-bombing. Advantage may also be taken of the pause of about three to five minutes every eight to ten minutes, when the guns have to stop firing in order to cool the barrels. Finally, photographs may be taken with a telephotographic lens from a safe altitude.

Aerial photographic reconnaissance requires the utmost co-operation between local headquarters of the air force in the attack zone and the staffs of the ground troop.

Tactical Requirements in Fighter Design. (M. P. Stroyeu, Aeronautical Engineering, U.S.S.R., Vol. 17, No. 12, Dec., 1940, pp. 18-24.) (93/2 U.S.S.R.)

The science of tactics ("methods of combat") depends on the quality of men and machines. Technical development is not static, and at any given moment bears potential possibilities of progress to a higher plane. It is the business of tactical science to examine these possibilities, and incorporate their fulfilment in the design of new weapons—in the present case, fighter aircraft:—

CONCLUSIONS.

1. Fighter aircraft of all types should be designed exclusively for aerial combat; any other employment should be purely subsidiary.
2. *Three* standard fighter types are necessary; single-seater, high speed and manœuvrable monoplanes, and long-range two-seater twin-engined machines.
3. For aerial combat it would be desirable to replace the existing single-seater fighters by a pusher-screw type, subject to suitable technical development of this arrangement.
4. Particular attention is desirable to the further development of flaps and similar controls so as to combine the qualities of manœuvrability and high speed in a single type of fighter.
5. Night fighters and sub-stratosphere types can be obtained by adaptation of existing basic types.

New Air Force Tactics in the Present War. (N. Juravlev, Aeroplane, U.S.S.R., Vol. 18, No. 1, Jan., 1941, pp. 31-34.) (93/3 U.S.S.R.)

All opinions on the tactics, methods, and objectives of aerial warfare are now undergoing the test of actual war; some opinions will be found maintained, others refuted, and others requiring modification. In any case, all tactical views and principles have become considerably more stabilized and concrete than in times of peace.

From a careful examination of German aerial tactics during the present war, the following conclusions result:

The air arm in its present development has become a mighty and effective weapon, capable of co-operating effectively with the sea and land forces, but able also to carry out independent strategical tasks (sea blockade, destruction of enemy economic resources) which can have a decisive influence on the course of the war.

Experience shows that such independent operations require ample resources, and *time*. The former assumptions of the ease with which "smashing blows" could be delivered on industrial centres need considerable revision.

Such operations, under present conditions, can be performed only at night. The success of night operations depends principally on the training of air-crews.

In daylight operations the most suitable aircraft type is the twin-engined, two-seater, fighter-bomber. Daylight bombing is limited in range by the endurance of the indispensable fighter escort.

The most effective interceptor is the *cannon* armed fighter.

The only really new tactical development in the present war is the use by the Germans of two-seater fighter-bombers for the attack on industrial targets.

Echo Sounder for Air Defence. (Inter. Avia., No. 764-765, 19/5/41, pp. 19-20.) (93/4 U.S.A.)

From publications by the U.S. Patent Office the plans are disclosed of a novel device for the detection of the position of aeroplanes at night or in bad visibility. The instrument appears to be based on principles similar to those employed in the Absolute Altimeter developed by the Western Electric Corp., which, with the aid of two dipole antennas, transmits radio waves and again receives part of the waves reflected from the ground, ultimately determining the absolute distance between the ground surface and the aeroplane from the elapsed period of time. However, while the waves transmitted by the transmitter of the altimeter spread over a hemispherical space below the aeroplane, the ultra-frequency waves of the aircraft locator (measuring about 50 centimetres) are focussed into beams by parabolic reflectors. When, directed into space, the beam encounters an aeroplane, the location and the altitude of the machine can be determined from the direction and time differential of the reflected wave; flying course and flying speed of the aeroplane are calculated from successive measurements. By rapid to and fro motions of the transmitted beam on the principle of the television apparatus, a certain air space can be constantly surveyed and the flying course of the aeroplane made visible by controlling a cathode ray. A distinction between attacking and defending aeroplanes is naturally not possible.

Bell Sound Detector. (Inter. Avia, No. 764-765, 19/5/41, p. 20.) (93/5 U.S.A.)

The Bell Telephone Laboratories Inc., of New York, have taken out U.S. patent No. 2,225,312 to protect a new type of sound detector for ground defences. The instrument consists of a cluster of parallel tubes varying in diameter and length, the open ends of which form a spiral. A completed model comprised 49 such tubes. The length of the longest tube corresponds to the wave-length of the lowest sound frequency to be detected. The sensitivity of the instrument to sound waves not exactly parallel to the tubes is very small and thus permits the accurate determination of the direction of the sound.

Dive Bombing (Attack Bombing) in Sea Warfare. (D. U. Marchukoo, Air Fleet News, U.S.S.R., Vol. 23, No. 1, Jan., 1941, pp. 17-22.) (93/6 U.S.S.R.)

The particular features of maritime targets—mobility, manœuvrability, small dimensions—entail a totally different technique of attack, which favours the use of attack-bomber types. Suitable types are instanced—the Japanese " 96 " aircraft, with a 850 h.p. Wright-Cyclone engine: top speed 300 km./hr., ceiling 7,000 m., range 2,000 km., crew of three, armament 5 machine guns, and 500 kilos. bomb load. Also the American " Vought 90," designed as a fleet fighter.

The Germans have used " Messerschmidt 110," " Dornier 17," " Heinkel He 111K," and " Junkers 87 " types. The ideal naval attack bomber would be a machine with 400 km. top speed, 4-6 machine guns or 2 m.g.'s and 2 cannon guns, possibly in turrets; bomb-chutes for a total of 400 kilos. small bombs, from 1 to 10 kilos. each; wing bombs up to 50 kilos., 8-10 in number. The machine must be able to alight on the water and remain afloat at least 2-3 hours.

Any type of fighter, fighter-bomber, or attack-bomber can, however, be used against naval targets provided the aircraft crews are suitably trained.

Winter Camouflage of Aircraft. (S. Y. Miroutsev, Air Fleet News, U.S.S.R., Vol. 23, No. 1, Jan., 1941, pp. 37-40.) (93/7 U.S.S.R.)

The article gives detailed instructions for the camouflage of aircraft on the ground under winter conditions in various surroundings; woods, bushes, open fields, built-up areas, burnt and ruined buildings, etc.

In addition, care should be taken in selecting positions for grounded aircraft, to prevent disclosure by the appearance of tracks, discoloured or trampled snow, shadows thrown by the aircraft or reflection or glare produced by it. Aircraft should preferably be disposed to take advantage of natural features, roads, buildings, etc., so as to conceal all traces of activity around them.

Instructions are given for the design and construction of building mock-ups, camouflage screens, sheets, etc. for the purpose of screening the aircraft.

The Servicing of Aircraft Weapons for Firing at High Altitudes. (H. Kumpiak, Air Fleet News, U.S.S.R., Vol. 23, No. 1, Jan., 1941, pp. 67-68.) (93/8 U.S.S.R.)

Automatically operated machine or cannon guns for action at high altitudes require special preparation, either by the use of heaters or by the use of cold resistant lubricants.

Heaters may be electric, or use exhaust gases, and serve to maintain a suitable temperature for unhindered operation of the automatic weapon. They are fitted on or around the breech mechanism and thus impair the accessibility of the gun. Electric heaters are essential for movable weapons and turret guns. Unfortunately the extra electrical energy required is not always easily provided for. Exhaust-gas heaters can only be used for fixed weapons.

The adoption of a lubricant of low congealing point appears the most suitable means of assuring the operation of automatic weapons at high altitudes. The lubricant should be kept in sealed drums until used, and the weapon thoroughly cleaned and dried before lubricating. All excess of lubricant should be avoided.

(No details of the oil specification are given.)

Aircraft versus Submarine. (A. Ignatier, Aeroplane, U.S.S.R., Vol. 18, No. 5, May, 1941, pp. 25-27.) (93/9 U.S.S.R.)

After giving details of the activities of German submarines in the Great War, and the methods of aerial warfare used to combat them, the author passes to a consideration of the interaction of aircraft and submarine forces under present conditions.

The submarine presents little danger to the aircraft. The aircraft, on the other hand, is specifically an offensive weapon. Its advantages in anti-submarine warfare are: the possibility of mass attack, the suddenness of the attack, and co-operation with surface craft.

Aircraft are an effective weapon against under-water craft on the surface, and unable to submerge. The submarine must then rely only on increased aerial observation, co-operation with defending aircraft, and camouflage to lower the visibility of the submarine when surfacing.

Co-operation between aircraft and submarines should be both tactical and operational. Simultaneous action should not be sought; co-operation resolves itself into reconnaissance, exchange of information, and individual attack on the target as opportunity presents itself.

The German attempt to blockade the British Isles in the " Battle of the Atlantic " affords the best example of operational co-operation of aircraft and submarine, *e.g.*, by aerial attacks on ports and bases, after the submarines have spotted and reported the approaching convoys; air attack on industrial and production centres, to render the country more dependent on imported materials, which then are exposed to submarine attack en route. The air forces carry out the " close blockade," and submarine forces the " long-range blockade."

Whether Britain's armed forces can cope with the menace, depends primarily on her ability to secure preponderance of aerial and anti-submarine forces. In any case, this battle for the lines of communication is the principal feature of the war at present.

Tactical Requirements in Fighter Design. (Y. P. Nikolaev, Aeronautical Engineering, U.S.S.R., Vol. 15, No. 3, May, 1941, pp. 56-58.) (93/10 U.S.S.R.)

The author's review refer to a previous article under the same title by M. P. Stroyev ("Aeron. Eng." U.S.S.R., Vol. 14, No. 12, Dec., 1940—R.T.P. notice 26,763). The following conclusions are put forward:—

1. The twin-engined, single-seater fighter, particularly with air-cooled engines, has considerable tactical advantages by comparison with the single-engined fighter.
2. In aerial combat with single-engined fighters the twin-engined machine will have the following advantages:—speed, vertical manœuvrability, service ceiling, armament, and field of vision from the cockpit.
3. The twin-engined machine is better adapted for bomber interception, particularly on account of its heavier armament. The same feature renders it suitable for anti-tank operations.
4. The subsidiary tactical possibilities of the twin-engined machine are far greater.

Aircraft Armour—Production Speed Up. (Scientific American, Vol. 165, No. 2, Aug., 1941, p. 95.) (93/11 U.S.A.)

The severe limitations on airplane weight require that the gauge of the armour plate be as light as possible, consistent with effective resistance to the projectile. Thus, airplane armour ranges up to 44 inches by 44 inches by 1½ inches, most of it being in ¼, ⅜, and ½ of an inch in thickness. Armour plate is essentially a nickel-alloy steel. It must be exceedingly hard on the exposed side; tough but more ductile on the interior side.

The requisite hardness is obtained by carburisation of the exposed surface. As much as 50 hours may be required for a complete heat for ¼ inch plate. In the new Breeze process, three heats can be carried out in 24 hours. The carburising treatment is accomplished with a liquid salt bath in an electric furnace. This equipment enables the work to be charged and removed quickly, brings the plates up to the desired temperature quickly and makes accurate control of the temperature possible.

Contribution to the Theory of Wind Tunnel Turbulence. (W. Tollmien and M. Schafer, Z.A.M.M., Vol. 21, No. 1, Feb., 1941, pp. 1-17.) (93/12 Germany.)

After a review of previous research work, a mathematical model of the wind tunnel turbulence is obtained by linearizing the hydrodynamic equations, without making the usual assumption of isotropic turbulence. A new integration theory is developed for the evaluation of the problem which results in a separation of the flow into a potential and a diffusion constituent. [The possibility of such a sub-division was first mentioned by the senior author when taking part in a discussion at the 5th Int. Congress of Applied Mechanics 1938.]

Some mean values for both types of flow taken separately are determined and methods are indicated for obtaining similar values for the constituent.

The Effect of Nozzle and Collector on Resistance Measurement in the Free Jet Wind Tunnel. (D. Kucheman and F. Vardrey, Z.A.M.M., Vol. 21, No. 1, Feb., 1941, pp. 17-31.) (93/13 Germany.)

The author calculates the 3 dimensional potential flow round semi infinite bodies and source-sink bodies in a circular tunnel consisting of nozzle, collector and free jet. In order to satisfy the boundary conditions the solid walls are provided with vortices. The integral equation determining their distributions is of the second kind and can be solved numerically by iteration. Once the source and vortex distribution is known, the flow round semi-infinite bodies and source-sink bodies of various thickness and in varying position relative to the nozzle, can be calculated and the force due to the additional velocities determined. The author shows that whilst the velocity distribution in the neighbourhood of the body may be appreciably affected by the presence of nozzzle, collector and jet confines, the effect on the resistance measurement is negligibly small.

Potential Flow Through Centrifugal Pumps and Turbines. (E. Sörensen, Z.A.M.M., Vol. 7, No. 2, April, 1927.) (R.T.P. Translation T.M. 973.) (93/14 Germany.)

The method of conformal transformation has only been applied to the potential flow about bodies in rotation to a limited extent. The main reason is the fact that the boundary conditions are not maintained after the transformation. In the case of pure translation this difficulty can be overcome by considering relative inertia only. This method is not applicable to rotary motions since the relative motion is no longer irrotational. The author, in applying the conformal transformation, follows *Spannhake* (Z.A.M.M., Vol. 5, No. 6, 1925, pp. 481/484) in taking the absolute flow as a basis of his investigations. Only two-dimensional flow is considered. Whilst, however, Spannhake's solution for the complex potential depends on finding the coefficients of a Fourier series (which for this purpose must be rapidly converging, and may often present difficulties), the author gives the potential in the form of a definite integral of the same type as first discussed by *Walther* (Trans. C.A.H.I., Moscow 1926). The case when the pump blades are logarithmic spirals is discussed in detail, use being made of a transformation function given by König (Z.A.M.M., Vol. 2, No. 6, 1922).

Of interest is the variation of angular velocity (w'_0) for shock-free entry with a number of blades n. With increase of n the angular velocity approaches the limiting value w_0 given by the Euler formula.

This is illustrated in the following table:

n	w'_0/w_0
1	.02
2	.23
3	.43
6	.72
12	.82
24	.92
∞	1.0

(For the effect of entry shock on the characteristics, see *F. Riegel & J. Weber*, Z.A.M.M., Vol. 12, Feb. 1941, pp. 63-69, R.T.P. Translation No. 1245).

Numerical Calculation of the Neutral Point of a Wing. (E. Kuhle, L.F.F., Vol. 17, No. 9, 20/9/40, pp. 257-266.) (Available as R.T.P. Translation No. 1,234.) (93/15 Germany.)

The neutral point of a wing section is defined as the point about which the longitudinal moment is independent of the incidence. Provided such a point exists for each end section, the author shows for all practical wing shapes, that a neutral point exists for the wing as a whole. The position of this point can be found provided the lift distribution over the span is known. An approximate method for calculating this distribution is described, which is of sufficient accuracy for the purpose in view, provided that no extensive cut-outs in the wing surface exist. This is illustrated by means of two worked-out examples and the good agreement with experiment indicates that an accurate knowledge of the lift distribution is not generally required.

Since the fuselage as such has no neutral point, the combination of wing and body will only have such a characteristic if the wing interference masks the body effect. In general, there will be a series of neutral points, each of which applies to a limited range of c_a values.

Explosive Rivets for the Repair of Aircraft at Advanced Air Bases. (Air Fleet News, U.S.S.R., Vol. 23, No. 2, Feb., 1941.) (93/16 U.S.S.R.)

The author summarises an article in the German periodical " Werkstatt und Betriel " for November, 1940, dealing with the system of explosive rivetting developed by the Heinkel works.

The method is particularly useful at advanced air bases for patching bullet holes in aircraft, where the hole is accessible only from one side. The hole is cut away to a suitable circular or rectangular shape, a patch laid on, and temporarily secured by a special form of hook-bolt with a securing nut. The rivets are then inserted and exploded in the usual way. It is important to select the right length of rivet, and a special form of micrometer gauge is therefore used to measure the thickness of the plates and patch to be joined in place.

It is estimated that this method speeds up repairs some seven to ten times.

A short note on the same German article is also given in " Aviation Industry," U.S.S.R., Vol. II, No. 3, January, 1934.

Notes on the Maintenance of Aircraft in Winter. (V. G. Alexandrov, Civil Aviation, U.S.S.R., Vol. 2, No. 1, January, 1941.) (93/17 U.S.S.R.)

These notes deal with the effect of low temperatures on materials of construction and equipment. Pine and spruce, frozen in a damp condition, lose up to 15-30 per cent. of their strength. Ice crystals forming between the fibres of the wood, dimish its strength and cause splitting. Expansion at freezing also weakens butts, joints, and connections. Upon thawing, the resultant moisture favours infestation with moulds. In winter, therefore, aircraft of *wooden* construction, or wooden parts of aircraft, should be protected from moisture as far as possible, kept dry and well ventilated, with painted or varnished surfaces intact, and carefully dried out after getting wet with rain or snow.

AIRCRAFT AND METAL PARTS.

The use of materials with different coefficients of expansion and heat transmission in *metal* causes internal stresses with change in temperature, leading to snapping of rivets, leakage of seams, and bursting of skin plating. Moisture penetrating inside also gives rise to corrosion. Rivetted and welded joints should therefore be carefully inspected in winter for failures arising from such temperature effects. Lubrication also needs attention; some oils thicken to such an extent at temperatures between $-10°$ and $-20°$, as to lose all lubricating properties. For prevention of corrosion, aircraft should be thoroughly dried, both inside and out, after being exposed to rain or snow. All bare places should be specially treated with anti-corrosives, as the usual painting is generally insufficient under winter conditions. Parts exposed to ice accretion should be thawed out with rags dipped in hot water (not over 50-60°C.) and rubbed dry. *Rubber* preserves its normal properties down to a temperature of $-25°$ to $-40°$C. Below this it loses its elasticity and resilience powers. On stony or gravelly ground tyre covers and tubes are often punctured owing to such loss of elasticity at low temperatures, and runways of this type should not be swept of snow. Iced or frozen surfaces may be lightly sanded or treated with chopped hay or straw, frozen in place by means of the aerodrome water-cart. If parked in the open, planks, twigs or straw should be placed under all landing wheels, skids or runners, and wheels kept covered.

Rubber parts should be protected from splashing by oil, petrol or paraffin, which softens the rubber. Splashes should be washed off only with warm soapy water.

Engines require special attention when starting up in winter. The cooling system should be filled with water at 70-90°C., and the engine warmly covered. The first 10-15 litres of cooling water should be at a lower temperature (50-60°) to prevent cracks in the radiator. All drain cocks should be left open until the water leaves them at approximately filling temperature. When filling, attention should be paid to any frozen pockets in the radiator. If such are found, filling should be stopped, and the frozen places thawed by rags dipped in hot water, or by hot air from the heating above. If left out in the cold, the water should be drained off as soon as its temperature falls below 30-40°C.; and in order to prevent fractures in the radiator or cylinder jackets the drain cocks must be left open. *Anti-freeze* compound contracts at low temperatures and therefore does not require to be drained off. To assist starting at temperatures of about $-8°$ to $-10°$C., the anti-freeze or the engine can be warmed up. On heating, anti-freeze expands more than water, and a smaller quantity should therefore be used in filling the radiator.

Air-cooled engines can be easily started if warmed up by the heating stove, filled with hot oil at 80-90°C., and the sparking plugs well cleaned from oil and dirt. Flooding the engine with petrol, or using low vapour pressure fuel will impede starting up. The engine should always be swung over some 8-10 revs. by hand before switching on.

The engine should never be started at very low temperatures without being first warmed up, as otherwise there is a grave risk of damage to the auxiliary drives.

Determination of the Optimum Flight Conditions for Aircraft PS-84. (L. S. Konikor, Civil Aviation, U.S.S.R., Vol. 11, No. 5, May, 1941, pp. 3-4.) (93/18 U.S.S.R.)

Experiments made on the Leningrad-Moscow air route to determine the optimum conditions of flight are described.

From the recorded wind strength, the speed-increment due to wind $(w-v)$ was determined and added to the speed-increment due to altitude (Δv). The optimum altitude was assumed to be that at which the algebraic sum of $\Delta v+(w-v)$ had the greatest positive value.

For the PS-84 aircraft, however, this method of estimating optimum flying height led to considerable wastage of fuel, amounting in some cases to more than 200 kg. above calculated consumption (0.92 kg. per kilometre).

It was found that pilots were in the habit of flying at recommended cruising output of 550 h.p. with a speed by instrument of 250-260 km./hour and about 450 h.p. output, 240 km./hr. speed by instrument and 600 m.m. supercharge, 700 m.m. supercharge. Loss of control was apparently feared at lower speeds.

Tests flights at reduced output were therefore made to check this. At 400- the excess fuel consumption was immediately reduced to 16 kg. for the trip (Leningrad-Moscow, 617 km.) with a following wind, and 22 kg. with a contrary wind. Finding that the aircraft still arrived at destination ahead of schedule (with a following wind), instrument speed was reduced to 235 km./hr. and supercharge to 580 m.m. This resulted in a saving in fuel of 25 kg. over the calculated standard.

The ultimate result of these experimental round trips with the PS-84 was as follows:—

1. Theoretical fuel consumption of 0.92 kg./hr. at a mean indicated speed 265 km./hr. could be maintained with a following, but not a contrary, wind.

2. It is recommended that the cruising h.p. be reduced to 420-450 h.p knowing the wind at optimum altitude, the indicated air speed for schedule follows. This in turn settles the h.p. more exactly.
3. Optimum flying height should be determined not only by the maximum $\Delta v+(w-v)$ but also allowing for increased fuel consumption in climb. Special curves are recommended for each route, from which pilots can obtain the optimum altitude in relation to maximum speed and minimum fuel consumption.

Airscrews for High-Speed Aircraft with High-Power Engines. (B. N. Egorov, Aeronautical Engineering, U.S.S.R., Vol. 15, No. 3, March, 1941, pp. 11-27.) (93/19 U.S.S.R.)

The available information on the problem can be summarised in the following points:—

1. The tip-speed of the airscrew should not exceed 0.90-0.95 of the velocity of sound.
2. High power engines require airscrews of large diameter, with corresponding reduction of the engine revolutions.
3. Increased airscrew diameter implies increased weight, and increased weight/power ratio. To reduce weight, many-bladed airscrews should be used, despite the consequent drop in efficiency.
4. High-power engines for fighter aircraft will require many-bladed airscrews on account of limitations of weight and diameter. This will, however, cause difficulty in take-off and landing.
5. For single-engined, high-powered aircraft, co-axial airscrews are necessary to reduce the reaction moments.
6. The increased weight of the airscrew for high powers suggests intensive research on the construction of airscrews of light alloys, or with hollow blades, and measures against blade-vibration.

Investigations were conducted for engine powers of 1,000, 1,500, 2,500 4,000, 6,000, and 8,000 h.p. at a standard altitude of 6,000 metres, for n/Δ ratios of 1,860 2,790, 4,650, 7,470, 10,150, and 17,850 (Δ=relative density), airspeeds of 500, 650, 800, and 950 km./hr., and airscrew diameters of 2.5, 3.0, 4.0, 5.0 and 6.0 metres, with 3, 4, and 6 blades. To elucidate the influence of the revolution speed and tip speed on efficiency, calculations were also carried out for Mach numbers of 0.8, 0.9, 1.0, 1.1, and 1.2.

The conclusions from these researches are as follows:—

1. With increase of flying speed to 650-700 km./hr., the efficiency increases for constant diameter, number of blades, and engine power; at higher speeds efficiency again falls.
2. Up to airspeeds of 850 km./hr. the tip speed should not exceed 0.9-0.95 of the velocity of sound. The top speed may equal the velocity of sound for airspeeds above 900 km./hr.
3. Increasing the engine power at constant airscrew diameter and airspeed reduces efficiency, the reduction being less with increasing diameter.
4. To allow maximum efficiency of airscrews for powers from 2,000 h.p. upwards, large diameters (up to 6 m.) with corresponding reduction of the revolution speed will be required.
5. Up to 1,500 h.p., four- and six-bladed airscrews are unsuitable on account of increased weight.
6. For powers of 2,000 h.p. and over, many-bladed airscrews are preferable in order to reduce weight and diameter.
7. The use of co-axial airscrews permits of reducing the diameter and reactive moment. The efficiency can also be somewhat increased by the elimination of twist in the slip-stream.

8. The considerable increase in weight caused by the increase in diameter and number of blades demands research on the lighter construction of airscrews.
9. The reduction ratio (of airscrew revolutions) calculated by Caldwell's method (Journal of Aeronautical Science, Dec. 1937) for powers of 1,000 to 1,600 h.p. at an altitude of 6,000 m., corresponds in practice with the reduction obtained by calculation according to the optimum distribution of circulation.
10. For engines exceeding 2,500 h.p. at an altitude of 6,000 m. (*i.e.* $\frac{n}{\Delta} > 4{,}650$) the revolution speeds, varying between 600 and 1,200 r.p.m. depending on diameter of airscrew recommended in this article will be suitable.

A New Wind Tunnel Balance for Model Airscrew Experiments. (A. Eula, Atto di Guidonia, No. 44, 20/2/41,) (93/20 Italy.)

The balance enables the usual thrust and torque measurements to be made on model airscrews with a diameter of the order of 1 m. rotating at speeds up to 3,000 r.p.m. The balance is intended for use in open jet wind tunnels with a diameter of the order of 2 m. Of main interest is the 3-phase electric motor for operating the screw. This has been designed and constructed by the Goettingen Laboratory (Germany), and delivers a maximum of 100 h.p. at 30,000 r.p.m. for a total weight of 70 kg., the external dimensions being approximately 18 cm. diameter, 60 cm. length. For the Guidonia Installation, the periodicity has been reduced from 500 to a maximum of 100 cycles/sec., with the result that the maximum h.p. is now of the order of 20 at 6,000 r.p.m. A 2/1 reduction gear between airscrew and motor reduces the speed of the former to a maximum of 3,000 r.p.m. Speed and power control are obtained by means of the well known Ward Leonard system (control of frequency of a/c. supply).

The propeller torque is measured directly from the reaction of the motor casing and can be estimated to ±10 gm. at a leverage of 20 cm. The thrust is obtained from the horizontal pull on the motor, with an error of ±20 gm.

By rotating the whole suspension about the wind tunnel axis, the lateral force acting on the propeller due to oblique incidence can be obtained with an accuracy of ±50 gm. For measuring propeller characteristics in free air, the motor is enclosed in a fixed stream line casing of considerable length, the propeller hub being shielded by a fixed nose piece of suitable shape.

The clearance between motor and casing is very small and in view of the restricted diameter of the former it is held that the flow approximates very closely to free air conditions.

If the effect of engine nacelles has to be investigated, models of the latter are mounted directly on the motor casing and the motor casing and the resultant torque and thrust measurements indicate the amount of body interference.

Model airscrew experiments necessarily suffer from the defect that both the Reynolds and Mach numbers differ appreciably from those occurring in full scale flight. The author, however, points out that similar corrections have also to be applied to full scale propeller tests on the ground, since the air speeds of the large wind tunnels so far constructed in which these experiments are carried out are all considerably below flying speeds. In view of the reduced cost and saving in time, experiments with models of the dimensions discussed above seem well worth while.

Parachutes and Their Manufacture. (G. Sedlwayr, Luftwissen, Vol. 8, No. 5, May, 1941, pp. 146-150.) (93/21 Germany.)

Some details of the manufacture of the standard parachute as employed by the Luftwaffe for their aircrews are given. The canopy requires about 40 m.^{2} of silk fabric and the packing requires benches 8 m. long. The cutting out is carried out on 20 m. benches by means of electrical machines, several hundred parts of the same shape being cut simultaneously. The complete canopy consists of 96 parts and great care is taken in the lay-out of the pattern to reduce wastage of the expensive material to a minimum. The sewing together of the parts is carried out by means of special 4-needle sewing machines, the seams being checked by means of transmitted light. A series of 13 photographs show details of the manufacture and method of packing. Female labour is extensively made use of. The main parachute is controlled by the release of a small pilot parachuted and generally is unfolded only after the speed of descent has dropped to about 200 km./hr. This reduces the opening shock on the body of the parachutist. In several emergency cases, however, the parachute had to be operated at speeds as high as 600 km./hr. without ill effect to the parachutist. The landing speed is normally of the order of 6-7 m./sec. If the parachute is used to drop supplies etc. greater landing speeds are permissible and a cheaper and more "transparent" fabric can be employed. It is obvious that such parachutes must be positively controlled either by being attached to the aircraft by means of a release line or fitted with some clockwork mechanism which will open the canopy after a certain time lag.

Operation of Aircraft Fuel System at High Altitudes. (M. P. Fokin, Air Fleet News, U.S.S.R., Vol. 23, No. 5, May, 1941, pp. 445-447.) (93/22 U.S.S.R.)

Irregularities in the running of aircraft engines at high altitudes are due to the formation of "vapour locks" in the fuel system.

Such vapour locks are produced by:—

1. Presence of high-volatility components in the fuel which separate at high altitudes owing to the reduced atmospheric pressure.
2. Pressure of dissolved air in the fuel which segregates under the same conditions.
3. Heating of the fuel in certain parts of the system, promoting volatilization of the fuel.

The proportion of high volatile fractions in the petrol can be determined by the vapour tension, the normal figure being 360 m.m. Hg. at 38°C. The higher the tension the greater the risk of vapour locks.

The fuel should therefore be kept as cool as possible in ground storage, protected both there and in the fuel tanks from the heat of the sun. A vapour tension of 270-330 m.m. Hg. at 38°C. should ensure normal running at altitude.

Operation of the Cooling System of a High Altitude Aircraft. (Air Fleet News, U.S.S.R., Vol. 23, No. 4, April, 1941, pp. 340-344.) (93/24 U.S.S.R.)

At altitude, either the designed radiator surface will be insufficient, causing overheating of the engines, or it will be excessive, causing over-cooling. This is due to the pressure and temperature drop at high altitudes. The boiling point of the coolant will also be reduced, and special measures will be required for its maintenance.

The usual remedy is to employ closed circuit cooling, permitting the coolant to be kept at a pressure above the atmospheric, and thus at a higher boiling point. The controlling element in such a system is a reducing or safety valve at the highest point of the circuit.

The necessary excess pressure can be determined by the formulæ

$$P_x = P_0 - P_h$$

where P_x = excess pressure in the cooling system, P_0 = atmospheric pressure at ground level, P_h = atmospheric pressure at altitude.

With change in altitude the relief valve of the closed circuit system will thus require spring tension and special precautions must be taken for the case of rapid loss of height (long glides or dive bombing).

The increased pressure in the system will call for increased care in construction and maintenance in order to ensure the structural strength of all components and prevent breakdown.

The relief valve, being the most vulnerable point of the closed circuit cooling system, requires special attention in regard to construction, operation and maintenance.

Design Features of D.B. 601A Aircraft Engine. (Autom. Ind., Vol. 84, No. 12, 15/6/41, pp. 616-617.) (93/23 U.S.A.)

The following comparisons of the D. 0601 with other representative water-cooled engines of similar power is of interest.

Comparison of Engine Specifications and Performance.

1. Make	Mercedes-Benz	Allison	Rolls-Royce	Hispano-Suiza	Juno
2. Model	DA-601A	V-1710C-15	Merlin X	12Y-51	211
3. Number of cylinders	12	12	12	12	12
4. Arrangement	Inverted Vee	Vee	Vee	Vee	Inverted Vee
5. Bore (inches)	5.7	5.5	5.4	5.9	5.9
6. Stroke (inches)	Stroke	6.0	6.0	6.7	6.5
7. Piston displacement (cubic inches)	2,070	1,710	1,647	2,197	2,136
8. Military rating (horsepower) ...	1,000	1,090	1,025	1,100	975
9. Military rating (r.p.m.) ...	2,400	3,000	3,000	2,400	2,300
10. Military rating altitude (feet) ...	14,760	13,200	17,750	10,696	15,584
11. Hypothetical horsepower at 15,000 feet	990	1,020	(High Blower) 1,150	920	(High Blower) 990
12. Take-off rating (horsepower) ...	1,150	1,040	1,045	1,100	1,100
13. Take-off rating (r.p.m.) ...	2,500	3,000	2,850	2,400	2,400
14. B.M.E.P. (military rating) ...	158	168	164	156	157
15. B.M.E.P. (take-off)	167	160	176	166	170
16. Compression ratio	6.8	6.65	—	7.0	6.5
17. Take-off piston speed (feet per minute)	2,625	3,000	2,850	2,690	2 600
18. Total piston head area (sq. inches)	306	285.5	275	328	328
19. Take-off horsepower per sq. in. piston area	3.84	3.65	3.81	3.36	3.36
20. Take-off horsepower per cubic inch displacement per minute	.000111	.000101	.000111	.000104	.000107
21. Dry weight (pounds)	1,367	1,325	1,394	1,085	1,356
22. Unit weight (pounds per take-off horsepower)	1.19	1.27	1.33	.993	1.23
23. Height (inches)	40.5	42.1	41.1	37.2	41.7
24. Width (inches)	29.1	30.6	29.8	30.1	31.7
25. Overall length (inches) ...	84.0	94.5	75.1	84.1	68.7

Increasing the Altitude Performance of Aircraft Engines. (V. A. Dollerzhal, Aeronautical Engineering, U.S.S.R., Vol. 15, No. 3, March, 1941, pp. 39-42.) (93/25 U.S.S.R.)

The conclusions arrived at are as follows:—

To increase the m.e.p. of the engine at altitude, the most suitable combination is a moderate compression ratio, and a high degree of supercharge.

It is doubtful whether the necessary supercharge is obtainable from a single stage blower. Either a two-stage blower, or a combination of mechanically operated blower and exhaust driven turbo-blower are probably required.

In connection with high altitude operation, the question of the blower speed becomes important. The present standardised two-speed drive becomes inefficient at intermediate altitudes, and the need for some infinitely variable gear is indicated.

For this purpose the author described a hydraulic coupling, somewhat on the line of that fitted to the German DB. 601 engine.

Cam Shape for the Valve Operation of Four-Stroke Engines. (H. Denkmeier, Luftwissen, Vol. 8, No. 5, May, 1941, pp. 157-162, and No. 6, June, 1941, pp. 181-188.) (93/26 Germany.)

A series of harmonic cams producing the same valve lift with different acceleration characteristics were investigated both theoretically and experimentally, special attention being paid to the effect of valve tappet clearance. It appears that the electricity of the valve operating gear, including lay shaft drive (if present), is of paramount importance in determining the force between cam and tappet. The " give " in the operating gear will generally increase with increasing radius of curvature of the cam flank and this will reduce the impact force automatically. The opening of the valve can then be carried out rapidly without undue risk. In the case of excessive tappet clearance, however, the symmetrical cam of high acceleration may overload the valve stem during the closing operation. Although according to the author, very rapid opening of the valve does not lead to mechanical difficulties, engine tests show that such rapid opening does not necessarily lead to an increase in power. Possible limitations due to gas speed and spring flutter are not considered by the author.

Bramo Jafnir Petrol Injection Radial Aero Engine, Type 323 *A-D and* 323 *P.* (Luftwissen, Vol. 8, No. 6, June, 1941, pp. 189-193.) (93/27 Germany.)

These nine-cylinder radials (bore 154 mm., stroke 160 mm.) are a development of the SH. 22 radial, manufactured by Siemens and Halske.

Earlier models of the 323 were fitted with Sum carburettors. The replacement of these by petrol injection pumps does not appear to have affected the power output appreciably. The most economic fuel consumption has, however, been reduced by about 10 per cent. Types C and D are both fitted with a low speed supercharger (9.5 gear ratio) and only differ in the value of the airscrew reduction gear (1.41 and 1.61 respectively). These models develop 1,000 h.p. at take-off. Types A and B are both supercharged to 4,200 m. (11.4 blower ratio) and differ again in airscrew reduction gear. These engines develop 730 h.p. at the rated altitude. Type P (not previously built) differs from the others in having a two-speed epicyclic blower gear (9.6 and 12.4 ratio), which enables the engine to combine 1,000 h.p. at take-off with an output of 775 h.p. at 4,250 m. Details of the blower reduction gear are given. Of special interest is a vapour trap which is incorporated in the fuel line between the supply pump and the injection pump.

Performance Tests on an Internal Combustion Gas Turbine. (A. Stodola, Z.V.D.I., Vol. 84, No. 1, 6/1/40, pp. 17-20.) (93/28 Germany.)

The plant designed by B.B.C. (Switzerland) is intended for emergency operation at the Neuchâtel electric power station and was exhibited at the Swiss Engineering Exhibition, 1938. It is now housed in a bomb-proof underground section of the power station. In order to save cost and space, the turbine exhausts straight into the atmosphere, and no heat exchangers are installed. The multi-stage axial compressor running at 3,000 r.p.m., delivers about 220,000 kg. of air/hour, at a maximum compression pressure of 4.34 atm. abs. ($t = 203$°C.). Only a portion of this air is directly burnt by passing the oil burner and the combustion gases mixing with the excess air enter the turbine (multi-stage axial) at 550°C. max. At maximum load the shaft horse-power of the turbine is 15,660 kW., and that of the compressor 11,480 kW., leaving an available power output of 4,180 kW. The corresponding thermal efficiency is 18 per cent. (compression efficiency of blower 85 per cent., and turbine efficiency 88 per cent.).

It is specially emphasised that this novel power plant, since it requires no cooling water, is extremely compact. By fitting heat exchangers an appreciable increase in the thermal efficiency should become possible.

Surface Quality of a Medium Carbon Steel. (O. W. Boston and W. W. Gilbert, Engineering, Vol. 152, No. 3,939, 11/7/41, p. 35.) (93/29 Great Britain.)

For the S.A.E. 3,140 steel in a normalised and annealed condition, when cut dry, the surface quality produced at low cutting speeds, as observed from photographs and profilograms, is poor. As high speeds are reached the surface quality is greatly improved. At a certain minimum speed, called the optimum speed, the cutting edge of the tool actually produces the machined surface which is superior to the surface at all lower speeds in which the chip is removed by means of a built-up edge. Photographs and profilograms show little difference in surface quality at high cutting speeds when various types of cutting fluids are used. At low speeds, however, it appears that the surface quality is improved as compared with dry cutting when a cutting fluid, consisting of a sulphurised mineral or sulphurised base oil, is used. The optimum cutting speed for each of several structures is lowest for the hardest steel and highest for the softest steel. It appears also that the surface quality changes but slightly as the speed, cutting fluid, or structure is changed for values of cutting speed above the optimum.

The Spot Welding of Light Alloys. (Tylecote, Trans. Inst. Weld., April, 1941, pp. 56-75.) (Met. Vick. Tech. News Bull. No. 770, 11/7/41, p. 8.) (93/30 Great Britain.)

Literature, published up to October, 1940, on the spot welding of light alloys is reviewed. The subject matter includes weldability, machines and machine settings, surface preparation, electrodes, strength properties, etc. A bibliography and an author index are appended.

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

The Welding of Non-Ferrous Metals. (West, Trans. Inst. Weld., April, 1941, pp. 76-112.) (93/31 Great Britain.)

The author reviews literature published during 1939-1940 on non-ferrous metal welding. It is stated that the main object has been to present as complete a picture as possible of the present position of non-ferrous metal welding and its problems. The subject matter is presented in the form of short abstracts and a subject and name index are appended.

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

Ball and Roller Bearings. (G. A. Ungar, Machinist, 5 and 12/7/41, pp. 130 E and 138 E-140 E.) (93/32 Great Britain.)

These issues contain an article dealing with the basic factors underlying the selection of ball and roller bearings, since confusion may arise from the wide differences in load capacity ratings for bearings of the same type and size, but of different makes. The author outlines how catalogued ratings may be corrected to a standard of comparison, factors discussed including the ratio of expected to tested life, actual bearing life, loading per unit of area, etc. Criteria of comparison are tabulated for various types of ball and roller bearings and for some needle bearings.

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

Ultrasonics—A New Metallurgical Tool. (Cosman, Iron Age, 15/5/41, pp. 48-50.) (93/33 Great Britain.)

The technique of ultrasonics is stated to be little beyond the theoretical stage, but some of its possibilities as an engineering tool are indicated. Ultrasonic radiations, produced by magneto-striction or the piezo-electric machine, occupy a position in the frequency scale between the upper limit of human hearing and radio waves. Fine cracks or impurities in material obstruct the passage of these waves, absorption and reflection taking place. They are also stated to produce marked physical effects and may be used for fatigue testing degassing liquid metals, speeding up hardening operations and other purposes.

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

Control of Carbon Content of Protective Gas in Heat Treatment Furnaces. (Scientific American, Vol. 165, No. 2, Aug., 1941, p. 63.) (93/34 U.S.A.)

In the Endogas method of treating steel, developed by Westinghouse Electric and Manufacturing Company, a protective gas is used in the heat-treating furnaces to prevent softening or scaling of the surface during treatment. It is necessary, however, that the protective gas be of precisely the correct composition for the work in hand.

Since the carbon content or pressure of Endogas is the critical factor, it must be carefully controlled. It is not possible, however, to make this determination quickly enough by ordinary chemical analysis; and a special so-called " hot wire carbon-gauge " has been produced for this purpose. In this gauge a thin steel wire is heated for a few minutes in a test sample of the Endogas until a " carbon balance " is established between the gas and the wire. Because the wire retains its carbon in a solid form known as martensite, its electrical resistance and certain other physical properties can then be used as a measure of its carbon content, which in turn measures the carbon pressure of the gas. By means of this gauge the quality of the furnace atmosphere can be quickly determined at any time and pre-adjusted to suit the carbon content of any steel to be treated.

Synthetic or Natural Rubber. (Inter. Avia., No. 766, 27/5/41, p. 1-4.) (93/35 Switzerland.)

Five different types of synthetic rubber are listed :—

1. *Neoprene* (polymers of chloroprene).
2. *Thiokole* (reaction products of aliphatic dihalides with alkali polysulfides).
3. *Perbunan, Buna S, Ameripols, Hycars, Chemigum* (co-polymers of butadiene with other polymerisable compounds).
4. *Koroseal* (plasticised polymers of vinyl chloride).
5. *Vistanex* (polymers of isobutylene).

All of these differ chemically from natural rubber.

The purely mechanical properties of composition of natural rubber are not surpassed to any marked extent by those of synthetic rubber stocks, so that in view of the present high production cost of synthetic rubber it is improbable that synthetic rubber will replace the natural product in articles which depend for utility on such properties alone. It frequently happens, however, that in service rubber must be subjected to influences which rapidly impair its mechanical excellence. Often high temperatures, direct exposure to bright sunlight, or contact with oil cannot be avoided. In such cases compositions of synthetics or of mixtures of synthetics with natural rubber may result in certain improvements.

The Synthetic products are superior to natural rubber in the following points :—

(*a*) Resistance to swelling and deterioration in contact with oils, organic solvents and water.
(*b*) Resistance to cracking in sunlight.
(*c*) Resistance to deterioration by heat.
(*d*) Resistance to powerful oxidising agents.
(*e*) Resistance to diffusion of gases.
(*f*) Possibility of compounding to graphite so as to render the product electrically conductory.

Natural rubber still exhibits superiority to all the synthetics now available in:—
(*a*) Elasticity and rebound.
(*b*) Low heat generation through hysteresis.
(*c*) Extensibility.
(*d*) Resistance to stiffening at low temperatures.

The synthetic rubber industry in Germany started on its way in 1934 with an annual output of 10 tons, was claimed to have reached 4,000 tons already by 1937, and is now estimated to produce at the rate of about 60,000 tons annually. As a comparison, the American industry now produces only about 3,000 tons of synthetic rubber a year, the yearly consumption of natural rubber being of the order of 750,000 tons.

Determination of the Shearing Stresses in Axially Symmetrical Shafts Under Torsion by Finite Difference Methods. (S. T. Newing, J. Phil. Mag., Vol. 32, No. 210, July, 1941, pp. 33-49.) (93/36 Great Britain.)

The application of finite difference methods to the determination of numerical solutions of differential equations provides a standard method of attack upon problems which are not amendable to exact formal analysis. Some methods of this kind are discussed in detail in a paper by L. F. Richardson,* who applied them to the determination of the stresses arising in masonry dams. It is found, however, that when numerical solutions are required over semi-infinite plane regions, the method described in this paper for arranging that the convergence of the process of iteration shall be rapid is not applicable.

The present paper describes the application of a similar finite difference method to three problems relating to the torsion of symmetrical shafts of different types, and treats the convergence of the process from a standpoint entirely different from Richardson's. The resultant shear stresses are determined for hollow shafts of varying section and also for a shaft with a concentric bore whose radius is 0.25 that of the shaft.

Friction and Adhesion. (J. J. Bikerman, J. Phil. Mag., Vol. 32, No. 210, July, 1941, pp. 67-76.) (93/37 Great Britain.)

Recent literature on sliding friction is critically reviewed, it is concluded that:—

1. Friction cannot be due to welding as the law of friction and its numerical constant may be identical for the pairs Pt/Pt, Pt/wood, and wood/wood.
2. Friction cannot be due to adhesion in general as no adhesion can be detected by measuring the normal force.
3. Coulomb's law cannot be reconciled with the adhesion hypothesis by assuming the real area of contact to be proportional to the load; this assumption is refuted by experiments using decreasing loads.
4. In experiments which seemed to prove that friction was not due to the surface roughness, the real friction was not measured; mostly it was scratch hardness.
5. " Stick-and-slip " patterns have no bearing on the mechanism of friction.
6. The absolute values of the coefficient of friction are accounted for by Coulomb's theory attributing friction to surface asperities.

The Buckling of Heavy Struts. (F. A. Willers, Z.A.M.M., Vol. 21, No. 1, Feb., 1941, pp. 43-51.) (93/38 Germany.)

The buckling of short struts is not affected by the weight of the strut. In the case of drills for deep bore holes, the weight of the rod is considerable and will affect the buckling load. Starting with the well known principle of minimum energy, stability equations and boundary conditions are developed by the author

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* Phil. Trans. Roy. Soc. A., ccx, pp. 307-57 (1910).

for this case. The integration of the differential equations is carried out by means of Bessel and Lommel functions. The asymptotic representation of these functions enables the buckling force of very large rods to be estimated.

The Strength of Lugs (Eye Bolts). (O. Volkersen and R. Goschler, Luftwissen, Vol. 8, No. 5, May, 1941, pp. 151-156.) (93/39 Germany.)

If

ρ = tensile load,
s = thickness of plate,
d = diameter of bolt hole,
$2a_1$ = width of plate,
a_1 = distance of hole from side of lug,

the maximum resultant stress in the lug on either side of the hole is given by

$$\sigma_L = 2.4 \frac{\rho}{(2a_1 - d)\, s} \text{ (app.)}$$

provided the elastic range of the materials is not exceeded. The ultimate breaking load of the lug cannot, however, be estimated from this equation, since the stress distribution will be considerably modified by the yielding of the material.

Experiments have shown that the breaking load does not only depend on " a_1 " (defined above), but also on " a " (distance of hole from end or vortex of lug) and on the ratio s/d. The plan form of the lug on the other hand (rectangular, round or necked) plays only an unimportant rôle.

The authors have carried out a series of experiments both on the ultimate strength of lugs (fractures either at vortex, *i.e.*, above hole or at sides of hole) as well as on the limiting tensile loads for either 0.1 and 1 per cent. permanent extension of the eye hole.

The results are given in a series of tables and graphs and cover dural plates ranging from 0.6 to 10 mm. in thickness. For most of the experiments, the diameter of the hole was 10 mm.

In order to utilise the material to the utmost, a lug should be designed so as to be equally strong at vortex and sides of hole (*i.e.*, resistance to crushing at hole equal to tensile strength of lug section perpendicular to load under these conditions). For a given value of a_1/d, a/a_1 will increase rapidly as s/d diminishes.

This is shown in the following table:—

s/d	a/a_1	a_1/d
0.08	1.8	1.0
0.10	1.2	1.0
0.15	2.3	1.5
0.20	1.5	1.5
0.60	1.4	1.5

Fatigue Testing Machines for Large Specimen. (E. Erlinger, Luftwissen, Vol. 8, No. 6, June, 1941, pp. 177-181.) (93/40 Germany.)

Experience has shown that mechanical strength investigations should be carried out whenever possible on the actual structural element, or if that is not feasible, the specimen undergoing test should closely resemble the finished product as to dimensions, shape and surface finish. Whilst tensile test machines capable of handling large samples have been in use for some time, the range of fatigue testing machines available so far only enabled relatively small samples to be tested. In this article the author gives some details of large fatigue testing machines designed by him to cover the range of bending, torsion and compression-extension.

(1) *Bending Fatigue*.—Rotating specimen, max. bending moment 750 mkg., max. length of sample 65 cm. The bending moment applied may be either constant or variable. A small axial load ensures separation of sample as soon as broken and prevents further damage to the surfaces of the fracture.

(2) *Torsion Fatigue*.—Three machines (" torsators ") working on the resonance principle are described with maximum torques of ±300, 1,000 and 2,000 mkg. respectively. If required, a static torque can be superposed on the fluctuations. The forcing frequency (20 or 50 cycles/sec.) is obtained by a rotary out-of-balance mass attached excentrically to one of the inertia masses of the system. These masses can be tuned so as to obtain resonance and the vibration amplitude of the specimen is maintained constant throughout the test by an automatic control of the forcing frequency. In this manner the development of a crack can be detected before complete fracture of the specimen. The machines are not only big enough to handle complete engine crankshafts, but provision is also made to control the temperature of the specimen during the tests and subject it to the influence of corrosive agents.

(3) *Tension-Compression* (*Pulsator*).—An oscillating stress up to ±25 tons at a frequency of 40 cycles per second can be applied to the specimen through the agency of a heavy leaf spring subjected to forcing impulses. A static stress up to 25 tons can be superposed, the maximum load thus being equal to 50 tons. A photograph shows an aero engine piston undergoing tests on a machine of this type.

Both " torsators " and " pulsators " are mounted on rubber blocks so as to isolate ground vibrations.

Acoustic Models of Radio Antennas. (E. C. Jordan and W. L. Everitt, Procs. of I.R.E., Vol. 29, No. 4, April, 1941, pp. 186-194.) (93/41 U.S.A.)

The large number of independent variables in antenna arrays make it advisable to develop means for rapidly surveying the field patterns which may be obtained. The advantages in the use of acoustic models for this purpose are shown.

Two analogous acoustic antennas are developed, one for the measurement of fields at a distance and the other for fields close to the antenna. The procedure which can be followed in setting up the models and making measurements is outlined.

Advantages are demonstrated for the acoustic model in the study of non-sinusoidal current distributions, and their effect on the field pattern.

The measurement of mutual impedance between antennas may be conveniently carried out with one of the models. The arrangement for phasing and magnitude control in a multi-unit array are shown. The field of an acoustic model is shown in comparison with the field of an actual array which it simulates.

Control of Night Error in Aeroplane Direction Finding (*Digest*). (H. Busignies, Procs. of I.R.E., Vol. 29, No. 4, April, 1941, p. 222.) (93/42 U.S.A.)

This paper describes the development of a method enabling pilots to determine the accuracy of night bearings obtained by means of a radio compass in the wave length range of 200 to 2,000 metres (150 to 1,500 kilocycles), and the effect on the indication when the plane passes through the combination of fields due to the reflection of waves from the *E* layer or from a mountain side. Consideration is given to the appearance of the night error on the ground and in altitude, taking into account the simultaneous presence of (1) the direct wave; (2) the sky wave; and (3) the sky wave reflected from the ground. It is demonstrated that the night error is smaller in the air than on the ground; also that there are regions in the atmosphere where the night error is very small.

The dynamic aspect of the night error is then studied in the case of a plane moving through the above-mentioned system of waves. How the radio-compass indication changes regularly about a mean value, whether correct or not, according to the polarisation of the sky wave, is next discussed. All cases of polarisation are examined.

In conclusion, a number of rules are formulated relative to night direction finding on board aeroplanes above land or sea, supplemented by maps showing areas where direction finding is safe, unsafe, or dangerous. The maps show that the practical range of night direction finding is increased substantially by the correct interpretation of the radio-compass indications.

A Mechanical Calculator for Directional Antenna Patterns (Digest). (W. G. Hutton, Procs. of I.R.E., Vol. 29, No. 4, April, 1941, p. 224.) (93/43 U.S.A.)

The object of this paper is to describe a mechanical directional-antenna-pattern calculator to be used when all the factors are known that completely determine the pattern. This mechanical directional-antenna-pattern calculator is a machine which can be adjusted for any or all the factors that determine completely the directional pattern, and which on operation will automatically rotate the vectors that represent the relative antenna fields in such a way with respect to each other that the resultant vector or field ratios may be read directly.

The design problem for a directional-antenna pattern may involve the calculation of several trial patterns before the correct pattern is obtained. Thus, a machine such as this paper describes will speed up and simplify design work for directional arrays.

The standard equation for field-intensity patterns is shown and an analysis is made to show that the result given by the machine is the solution to this equation.

The operating procedure is given for calculating the horizontal pattern with the machine described. The operating procedure is given for calculating the vertical-field pattern for any particular horizontal angle after the horizontal pattern has been figured by use of the machine.

The procedure is given for converting the vector values given by the machine to micro-volts per metre both for the horizontal and vertical patterns.

Aerial Photography in Winter. Experience of the Operation of the A.F.A. Aerial Camera Under Winter Conditions. (P. G. Timofeev, Air Fleet News, U.S.S.R., Vol. 23, No. 2, Feb., 1941, pp. 254-258.) (93/44 U.S.S.R.)

A list of defects in design and breakdowns in operation of various (Russian) service types of aerial cameras is given. The main troubles due to winter conditions are:—Freezing of the film-feed rollers, freezing of the shutter, rupture of flexible shafts.

The heating device of the camera should be carefully inspected before the flight. The heater should be adjusted to a number of temperature stages, since in view of the danger of the shutter freezing-up at temperatures not requiring general heating of the camera, it is desirable to have an auxiliary heating stage for the shutter only.

A Device for Joining Short Lengths of Aerial Photo Films. (K. N. Sakharov, Air Fleet News, U.S.S.R., Vol. 23, No. 3, March, 1941, pp. 263-264. Translated by L. J. Goodlet.) (93/45 U.S.S.R.)

In the practical evaluation of aerial reconnaissance material, it is frequently necessary to deal with short length aero films, usually those from the " AFA-I " aerial camera.

The length of such films does not exceed nine metres, and they are developed in apparatus designed for handling films of 28-30 metres in length, taking from 30 to 35 minutes for the operation. Consequently, if the laboratory receives three to six such films, it will require 1½ to 3 hours to deal with them. Furthermore, the utilisation of the apparatus will be one-third only of the designed capacity, and the consumption of solutions and chemicals will be correspondingly excessive.

The most economical method of treating such short films is, therefore, to handle a number of them simultaneously by glueing them together into one strip.

The glueing is performed in the following manner:—Using a brush or a tuft of cotton wool, ordinary technical " Emaillit " is applied to the emulsion side of the aero film (about 4-5 cm. wide). Before the adhesive dries, the section to be joined on is applied with the gelatine side to the glued section and rubbed down with a clean rag until the adhesive has dried. This method is reliable, the glued film does not tear when passed through the standard Air Force developing appliance, nor dissolves in the liquid used in the treatment of negatives: De-sensitiser, water, developer, fixing bath, or alcohol.

Determination of Position and Altitude of an Aircraft in Space by Means of Photogrammetric Methods. (M. di Jordis, Atti di Guidonia, No. 43, 10/2/41, pp. 21-36.) (93/46 Italy.)

In the usual method of aerial survey, the ground is photographed from an aircraft flying at a known altitude and the resulting picture converted into a scalar map by means of special machines, provided the inclination of the optre axis of the camera with the vertical is known. It is obvious that the procedure can be reversed, *i.e.* if the relative position of a number of landmarks appearing on the photograph is already known from a terrestrial map, the position of the camera at the instant the photograph was taken can be determined. The author describes a simplified form of projector which will achieve this and estimates that the error in altitude is not more than .1 per cent. for the range 2,000 to 5,000 m. whilst angular inclination of the aircraft can be read to about $\frac{1}{8}^\circ$, provided the exposures are not taken too near the vertical. By taking a series of ground photographs each with a clock face image giving time to 1/50 sec., the speed of aircraft between successive exposures can be calculated.

Cases of Petrol Poisoning in Flight. (P. F. Vokhmyani, Air Fleet News, U.S.S.R., Vol. 23, No. 3, March, 1941, pp. 265-266.) (93/47 U.S.S.R.)

Two recent instances of poisoning by petrol fumes in flight are described. Both refer to " R2 " two-sector bombers with open cockpit. In one case the pipe line between fuel tank and engine fractured; in the second, the nipple on the fuel pressure gauge became unscrewed. In neither case did the defect reveal itself, as a petrol spray or splash and the smell in the cockpit was not unduly marked. Nevertheless, the broken pipe led to both pilot and observer ultimately losing consciousness and being injured in the subsequent crash. The consequences of the unscrewed nipple were not so serious since the pilot landed soon after the smell became noticeable. The landing was, however, rough and the handling of the aircraft much below the standard for this pilot. The latter, however, seems to have been unaware of this.

It must consequently be assumed that in both cases petrol poisoning in flight took place, owing to leakage and an accumulation of highly concentrated fuel fumes in the cockpit. The handbook description of petrol-fume poisonng states: " Light cases of petrol or paraffin poisoning are manifested in the form of a slight intoxication. The symptoms are hallucinations of short duration."

In serious cases, reduced pulse with irregular breathing, contracted or dilated pupils, foam on the lips, cutaneous hæmorrhage, and loss of consciousness result. Loewe and Kolesnikov (Baku) and Lazarev (Leningrad) found by experiments on animals that aviation spirit (pure) is a heart toxic. Insensibility results from a concentration of 0.05 gm. per cubic metre after 4-5 hours.

Since doped petrol was used in the above cases, the question arises whether poisoning was due to the petrol or the added tetra-ethyl lead. Acute tetra-ethyl lead poisoning is distinguished by the following symptoms: insomnia, extreme excitation, visual and aural hallucination, delirium, talkativeness, insecure gait. In light cases, insomnia, nightmare, sickness, bad taste in the mouth, giddiness, headache, general lassitude. Characteristic for tetra-ethyl lead poisoning is a dormant form lasting several days. The official handbook states that owing to the small percentage of addition, poisoning with doped petrol is scarcely distinguishable from the effects of pure petrol.

Comparing these descriptions of symptoms with the two cases quoted above, it may be concluded that, even if the dope participated in the effect, the principal poisoning was by means of petrol. Neither did tetra-ethyl lead poisoning appear later.

CONCLUSIONS.

1. Acute poisoning by the fuel, in case of leakage in flight, is possible even in an open cockpit.
2. In both cases mentioned, the poisoning manifested itself as rapid, but not deep, insensibility, after a short previous phase of excitation.

The Reflections of Sound Pulses by Convex Parabolic Reflectors. (F. G. Friedlander, Proc. Cambs. Phil. Soc., Vol. 37, Part 2, April, 1941, pp. 134-149.) (93/48 Great Britain.)

The reflexion of a train of simple harmonic waves by a convex parabolic of revolution, and by a parabolic cylinder, has been discussed by Lamb.* In the present paper these results are extended to the reflexion of plane waves of arbitrary form. It is found that on the introduction of suitable variables the equation of sound propogation transforms (in each case) into a simpler equation whose general integral can be obtained by quadratures. Two unknown functions are introduced during the integration, which have to be determined from the boundary conditions. This involves in both cases the solution of a Volterra integral equation, which is effected numerically by calculation of the first terms in the series development of the resolving kernel. An interesting feature of the solutions obtained is that when a suitable time scale is introduced (for a sharp-fronted pulse the time must be counted from the onset of the wave), the reflected wave experienced is the same at all points on any paraboloid (or parabolic cylinder) confocal with the reflector.

Experiments in Approximating to Solutions of a Partial Differential Equation. (W. G. Bickley, J. Phil. Mag., Vol. 32, No. 210, July, 1941, pp. 50-66.) (93/49 Great Britain.)

The author describes a number of experimental attempts to approximate to the solution of the differential equation

$$\frac{\partial^2\theta}{\partial\xi^2}=\frac{\partial\theta}{\partial z}$$

for the ranges $0<\xi<1$, $0<z<\infty$ with certain boundary and initial conditions. By assuming a polynomial in ξ, the coefficients of which are functions of z, the problem is reduced to solving ordinary differential equations for these coefficients. These differential equations may be constructed by collocation, or by the Galerkin method of (weighted) integrals. The initial conditions are similarly treated. Quite good agreement is obtained with only two disposable coefficients; if interest is largely centred in one point, collocation at that point produces results better than the Galerkin method. The method of least squares applied to the error is apparently not well suited for use with an infinite range, unless it is the asymptotic behaviour only which is sought.

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* Lamb. "On Sommerfield's diffraction problem; and on reflexion by a parabolic mirror." Proc. London Math. Soc. (2), 4 (1906), 190.

Expansion Turbine Producing Low Temperature Applied to Air Liquefaction.
(P. Kapitza, Journal of Physics, U.S.S.R., Vol. 1, No. 1, 1939, pp. 7-27.)
(93/50 U.S.S.R.)

In the well known Linde process, the air is compressed to about 200 atmospheres and expanded through a nozzle, the resulting cooling being due to the Joule-Thomson effect. This effect is small in the case of air and much greater cooling would result if the expanding gas could be made to do useful work.

The author has succeeded in designing a suitable radial turbine for this expansion, the required pressure drop being only of the order of five atmospheres instead of the 200 atm. of the Linde machine. The main difficulty in the design of such expansion turbines is the rotor friction and proper utilisation of the large centrifugal forces in the medium due to its relatively high density. The final design has a rotor of only 8 cm. diameter, weighing 250 gm. and running at 40,000 r.p.m. Although this speed is well above the critical speed of the shaft, stability of operation required the introduction of a damper. The rotor is not mounted directly on the shaft, but a special universal joint allows the principal axis of inertia to coincide automatically with the axis of rotation. The expansion efficiency is of the order of 83 per cent. and the plant will yield about 30 kg. of liquid air per hour, at an energy cost of about 1.7 kw.h. per kg. Although this energy consumption is about 30 per cent. greater than that of orthodox installations, the simplicity, reliability and safety of the turbine plant are great assets. The space required is about one-sixth that of an equivalent Linde machine and the starting period only of the order of twenty minutes.

LIST OF SELECTED TRANSLATIONS.

No. 36.

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.

AERO- AND HYDRODYNAMICS.

TRANSLATION NUMBER AND AUTHOR.		TITLE AND REFERENCE.
1220	Multhropp ...	... *Aerodynamics of the Fuselage.* (L.F.F., Vol. 18, No. 2-3, 29/3/41, pp. 52-66.)
1226	Eckert, B ... Pfluger, F. ...	... *Resistance Coefficients of Commercial Type of Wire Grids.* (L.F.F., Vol. 18, No. 4, 22/4/41, pp. 142-146.)
1234	Kuhle, E. ...	... *Numerical Calculation of the Neutral Point of a Wing.* (L.F.F., Vol. 17, No. 9, 20/9/40, pp. 257-266.)

AIRCRAFT AND ACCESSORIES.

1219	Wolff, H. ...	... *The Influence of the Mach Number on the Efficiency of Airscrews.* (L.F.F., Vol. 18, No. 2-3, 29/3/41, pp. 67-69.)
1227	Brode, K ...	... *Dornier Do. 18 Flying Boat Fitted with B.M.W. 132 Air-cooled Radial Engine.* (Luftwissen, Vol. 7, No. 12, Dec., 1940, pp. 420-422.)
1228	Hiorth, N. ...	... *Towed Gliders.* (Flugsport, Vol. 33, No. 1-2, pp. 10-15 and 35-37.)

STRUCTURE.

1218	Fohlbusch, H. Wagner, W.	... *The Loading of Circular Frame Members in Shell Structures.* (L.F.F., Vol. 18, No. 4, 22/4/41, pp. 122-127.)
1224	Wagner, H. Simon, H. . .	... *The Provision for Taking up Longitudinal Forces in Thin Walled Cylindrical Shell Structures.* (L.F.F., Vol. 13, No. 9, 1936, pp. 293-308.)

THEORY AND WARFARE.

1223	Borsani, D.	... *Vulnerability of Aerial Targets.* (L'Ingegnere, Vol. 18, No. 5, 1940, pp. 369-374.)
1225	Stehli, R. H.	... *Estimation of Aircraft Distance with the Help of Binoculars.* (Flugwehr und Technik, Vol. 2, No. 10, Oct., 1940, pp. 226-227.)
1232	Kuhlen Kamp, A. ...	*Sound Location of Invisible Aircraft.* (Z.V.D.I., Vol. 85, No. 17, 26/4/41, pp. 393-400.)

MISCELLANEOUS.

1233	Ackeret, J. ... Keller, C. ...	... *Closed Circuit Aerodynamical Heat Engines (Hot Air Turbines).* (Z.V.D.I., Vol. 85, No. 22, 31/5/41, pp. 491-500.)

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

78/1	Great Britain	*Bristol Beaufort General Purpose Aircraft.* (Engineering, Vol. 151, No. 3,934, 6/6/41, pp. 456-457.)
78/2	Great Britain	*Civilian Population Under Bombardment.* (R. J. Bartlett, Nature, Vol. 147, No. 3,736, 7/6/41, pp. 700-701.)
78/3	Great Britain	*Anti-Scatter Treatment for Windows.* (H. M. Llewellyn, J. of Soc. of Chem. and Ind., Vol. 60, No. 23, 7/6/41, pp. 433-434.)
78/4	Great Britain	*An Automatic Aid to the Rapid Testing of War Gases in the Field.* (Huson and Hardwick, J. of Soc. of Chem and Ind., Vol. 60, No. 23, 7/6/41, pp. 436-437.)
78/6	Germany ...	*German Air Raid Defence of Factories.* (C. Wachtl, Chem. and Metallurgical Eng., Vol. 78, No. 4, April, 1941, pp. 92-94.)
78/7	Germany ...	*Mass Production of He. III.* (Motor Schau., Vol. 5, No. 1, Jan., 1941, pp. 48-52.)
78/8	Germany ...	*F.W. "Kurrier" (Photograph).* (Motor Schau., Vol. 5, No. 2, Feb., 1941, p. 127.)
78/9	Germany ...	*Photograph of Modern German Seaplanes.* (V. Kinzel, Motor Schau., Vol. 5, No. 3, March, 1941, pp. 200-253.)
78/10	Switzerland...	*Bombing by Day.* (E. Amstutz, Inter. Avia., No. 763, 9/5/41, pp. 1-3.)
78/11	U.S.A./ Great Britain	*Atlantic Ferry (U.S.A.-Great Britain).* (Inter. Avia., No. 763, 9/5/41, pp. 6-7.) (Abstract available.)
78/12	Spain ...	*Hispano H.S. 42 Trainer.* (Inter. Avia., No. 763, 9/5/41, pp. 8-9.)
78/13	Germany ...	*Focke-Wulf F.W. 158 Single-Seat Pusher Fighter.* (Inter. Avia., No. 763, 9/5/41, p. 10.)
78/14	U.S.A. ...	*Beechcraft AT. 7 Trainer.* (Inter. Avia., No. 763, 9/5/41, p. 11.)
78/15	U.S.A. ...	*Boeing B. 17 D. Flying Fortress (Photograph).* (Inter. Avia., No. 763, 9/5/41, p. 1.)
78/16	Switzerland...	*Estimation of Aircraft Distance with Binoculars.* (R. H. Stehli, Flugwehr und Technik, Vol. 2, No. 10, Oct., 1940, pp. 226-227.)
78/17	Germany ...	*German A.A. Gun of 130 mm. Calibre.* (Flugwehr und Technik, Vol. 2, No. 10, Oct., 1940, pp. 227-228.)

78/18	Germany	*German Air Raid Defence of Factories.* (C. Wachtel, Chemical and Metallurgical Engineering, Vol. 48, No. 4; April, 1941, pp. 92-94.) (Abstract available.)
78/19	Germany	*Focke-Wulf F.W. 189 Short Reconnaissance Plane.* (Inter. Avia., No. 760, 16/4/41, pp. 6-7.)
78/20	U.S.A.	*Timn P.T.-160-K Plastic Trainer.* (Inter. Avia., No. 760, 16/4/41, p. 9.)
78/21	Switzerland	*Piaggio P. 23 R. Three-Engined Bomber (Photograph).* (Inter. Avia., No. 760, 16/4/41, p. 1.)
78/22	U.S.A.	*Organisation of U.S. Air Force.* (Inter. Avia., No. 762, 1/5/41, pp. 1-5.)
78/23	U.S.A./ Great Britain	*Caribou (Extra Weight of British Version of Bell P. 39).* (Inter. Avia., No. 762, 1/5/41, p. 8.)
78/24	U.S.A./ Canada	*Fairchild M. 62 Trainer.* (Inter. Avia., No. 762, 1/5/41, p. 8.)
78/25	U.S.A.	*Ammunition Supply of Republic P. 43 Lancer.* (Inter. Avia., No. 762, 1/5/41, p. 8.)
78/26	U.S.A.	*Northrop N-3PE Twin Float Patrol Bomber.* (Inter. Avia., No. 762, 1/5/41 pp. 8-9.)
78/27	U.S.A.	*Lockheed L. 49 Giant Aircraft Project.* (Inter. Avia., No. 762, 1/5/41, p. 9.)
78/28	U.S.A.	*Morrow Trainers Made of Plastic Plywood.* (Inter. Avia., No. 762, 1/5/41, pp. 9-10.)
78/29	U.S.A.	*U.S.A. Type Designation.* (Inter. Avia., No. 762, 1/5/41, p. 10.)
78/30	Great Britain	*North American Mustang and Me. 109F. (Silhouette).* (Flight, Vol. 39, No. 1,696, 26/6/41, pp. 430d.)
78/31	Great Britain	*Miles Master II Trainer.* (Flight, Vol. 39, No. 1,696, 26/6/41, p. 434.)
78/32	U.S.A.	*Douglas B. 19 Giant Bomber Ready for Flight Trials.* (Flight, Vol. 39, No. 1,695, 19/6/41, p. 416f-h.)
78/33	Great Britain	*Oerlikon 20 mm. High Explosive Shell.* (Flight, Vol. 39, No. 1,695, 19/6/41, p. 417.)
78/34	Great Britain	*Types of Ammunition Used by Germany and Italy (Photograph).* (Flight, Vol. 39, No. 1,695, 19/6/41, p. 417.)
78/35	U.S.A.	*Martin B. 26 "Marauder" Attack Bomber.* (Aeroplane, Vol. 60, No. 1,570, 27/6/41.)
78/36	U.S.A.	*Curtiss Tomahawk Single-Seat Fighter (Sectional Drawing).* (Aeroplane, Vol. 60, No. 1,570, 27/6/41, p. 718.)
78/37	France	*French Aeroplanes in Action.* (Aeroplane, Vol. 60, No. 1,569, 20/6/41, p. 675.)
78/38	U.S.A.	*Bell Aircobra (P. 39).* (Aeroplane, Vol. 60, No. 1,569, 20/6/41.)
78/39	Italy	*Caproni 316 Float Seaplane (Photograph).* Inter. Avia., No. 761, 24/4/41, 1.)
78/40	U.S.A.	*Taxi-ing Test of Douglas B. 19 Giant Bomber (Photograph).* (Inter. Avia., No. 761, 24/4/41, p. 13.)
78/41	Germany	*German Air Force—Preliminary Training of Hitler Youth.* (Inter. Avia., No. 761, 24/4/41, p. 18.)
78/42	France	*The French Air Force (Description of Principal Types).* (Flugwehr und Technik, Vol. 1, No. 3, March, 1941, pp. 61-65.)
78/43	Switzerland	*Bomb Ballistics.* (H. Bachofner, Flugwehr und Technik, Vol. 1, No. 4, April, 1939, pp. 90-92.)

78/44	Switzerland...	*20 mm. Oerlikon Shell Gun for Tail Defence.* (Flugwehr und Technik, Vol. 1, No. 4, April, 1939, p. 97.)
78/45	Switzerland...	*The Link Trainer.* (O. Wuhrmann, Flugwehr und Technik, Vol. 1, No. 1, Jan., 1939, pp. 14-16.)
78/46	Germany ...	*Dornier Do. 17 Bomber.* (Flugwehr und Technik, Vol. 1, No. 1, Jan., 1939, p. 22.)
78/47	Switzerland...	*Oerlikon 20 mm. Wing Gun.* (Flugwehr und Technik, Vol. 1, No. 2, Feb., 1939, pp. 35-36.)
78/48	Switzerland...	*Aerial Combat Between Fighter and Bomber.* (C. Rougeron, Flugwehr und Technik, Vol. 1, No. 2, Feb., 1939, pp. 37-40.)
78/49	Switzerland...	*The Importance of Psychological Factors in the Choice of Military Pilots.* (H. Meier-Muller, Flugwehr und Technik, Vol. 1, No. 2, Feb., 1939, pp. 43-46.)
78/50	U.S.A. ...	*P. 36 Mohawk Fighter—Control and Armament Details and Flight Instructions.* (R. A. Keith, Canadian Aviation, Vol. 14, No. 5, May, 1941, pp. 18-30.)
78/51	U.S.A. ...	*Cub. J-5 Cruiser (Blind Flying Trainer).* (Canadian Aviation, Vol. 14, No. 5, May, 1941, p. 23.)
78/52	U.S.A. ...	*Hurricane and Martin B. 26 Produced in Canada.* (Canadian Aviation, Vol. 14, No. 5, May, 1941, pp. 48-58.)
78/53	U.S.A. ...	*Curtiss X5B.2C-1 Dive Bomber.* (Canadian Aviation, Vol. 14, No. 5, May, 1941, p. 66.)
78/54	U.S.A. ...	*Republic XP-47B "Thunderbolt" Interceptor Fighter.* (American Aviation, Vol. 5, No. 1, June 1st, 1941, p. 8.)
78/55	U.S.A. ...	*North American XP-51 "Mustang" Pursuit.* (American Aviation, Vol. 5, No. 1, June 1st, 1941, p. 141.)
78/56	Germany ...	*Demolition by Means of Explosives (Earth, Rock, Bricks and Concrete).* (Z.G.S.S., Vol. 36, No. 4, April, 1941, pp. 85.)
78/57	U.S.A. ...	*Production of 14-Cylinder Wright Cyclone.* (Trade Winds, May, 1941.)
78/58	U.S.A. ...	*American Consolidated "Liberator" Heavy Bomber.* (Aircraft Engineering, Vol. 13, No. 148, June, 1941, pp. 164-165.)
78/59	U.S.S.R. ...	*The Soviet Air Force.* (Flight, Vol. 40, No. 1,697, 4/7/41, pp. 64-69.)
78/60	Great Britain	*Bristol Beaufighter Night Interceptor.* (Flight, Vol. 40, No. 1,697, 4/7/41, p. 10.)
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78/63	Canada ...	*Canadian Trainer and Transport (Fleet Aircraft, Ltd.).* (Aviation, Vol. 40, No. 5, May, 1941, pp. 60-61.)
78/64	U.S.A. ...	*Owlet Tricycle Trainer.* (P. H. Wilkinson, Aviation, Vol. 40, No. 5, May, 1941, pp. 64-65.)
78/65	U.S.A. ...	*Five-Gun Turret with Variable Fire Pattern.* (L. Brukiss, Aviation, Vol. 40, No. 5, May, 1941, pp. 44-45, 146-148.)
78/66	U.S.A. ...	*Blackburn Botha I.* (Aviation, Vol. 40, No. 5, May, 1941, p. 67.)
78/67	U.S.A. ...	*North Atlantic Ferry.* (V. E. Smith, Aviation, Vol. 40, No. 5, May, 1941, pp. 30-31 and 132-138.)

78/68	Great Britain	*The Effect of Rain on Rifle Fire.* (Engineer, Vol. 171, No. 4,458, June 20th, 1941, pp. 401-402.)
78/69	Germany ...	*Me. 109 F High Altitude Fighter.* (Nature, Vol. 147, No. 3,738, 21/6/41, p. 773.)
78/70	U.S.S.R. ...	*Air Force of the U.S.S.R. (Equipment and Organisation).* (Aeronautics, Vol. 4, No. 5, June, 1941, pp. 40-46.)
78/71	Great Britain	*The First Power-Operated Gun Turret.* (C. A. Rae, Vol. 4, No. 5, June, 1941, p. 77.)
78/72	Great Britain	*Supplies Dropper (Blue Print).* (Aeronautics, Vol. 4, No. 5, June, 1941, p. 59.)
78/73	Great Britain	*Westland Lysander (Blue Print).* (Aeronautics, Vol. 4, No. 5, June, 1941, pp. 60-61.)
78/74	U.S.A. ...	*Consolidated Catalina (Blue Print).* (Aeronautics, Vol. 4, No. 5, June, 1941, p. 62.)
78/75	Great Britain	*Towed Glider Tactics.* (W. E. Hick, Aeronautics, Vol. 4, No. 5, June, 1941, pp. 66-67.)
78/76	U.S.A. ...	*The Floating Fortress (Sea Drome).* (C. F. McReynolds, J. of Coast Artillery, Vol. 84, No. 3, May-June, 1941, pp. 220-225.)
78/77	U.S.A. ...	*War Rockets in the Past.* (W. Ley, J. of Coast Artillery, Vol. 84, No. 3, May-June, 1941, pp. 226-233.)
78/78	U.S.A. ...	*Parachute Troops (Successes, Training and Equipment).* (C. J. Schmidt, J. of Coast Artillery, Vol. 84, No. 3, May-June, 1941, pp. 242-247.)
78/79	U.S.A. ...	*Shell Burst Projector and Spotting Trainer for A.A. Artillery.* (B. D. Gill, J. of Coast Artillery, Vol. 84, No. 3, May-June, 1941, p. 259.)
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