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

SUBSIDIARY INDEX.

On High Speed Fighters. (Inter. Avia, No. 792, 26/11/41, pp. 1-6.) (99/1 Switzerland.)

The author reviews a paper by Johnson on the same subject (J. of Aeron. Science, Vol. 8, No. 12, October, 1941, pp. 467-474, R.T.P. Abstract 96/7) in which the desirable qualities of a fighter aircraft are placed in the following order :—

1. Speed at high altitudes (at least 50 m.p.h. faster than bomber).
2. Effective armament.
3. Ease of production.
4. Manœuvrability.
5. Time required for development.
6. Flight qualities.
7. Cost.

The insistance on speed as the primary consideration is in agreement with German views on the same subject (R.T.P. Abstract 98/4) although the author of the present review points out that for an interceptor, rate of climb may be of greater importance and this may definitely put a limit to the permissible wing loading.

The author is also of the opinion that with the advent of aircraft armour, the small calibre machine gun (even if installed in large numbers) has now been superseded by the cannon of 15 or 20 mm. calibre. Such weapons have the additional advantage that they can be used effectively against ground targets, including tanks and the aircraft thus equipped form a useful alternative to the dive bomber.

Price Policy Giving Requirements of the German Armed Forces. (Inter. Avia., No. 792, 28/11/41, p. 16.) (99/2 Germany.)

New guiding lines concerning the *price policy of the German Government* have now been published; they state approximately the following:—The requirements of the Armed Forces must be met at the lowest possible prices in the interest of the national economy. The determination of contract prices is based on the price calculation of a so-called " good concern," *i.e.*, of a company that operates economically. Firms operating uneconomically are thus forced to adopt measures of economy. To the cost of the " good concern " are added certain elastic " profit standards " which provide a premium for special performance. On the basis of competitive bids, fixed prices for certain quantities and fixed delivery periods can be expected within a specified industry. However, fixed prices of this kind cannot be applied for development and experimental work, in which case the cost is rigorously checked. Also for experimental work premiums are granted.

Military Air Transport. (Inter. Avia., No. 792, 28/11/41, p. 19.) (99/3 Germany.)

The following figures have been released concerning the performance of the " flying transport formations " of the German Air Force in the campaign in the East during the time from June 22nd to October 31st: 30,000 missions, 22,000,000 aircraft kilometres, 38,000,000 kg. of goods of all kinds, etc. The report emphasises that the organisation succeeded in transporting several divisions to the front by air and developed a particularly intensive activity in the transport to the rear of wounded personnel.

Parachute Flares (Digest from the Dutch). (Luftwissen, Vol. 8, No. 12, Dec., 1941, p. 385.) (99/4 Netherlands.)

The parachute flares described (Dutch pattern) descend at about 1.5 m./sec., burn for 3-5 minutes and develop up to 400,000 candle power. They are packed in cylindrical canisters housed in the tail of the aircraft. On release, the top of the canister is pulled off and the silk parachute drawn out by means of a 6 m. ripping cord. (Breaking load of the latter 4 kg.) The flare (magnesium mixture) ignites when the parachute has moved some distance (12 m.) from the aircraft. It is stated that the flare can be dropped from a minimum height of 400 m. (maximum speed of aircraft 240 km./h.) and besides illuminating the ground it is also effective in camouflaging the aircraft.

The total weight of flare plus parachute is given as 8 kg.

Torpedo Dropping from Aircraft (Digest from the Dutch). (Luftwissen, Vol. 8, No. 12, Dec., 1941, p. 388.) (99/5 Netherlands.)

Present-day aircraft torpedoes are dropped from altitudes of 8 to 30 m., the aircraft speed at release being of the order of 160-200 km./h. (Maximum distance from target is of the order of 4,000 m.)

The torpedoes employed are 45 cm. calibre, 5 m. long and contain a charge of 170 kg. of Trolyte. They are suspended in the aircraft in such a way that a

rotation about the longitudinal axis is imparted to the torpedo on release so that the correct angle of inclination is maintained during the drop. The torpedo will then reach its correct depth after a run of about 200 m. Some Italian and Norwegian designs of torpedoes are fitted with devices controlling the angle of incidence during the passage through the air and thus rendering drops from greater altitudes possible.

Even from low altitude, however, the shock on impact with the water presents difficulties.

On the Stability of Laminar Flow on a Sphere. (J. Pretsch, L.F.F., Vol. 18, No. 10.) (99/6 Germany.)

The circumstances controlling the breakdown of the laminar boundary layer into turbulent form is of fundamental importance in the calculation of the resistance. The two-dimensional problem has been investigated by a number of authors using the method of small oscillations and the stability of the laminar layer (velocity profile) can be expressed in terms of a certain critical Reynolds number.* Such critical Reynolds numbers have been obtained for the velocity profiles associated both with positive and negative pressure gradients in the flow and some information on the position of the breakdown point on a wing surface is thus available. Similar information would be of great value in the three-dimensional case of a fuselage. Unfortunately velocity profiles of sufficient accuracy are not yet available for this general case. In the simpler case of a sphere, however, it appears probable that velocity profiles suitable for stability investigation will soon become available and the case of the sphere is moreover of great interest since it has been extensively used in resistance and turbulence investigations. The author shows that the method of stability investigation employed in the two-dimensional case can be applied without charge to the special case of the sphere. Making use of the known velocity profile of the sphere at the stagnation point the author shows that the laminar boundary layer is in this case more unstable towards towards small disturbance than in the two-dimensional case previously considered. For velocity profiles at the stagnation point therefore, the critical Reynolds number is thus less for bodies of revolution than for the two-dimensional plate, the values for Re being 4,200 and 12,100 respectively.

On the Theory of Turbulent Boundary Layer on a Flat Plate. (T. Sasaki, Aeronautical Research List, Tokio Rept. No. 211, August, 1941, pp. 485-492.) (99/7 Japan.)

The author considers the turbulence as due to the distribution of very fine vortices, and expresses the two-dimensional boundary layer equation in the form

$$\frac{\partial}{\partial x}\left[\frac{\rho}{2}(u^2+v^2)\right]+\rho v z=\mu\frac{\partial^2 u}{\partial y^2}$$

where z = vorticity.

Considering the mean vortex in an elementary area the following equation is derived

$$axw\frac{\partial w}{\partial x}+bw^2=-c\frac{\partial w}{\partial y}$$

when w = strength of mean vortex $=\partial u/\partial y$.

$$\left.\begin{matrix}a\\b\\c\end{matrix}\right\}=\text{constants.}$$

*$Re_{crit}=U_\infty\delta/\gamma$ where δ = displacement thickness of boundary layer. If $Re<Re_{crit}$ for a given velocity profile, small disturbances of any frequency are ultimately damped out.

The general solution of the above will be in the form

$$f\left(\frac{bw}{1}-\frac{y}{c},\ \log wx^{b/a}\right)=0$$

As possible solutions, the author suggests

$$\frac{1}{bw}-\frac{y}{c}=\frac{m}{w}\,x^{-b/a}+n \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$\sqrt{\left(\frac{1}{w}-\frac{b}{c}y\right)}=m\log_{10} wx^{b/a}+n \quad . \quad . \quad . \quad . \quad (2)$$

The former gives the local friction coefficient in the form

$$C_f{}^1AR_x{}^{-a}+B$$

whilst the latter gives

$$i/\sqrt{(C_f{}^1)}=A\log_{10} C_f{}^1R_x{}^a+B$$

and agrees with the corresponding expression of van Karman if $(a)=1$.

Note on the Thermal Effects Accompanying the Displacement of a Solid in a Fluid. (E. Brun, Compts Rendus de l'Academie des Sciences, Vol. 212, No. 20, 19/4/41, pp. 843-845.) (99/8 France.)

The author has measured the surface temperature of a plate rotating in still air and deduces the following formula, v being in cm./sec. :—

$$\theta=4.4\times 10^{-8}v^2\ (°C.).$$

The upper limit of the Reynolds number is of the order 10^6, and the results are in good agreement with Hilton's measurements (Proc. Roy. Soc., Vol. 168, p. 43) on a fixed plate at $Re\ 0.8\times 10^5\simeq 3.6\times 10^5$.

The same value for θ has been deduced theoretically by Pohlhausen (Z.A.M.M., Vol. 1, 1921) on the supposition that the boundary layer is laminar. Since the author is of the opinion that in his own experiments the boundary layer was turbulent, he deduces that the thermal effects must be concentrated in the laminar sublayer. Reference is made to some unpublished tests carried out with hot air (up to 500°C.) which gave the law (for Mach numbers up to 0.93).

$$\theta=3.2\times 10^{-8}v^2.$$

These tests also indicated that the mean temperature of a very small body moving at high speed is independent of its shape. (For previous publications by Brun, see Comptes Rendus, Vol. 194, p. 594; Vol. 195, p. 302; Vol. 196, p. 1,960; Vol. 198, pp. 899 and 1,213; Vol. 202, p. 555; and Pub. Scient. du Min. de l'Air, No. 119.)

On the Effect of the Slipstream of Two Counter Rotating Airscrews in Tandem on the Lift of the Complete Aircraft and the Efficiency of the Propellers. (R. Silbur, Comptes Rendus, Vol. 212, No. 20, 19/5/41, pp. 845-848.) (99/9 France.)

From previous model tests (Compt. Rend., Vol. 212, p. 600), the author deduced that the power coefficient $C_x=C_x/\eta$ of the complete aircraft was improved by about 3-4 per cent. on substituting two three-bladed propellers in tandem for the single three-bladed airscrew previously fitted. (C_x=drag, η=propulsive efficiency.)

A similar improvement is effected in the lift coefficient C_z of the complete aircraft and as a result the polar diagram of the latter rises above that of the equivalent glider for drags in excess of 0.15, the maximum differences in the lift coefficient being of the order of 0.3. It is interesting to note that whilst the propulsive efficiency η=(thrust × velocity)/horse-power of a three-bladed tandem arrangement (contra-rotating) is only very slightly greater than that of the single airscrew, the efficiency peak occurs at appreciably higher values of v/u (1.2 against 0.8 for the case examined).

(For previous papers of the same author, see Comp. Rend., Vol. 205, p. 716 and 958.)

Three Dimensional Flutter Analysis. (W. M. Blackney, J. Aeron. Sci., Vol. 9, No. 2, December, 1941, pp. 56-63.) (99/10 U.S.A.)

The stability equation for the structure acted upon by air forces is set up in a form convenient for flutter analysis. Unrestricted generalised co-ordinates in complex form are used. Useful expressions are given for the aerodynamical coefficients of aerofoils in terms of theoretical two-dimensional coefficients. The mechanical coefficients for aerofoils are expressed in terms of quantities generally known or easily calculable. The value of empirical data from resonance and static-deflection tests is emphasised. The paper is intended as a basis for further development. Detailed steps involved in typical applications will be discussed in a subsequent paper.

On the Reaction of an Elastic Wing to Vertical Gusts. (W. R. Sears and B. O. Sparks, J. Aeron. Sci., Vol. 9, No. 2, December, 1941, pp. 64-67.) (99/11 U.S.A.)

The problem of the behaviour of an elastic wing during and subsequent to its entrance into a vertical gust has been considered by several authors who have made various assumptions regarding the properties of the wing and the nature of the aero-dynamic forces. These forces have usually been calculated by neglecting entirely the " non-stationary flow " effects or by including them in certain terms and neglecting them in others. The results have often shown that wing deflections (and therefore stresses) considerably greater than those corresponding to steady-state values are produced by certain combinations of gust gradient and wing elastic properties.

The present paper is a step in an attempt to determine whether this conclusion may be due in part to the neglect of non-stationary effects.

For this purpose the case of a wing elastic in bending but perfectly rigid in torsion is considered. It is treated approximately by assuming two-dimensional flow conditions at a typical section of the wing and representing the elastic properties of the wing by a spring restraining the vertical motion of this section. The aerodynamic forces are then calculated from the theory of two-dimensional thin airfoils in non-uniform motion. The use of this theory permits proper account to be taken of the " lag " of both the lift due to the gust and the lift due to the vertical motion of the wing.

The author concludes that inclusion of all of the non-stationary aerodynamic effects in the calculation leads to relatively low rates of wing deflection and maximum deflections only slightly greater than the asymptotic values. The large deflections calculated in certain cases by other approximate theories do not appear in the particular cases considered here.

These conclusions are strictly applicable only to the cases of infinite torsional rigidity considered here. In application to actual aeroplane wings entering gusts the calculations should be extended to account for torsional flexibility. The wing deflection will then depend intimately on the relative rigidities in bending and torsion and on the location of the elastic and inertial axes. The results presented here can be expected to indicate the behaviour of wings that are relatively very stiff in torsion.

Lectures on Aerodynamics and Aeronautical Engineering at the E.T.H., Zurich. (Boundary Layer, Supersonics. Jet Propulsions, Belt Drives.) (99/12 Switzerland.)

Brief summaries of lectures delivered in November and December, 1941, are given. The following points are of interest:—

BOUNDARY LAYER.

Detailed velocity profile measurements carried out on a flat plate (30 cm. long) forming part of the wall of a small wind tunnel and fitted with a series of fine slots for sucking off the boundary layer showed that such suction delays the onset of turbulence in the layer and may also reconvert a turbulent into a laminar layer. The critical effect of a pressure rise in the direction of flow can also be considerably reduced by boundary layer suction.

SUPERSONICS.

The 900 h.p. low density supersonic wind tunnel of the E.T.H. is now employed in routine investigations on boundary layer phenomena at high speeds and a film showing how the layer on a plate, sphere or profile increases with speed has been prepared by the Schlieren method. Measurements in the immediate vicinity of the velocity of sound create especial difficulties due to the reflection of impact waves generated in certain high speed regions from the channel walls. These difficulties were partly overcome by installing flexible steel walls over the channel section surrounding the model. Air speeds are determined either by the corresponding adiabatic pressure rise or the value of the Mach angle at a small obstacle.

JET PROPULSION.

The Campini system is explained, and its success attributed to the utilisation of the exhaust and jacket heat of the engine driving the compressor. When operating with a normal propeller, these important sources of energy are wasted. Although the thermal efficiency of the Campini system as a whole is less than that of the normal power plant, the heat in flow for the same fuel consumption is increased about three times and consequently the results do not compare unfavourably with orthodox methods of propulsion. Although the inventor has envisaged fuel injection in the nozzle, the lecturer (Ackeret) is of the opinion that such a process would be very wasteful and scarcely worth while.

BELT DRIVES FOR AIRCRAFT ENGINES.

Belts made of silk in the form of a continuous woven band are stated to be very suitable for high speed operation, since the material has good damping capacity and its porous nature prevents the formation of an air cushion on the pulley, thus ensuring steady running. Experiments were carried out on a silk belt 150 mm. wide passing over 250 mm. diameter pulleys, one of which was fitted with a wind brake whilst the other was attached to the crankshaft of a 150 h.p. aero engine (span not given). It is stated that the belt will function satisfactorily without auxiliary tension rollers, the belt tension being of the order of 400 kg. The efficiency of transmission is high (96 per cent.) and satisfactory operation can be maintained over several hundred hours. The silk belt is stated to be much better than the multiple wedge shaped rubber belt and its incorporation for distant power transmission on a light aircraft is contemplated.

Anti-Vibration Mounting of the Guidonia Low Pressure Supersonic Wind Tunnel. (R. Songia, Riv. Aeron., Vol. 17, No. 4, April, 1941, pp. 1-14.) (99/13 Italy.)

The Guidonia tunnel resembles in its general lay-out the supersonic tunnel of the E.T.H. (Zurich), most of the plant having been supplied by the same Swiss firm of Brown Boveri. Whilst, however, the Swiss tunnel had given considerable trouble due to vibration (both acoustic and structural) great care was taken in the Italian design to overcome these difficulties.

For this purpose the whole of the return circuit (steel pipe placed underneath the floor of the laboratory) was mounted elastically on special dampers inside a concrete channel, which is structurally insulated from the rest of the building.

This channel also contains the cooling plant and is lined internally with sound absorbing material and rests externally on a special foundation, composed of layers of bituminous felt, clay and broken china.

The superstructure of the main building is also insulated from its foundations and silencers are fitted to all the air inlets. It is stated that as a result of these measures, the noise accompanying the operation of the tunnel has been reduced from 100 to 50 decibels. Further improvements involving the lining of certain sections of the tunnel with sound absorbing material are being investigated.

The Laminar Boundary Layer of Elliptic Cylinders and Ellipsoids of Revolution Under Symmetrical Flow Conditions. (J. Pretsch, L.F.F., Vol. 18, No. 12, 29/12/41, pp. 397-402.) (99/14 Germany.)

Theoretical investigations on the resistance of the wings and fuselage of an aircraft involve consideration of the growth of the boundary layer in each case. As a preliminary to the more general problem, the author considers the case of sections which are geometrically similar in the two and three-dimensional case and for which the pressure distribution is of the same type. These conditions are fulfilled for elliptic cylinders and ellipsoids of revolution, provided the flow is at zero incidence and parallel to the generating axis of the ellipsoid. If " a " and " b " are the semi-axis of the ellipse and ellipsoid respectively (" a " being the generating axis of the latter) it appears that for the same $Re = 2au_\infty/\nu$ and $b/a = k = \text{constant}$, the shearing stress at the wall surface is always smaller for the ellipsoid. The impulse thickness of the boundary layer in the two cases depends on whether $K >$ or $< (2/3)\sqrt{3}$ (*i.e.*, on whether or not the velocity distribution along arc has a point of inflection).

If $K > (2/3)\sqrt{3}$ the impulse thickness on the ellipsoid is always greater than on the cylinder. In the reverse case, it only becomes greater at a certain distance behind the pressure minimum. The point of separation for the ellipsoid is only slightly in front of that of the cylinder. For the same pressure distribution on cylinder and ellipsoid, however, the impulse thickness is always smaller for the ellipsoid between stagnation point and pressure minimum. Behind the pressure minimum, the boundary layer thickness of the ellipsoid increases however, at such a rate, that by the time separation takes place the ellipsoid layer is the thicker. As a result, the wall stresses up to point of minimum pressure are now greater for the ellipsoid than for the cylinder, but fall below the cylinder values when the minimum pressure point is passed.

The Design of Propeller Blade Roots. (G. Cordes, L.F.F., Vol. 18, No. 4, April 22nd, 1941, pp. 128-134.) (Available as Translation T.M. 1,001.) (99/15 U.S.A.)

The steadily increasing engine horse-power, as well as the increasing utilisation of the propeller as a brake during high speed power dives and the concomitant higher propeller stresses, demand careful study of the selection of size for safety in service. Apart from the stressing of the hub itself, the walls of which, for instance, must be strong enough to withstand a deformation attendant to the abnormally high air loads in power dives so as to prevent difficulties in the operation of the pitch-changing mechanism—the strength of the blade root is of greatest significance. Although the dynamic stresses have been the subject of detailed investigations, the reciprocal relation between static and dynamic stress defined as the relation between the permissible alternating stresses in the blade root and the initial stress has not been sufficiently taken into account. From this point of view the relation of the required root diameter to the take-off power of the particular engine and of the type of propeller stress—of which four different cases are identified—is investigated.

It appears that an increase in blade root diameter is relatively more effective for raising the permissible horse-power than an increase in the number of blades. Thus, to obtain a 3,000 horse-power propeller for current engine installations with wood blades while maintaining root diameter 160 mm. would require six to seven blades; whereas, on the other hand, four blades are sufficient if the blade root diameter is raised 18 to 19 per cent.

Although the multi-blade propeller has advantages from the aerodynamic point of view, the alternative of increased root diameter is recommended from the point of view of production.

Two-Control Planes (" *The Skyfarer* "). (O. C. Koppen, S.A.E.J., Vol. 50, No. 1, Jan., 1942, p. 23.) (Digest.) (99/16 U.S.A.)

Of strictly " two-control " design, " The Skyfarer " plane has no rudder at all, merely ailerons and elevators with independent controls. The yawing effect of slipstream rotation, counteracted in a conventional type of airplane at take-off by the use of the rudder, is greatly reduced by two large vertical fins on the tail at the ends of a long horizontal stabiliser. The distance between the fins is greater than the effective diameter of the slipstream.

The steerable front wheel of the tricycle landing gear aids longitudinal control during the take-off. A degree of longitudinal stability sufficient to control aileron yaw and to ease the strain of piloting in gusty air is achieved through the large area of the twin vertical tail surfaces.

The plane is " spin-proof " and cannot be side-slipped. Controllable flaps make unnecessary the side-slip technique used in conventional cross-wind landings.

The tricycle landing gear gives the " Skyfarer " pilot excellent visibility in manœuvring the plane on the ground, in taking-off and landing; greatly increases the range in the use of wheel brakes; and makes landing in high winds a common and safe practice.

The Vibration and Sound of a Revolving Thin Plate. (J. Obata and others, Aeron. Research Inst., Tokio, Rept. No. 206.) (99/17 Japan.)

Flutter experiment on model airscrews are rendered difficult by the fact that the torsional and bending frequencies of the blades increase rapidly with diminution of scale and very high speeds of rotation are consequently required.

By substituting a thin duralumin plate (20 cm. long, 20 cm. wide, 0.5 mm. thick) the acoustic phenomena of flutter can be reproduced at quite moderate r.p.m. The authors first show that the flexural and torsional frequencies as measured with the plate stationary are in satisfactory agreement with calculation and that further the characteristic flutter sound agrees in pitch with the natural torsional oscillations. This agrees with previous results of the author on the origin of the flutter sound of full-scale propellers. It is interesting to note that as many as six distinct flutter speeds can be obtained, corresponding to different orders of the torsionals, with intermediate quiescent periods.

The quality of the sound emitted was analysed and its directional characteristics investigated. For most of the experiments the plate was driven edge on (zero angle of incidence). Increasing the incidence was found to reduce the flutter and higher speeds of rotation are required to set up any of the characteristic modes. This is contrary to the case of an actual propeller. Reduction of the density of the air in which the plate rotates causes the flutter amplitude to diminish, the various orders disappearing in succession. Whilst first order flutter already disappeared at a pressure of 500 mm. (r.p.m. 2,700), the fifth order (r.p.m. 5,000) required a reduction to 100 mm. for its extinction.

Aircraft Lighting (Navigation and Landing, Cockpit and Instrument). (G. Reisberg and E. Rosler, Luftwissen, Vol. 8, No. 12, Dec., 1941, pp. 380-384.) (99/18 Germany.)

The usual voltage of aircraft electric circuits is either 12 or 24. With the generator in action (battery charging), the voltage generally rises to 14 or 29 volts, and the lamps operating under these conditions must be designed accordingly. Lamps, such as the landing searchlight, which operate on the battery only (generator out of action) must operate on the lower voltage.

Aircraft lamps are subjected to considerable vibration, not only during landing and take-off (rough ground), but also in the air. At the same time (and this applies especially to external lights such as navigation and searchlights) the lamps must be as small as possible so that the air-drag can be kept to a minimum. Position lights are rated between 5 and 25 watt, whilst the searchlights go up to 500 watt. The lamp for cockpit and instrument lighting vary between 2 and 15 watt.

The authors describe typical lamps used for these various purposes (Osram) references being also made to fluorescent lighting by means of ultra-violet lamps. Till quite recently such mercury vapour lamps required alternating voltage of at least 220 volts. The new Osram lamp, however, functions on 12 v. (d.c.).

Whilst the illumination for the pilot and his instruments may be considered adequate, the authors stress the fact that the amount of light available for the rest of the cabin is inadequate and this applies especially to civil aircraft. Improvements are scarcely possible until the amount of electrical power available on aircraft is increased considerably over present-day standards.

Jet Propulsion (Patent 692,163). (L. Stripe, Flugsport, Vol. 32, No. 18, 28/8/40, Patent Collection No. 32, p. 128.) (99/19 Germany.)

PRINCIPAL CLAIMS.

1. Jet propulsion system consisting of a number of parallel cylinders open at each end and arranged along circumference of a circle, characterised by the provision of a rotating sector, turning about the axis of symmetry of the cylinders, and being driven by the relative wind. The sector has fewer blades than there are cylinders, injection and ignition taking place in those cylinders, one end of which is thus closed, whilst the open cylinders are scavenged.

2. Jet propulsion system according to claim 1 provided with a second blade system at the rear of the cylinders. This second sector runs at the same speed as the first (*e.g.*, on common shaft) and closes the rear of the cylinder before injection and ignition, thus enabling precompression of the charge by means of the relative wind.

3. Jet propulsion system, according to claim 1, characterised by speed control of the rotating blade system.

Jet Propulsion for Aircraft. (Flugsport, Vol. 33, No. 22, 29/10/41, p. 439.) (99/20 Germany.)

Rocket propulsion has frequently been proposed for facilitating take-off.

Utilising ethyl alcohol and liquid oxygen, it is possible to obtain about 200 kg. thrust for the combustion of 1 kg. mixture, as against 50 kg. thrust for the same weight of solid explosive (powder rocket). Even the latter compares favourably on a thrust/weight basis with existing power-driven propellers, which weigh 2.5-3 kg. for 50 kg. thrust.

The propulsive efficiency of the jet can be markedly improved by the provision of a suitable venturi.

The thermal and mechanical fundamentals of jet propulsion by means of heated air (exhaust) are well known, but only very limited application has been made of

this method up to now. It appears that the following efficiencies should be realisable :—

Diffusor	... ...	85 per cent.
Nozzle	... ...	99 ,,
Thermal	... ...	17 ,,
Overall efficiency	... ...	6 ,,

The overall efficiency is thus considerably lower than that of the standard power plant with propeller. The jet system is, however, simpler whilst the installation weight is considerably less.

It appears likely that the jet propulsion will be installed at first as an auxiliary to the normal propeller and only operate at high altitudes and speeds.

Methods of Balancing the Axial Thrust of High Pressure Centrifugal Water Pumps. (K. Rutschi, Schweiz, Bauz, Vol. 117, No. 16, 19/4/41, pp. 176-177.) (99/21 Switzerland.)

High pressure centrifugal water pumps necessarily employ a large number of single entry impellers in series and the corresponding axial thrust and gland leakage may present difficulties. It is true that satisfactory mechanical bearings exist to deal with end thrusts of large amount, but the cost and installation difficulties present drawbacks. The author illustrates how end thrust can be automatically balanced by arranging the impellers in groups with alternate right and left hand entry. The grouping can be in parallel or in series, the latter arrangement being the more common. The author describes a pump of this type having two groups of 12 impellers with the gland placed in the centre in a separate compartment which is sealed. Any leakage gradually builds up a back pressure till a balance is reached. The pump delivers 5 l/sec. against a head of 540 m. absorbing 52 h. (efficiency=79 per cent.).

An alternative solution to the problem of end thrust is furnished by the so-called " Hohllaufer " system, in which the casing revolves. This design, although ingenious, is not considered to possess any advantage over the " balanced entry " type described above.

Recent Development in Turbine Technique. (Alton, Engineering and Boiler House Review, Jan., 1942, pp. 226-232.) (99/22 Great Britain.)

The part played by turbine governors in system frequency changes resulting from load variations is considered, and the effect of speed stability by the introduction of superposed turbines and of large high speed units is discussed. Characteristics of turbine governors are briefly analysed, and it is shown how speed stability improvements may be obtained without materially changing existing governors, by installing special control equipment. Results obtained with an experimental unit, built in Italy are reviewed, in which the principle of the Brush Ljungström turbine was applied to an axial unit. Some particulars are given of the combustion gas turbine as designed by Messrs. Brown-Boveri, which is stated to have reached a commercial stage.* Basically, it comprises a five-stage reaction type gas turbine directly coupled to a fifteen-stage axial compressor.

Wind Tunnel Experiments on Model Reaction Turbines. (M. R. Youssef, Engineering, Vol. 153, No. 3,970, 13/2/42, pp. 138-140.) (99/23 Great Britain.)

Interference between blades reduces the optimum performance attainable with an isolated blade, just as the lift per square foot of wing area is less for a biplane or triplane than for a monoplane. For the case of a turbine this is true for any practical blade spacing, and the question arises how far the multiplicity of blades in a blade ring is detrimental to the action of the individual blades. By analogy

* R.T.P. translation No. 1414. (Abstract supplied by Research Dept. Met. Vick.)

with the aeroplane, the fewer the blades the greater the torque that each would develop from a given steam flow. On the other hand, with blades widely spaced, some steam could evidently traverse the blade ring without sensible deflection, and hence without contribution to torque. Clearly there must be some optimum pitch for blades of a given width or form, but it is a matter not amenable to calculation and every turbine manufacturer must rely on experiments to find it. The total torque on a turbine rotor, however, is equal to the torque per blade multiplied by the number of blades, so that the gain due to an increase of pitch will soon be lost by the reduction of the number of blades in action. The practical question raised is, whether any better results would be obtained by spacing the moving blades of a steam turbine much more widely than is now customary. Against such a proposal must be set the long experience of turbine builders, and the apparent confirmation by the present tests, which show that every increase in pitch beyond a certain maximum results in a lower efficiency ratio of the turbine. It is evident, further, from the experiments on pitch variation, that if any increase in pitch is desirable, it should be given equally to the fixed and the moving blades.

Icing of Aircraft Engine Induction Systems. (A. A. Brown, J.S.A.E., Vol. 50, No. 1, January, 1942, p. 22.) (Digest.) (99/24 U.S.A.)

After describing the refrigerated wind tunnel of the Goodrich Co., the author refers to experiments carried out on engine induction systems. Ice forming in such systems can be classified as impact ice, throttle ice and fuel evaporation ice respectively.

Impact ice is collected from the outer atmosphere and can be eliminated by proper scoop design. Throttle ice occurs at small openings due to drop in the air temperature in the restricted passage and can best be dealt with by preheating the air (the injection of alcohol is not recommended).

Fuel evaporation ice can be rendered harmless by proper design of fuel discharge nozzle. It is stated that Pratt and Whitney carburettors are free from any icing in the blower throat due to this cause.

Aircraft Fuel Systems. (F. W. Heckert, S.A.E. Journal, Vol. 50, No. 1, January, 1942, p. 23.) (Digest.) (99/25 U.S.A.)

Fuel tanks should have their outlet lines covered in all normal flight operations. Proper vents must be fixed and hydraulic losses, especially on the suction side, reduced to an absolute minimum.

Traps in the fuel line system must be as few as possible and all necessary connections should be mounted so that they are free from vibration.

The primary difficulty is the avoidance of vapour lock. Most existing systems have their pumps located below the hydraulic gradient and vapour lock may occur at high altitudes. The author describes an electric driven centrifugal pump which automatically vents the vapour and which placed in front of the engine driven pump, feeds the latter with vapour free liquid at a pressure in excess of that of the outer atmosphere. In addition to thus solving vapour lock troubles, the booster system has the following additional advantages:—

(1) Standard engine driven fuel pumps can be retained.
(2) Starting up is facilitated.
(3) In case of engine pump failure, the booster can maintain supply and take the place of the hand pump.
(4) The booster can be employed for transfer of fuel from one tank to another.

Cooling Characteristics of Submerged Light Aircraft Engines. (H. N. Ellerbrock, S.A.E.J., Vol. 50, No. 1, Jan., 1942, pp. 7-14.) (Translations.) (99/26 U.S.A.)

Results are presented of tests on an engine to determine the quantity of air and the pressure difference required for satisfactory cooling at sea level and at

altitude. The tests are part of an investigation that has been started by the N.A.C.A. to determine the performance of a small aeroplane with two continental A-75 air-cooled engines enclosed in the wings.

The results showed that the engine cooled satisfactorily at sea level with wide-open throttle and maximum power mixture with 4.5 in. of water pressure difference across the baffles and 1.06 lb. of cooling air per sec. In addition, from the tests on the ground, calculations showed that the maximum cylinder temperature would not exceed the limit of 500°F. at 8,000 ft. altitude with wide-open throttle and either maximum power or maximum economy mixture if the pressure difference across the baffles was 2.6 in. of water. The cooling air required with this pressure difference would be $\frac{3}{4}$ lb. per sec. The percentage of the brake horse-power required for cooling with the foregoing conditions at sea level and at 8,000 ft. altitude would be approximately 1.0 and $\frac{1}{2}$, respectively.

The Ignition Systems of Motor Car Engines as Influenced by Fuel Characteristics. (J. T. Fitzsimmons, S.A.E.J., Vol. 50, No. 1, Jan., 1942, pp. 15-19.) (Transactions.) (99/27 U.S.A.)

Recent tests indicate that ignition timing can be used to measure the detonation characteristics of a fuel at various speeds in a multi-cylinder engine. Present engines usually require a spark to be set below the point of maximum power to avoid objectionable detonation. A more advanced spark timing with a higher octane fuel will give more power where desired.

Unfortunately, the spark advance requirements with change of speed are not uniform on various commercial fuels from different sources with different processing and blending. Unless a very high octane fuel is used, the automatic spark advance on the distributor supplied on the engine may not be equally satisfactory on different fuels. There seems to be no easy or practical way to make possible the adjustment of the ignition timing by the driver to accommodate different fuels now used.

At present it does not seem desirable, from an economic point of view, to increase the accuracy of the ignition distributor if there is much additional cost involved. When fuels become more nearly standardised as to detonation, it may be worth while not only to improve the accuracy of the distributor but to change the method by which it is driven by the engine.

Roller Bearings. (T. V. Buckwater, S.A.E.J., Vol. 50, No. 1, Jan., 1942, pp. 20-36.) (99/28 U.S.A.)

This paper traces the introduction of tapered roller bearings into all phases of industry, manufacturing and transportation—particularly the automotive industry, the railroad industry, steel mills, oil industry, and machine tools.

Discussing design principles, the author brings out that one of the fundamental concepts of tapered roller bearing usage is that they must be mounted in pairs and a second is that the bearings accommodate any combination of thrust and load; for high thrust reactions, the bearing is made with a steep taper. He points out that tapered roller bearings are rated in accordance with a speed factor, life factor, and application factor, explaining how each of these factors is derived.

In the remainder of the paper are discussed: Lubrication, extreme pressure lubricants, lubricant testing, types of tapered roller bearings, contact stresses in solid and hollow rollers, starting friction on railroad axles, crankshaft and crankpin application, machine tool applications, steel rolling mill applications, and oil well applications.

Lubrication of Cold Engines. (R. W. Young, S.A.E.J., Vol. 50, No. 1, Jan., 1942, pp. 41-42.) (99/29 U.S.A.)

The design of the Mercedes-Benz engine seems planned for military necessity to eliminate preliminary warm-ups, so that the engine starts promptly, the plane begins rolling, and the rest of the engine warm-up takes place while the plane is gaining altitude.

During this warm-up period in climb, the aeroplane installation provides a separate tank for fuel mixed with a small portion of oil until the normal operating temperature of the lubricating oil has been attained. At this point, the pilot switches the fuel valve to draw from the main supply system. The generous use of ball bearings in the rear section and the application of roller bearings to the connecting rods as well as large oil passages and grooves throughout the engine all indicate consideration of the special cold lubrication requirements of the engine.

The universal use of fuel injection on German aircraft engines has been reported to be the result of: (1) The high degree of development of Diesel pumps by Bosch; (2) the possibility of the depreciation of the quality of fuel available in Germany with the resultant necessity of operating military aircraft on low octane fuel. The German development of synthetic fuel and their access to new sources of supply have, however, produced military aircraft fuel reported to be 92 C.F.R. octane rating.

Development of High Duty Pistons Based on Modern Researches on Heat Flow. (E. Gosslau, A.T.Z., Vol. 44, No. 24, 25/12/41, pp. 613-617.) (99/30 Germany.)

As is well known, heat treated Al. alloys undergo a reduction in hardness on being subjected to elevated temperatures over a period. By subjecting E.C.124 alloy to specialised heat treatment, the author claims to have obtained a consistent relationship between Brinell hardness and temperature after three hours exposure. The change with temperature is quite appreciable, ranging from B.N.110 at 200°C. to B.N.68 at 400°C.

The author utilises this fact to determine the temperature distribution in pistons made of this alloy, the piston being sectioned after a three hours full power run and the hardness determined at closely spaced intervals of the surface.

As a result of this investigation, the finning of the corner between piston skirt and lower surface of the crown is recommended as a simple and effective method for reducing piston groove temperature and this design (German patent No. 704,066) is now being adopted in the Argus aero engine. The new piston has a relatively thin crown and top land, the radial fins in the corner projecting beyond the lowest gas ring. Although heat transfer by the rings is thus deliberately reduced at the expense of greater cooling by oil splash, it is stated that the oil radiator need not be increased since the rate of oil circulation in the engine can now be reduced. Full power runs of several hundred hours have been carried out (40-55 h.p. per litre) without ring trouble, using leaded fuel of 87 octane number.

The Measurement of Piston Temperature of Spark and Diesel Engines. (I. Kuhn, A.T.Z., Vol. 44, No. 24, 25/12/41, pp. 617-620.) (99/31 Germany.)

The author reviews the various methods available. In the earliest tests, the engine had to be stopped and a thermocouple pressed against some part of the piston crown, the load temperature being obtained by extrapolating the cooling curve backwards. This method is uncertain and moreover only lends itself to restricted parts of the piston. Temperature measurements under load can be carried out by means of fusible plugs. Apart from ensuring good thermal conduct,

it is difficult to obtain alloys with well defined melting points especially over the higher range (above 350°C.). Temperature sensitive paints have the advantage that the measurements can be extended over the whole surface and are not restricted to isolated points. They cannot, however, be used on the piston crown (burnt off) or skirt (rubbed off). Interesting results have been obtained with such paints on the inside of the piston, although the running time must be restricted since the critical temperature of colour change is affected by length of exposure. The removal of accumulated deposits without damaging the paint also becomes more difficult with time and the tests have therefore generally to be restricted to ½-1 hour.

Length of running time also affects results based on change in the hardness of the piston material with temperature and the author is of the opinion that this method will only give relative and not absolute temperature distributions (see previous abstract 99/30). As regards direct measurement by means of thermo-couples, the fundamental difficulty exists of providing either sliding contacts or flexible leads which will operate satisfactorily at high r.p.m. Thus the D.V.L. arrangement (flexible leads carried through a plunger fitting attached to the connecting rod) entails swinging the wires over an arc of 60° and fatigue fracture occurs after 3½ hours at 1,800 r.p.m. Reference is made to a contact method developed in America (J.S.A.E., Vol. 44, 1939. pp. 157-160) which is stated to have operated at higher speeds.

The drawback of such devices is the fact that measurements have to be carried out on special experimental units which may not correspond in all details with practical conditions.

Variation of Specific Fuel Constumption of Non-Supercharged Engines with Altitude. (W. Fadinger, A.T.Z., Vol. 44, No. 24, 25/12/41, p. 632.) (99/32 Germany.)

The variation of fuel consumption with altitude depends on the mechanical efficiency on the ground, and the proportion of mechanical losses which are independent of altitude expressed as a fraction of the total ground losses.

The author proposes the following equation:—

$$C_a = C_o \frac{\eta_m}{\{1-(T/T_o)^n (1-\beta+\beta p_o/p)\}}$$

where C_a = specific consumption at altitude.
T = temperature at altitude (°C_A).
p = pressure at altitude.
T_o = } pressure at ground.
p_o = }
C_o = specific fuel consumption at ground.
η_m = mechanical efficiency at ground.

$$\beta = \frac{\text{friction h.p. (mechanical, indep. of altitude)}}{\text{total friction h.p. on ground}}$$

Representative values of $\beta = 0.75$
$\eta = 0.70$
$\eta_m = 0.85$

Exhaust Turbo Superchargers for Aero Engines. (W. Von der Null, Z.V.D.I., Vol. 85, No. 43-44, 1/11/41, pp. 847-857.) (99/33 Germany.)

After briefly discussing thermodynamic fundamentals, the author deals with questions of control and blade materials. Some existing types of installation, such as Junkers Ju. 205, Brown-Boveri (for Rolls-Royce), Rateau, D.V.L., etc., are described. As is well known, the high exhaust temperature of the spark ignition aero engine presents considerable difficulties for the turbine blading.

Although the D.V.L. and Krupp's have developed nickel cobalt-chromium alloys and chrome-nickel-titanium steels of remarkable creep strength and corrosion resistance (see R.T.P. Translation No. 1,379) continuous operation at maximum r.p.m. is still only possible if the blade temperature is kept below 650°C. As the exhaust temperature is generally above 1,000°C., some method for cooling the blade becomes imperative. The most practical way of achieving this appears to be the admission of air over part of the blading circumference. As this cooling air enters at relatively low speeds (under the influence of the flight dynamic head) a compromise blade design must be adopted to reduce shock losses. Instead of the usual sharp entry familiar in steam turbine blade design, the D.V.L. have developed a blunt-nosed blade of characteristic aerofoil shape, the only difference being the higher camber. It is stated that this type of blading not only maintains practically constant efficiency over a large range of relative inflow angles, but that this efficiency is at least as good as can be obtained with orthodox blades operating at the designed (shock free) conditions. Whilst this method of cooling affords a practical solution, the thermal stresses induced in the rotor must be carefully allowed for.

The description of known installations reveals nothing new.

The Brown-Boveri turbo supercharger developed for Rolls-Royce Merlin is stated to weigh 40 kg. for each cylinder bank and reproduces ground level pressure at 7,000 m. (24,000 r.p.m.).

The possibility of running a turbo and mechanically driven supercharger in series is briefly touched on. This has certain advantages from the point of view of control, especially for two-stroke engines.

A bibliography of 32 items concludes the article, which is well illustrated and has numerous explanatory footnotes.

Experiments on Ball and Roller Bearings Under Conditions of High Speed and Small Oil Supply. (G. Getzlaff, Yearbook of German Aeronautical Research, 1938, Vol. 2, pp. 110-118.) (Available as Translation TM. No. 945.) (99/34 Germany.)

The effect of bearing installation, oiling system, oil feed and oil volume, also bearing fit and clearance on the running condition of bearings are described on the basis of test runs on special machine with single-row, deep-groove, and roller bearings with 35 millimeter bearings at speeds between 16 and 21,000 r.p.m. corresponding to velocity coefficients of from 560,000 to 735,000. (Velocity coefficient = diameter of bearing in mm. × r.p.m.) With consideration of the requirement for minimum oil volume so essential in aeroplane superchargers, it was found that dependable operation could be insured with oil volumes of from 5 to 0.5 litres per hour (and less in many cases) when the oil was fed through a hole in the inner or outer race. The lowest figures are for roller bearings. The radial clearance is decisive for the operating temperature. Small clearances give higher temperatures. With radial clearances over 30μ the operation was not always satisfactory on shafts without overhang. The reduction in clearance through the seat of the inner race must also be considered, even when the shaft is little oversize. Additional axial loads up to 120 kilograms are accompanied by temperature rise. Oil viscosity has an appreciable effect on the bearing temperature. The lowest viscosity gave the least heat, even by rising oil-inlet temperatures. The power required was approximately defined and amounted, for example, to about 1 horse-power at 21,000 r.p.m. and 20 litres per hour volume. Inspection of the suitability of commercially listed bearings resulted in the preference for the light series, whereby the rising internal load on large roller body diameters is pointed out. A change in the present cage shapes so as to facilitate the entry of the oil into the bearing might make it possible to simplify the oiling system.

Thermo-Chemical Steam Transformer. (Eng. and B.H. Review, Sept., 1941, pp. 84-88.) (99/35 U.S.S.R.)

Mechanical transformation of low pressure steam to a higher pressure level involves the re-transformation of mechanical energy and hence is not entirely satisfactory from the thermodynamic aspect. A thermo-chemical process is described which utilises the fact that the hydration by the absorption of steam, of a concentrated solution of potassium or sodium hydroxide, is accompanied by a rise in temperature. The heat of the hydrated solution possessing a temperature in excess of the original steam temperature serves in part to generate steam of a pressure higher than that of the absorbed steam. It is stated that a plant of this type has been thoroughly tested in Russia at the Central Boiler and Turbine Institute and performance figures are presented.

(Abstract supplied by Met. Vickers Research Department.)

The Effect of the Subsidiary Connecting Rod on the Force Acting Perpendicular to the Crankshaft Axis. (A. Kimmel, L.F.F., Vol. 18, No. 12, 29/12/41, pp. 403-416.) (99/36 Germany.)

In a previous paper (L.F.F., Vol. 18, No. 6, 30/6/41, pp. 229-240) the author has investigated crankshaft bending vibrations induced by forked connecting rod assemblies.

In the present paper the investigation is extended to the master subsidiary rod assembly, the calculation being carried out accurately, *i.e.*, allowing for exact motion of piston and connecting rods both for gas and inertia forces up to fourth order terms in λ $(=1/r)$.

In a worked out example (Brams 323 9-cylinder radial) numerical values are obtained for the gas, inertia and resultant bending forces due to cylinder No. 3 as well as for the resultant bending force for the complete engine.

The bending force of the single cylinder reaches a maximum of about 6,500 kg. whilst the complete engine exhibits nine bending cycles every two revolutions. These cycles do not differ much from each other and on the average have an amplitude of about 6,000 kg. (*i.e.*, the bending force varies between 5,000 and 11,000 kg.). As is to be expected, the effect of the subsidiary connecting rod is mostly found in the higher harmonic terms as appears in the following table for the resultant of the inertia bending forces for all the cylinders.

	Inertia Bending Force, kg.	
Amplitude.	Articulated.	Forked.
Term ind. of ϕ ...	−12,687	−12,425
$x \cos \phi$	879	−14
$x \cos 2\phi$	196	−80
$x \cos 3\phi$	−44	−41
$x \cos 4\phi$	−8	−4
$x \cos 5\phi$	3	1

In the above, the forked assembly is assumed to have the same λ as the main cylinder at $\phi=0$ (crank vertical) the total inertia bending force then amounts to 11,611 kg. (articulated) and 12,564 kg. (forked) respectively.

With $\phi=180°$, the articulated fork assembly gives, however, the smaller resultant force (12,455 kg. against 13,337 kg.).

In order to cut down the labour involved in the accurate investigation, the author introduces certain simplifications, such as limiting the terms involving λ to the third power or replacing subsidiary connecting rod by equivalent masses located at crank and gudgeon pin.

The error involved in each case is discussed.

Steam Power Plants for Aircraft. (E. Knornschild, Luftwissen, Vol. 8, No. 12, Dec., 1941, pp. 366-373.) (99/37 Germany.)

The idea of a central steam generating plant operating a number of turbines distributed along the wing and driving individual propellers is so tempting for large aircraft necessitating 10,000 h.p. or more, that the problem has frequently been investigated. The fundamental difficulty in such installations is the condenser, which has to deal with about four times the heat flow of an i.c. engine of equivalent output. At the same time the steam must be condensed entirely by air cooling and the heat transfer coefficients under these conditions are low. It appears certain that the available wing area will not suffice to house a surface condenser of sufficient size and the author suggests that a tunnel installation inside the fuselage operating in conjunction with a blower offers a chance of some of the waste heat being utilised for propulsion.

If the condenser problem could be solved, reasonable specific weights for turbine and boiler should be possible, although the specific fuel consumption is bound to be higher than that of the i.c. engine because a high vacuum cannot be maintained in the condenser.

In this connection the rotary boilers of Huttner and Vorkauf (Germany) and Bechard (France) are of interest.

The basic features of these machines are described by the author, who also gives some details of experiments carried out in the U.S.A. by the Great Lakes Aircraft Corporation and the G.E.C.

It appears likely that boilers of the Velox type with supercharged combustion and forced circulation will be the most suitable for aircraft installation. In this connection the 1,600 h.p. turbine installation on a German coastal patrol boat is of interest. It is stated that this power plant has a specific weight of about 10 kg./h.p. at a fuel consumption of 310 gm./h.p. hour.

A useful bibliography of 23 items concludes the article, which is well illustrated (15 figures).

Critical Load and Breaking Strength of Ball Bearings Used in Aircraft Controls. (H. Perret, Luftwissen, Vol. 8, No. 12, Dec., 1941, pp. 375-379.) (99/38 Germany.)

Ball bearings installed in aircraft control circuits are subjected to special load conditions since they only swing over a limited arc.

Neither the static nor the dynamic load factors commonly used in ball bearing design thus apply. At the same time it is important that the bearing should be as light as possible and move easily without introducing back lash. In order to obtain criteria for installation of this type, the author carried out experiments in a special machine in which the bearing, whilst subjected to a known radial load could be freely oscillated. It was found that the damping of such natural oscillation underwent a sudden change at a certain critical load, P_K at which the deformation of the bearing causes a marked increase in friction.

This critical load (in kg.) can be represented by the equation $P_K = (56/5)\, zD$ where

z = number of balls in bearing.
D = diameter of balls in mm.

This gives a good approximation to the experimental result over the range $D = 3$ to 8 mm.

It is interesting to compare this critical load with its static load capacity C_o of the bearing defined as the maximum load the stationary bearing will support without affecting its subsequent high speed performance.

The experiments show that P_K/C_o varies between about 2 and 9 depending on types of bearing, the higher values being generally obtained with smaller bearings.

The author concludes that provided the maximum load on an aircraft control bearing is less than 10 C_0, safety against fracture of cage is sufficient.

Drive and Control of Aero Engine Superchargers. (W. V. der Null, Z.V.D.I., Vol. 85, No. 51-52, 27/12/41, pp. 981-989.) (99/39 Germany.)

Although exhaust driven superchargers possess great advantages from the point of view of operation and control, most of the present day installations are still mechanically operated by means of gears interposed between engine and supercharger.

In order to reproduce ground level pressure in the induction pipe at a given altitude, the supercharger is naturally "oversize" as regards ground level output. In the earlier models, designed for limited altitude, the engine was protected against excessive ground level pressure by means of a throttle, either placed on suction side (Hispano) or delivery side of blower (D.B. 600). The temperature rise of the charge associated with this method of control presents however serious difficulties, especially if the altitude for full throttle operation is great. In this case two-speed gears are essential and the author describes typical examples of such gears as fitted to the Jumo 210, Rolls-Royce, Merlin X and Bristol Pegasus XVIII (the latter hydraulically operated). Lately purely hydraulic (infinitely variable gears) have become available, of which the fundamental principles are discussed and incorporation in the D.B. 601 engines described. The limitation of such gears is the warming up of the oil at low operative speeds (large slip). As an alternative, epicyclic (planetary) gears have been proposed, in which the sun wheel is allowed to slip at various rates depending on the adjustment of a hydraulic brake. With the brake locked, the full step up gear ratio is available. The heat generated in the brake does not lead to design difficulties.

It is interesting to note that even with a fixed gear ratio, overheating of charge at low altitude can be substantially reduced by purely aerodynamic means. Thus in the Planiol supercharger, adjustable guide vanes give the air a velocity component in the direction of rotation before entry to the impeller. In this way the pressure head is automatically reduced when operating near the ground. As an alternative, the author suggests the employment of two or more impellers on a common shaft, only one impeller being in operation at low altitude, the others being sealed off. With increasing altitude two or more of the impellers are operated in series by means of suitable valves. Although such an arrangement is scarcely likely to be lighter than the orthodox two-speed gear, the absence of the gear changing mechanism with its clutches is a very great advantage.

The Measurement of Interfacial Surface Tension by the Immersed Plate Method. (A. Dognon, Compt. Rend., Vol. 212, No. 20, 19/4/41, pp. 854-855.) (99/40 France.)

In a previous publication (Bull. Soc. Fr. de Physique, No. 418, p. 22) the author calls attention to the advantage of using a roughened platinum surface for determining surface tensions by the plate (or Wilhelmy) method.

When determining the interfacial surface tension water/benzene, the plate should be first made wet with water and wiped dry before passing through the top layer of benzene, which must be sufficiently thick so that the plate is completely immersed in it when the weighing is carried out.

As an alternative method, very thin layers may be employed for those liquids which spread on water. In this case the forces exerted on the plate is the resultant of the force due to the free energy of the interspace and that associated with the free surface. The latter can be determined by measurement, the plate touching the surface only.

The following are some experimental results (13.5°C.):—

	S.T. of Surface.	Interfacial Tension with respect to Water.	
Benzene ...	... 30.5	34.2	34.0
Chloroform ...	... 28.5	—	31.0
Ether ...	... 18.6	9.5	9.8
Pea nut oil ...	... 44.5	9.3 (direct method)	9.8 (indirect method)

Prediction of Octane Numbers and Lead Susceptibilities of Petrol Blends. (Du Bois Eastman, Ind. and Eng. Chem. (Ind. Ed.), Vol. 33, No. 12, Dec., 1941, pp. 1,555-1,560.) (99/41 U.S.A.)

Data on pure hydrocarbons and experience with commercial petrol have shown that the octane values of blends of saturated hydrocarbon types, such as paraffins and naphthenes, are related arithmetically to the octane numbers of the components and to the relative proportions in which they are blended. If, however, these materials are blended with unsaturated fractions containing olefinic or aromatic types, substantial deviations from an arithmetic relation are commonly encountered.

Methods for the prediction of the octane numbers and lead response characteristics of petrol blends are presented. Octane numbers are predicted by means of a blending coefficient which has been correlated with the difference in octane sensitivity between the stocks blended. A modification of the Hebl, Rendel, and Garton chart is presented for the evaluation of lead response, and correlations for the prediction of this factor from sulphur content and octane sensitivity are given.

It is pointed out that all the correlations are empirical and should be verified before being applied to unusual stocks.

Response of Aircraft Fuels to Tetraethyllead. (A. G. Cattane and A. L. Stanly, Ind. and Eng. Chem. (Ind. Ed.), Vol. 33, No. 11, Nov., 1941, pp. 1,370-1,373.) (99/42 U.S.A.)

On the ethyl blending chart proposed by Hebl, Rendel and Garton, the horizontal scale of cc. tetraethyllead per gallon and the vertical scale of octane number were so chosen that a lead response curve becomes a straight line. This was later revised for A.S.T.M.-C.F.R. motor method octane numbers, and also to take better account (by the use of slanting ordinates) of the effect of the anti-knock value of the base stock upon the relation between lead concentration and increase in compression ratio.

The ethyl blending chart for evaluating lead response of petrol in the A.S.T.M.-C.F.R. engine has now been extended into the region above 100 octane number. The extension is consistent with the original chart in that the line representing the response of a given fuel is continuous and of constant slope throughout its length.

The extended chart permits a quantitative measure of lead susceptibility throughout the range from O octane number to iso-octane plus 3 cc. of tetraethyllead per gallon.

On the supercharged C.F.R. engine the indicated power output is substantially proportional to the manifold pressure at constant-mixture strength, and therefore the power output at incipient detonation for any given fuel is proportional to its allowable boost ratio. If we call the power output possible on iso-octane 100 per cent., then under a certain set of engine conditions iso-octane plus 3 cc. tetraethyllead permits, say, 140 per cent. power, and a 75 octane number fuel, 65 per cent.

Film Lubrication Problems. (Christopherson, J. Inst. Mech. Engrs., Jan., 1942, pp. 126-135.) (99/43 Great Britain.)

This paper applies the technique of the " relaxation " method to solving mathematically the problem of fluid-film lubrication. It was found that a solution to Osborne Reynold's governing equation could be obtained by this means in all cases of practical importance. The method is said to allow the use of a new treatment of the difficulty arising from divergent films in journal bearings. The problem is shown to be tractable even when viscosity is correctly treated as a function of both temperature and pressure, and means of estimating the temperature distribution over the bearing surface are provided. A numerical example is used to illustrate the modifications in the solution resulting from viscosity variation.

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

Automatic Magnetic Crack Detector. (E. A. W. Muller, E.T.Z., Vol. 62 (1941), No. 30, pp. 653-658.) (Reviewed in Z.V.D.I., Vol. 85, No. 37-38, 20/9/41, pp. 788-789.) (99/44 Germany.)

The cost of magnetic crack detection in small parts is largely a question of the time taken in setting up the specimen. The author describes a machine which carries out all the manipulation automatically, provided the specimens are all cylindrical and of the same size (*e.g.*, gudgeon pins). The pins are transferred in succession to end grips, magnetised, rotated and sprayed with oil containing metal filings. After a definite time interval the oil spray is stopped and the current cut off. The specimen continues to rotate slowly, the inspector operating a button which automatically unclamps the specimen and allows it to drop into the " pass " or " reject " box. A new specimen is then introduced automatically and the cycle repeats. The inspector sits in comfort in front of the apparatus and can give his whole attention to the examination, without being distracted by any mechanical work.

Soldering Hard Metal Tips on Tool Steels. (K. Steinbecker, Masch. Markt, Vol. 46, 1941, No. 49, pp. 15-16.) (Reviewed in Z.V.D.I., Vol. 85, No. 37-38, 20/9/41, p. 788.) (99/45 Germany.)

Hard metal tips on tool steels can be attached either by means of a welding flame, high temperature furnace or use can be made of electric resistance heating. In the latter case the usual procedure has been to clamp the tipped tool between two copper electrodes, the current then passing through the hard metal plate and underlying copper foil (acting as solder) to the tool holder. This is liable to cause local overheating due to differences in contact resistance and may damage the tip. The author describes a modification of the process, in which the tool steel forms one electrode and is heated by contact with a single copper electrode. The heat generated melts the solder, and the hard metal tip is then pressed on the soldered surface by means of an elastic roller. The device uses alternating current and a transformer with several tappings is incorporated so that the heating current can be adjusted depending on the cross-section of the steel tool, the current connectors to the steel and copper electrode being water-cooled.

For steel cross-section of 10×10 mm. and 20×20 mm. the soldering time amounts to 1.5 and 3 minutes respectively, the electrical rating being 8 kw.

Wound Plastics Bearings. (Inter. Avia., No. 792, 28/11/41, p. 16.) (99/46 Germany.)

These bearings consist of textile fabric tape, preferably linen, soaked in thermo-setting synthetic resin; before setting the resin, the tape is wound on to the journal itself to a thickness of only 0.008 to 0.04 in. and then hardened under

pressure. Owing to the small thickness of the plastics bushing so formed, contact with lubricants or even with water causes it to swell in a lesser degree than the play usually provided, so that the tolerances of aircraft engine construction can be met without prejudice to the operational safety. The new type of bearing withstands repeated alternating loads of 3,500 lb./sq. in., for short periods even loads exceeding 4,250 lb./sq. in., as well as operational temperatures of 120 deg. C., whereas the wear under the operational conditions prevailing in the engine amounts to less than 0.2 per cent. of the shaft diameter after 200 hours of operation. Even though this value is acceptable only for the comparatively short life of aircraft engines, the new type of bearing is claimed to offer advantages as regards space requirements, protection from corrosion and immunity to misalignment.

Working-Range Flow Properties of Thermoplastics. (F. E. Wiley, Ind. and Eng. Chem. (Ind. Ed.), Vol. 33, No. 11, Nov., 1941, pp. 1,377-1,380.) (99/47 U.S.A.)

One of the most important properties of a thermoplastic moulding compound is the temperature at which the consistency of the material renders it suitable for some forming process. Many tests have been devised to measure such temperature-consistency relations. In this paper a simple method is described which requires a minimum of apparatus and is therefore available to any laboratory. The test is capable of determining the temperature necessary for the successful forming of a plastic in many machines and processes as well as determining rheological characteristics.

This method measures the coefficient of viscous traction of a thin plastic test strip subjected to high temperatures and low stresses. The viscosity of the plastic is calculated and a viscosity-temperature chart obtained.

Results can be readily correlated with those obtained on the Bakelite-Olsen flow apparatus. By this test, data on flow characteristics of thermoplastics have been obtained that are of value in establishing correct thermal conditions in certain processes. Undoubtedly there are other processes in which such data would be useful.

Stainless Steel Movable Control Surfaces. (G. G. Cudhea, J. Aeron. Sci., Vol. 9, No. 2, Dec., 1941, pp. 44-55.) (99/48 U.S.A.)

The general problems affecting the structural design of movable control surfaces are discussed. The need for more adequate specifications for the degree of rigidity of the control surfaces is emphasised. Curves are shown illustrating the effect of hinge location on the weight of dynamically balanced surfaces. The use of light aeroplane fabric for movable control surfaces is suggested. A short history of stainless steel control surfaces is given. Photographs, weight and dynamic balance data are presented for some typical designs. Deflection data and buckling stresses are shown for tests of ten varying shapes of symmetrical and unsymmetrical leading edge stainless steel nose boxes. The theory of torsion bending of open sections is discussed and has been applied to the results of tests on thirteen nose box cut-outs with varying thicknesses and widths of flanges. The specimens tested consisted essentially of simple channels restrained at the ends by three typical leading edge sections. Comparative weight studies are presented for the rudders of two large high speed aeroplanes as designed in aluminium alloy and stainless steel. Calculations showing the relative strengths, rigidities and weights of these surfaces are included.

(*a*) The present requirements for rigidity are inadequately stated for the designer's use. A wide range of rigidities are possible with the same strength.

(*b*) The increasing severity of dynamic balance requirements without regard to structural rigidity is unduly conservative.

(*c*) The location of the hinge line is one of the most important factors affecting the weight of surfaces requiring a low degree of dynamic balance. Every effort should be made to use hinge locations of at least 20 per cent. or more.

(*d*) The use of light aeroplane fabric for movable control surfaces in the range of speeds higher than that now recommended in A.C.M. 04 should be considered.

(*e*) The torsion bending theory applied to hinge cut-outs of the type described gives a reasonable method for estimating the effect of the various parameters on the deflections.

(*f*) The principles of mass distribution used in typical stainless designs result in relatively light and rigid surfaces with low inherent products of inertia, when applied to the usual somewhat blunt nose surface. For the best utilisation of this principle the maximum ordinate for the nose shape should be well forward of the hinge line.

Modern Bearing Technique. (Hollies, Engineering and Boiler House Review, Jan., 1942, pp. 216-220.) (99/49 Great Britain.)

Some outstanding features of modern bearing technique are reviewed. Development leading up to the present perfection of the Michell bearing is described. The properties and constituents of the most widely used anti-friction metals are discussed, such as those on a tin or lead basis. Characteristics and uses of ball and roller bearings are considered, and advantages stressed of special features, including self-aligning tapered roller bearings.

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

A.C. Arc Welding. (Potter, Welding Engineer, Dec., 1941, pp. 30-32.) (99/50 Great Britain.)

Reasons for the increasing prominence of a.c. arc-welding as compared with d.c. processes are discussed in this article. For practically all types of mild steel fabrication, suitable electrodes are available. When such work permits the use of welding currents of 200 amperes or more, requiring 3/16 in. diameter electrodes, a.c. welding is said to be unquestionably more economical. Defects such as slag inclusions and porosity, due to magnetic blow may be more easily avoided with a.c. than with d.c. welding, whilst relative absence of " arc-blow " gives lower costs by making it feasible to use larger diameter electrodes and high currents, thus improving welding speeds. Also less time for training operators is claimed to be needed for a.c. systems, and low operation costs are obtained by higher electrical efficiency and less maintenance cost.

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

Oxy-Acetylene Flame Hardening—VIII. (Magrath, Machinist, 10/1/42, pp. 958-960.) (99/51 Great Britain.)

In flame hardening, the degree of hardness is said to be directly dependent upon the analysis of the metal (carbon being the principal hardening element) and upon the rate of quench. The author shows the theoretical relation between Brinell hardness and carbon content in carbon steel, based on a comparison of hardness acquired by small specimens as annealed, and as water quenched after furnace hardening. In general, higher hardnesses are obtainable on large objects by flame hardening than by furnace hardening. The importance of the nature, velocity and position of the quench in flame hardening is stressed, and advice in regulating and positioning the quench is given. The effect of different quenching mediums on hardness is discussed, and results obtained are compared. The article is to be continued.

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

Non-Destructive Testing. (Autom. Eng., Dec., 1941, pp. 448-450.) (99/52 Great Britain.)

Principles of operation and brief outlines of apparatus used in non-destructive methods of testing welds, castings, etc., are given. By placing the rubber-capped cone of a stethoscope against the work whilst the latter is tapped with a hammer, the natural period note of the part can be heard when it is free from defects. Portable tensile testing machines are reviewed. Magnetic and electrical testing methods may be employed, and it is shown how permanent records from the former method may be obtained. Particulars of X- and Gamma-ray testing are given, and in explaining the interpretation of radio-graphs, some industrial X-ray plants are reviewed.

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

Fatigue Investigations on Dural Connecting Rods (as Fitted to Bucker 80 h.p. Light Aircraft Engines). (E. V. Rajakovics, Z.V.D.I., Vol. 85, No. 43-44, 1/11/41, pp. 867-868.) (99/53 Germany.)

The Bucker Aircraft Company has developed a four-cylinder light aircraft engine developing 80 h.p. for a dry weight of 80 kg. This was made possible by the extensive use of light alloys including the connecting rods for which heat treated Dural forgings (material number 3115.4) were employed. The author describes fatigue tests (tension-compression) carried out on these rods, using a Shenk machine operating at 2,900 load cycles per minute. From engine stress investigations it appeared that the maximum compression in the rod under load is 2,100 kg. and the maximum tension 400 kg. (r.p.m. 2,500). Since bending stresses can be neglected, the load cycle can be replaced by a sinusoidal force of +1,250 kg. on which is superposed a constant force of 800 kg. The resultant Wohler diagrams showed that the rods had an endurance of over 150×10^6 cycles under these conditions which corresponds to over 2,000 hours flying time. These results have been confirmed in practice. It is interesting to note that the little ends of these rods are not bushed, but the gudgeon pin (Chrome Molybdenum case hardening steel) work directly in the Dural (pin has 25 mm. diameter and 0.04 mm. clearance). No oil holes are fitted, lubrication being entirely by splash.

Stress Test on Rotating Drive with Numerous Holes. (Teverovskiy, Sov. Kotloturb, No. 11, 1940, pp. 402-411.) (99/54 U.S.S.R.)

The author summarises the chief results of investigations into stress distribution in discs weakened by several holes disposed in eccentric order. He refers to the theoretical solution found for discs with one eccentric hole, and which fully agrees with the experimental results obtained. He gives graphs which enable the coefficient of stress concentration of any disc to be promptly determined, irrespective of the number of holes in the disc. He cites various examples, which are fully analysed from the theoretical and practical point of view, to prove his statements.

(Abstract supplied by Met. Vick Research Department.)

Thick-Coated Electrodes for Boiler Welding. (K. A. Khakimyanova and E. A. Podtzebenko, Sov. Kotloturb, No. 11, 1940, pp. 395-397.) (99/55 U.S.S.R.)

The author indicates present Soviet requirements in regard to seam welding of vessels of various kinds. As available electrodes were not capable of fully satisfying the specific demands of present-day processes, the Soviet welding industry was obliged to reconsider the type of coating used on electrodes, and

to arrange for the use of a combined coating having universal application. Various experiments and tests made in this direction are reviewed. The strength characteristics of the electrode with the new coating are stated to be: Tensile strength 45/47 kgs./mm.^{2}; elongation 18-20 per cent.; impact strength not less than 9 kgs./cm.^{2}; bending angle 180°.

(Abstract supplied by Met. Vick. Research Department.)

Corrosion Fatigue of Some Wrought Al. Alloy Under the Influence of Hot Liquids. F. Bollenrath and W. Bungardt, L.F.F., Vol. 18, No. 12, 29/12/41, pp. 417-424.) (99/56 Germany.)

The authors carried out experiments on the bending endurance of a number of rolled and pressed Al. alloys, the specimen being either sprayed with distilled water (90-95°C.), or pure methanol (60-63°C.).

Experiments in air at 20°C. were also carried out, the endurance limit being determined for 10^7 reversals in each case, the rotary bending test machine running at 5,000 r.p.m.

From an examination of the 38 Wohler curves obtained, it appears that in the case of exposure to methanol (water free), best results were obtained with Al. Cu. Mg. alloys which had been aged at room temperature. In their case the endurance limit is lowered about 10-20 per cent., whilst the copper free alloys drop as much as 50 per cent. below the value in air.

In the presence of distilled water, however, Al. Mg. alloys either with or without the addition of Zn. are much superior, especially when care is taken to obtain a stable grain structure in the manufacturing process. In this case the drop in endurance (10^7 cycles) is only of the order of 10 per cent., compared with air (*i.e.*, 15 kg./mm.^{2} to 13.5 kg./mm.^{2}), whilst some of the alloys containing copper under similar conditions exhibit a drop of nearly 40 per cent.

New Method for Making Glued Repairs on Plywood Wing Covering for Aircraft (Use of Needle Clamp). (Luftwissen, Vol. 8, No. 12, Dec., 1941, p. 374.) (99/57 Germany.)

When carrying out repairs on plywood wing covering, the difficulty arises of clamping the plywood patch tightly over the hole whilst the glue is drying. A special tool is described for this purpose. A long needle carrying a thread through a hole near its point is pushed through the patch and underlying cover. On rotating the tool, the thread winds round the needle and acts as a lock nut, preventing its withdrawal. By turning a nut on the upper part of the needle shaft, pressure can then be exerted against a slotted collar and the patch pressed tightly against the base whilst the glue dries.

Withdrawal of the needle is effected by unwinding the thread. The holes made by the needle are only 1.2 mm. diameter and can be easily stopped with varnish to prevent moisture leaking in.

Propagation of Sound Through the Atmosphere. (B. Haurwitz, J. Aeron. Sci., Vol. 9, No. 2, Dec., 1941, pp. 35-43.) (99/58 U.S.A.)

This article gives an elementary survey of the geometrical laws to which sound propagation through the atmosphere is subjected. In a calm atmosphere with decreasing temperature upward, the sound rays are bent upward. If the sound ray returns to the ground, the temperature must increase upward. A wind which becomes stronger with the elevation bends the sound ray back to the ground in the direction of the wind, but increases the upward curvature of the sound ray in the opposite direction. Thus, a region of audibility around a source of sound must be asymmetrical if it is due to the wind. Due to the curvature of

the sound rays, aircraft can only be heard within a region well above the visual horizon, the so-called acoustical bowl. The zones of anomalous audibility around an explosion which are separated from the region of normal audibility by zones of silence are to be explained by high air temperatures, of about 340° absolute or more, at about 40-50 km. altitude.

Influences of Surfaces on the Coefficient of Heat Exchange. (W. A. Rachko, Sov. Kotloturb, No. 11, 1940, pp. 411-414.) (99/59 U.S.S.R.)

The author reviews the results of investigations on the problems of the dependence of the heat exchange coefficient on the roughness of heat dissipating surfaces, and discusses the dependence of the heat exchange coefficient on the thermal effect on a corroded steel tube. He illustrates his arguments by a series of diagrams and compares his work with identical work by other investigators.

(Abstract supplied by Met. Vick. Research Department.)

Integrating Altimeter. (F. Charron, Compt. Rend., Vol. 212, No. 20, 19/4/41, pp. 852-854.) (99/60 France.)

The usual altimeter measures the altitude according to the formula

$$z = -\left(\frac{1}{g}\right)\int_{P_1}^{P_2} \frac{dp}{a} \qquad (1)$$

where a = mass of unit volume of air at altitude z.

The integration is effected by assuming a law of variation of temperature with altitude.

The author describes an instrument which will carry out the integration automatically during the ascent without a prior knowledge of the law of variation of temperature being necessary.

Re-writing equation (1) in terms of standard density a_0 we have

$$z = -\left(\frac{P_0}{g a_0}\right)\int_{P_1}^{P_2} \left(\frac{T}{T_0}\right)\frac{dp}{P} \qquad (2)$$

The pointer of an ordinary aneroid willundergo a deflection $d\theta$, given by

$$-dp = K d\theta \qquad (3)$$

In the author's instrument, the pointer serves as axis to a finely toothed wheel of radius ρ the distance r of the wheel from the axis of rotation being governed by a second very flexible control box containing a sealed quantity of air under these conditions

$$\frac{T}{T_0} = \frac{\rho}{\rho_0}\frac{r}{r_0} \qquad (4)$$

Substituting (3) and (4) in (2) we have

$$z = \left(\frac{K}{g a_0 r_0}\right)\int_{\theta_1}^{\theta_2} r d\theta \qquad (5)$$

Now if the wheel on the pointer is in contact with a plain surface,

$$\int_{\theta_1}^{\theta_2} r d\theta = \rho\phi$$

where ϕ = angles turned through by wheel.

If the wheel is provided with very fine teeth and inked, the number of marks on the paper is a measure of the rotation and thus of the altitude, automatically corrected for temperature.

The author states that an instrument designed on these lines has functioned satisfactorily.

High Speed Action Analysis. (Watson, General Electric Review, Oct., 1941, pp. 549-557.) (99/61 Great Britain.)

The article describes and classifies individually various devices produced from time to time to aid the analysis of motions too rapid for unaided visual observation. The various systems are tabulated and particulars given of shutter and stroboscopic methods of film exposure. Direct visual observation is effected either through a shutter or without optical apparatus by observing the action of devices performing repetitive cycles. Still cameras can be used to obtain single and multiple images and three types of cinema camera have been employed. Stroboscopic equipment described consists of a toothed wheel and a neon tube energised by a quickly re-charging condenser. Results illustrated include a bullet striking a lamp, glass breaking, multiple exposure arc interruption and multi-stroke lightning.

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

Measurement of Gases. (T. Baker, El. Rev., 9/1/42, pp. 41-42.) (99/62 Great Britain.)

Equipments using electrical methods for the computation and analysis of gases are described. Apparatus is available devised for measuring leakage of hydrogen through balloon fabrics. This is a slight modification of the Katharometer, and operates on the Wheatstone bridge principle, incorporating four platinum spiral resistances enclosed in glass cells, two filled with a standard gas and two with the gas to be measured. Equipment for testing the porosity of parachute fabrics is briefly reviewed. Apparatus for the important industrial application of measuring the quantity of oxygen in boiler feed water is described. A small amount of feed water is " scrubbed " by hydrogen and the gaseous mixture obtained is compared against pure hydrogen.

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

Electronic Microscope Developments (Hillier and Vance, Procs. I.R.E., April, 1941, pp. 167-176.) (99/63 Great Britain.)

The basic principles involved in the electron microscope are briefly dealt with and a detailed description is given of the newly developed R.C.A. electron microscope, which, although said to be equal or superior in performance to any previous microscope, occupies less space and is claimed to be self-contained, and can be readily handled by an inexperienced operator. Examples of the work done by this new instrument are shown, and the power supply system for the microscope is described. The reduction in size is obtained chiefly by the use of a radio-frequency-actuated rectifier system. By using radio frequency and a special designed voltage divider, the 60 kv. output voltage is maintained constant to 0.004 per cent. at 0.5 ma. drain.

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

Aircraft Precipitation-Static Radio Interference. (Starr, A.I.E.E. Transactions, Suppl. to Electrical Engineering, June, 1941, pp. 363-370.) (99/64 Great Britain.)

The author discusses radio interference, precipitation-static flight research, high voltage d.c. ground tests, co-ordinated laboratory and analytical studies

and the control of electrical discharges from aircraft. A trailing wire has been found to be quite useful as a discharging arrangement for controlling the accumulated charges and reducing radio interference resulting from their dissipation to the atmosphere.

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

The Determination of Exposure Time in Aerial Photography. (A. Charrion and S. Rocher-Vallette, Publ. Scient. Techn. du Secretariat d'Etat a l'Aviation, B.S.T., No. 94, 1941.) (99/65 France.)

Simultaneous aerial photographs of the same subject were taken by the authors, utilising a battery of Leica cameras for which either the exposure time, sensitivity of film, lens stop or filter could be varied. By carrying out the experiments under various weather conditions and altitudes for ground objectives of different types, sufficient data were obtained for predicting optimum exposure conditions for cases likely to arise in practice. The results were embodied on a special circular slide rule which is operated as follows:—

1. Characteristic figures are read off for month and time of day (0-8).
   Light value (state of sky) (0-6).
   State of atmospheres and altitude (1-10).
2. The above figures are added (giving amounts varying between 1 and 24) and the total is set to coincide with sensitivity figure of film employed, taking into account effect of filter, if any.
3. The slide will then give a choice of exposure times and corresponding lens stops. In order to reduce blurring, the shortest time (largest stop) will generally be chosen.

Although this meter will give good results in most cases, the determination of the characteristic light value may present difficulties if the observer has insufficient experience. For this reason, the authors have developed a photo-electric cell for direct measurement of the illumination of the object. The cell is of the usual boundary layer type and resembles commercial type of exposure meters, except in the provision of a cylindrical tube to cut out stray illumination. The photometer which operates on the Null method can be coupled with the lens stop in such a way that the correct stop corresponding to a given exposure time is automatically obtained. The authors point out the necessity for the films intended for aerial photography to be available for a range of standard sensitivities and that the effect of various standard filters should be clearly marked.

The Elimination of Hypo from Photographic Images. (J. I. Crabtree and others, J. Frank. Inst., Vol. 230, No. 6, Dec., 1940, pp. 701-725.) (99/66 U.S.A.)

It is very difficult, if not impossible, to remove the last traces of hypo from photographic papers by any known procedure of washing. The sulphur in the residual hypo ultimately (and especially under abnormal conditions of temperature and humidity) combines with the silver image to form yellowish brown silver sulphide. This phenomenon is known as sulphiding or " fading " of the image. The various factors which affect the rate of fading of images and the washing out of hypo from films and papers are outlined.

Chemical methods of hypo elimination have been proposed from time to time, but the majority of these have not been satisfactory because they tend to leave substances such as thionates in the photographic material, which are equally as difficult to wash out as hypo and which also tend to sulphide or fade the silver image. A new hypo eliminator is recommended consisting of two volatile chemicals, hydrogen peroxide and ammonia. This eliminator oxidises hypo to sodium sulphate, which is inert and soluble in water, while any excess eliminator evaporates on drying.

Two formulæ and treatments are proposed: (1) Complete elimination of hypo for use by the professional, advanced amateur, and photo finisher who demand the highest standard of photographic quality in their prints. (2) Almost complete elimination of hypo (less than 0.01 milligram per sq. inch). Since the conditions to which prints will be subjected are rarely known in advance, use of the "complete elimination treatment" is advised in all cases.

LIST OF SELECTED TRANSLATIONS.

No. 42.

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.

THEORY OF WARFARE (STICK AND DIVE BOMBING).

TRANSLATION NUMBER AND AUTHOR.		TITLE AND REFERENCE.
1369	Tommasi, A. ...	*Stick Bombing at Decreasing Speed and Constant Height on Fixed Targets Moving at Constant Speed.* (L'Aerotecnica, Vol. 21, No. 9-10, Sept.-Oct., 1941, pp. 615-620.)
1370	Wenke, H. ...	*Dive Bombing.* (Luftwissen, Vol. 8, No. 4, April, 1941, pp. 115-117.)
1375	Solovyev	*Some Problems of Dive Bombing.* (Air Fleet News, U.S.S.R., Vol. 23, No. 4, April, 1941, pp. 317-322.)

AIRCRAFT AND AIRSCREWS.

1372	——	*Cant. Z 1007 bis Aircraft.* (Flugsport, Vol. 33, No. 16, 6/8/41, pp. 317-319.)
1391	Bilharz, H.	*Rolling Stability of an Aircraft with Freedom about its Longitudinal Axis with Automatically Controlled, Intermittent, Constant Aileron Moments.* (L.F.F., Vol. 18, No. 9, 20/9/41, pp. 317-326.)
1394	Egorov, B. N. ...	*Airscrews for High Speed Aircraft with High Power Engines.* (Aeron. Eng., U.S.S.R., Vol. 15, No. 3, March, 1941, pp. 11-24.)

ENGINES (INCLUDING FUEL AND MATERIALS).

1376	Novak, D.	*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.)
1379	Cornelius, H. ... Bungardt, W. ...	*Investigations on the Suitability of Heat Resistance Materials for Combustion Engines, Pt. IV.* (L.F.F., Vol. 18, No. 9, 20/9/41, pp. 305-310.)
1384	Riedel, G.	*Power Gas and Diesel Gas Process.* (Kraftstoff, Vol. 17, Aug., 1941, pp. 239-242.)

TRANSLATION NUMBER AND AUTHOR.		TITLE AND REFERENCE.
1385	Reussner, E. A. ...	*Explanatory Note on the German Aero Engine Specification. Pt. 1, Definition of Fundamental Terms.* (Luftwissen, Vol. 8, No. 10, Oct., 1941, pp. 315-322.)
1386	Loose, F.	*Materials for the Construction of Aero Engines.* (Der Flieger, Vol. 20, No. 56, June, 1941, pp. 163-168.)

TURBINE AND COMPRESSORS.

1377	Klingemann, G. ...	*A Method for Calculating the Theoretical Characteristics of Turbo Machines (Rotating Blade System).* (Ing. Arch., Vol. 11, No. 3, June, 1940, pp. 151-178.)
1389	Cherniskevsky ...	*Determination of the Natural Frequency of Vibration of Turbine Blades.* (Sov. Kotloturbo, No. 8, Aug., 1940, pp. 269-273.)
1390	Ries, V. F.	*On the Automatic Regulation of Output in Centrifugal Compressors.* (Sov. Kotloturbo, No. 8, Aug., 1940, pp. 261-269.)

GEARS AND BEARINGS.

1373	Lanzizer, N. ...	*Determination of the Permissible Circumferential Force of Straight Toothed Bevel Gear.* (Supplement.) (A.T.Z., Vol. 3, 10/2/40, pp. 43-44.)
1393	Mundt, R.	*Load Capacity of Ball anl Roller Bearings.* (Z.V.D.I., Vol. 85, No. 39-40, 4/10/41, pp. 801-806.)

STRENGTH OF MATERIALS.

1368	Volkersen, O. Goschler	*The Strength of Lugs or Eyebolts.* (Luftwissen, Vol. 8, No. 5, May, 1941, pp. 151-156.)
1383	Beerwald, A. ...	*On the Fatigue Strength of Heavily Chromium Plated Dural.* (L.F.F., Vol. 18, No. 10, 27/10/41, pp. 368-371.)

MISCELLANEOUS.

1381	Romberg, H. W. ...	*Parachute Jumps from High Altitudes.* (Luftwissen, Vol. 8, No. 10, Oct., 1941, pp. 310-314.)
1382	Sretensky, L. ...	*The Theory of Hydrodynamic Gliding.* (U.S.S.R., Acad. Sci. Bull. Dept. Tech. Sci., No. 7, 1940.)
1392	——	*Large Wind Tunnel at Chalais Meudon, near Paris.* (Luftwissen, Vol. 8, No. 2, Feb., 1941, pp. 50-56.)