ABSTRACTS FROM THE SCIENTIFIC AND TECHNICAL PRESS.

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(Prepared by R.T.P.)

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Insufficient Training of Russian Pilots. (Les Ailes, No. 901, 22/9/38, p. 6.) 65/1 France.)

According to the author of " Russian Aviation "* a large number of Russian pilots can scarcely be considered as trained in the European sense. This has now been realised by the Russian authorities, since, by a recent decision of Marshal Vorochilov, the examination for pilot's certificate has been made more difficult and the members of the committees who are in charge of flying instruction have been rendered personally responsible for the quality of the flying training of each pilot leaving the school.

The Military and Political Considerations which Led to the Choice of the Flying Boat for British Empire Communications. (H. Lufft, Luftwehr, Vol. 5, No. 8, Aug., 1938, p. 313.) (65/2 Great Britain.)

The choice of the flying boat instead of the land plane appears to be mainly due to the following factors:—

(1) Land aerodromes are difficult to defend against attack, especially sabotage by natives. A harbour is easily patrolled by ships.

(2) The landing surface on the ground may be affected by weather or enemy action. This does not apply to landing on a water surface.

(3) Overland routes require a considerable ground organisation which is not only expensive but also vulnerable to enemy action. For this reason the Cape-Cairo route has now been shifted from the direct central African position to the east coast.

It appears that the object throughout has been to link the command of the sea by surface ships to the problem of Empire communication by air.

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* L'Aviation Sovietigne, published by Les Ailes-Paris, 12 frcs.
Principal Contents:
1. Equipment of the Air Force.
2. Technical Development.
3. Industrial Organisation.
4. Personnel.
5. Civil Aviation.
6. Sporting Aviation.
7. Parachutism.
8. Politics and Aviation.

According to the anonymous author, Russian aviation suffers from the low mental standard of the rank and file and from the political interference with those occupying the higher grades. Thus both the single-seater fighters I 5 and I 15 were designed whilst their originators were in prison!

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Bombing Aviation (Résumé of Rougeron's Theories). (E. Margis, Luftwehr, Vol. 5, No. 8, August, 1938, pp. 314-318.) (65/3 Germany.)

Rougeron's theories on bombing have been studied with interest by the experts of all nations. In Vol. I the author considers the development of the light fast bomber in contradistinction to the " Flying Fortress " of Douhet. In the Vol. II. new methods of bombing attack are discussed, of special interest being the use of planing bombs against a fleet at anchor. According to Rougeron, " The days of the fleet are numbered," and the British fleet could be destroyed in a few hours should it be foolhardy enough to seek shelter in Gibraltar harbour. Speaking generally, Rougeron is obsessed with the importance of speed in aircraft. According to him, an advantage in speed will always make up for lighter armament. In air fighting, a number of high speed craft fitted with light guns will get the better of a smaller number of slower but heavier armed machines. As regards anti-aircraft artillery, Rougeron adopts Fisher's famous maxim concerning the armament of the dreadnought class of ship: " The biggest gun and the smallest gun." Only by utilising automatic guns up to 8in. calibre can the ground defence hope to keep aircraft raiders at bay.

NOTE.—For an abridged translation of Rougeron's book see R.A.F. Quarterly, October, 1938, and January, 1939.

Can England Maintain its Oil Supply in War? (P. Ruprecht, W.T.M., Vol. 42, No. 10, October, 1938, pp. 453-6.) (65/4 Germany.)

The production of synthetic fuel from coal in England has been investigated by the Falmouth Committee and turned down in favour of extensive oil storage and tanker fleets.

According to the report, the main reason for the decision is an economic one, the synthetic fuel requiring a considerable outlay in plant and subsidy.

Now cost is relative and there is no guarantee that the same economic consideration would apply in war.

Britain's peace time consumption amounts to 12.6 million tons. In 1936 the whole of Europe consumed 43×10^6 tons, U.S.A. 186×10^6 tons, whilst the world production amounted to 247×10^6 and increased to only 278×10^6 tons in 1937.

It is obvious that a war in which several countries participate will cause a fierce competition for oil supplies and the cost may well rise to a figure commensurable with that of the synthetic fuel. It thus appears that apart from the official reasons given in the report, the Falmouth Committee were of the opinion that:—

(*a*) A future war will be short, in which case the stored supplies will suffice.

(*b*) The oil fuel shortage will be felt more keenly by England's possible adversaries than by the home country.

The author questions both these conclusions, and, as an example, quotes the Japanese Navy which has been equipped to burn coal if the oil supply should fail.

Military Uses of Television. (W.T.M., Vol. 42, No. 10, October, 1938, pp. 472 and 473.) (65/5 U.S.A.)

According to reports from the U.S.A., a long distance range finder embodying television principles has been developed for the coast artillery. Two television cameras at the end of a base line are adjusted till the two images coincide. It is claimed that this range finder by employing wave length outside the optical range will function in total darkness or fog. The French General Neissel is also stated to be enthusiastic about the future possibilities of television for reconnaissance work. Even in its present state of development, Neissel is of the opinion that television already presents some advantages over normal wireless methods of communication.

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The Internal Ballistics of Rifled Gun Barrels with Special Reference to Frictional Effects. (K. H. Bodlien, Z.G.S.S., Vol. 34, No. 2, February, 1939, pp. 33-38.) (65/6 Germany.)

The friction of the shell in the gun barrel is determined by a simultaneous record of the recoil of the barrel and the gas pressure in the barrel. The great difficulty is to obtain accurate co-ordination between the two sets of records.

It appears that the shell experiences two well-defined resistance maxima whilst travelling through the barrel, the second maximum being due to the rotary acceleration impressed by the rifling. The condition of the gun affects the results very considerably and further work is in progress.

An alternative method for determining the frictional effect of gun rifling has been proposed. Two equal shells are fired simultaneously in opposite directions from a central chamber fitted on either side with a rifled and plain barrel respectively.

The resultant deflection of the suspended unit gives a measure of the frictional effect. No experiments have as yet been carried out by this method.

Aerial Rearmament in the U.S.A.—Estimated Cost of Some Aircraft Types. (Inter Avia, No. 622, 28/2/39, pp. 1-3.) (65/7 U.S.A.)

The following estimate of dollar prices are of interest:—

Type.	Aircraft.	Cost of power plant.	Equipment.	Total.
Single-engined single-seater fighter ...	13,600	9,000	6,200	28,800
Twin-engined single-seat fighter ...	60,200	18,000	4,460	82,660
Twin-engined bomber	90,000	16,650	16,566	123,216
Twin-engined attack plane	76,370	20,000	5,400	101,770
Twin-engined observation plane ...	78,400	16,000	20,600	115,000
Twin-engined observation amphibian	52,750	10,800	6,900	70,450
Single-engined transport	41,100	8,000	8,900	58,000
Twin-engined transport	67,500	11,000	10,600	89,100

The Increase in Calibre and Performance of Modern Anti-Aircraft Artillery. (C. Rougeron, La Science et la Vie, No. 261, March, 1939, pp. 210-18.) (65/8 France.)

Modern anti-aircraft artillery must not only possess long range in order to reach high flying aircraft but the time taken by the projectile to reach this altitude must be as short as possible. For a given muzzle velocity the time of trajectory is diminished by increasing the calibre. For a given calibre an increase in muzzle velocity is of extreme benefit since it flattens the trajectory and this, by itself, reduces the trajectory time still further. Increase in calibre reduces rate of fire unless complicated mechanical loading devices are fitted. On the other hand high muzzle velocities lead to rapid wear of the gun. This wear is, however, limited to certain sections of the barrel only and if the gun is properly designed these parts can be replaced fairly easily. Till quite recently most A.A. artillery were of 75 mm. calibre. The 88 mm. and 105 mm. guns of German origin used in the Spanish war demonstrated the superiority of the larger calibre. There is no doubt that in the near future even larger calibres will be required.

Air Defence Zone on the Western Front. (General Kitzinger, Die Wehrmacht, Vol. 3, No. 3, Feb. 1, 1939.) (65/9 Germany.)

The object of the new Western Air Defence Zone is to prevent enemy aircraft from penetrating into the interior of Germany.

Based on long meteorological experience, the most favourable grouping of fighter squadrons has been carried out. Various calibre anti-aircraft guns, intermingled with searchlights have been placed over a considerable depth of territory, sectors of special importance being also provided with kite and balloon barrages (floating mine systems).

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Reserves are housed underground in ample bomb-proof shelters fitted with all modern appliances.

Special attention is given to the signalling section, all the positions being connected by cable and wireless.

The anti-aircraft batteries are nearly all mechanised and special roads have been built to facilitate a rapid regroupment. The supply system for this zone is very elaborate, the water supply alone requiring the help of foremost German geologists.

All emplacements in the zone are protected by armour and ferro-concrete. An enemy attacking on the ground, after passing the first line, meets a whole system of defensive earth works, interconnected to a depth of 60 km. All roads can be blocked and special tank traps are provided. The whole system will force attacking aircraft to fly at such great heights that their efficiency will be seriously impaired. (Oxygen breathing, blind flying.) It is confidently thought that even if isolated aircraft should be able to pass and attack the Ruhr, the possible damage would be slight, since the crew would be fatigued and the possible bomb load would be small.

Design and Construction of External Strongholds. (C. F. de Steiger, J. Air Raid Protection Inst., Vol. 1, Dec., 1938, pp. 33-43. Eng. Absts., Vol. 2, No. 1, Section 1, January, 1939, p. 5.) (65/10 Great Britain.)

" Strongholds " are defined as structures designed to give the highest possible degree of protection against all types of aerial attack, and, in particular, against direct hits by high-explosive bombs. The author deals only with strongholds built independent of other structures, taking no advantage of the possible protective value of buildings above or near. He discusses the advantages of using reinforced concrete in such structures, and describes strongholds of German and Swiss design.

Downwash at the Tail Surfaces of an Aeroplane with a Wing of an Arbitrary Plan Form. (J. Ostoslavsky and M. Mogilevsky, C.A.H.I. Report No. 312.) (65/11 U.S.S.R.)

In 1930 the authors of the present work developed a formula for the downwash at the tail surfaces on the assumption of an elliptical distribution of the circulation along the wing span. This formula gave satisfactory results for types of wings used at that time. The use of highly tapered wings and wings with split flaps situated on a part of the wing span necessitated the introduction of a factor x which is the function of the tail surface co-ordinates, the wing taper and the increase in lift due to the flap deflection.

Charts of the x function (both for the case of a rectangular wing ($K=1$) and tapered wings with a taper of $K=\frac{1}{2}$ and $K=\frac{1}{3}$) are given and some practical recommendations to designers are added.

The results of these calculations are compared with experimental data obtained by Muttrey, A. Martinov and others and a practical method for the determination of the downwash at large angles of incidence is given.

At the same time an approximate analysis of the effect of the distortion of free eddies by the induction as well as the influence of the rolling up of the wake on the downwash at the tail surfaces is given. It appears that both these factors may be safely neglected in practice.

Hydrodynamic Forces on an Accelerated Cylinder Moving in Two Dimensions. (M. A. Omara, Phil. Mag., Vol. 27, No. 181, Feb., 1939, pp. 200-211.) 65/12 Great Britain.)

In this paper the Blasius contour integral expressions for the determination of the resultant force and moment on a profile in a Joukowski's stream are extended to the case of the general uniplanar motion of the profile.

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The potential function of the fluid motion induced by the motion of the solid is given in the form of a Laurent's series, the coefficients of which are expressed in terms of the coefficients of the expansion of the function transforming conformally the exterior of the profile into the exterior of a unit circle.

The resultant force and moment are calculated in terms of these coefficients, and the application to the classical case of the ellipse gives the well-known results.

Application to the case of a flat plate is given.

Uniform Motion of a Sphere or a Cylinder Through a Viscous Fluid. (B. R. Seth, Phil. Mag., Vol. 27, No. 181, Feb., 1939, pp. 212-9.) (65/13 Great Britain.)

(1) Oseen's criticism of Stokes's solution that it is defective at points distant from the sphere holds good only when the liquid flows past the fixed sphere, and not when the sphere is moving uniformly through it.

(2) When a large sphere moves slowly through a slightly viscous liquid the value of the drag should be at least greater than one and a half times that given by Stokes.

(3) As R increases from O to ∞ the kinetic energy of the fluid decreases from infinity to the value for the corresponding irrotational motion.

(4) For a very large sphere or a cylinder moving slowly through a slightly viscous liquid the motion is everywhere irrotational except in a thin layer near the boundary.

The Lift and Drag of a Rectangular Wing Spanning a Free Jet. (H. B. Squire, Phil. Mag., Vol. 27, No. 181, Feb., 1939, pp. 229-239.) (65/14 Great Britain.)

Investigations by Glauert and Stüper lead to discordant results for the effect of the jet boundary on the lift and drag of a rectangular wing spanning a free jet of circular section. This problem is solved by an independent method; the results obtained are in agreement with Glauert's results.

The Unsteady Lift of a Finite Wing. (R. T. Jones, N.A.C.A. Tech. Note No. 682, Jan., 1939.) (65/15 U.S.A.)

Unsteady lift functions for wings of finite aspect ratio have been calculated by approximate methods involving corrections of the aerodynamic inertia and of the angle of the infinite wing.

The starting lift of the finite wing is found to be only slightly less than that of the infinite wing; whereas the final lift may be considerably less. The calculations indicate that the distribution of lift near the start is similar to the final distribution.

Approximate operational equivalents of the lift functions have been devised to facilitate the calculation of lift under various conditions of motion.

Experimental Aerodynamics. (R. Pris, Bulletin des Services Techniques, No. 83 and 83a, 1938.) (65/16 France.)

In the preface, the author states that his aim is to provide the aircraft designer with the necessary data to enable him to utilise the most recent information on the controlling factors of performance, stability and safety. The subject matter is treated on the lines of the course in aerodynamics given by Professor Toussaint at the Paris University. The explanatory matter is, however, restricted to the utmost, the main emphasis being placed on tables and diagrams. Most of these are collected in a separate Volume (83*a*).

The principal points dealt with are the following:—

(1) Wing characteristics with special reference to high lift devices.
(2) Drag of fuselage, including fittings.
(3) Drag of engine installation.
(4) Action of propeller, both at normal and oblique incidence.
(5) Stability of control.

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It appears that most of the data given are based on N.A.C.A. publications, and, whilst the book may to some extent fulfil the author's hope and be of use to the designer, it is felt that the treatment will appeal rather to the general student of aerodynamics who is looking for a summarised statement on certain aspects of his science, and to whom the extensive bibliography quoted at the end of each chapter will be specially useful.

Vaneless Diffusors. (V. Dowshik, C.A.H.I. Report No. 305.) (65/17 U.S.S.R.)

According to the theory of Pfleiderer, the friction of the walls of a vaneless diffuser causes a gradual reduction in the angular momentum of the fluid, this reduction being effective over the whole width of the channel. As a result, the path of the fluid gradually departs from the ideal logarithmic spiral. Experiments at the C.A.H.I. have, however, shown that the effect of friction is confined to a relatively thin boundary layer and that the major part of the fluid in the centre of the channel obeys potential flow laws.

The author investigates the flow picture obtained under these conditions, paying special attention to the production of pulsation and breakaway of the flow.

As a result a new method for estimating the losses in a vaneless diffusor is given.

Approximate Method for Determining the Hydrodynamic Forces on an Under Water Wing of Finite Span. (A. Wladimirow, C.A.H.I. Report No. 311.) (65/18 U.S.S.R.)

The theory of the motion of a body below the free surface of an ideal heavy fluid is reviewed, with special application to a body of aerofoil shape. Theoretical expressions are next developed for the lift and wave resistance of a wing of infinite span.

The effect of viscosity and finite span are then expressed in an approximate form by the author and the final prediction compared with experiments in the C.A.H.I. tank. It is concluded that the method gives satisfactory results for small angles of incidence, provided the depth of the wing below the free surface is at least equal to one chord.

Downwash at Tail Surface Taking into Account the Mutual Interaction of Propeller and Wing. (E. Kolossow, C.A.H.I. Report No. 315.) (65/19 U.S.S.R.)

A theoretical expression for the downwash is obtained by calculating the effect of the propeller on the distribution of the circulation along the span of the wing.

Both the case of single and multi-engine installations is investigated and the application of the resultant formulæ is simplified by the provision of diagrams.

Finally the results are compared with those obtained from previous formulæ and also with direct experiments.

The Vortex Resistance of Theoretical Profiles. (A. Kosjmodemjausky, C.A.H.I. Report No. 317.) (65/20 U.S.S.R.)

The author calculates the vortex resistance of a circular cylinder for the cases of laminar, turbulent and transition flow. The problem is also solved for a series of elliptic cylinders and symmetrical profiles of the Joukousky type. The calculations require the position of minimum pressure or of separation to be known, and for this purpose the author has reviewed existing experimental data and chosen the most reliable figures. The method is based on the following additional assumptions:—

1. The width of the vortex zone behind the body is equal to the distance between the lateral points of separation.
2. The velocity of a completely formed vortex is in the same direction as that of the undisturbed flow.

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In conclusion, the author shows how to calculate in certain cases the periodicity of the shed vortices. The pressure distribution between the stagnation point and the (known) point of separation can also be determined.

A Non-Linear Wing Theory and its Application to Rectangular Wings of Small Aspect Ratio. (W. Bollay, Z.A.M.M., Vol. 19, No. 1, Feb., 1939, pp. 21-35, in English.) (65/21 U.S.A.)

The author demonstrates that the flow round a wing of small aspect ratio is not purely a stalling phenomenon but is amenable to treatment by the perfect fluid theories. A new non-linear theory is developed which differs from previous theories (Prandtl and Blenk) in the fact that the trailing vortices are assumed to leave the wing at an angle θ which can be determined approximately by the Helmholtz vortex laws.

For the limiting case of zero aspect ratio, the normal force co-efficient

$$C_N = 2 \sin^2 \alpha$$

For infinite aspect ratio

$$C_N = 2\pi \sin \alpha \cos \alpha$$

in agreement with the Prandtl lifting line theory. For intermediate aspect ratios, the theory gives the transition between the two limiting cases, the agreement with experiment being very good for very small aspect ratios and fair for larger ones.

Pressure Distribution Measurements on a Tapered Wing with a Full Span Split Flap in Curved Flight. (T. Troller and F. Rokus, N.A.C.A. Tech. Note No. 683, Jan.. 1939.) (65/22 U.S.A.)

Pressure-distribution tests were made on the 32-foot whirling arm of the Daniel Guggenheim Airship Institute of a tapered wing to determine the rolling and yawing moments due to an angular velocity in yaw. The model was tested at 0° and 5° pitch, $-1°$ and 5° yaw, and with a full-span flap deflected 60°. The results are given in the form of span load distributions and in calculated moment coefficients.

CONCLUSIONS.

1. The rolling-moment coefficients measured at the whirling arm are in fairly close agreement with those derived by means of a simple approximate theory even for high deflection of the full-span flap.

2. The rolling moments are little affected by the angle of yaw within the range of the tests.

3. The ratio $L/L_w b$ decreases with the lowering of the flap by about 16 per cent. for the 0° pitch setting of the wing and is almost constant at 5° pitch.

4. The ratio N/Db decreases with the lowering of the flap.

A Flight Comparison of Conventional Ailerons on a Rectangular Wing and of Conventional and Floating Wing Tip Ailerons on a Tapered Wing. (H. A. Soule and W. Gracey, N.A.C.A. Report, 1938.) (65/23 U.S.A.)

Flight tests comparing the relative effectiveness of conventional ailerons of the same size on wings of rectangular and tapered plan forms were made with a Fairchild 22 aeroplane. Information is included comparing conventional and floating wing-tip ailerons on a tapered wing. The results showed that the conventional ailerons were somewhat more effective on the tapered than on the rectangular wing. The difference, however, was so small as to be imperceptible to the pilots. The floating wing-tip ailerons were only half as effective as the conventional ailerons, and, for this reason, were considered unsatisfactory.

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The Effect of Compressibility on Eight Full-Scale Propellers Operating in the Take-off and Climbing Range. (D. Biermann and E. P. Hartman, N.A.C.A. Report No. 630, 1938.) (65/24 U.S.A.)

Tests were made of eight full-scale propellers of different shape at various tip speeds up to about 1,000 feet per second. The range of blade-angle settings investigated was from 10° to 30° at the 0.75 radius.

The results indicate that a loss in propulsive efficiency occurred at tip speeds from 0.5 to 0.7 the velocity of sound for the take-off and climbing conditions. As the tip speed increased beyond these critical values, the loss rapidly increased and amounted, in some instances, to more than 20 per cent. of the thrust power for tip-speed values of 0.8 the speed of sound. In general, as the blade-angle setting was increased, the loss started to occur at lower tip speeds. The maximum loss for a given tip speed occurred at a blade-angle setting of about 20° for the take-off and 25° for the climbing condition.

The compressibility loss at the take-off for controllable propellers was considerably reduced because of decreased blade-angle operation necessitated by increased power coefficients, but the reverse was true for fixed-pitch propellers inasmuch as the higher power coefficients resulted in reduced engine speeds.

A simplified method for correcting propellers for the effect of compressibility is given in an appendix.

Tests of Five Full-Scale Propellers in the Presence of a Radial and a Liquid-Cooled Engine Nacelle, including Tests on Two Spinners. (D. Biermann and E. P. Hartman, N.A.C.A. Report No. 642, 1938.) (65/25 U.S.A.)

Wind-tunnel tests are reported of five 3-blade 10-foot propellers operating in front of a radial and a liquid-cooled engine nacelle. The range of blade angles investigated extended from 15° to 45°. Two spinners were tested in conjunction with the liquid-cooled engine nacelle. Comparisons are made between propellers having different blade-shank shapes, blades of different thickness and different aerofoil sections.

The results show that propellers operating in front of the liquid-cooled engine nacelle had higher take-off efficiencies than when operating in front of the radial engine nacelle; the peak efficiency was higher only when spinners were employed. One spinner increased the propulsive efficiency of the liquid-cooled unit 6 per cent. for the highest blade-angle setting investigated and less for power blade angles. The propeller having aerofoil sections extending into the hub was superior to one having round blade shanks. The thick propeller having a Clark Y section had a higher take-off efficiency than the thinner one, but its maximum efficiency was possibly lower. Of the three-blade sections tested, Clark Y, R.A.F. 6, and N.A.C.A. 2,300-34, the Clark Y was superior for the high-speed condition, but the R.A.F. 6 excelled for the take-off condition.

A Summary of N.A.C.A. Investigations on High Lift Devices. (C. J. Wenzinger, J.S.A.E., Vol. 44, No. 2, February, 1939, p. 28.) (65/26 U.S.A.)

Two general classes of high lift devices are considered, located at the leading and trailing edge of the wing respectively. Several combinations of both classes are also described.

The effect on the lift due to type of device, size, location on wing profile and Reynolds number are discussed and the conclusions presented in the form of charts. It appears that the slotted type of flap (in particular the N.A.C.A. double slot) is the most promising.

The increase in lift of most of the devices discussed is relatively constant over the range of Reynolds numbers. It is thus possible to select a basic aerofoil and add the desired high lift device with fair accuracy.

In the discussion, the possibility of providing boundary layer control by suction at the critical points of unstable air flow and blowing out the air at points where it would help to reduce drag was mentioned.

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Pressure Cabin Investigations (Phase I). (J. G. Taylor, and others, A.C.I.C., Vol. 8, No. 710, 1/10/37, pp. 1-72.) (65/27 U.S.A.)

This most interesting and well illustrated report deals with the following aspects of the problem:—

1. Experimental investigations, including physiological requirements.
2. Development and process for construction and sealing all metal fuselage and compartments for supercharged high altitude aeroplanes.
3. Stress analysis of pressure cabin.
4. Some strength characteristics of laminated glass for windows of pressure cabins.
5. Automatic control of air pressure and flow in cabin.
6. Physiological requirements.
7. Air conditioning.
8. Air compressors and sources of power.
9. Requirements of a pressure cabin experimental aeroplane.

In the final conclusions the authors state:—

"There is absolutely no doubt about the possibility of supercharging aeroplane cabins for the purpose of high altitude flying. There are, however, a great many problems to be overcome before the pressure cabin can be made practical. The entire project is one of making a great many devices operate satisfactorily all at the same time."

The Torsional and Bending Deflection of Full-Scale Aluminium Alloy Propeller Blades Under Normal Operating Conditions. (E. P. Hartman and D. Biermann, N.A.C.A. Report No. 644, 1938.) (65/28 U.S.A.)

The torsional deflection of the blades of three full-scale aluminium-alloy propellers operating under various loading conditions was measured by a light-beam method. Angular bending deflections were also obtained as an incidental part of the study.

The deflection measurements showed that the usual present-day type of propeller blades twisted but a negligible amount under ordinary flight conditions. A maximum deflection of about $1/10°$ was found at a V/nD of 0.3 and a smaller deflection at higher values of V/nD for the station at 0.70 radius. These deflections are much smaller than would be expected from earlier tests, but the light-beam method is considered to be much more accurate than the direct-reading transit method used in the previous tests.

Recent Developments in Piston Ring Materials. (B. A. Yates, J.S.A.E., Vol. 44, No. 2, February, 1939, pp. 49-58 (Transactions).) 65/29 U.S.A.)

The importance of the material of the piston ring has too long been relegated to the background as compared with such design factors as ring proportions, ring loadings, circularity, point pressure, and so on; therefore, this paper concentrates on the material factors—such as composition, structure, and surface finish—which should go into the modern piston ring. The causes of piston-ring wear are analysed and classified under three headings—abrasion, corrosion, and erosion.

Various types of coating materials, both metallic and non-metallic, employed to reduce the severity of scuffing or scoring, are considered. From test results it appears that superficial coatings reduce piston-ring wear from scuffing and erosion, and that a very thin coating of tin was more effective than other types of metallic and non-metallic coatings.

Recent European Developments in High Speed Diesel Engines. (P. M. Heldt, J.S.A.E., Vol. 44, No. 2, Feb., 1939, Transactions, pp. 77-84.) (65/30 U.S.A.)

The two-stroke cycle is in the ascendancy in European Diesel engine development, especially for aircraft, even though most of the European Diesels operating

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to-day, with the exception of the Junkers, are of the four-stroke cycle type. The author explains that automotive-type Diesel engines are being used much more extensively in European countries than in the United States, principally because of the much greater difference between the cost of carburettor-engine fuels and Diesel fuels in Europe.

Of 176 European automotive Diesels for which specifications were published recently in Automotive Industries, Mr. Heldt points out that 55 have direct injection; 53 have precombustion chambers; 49 have turbulence chambers; and 19 are the air-chamber type.

Co-ordinating Aircraft Engine Design and Production. (A. H. Leak, J.S.A.E., Vol. 44, No. 2, Feb., 1939, Transactions, pp. 85-92.) (65/31 U.S.A.)

Close attention to the following items is necessary to produce and maintain satisfactory production designs:—

1. Carefully developed design and test programs are essential to develop advanced engines and details by orderly and logical processes.
2. Standardised engineering and drafting practices are a necessary part of any engineering organisation to maintain drawing consistency.
3. Close co-operation between production and engineering departments, starting with the original design and manufacture of experimental parts, is particularly important.
4. The utilisation of developed units and parts on new models when practicable. The desirability of reducing the total quantity of different parts made is evident to facilitate manufacture and servicing.
5. Consideration of suggested changes from all sources to simplify production and reduce costs.
6. Adequate quality and finish control. Finishes usually are controlled by samples, but the development of instruments to measure finish accuracy will assist materially in establishing a more precise control.

Correction of Temperatures of Air-Cooled Engine Cylinders for Variation in Engine and Cooling Conditions. (O. W. Schey, B. Pinkel and H. H. Ellerbrock, Jr., N.A.C.A. Report No. 645, 1938.) (65/32 U.S.A.)

Seven conventional air-cooled engine cylinders enclosed in jackets and cooled by a blower were tested to determine the effect of cooling-air temperature and carburettor-air temperature on cylinder temperatures. The cooling-air temperature was varied from approximately 80°F. to 230°F. and the carburettor-air temperature from approximately 40°F. to 160°F. Tests were made over a large range of engine speeds brake mean effective pressures, and pressure drops across the cylinder.

CONCLUSIONS.

1. The values of the cylinder-temperature correction factors for cooling-air temperature for constant engine conditions and constant mass flow calculated from semi-empirical equations agree reasonably well with the experimental values.

2. The cylinder-temperature correction factors are lowest for the constant-mass-flow condition and highest for the constant-velocity condition.

3. The cylinder-temperature correction factors for a fast climb are slightly higher than those for a slow climb when the cylinder temperatures do not attain equilibrium in the fast climb.

4. A change in carburettor-air temperature affects the cylinder-temperature correction factors by changing the effective gas temperature, but the effect is small.

5. It is recommended that the average of a number of thermocouples on the cylinder head and barrel be used as a measure of the head and barrel temperatures. A single thermocouple, especially one located on the rear spark-plug gasket, may give misleading results.

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The Combustion Gas Turbine. (A. Meyer, The Engineer, Vol. 167, No. 4338, 3/3/39, pp. 291-294.) (65/33 Switzerland.)

The brake thermal efficiency of any heat engine depends on:—

(1) The thermal efficiency of the heat cycle adopted.
(2) The efficiency of compression.
(3) The efficiency of expansion.
(4) The ratio of negative to positive work.

In the case of the gas turbine working on the constant pressure cycle, the compression pressure is usually of the order of 20-30lb. per sq. in. This necessarily means that the thermal efficiency of the cycle is small. The heat addition is limited by the fact that the blade temperature in continuous operation must not exceed 550°C. The ratio of negative to positive work is thus large and the brake thermal efficiency depends almost entirely on the efficiency with which the compression and expansion can be carried out. Under these conditions it is easily shown that the combination of turbine and compressor can only do useful work if the turbine efficiency amounts to 78 per cent. and that of the compressor to 68 per cent. It is only recently that such efficiencies have become possible and although axial blowers are now available with compression efficiencies as high as 85 per cent. and turbine efficiencies of the order of 90 per cent. appear possible, the overall efficiency of the turbine is not likely to rise above 20 per cent. unless the limiting blade temperature can be raised. In certain fields of application, however, such an efficiency is sufficient and several plants are now running both in America and on the continent.

Power Loss Accompanying Detonation. (N. McCoull, J.S.A.E., Vol. 44, No. 2, Feb., 1939, pp. 34-5.) (65/34 U.S.A.)

In tests on a single-cylinder CFR engine, as the compression was raised above the critical compression ratio, the author found that:—

1. Power output increased steadily with compression ratio if the spark advance was adjusted for maximum power at each ratio. The limit apparently was set by pre-ignition.
2. If the spark was retarded to the threshold of knock at each compression ratio, the power increased and then dropped off rapidly at higher compressions.
3. Temperatures of spark plug, piston, and intake valve, rose with compression ratio even when free from detonation, but compression ratios above the critical did not cause excessive temperatures.
4. Temperatures of exhaust gas and exhaust valve, as well as heat losses to jacket, were lowered with increased compression ratio, even during detonation, when the spark was set for maximum power.

As a result the author concludes that the octane requirements may be appreciably lowered by retarding the spark at the cost of a trivial power loss.

Fabric Fuel Tanks (Mareng Fuel Cell). (Sci. Am., Vol. 160, No. 3, March, 1939, p. 162.) (65/35 U.S.A.)

Bags of treated fabric are designed to the shape of the interior compartment of wings, fuselage, or floats and are inserted in place somewhat as inner tubes are installed in tyre casings. The bag is oversize in the sense that it rests against the surrounding walls of the structure and is not subjected to stretching or twisting.

A great advantage of this type of fuel container is its relative immunity to bullets, since the resulting slit has a tendency to close. A tank of this type was pierced by enemy bullets on a foreign war front (Spain?), but the leakage was so small that the aircraft could return to its base more than 100 miles away.

It is stated that the fabric tank has successfully withstood stringent official vibration tests.

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Secondary Reference Fuels for Use in the Determination of Octane Numbers. (Report by the Knock-Rating Aviation Fuels Panel, Inst. of Petroleum, J. Inst. Petrol, Vol. 25, No. 134, Feb., 1939, pp. 106-108.) (65/36 Great Britain.)

The Standard Oil Company of New Jersey have manufactured three secondary reference fuels known respectively as A, C and F.

The range 79-93 octane number is best covered by reference fuel C plus tetraethyl lead up to 4 mls. per imperial gallon.

The range 93-100 (102 with extrapolation) is covered by blends of C and F fuels, each containing 4 cc. of tetraethyl lead per imperial gallon.

The calibration curve by the C.F.R. motor method is of the following form:—

Octane No.	Per cent. Volume of F_1 in F_1/C_{10} Blend.
93	0
96	20
98	30
100	38
102	45

Some Recent Work on the Problem of Automatic Control. (R. Wilde, Collected Papers of the Lilienthal Society, 1938, pp. 243-247. In course of translation.) (65/37 Germany.)

The increased speed range and reduced aerodynamic damping of modern aircraft makes automatic control more difficult. At the same time the need for such control gear is becoming increasingly urgent for reducing the strain on the pilot and rendering blind starting and landing possible.

The author deals in detail with the latest Askania instruments for automatic control (course setting gyro, pre-corrector gyro responding to angular acceleration, electro-hydraulic servo motor, artificial horizon, etc.).

In the complete (three component installation) all the gyroscopes are placed in a separate control box which is housed in a suitable position on the aircraft. This is important since most modern high speed aircraft are subject to fuselage vibration which might induce a dangerous gyro precession. The precorrector gyro utilises an ingenious air jet control for transmitting the necessary steering impulse. (When measuring acceleration the deflection of the vertical gyro frame must be kept very small.)

The weights of the Askania instruments are very low. A complete servo motor (oil pump with electric motor and relay) weighs 6.5 kg. and will transmit a power of 5 kg. m./sec.

A course setting installation (gyro course setter, precorrector and servo motor) weighs 11 kg., whilst the full automatic control about three axes weighs 45 kg. completely installed.

The Principle and Constituent Elements of Automatic Steering Apparatus for Aircraft. (E. Fischel, Collected Papers of the Lilienthal Society, 1938, pp. 231-236. In course of translation.) (65/38 Germany.)

The general law of control which must be satisfied by any steering gear is of the form

$$\beta = a\phi + bd\phi/dt + c\int\phi dt$$

β = deflection of rudder.

ϕ = deviation of aircraft from set course.

a, b, c = design constants.

$bd\phi/dt$ controls the damping and $c\int\phi dt$ deals with permanent disturbances.

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The steering gear may satisfy the above law directly, by co-ordinating the rudder position with the control impulse or the more indirect method of co-ordinating impulse and speed of rudder operation may be adopted. In the case of "direct position control," the control units respond to the course angle, angular velocity and time integral of course. For "rudder movement control," we require angular velocity, angular acceleration and course angle, *i.e.*, the time derivatives of the first set of factors. The author discusses the relative advantages of these two methods and then describes in greater detail constituent elements such as course setting gyro with magnetic control (type Siemens), artificial horizon, damping gyroscopes and servo motors. Complete steering installations with three axes control are next discussed, including the possibility of automatic curvilinear flight.

Application to bombing and automatic landings are briefly touched upon.

The Importance of Automatic Steering in Aircraft Design. (G. Klein, Collected Papers, Lilienthal Society, 1938, pp. 237-272. In course of translation.) (65/39 Germany.)

Automatic control gears must not only satisfy the general flight conditions as regards design and installation, but must also take into account the aerodynamic characteristic of the aircraft. The best results can only be obtained if there exists complete co-operation between the aircraft and instrument designer. If the aircraft possesses suitable characteristics, automatic rudder control alone (automatic course setting) will also very materially affect the motion above the other two axes, and may thus be well worth while adopting on its own merits, at any rate on smaller sized aircraft. For the heavier machines, automatic three-component control is however generally fitted. The weight of such a gear depends primarily on the magnitude of the control force required and here again the aircraft designer can help. The author gives flight records showing the relative accuracy of manual and automatic flight control, showing the great superiority of the latter. The course setting gyro will keep course to 0.6° in gusty air. Under favourable circumstances, similar accuracy is obtainable for roll and pitch. Long distance record flights have demonstrated reliability under working conditions. Certain pilots appear to resent the installation of automatic gears as a reflection on their piloting capacity. Once, however, the accuracy of automatic control is more fully realised, such prejudice will rapidly disappear.

Magnaflux—What Does it Show? (J. B. Johnson, J.S.A.E., Vol. 44, No. 2, February, 1939, Transactions, pp. 56-67.) (65/40 U.S.A.)

Magnaflux testing means the detection of defects in magnetised metal with para-magnetic powder.

Magnaflux testing has become an important adjunct in connection with the inspection of aircraft parts fabricated from magnetic materials. The method is very sensitive and may indicate not only defects which seriously weaken the part, but also non-injurious imperfections. The author has classified the several defects indicated by magnaflux which have been found in the routine inspection and examination of a large number of parts which have been in service in engines, aeroplanes, and accessories operated by the U.S. Army Air Corps.

The Stability of a Cylindrical Shell by the Method of Integral Equations. (N. Swolinsky, C.A.H.I., Report No. 320.) (65/41 U.S.S.R.)

The author considers the case of a freely supported cylindrical plate of rectangular plan subjected to tangential forces at the circumference.

The system of approximate differential equations (originally due to Donnell) has already been discussed by the author in a previous report (C.A.H.I. No. 246). the solution leads to the Fredholm type of integral equation possessing an unsymmetrical core.

The results are finally compared with those given by the Ritz method.

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The Equilibrium and Oscillation of Rods Under Torsion. (S. Tumerkin, C.A.H.I. Report No. 341.) (65/42 U.S.S.R.)

The author shows that the methods of Gallerkin and Ralley-Ritz when applied to problems of torsion suffer from certain defects. As a result of these investigations, a modification of the Ralley-Ritz method is proposed which is sufficiently accurate even in complicated cases.

The effect of centrifugal force on the vibration frequency is also considered and a number of examples are worked out numerically.

Impact Bending Force Produced by Distributed Load. (K. Leiteisen, C.A.H.I., Report No. 351.) (65/43 U.S.S.R.)

After discussing the theory of Saint Venant on the impact forces due to a concentrated load, various cases of distributed load are considered.

The initial conditions for concentrated and distributed load are compared and a certain number of experiments are discussed.

Welding Coated Steel. (W. Spraragen and G. E. Claussen, Welding Journal, February, 1939, pp. 33-43. Metropolitan Vickers Technical News Bulletin, No. 650, 3/3/39, p. 4.) (65/44 Great Britain.)

This report consists of a review of the literature to July 1st, 1937, and discusses spot welding, fusion welding and bronze welding of galvanised iron; fusion and spot welding, iron pick-up, mechanical properties, and flame cutting of nickel clad steel, and welding problems relating to Monel-clad steel, Inconel-clad steel, stainless-clad steel, tin plate, Terne plate, chromium plated steel, cadmium plated steel, aluminium and copper-clad steels and oxide coated steel. The report closes with some suggested research problems. Illustrated with six tables and three diagrams.

Heterostatic Loading and Critical Astatic Loads. (L. B. Tuckerman, Bur. Stan. J. Res., Vol. *22*, No. 1, January, 1939, pp. 1-18.) (65/45 U.S.A.)

Southwell has shown how, in some cases, it is possible to compute the critical astatic load, that is, the elastic buckling load, of a structure from measurements of its heterostatic deflections at lower loads. The history of the theory of heterostatic loading and Southwell's method is briefly reviewed. Westergaard's general theory is then applied to the problem. It is shown that Southwell's method and Lundquist's modification of it are theoretically accurate for results of measurements which are proportional to the value of any one astatic parameter. These measurements need not be deflection measurements, but may be strain measurements or, theoretically, measurements of any effect linearly dependent upon the deformation. Further, the parameter need not be the parameter corresponding to the lowest critical load but, theoretically, may correspond to any higher critical load.

Southwell's method is thus useful in cases where measurements within the elastic range can be made to depend primarily upon the change of a single astatic parameter. The theory is valid only for cases in which the buckling loads are lower than the load at which appreciable plastic deformation of the material or appreciable deviation from Hooke's law would occur. If, even within the elastic range, the measurements are affected appreciably by changes in other parameters, the critical elastic load computed by Southwell's method or Lundquist's modification may still be considerably in error. A combined numerical and graphical method of computation is outlined which by successive approximations, gives more accurate results in such cases. Finally, experimental results are given in which the second and third critical loads of a " round-end " Euler column are computed from strain-gauge measurements taken at loads below the first critical load.

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Alloy Steel Containing Lead. (G. Ledlov, Mechanical World and Engineering Record, 3/3/39, pp. 222-3. Metropolitan Vickers Tech. News Bulletin, No. 651, 10/3/39, p. 3.) (65/46 Great Britain.)

The introduction of lead into steel to form a homogeneous structure is complicated by its insolubility in solid steel, and low miscibility in the liquid state. Satisfactory production methods have now been developed, and machining and working tests taken. It is claimed that the new alloy improves machinability, allows higher cutting speeds with smaller tool wear, permits normal case-hardening, and possesses similar properties to non-lead bearing steel with regard to quenching, tempering, and fatigue.

Illustrated with five photographs and four diagrams.

Boiling Film Heat Transfer Coefficients in a Long Tube Vertical Evaporator. (G. W. Stroebe, E. M. Baker and W. L. Badger, Ind. and Eng. Chem. (Industrial Edition), Vol. 31, No. 2, February, 1939, pp. 200-6.) (65/47 U.S.A.)

Film coefficients are given for water, sugar, and " Duponol " solutions, boiling in a long tube vertical evaporator, equipped with a single 20-foot tube, under a wide range of conditions. From the data obtained, an empirical correlation of the coefficients is derived, expressing the coefficients in terms of the Prandtl number, surface tension of the liquid, specific volume of the vapour, and average temperature drop across the liquid film; all of these are based on the average temperature of the boiling liquid.

A relation between the average liquid temperature and the vapour temperature is derived, from which the average liquid temperature can be predicted from variables usually known to the commercial designer.

An explanation for the effect of the several variables is given in the light of this and previous investigations, and of certain known factors affecting the mechanism of boiling in the tube.

Steam Film Heat Transfer Coefficients for Vertical Tubes. (E. M. Baker, E. W. Kazmark and G. W. Stroebe, Ind. and Eng. Chem. (Industrial Edition), Vol. 31, No. 2, February, 1939, pp. 214-8.) (65/48 U.S.A.)

Steam film coefficients for a two-inch o.d., 20-foot long vertical tube are correlated by means of the usual non-dimensional co-ordinates. Other data for tubes 8 feet and 12 feet long are also correlated on the same basis and found to deviate from those for the 20-foot tube by a factor of $L^{\frac{1}{4}}$. No apparent break in the curve, indicating viscous and turbulent flow, could be observed, though it is believed that turbulence must occur over at least part of the tube, It appears, therefore, that turbulence in the steam condensate film does not control the rate of heat transfer, within the range of these experiments.

Invisible Glass. (K. B. Blodgett, Sci. Am., Vol. 160, No. 3, March, 1939, p. 160.) (65/49 U.S.A.)

A new process for suppressing glare due to reflection from glass surfaces has been developed by K. B. Blodgett, of the Research Laboratory of the G.E.C.

The glass is treated by dipping it into a tank of liquid on the surface of which is a film of insoluble soap only one molecule thick. Repeated immersion and withdrawal gradually builds up a layer on the glass equal in thickness to one quarter wave length of light. This layer is transparent and the resultant interference between the light reflected from the top and bottom surface causes all trace of reflection to disappear. Objects viewed through the glass therefore appear as if the glass were absent.

The process is still in the experimental stage, but hope is expressed that this non-glare treatment may have ultimately a wide application.

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The Sectoral Electro-magnetic Horn. (W. L. Barrow and F. D. Lewis, Proc. Inst. Rad. Eng., Vol. 27, No. 1, Jan., 1939, pp. 41-50.) (65/50 U.S.A.)

An electro-magnetic horn radiator, two of whose opposite sides are flared, the other two being parallel, was studied experimentally at wave lengths between 40 and 100 centimetres. For comparison, measurements on parabolic reflectors and broadside arrays were also made. By virtue of its unusual freedom from secondary lobes and stray radiation, its ability to operate well over a broad band width, its simple construction, and its ease and stability of operation, the electro-magnetic horn offers unique possibilities as a directive radiating system for micro-wave applications. These results and the application to a straight-line blind-landing system for aeroplanes are discussed.

Theory of the Electro-magnetic Horn. (W. L. Barrow and L. J. Chu, Proc. Inst. Rad. Eng., Vol. 27, No. 1, Jan., 1939, pp. 51-64.) (65/51 U.S.A.)

A theoretical analysis of the operation of the electro-magnetic horn " antenna " is derived from Maxwell's equations. The details apply to a horn of sectoral shape. The analysis also applies to a tapered hollow pipe transmission line. Certain transmission quantities, like the phase constant, attenuation constant, velocity of propagation, etc., are calculated for horns of any angle of flare and the field configuration within the horn is plotted. One result is a clear understanding of the propagation of waves within the horn. Another result is that design specifications for horns may be established. Calculations of radiation patterns made by this analysis agree satisfactorily with experiments.

L.M.T. Blind Landing Systems. (Inter. Avia., No. 621, 24/2/39, pp. 6-7.) (65/52 France.)

In the system developed by Le Materiel Telephonique (L.M.T.), vertical navigation is carried out by means of an independent transmitter employing a special antenna composed of four elements. The waves are polarised horizontally and the following advantages are derived :—

(1) Flat glide path.

(2) Humidity of ground has no effect.

(3) Absence of interference between vertical and directional navigation, since the latter employs vertically polarised waves.

The starting point of the glide is 4.5 km. from the landing field and the average slope of the glide path curve is 6.6 per cent. Out of twenty-two different approaches carried out under blind conditions, on different days only one showed a variation of more than 12 m. from the standard altitude of 66 m. at a distance of 1,000 m. from the glide path transmitter. Twenty of the landings had the correct altitude within 10 m.

No difference in the vertical localisation could be detected for lateral deviation of $\pm 10°$ from the centre line of approach.

Electrical Equipment of the Airship " LZ 130." (E. Hilligardt, E.T.Z., 16/2/39, pp. 185-9. Metropolitan Vickers Tech. News Bulletin, No. 649, 24/2/39, p. 6.) (65/53 Germany.)

The electrical equipment of the airship " LZ 130 " is described in so far as it differs from that of the " LZ 129," of which details were given in E.T.Z. 57 (1936), page 354. The use of three-phase current in place of D.C. has led to a saving of 18 per cent. in weight. The utilisation of the exhaust and cooling water heat of the 40 h.p. Diesel engines for cooking and water heating made possible a reduction of 7.2 kw. in installed capacity and resulted in a saving in weight of 300 kgs. Illustrated with five diagrams and three photographs.

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Model Experiments on the Radiation Characteristics of Fixed Short Wave Aircraft Antennæ. (E. Harmening and W. Pfister, H.F. Technik., Vol. 53, No. 2, February, 1939, pp. 41-45.) (65/54 Germany.)

The model aircraft represented Ju 52 to 1/18 scale and was fitted with a small transmitter emitting on 5 m. This corresponds to a 90 m. wave length on the full-scale aircraft.

The radiation characteristics were obtained along the three principal axes of the model, the latter being mounted on a wooden tower 50 m. high. The receiver was placed on a similar tower at a distance of 50 m.

It appears that the horizontal characteristic (diagram about the vertical model axis) is almost circular for the usual arrangements of the aircraft antenna.

A rod antenna has a pronounced directional effect depending on the locality of fixing.

Metal Horns as Directive Receivers for Ultra-Short Waves. (G. C. Southworth and A. P. King, Proc. Inst. Rad. Eng., Vol. 27, No. 2, February, 1939, pp. 95-102.) (65/55 U.S.A.)

The following paper describes some experiments made to determine the directive properties of metal pipes and horns when used as receivers of electro-magnetic waves. The experiments were of two kinds. One consisted of measurements of received power, with and without the horn in place, and the other of the determination of the directional patterns of the horns in two perpendicular planes. The results indicate that electro-magnetic horns of this kind provide a simple and convenient way of obtaining power ratios of a hundred or more (20 decibels). The effect of varying the several horn parameters are investigated. It is shown that there is an optimum angle of flare. The possibility of forming arrays of pipes or horns is mentioned.

Marconi Ultra-Short Wave Aerodrome Approach Beacon Equipment. (Inter. Avia., No. 623, 3/3/39, pp. 1-2.) (65/56 Great Britain.)

This equipment, known as A.D. 66, does not provide vertical guidance. It is thus not "100 per cent. blind," but intended to assist aircraft in approaching aerodromes during conditions of poor visibility.

The most important difference between the A.D. 66 and other well known track systems is in the arrangement of the aerials, two parallel-series phase aerials with numerous vertical sections and a similar reflector system being employed instead of single dipoles. It is claimed that this arrangement increases the radiation along the main course (*i.e.*, reduces power output required) and reduces the interference with other short wave sets working in the neighbourhood to a marked extent. The installation works on the well known method of two equi-signal zones keyed E and T, the interlocking portions of which form the approach beam characterised by a continuous dash.

An Improved Radio Meteorograph on the Olland Principle. (L. F. Curtiss, A. V. Astin, L. L. Stockmann, and B. W. Brown, Bur. Stan. J. Res., Vol. 22, No. 1, January, 1939, pp. 97-103.) (65/57 U.S.A.)

A description is given of the construction and tests of a radio telemeter of high precision built according to the Olland principle, in which all indicating arms rotate on a common axis. Combined with a 5 meter radio transmitter of push-pull type, this telemeter provides a radio meteorograph which has been tested under actual working conditions and found to be reliable and accurate in its indications. Since it gives relatively strong signals with a good stability in frequency, it is easy to operate and very little retuning during an observation is required. Special attention has been given to the thermal insulation of the compartment containing batteries and transmitter so that no failures due to drop in

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battery temperature have been observed even at altitudes above 60,000 feet. The cost of manufacture compares very favourably with that of other models recently developed in the U.S.A.

Future Development of the N.A.C.A. (Inter. Avia., No. 621, 24/2/39, pp. 5-6.) (65/58 U.S.A.)

In addition to the normal budget for 2.18 million dollars, a supplementary appropriation of 6.72 million dollars has been submitted. Of this extra sum, 4 million dollars are to be spent on a modern research station at Sunny Vale, California.

During 1938, the following research equipment was completed at Langley Field:—

(*a*) 19-foot pressure wind tunnel (3 atmospheres, 200 m.p.h.).
(*b*) 7½ by 3-foot refrigerated wind tunnel (ice formation).
(*c*) 12-foot freeflight wind tunnel.

A two-dimensional flow wind tunnel for work at very high Reynolds numbers is under construction.

The creation of a special laboratory for structural investigation on aircraft is stated to be very urgent.

In future a much closer liaison will exist between the Research Institute and the Civil Aviation Authority.

Boots' Self-Locking Aircraft Nut. (Inter. Avia., No. 621, 24/2/39, p. 6.) (65/59 U.S.A.)

The one-piece nut carries two threads, the smaller thread is slightly displaced against the bigger load carrying section, the two sections being connected by means of a tubular spring member. Upon inserting the bolt, the spring member extends till both thread systems engage and the resultant spring force prevents the nut from unscrewing.

It is stated that the device has been approved by the Civil Aviation Authority (U.S.A.).

Numerical Computation and Application of Certain Function Related to Bessel Functions. (R. Muller, Z.A.M.M., Vol. 19, No. 1, Feb., 1939, pp. 36/54.) (65/60 Germany.)

The author gives numerical tables for Bessel and Hankel functions of the first kind, zero order for purely imaginary arguments as well as for the function

$$\phi(x) = \int_0^{\pi/2} e^{-x \sin t} dt$$

and its derivative $d\phi/dx$.

These letter functions are of importance in the theory of wing vibration.

The author shows how by means of the tables provided the solution of the non-homogeneous Bessel differential equations associated with the forced vibration of elastic cylindrical bodies can be carried out, the disturbance function being expressed in the form of a power series with whole positive and negative exponents.

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