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Defence Against Parachute Troops. (Schenk v. Stauffenberg, Luftwissen, Vol. 5, No. 5, May, 1938, p. 174.) (62/1 Germany.)

Parachute troops may be divided into two classes: The first class comprises agents for intelligence, sabotage and propaganda. These troops are dropped in restricted numbers and may undertake small scale destructive work. The other class of parachute troops is intended to engage in active fighting and carry out large scale destruction in the interior of the country.

The defence against parachute troops can be considered under three heads:—

(1) Proper air control to prevent the break through of carriers.
(2) Provision of efficient and highly mobile columns to deal with landings.
(3) Organisation to repair any damage done as quickly as possible.

It goes without saying that the advent of parachute troops renders necessary the provision of some method of defence for all ground objectives. These defensive measures must prevent the enemy carrying out extensive damage and hold up the attack till the arrival of the mobile column.

To keep out spies and foreign agents will necessitate strict supervision of all lines of communication. It is important that the civil population be trained to co-operate in this work.

Italian Opinions on the Armament of the Fighter. (A. Serra, Luftwehr, Vol. 5, No. 7, pp. 271-3.) (62/2 Italy.)

The author compares the effectiveness in aerial combat of the 12.7 mm. and 20 mm. automatic guns, both guns firing explosive bullets with a muzzle velocity of 800 m/sec.

Taking a total weight of 120 kg. as available for armament, either two of the lighter guns (with 720 rounds) or one heavy gun (with 160 rounds) can be fitted.

Even if we take the same firing rate of 720 rounds a minute for each type, the two lighter weapons will be able to fire 10 bursts of 3 seconds each against only 4 bursts of the single 20 mm. gun. Although the weight of projectiles per burst favours the heavier gun (8.6 kg. against 5.8 kg.) the author is of the opinion that the increased number of bursts more than makes up for this. As a matter of fact, for reliability, the firing rate of the heavier gun will probably have to be less than the 720 rounds per minute assumed, in which case the projectile weight per burst may even favour the lighter guns.

Air fighting in Spain has clearly demonstrated that only close range engagements (of the order of 200 m.) are effective, and the extra number of bullets available with the 12.7 mm. calibre are decisive. As a matter of fact, for most work the 7.5 calibre gun with its high rate of fire suffices.

Engineering Aspects of Air Raid Protection. (H. Chatley and H. Gutteridge, The Engineer, No. 4322, 11/11/38, pp. 529-531.) (62/3 Great Britain.)

After some remarks on the terminal velocity of bombs and their destructive effort, the authors deal with attempts to increase the resistance of structure to attacks of this kind. No normal building can be designed to withstand a direct hit, the effects of the explosion can, however, be more or less localised in frame structures which are free from all brick or tile wall panels, the subdivision being carried out by means of expanded metal directly connected to the frame. The whole structure must be subdivided into units which are separately stable, ample window space being provided to allow bursting without injury to the frame. The improvement of old structure in fire resistance and strength is very difficult and expensive.

Probably few owners will be willing to spend more than 10 per cent. extra in structural provisions and more than 2 per cent. of gross costs in actual running precautions. Yet the minimum figures for A.R.P. are reckoned by the authors as 25 per cent. and 5 per cent. respectively.

As a result there is a tendency to accept the hazard as being cheaper than the remedy. As long as A.R.P. is voluntary, the costs become a penalty against the owner who spends them and are in favour of the one who does not.

Protection from Incendiary Bomb Fires. (Chem. and Ind., Vol. 57, No. 48, 26/11/38, p. 1125.) (62/4 Great Britain.)

A mineral paint for controlling fire from incendiary bombs has been evolved by Imperial Chemical Industries.

The new product, known as a fire-resistant finish, enables the effect of the incendiary bomb to be localised after it has penetrated the roof and come to rest on the floor of the loft, attic or upper room. Tests have shown that small incendiary bombs discharged within wooden models of roof spaces spent themselves without the structure catching fire, if it was coated with the new finish. Whether extinction or valuable retardation of fire would occur in practice depends largely upon the size and severity of the bomb. If all exposed woodwork above the wooden floor on which the bomb is stopped and the floor itself are coated to a thickness of an ordinary matchstick—1/16th of an inch—a high degree of retardation of fire caused by small incendiary bombs is assured.

German Naval Plans. (Engineer, Vol. 166, 26th August, 1938, p. 217. Eng. Absts., Vol. 1, No. 9, Section 3, October, 1938, p. 160.) (62/5 Great Britain.)

The limitation to 35 per cent. of surface vessels and 45 per cent. of submarine tonnage built by Britain, agreed to by Germany in the naval treaty, would give her 255,000 tons of battleships, allowing 87,000 tons for aircraft-carriers, 300,000 tons of cruisers and destroyers and 33,700 tons of submarines. At present "Gneisenau" (26,000 tons) is in commission and "Scharnhorst" will shortly be completed. Two 35,000-ton battleships, two aircraft-carriers, three heavy cruisers (of which "Blucher" and "Admiral Hipper" are nearly completed) and two 10,000-ton light cruisers are being constructed. Three 7,000-ton cruisers, sixteen 1,625-ton destroyers and ten 1,811-ton others are projected or commissioned. The German submarines include twenty-four of 250 tons, thirteen of 500 or 700 tons, and thirty-one others, bringing the total ratio up to 45 per cent. Thirteen fast motor-boats are in service and eleven under construction. On completion of this programme it is calculated that she will possess a modern fleet well

adapted to protection of the Reich, maintenance of essential sea-routes and representation abroad.

The Influence of Aircraft on Land Operations. (R. J. Collins, Aeroplane, Vol. 55, No. 1437, 7/12/38, pp. 743-745.) (62/6 Great Britain.)

There are five methods by which aircraft can influence land operations:—

1. Air attack on land forces.
2. Use of aircraft to provide covering fire.
3. Attack on communications.
4. Bombing of headquarters.
5. Transport of troops (including parachute drops).

The author gives examples of each of these methods covering not only the 1914-18 war but also more recent events in Spain, China and Abyssinia.

Although according to the author, the air force is not likely to be able to force a final decision, there is no doubt that the influence of aircraft on land operation is much greater than it was.

Three types of aircraft seem to call for special development.

1. Ground strafing.
2. Long range fighters to accompany bombers.
3. Fast troop transport.

Parachute Troops—Training and Utilisation. (R. Chevalier, Luftwehr, Vol. 5, No. 10, Oct., 1938, pp. 392-398.) (62/7 France.)

The Central Training School for Parachutists is at Pujant-Avignon and the author describes the method of training devised by Major Geille. Over 1,900 jumps have so far been carried out from aircraft without a serious accident. Two types of parachutes are employed: the Irving S.G.P. and the Russian Irvin. The surface of the chute is 58 m.^{2} and the landing speeds vary between 5 and 7 m./sec. The armament of the troops comprises a light machine gun and a 7.5 mm. rifle and is contained in special leather bags strapped to the parachutist. On approaching the ground, the parachutist can release this bundle which falls about 6 m. and is then held by a rope. Thus, on landing, this bundle touches the ground first and slows up the descent. Heavier armament is dropped in containers which are attached to special parachutes. The container weighs 50 kg. and can carry a weight of 150 kg. (either ammunition or special guns up to 37 mm. calibre, etc., mortars up to 81 mm.).

The author gives various examples of the use of parachute troops such as (1) temporary occupation of a sector (2) flank protection (3) pursuit (4) destruction of roads, etc. (5) dropping of intelligence agents. Parachute troops appear to have special possibilities in mountainous country.

Methods of Using Aircraft for Ground Attack. (Luftwehr, Vol. 5, No. 10, Oct., 1938, pp. 399-400.) (62/8 Sweden.)

The various methods such as horizontal high and low altitude bombing and dive bombing are illustrated. Low altitude bombing is carried out between 50 and 500 m. the aircraft flying horizontally at great speed and subjecting the ground to a simultaneous machine gun fire. This method of attack has been used successfully in Spain and can only be carried out against targets weak in A.A. Artillery. If proper use is made of geographical features, darkness, clouds, etc., the risk which the attacking aircraft run is not excessive, especially if a surprise can be effected. Both high and low altitude bombing require fairly extended targets, whilst dive bombing is specially intended to deal with restricted objectives, the accuracy of aim being much greater. Recent improvements in A.A. Artillery have forced the dive bomber to keep above 1,500 m. at release. Even at this height, however, the method presents considerable advantage when used against mobile targets such as ships. The time of drop from 1,500 m. (taking

into account a diving velocity of the aircraft of the order of 550 km./h.) is of the order of 10 sec., which is about $\frac{1}{8}$ of the time required for the bomb to drop from 5,000 m. with the aircraft flying horizontally. There is thus less chance of the ship escaping by altering course.

The Gun Defence of the Bomber. (C. Nikitin, Luftwehr, Vol. 5, No. 10, Oct., 1938, pp. 401-2.) (62/9 U.S.S.R.)

The high altitude bomber is not exposed to much danger by A.A. fire from the ground. The risk of a surprise attack from fighters is, however, considerable. For this reason the utmost attention must be paid to the training of the gunners on the bomber so that they do not allow themselves to be surprised but are ready to repel the fighter as soon as he appears. If the bombers maintain formation so as to have mutual fire support, they have little to fear of a fighter attack. Several cases have occurred in Spain where bombers were shot down over their own territory after returning from a raid. This shows that vigilance must be kept up continuously and not relaxed because an attack is considered improbable. Such attacks are usually carried out by one or other of the following methods:—

(1) The fighter approaches with the sun in his rear.
(2) Attack from a cloud.
(3) Simultaneous attack from several directions.
(4) Attack from the rear, the fighter diving.

The gunner on the bomber must be adequately trained to deal with any of these methods. Both initiative and rapid observation power are required, quite apart from considerable courage. On the proper choice of the gunner will depend the success of the bombing raid.

Organisation of the Italian Air Force. (Luftwehr, Vol. 5, No. 10, Oct., 1938, p. 415.) (62/10 Italy.)

The fundamental unit of the Air Force (armata aerea) is the flight (squadriglia). Several flights form a group (gruppo) whilst a number of groups form an air regiment (stormo). Two combined regiments are called an aerial brigade (brigata aerea), whilst three or more regiments form an aerial division (divisione aerea). Two or more divisions are called an aerial squadron (squadra aerea) and such a squadron would also comprise a variable number of reconnaissance flights. A number of squadrons, divisions and brigades form a large battle unit.

The Italian Air Force consists of 93 groups without counting the units stationed in Africa.

Edge Resistance of Blade Rows. (E. Grunagel, Forschung, Vol. 9, No. 4, July/August, 1938, pp. 187-196.) (62/11 Germany.)

For the determination of the no-load power of turbo-type machines, or of the wheel friction of rotor rims, it is of great importance to know the edge resistance of the blade rows. The present paper reports on experiments with an air passage of rectangular cross-section, the two side walls of which are fitted with blades which could be inclined to any desired angle with the direction of the flow. The edge resistance was found to be essentially dependent on the Reynolds number, the blade angle, the ratio of the width of the passage to the blade pitch, and, in the case of small passage widths, also on the relative displacement of the blade rows.

Calculation of the Chordwise Load Distribution Over Aerofoil with Sections with Plain, Split, or Serially Hinged Trailing Edge Flaps. (H. J. Allen, N.A.C.A. Report No. 634, 1938.) (62/12 U.S.A.)

A method is presented for the rapid calculation of the incremental chordwise normal-force distribution over an aerofoil section due to the deflection of a plain flap or tab, a split flap, or a serially hinged flap. This report is intended as a

supplement to N.A.C.A. Report No. 631, wherein a method is presented for the calculation of the chordwise normal-force distribution over an aerofoil without a flap or, as it may be considered, an aerofoil with flap (or flaps) neutral.

The calculations are made possible through the correlation, by means of thin-aerofoil theory, of numerous experimental normal-force distributions. The method enables the determination of the form and magnitude of the incremental normal-force distribution to be made for an aerofoil-flap combination for which the section characteristics have been determined.

A method is included for the calculation of the flap normal-force and hinge-moment coefficients without necessitating a determination of the normal-force distribution.

A Method of Rapidly Estimating the Position of the Laminar Separation Point. (A. E. von Doenhoff, N.A.C.A. Tech. Note No. 671, 1938.) (62/13 U.S.A.)

A method is described of rapidly estimating the position of the laminar separation point from the given pressure distribution along a body; the method is applicable to a fairly wide variety of cases. The laminar separation point is found by the von Kármán-Millikan method for a series of velocity distributions along a flat plate, which consist of a region of uniform velocity followed by a region of uniformly decreasing velocity. It is shown that such a velocity distribution can frequently replace the actual velocity distribution along a body in so far as the effects on laminar separation are concerned.

An example of the application of the method is given by using it to calculate the position of the laminar separation point on the N.A.C.A. 0012 aerofoil section at zero lift. The agreement between the position of the separation point calculated according to the present method and that found from more elaborate computations is very good.

Flow Observations with Tufts and Lampblack of the Stalling of Four Typical Aerofoil Sections in the N.A.C.A. Variable Density Tunnel. (I. H. Abbott and A. Sherman, N.A.C.A. Tech. Note No. 672, 1938.) (62/14 U.S.A.)

A preliminary investigation of the stalling processes of four typical aerofoil sections was made over the critical range of the Reynolds number. Motion pictures were taken of the movements of small silk tufts on the aerofoil surface as the angle of attack increased through a range of angles including the stall. The boundary-layer flow at certain angles of attack was also indicated by the patterns formed by a suspension of lampblack in oil brushed on to the aerofoil surface. These observations were analysed together with corresponding force-test measurements to derive a picture of the stalling processes of aerofoils.

The final flow break down occurs either as leading edge separation (laminar boundary layer separates and failure to re-establish the flow through the formation of turbulence) or as separation of the turbulent boundary layer near the trailing edge.

These two stalling processes are not separate phenomena but are intimately related, the actual point of separation being influenced by the general boundary layer conditions. The tufts often failed to show local separation indicated by the lampblack and it seems, therefore, that the region of reversed flow may be very shallow and have little effect on the general flow.

Further studies of the flow changes and force fluctuations at the stall are required as well as the effects of scale and turbulence and type of stall on the performance of the aircraft in general.

The Approximate Prediction of Skin Friction and Lift. (N. A. V. Piercy, J. H. Preston and L. G. Whitehead, Phil. Mag., Vol. 26, No. 178, Nov., 1938, pp. 791-815.) (62/15 Great Britain.)

The method of successive approximation previously developed for the flat plate case of skin friction with laminar flow can be generalised to yield a close approxima-

tion to that round the contours of cylinders appropriate to any analytical assumption regarding the irrotational flow outside their boundary layers. Computation is almost eliminated till the stage is reached when mathematical errors become small. A simple third approximation to the solution of the boundary layer equations suffices for many purposes until breakaway is approached. Explicit approximate formulæ follow for the position of breakaway and for the skin friction of elliptic cylinders. Regarding the external flow, an appropriate assumption is obtained by recognising the existence of a wake to the extent of elongating the cylindrical boundary from the points of breakaway to infinity. A rapidly convergent method of successive approximation is developed for its application. Any reasonable assumption regarding the thickness and configuration of this rudimentary wake secures, it appears, much closer agreement with experiment than has so far been possible by ignoring the wake. Determining the circulation round a lifting cylinder from considerations relating to the artificial wake rather than to the points of breakaway considerably decreases earlier divergence from experiment. As an illustration, the variation of lift with inclination of section is calculated from first principles for a given elliptic cylinder, and the result is found to agree fairly with experiment, the " stall," in particular, being predicted with some accuracy.

Compared with earlier methods, those now advanced promise improved physical accuracy in predictions of skin friction, breakaway lift, and stall which make no appeal to experimental data. Their analytical convenience will, it is hoped, facilitate investigations of associated problems for which an exceptional degree of mathematical accuracy may not be required.

Oscillatory Motion of a Fluid Along a Circular Tube. (D. G. Chrostopherson, A. Gemant, A. H. A. Hogg and R. V. Southwell, Proc. Roy. Soc., Series A, Vol. 168, No. 934, 7/11/38, pp. 351-78.) (62/16 Great Britain.)

This paper is concerned with oscillatory motion (either free or forced) of a viscous fluid along a circular tube: the restoring force comes in both instances from the " gravity head " which results from the passage of fluid. Part I is a theoretical discussion of the problem. Part II deals from a practical standpoint with complicating factors (e.g., turbulence, or meniscus and other end effects) which the theory does not take into account, and briefly discusses a possible application to viscometry. Part III gives the results of experiments made to test the predictions of Parts I and II.

Supersonic Flow Over an Inclined Body of Revolution. (Hsue-Shen-Tsien, J. Aer. Sci., Vol. 5, No. 12, Oct., 1938, pp. 480-3.) (62/17 U.S.A.)

A first approximation is obtained for the side force or the lift of a body of revolution inclined in a supersonic flow from the linearised equation of motion of compressible fluids. It is shown that the lift at any fixed Mach's number is directly proportional to the angle of attack of the body. The case of the cone is calculated in detail and a general method using step-wise doublet distribution is developed for a pointed projectile.

The Influence of Lateral Stability on Disturbed Motions of an Aeroplane with Special Reference to the Motions Produced by Gusts. (R. T. Jones, N.A.C.A. Report No. 638, 1938.) (62/18 U.S.A.)

Disturbed lateral motions have been calculated for a hypothetical small aeroplane with various modifications of fin area and dihedral setting. Special combinations of disturbing factors to simulate gusts are considered and the influence of lateral stability on the motions is discussed.

The modifications of the aeroplane include changes of dihedral from 0° to 10° and changes of the weathercock stability from zero to $C_n = 0.137$ (the equivalent of a fin as large as 10 per cent. of the wing area). The positions of the modified aeroplanes on the lateral stability charts are shown.

Fin area and wing dihedral were found to be of primary importance in side gusts. It was found that the rolling action of the wing with as much as 5° dihedral was distinctly unfavourable, especially when the weathercock stability was small. A study of the effects of gusts gives different indications depending on the interval of time considered. During the first stages, the upsetting movements of the stable aeroplane may be more severe than those of a slightly unstable one. If the aeroplane is under control and if the gusts are of noticeable magnitude, then the motion during the first 2 or 3 seconds is of primary concern. For uncontrolled flight or for flight in relatively calm air where disturbances could become apparent only through introducing a divergence, the later stages of the motion are of interest.

The damping of rolling is such that the aeroplane very quickly takes on any rolling component of gust velocity.

The Drag of Inflatable Rubber De-icers. (R. G. Robinson, N.A.C.A. Tech. Note No. 669, 1938.) (62/19 U.S.A.)

Force tests on rubber de-icer models of several different profiles at approximately 1/3 full scale were carried out in the N.A.C.A. eight-foot high speed wind tunnel. The experiments lead to the following conclusions:—

(1) Drag additions caused by a normal deflated de-icer were from 13 to 29 per cent. of the smooth-wing drag, depending on the speed and attitude of the wing.

(2) For the inflated conditions, the drag additions were of the order of 100 per cent. of the smooth-wing drag.

(3) Beneficial results were obtained both by eliminating the irregularities of the deflated de-icer surface and by making the attaching fittings as nearly flush as possible. The drag additions were then from 1 to 19 per cent.

(4) Fluttering and bulging of rubber de-icers were experienced when they were subjected to negative pressures of the order of 60 pounds per square foot. The critical speed was raised as much as 100 miles per hour by increasing the tension in the rubber and backing the rubber with fabric.

On the Correction to be Applied to the Measured Take-off Run so as to Eliminate Differences Due to Pilotage. (H. Kimura, Aer. Res. Inst., Tokio, Report No. 169, September, 1938.) (62/20 Japan.)

The take-off run of an aircraft depends very markedly on the speed at take-off. Since personal difference of pilotage is unavoidable, the length of run, even when corrected for wind and reduced to standard air conditions, is variable and extrapolation to overload conditions is thus uncertain.

The author proposes the following method of overcoming this difficulty.

(1) The take-off speeds, corrected for wind are plotted against the weight and a mean curve drawn.

(2) The variation ΔS in take-off runs due to a variation ΔV from the mean speed is measured or calculated assuming constant incidence.

(3) The take-off run corresponding to the mean take-off speed is then plotted against weight and the resultant curve extrapolated to overload conditions.

The method was applied successfully to the Japanese long range aircraft Koken.

The author also discusses the effect of wind on the length of take-off runs.

If S_0 = take-off run with no wind,
S_1 = take-off run into a wind velocity V_1,
t_1 = take-off time at a wind v_1
$(S)_{0\to v1}$ = distance required to attain a speed v_1,

Then $S_0 = S_1 + v_1 t_1 + (S_0)_{0\to v1}$

The author shows how the factor $(S_0)_{0\to v1}$ (which is often neglected) can be obtained in a simple manner.

Estimation of Wing Weights. (J. E. Lipp, J. Aer. Sci., Vol. 5, No. 12, Oct., 1938, pp. 491-3.) (62/21 U.S.A.)

A method for making preliminary estimates of wing weights is described. Equations are given to show the manner in which spar cap, spar web, rib, and miscellaneous weights vary with the dimensions of the aeroplane.

Some Aerodynamic Problems in the Design of the Convertible Aeroplane. (G. P. Herrick, J. Aer. Sci., Vol. 5, No. 12, Oct., 1938, pp. 494-7.) (62/22 U.S.A.)

The main feature of this paper lies in the fact that, up to July 30, 1937, heavier-than-air machines could be divided into two general classes. In the first class were the aeroplanes with their refinements and improvements for efficiency and speed. In the second class were the rotor-planes with their special characteristics of jump-off, hovering, high-angle and vertical take-off, and landing.

On July 30, 1937, a convertible aeroplane took off and landed as an aeroplane, did likewise as a rotor-plane, and then took off and flew as an aeroplane or machine of the first class mentioned, and, at 1,700ft. released and started its upper wing in rotation, landing as a rotor-plane, or machine of the second class mentioned. This might be regarded as demonstrating a new class, the convertible, a combination of both aeroplane and rotor-plane.

Conversion of the convertaplane was accomplished by releasing and starting the upper wing rotating and by control of its unbalanced moments, occasioned by the differential in lift between the advancing and receding blades of the rotor-wing.

Some Details on the Italian Altitude Record. (Les Ailes, No. 910, 24/11/38, p. 8.) (62/23 Italy.)

The Caproni aircraft which reached an altitude of 17,100 metres weighed 1,690 kg. No details are given with regard to the engine, a 14-cylinder twin row Piaggio. Marelli magnetos and sparking plugs were fitted, preliminary researches having revealed methods for overcoming high tension leakage in the stratosphere.

A 4-blade wooden airscrew of large blade area was used on account of its low weight, although the fixed pitch made the take-off difficult. The cabin is in the form of a metallic cylinder surmounted by a hemispherical cupola fitted with windows. The pilot was supplied with an oxygen mask and sealed the cabin at 8,000 m. The cabin thus had only to withstand the pressure differences between this altitude and the ceiling, approximately 200 mm. of mercury. The air in the cabin is circulated by means of a pump, the excess moisture and CO_2 being extracted.

It is stated that the stuffing boxes through which the engine and aircraft controls pass gave considerable trouble before they could be made reasonably airtight.

Methods of Aircraft Production in U.S.A. (T. P. Wright, Airc. Eng., Vol. 10, No. 118, Dec., 1938, pp. 386-409.) (62/24 U.S.A.)

In this well illustrated article (119 figures) the author describes the general production method of leading American aircraft firms.

Although great strides have been made in the construction of quality and quantity production, the following improvements are suggested:—

(*a*) Greater shop experience for drafting personnel.
(*b*) Standardisation of best method of wing construction.
(*c*) Study of stainless steel and spot welding.
(*d*) Development of riveting tools.

Whilst the methods of fuselage, tail and control surface construction are not likely to change in the near future, wing construction is still in a state of flux and the design adopted by various firms differs appreciably.

Engine mountings of welded chrome molybdenum steel are fairly general and riveted fuel tanks (using synthetic rubber as a leak preventative) are likely to be used more extensively in the future.

It is interesting to note that the relative cost of the assembly constituents of aircraft have not changed very much over the last 10 years. This is shown in the following table:—

	1929	1938
Wing Group	29	32
Tail Group	7	6.5
Fuselage	18.5	13.5
Landing Gear	7	15.5
Power Plant	15	16.0
Equipment	12.5	8.0
Armament	3.5	3.0
Assembly	7.5	5.5
	100.0	100.0

The 1929 construction is a tube fuselage, wooden beam biplane, fabric covered with fixed landing gear. The 1938 product is a stressed skin all-metal monoplane with retractable landing gear. The extra cost of this gear represents the main difference.

Increase in the Speed of Aircraft During Recent Times. (E. Heinkel, General Meeting Lilienthal Society, Berlin, Oct. 12, 1938. Translation No. 766.) (62/25 Germany.)

The maximum speed of a single seat fighter has increased from 250 km./h. (1921) to 700 km./h. in 1938. Of this speed increase 300 km./h. are due to aerodynamic improvement of the aircraft structure, and 150 km./h. to increased engine performance (supercharging).

The supercharged engine gives a poor ground performance unless variable pitch propellers are fitted. Even then it may be necessary to fit a variable speed gear between engine and propeller in order to obtain the necessary thrust at take-off. The high flying speeds also affect the propeller efficiency (compressibility of the air). The velocity of sound at the ground is 1,230 km./h. and falls off to 1,060 km./h. at an altitude of 11,000 m. Since the resistance increases rapidly as the speed approaches the velocity of sound, the most efficient altitude decreases with increase in flying speed above 650 km./h. The author is of the opinion that a speed of the order of 1,000 km./h. near ground level will present the ultimate possible limit. Of interest is the effect of armament on maximum speed. External machine gun emplacements such as were employed in the 1914-18 war would cause a speed reduction of nearly 70 km./h. in the case of a modern bomber capable of doing 500 km./h. without excrescences. By suitable fairing this drop can be reduced to something of the order of 10-20 km./h. in modern installations.

Studying Engine Combustion by Physical Methods. (I. Withrow and G. M. Rossweiler, J. Applied Physics, Vol. 9, June, 1938, pp. 362-72. Fuel, Vol. 17, No. 11, Nov., 1938, p. 348.) (62/26 U.S.A.)

The author reviews the various physical methods that are being used for the study of combustion in an internal combustion engine. The latest development of high-speed cinematography is described and, as a typical result, 24 successive pictures of the propagation of an explosion over 43 crankshaft deg. are shown. Typical emission spectra are shown, those in the flame-front being contrasted with those in the afterglow and those in a bunsen flame. Temperature measurements determined by the sodium-line reversal method show a temperature of 2,000°C. at the beginning of combustion, 10 deg. after ignition, and 2,400°C. on completion

of combustion 45 deg. after ignition. Time displacement photographs which show pressure waves in the inflamed charge are shown. Absorption spectra are given for knocking and non-knocking conditions.

Spectroscopical Investigation of the Process of Combustion in Internal Combustion Engines. (E. Czerlinski and M. Seibt, L.F.F., Vol. 15, No. 6, 6/6/38, pp. 316-20. Fuel, Vol. 17, No. 11, Nov., 1938, pp. 348-9.) (62/27 Germany.)

The facts brought to light by spectroscopical investigations of the process of combustion in internal combustion engines are discussed. As an aid to the interpretation of the reported phenomena, the results of spectroscopical research on open flames are referred to. The experiments that have proved most productive in yielding information have been those conducted with a carburettor engine in the visible and the ultra-violet regions. It has been established that a narrowly defined flame front emits characteristic bands which in the case of normal combustion correspond to the spectrum of the inner cone of the Bunsen-burner flame. The carriers are the dicarbon CC, methane CH, and hydroxyl OH. In an engine producing the phenomenon of knock, the bands of the radicals CC and CH in the flame front disappear at the instant of setting in of the knock. The admixture of anti-knock agents not only restores the normality of the pressures, but the spectral emissions also provide evidence of normal combustion. The presence of formaldehyde ahead of the flame front is manifested only in the case of knock, and at no other time. The chemical process in the mechanism of combustion with knock pursues a different course from that followed in normal combustion. The discussion is illustrated by spectrograms showing the effects of different conditions and the influence of detonation-inhibiting agents.

Aircraft Fuels (42 *References*). (S. D. Heron and H. A. Beatty, J. Aer. Sci., Vol. 5, No. 12, October, 1938, pages 463-79.) (62/28 U.S.A.)

Experience in the United States show that the safest fuels for general service are those whose octane numbers are least subject to change with engine test conditions. Thus, straight-run petrols or their blends with branched chain paraffins are much less open to doubt than petrol blends with aromatics, alcohols, or olefins. Any fuel which shows the characteristic of a falling octane number with increase of speed, cylinder temperature, or mixture temperature in knock testing may be subject to doubts as to its full-scale reliability. These views are not accepted in Europe and other parts of the world, and change of engine type in the United States may cause modification.

By and large, in the light of present knowledge, straight-run petrols (or synthetic petrols of similar properties) and branched-chain paraffins are the outstandingly useful aviation fuels. They are stable in storage, have very low water solubility, give the highest heating values, and their octane numbers are subject to only a slight variation with engine type or operating conditions.

While the anti-knock properties of the water-soluble fuels such as alcohols and ketones may appear attractive, such fuels are less desirable than hydrocarbons for general service use. In some types of operation, however, take-off output and fuel availability may be more important than range, and in such cases oxygenated fuels may find a field of application, in spite of their inherent danger of water separation.

Evaporation and Knock Rating of Motor Fuels. (O. Herstad, Oelu. Kohle, Vol. 14, 1938, pp. 657-60. J. Sci. Chem. Ind. (Abstracts B), Vol. 57, No. 11, Nov., 1938, p. 1256.) (62/29 Germany.)

The time of evaporation (y) of drops of org. liquids is related to the wt. of the drops (x) by $y = cx^m$, where c is a constant and m has the value 1.65—1.78 for evaporation in the ordinary state and 2.5—2.9 for that in the " transformed " (spheroidal) state. The bearing of the results on the behaviour of drops of motor

spirit in the cylinder of the internal-combustion engine is discussed. The rate of evaporation of very small drops has been studied under the microscope; as the drop diminishes in size the evaporation may pass from the normal type through a labile state to the " transformed " type. It is suggested that the ultimate rate of evaporation of very small drops can be related to mol. velocities as calc. from the kinetic theory.

Behaviour of Diesel Fuels at Low Temperatures. I—Influence of Temperature of Suction Air and Cylinder Walls on Critical Compression Ratio. II—Influence of Low Temperature on Flow of Diesel Fuels Through Bosch Filters. (L. Rosenfeld, Petrol Times, Vol. 39, 1938, pp. 593-5 and 627-9. J. Soc. Chem. Ind. (Abstracts B), Vol. 57, No. 11, Nov., 1938. p. 1256.) (62/30 U.S.A.)

I. Six petroleum fuels of cetane nos. ranging from 44.5 to 65.5 were tested in a C.F.R. single-cylinder engine with direct ignition head. The suction air was cooled to $-30°$ and various cylinder temperatures were maintained by means of cooling fluids, e.g., MeOH. The critical compression ratio increased with rise in temperature. Changes in the temperature of the suction air or cooling liquid produced about the same effect. The cetane number of the fuel gave no indication of its ignition quality under changed temperature conditions.

II. The filterabilities at $-100°$ of normal gas oil, oil filtered once at room temperature, and oil freed from asphaltic matter by acid treatment were compared. The data show that impurities alone caused pumping difficulties. Asphaltic matter and high η due to low temperature did not cause choking of the filter.

Changes Occurring in Lubricating Oils in Internal Combustion Engines. (H. Weiss and A. Maillard, J. Inst. Petroleum Tech., Vol. 24, 1938, pp. 407-20.) (62/31 U.S.A.)

Experiments with oils in Diesel and spark-ignition engines indicate that the increase of d, η, acidity, ash and the quantity of oxidation products precipitable by light naphtha is very regular. Of these products that portion insoluble in $CHCl_3$ is the most important for it is also insoluble in hot oil. It is shown that this insoluble portion is not always soot. Pyrolysis does not appear to be likely with mineral oil; experiments show that it does not occur with mineral oil until 360° is reached, though with castor and olive oils the temperature is 250° and 310°, respectively. Unburnt or partly burnt fuel does not seriously increase sludge, which latter is mainly the outcome of oil oxidation. Tests by which it is hoped to recreate the reactions of oil in engine service are described.

The Behaviour of Compressed Gas in Steel Flasks. (J. H. Brunklaus, Gas u. Wasserfach, Vol. 81, 1938, pp. 696-8. Chem. Absts., Vol. 32, No. 22, 20/11/38, p. 9445.) (62/32 U.S.A.)

When a steel cylinder filled with coal gas under high pressure was discharged it was found that the liquid light oil present in the cylinder served as a solvent for gas constituents such as H, CH_4, etc., and that these gases carried light oil in the form of a fog, which was vapourised, enriching the gas. Light petrol is a better solvent for CH_4 than is propane or butane. These observations are of special value for automotive operation with compressed gases.

The Differential Analyser and its Applications in Electrical Engineering. (D. R. Hartree and A. K. Nuttall, J. Inst. Elec. Eng., Vol. 83, No. 503, Nov., 1938, pp. 643-7.) (62/33 Great Britain.)

The present paper describes the mathematical principles underlying the solution of differential equations by means of the differential analyser. A brief description of the principal mechanical features of the machine is given, and the method of operation is outlined. The paper reviews a number of problems which have been

investigated by means of the differential analyser, and indicates further problems which appear to lend themselves to this method of attack.

Measuring Instruments. (R. M. Archer, Electrician, 28/10/38, pp. 497-9. Metropolitan Vickers Tech. News Bulletin, No. 633, 4/11/38, p. 5.) (62/34 Great Britain.)

This article which deals with the more notable developments in measuring instruments during the past year is supplemented by descriptions of new meters and instruments on pp. 500-511 of this issue. The products described include: galvanometers having high sensitivity, indicators, test sets, oscillographs recorders, remote indicators, meter testing transformers, photometric and acoustical apparatus, and recent laboratory and radio-frequency instruments. Illustrated with seven photographs and one oscillogram.

Optical Inspection in the Metal Industries. (H. Dunlein, Eng. Prog., Oct., 1938, pp. 189-93. Metropolitan Vickers Tech. News Bulletin, No. 633, 4/11/38, p. 11.) (62/35 Great Britain.)

This article describes various types of optical apparatus produced by Carl Zeiss for the examination of materials and machine parts (greatly varying in form and size), for slag inclusions, porosity, the fineness of machined surfaces and similar conditions. Arrangements are made for the viewing of an object in a bright field, dark field, or under polarised light and also for the projection of the image on to a photographic plate. The author concludes by describing and outlining the advantages of apparatus applying the principles of spectrum analysis and photometry to the qualitative and quantitative analysis of materials. Illustrated with 11 photographs.

Bronzavia Tail Drift Sight. (H. A. Taylor, Flight, Volume 34, No. 1563, 8th December, 1938, pp. 534-5.) (62/36 France.)

This new sight is of the periscope type and has a specially controlled sighting bubble. In ordinary use, the ground object is followed on the bubble down a grid wire and a special stop watch arrangement enables the speed of the machine to be read off if the altitude is known. The hand of the watch stops automatically after the prism has been turned through a certain angle.

Pressure Responsive Elements. (P. G. Exline, Transactions (A.S.M.E.), Vol. 60, No. 8, Nov., 1938, pp. 625-32.) (62/37 U.S.A.)

Pressure-responsive elements commonly used in indicating and recording instruments are manometers, free piston gauges, Bourdon tubes, diaphragms, and bellows. The mathematics of the primary elements, manometers, and free piston gauges is simple and direct. Analyses of Bourdon tubes and diaphragms show that predictions of their performance curves are not amenable to precise calculation even under the simplest conditions, which conditions do not generally obtain in instruments. Generally, the instrument maker must rely upon empirical knowledge, coupled with approximate calculations, for design data. Linkage adjustments must be provided to correct for variations in dimensions and materials normally encountered in manufacture.

Emphasis is placed on the usefulness of bellows as pressure elements, and approximate formulæ for calculating their behaviour are given. The results of considerable experimental work on the characteristics of bellows of various sizes and materials show that in many cases they are ideal elements for pressure-responsive instruments. An example of such use in a special duty pressure gauge is given.

Pressure-Type Thermometer Systems. (L. G. Bean, Transactions (A.S.M.E.), Vol. 60, No. 8, Nov., 1938, pp. 657-63.) (62/38 U.S.A.)

This paper, which deals exclusively with the common forms of industrial temperature-measuring systems working on a pressure principle, analyses the essential elements of a basic pressure-type system with reference to the design problems involved and describes various typical instruments in the conventional classifications in order to illustrate the development of these thermometer systems into reliable instruments for commercial measurements. Included in these classifications are liquid-filled, vapour-tension, and gas-filled thermometers, all of which are described and illustrated.

New Automatic Direction Finder. (*Sperry—R.C.A.*) (American Aviation, Vol. 2, No. 11, 1/11/38, p. 17.) (62/39 U.S.A.)

According to the manufacture, the Sperry—R.C.A. radio automatic direction finder requires only that the pilot tune to a station. The pointer on the instrument has an arrow at one end and indicates the exact bearing of the station. A great advantage consists in the fact that this bearing is held up to the point of passing over the station. Positive information is thus available to confirm the " cone of silence " if the pilot has been flying on the regular radio beam. This cone by itself is unsatisfactory because it only corresponds to a momentary complete absence of any signal. The instrument will also be very useful as an auxiliary or checking device on other methods of position finding. It is stated that it can be worked successfully under conditions of " static " which rule out all null methods by hand operated loop.

Torsional Fatigue Strength of Beryllium-Nickel and Beryllium-Contracid Spring Wire at Temperatures up to 300°C. (W. Hellwig, Forschung. Vol. 9, No. 4, July-August, 1938, pp. 165-176.) (62/40 Germany.)

The tests were carried out on straight pieces of cylindrical wire, special attention being paid to the method of clamping. The fatigue tests were carried out both with and without previous static loading and demonstrated the superiority of the alloy wires to the best steel samples. Thus the working capacity of a beryllium-nickel spiral spring is at least 30 per cent. greater than that of a steel spring of the same dimensions. It should be noted that other advantages of the alloy are its freedom from rust and stability in sea water. Good results can, however, only be obtained if special attention is paid to the heat treatment of the alloy prior to use.

Transverse Oscillations of Flywheels. (G. Heinrich, Forschung, Vol. 9, No. 4, July-August, 1938, pp. 177-186.) (62/41 Germany.)

A flywheel situated between two cranks displaced by 120° showed marked transverse oscillation at certain r.p.m. The author investigates this effect mathematically and develops a method for determining critical speeds. It appears that resonance is generally only possible if pronounced higher harmonics are present in the forcing torque.

Calculation of Stresses in Revolving Flywheels, Belt and Rope Pulleys. (W. Heusinger, Forschung, Vol. 9, No. 4, July-August, 1938, pp. 197-208.) (62/42 Germany.)

The calculation of the stresses in flywheels and similar elements has not received much attention in scientific literature. In order to simplify the calculations, certain factors are usually neglected (often without sufficient justification), as the procedure becomes otherwise too complicated for practical application. The author develops an accurate and strictly scientific method of calculation which meets the designer's requirement as to simplicity both in respect of the development of the formulæ and of their application to practical cases.

The Relations Between the Energy Theorems Applicable in Structural Theory. (D. Williams, Phil. Mag., Vol. 26, No. 177, Nov., 1938, pp. 617-35.) (62/43 Great Britain.)

The following theorems are discussed:—

(A) Theorem of Virtual Work.

(B) Theorem of Minimum Potential Energy.

(C) Castigliano's Theorem of the Differential Coefficients of the Internal Work (Parts I and II).

(D) Castigliano's Theorem of Least Work (called by Southwell The Second Theorem of Minimum Strain Energy.)

(E) Statical analogue of Bertrand's Theorem in Dynamics, alternatively, The Theorem of Maximum Strain Energy.

(F) Statical analogue of Kelvin's Theorem in Dynamics (called by Southwell The First Theorem of Minimum Strain Energy).

It is shown that Theorems (A) (B) and Part I of (C) are in their application to structural problems fundamentally identical, and capable of general application in that they are true whatever the law connecting load and deformation may be. Part II of (C) is based on Part I and on the assumption that the total strain energy is equal to half the sum of the products of the external forces and their respective displacements. As the latter assumption is only valid for structures that obey Hooke's law, Part II of (C) is only true when this law is satisfied.

Theorem (D) is deducible directly from Part II of (C) and is, therefore, subject to the same limitation. In this way Theorems (B) and (D) may be regarded as the first and last links in a chain of interrelated theorems. At this stage in the argument the two Theorems (B) and (D) are directly compared, and the essential features that distinguish the one from the other are analysed. Their relative usefulness in the solution of structural problems is also discussed.

Theorems (E) and (F) are next considered and the relevant proofs are included in the appendix, chiefly because they appear never to be given fully except in their dynamical form. The validity of both theorems is dependent on the operation of Hooke's law. Theorem (E) is next enunciated in a new form, and so shown (in the appendix) to be directly related to Theorem (B) in fact to be merely a particular case of that theorem. The physical connection between Theorems (E) and (F) is then explained and their relative usefulness discussed.

Stainless Steel Welding. (V. W. Witmer, Sheet Met. Ind., Nov., 1938, pp. 1299-1302. Metropolitan Vickers Tech. News Bulletin, No. 634, 11/11/38, p. 5.) (62/44 Great Britain.)

The author examines the welding properties of chromium steels and nickel-chromium steels. The former is shown to give a brittle weld which can be partly improved by heat treatment, whilst the latter, although giving a tough weld, gives rise to difficulties due to its large coefficient of expansion. The above are considered in relation to electric arc welding, but projection, seam and flash welding of stainless steels with a choice of electrodes are also reviewed.

Illustrated with four photographs.

The Working of Stainless Steels. (Machinist L., 5/11/38, pp. 869-80. Metropolitan Vickers Tech. News Bulletin No. 634, 11/11/38, p. 8.) (62/45 Great Britain.)

Particulars are given of the composition of stainless steels together with a list showing the corrosive resistance of various steels to different acids and salts. Machining of the alloys is discussed as well as the tools required for particular steels, followed by a description of polishing and grinding methods now in use. After explaining how stainless steels can be cold worked, a list of their various mechanical properties is given and a description of the design and use of welded

joints with stainless steels. Finally, modern methods of annealing chrome stainless steels are explained.

Illustrated with four diagrams and three tables.

Fatigue and Corrosion Fatigue of Steels. (B. B. Wescott, Mech. Engineering, Nov., 1938, pp. 813-822. Metropolitan Vickers Technical News Bulletin No. 634, p. 13.) (62/46 Great Britain.)

The author points out the present-day need for knowledge in this field and then discusses various results obtained by the machine developed by R. R. Moore. He then discusses various formulæ for the range of stress to be safely applied and continues by describing the nature of fatigue failure and shows how different forms of heat treatment can alter the fatigue limit. He concludes the article by first showing how tests were made with notched and corroded specimens and the results deduced from these, also the effect of damping capacity on fatigue strength. Illustrated with four photographs, 14 diagrams and four tables.

Magnetic Crack Detecting on Turbine Blades and Rotors. (T. C. Rathbone, Power, Nov., 1938, pp. 74-7. Metropolitan Vickers Technical News Bulletin No. 635, 18/11/38, p. 5.) (62/47 U.S.A.)

The author discusses the earlier methods for crack testing in the case of both assembled and unassembled blades, and points out the advantages of a powder called magnaflux used for this purpose. This consists of iron particles coated with an inert oxide and capable of passing through a hundred mesh. The powder is used dry and therefore cleaning of large turbine shaft assemblies is simplified, though the real difficulty is to ensure proper magnetisation. Photographs showing typical examples and methods of magnetising blades and turbine shaft assemblies are given. Illustrated with five photographs.

Testing Tensile Strength of Deposited Weld Metal. (J. Sack, Phillips' Tech. Rev., Sept., 1938, pp. 279-82. Metropolitan Vickers Tech. News Bulletin No. 632, 28/10/38, p. 6.) (62/48 Great Britain.)

In this article it is shown that it is no longer correct to require in specifications an upper limit for the tensile strength of deposited weld metal. This requirement originated from an assumed relation between the variation with composition of the tensile strength and the brittleness of the material. The relation is stated to be valid for ordinary carbon steels such as have long been used, but no longer holds for modern welding materials. If this stipulation is made it leads to the use of welding rods of poorer quality than would be used if the obsolete requirement were omitted. Illustrated with two diagrams and four tables.

Alloys for Springs. (L. L. Stott and R. W. Carson, Met. Ind., 21/10/38, pp. 395-7. (Metropolitan Vickers Tech. News Bulletin No. 632, 28/10/38, p.9.) (62/49 Great Britain.)

It is shown that the retention of " springiness " in a material under service loads depends on the material's resistance to drift or creep at low temperatures. The drift measurements reported here show that a salt bath heat treatment at 650°F. for 20 minutes, gives minimum drift in cold-rolled beryllium copper strip. Spring temper phosphor bronze was found to have 2.8 times as much drift as beryllium copper and nickel silver 1.4 times as much as beryllium copper when heat treated as above. Illustrated with five diagrams.

Synthetic Resin Moulded Material for Guide Ways on Heavy Machine Tools. (H. Ragotzi, Maschinenbau, Oct., 1938, p. 525. Metropolitan Vickers Tech. News Bulletin No. 632, 28/10/38, p. 12.) (62/50 Germany.)

The author describes experiments carried out by Fried. Krupp A.G. with the object of protecting the guide ways on heavy machine tools. Bronze sheets were

originally used, but were later replaced by synthetic resin boards which gave satisfactory results. Hints are given as to the installation of the latter. Illustrated with two diagrams.

Applying Heavy Metal Deposits. (Electrical Review, 28/10/1938, p. 623. Metropolitan Vickers Tech. News Bulletin No. 633, 4/11/38, p. 10.) (62/51 Great Britain.)

Some details are given of the Fescol method for the salvage of parts that have become worn in use, the rectification of machine shop errors, securing of protection against corrosion, and the improvement of surface quality by the application of heavy metal deposits. One interesting feature is the conversion of the supply from single phase to three-phase by the multi-capacitor pilot motor system devised by the B.T.H. Co. Illustrated with three photographs.

Frettage Corrosion. (Autom. Eng., Vol. 28, August, 1938, p. 278. Eng. Absts., Vol. 1, No. 9, Section 3, October, 1938, p. 153.) (62/52 Great Britain.)

With dry metal surfaces (*e.g.*, splined hubs of gears, fitted bolts, ball races, flanges, propeller shafts and housings) fine Fe_2O_3 dust is formed when the mating surfaces are subject to vibration, if one of the parts is ferrous; this will occur even in what is normally regarded as a tight fit. The rapidity of the action, and consequently the amount of debris, is proportional to the amplitude of relative motion, but independent of both speed and load. Stainless steels and hard steels show the maximum effect, but soft metals are more liable to seize and show less corrosion; the minimum occurs when brass forms one of the pair. Even in contact with glass or wood, steel shows the phenomenon. Lubrication reduces its intensity and in rotational motion it does not occur—apparently under vibration the oil film breaks down. An apparatus for investigating the phenomenon is described, using lapped specimens with a convex and flat face respectively to keep the contact area small. A lateral oscillation is imparted to one by a cam, under any desired load; the outer end of the arm allows the amplitude of vibration to be observed with a micrometer. It appears that minimum frettage occurs with a maximum difference in hardness between the pair of metals.

New Method of Metal Spraying. (The Engineer, Vol. 166, 16th September, 1938, p. 318. Eng. Absts., Vol. 1, No. 9, Section 3, October, 1938, p. 153.) (62/53 Great Britain.)

The process depends on a Swiss " Schori " patent in which the powdered metal is sucked into a stream of compressed air, avoiding the packing which occurs when pressure is used. Interesting applications of the process are the spraying of tanks, hulls, bridges, machinery, aluminium seaplane floats (with Al, Zn or Cd), ammunition, mines and shells (in which it acts as a lubricant in the rifling). The coating can be hammered, riveted or bent without injury, and a patent is being taken out for a (metal and glass) mixture which forms a fusible slag, and a similar mixture with Al base is suitable for protection of iron exposed to high temperature.

Crankshaft and Cylinder Materials. (Autom. Eng., Vol. 28, p. 217. Eng. Absts., Vol. 1, No. 9, Section 3, October, 1938, p. 163.) (62/54 Great Britain.)

The author reports tests on " wet " liners in a wide variety of materials, ranging from English and French nitrided cast iron (reputed 900 Brinell), through heat treated and untreated Ni-Cr-Mo cast iron, chill cast iron with varying quantities of Ni and Cr, centrifugally cast soft iron, a Ni cast iron, electric furnace iron, 35 per cent. Cr iron and other irons, to common cast iron. Recently thin " dry " nitrided liners of 1,000 Brinell have been developed. Oxy-acetylene

hardening for crankshafts is being displaced by induction heating to eliminate the human factor. With h.f. (2,000 cycles) owing to skin effect, heating is mainly superficial and in 4.5 sec. the steel is at hardening temperature to a depth of $\frac{1}{8}$in. Current is then turned off and the article quenched by water spray; some heat is also conducted to the core. File hardness can almost be attained and, apart from conduction, no heat is applied to any part other than the bearing surfaces. The whole crankshaft is then slightly tempered to remove internal stresses. The process confers a hardness greater than any other except nitriding; the core remains strong and such crankshafts last much longer in service than untreated crankshafts.

Stresses and Deformations in Pipe Flanges Subjected to Creep at High Temperatures. (J. Marin, J. Frank. Inst., Vol. 226, No. 5, Nov., 1938, pp. 645-7.) (62/55 U.S.A.)

Various methods have been employed for determining the stresses in pipe flanges using the theory of elasticity (I). There are many cases, however, of pipe flanges which are subjected to stresses and at the same time a high temperature such that creep occurs. This paper gives an analysis of the stresses and deformations produced in a circular ring of rectangular cross section subjected to twisting couples uniformly distributed along its centre line. Such a solution will also give an approximate analysis of the pipe flange. This approximation is justified in view of the complexity of the problem and the uncertainties still present in the fundamental creep-stress relation for metals. In the solution of this problem a deflection theory is also developed for straight beams subjected to bending accompanied by creep.

Methods and Means for Determining the Natural Modes of Vibration of Mechanical Structures. (H. C. Hayes and E. Klein, J. Am. Soc. Nav. Eng., Vol. 50, No. 4, Nov., 1938, pp. 519-26.) (62/56 U.S.A.)

Cyclic strains in vibrating mechanical structures often lead to failures because of the resulting fatigue of the material. Both theory and practice indicate that the breaks or other types of failure occur at a node of one of the numerous natural modes of vibration of the structure. These natural modes of vibration can be determined theoretically if the structure is simple and the parts are of geometrical form, but usually the problem is too complicated for exact solution and the best that can be hoped for from theory is a rough approximation of the resonant frequencies and a still rougher approximation of the location of the nodes of the vibrating system. The present paper describes a simple method and means for experimentally determining the several natural resonant frequencies of any mechanical system and the location of the nodes of their respective standing wave systems. Its effectiveness is demonstrated by analysing three modes of vibration of a ship's propeller.

Resonance in Truncated Cones. (A. E. Bate, Phil. Mag., Vol. 26, No. 178, Nov., 1938, pp. 752-7.) (62/57 Great Britain.)

(*a*) The open-end correction appears to be independent of the frequency in the cylindrical pipe, but varies with it in conical pipes.

(*b*) When the cylindrical pipe terminates in a conical pipe of semi-apex angle of about 1-2°, the end correction disappears, the actual value of the angle at which this occurs depending on the frequency.

(*c*) For cones of large angle the correction (measured along the axis) is negative, and remains so up to about 86°; the cone angle 90° is a plane flange with a positive end correction.

(*d*) The conical pipes closed at the narrow end have natural resonant frequencies below about 10° semi-apex angle, the wave length being four times the slant height—including the appropriate correction for the unattached end.

(*e*) Conical ends above about 10° behave as conical flanges.

(*f*) The relation between frequency, slant length, and angle for cones of small angle is obscure.

Heat Transfer from Tubular Elements to Air in Cross Flow. (R. Benke, Archiv für Warmewirtschaft, Nov., 1938, pp. 287-8. Metropolitan Vickers Technical News Bulletin No. 634, p. 11.) (62/58 Germany.)

The question as to whether an in-line or a staggered arrangement of the tubes creates more favourable conditions of heat transfer has not been finally determined. The author describes tests carried out on a modern type of air heater in which the current of air is heated electrically by tubular elements (Backer tubes). He reaches the conclusion that the heat transfer is independent of the arrangement and distances apart of the tubular elements combined in the bank. Illustrated with four diagrams and one photograph.

The Pressure Available for Ground Cooling in Front of the Cowling of Air-Cooled Engines. (G. W. Stickle and U. T. Joyner, N.A.C.A. Tech. Note No. 673, November, 1938.) (62/59 U.S.A.)

A study was made of the factors affecting the pressure available for ground cooling in front of a cowling. Most of the results presented were obtained with a set-up that was about one-third full scale. A number of isolated tests on four full-scale aeroplanes were made to determine the general applicability of the model results. The full-scale tests indicated that the model results may be applied qualitatively to full-scale design and quantitatively as a first approximation of the front pressure available for ground cooling.

The available pressure in front of the cowling increased rapidly with propeller radius up to 30 or 40 per cent. of the propeller radius. The cowling should be located as close to the propeller as practicable.

Discs located in front of the nose of the cowling greatly increased the average pressure in front of the engine baffles. It is important that the plane of the disc be even with the nose of the cowling. A round-edge disc was superior to a straight flat disc. The size of the disc should be such that the area of the front opening is optimum for the total conductivity used.

Tests on full-scale aeroplanes showed that the model tests may be qualitatively applied to full-scale design and quantitatively applied as a first approximation of the available front pressure.

A Survey of Ultra-High Frequency Measurements. (D. L. Nergaard, R.C.A. Review, Vol. 3, No. 2, Oct., 1938, pp. 156-195.) (62/60 U.S.A.)

A simple magnetron signal generator is described. The more useful transmission line and skin effect formulæ are listed. In connection with transmission lines, it is pointed out that even at very high frequencies the quadrature component of the characteristic impedence cannot be neglected. Methods which have been used for the measurement of the following quantities are described:—

(1) *Wave Length.*—Wave length has been measured by reflection of waves in free space and transmission line wave meters. A method of determining the end correction of a transmission line wave meter is described.

(2) *Power.*—Thermocouples for the measurement of small powers are described. The use of incandescent lamps for the measurement of large powers is discussed.

(3) *Voltage.*—Diode voltmeters and thermocouples have been used for the measurement of voltage. The errors of these voltmeters are discussed.

(4) *Reactance.*—Reactance has been measured by tuning the unknown reactance to resonance with a transmission line of known characteristics. The method is illustrated by two examples: The determination of the resonant wave length, the inductance and capacitance of a diode, and the calibration of a variable condenser.

(5) *Resistance.*—Resistance has been measured by the substitution method, the resistance variation method, and the reactance variation method.

(6) *Current.*—The measurement of current with thermocouples is discussed.

Temperature Reduction in High-Powered Loudspeakers. (F. Massa, R.C.A. Review, Vol. 3, No. 2, Oct., 1938, pp. 196-202.) (62/61 U.S.A.)

An ideal loudspeaker designed for high-power output is ultimately limited in its rating by the maximum permissible temperature that can be safely tolerated by the voice coil structure which is generally the hottest operating portion of the speaker. The high voice coil temperature results from the insulating film of air which separates the voice coil from the magnetic structure. Data are presented showing the reduction in temperature rise which resulted when the air in the air gap of two speakers was replaced by helium and hydrogen, each gas having a higher thermal conductivity than air. The reduced voice coil temperature permits either the lowering of the voice coil dimensions with a corresponding decrease in weight of the magnetic structure, or operation of a given structure at greatly reduced temperature. A small weight high-powered speaker is particularly desirable for special applications, such as public address from aircraft. If weight is of no importance, the cooler operation due to the use of helium or hydrogen in the gap will permit an increased operating efficiency of the speaker.

Microphone Wind Screening. (W. D. Phelps, R.C.A. Review, Vol. 3, No. 2, Oct., 1938, pp. 203-12.) (62/62 U.S.A.)

Some principles of hydrodynamics applicable to the problem of screening a microphone from pressure fluctuations due to wind are considered. An expression is derived for the wind pressure on a sphere assuming the air to act as a perfect incompressible fluid in irrotational motion. The pressure is found to vary both in phase and magnitude over the surface of the sphere. The Bernoulli wind screen is described which takes advantage of the pressure and phase difference existing over the surface of a microphone to reduce the wind pressure effective at the diaphragm. The effect of resistance in the vents of the screen is shown. A comparison of the wind pressure directional characteristic of the Bernoulli screen is made with that of a relatively large ellipsoidal screen.

Performance Tests of Navy Radio Meteorograph System. (H. Diamond, W. S. Hinman, Jr., and E. G. Lapham, J. Aer. Sci., Vol. 5, No. 12, Oct., 1938, pp. 484-90.) (62/63 U.S.A.)

Improvements of the navy radio meteorograph system are described and the results are given of a series of 50 simultaneous radio meteorograph and aerograph soundings under typical service conditions. The improvements have resulted in a simplified calibrating and operating procedure which affords greater accuracy of performance while at the same time increasing the allowable manufacturing tolerances. The results of the simultaneous soundings show that the radio meteorograph is sufficiently accurate to warrant its early adoption for routine use.

LIST OF SELECTED TRANSLATIONS.

NOTE.—Applications for the supply of copies of translations mentioned below should be addressed to the Under-Secretary of State, Air Ministry (R.T.P.), Kingsway, W.C.2, and will be supplied, free of charge, as far as availability of stocks permit.

Suggestions concerning new translations will be considered in relation to general interest and facilities available.

TRANSLATION NO. AND AUTHOR.		TITLE AND JOURNAL.
		ARMAMENTS.
599	D'Adhemar, R. ...	*Theory of the Gyroscopic Motion of Projectiles. General Characteristics. A Study of Approximations.* (Ann. Soc. Scientifique, Bruxelles, Vol. 56, Nos. 1 and 2, 1936, pp. 44-68 and 76-97.)
717	——	*The Japanese Air Force at the Beginning of* 1937. (Air Fleet News, U.S.S.R., Vol. 18, No. 12, December, 1936, pp. 32-8.)
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