ABSTRACTS FROM THE SCIENTIFIC AND TECHNICAL PRESS.

Issued by the
Directorates of Scientific Research and Technical Development, Air Ministry.
(Prepared by R.T.P.)

No. 61. NOVEMBER, 1938.

The Defence of Aerial Bases (from the Italian). (V. Biani, Luftwehr, Vol. 5, No. 6, June, 1938, pp. 238-42.) (61/1 Italy.)

The primary objective of the air force must be the destruction of the aircraft of the enemy. Since the latter cannot be forced to offer an aerial battle, an attack on aerial bases is most likely to yield the required results, since all aircraft necessarily spends most of its life on the ground. There are three methods of defending aerial bases: fighters, decentralisation and camouflage, and A.A. artillery.

The author is of the opinion that decentralisation and camouflage, together with a certain amount of A.A. guns, form the cheapest and most effective method of defence for aerial bases. Adequate protection by fighters is questionable and in any case would entail supplying more fighting aircraft than bombers which are to be protected. This is considered bad policy since it weakens the offensive capacity of the air arm, which must be the primary consideration.

Organisation of Italian Air Force. (Luftwehr, Vol. 5, No. 6, June, 1938, p. 233.) (61/2 Italy.)

The following new departments have been established to act in a consulting capacity:—

1. Air Council (Consiglio dell' Aria) consisting of:—
   (*a*) Air Minister
   (*b*) Under Secretary of State
   (*c*) Chief of the general staff of the air force
   (*d*) Air Marshals
   (*e*) Generals in command of the air force
   (*f*) Commanders of flying squadrons and air zones.

The air council deals with all major questions of military and civil aviation.

2. Supreme Command of the Air Force (Commands Superiore dell Aeronautica) consisting of:
   (*a*) Four flying officers of high rank
   (*b*) One general of technical services
   (*c*) One colonel (administrative departments)
   (*d*) One officer of the Air Ministry.

The Supreme Command deals with all technical questions from the point of view of economics and administration. It also deals with a series of military matters, especially organisation and ground equipment.

3. Technical Committee for Aircraft, including installations and Armament (Comitato per i. progetti dei velivoli delle installazioni di bordo e delle armi).

This committee is composed of three generals and four technical officers of high rank.

Anti-Aircraft Artillery. (W. Matthey, Service in the Air Force Series, Vol. 13, J. Detke, Leipzig, 1938, price RM. 0.80.) (61/3 Germany.)

This booklet is issued under the auspices of the German Air Ministry and gives some particulars of the training and duties of the men joining this division of the air force. Interesting accounts are given of a normal day's work, manœuvres and special training at a coastal gunnery school.

Motor transport forms an important part of A.A. artillery. Thus a battery equipped with searchlights requires 42 lorries apart from trailers and motor cycles. In addition to mastering their specialist duties, over one third of the troops must be competent drivers. The weapons mentioned are:—

1. 8.8 cm. heavy gun, capable of attacking aircraft at a height of 5,000 m. and a distance of 9,000 m. Rate of fire 20-25 shots per minute.
2. 2 cm. to 2.7 cm. light machine gun, 200 shots per minute at a distance of 3,000 m. (tracer ammunition).
3. Carbines to repel ground attack.

The Air Force—Ground Personnel (H. Ader) *and Flying Personnel* (G. Rieckhoff). (Vol. 11 and 12, Air Force Series, J. Detke, Leipzig, 1938, price each volume RM. 0.80.) (61/4 Germany.)

A considerable proportion of the recruits coming forward every autumn and spring chose the air force in preference to the other arms and this enables the German authorities to undertake a considerable weeding out process. The two booklets are intended to give the would-be recruit some idea of what is required from the ground and flying personnel respectively. Life and training are described in general terms.

The flying personnel comprises the following:—

1. Pilots (com. and non-com. officers).
2. Observers (officers).
3. Assistant observers (non-com. officers).
4. Mechanics/gunners (non-com. officers).
5. Wireless operators/gunners (non-com. officers).

The age limit is 23.

Ground personnel include:

1. General duties (drivers, storekeepers, etc.).
2. Technical duties (mechanics, electricians, photographers, etc.).

Ground personnel can volunteer for flying service and will be accepted, provided:—

1. They are good soldiers (recommended to non-com. rank).
2. Fit for air service (medical test) and give signs of special talent (psychological tests).

The Mathematics of Air Raid Protection. (J. B. S. Haldane, Nature, Vol. 142, No. 3,600, 29/10/1938, pp. 791-2.) (61/5 Great Britain.)

The object of this note is to give a quantitative measure of the degree of protection afforded by a given shelter, risk of death from high explosive bombs being only considered.

Let n = number of bombs dropped during the war on an area A containing an individual (distribution of bombs assumed uniform),

p = probability of a single bomb falling at point $(x.y)$ in area A killing individual.

Then probability P of individual being killed in the course of the war is:

$$P = \left(\frac{n}{A}\right) \int p \, dx \, dy.$$

To obtain the total casualties during the war, P must be summed for the whole nation.

The policy of evacuation is intended to reduce n but may increase p. The policy of dispersal within a dangerous area reduces neither n nor p. It merely ensures that no single bomb will kill a large number of people while increasing the probability that any given bomb will at least kill one.

The effect of shelters is to diminish the mean value of p in the immediate neighbourhood when a bomb falls and to decrease the area over which p has a value large enough to be taken into consideration. It is clear that P will depend on the area of the straight section of a trench which should, therefore, be as small as possible. Shelters with a roof must be subdivided to afford horizontal protection.

The author suggests that it should be possible to arrive at a rough value of P/n for each type of shelter and concludes that the trench should be preferred in an area where heavy bombs are likely to fall. The best solution is, however, the provision of stout concrete shelters properly subdivided. In some Spanish towns completely bomb-proof shelters have been constructed underground and this appears to be the ultimate solution.

The Need of Aircraft Observers for Ground Artillery. (A. Verdurand, Rev. de l'Arm. de l'Air, No. 111, October, 1938, pp. 1083-1100.) (61/6 France.)

The author suggests the following characteristics for aircraft suitable for artillery observation.

1. Small two-seater, 70 to 100 h.p., duo-control.
2. Engine placed behind crew, pilot and observer close together to facilitate speech.
3. Max. speed 130 km./h.
4. Min. speed 50 km./h.
5. Take-off 100 m.
6. Landing run 50 m. } still air.
7. Great manœuvrability.
8. No armament.
9. Small range wireless (telegraphy and telephony).
10. Simple robust construction, demountable wings to facilitate lorry transport.

Machines of this type should be quite cheap and at least two should be provided for each artillery group. The duo-control will enable most artillery officers to learn flying without having to attend special schools.

Aircraft Cannons. (R. Maurer, Rev. de l'Arm. de l'Air, No. 111, October, 1938, pp. 1101-1108.) (61/7 France.)

From the point of view of destruction, the calibre of the cannon must not be less than 20 mm. (shell containing 20 gm. of high explosive). Practical installation difficulties on the other hand place an upper limit at 37 mm. calibre (50 gm. of high explosive). In either case the shell must be fitted with contact fuses of extreme sensitivity. For the same muzzle velocity, the rates of fire of these two guns are 500 and 200 shots per minute and the weights are 50 and 300 kg. respec-

tively. The main difficulty for the heavier gun is the force of recoil, which amounts to 1,600 kg. against 200 kg. for the 20 mm. weapon.

On the other hand the effective range of the larger calibre is twice that of the smaller (2,000 m. against 1,000 m.). In spite of the urgent need of larger range, at the present moment only cannons of calibre 20-25 mm. are in use.

In general all these aircraft cannons have a locked breech, and recoil as a complete unit.

Only fire in the longitudinal axis (or approximately so) is generally possible. In the case of the fighter a well-tried installation is that of the Hispano cannon engine.

One of the advantages of twin-engine fighters is the fact that the fuselage nose can be adapted to carry the cannon.

In conclusion it is pointed out that the principal advantage of the cannon is the possibility of increased range. At close range the higher rate of fire of the multiple machine gun will produce better results. Long range fire requires accurate sights which thus become an essential feature of the installation.

Opinions on the Technical Aspects of the Spanish War. (D. Ludwig, W.T.M., Vol. 42, No. 10, October, 1938, pp. 456-463.) (61/8 Germany.)

In discussing the Spanish war and especially the effectiveness of certain types of weapons, it is important to remember that:—

1. The number of aircraft engaged is small.
2. The equipment in heavy artillery is well below what is generally considered necessary.
3. The territory is difficult and favours the defence.
4. The troops are not sufficiently trained to take full advantage of modern weapons.

It is therefore dangerous to make sweeping statements and the only definite conclusions which can be drawn appear to be the following:—

1. Modern weapons, to be effective, require better trained troops and greater technical knowledge in leadership than has been the case in the past. This applies especially in attack.
2. Any future war is likely to be of long duration.
3. The number of aircraft brought down by A.A. artillery greatly exceeds losses due to aerial combat. The reverse was the case in 1914-1918.
4. Fighting aircraft should have some armour protection for the pilot.
5. Defensive measures against the tank are now so successful that this weapon must now be relegated to special co-operation duties.

Thermal Effects on Bodies in an Air Stream. (W. F. Hilton, Proc. Roy. Soc., Series A, Vol. 168, No. 932, 10/10/38, pp. 43-56.) (61/9 Great Britain.)

Pohlhausen's equation for the temperature at the surface of a flat plate with a laminar boundary layer has been verified to within the limits of experimental accuracy. The theoretical temperature slope is in excellent agreement with the experimental value found near to the leading edge where the flow is probably laminar. The result near to the trailing edge is consistent with the flow being turbulent in this region. The linear relation between δT and V^2 breaks down at high speeds, due to the formation of shock waves, and an inflexion occurs in the curve. By measurements of total head in the wake, and by force measurements on the balance, it has been verified that this inflexion is caused by a shock wave. Thus thermocouples may be used to detect the presence of shock waves, and it is suggested that by placing thermocouples on models of aeroplanes, or even on actual aeroplanes in flight, the parts giving rise to shock waves could easily be found, and modified to obtain a higher top speed.

Blade Interaction in Axial Flow Turbines. (M. Sedille, Tech. Moderne, Vol. 30, 15/6/38, pp. 410-14. Eng. Absts., Vol. 1, No. 9, Section 2, Sept., 1938, pp. 128-9.) (61/10 France.)

The author observes that in axial-flow turbines, pumps, fans, or compressors in which the blades are heavily loaded and the gap, *i.e.*, the mean distance between adjacent blades, is nearly equal to or smaller than their chord-length, the interaction effect assumes appreciable proportions. He develops two approximations based upon the method of conformal transformation, by means of which the correction-factor to be applied to the lift-coefficient deduced from the circulation around the isolated blade of infinite span can be determined. In two numerical examples he calculates the interaction coefficients for a lattice composed of Joukowsky blade-sections, arranged respectively for the design of a pump and a turbine, and reproduces the resulting curves of lift-coefficients plotted to a base of angle of incidence, together with the curve of lift-coefficients of the isolated blade.

Aerodynamic Characteristics of a Large Number of Aerofoils Tested in the Variable Density Wind Tunnel. (R. M. Pinkerton and H. Greenberg, N.A.C.A. Report No. 628, 1938.) (61/11 U.S.A.)

The aerodynamic characteristics of a large number of miscellaneous aerofoils tested in the variable-density tunnel have been reduced to a comparable form and are published in this report for convenient reference. Plots of the standard characteristics are given for each aerofoil and, in addition, the important characteristics are given in tabular form. Included also is a tabulation of important characteristics for the related aerofoils reported in N.A.C.A. Report No. 460.

This report, in conjunction with N.A.C.A. Report No. 610, makes available in comparable and convenient form the aerodynamic data for aerofoils tested in the variable-density tunnel since January 1, 1931.

Aerofoil Section Characteristics as Applied to the Prediction of Air Forces and Their Distribution on Wings (E. N. Jacobs and R. V. Rhode, N.A.C.A. Report No. 631, 1938.) (61/12 U.S.A.)

The results of previous reports dealing with aerofoil section characteristics and span load distribution data are co-ordinated into a method for determining the air forces and their distribution on aeroplane wings. Formulæ are given from which the resultant force distribution may be combined to find the wing aerodynamic centre and pitching moment. The force distribution may also be resolved to determine the distribution of chord and beam components. The forces are resolved in such a manner that it is unnecessary to take the induced drag into account.

An illustration of the method is given for a monoplane and a biplane for the conditions of steady flight and a sharp edge gust. The force determination is completed by outlining a procedure for finding the distribution of load along the chord of aerofoil sections.

Operational Treatment of the Non-Uniform Lift Theory in Aeroplane Dynamics. (R. T. Jones, N.A.C.A. Tech. Note No. 667, Oct., 1938.) (61/13 U.S.A.)

Problems in aeroplane dynamics are usually treated on the assumption that the air forces are instantly adjusted to each motion of the aeroplane. Since the development of recent theories for the non-uniform motion of aerofoils, it has become possible to consider more exact laws for the adjustment of the lift.

The non-uniform lift theory has already been applied to certain dynamical problems, notably to the problem of flutter. These applications have, however, been confined either to approximate solutions or to cases in which the type of motion is prescribed beforehand. The more usual problem, in which the resulting motion is unknown, requires the solution of integral equations. The present paper shows

how solutions of these equations may be obtained fairly simply by operational methods.

The method is adapted to the determination of the lift under prescribed conditions of motion or to the determination of the motions with prescribed disturbing forces.

The Problem of Calculating Labyrinth Packing. (K. V. Chebishova, Centr. Aero-Hydrodyn. Inst., Moscow, Techn. Note No. 142, 1937.) (61/14 U.S.S.R.)

The present paper describes a method for calculating one-sided labyrinth packings, based on analysis of experimental results obtained with models of labyrinth channels.

The relationship between the coefficient for the loss in the labyrinth channel and the corresponding geometrical parameters of the latter, *i.e.*, the value a/b where a = length of channel, b = its breadth, as plotted and the experimental curve obtained characterises both the losses due to destruction of the free jet and also those occurring as a result of impact when filling out the cross section after contraction on entering the narrow part of the channel behind the labyrinth.

Examples are given to show the subsequent calculation of different types of construction of labyrinth packings, both in the form of smooth or rectangular channels, and also in the case of labyrinths with sharp-edged grids.

Several calculated graphs of general character, constructed in non-dimensional co-ordinates, illustrate the relationship between the efficiencies of labyrinth packings and their individual geometrical parameters (interspace, total length, number of sectors and edge curvature).

The Use of Vertical Pipes as an Overflow for a Large Tank. (A. M. Binnie, Proc. Roy. Soc., Series A, Vol. 168, No. 933, 25/10/38, pp. 219-37.) (61/15 Great Britain.)

The performance of vertical pipes arranged as overflows in a tank was studied experimentally on a small scale with special apparatus, which ensured that the water reached the pipe inlet with no tangential component of velocity.

Under normal conditions, the change of head with discharge was small at low heads. At this stage the flow was not rotational, but a considerable volume of air was drawn down the pipe in the form of bubbles. Above a sharply marked critical head, the pipe ran full and a large rise of head caused only a slight increase in the discharge. The effects on the critical head of lengthening the pipe and of sharpening its inlet end were comparatively small, but the insertion of a trumpet-shaped mouthpiece greatly improved the performance.

The types of flow described by Borda as free and full flow were possible with overflow pipes of uniform diameter, and they resulted in a serious reduction in the discharge.

Pressure Distribution Over an N.A.C.A. 23,012 Aerofoil with a Slotted and a Plain Flap. (C. J. Wenzinger and J. B. Delano, N.A.C.A. Report No. 633, 1938.) (61/16 U.S.A.)

Pressure-distribution tests of an N.A.C.A. 23,012 aerofoil equipped with a slotted flap and with a plain flap were made in the 7ft. by 10ft. wind tunnel. A test installation was used in which the 7ft span aerofoil was mounted vertically between the upper and lower sides of the closed test section so that two-dimensional flow was approximated. The pressures were measured on the upper and lower surfaces at one chord section both on the main aerofoil and on the flaps for several different flap deflections and at several angles of attack.

The data are presented in the form of pressure-distribution diagrams and as graphs of calculated section coefficients for the aerofoil and flap combinations and also for the flaps alone. The results are useful for application to rib and flap

structural design; in addition, the plain flap data furnish considerable information applicable to the structural design of plain ailerons.

Free-Spinning Wind Tunnel Tests of a Low-Wing Monoplane with Systematic Changes in Wings and Tails. III—Mass Distribution Along the Wings. (O. Seidman and A. I. Neihouse, N.A.C.A. Tech. Note No. 664, September, 1938.) (61/17 U.S.A.)

Eight wings and three tails, covering a wide range of aerodynamic characteristics, were independently ballasted so as to be interchangeable with no change in mass distribution. For each of the 24 resulting wing-tail combinations, observations were made of the steady spin for four control settings and of recoveries for five control manipulations, the results being presented in the form of charts comparing the spin characteristics.

For the tail with deepened fuselage, raised stabiliser, and full-length rudder, recovery was satisfactory and the results were similar to those reported for the basic-loading condition. For the tail with deepened fuselage, raised stabiliser, and short rudder, an adverse effect resulted as compared with the basic-loading results for the wings with Army tips and N.A.C.A. 23,012 or N.A.C.A. 6,718 section and for the wing with flaps. For the more nearly conventional tail, an adverse effect resulted for the wing with Army tips and N.A.C.A. 23,012 section, both with and without flaps. For the wing with N.A.C.A. 0009 section and for the Army standard wing, this loading appeared to have a somewhat favourable effect.

Tests of N. 85, N. 86 and N. 87 Aerofoil Sections in the Eleven-inch High Speed Wind Tunnel. (J. Stack and W. F. Lindsay, N.A.C.A. Tech. Note No. 665, Sept., 1938.) (61/18 U.S.A.)

Three aerofoils, the N-85, the N-86 and the N-87, were tested in the 11-inch high-speed wind tunnel at the request of the Bureau of Aeronautics, Navy Department, to determine the suitability of these sections for use as propeller-blade sections. Further tests of the N.A.C.A. 0009-64 aerofoil were also made to measure the aerodynamic effect of thickening the trailing edge in accordance with current propeller practice.

The N-86 and the N-87 aerofoils appear to be nearly equivalent aerodynamically and both are superior to the N-85 aerofoil. Comparisons of these aerofoils with the previously developed N.A.C.A. 2,409-34 aerofoil indicates that the N.A.C.A. 2,409-34 is superior, particularly at high speeds. Thickening the trailing edge appears to have a detrimental effect, although the effect may be small if the trailing-edge radius is less than 0.5 per cent. of the chord.

Longitudinal Stability in Relation to the Use of an Automatic Pilot. (A. Klemin, P. A. Pepper and H. O. Wittner, N.A.C.A. Tech. Note No. 666, Sept., 1938.) (61/19 U.S.A.)

The effect of restraint in pitching introduced by an automatic pilot upon the longitudinal stability of an aeroplane has been studied. Customary simplifying assumptions have been made in setting down the equations of motion and the results of computations based on the simplified equations are presented to show the effect of an automatic pilot installed in an aeroplane of known dimensions and characteristics. The equations developed have been applied by making calculations for a Clark biplane and a Fairchild 22 monoplane. (Extended abstract available in R.T.P.)

Aircraft Propellers of the Future. (G. W. Brady, J.S.A.E., Vol. 43, No. 4, October, 1938, p. 426, Transactions.) (61/20 U.S.A.)

The requirements of propellers of the future will include the following:—

1. Automatic synchronising control for multi-engined power plants.
2. Unlimited pitch range with low pitch, high pitch and feather pitch stops.

3. Manual selective control in addition to automatic constant speed control.
4. Pitch indicator.
5. Four or more blades for high powers with restricted diameters.
6. Improved fairing to propeller shanks on liquid cooled installations with tapered nose shapes.

In addition the possibilities of a two-speed reduction gear working in conjunction with a variable pitch propeller will require further investigation.

Progress in Aircraft Design and Efficiency. (N. A. V. Piercy, Engineering, Vol. 146, No. 3797, 21/10/38, p. 472.) (61/21 Great Britain.)

The outstanding feature of modern aircraft is high speed, *i.e.*, high wing loading. As a rough approximation, the maximum speed in m.p.h. is ten times the wing loading in lb./sq. foot. The high speed necessitates that the drag must be reduced to the utmost, not only by smoothing the surface but also by reducing interference effects. In this connection visual examination of three dimensional flow is at last coming into its own and attempts are made to establish the corresponding mathematical apparatus.

Landing and take-off still present many problems such as ground effect which have important repercussions on design.

Taken all together, however, the progress during the last few years has been very marked. Comparing a 1930 design with one of 1937, the pay load for 1,000 miles in still air has been trebled, with a 30 per cent. increase in cruising speed. The pay load expressed in ton miles per gallon of fuel has increased by 25 per cent.

Hydrodynamic and Aerodynamic Tests of Models of Flying Boat Hulls Designed for Low Aerodynamic Drag—N.A.C.A. Models 74, 74A and 75. (S. Truscott, J. B. Parkinson, J. W. Ebert, E. F. Valentine, N.A.C.A. Tech. Note No. 668, Oct., 1938.) (61/22 U.S.A.)

The tests illustrate how the aerodynamic drag of a flying boat hull may be reduced by following closely the form of a low-drag aerodynamic body and also the manner in which the extent of the aerodynamic refinement is limited by poorer hydrodynamic performance. This limit is not sharply defined but is first evidenced by an abnormal flow of water over certain parts of the form accompanied by a sharp increase in resistance, *i.e.*, " sticking." In the case of models 74A and 75, the sticking occurs only at certain combinations of speed, load, and trim and can be avoided by proper control of the trim at high water speeds.

Model 75 has higher water resistance at low speeds and lower resistance at very high speeds than does model 74A. With constant-speed propellers and high take-off speeds, it appears that the form of model 75 would give slightly better take-off performance. Model 74A, however, has lower aerodynamic drag than does model 75 for the same volume of hull.

Method for Investigating a Wing with Ailerons. (E. E. Solodkin, Centr. Aero-Hydrodynamic Inst., Moscow, Tech. Note No. 146, 1937.) (61/23 U.S.S.R.)

A theoretical method for obtaining accurate values of the rolling and yawing moments, both with symmetrical and differential positions of the ailerons, is described; this is based only on the results of tests of a wing with one aileron.

Experiments carried out at the C.A.H.I. on a rectangular wing, and also foreign experimental work, entirely corroborate the conclusions arrived at, as regards both rolling and yawing moments at angles of attack $\alpha = 25\text{-}30°$ and with the ailerons displaced by $\theta = 30\text{-}35°$. It is thus possible to simplify the selection of differential positions of the ailerons, since it can be calculated simply on the basis of results obtained with a wing with a single aileron.

The results obtained make it possible to raise the question of altering the methods by which a wing with ailerons is investigated for the purpose of determining the control moments.

International Air Traffic Accidents. (Inter. Avia., No. 589, 29/10/38, page 9.) (61/24 U.S.A.)

Year.	Miles flown (in millions)		Passengers killed		Miles flown (in millions) for one death.	
	U.S.A.	Rest of World	U.S.A.	Rest of World	U.S.A.	Rest of World
1936	73	62	46	69	1.7	.9
1935	64	49	15	47	4.2	1.0
1934	49	13	21	34	2.3	.4

It appears from the above that the United States are leading the world in flying safety, but that with the increase in flying speed there is a distinct increase in the number of fatal accidents.

Engines for Light Aeroplanes. (N. M. Tilley, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 20. Digest of Paper, National Aeronautic Meeting, Washington, D.C., March 10-11, 1938.) (61/25 U.S.A.)

Civil aviation is interested largely in the light aeroplane which, with two persons, weighs about 1,000 lb. gross. It lands below 40 m.p.h. and cruises from 70 to 90 m.p.h. This year there are a number of new small engines which should greatly improve take-off and climb, particularly for seaplanes.

Improvements in the life of the small engine has made possible the general acceptance of the light aeroplane. The increased life is due to better materials, relatively small modifications of design details, and improvements in cooling.

Adequate smoothness for this power range is given by the four-cylinder horizontally opposed type engine. There is need for efficient high-speed propellers. The common use of low-octane fuels and low landing speeds limits the compression ratio to about 5.4:1. The ell-head type is compared with the valve-in-head type. Simplicity in accessories has been the practice.

The development of the Continental A40 and A50 engines is described briefly with some indications of future performance.

Supercharging Diesel Engines. (E. D Newell, J.S.A.E., Vol. 43, No. 4, October, 1938, p. 21. Digest of Paper, National Aeronautic Meeting, Washington, D.C., March 10-11, 1938.) (61/26 U.S.A.)

Various methods of supercharging Diesel engines are discussed, together with the names of the manufacturers employing them and some typical installations. The performance of Diesel supercharged engines is compared with the same engines operating with atmospheric induction.

Three types of superchargers which derive their energy from the exhaust gases of the engines that they serve are dealt with in considerable detail, as are types of superchargers that derive their energy solely from the dynamic action of fluid columns.

In conclusion, it is observed that supercharging is not a universal remedy, but, for some applications, it can be used successfully.

Problems in the Construction of Exhaust Gas Turbines. (K. Leist, L.F.F., Vol. 15, No. 10-11, 10/10/1938, pp. 481-494. In course of translation.) (61/27 Germany.)

The characteristic differences in the design of exhaust gas and steam turbines are enunciated. The influence of lightness of construction on the power output range, the specific weight and the load factors is discussed by means of approximate equations and considerations of symmetry. A nomograph for determining the principal characteristics of exhaust gas turbines is described. The limiting gas temperature is deduced from stress measurements on materials and temperature measurements on turbine blades. These permissible limits are compared with practical exhaust gas temperatures. Various means for controlling blade tem-

perature are investigated. Modern development is towards the utilisation of uncooled exhaust gas together with means of controlling the temperature of those parts which would otherwise rise to dangerous values. It appears from experiments carried out by the D.V.L. that the passage of external air through auxiliary nozzles constitutes a practical method for cooling the blades. These nozzles are placed along the circumference of the turbine wheel between the exhaust gas nozzles and are fed with cool air from the propeller slipstream. The basis of exhaust gas turbine control is discussed.

Experiments on the Internal Cooling of Exhaust Turbine Blades, Operating at High Exhaust Temperatures. (C. Schorner, L.F.F., Vol. 15, Nos. 10-11, 10/10/38, pp. 495-499.) (61/28 Germany.)

Experiments were carried out by the D.V.L. on a stationary turbine blade fitted with various types of internal cooling passages. The cooling air was at an average temperature of 100°C. whilst the outer surface of the blade was exposed to an airstream varying between 300 and 600 m./sec. and electrically heated to 500-800°C. With internal cooling it was found possible to produce a temperature drop at the leading edge of the blade amounting up to 25 per cent. of the temperature difference between the stagnation temperature and the mean cooling air temperature.

Thus if

t_G = blade temperature without cooling.
t_W = blade temperature with cooling.
t_L = mean cooling air temperature.
$(t_g - t_W)/(t_G - t_L) = 0.25$.

For the back of the blade, this ratio could be increased to 0.50.

Applying these results to practical conditions, it appears that for turbines handling a considerable quantity of exhaust gas, exhaust temperature of the order of 850°C. may be permissible at altitude.

If compressed air is used for the internal cooling, a further increase in blade temperature to 900-950°C. is possible.

Contribution to the Theory of the Cowled Radiator Installation Functioning with Heat Input. (H. Winter, L.F.F., Vol. 15, No. 10-11, Oct. 10th, 1938, pp. 500-504.) (61/29 Germany.)

The author develops a simplified and yet sufficiently accurate method for determining the decrease in the resistance and quantity of air passing a symmetrical cowled radiator installation of streamline shape when working under conditions of heat input.

The results are also applicable to non-symmetrical aircraft installations.

Investigation of a Radiator in the Wing of an Aeroplane. (S. G. Litken, Centr. Aero-Hydrodynamic Inst., Moscow, Tech. Note No. 147, 1937.) (61/30 U.S.S.R.)

Results are given of an experimental investigation of a radiator situated in the wing of an aeroplane. The experiments were carried out both in wind tunnels and also directly on an aeroplane. The results of laboratory tests show that when the radiator mountings are suitably situated in the wing, it is possible to obtain the effect of a slotted wing.

The effect on drag of having air passing through channels situated in the wing is studied; the problem of the pressures occurring when the air does not pass through channels was also investigated.

Flight tests were carried out in a two-engined monoplane. Radiators mounted under engine cowlings of the tunnel type were transferred to the wing, with corresponding alteration to the cowling. Tests of the aeroplane with the radiator mounting in the wing showed a whole series of advantages both with regard to

the flight performance of the aeroplane and with regard to the durability and efficiency of the given radiator.

Combustion Pressures in Spark Ignition Engines. (J. J. Breeze and others, Nature, Vol. 142, No. 3600, 29/10/38, pp. 798-9.) (61/31 Holland.)

With the help of modern engine indicators (piezo electric, capacity, balanced pressure type, etc.) it appears now to be definitely established that the maximum explosion pressure in a spark ignition engine may exceed by a considerable margin that calculated from classical specific heat data (in certain cases even if no allowance for heat loss is made in the calculation).

The authors account for this by the fact that the chemical energy may be transformed directly into translatory energy of the molecules (excitation lag of Lewis and Von Elbe), this leading to a temporary reduction of the effective specific heat of the gas undergoing combustion.

Since both the pressure of the gas and the rate of heat transfer depend on the translatory energy, this may account for the mechanical and thermal damage due to detonation.

Effect of Oil Characteristics on Wear in Aviation Engines. (O. C. Bridgeman and M. L. Leidig, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 19. Digest of Paper, 1938 Annual Meeting, Detroit, Mich., Jan. 10-14, 1938.) (61/32 U.S.A.)

An analysis is reported of the general problem of wear on materials used in aviation engine cylinders and piston rings with particular reference to the effect of oil characteristics on wear. One method is described that is being used at the National Bureau of Standards for the investigation of oil characteristics on wear in aviation engines in which particular attention is given to the effect of compounding agents in decreasing wear. The growing number of variables that complicate aircraft lubrication are reviewed.

The author concludes that wear is not an inherent property, and that no wear value can be assigned to any metal which will have significance except in relation to the specific test conditions under which the wear value was obtained. He suggests that, in addition to compounding for wear control, it may be necessary or desirable to compound for reduction in ring-sticking, for high oiliness, for extreme pressure characteristics, and for protection against corrosion and rusting so that aircraft lubricants will be compounded to suit the characteristics desired.

Accessory Knock Suppressors. (L. B. Kimball, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 18. Digest of Paper, 1938 Annual Meeting, Detroit, Mich., Jan. 10-14, 1938.) (61/33 U.S.A.)

A number of accessory knock suppressors have been created since the detonation phenomenon first became a factor in automotive design.

Devices embodying various principles, such as the injection of water or exhaust gas into the carburettor, an automatic spark regulation, and carburettor-enriching devices, have made their appearance in one form or another. The last two mentioned are in common use to-day.

A system of detonation control has been developed over a period of years for the automotive and aircraft fields, comprising an accessory unit which meters required amounts of knock suppressor into the engine at the proper time. Several units have been in use on privately owned cars for several years and during the past two years they have been in regular use on many transport planes.

For aircraft use, the suppressor fluid was designed to have de-icing properties and is a very efficient carburettor and propeller de-icer. This characteristic has brought the system into the category of safety devices, in that aircraft carburettors cannot ice up on the take-off. Throttles can be left at the take-off positions for

a longer period of time in cases of emergency. The emergency controls can be used in obstinate cases of carburettor ice formation.

C.F.R. Motor Survey. (J. B. Macauley, J.S.A.E., Vol. 43, No. 4, October, 1938, p. 19. Digest of Paper, 1938 Annual Meeting, Detroit, Mich., Jan. 10-14, 1938.) (61/34 U.S.A.)

This paper is the summary report of the Co-operative Fuel Research Motor Survey Section. In the survey reported the American Petroleum Institute co-operated with the C.F.R. in obtaining the octane requirements of current model cars on the road, and in determining their vapour-handling capacity.

Octane requirements of six of the 25 1937 cars tested, corrected to 29 in hg. barometric pressure showed an average value of over 70 octane number with standard spark setting, and spark advance was found to be the principal cause of the spread encountered. A difference of 1,000ft. in altitude below 6,000ft. was found to be equivalent to a change in requirement by about three octane numbers. Vapour lock was found most likely to occur on full throttle acceleration after a stop of 5 min. following the 30 min. stabilisation run, and the vapour pressure limits of the 23 models tested ranged from 4.2 to 12.0lb. per sq. in. when corrected to standard conditions.

The report closes with the plea for the co-operation of more motor car manufacturers in the motor survey work.

Carburettor Icing. (R. Saunders, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 20. Digest of Paper, National Aeronautic Meeting, Washington, D.C., March 10-11, 1938.) (61/35 U.S.A.)

This paper reports a study of the conditions under which ice will form in an aeroplane engine carburettor, and gives the results of tests made in flight to substantiate and amplify the study. It includes a chart for pilot's use in connection with a psychrometer installation to tell when icing is to be expected.

The application of heat to intake air is considered and rules are given to guide pilots in the use of heat controls. The testing was done at Lima, Peru.

Highlights on Carburation. (F. C. Mock, E. O. Wirth and W. A. Gebhardt, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 21. Digest of Paper, National Aeronautic Meeting, Washington, D.C., March 10-11, 1938.) (61/36 U.S.A.)

An important point in selecting carburettor settings is recognition of the tolerances which must be considered when determining limits of rich and lean setting, including a 4 per cent. minimum variation in metering of any given sample between summer and winter temperatures, plus a demonstrated variation of 6 per cent. in production engines off the line, along with a ± 3 per cent. variation necessary in commercial production of the carburettor itself.

The paper then discusses actual engine mixture requirements, showing how the full-power mixture ratio is determined chiefly by distribution. The part load mixture ratio requirement, however, under which fuel economy is the main consideration, is set partly by engine friction and partly by conditions of ignition and flame propagation since, in obtaining light loads, the intake charge density is diminished while the weight of the exhaust residue remains either constant or increases.

Data are given showing that the maximum improvement which might be expected by any possible increase in atomisation and distribution with present manifold systems would amount to about 3 per cent. gain in torque, but at least a 10 per cent. reduction in fuel consumption at full load.

A description is given of recent developments in eliminating vapour lock and percolation with high volatility petrols, as well as of other recent developments.

Increase in Viscosity of a Mineral Oil at Rest. (A. Marcelin, Comp. Rend., Vol. 207, No. 15, 10/10/38, pp. 616-618.) (61/37 France.)

A steel ball 15 mm. diameter runs down a groove in an inclined plane and enters a horizontal trough 20 cm. long and 2 cm. wide covered with a film of oil approximately 1 mm. deep.

The length of run before the ball comes to rest is a measure of the viscosity of the oil.

The author notes the following experimental results:—

1. If the oil film on the trough has been freshly formed, using well stirred oil, a definite reproducible length of run for the ball is obtained. If now the oil film is allowed to stand several hours, a new set of values are obtained, the run being about 25 per cent. shorter than before. This new value will be maintained for several days.
2. If, however, repeated tests are carried out with the "aged" oils at intervals of two minutes, the longer runs corresponding to the fresh oil are gradually reproduced and maintained.

The author explains these phenomena by absorption of the polar oil molecules by the metal. This absorption takes time and this accounts for the shorter runs obtained after six hours. Repeated runs of the ball will, however, flatten out the polar chains and thus reduce the resistance.

Characteristics of Insulating Oils Under Constant Temperature and Humidity. (H. Hirai, Electrotechnical Journal, September, 1938, pp. 206-9. Metropolitan Vickers Techn. News Bulletin, No. 631, 21/10/38, p. 4.) (61/38 U.S.A.)

It is shown experimentally that, when insulating oil, free from air and moisture, is kept in a container of constant temperature and humidity, the quantity of air absorbed by it is greatly affected by the humidity of the air, and it has been assumed that the main cause of the gradual decrease in the dielectric strength of oil corresponding to the duration of exposure is the moisture absorbed by the oil. It is also stressed that, in order to solve a problem of this nature, it is essential to study the process by which air and moisture are absorbed by the oil and the conditions and characteristics of the air and moisture after absorption. Illustrated with eleven diagrams.

Air Track System of Aircraft Instrument Landings. (G. L. Davies, J.S.A.E., Vol. 43, No. 4, October, 1938, p. 18. Digest of Paper, 1938 Annual Meeting, Detroit, Mich., Jan. 10-14, 1938.) (61/39 U.S.A.)

The air track is a system embodying all the basic principles proved by the Bureau of Standards and meeting all the specifications set up by the air lines. The ground equipment comprises ultra-high frequency visual localiser, glide path, and marker beacon transmitters, all crystal controlled, together with a monitor and remote control system assuring proper indications in the aeroplane. The localiser and glide path transmitters are mounted in a trailer so that they may be located in the best position for the wind conditions existing at the time of use, and will not constitute a hazard when not in use.

Immediate installation of instrument landing equipment is desirable, not only from the standpoint of safety, but to begin the accumulation of operating experience which alone will permit lowering of present minimums and increased regularity of service.

Relief of present congestion at busy airports in bad weather is another important function of instrument landing equipment, and it may be expected reasonably that the traffic handling capabilities of airports will be increased from 25 to 50 per cent. in bad weather by the addition of landing systems. Further progress in instrument landing technique is up to the air lines themselves, as actual operating experience is now lacking.

Ground Training for Instrument Flying. (C. J. Crane, J.S.A.E., Vol. 43, No. 4, 1938, p. 20. Digest of Paper, National Aeronautic Meeting, Washington, Washington, D.C., March 10-11, 1938.) (61/40 U.S.A.)

Instrument flying, sometimes known and referred to as " blind " flying, requires careful preparation in the technique of execution. This technique is built up from the classical demonstration of Ocker and Meyers evolved in the year 1926. From that time various ground devices have been built to assist the airman to master the various intellectual processes combined with physical reactions which may become so complex during an instrument flight along the airways of the United States under aggravated weather conditions, especially those which do not provide the pilot of the aeroplane with the ability to see ground or celestial objects.

Indeed, not only ground training devices, such as the link trainer, but also certain flight training devices which prepare the pilot to master the science of instrument flying are necessary.

Plotted Transport Flight Plan. (A. A. Barrie, J.S.A.E., Vol. 43, No. 4, Oct., 1938, p. 20. Digest of Paper, National Aeronautic Meeting, Washington, D.C., March 10-11, 1938.) (61/41 U.S.A.)

This paper deals with the history of the practical application of the information acquired during the development of the optimum flight path theory.

The flight of an airliner from point of origin to destination is divided into five operations, assuming that the airliner is equipped with an automatic carburettor and constant speed propellers. Practical limiting factors that were found to exist in all five classifications except one are discussed. The paper explains how the accurate information of existing conditions necessary to develop a plotted transport flight plan was obtained.

It is explained how, by means of this flight plan, the altitude, the estimated flying time from point of origin to destination, and the estimated time of arrival over intermediate points could be predicted in advance with a great degree of accuracy. Actual flight examples of the operation of this plan are cited.

The Siemens Electron Microscope. (Engineering, Vol. 146, No. 3797, 21/10/38, pp. 474-475.) (61/42 Germany.)

In the case of an optical microscope, the maximum possible magnification is limited to about 2,000 diameters since the resolving power is limited by the wave-length of the light.

The wave-length of the wave system accompanying an electron is very much shorter than even ultra-violet light. A beam of electron can be focused by an electro-magnetic " lens " and, by suitable arrangements of two coils, it is possible to reproduce the equivalent of a microscope which will detect particles as small as 100 or even 10 Ångstrom units. With an optical microscope, on the other hand, the smallest visible object is of the order of 3,000 Ångstrom units ($1\ AU = 10^{-7}$ mm.).

The electron microscope illustrated has a useful magnification of the order of 30,000 diameters and interesting photographs of micro-culture taken with this instrument are given. The new technique will also be useful in the general examination of materials, such as the grinding process and abrasive wear.

N.A.C.A. Stall Warning Indicator (Inter. Avia., No. 590, 2/11/38, p. 5. See also N.A.C.A. Tech. Note No. 670, 1938.) (61/43 U.S.A.)

The instrument makes use of a pitot static head set close to the wing surface in a region where stalling occurs at an angle of attack considerably below that at which the main portion of the wing stalls.

As a result of a local stall the dynamic pressure drops sharply and a pressure cell closes an electric circuit operating a warning device. In certain cases a

reference region (liable to stall early) is already known on the wing. In the majority of cases, this region must be produced artificially, *e.g.*, by fitting a small portion of the wing nose with a projecting edge.

In general two pressure heads are installed, one near each wing tip in order to allow for asymmetry of the angle of attack when banking. The device may be of special importance for highly manœuvrable fighter aircraft, which, during sharp turns and loops, may stall already at $2\frac{1}{2}$ times the minimum flying speed of the aircraft V stall $= V$ min. $\sqrt{}$ (load factor).

The Absolute Wireless Altimeters. (H. W. Roberts, Aero Digest, Vol. 32, No. 11, November, 1938, pp. 87-105.) (61/44 U.S.A.)

An instrument developed jointly by Western Electric Company Bell Telephone Laboratories and United Air Lines is briefly described. The altimeter is based on U.S. patents No. 2,043,071/2 and has undergone preliminary flight tests, although it is stated that a commercial form will not be available for some time. The present weight for a 5 watt installation is over 50lb.

The altimeter measures indirectly the time lag between direct and ground reflected wave indirectly by a method of beats. For this purpose the frequency of the radiated wave is altered over wide limits at a constant rate (80/sec.) by means of a motor driven variable condenser.

The frequency variation is linear (saw tooth pattern) and both direct and reflected wave have identical pattern and the amount of shift (difference in frequency) is a function of the altitude. This difference in frequency is measured by " beating " the direct and reflected wave. The number of beats is equal to the number of cycles through which the oscillator is varied for each condenser sweep multiplied by the number of sweeps per second and divided by the frequency interval through which the oscillator must be varied for one beat.

The system thus depends only on the instantaneous difference between the frequencies of the direct and reflected waves as measured by the beats and can be calibrated directly in feet.

Experiments are also in hand to direct the beam forward to act as a collision warning indicator.

Creep of Solid Cylinders in Torsion. (M. C. Fetzer, Trans. Amer. Soc. Metals, Sept., 1938, pp. 850-83. Metropolitan Vickers Tech. News Bulletin No. 629, 7/10/38, p. 7.) (61/45 U.S.A.)

Short time tests (up to thirty-five hours) were made on 0.10 and 0.25 per cent. carbon steels in several conditions. Creep rates were measured during the third to sixth, fifth to tenth and twenty-fifth to thirty-fifth hours by the method of Pomp and co-workers. An attempt was then made to correlate creep rates in torsion with creep rates in tension, using for the latter data from Pomp and Hoger on similar steels. The comparisons showed that the shear creep rate in tension is faster than in torsion for the same shear stress, and it is suggested that this is due to the greater availability of slip planes in tension.

Illustrated with 11 photographs, 13 diagrams and four tables.

The Metalastik Process. (Machinery, 29/9/38 pp. 819-20. Metropolitan Vickers Tech. News Bulletin No. 629, 7/10/38, p. 9.) (61/46 Great Britain.)

The process used by Metalastik, Ltd., for the bonding of rubber to any metal, involves the plating of the metal successively with copper and brass and then bonding and vulcanising simultaneously in steel moulds. The feature of mountings using this process is that there is no metal-to-metal contact and hence vibration transmission is at a minimum. The applications of this process are numerous and one example is given showing Metalastik mountings for a large press installation. The above firm also make dynamic stabilisers and flexible couplings based on the bonding of rubber to metal.

Illustrated with three photographs and one diagram.

Welding of Silicon Steels. (W. Spraragen and G. E. Clausser, Welding Journal, Sept., 1938, Suppl., pp. 1-7. Metropolitan Vickers Tech. News Bull., No. 628, 30/9/38, p. 7.) (61/47 Great Britain.)

The authors review the literature on the above subject to July 1st, 1937, and deal with the physical properties of arc welds in silicon steel. Such welds possess excellent tensile strength, but have poor fatigue characteristics. Further aspects covered by this article are recovery and pick-up, fusion welding properties, resistance welding, forge welding and flame cutting. Finally some problems are put forward suggesting a basis for future research. Illustrated with nine tables.

Strength of a Riveted Steel Rigid Frame having Straight Flanges. (A. H. Stang, M. Greenspan and W. R. Osgood, Bur. Stan. J. Res., Vol. 21, No. 3, Sept., 1938, pp. 269-313.) (61/48 U.S.A.)

The distribution of stress in and near the knee of a riveted steel rigid frame specimen having straight flanges was investigated both experimentally and theoretically for various conditions of loading. The theory developed for the distribution of stress in the knee gave stresses which agreed within the experimental error with those obtained experimentally. Reinforcing the outer corner was shown to have little effect on the stress distribution in the frame. The maximum load that could be sustained by the specimen was determined.

Electronics in the Production and Fabrication of Steel. (E. H. Vedder, Electric J., September, 1938, pp. 339-41. Metropolitan Vickers Tech. News Bulletin, No. 630, 14/10/38, p. 8.) (61/49 Great Britain.)

The rapid response of electronic devices renders them specially suitable for many control purposes and in this article applications are described which utilise this property. A description is given of a device known as the " Weld-o-trol " which controls the current in the primary of the welding machine transformer by means of two ignitions, claimed to interrupt currents of thousands of amperes at rates as high as 700 times per min. Other applications receiving examination are the timing of flying shear apparatus and the detection by means of photo-electric devices of holes as small as $\frac{1}{16}$ inch diameter in steel strip moving at high speed. Illustrated with four photographs and two diagrams.

A Dynamic Damper for Torsional Resonance. (Schweizerische Bauzeitung, Vol. 3, 11/6/38, p. 303. Eng. Absts., Vol. 1, No. 9, Section 2, September, 1938, pp. 129-30.) (61/50 Germany.)

Dampers depending upon solid or liquid friction entail loss of energy and the production of heat at inconvenient points, and with slowly-running motors their dimensions must be large. The author describes a new damper consisting of a number of pendulums bolted on a face-plate normal to the shaft; the added weight is negligible in comparison with their damping effect. Dimensions for counter-resonance can be calculated by treating the pendulum itself as resonant, *i.e.*, $n^2r=R$, where r denotes the reduced radius of the pendulum and R its distance from the axis of rotation. Since r and R necessarily remain fixed, the apparatus is completely effective for only one critical speed. This is due to the fact that for a pendulum the resonance-velocity is proportional to the root of the restoring force, which, however, being centrifugal force, is proportional to the square of the rotational velocity, so that the pendulum's own frequency is proportional to the speed of the shaft. In practice r can be only a few mm., with consequent restricted rotational moment of inertia. The heart of the device is in the use of a pendulum hung on double pins, when, by simple mechanics, it behaves as though on an arc of radius $(r_2-r_1)/^2$ which can be varied within wide limits. A graph for a six-cylinder 300 h.p. Diesel engine with and without this pendulum damper illustrates its remarkable efficiency.

Gear Cutting on Non-Circular Wheels. (K. Hoecken, Maschinenbau, Vol. 17, July, 1938, pp. 349-50. Eng. Absts., Vol. 1, No. 9, Section 2, Sept., 1938, pp. 136-7.) (61/51 Germany.)

The author observes that the application of non-circular wheels for the transmission of variable speeds is frequently rejected owing to the difficulty of cutting the teeth; and although in some instances steel tapes may be used as a substitute, limitations of size and of durability render them undesirable. He has, therefore, devised a method by means of which any shape of wheel can be toothed under mass production conditions with complete accuracy and with generated tooth profiles. The method consists in rolling an enlarged blank attached to one corner of a pantograph, along a base-line, whilst the blank to be cut is rolled along a parallel line which is on the pitch-cylinder of the rack-sectioned hob used to cut the teeth. The blank to be cut is mounted on the extended limb of the pantograph, and the latter is pivoted at a point between the two blanks in the ratio of their dimensions. The enlarged blank is rolled by steel tapes and held against the base-line by a cord weighted over a pulley; the smaller blank to be cut is rotated by chain gearing coupled to the enlarged blank. In order to relieve the mechanism of load the work is clamped by a magnetic chucking device; the feeding and clamping are alternate and intermittent. The author illustrates examples of gears cut by his device; one of these, for radio work, has the larger wheel duplicated and staggered by a tension-spring to avoid backlash. A bibliography is appended to the article.

Crankshaft Damping. (N. S. Stern, Autom. Eng., October, 1938, pp. 360-2. Metropolitan Vickers Tech. News Bulletin, No. 631, 21/10/38, p. 1.) (61/52 Great Britain.)

One of the most important applications of the " Metalastik " process for bonding rubber to metal is in the manufacture of dampers for shafts subjected to vibrations. The author discusses the construction of the damper, characteristics of the vibrating element required before design can be commenced and the efficiency of the damper when applied to a crankshaft running at a critical speed. Although the rubber spring in the damper is not called on to transmit torque, results show the strength of the bonding equal to any stresses likely to be created by torsional oscillations of the " floating " steel ring. Illustrated with three photographs and 12 diagrams.

Electrically Welded Joints (Part III). (A. L. Hale, Welding Journal, October, 1938, pp. 317-20. Metropolitan Vickers Tech. News Bulletin No. 631, 21/10/38, p. 7.) (61/53 Great Britain.)

The author discusses the internal residual stresses in a " V " shaped weld subjected to partial and complete restraint, and also the removal of internal stresses by the application of a uniform tensile force. The author also examines the question of plastic deformation and the neutralisation of residual stresses by external loading arising out of the practical application of a structure. Illustrated with seven diagrams.

Plastics and Electrical Insulation. (L. Hartshorn, N. J. L. Megson, E. Rushton, Journal of the Institute of Electrical Engineers, October, 1938, pp. 474-87. Metropolitan Vickers Tech. News Bulletin, No. 631, 21/10/38, p. 7.) (61/54 Great Britain.)

This paper was submitted to a joint meeting of plastics chemists and electrical engineers as a contribution to a general survey of the field in which their activities meet. The following are discussed in the paper: (*a*) dielectrics and the factors which represent their value to the electrical engineer; (*b*) the various synthetic plastics now available and such of their properties as are of importance in electrical practice, with some general conclusions as to the lines of research which

may be expected to yield results profitable to both the industrial chemist and the electrical engineer. An experimental investigation was made into the way in which the electrical properties of synthetic resins of the bakelite type may be affected by chemical and physical factors. Illustrated with seven diagrams and three tables.

Industrial Application of Spiral Bevel Gears and Hypoid Gears. (A. H. Candee, Trans. A.S.M.E., Vol. 60, No. 7, Oct., 1938, pp. 549-560.) (61/55 U.S.A.)

The paper includes a definition of terms and a general comparison of spiral bevel gears and hypoid gears with other types. The features and advantages peculiar to each type are discussed as are also tooth contact conditions, elements of good and bad design, the importance of accurate mounting and assembling, size range and ratios, materials, and lubrication.

Numerous illustrations of equipment used in gear manufacture are shown and also photographs of applications of both small and large sizes in various fields.

Specific Heat Temperature Curves of Some Age Hardening Alloys. (N. Swindells and C. Sykes, Proc. Roy. Soc., Series A, Vol. 168, No. 933, 25/10/38, pp. 237-63.) (61/56 Great Britain.)

The changes in atomic configuration taking place during hardening affect the apparent specific heat of age-hardening alloys. Specific heat-temperature curves and hardness measurements have been obtained on five typical age-hardening alloys.

The results show that in certain cases, *e.g.*, the silver-copper and copper-beryllium alloys, maximum hardness is attained when the major portion of the chemical energy associated with the supersaturated solid solution has been evolved, *i.e.*, precipitation has taken place. In other cases, duralumin and aluminium-copper alloys, maximum hardness is associated with segregation of the solute atoms in the parent lattice prior to precipitation.

Stability of the Viscose Type of Ozaphane Photographic Film. (A. M. Sookne and C. G. Weber, Bur. Stan. J. Res., Vol. 21, No. 3, Sept., 1938, pp. 347-52.) (61/57 U.S.A.)

Viscose Ozaphane, a new type of film with a base of regenerated cellulose sheeting, and having certain advantages for record use, was tested to determine its comparative stability. Its stability was compared with that of cellulose nitrate, and also with that of cellulose acetate, which is widely used for film-slides, and which has been found to be a very stable material for preserving records in libraries. The viscose type of film apparently is not suitable for permanent records, but does appear to have properties to recommend its use for reading-room copies that can be replaced when they become unserviceable. The stability was determined by measuring changes in its chemical and physical properties under accelerated ageing. The changes observed were increase in acidity and copper number, and decrease in viscosity, weight, and flexibility.

Photographic Sensitivity and the Reciprocity Law at Low Temperatures. (W. F. Berg and K. Mendelssohn, Proc. Roy. Soc., Series A, Vol. 168, No. 933, 25/10/38, pp. 168-75.) (61/58 Great Britain.)

1. Photographic materials show an appreciable sensitivity down to 20°K. Little change occurs when the temperature is dropped from 90°K. to 20°K. The main difference is a drop in contrast and a maximum density.

2. No reciprocity failure occurs at temperatures of 90°K. and 20°K.

3. It is suggested that at these temperatures the latent image is formed in two distinct stages: (*a*) an electronic process in which the electrons are separated from the bromine ions absorbing the light, and freeze into the lattice, and (*b*) an ionic process, taking place on warming up, consisting of a movement of the silver and probably also the bromine atoms.

The Properties of Glass for Heat Insulation. (Mech. Welding, 7/10/38, pp. 341-2. Metropolitan Vickers Tech. News Bulletin No. 630, 14/10/38, p. 4.) (61/59 Great Britain.)

The process of extruding molten glass, collecting it and working it into blanket form for insulation purposes is described. The article continues by discussing the size of fibre, the cause of oversize diameter and its effect on quality. Finally the characteristics of glass fibre insulation are examined and some details of the method of application given with the different external finishes for use under various conditions. Comparison with other insulating materials reveals glass to advantage over a range 250°F. to 300°F. although temperatures as high as 1,000°F. are permissible. Illustrated with one photograph, one diagram and one table.

Resistance and Heat Transfer in Bundles of Tubes. (R. Javerick, Die Warme, 8/10/38, pp. 738-43. Metropolitan Vickers Tech. News Bulletin No. 631, 21/10/38, p. 10.) (61/60 Germany.)

The author extends to high Reynolds numbers the existing equations for the resistance and heat transfer in bundles of tubes. He determines the proportion of the resistance and the heat transfer applicable to the individual series of tubes in the bundle, and also the distribution of the resistance and heat transfer over the depth of the individual tubes in the bundle. The article is to be concluded. Illustrated with five diagrams and two photographs.

Position Finding by Wireless. (W. Immler, L.F.F., Vol. 15, No. 8, 20/8/38, pp. 409-425.) (61/61 Germany.)

The various methods which have been developed for wireless position finding since the introduction of wireless are reviewed, and critically examined as to their relative suitability for large, medium and small distances.

Special map projections utilised to facilitate the work are described. In addition, the following factors are considered:—

(1) Elliptic shape of the earth,
(2) The error equations of directional wireless,
(3) Variation of errors with time of day,
(4) Homing flight,
(5) Errors due to the antenna.

Synopsis

1. Introduction.
2. Bearing and position line.
3. The orthodrome and azimuth position line.
4. Position finding from bearings obtained at a ground station.
5. The geometrical properties of the azimuth position line.
6. Weir's azimuth diagram.
7. Graphical representation of azimuth line in the polar zone.
8. Calculation of azimuth line.
9. Replacement of azimuth line by a loxodrome.
10. The azimuth line in conical co-ordinates.
11. The spheroidal (elliptic) azimuth line.
12. Lines of constant azimuth difference.
13. Errors in wireless position finding.
14. Variation of errors with time of day.
15. The navigation for homing flight.
16. Antennæ error.
17. Bibliography (73 items).

The Iodine Accumulator. (C. M. R. Balbi and R. S. H. Boulding, Electrical Review, 30/9/38, pp. 447-8. Metropolitan Vickers Tech. News Bulletin No. 629, 7/10/38, p. 5.) (61/62 Great Britain.)

This accumulator has a carbon anode and a zinc cathode whilst the electrolyte is a solution of zinc iodide. One of the difficulties associated with the practical application of this accumulator was due to the necessity for good adherence of iodine to the carbon anode. It is stated that this has now been overcome by the use of porous carbon around the anode. Most of the characteristics of this accumulator are given and a favourable comparison is made with lead and nickel cadmium types of accumulator. Some examples of the possible uses of the iodine accumulator are set forth. Illustrated with three photographs, three diagrams and one table.

A Method for the Investigation of Upper Air Phenomena and its Application to Radio Meteorography. (H. Diamond, W. S. Hinman and F. W. Dunmore, Proc. Inst. Rad. Eng., Vol. 26, No. 10, October, 1938, pp. 1235-65.) (61/63 U.S.A.)

Experimental work conducted for the United States Navy Department on the development of a radio meteorograph for sending down from unmanned balloons information on upper-air pressures, temperatures, and humidities, has led to radio methods applicable to the study of a large class of upper-air phenomena. The miniature transmitter sent aloft on the small balloon employs an ultra-high-frequency oscillator and a modulating oscillator; the frequency of the latter is controlled by resistors connected in its grid circuit. These may be ordinary resistors mechanically varied by instruments responding to the phenomena being investigated, or special devices, the electrical resistances of which vary with the phenomena. The modulation frequency is thus a measure of the phenomenon studied. Several phenomena may be measured successively, the corresponding resistors being switched into circuit in sequence by an air pressure-driven switching unit. This unit also serves for indicating the balloon altitude. At the ground receiving station a graphical frequency recorder, connected in the receiving set output, provides an automatic chart of the variation of the phenomena with altitude. The availability of a modulated carrier wave during the complete ascent allows of tracking the balloon for determining its azimuthal direction and distance from the receiving station, data required in measuring the direction and velocity of winds in the upper air.