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. 87. February, 1941.

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

List of Abbreviations of Titles and Journals.

A.	Abstracts from the Scientific and Technical Press.
Aeron. Eng.	Aeronautical Engineering (U.S.S.R.).
Aer. Res. Inst. Tokyo	Aeronautical Research Institute of Tokyo.
A.C.I.C.	Air Corps Information Circular.
Ann. d. Phys.	Annalen der Physik
Army Ord.	Army Ordnance.
Autom. Eng.	Automobile Engineer
Autom. Ind.	Automotive Industries.
Autom. Tech. Zeit. ...	Automobile Technische Zeitschrift.
Bell Tele. Pubs. ...	Bell Telephone Publications.
Bur. Stan. J. Res. ...	Bureau of Standards (U.S.A.) Journal of Research.
Chem. Absts.	Chemical Abstracts.
Chem. and Ind. ...	Chemistry and Industry.
Comp. Rend.	Comptes Rendus de L'Académie des Sciences.
Eng. Absts.	Engineering Abstracts.
E.N.S.A.	Revenue Technique de l'Association des Ingénieurs de l'Ecole Nationale Supérieure de L'Aéronautique.
Forschung	Forschung auf dem Gebiete des Ingenieurwesens.
Fuel	Fuel in Science and Practice.
H.F. Technik.	Hochfrequenztechnik und Electroakustik.
Ind. and Eng. Chem. ...	Industrial and Engineering Chemistry.
Ing.-Arch.	Ingenieur-Archiv.

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

Wind Tunnel Tests of an N.A.C.A. 23021 *Aerofoil Equipped with a Slotted Extensible and a Plain Extensible Flap.* (T. A. Harris and R. S. Swanson, N.A.C.A. Tech. Note No. 782, November, 1940.) (87/1 U.S.A.)

An investigation has been made in the N.A.C.A. 7 × 10ft. wind tunnel of a large-chord N.A.C.A. 23021 aerofoil equipped with two arrangements of a completely extended 15 per cent. chord extensible flap. One of the flaps had a faired junction without a gap; the other was provided with a slot between the trailing edge of the aerofoil and the nose of the flap. Complete aerodynamic section characteristics are presented for the various flap deflections for both arrangements in the completely extended position.

The results showed that the basic aerofoil gave the lowest profile-drag coefficients over the low lift range; the aerofoil with the plain extensible flap gave the lowest profile-drag coefficients over the high lift range. The aerofoil with the slotted extensible flap had the same maximum lift at a flap deflection of 25 degrees as the aerofoil with the plain extensible flap had at a flap deflection of 60 degrees. The results of comparisons of the aerofoil pitching moment coefficients obtained with the two types of flap depend upon the basis chosen for comparison.

The Application of Basic Data on Planing Surfaces to the Design of Flying Boat Hulls. (W. S. Diehl, N.A.C.A. Report No. 694, 1940.) (87/2 U.S.A.)

Basic lift data on planing surfaces have been analysed and the data applied to the design of flying boat hulls. It is shown that a balance between air and water forces requires that the beam of the planing area bear a relation to the wing area that is determined by the lift coefficient of the wing and by the angle of dead rise in the planing surface. It is also shown that the fore-and-aft extent of the required planing area depends on the angle of dead rise. Failure to provide sufficient length of planing area appears to be the main reason for the poor water performance sometimes obtained when a large angle of dead rise is used.

Wind Tunnel Investigation of Fuselage Stability in Yaw with Various Arrangements of Fins. (H. P. Hoggard, N.A.C.A. Tech. Note No. 785, Nov., 1940.) (87/3 U.S.A.)

An investigation was made in the 7 x 10ft. wind tunnel to determine the effects of dorsal-type fins and of various arrangements of fins on the aerodynamic characteristics of a streamline circular fuselage. Comparative plots of the aerodynamic characteristics of the fuselage alone and the fuselage with various fin arrangements are given to show their effects on coefficients of yawing moment, drag and lateral force. Results are also given for one case in which a rear fin on a circular fuselage was faired with modelling clay to obtain a fuselage shape with the same side elevation as the fuselage with the unfaired fin, but with an elliptical cross section over the rearward portion of the fuselage.

The results indicated that fin area to the rear of the centre of gravity of the fuselage was beneficial in reducing the magnitude of the unstable yawing moments at large angles of yaw; whereas, fin area forward of the centre of gravity was harmful. The dorsal-type fin was more effective for increasing the yawing stability of the fuselage than was a smoothly faired rearward portion with the same side elevation as the fuselage with the unfaired dorsal-type fin. The minimum drag coefficient and the slope of the curve of yawing moment coefficient of the fuselage at zero yaw were unaffected by the addition of the fins, within the experimental accuracy of the tests.

Stainless Steel for Aircraft Structures. (H. W. Perry, Aircraft Production, Vol. 2, No. 2, Feb., 1940, pp. 35-7.) (87/4 U.S.A.)

Fleetwings Inc. U.S.A. has specialised during the last ten years in the development and production of stainless steel aeroplane wings, control surfaces, fuel tanks and complete amphibian aircraft. Recent products include full cantilever-type wings and control surfaces for Seversky pursuit planes, and wing-tip floats for the Douglas Dolphin seaplane. Also, the Fleetwings Sea Bird amphibian has a basic structure made entirely from stainless steel. Owing to the high strength-weight ratio of steel, the thickness required for equal weight and greater strength of a structure is only one-third that of an aluminium alloy. Full advantage of this can be taken in large structures, such as flying boats, in which the thicker gauges of metal can be used. In smaller craft the minimum thickness is determined by handling qualities and stiffness under compression. The high electrical resistance, low heat conductivity, and hard, clean surface of stainless steel, are particularly advantageous for rapid and economical production by the spot-welding process and for the strength of the joints so made. Since fusion spot-welds add no weight, and those in stainless steel are of small diameter, welds can be made in small outstanding flanges of widths as small as $\frac{1}{8}$in.

Since the very thin gauges in steel sheet have low lateral stiffness, relatively wide flat pitches are avoided by use of corrugated sheet or of channel sections with flanges, welded to flat sheets to produce closed box beams, stringers or stiffeners. The technique developed for employing corrugated sheet in the construction of wings and fuel tanks is described. A special welding technique, employing a machine capable of making 960 spot-welds per minute, has been developed.

Curtiss Propeller Production—including the Hollow Steel Bladed Propeller. (Aviation, Vol. 39, No. 10, Oct., 1940, pp. 42-3, 110-12.) (87/5 U.S.A.)

Each blade is cut in two parts from steel plates tapering in thickness from $\frac{3}{8}$in. to approximately $\frac{1}{16}$in. One section forms the curved part of the blade and the the shank, the other forms the flat or thrust face of the blade. After shaping by means of forming dies, the sections are welded together by the atomic hydrogen method. The welded product is immediately heated to 1,700°F. in the electric furnace to remove welding strains, the hub or shank end is turned, and the blade is rough finished. Heat treatment at 1650°F. and oil quenching are followed by three hours in an electric furnace at 1,000-1,100°F. The final physical properties are as follows:—Elastic limit 125,000 lb./sq. in.; ultimate strength 138,000-154,000 lb./sq. in.; elongation 12-15 per cent.; reduction of area 57-62 per cent.

The hollow construction makes it possible to obtain correct vertical and horizontal balance by application of metal within the blade.

Internal Flow Systems for Aircraft. (F. M. Rogallo, N.A.C.A. Tech. Note No. 777, Oct., 1940.) (87/6 U.S.A.)

An investigation has been made to determine efficient arrangements for an internal flow system of an aircraft when such a system operates by itself or in combination with other flow systems. In addition to a theoretical treatment, some experiments on flat plates and wings provided with inlet and outlet openings were also carried out in the N.A.C.A. 5ft. vertical wind tunnel.

When an internal flow system tends to decrease the final velocity of its wake, the results show that it should be arranged in series with the propulsive system. In this case the inlet should be located at a forward stagnation point, and the outlet opening should be so shaped and located so as to recover the kinetic energy of the jet without increasing the drag of other portions of the aircraft. When an internal flow system tends to increase the final velocity of its wake, as does a propeller, location of the inlet opening in the boundary layer or in the wake of the wing or fuselage may be desirable. A narrow slot inlet opening in a region where the boundary layer is relatively thick appears promising and justifies further investigation.

If the quantity of air required is, however, large, the boundary layer supply will probably be insufficient and a location at the forward stagnation point may be found to be the most efficient.

As regards duct design, the author's recommendations may be briefly summarised as follows:—

(1) High velocities and abrupt changes of shape or area of cross-section must be avoided (except at the outlet).

(2) No throttling devices should be placed within the duct. Regulation at the outlet is practicable and efficient.

(3) Leakage losses must be eliminated at all cost, and all internal flow systems (including cabins) should be tested periodically for tightness.

A Flight Investigation of Exhaust Heat De-icing. (L. A. Rodert and A. R. Jones, N.A.C.A. Tech. Note No. 783, Nov., 1940.) (87/7 U.S.A.)

The National Advisory Committee for Aeronautics has conducted exhaust-heat de-icing tests in flight to provide data needed in the application of this method of ice prevention. The capacity to extract heat from the exhaust gas for de-icing purposes, the quantity of heat required, and other factors were examined. The results indicate that a wing-heating system employing a spanwise exhaust tube within the leading edge of the wing removed 30 to 35 per cent. of the heat from exhaust gas entering the wing. Data are given from which the heat required for ice prevention can be calculated. Sample calculations have been made on a basis of existing engine power/wing area ratios to show that sufficient heating can be obtained for ice protection on modern transport aeroplanes, provided that uniform distribution of the heat can be secured.

Mechanism of Flutter: A Theoretical and Experimental Investigation of the Flutter Problem. (T. Theodorsen and I. E. Garrick, N.A.C.A. Rept. No. 685, 1940.) (87/8 U.S.A.)

The basic flutter theory devised in 1934, and originally published as N.A.C.A. Report No. 496, is presented in a simpler and more complete form. This paper attempts to facilitate the judgment of flutter problems by a systematic survey of the theoretical effects of the various parameters. A large number of experiments have been conducted in the N.A.C.A. high-speed wind tunnel for the purpose of verifying the theory and studying its adaptability to three-dimensional problems. The experiments included studies on wing taper ratios, nacelles, attached floats and external bracings. General conclusions are as follows:—1. The two-dimensional theory has been verified within the limits of error in the determination of the primary parameters. 2. The most essential three-dimensional effect is the occurrence of distinct flutter bending modes, which differ from the ordinary vibration modes in that they tend to assume a form which approaches the next higher vibration mode and exhibit a correspondingly higher frequency. The flutter speed is consequently lower than that calculated on the basis of the lowest vibration frequency and the flutter frequency itself is higher. For ordinary damped structures this effect lowers the flutter speed calculated on the basis of the lowest bending mode by only a few per cent. 3. A cantilever wing flutters at a speed calculated by using the constants for the most representative section, situated at about three-quarters of the semi-span. 4. Aspect ratio and structural damping effects tend to increase the flutter speed by a few per cent. above that calculated for infinite aspect ratio and zero internal damping. 5. The effect of mass balancing to bring the centre of gravity forward is essentially as predicted by theory. The effect of nacelles is of lesser importance, but large weights located at some distance away from the wing and attached to it show a very detrimental effect on wing flutter. 6. Wing-aileron experimental studies show that the characteristic flutter range predicted by theory exists and is in substantial agreement with the predicted values.

Structural Tests of a Stainless Steel Wing Panel by Hydrostatic Loading. (R. H. Upson, N.A.C.A. Tech. Note No. 786, Nov., 1940.) (87/9 U.S.A.)

A simplified type of all-metal wing construction of 18-8, spot-welded except for the skin attachment, was tested by means of hydrostatic loading, the wing being proportioned to permit close representation of typical conditions by means of the waterhead.

The general principle of design was to apply the skin on the wing under controlled initial tension and to utilise a finite internal pressure in flight. The initial tensioning was found to be an essential factor and the internal pressure in flight an important factor, although neither was critical with respect to small variations.

The results showed the possibility of eliminating almost all of the stiffeners from a stressed-skin wing, the possible reduction of weight in a lightly loaded wing and of substantial cost in the construction of any all-metal wing. Further experiments are suggested, however, on the magnitude and the effect of slight surface irregularities, and on the contribution of the complete wing-tip. A discussion of these suggested experiments is not included in the present paper.

With certain recommended improvements, the test method described is believed to be a valuable one for research on any new type of wing construction, particularly in cases where the covering, regardless of material or arrangement, is questionable.

Oscillation of Castoring Wheels. (J. L. Taylor, Aircraft Engineering, Vol. 13, No. 143, Jan., 1941, p. 13.) (87/10 Great Britain.)

Under certain conditions, the nose wheel of a tricycle undercarriage will undergo periodic vibrations (shimmy or wobble) whilst the aircraft is rolling on the ground. It is important that such vibrations should be of small amplitude without requiring excessive damping in the castoring axis. The motion of the wheel is essentially periodic in azimuth, accompanied by a simultaneous periodic translation of the point of contact of the tyre with the ground (*i.e.*, tyre vibrates laterally with regard to the rim). Both tyre and wheel vibrations have the same period, but obviously differ in phase and amplitude. Assuming S.H.M., this can be expressed in the form:

$$\theta = ae^{ikt} \quad \ldots\ldots \quad (1)$$

$$\delta = be^{i(kt+\alpha)} \quad \ldots\ldots \quad (2)$$

where θ = wheel deflection in azimuth,

δ = tyre deflection with regard to the rim.

The author investigates the minimum amount of fluid damping required in the castoring axis so as to maintain (*a*) and (*b*) constant in (1) and (2).

A number of simplifying assumptions are made, such as:—

(1) Castoring axis is vertical.

(2) Damping torque is proportional to $d\theta/dt$.

(3) Damping of tyre can be neglected.

(4) Fuselage is rigid.

(5) No gyroscopic couples.

From the automatic tracking tendency of the castoring wheel, it can easily be shown that

$$b^2/a^2 = (r^2 + v^2/k^2)$$

where v = forward speed of wheel axis. Taking moments about the castoring axis, the author shows that the fluid damping coefficient $k = v\,I/r$ (where I = moment of inertia of complete wheel unit).

The frequency of the coupled system follows from the equation

$$k^2 = r\ (Er - \mu W)/I$$

where W = vertical load on wheels,

μ = coefficient of friction with the ground.

$E = P/\delta$ where P = side load on tyre.

From a review of the possible effect of factor neglected in the simplifying assumptions, the author concludes that the value obtained for the damping torque is a conservative figure which may safely be used.

Load Factors in Gusts. (F. R. Shanley, U.S. Civil Aeronautics Board, Aircraft Airworthiness Section Rept. No. 7, 1940; reviewed in Flight, Vol. 39, No. 1,676, 6/2/41, pp. 111-2.) (87/11 U.S.A.)

This report, intended principally for pilots, presents the theory of load factors due to gusts in a simplified manner. It is shown that while an aeroplane designed with a heavier wing loading is more able to resist gust effects than one designed with light wing loading, to reduce stress on an aeroplane it is best to reduce its load when flying in gusty air. Added load factor due to a gust is directly proportional to the aeroplane's airspeed, hence the safety precaution of reducing speed in gusty weather. Research work has been carried out on gusts, and statistics collected from numerous flights to determine the maximum gust velocity likely to be encountered under various conditions of flight. The instrument used for this purpose consists of the accelerometer coupled to the airspeed indicator so that simultaneous readings are obtained on two co-ordinate axes at right angles. The instrument is known as the V-G recorder.

Results obtained during diving tests with the recorder installed in a D.17-S Beechcraft are discussed.

Wing Loading, Icing and Associated Problems of Modern Transport Design. (C. L. Johnson, J. Aeron. Sci., Vol. 8, No. 2, Dec., 1940, pp. 43-54.) (87/12 U.S.A.)

Problems relating to the use of high wing loadings are considered in two broad groups:—

I—Flight Problems: (*a*) Handling characteristics—landing speed, stability, manœuvrability; (*b*) Take-off and climb performance; (*c*) Icing effects; (*d*) Pilot technique.

II—Economic Problems: (*a*) Payload carried; (*b*) Performance gained; (*c*) Initial cost of aircraft; (*d*) Operating costs for given speed; (*e*) Hangar size; servicing problems; (*f*) Crew required.

Conclusions are as follows:—

1. The use of increased wing loading is fully justified on the basis of improved performance, range and economy.

2. Increased wing loading will lead to aircraft with lower first cost and smaller size, both of which have important effects on operating economy.

3. The slight increase in landing speed will not involve a decrease in safety, since stalling characteristics, control, stability and landing gears can be improved.

4. The problem of icing is no more severe for an aircraft with high wing loading than for one with light wing loading. The advantages of higher initial rate of climb, higher speed, etc., still remain with the heavily loaded aeroplane even under severe icing conditions.

5. The icing problem is relatively less severe on large aircraft than on small ones. Current research will lead to substantial improvements in performance under icing conditions.

6. Flight characteristics now common in large aircraft should not be considered as necessarily applying to future designs where changes in safety regulations are considered.

Gas Engine Valves. (S. D. Heron, O. E. Harder and M. R. Nestor, Paper to A.S.T.M., Detroit, March, 1940. Metal Progress, Vol. 37, No. 4, April, 1940, pp. 418 and 456.) (87/13 U.S.A.)

A comprehensive research programme into valve steels included several changes in analysis to improve forgeability and machinability, over 1,000 experimental valves being made and tested in the engine and by new laboratory tests. The best laboratory tests for determining resistance to corrosion by hot exhaust gases are:—(*a*) loss in weight after short immersion in molten lead compounds; (*b*) loss after cyclic heatings and coolings in the gaseous combustion products. The effect of cold corrosion by moisture condensed from exhaust gases can be duplicated by observing samples after being sprayed daily with engine exhaust condensate. The laboratory test for " hot hardness " is that of mutual indentation of a pair of short cylinders pressed together while hot along a common element of their surfaces. The best temperature is 1,800-1,900°F. Austenitic steels, such as Cr 14, Ni 14, Co 5, Si 0.75, W 2.0 and Mo 0.50 are only moderately hard at atmospheric temperature, but retain this hardness at high temperature. Similar steels containing sufficient Si or Mo to age-harden at 1,600°F. are particularly interesting from the point of view of hot hardness. The above steel is in practically universal use as a valve material. Seating areas have layers of Stellite in America or Brightray (80 per cent. Ni, 20 per cent. Cr) in England. Comparative tests of the two have been inconclusive.

The Maximum Delivery Pressure of Single-Stage Radial Superchargers for Aircraft Engines. (W. von der Nüll, Luftwissen, Vol. 7, No. 5, May, 1940, pp. 174-180. Translation available as N.A.C.A. Tech. Memo. No. 949.) (87/14 Germany.)

The author is of the opinion that the limiting critical altitude of aero engines, both for the present and for some time to come, will be set not by the maximum possible delivery head, but by the temperature rise associated with the compression. However good the fuel, there exists a definite limit to the induction temperature, and unless intercoolers are fitted, it is the compression efficiency, rather than the delivery pressure, that matters. Although intercoolers may become ultimately necessary, it appears that the efficiency of the single-stage has not yet reached its limit, and that by adopting the fully shrouded type investigated by the D.V.L., an improvement in compressive efficiency of the order of 5-10 per cent. should be possible over that attainable with the standard semi-shrouded wheel operating at the same tip speed (300-400 m/sec.).

The author also deduces from test results that supercharger control (at constant speed) will always be more efficient if the throttle is placed at the intake instead of the delivery side of the blower. Both these conclusions are in contradiction with statements by Kollmann, published in a previous issue of this Journal (" Limiting Factors in Single-Stage Centrifugal Superchargers for Aero Engines," K. Kollmann, Luftwissen, Vol. 7, No. 3, March, 1940, pp. 54-61 (R.T.P. Translation No. 1,059), published in Journal of the Royal Aeronautical Society, October, 1940, pp. 775-790). Kollmann is of the opinion that the superiority of the fully shrouded impeller only holds in the region of relatively low tip speeds (~200 m/sec.) and that in the interesting range of 300-400 m/sec. there is nothing to choose between the semi-shrouded and the completely shrouded impeller. As the latter is much more difficult to manufacture, its adoption could thus be justified only in special cases (multi-stage wheels?).

As regards throttle control, Kollmann states that position of the throttle on the delivery side facilitates automatic control and can be made fully as efficient as the more normal intake throttle.

For a more detailed account of von der Nüll's researches at the D.V.L., see R.T.P. Translation No. 517 and 517A entitled " The Design of Aero Engine Superchargers."

Determination of Free Oscillation Frequency of Turbine Blades. (I. K. Chernishevskiy, Sov. Kotloturbo, No. 8, 1940, pp. 269-73.) (87/15 U.S.S.R.)

The author deals with various factors influencing blade frequency, which are not taken into consideration by methods of calculation for determining such frequency, and also with the question of empirical correction factors, and the possible value of the distinction between calculated and actual frequencies. He considers that the system of correction factors should be determined by the united experimental efforts of all Soviet Union turbine works and scientific research institutes. He points out that with a rational system of empirical correction factors as above-mentioned, the tolerance in determining the actual frequency of the blade on the wheel will be dependent on the relative calculation error ; variations in blade frequency characteristics in course of manufacture; frequency variation dependent on the varying force of clamping of the blade in the rim of the wheel. Illustrated with eight diagrams and one photograph.

(Abstract supplied by Research Dept., Metropolitan-Vickers.)

Problem of Valve-Stem and Valve-Head Deposits. (A. T. Colwell, J.S.A.E., Vol. 47, No. 3, Sept., 1940, pp. 358-65.) (87/16 U.S.A.)

Deposits on valve stems to-day are causing about 50 per cent. of the valve trouble in the automotive field, and slightly more than 50 per cent. in the aircraft field. Although much work has been done on varnish and lacquer deposits, most of it has applied to pistons and rings, with valves receiving only passing interest.

Valve deposits are divided into six classifications: those on the valve head; the hard, flint-like deposit from operation; varnish on the stem; deposits under the head and on the stem at the valve-head end of the guide formed by shuttle driving; deposits on intake valves; and deposits on valve seats.

The fact that any oil will oxidise or decompose at some temperature found along the valve stem makes a complete solution of the build-up problem most difficult. It has been definitely proved that oils with good oxidation resistance at high temperatures cause the least trouble. The design problem, therefore, is to attempt to get a valve-stem temperature at the top of the guide which will not cause oil decomposition, or to meter the oil so that the deposit formed is not thick enough to cause trouble between overhauls; or to remove the deposit in some way as it is formed.

Comparing automotive and aircraft remedies, the automotive status is more confusing because operating conditions vary far more. A number of aircraft and automotive remedies for preventing valve deposits are discussed.

48 Ordinate Harmonic Analysis and the Harmonic Spectrum of Two-Cycle Diesel Torque. (N. Klock, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 158-60.) (87/17 U.S.A.)

For the harmonic analysis of periodic curves, machines as well as numerical methods are available. The machines are expensive and not generally available, and time is required to learn their operation. Therefore, an occasional analysis of a curve consumes even less time by the numerical method than by the machine. The best-known numerical method is that of Runge described in many places—a good account is found in Scarborough's book. The principle is clear, but writers usually give the method for 6, 12 or 24 ordinates for the sake of simplicity, which is not sufficiently accurate for most applications. In this paper the 48-ordinate scheme is fully given in Tables 1, 2 and 3.

For the analysis of torsional vibrations the harmonic content of the torque curve of the disturbing engine is required. Such analyses have been published for the four-cycle Diesel engine and for the four-cycle gasoline engine for aviation purposes. But to the author's knowledge none has been published for the two-cycle Diesel engine. Such a spectrum is given herein.

Turbine Blade Vibration Due to Partial Admission. (R. P. Kroon, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 161-5.) (87/18 U.S.A.)

This paper deals with stresses in steam-turbine blades set up during partial admission—that is, when the steam loading on the blades is intermittent. By making simplifying assumptions about the character of the loading, it is possible to develop simple relations showing how the blade stress depends on frequency, running speed and damping. Apparatus to determine experimentally the damping of blade steels and optical equipment to investigate the exact nature of the steam forces acting on the blades in actual operation are described.

Generally speaking, the damping increases with the stress, and decreases with frequency and temperature. In the normal working range, the 12 per cent. Cr steel has about ten times as much damping as the Cr-Ni steels.

Piston Temperatures in an Air-Cooled Engine for Various Operating Conditions. (E. J. Manganiello, N.A.C.A. Report No. 698, 1940.) (87/19 U.S.A.)

As part of a programme for the study of piston cooling, tests were conducted on a single-cylinder, air-cooled, carburettor engine to determine the effect of engine operating conditions on the temperature at five locations on the piston.

Indicated mean effective pressure, engine speed, fuel-air ratio, spark timing, cylinder temperature, oil temperature and oil viscosity were each separately varied, the other conditions being held constant. The tests showed that the piston temperatures increased with indicated horse-power, the variation being slightly greater for a change in indicated horse-power obtained by varying the indicated mean effective pressure than for that obtained by increasing the speed. The piston temperatures varied linearly with cylinder temperature, increasing about 0.66°F. per degree Fahrenheit rise in wall temperature; increased rapidly with increased spark advance; and increased as the mixture was enriched to a fuel-air ratio of about 0.077, decreasing with further enriching. Decreased oil viscosity resulted in a slight decrease of piston temperatures. Piston temperatures slightly decreased with an initial increase in oil (out) temperature, and started increasing with a continued rise in oil temperature. A rough test indicated that the crankcase air and the oil thrown off from the bearings provide a small amount of piston cooling.

Factors Affecting Heat Transfer in the Internal Combustion Engine. (P. M. Ku, N.A.C.A. Tech. Note No. 787, Dec., 1940.) (87/20 U.S.A.)

A method was developed for the direct measurement of the average heat-transfer coefficient from the gases in the cylinder during the cycle of operations of an internal-combustion engine. Experimental measurements were made with a heat collector projecting through a spark-plug hole into the combustion chamber of the test engine, in order to examine the effects of several engine-operating and design parameters on the mean heat transfer to the collector.

For an engine of a fixed compression ratio and valve timing, operating with a given mixture ratio, with ignition adjusted to give maximum pressure at the same crank-angle position, the mean heat transfer was found to be a function of the air consumption only, no matter what changes the volumetric efficiency, inlet-air density or mean piston speed might undergo. The heat transfer was found to vary with the 0.5 power of air consumption in both a slow-speed and a high-speed C.F.R. engine. This figure was surprisingly constant for all tests.

The effect of the heat-resistive coating formed by the combustion deposits on the surface of the heat collector was also examined. Starting with a clean heat collector, the heat transfer fell about 20 per cent. during the first fifteen hours of operation, after which it fell off at a very slow rate, becoming constant after about forty hours of operation.

Measurements on Detonation in the Duchêne Apparatus. (G. Broersma, J. Aeron. Sci., Vol. 8, No. 2, Dec., 1940, pp. 62-72.) (87/21 Holland.)

Investigations have been made in the Duchêne apparatus (Publ. Sci. et Tech. du Ministère de l'Air, No. 11, 1932) as to whether the mechanism of detonation obtained with this apparatus differs from that obtained with the "Delft" window engine (Boerlage, Broeze, Van Driel and Peletier, "Engineering," March 5th, 1937). The Duchêne apparatus consists of a steel cylinder with piston (bore 50 mm., stroke 295 mm.), the combustion chamber being bored from the same block of steel at the end of the cylinder. A sparking plug closes the opposite end of the combustion chamber. Flame photographs are taken through a small glass window running the entire length of the explosion chamber. In the present experiments fuel was introduced through a glass carburettor. The results obtained consisted of flame pictures, pressure diagrams and ionisation diagrams. They indicate that there are two mechanisms of detonation:—(*a*) Physical detonation produced by physical processes of aerodynamic flow, mixing and diffusion. A critical state is reached at which the speed of the flame front changes from the subsonic to a supersonic rate. (*b*) Chemical detonation in which the chemical chain reactions in the end gases produce a critical state in which the end gas ignites at one or more points. From these points combustion proceeds at normal subsonic speeds. Each combustion mechanism has its own time constant depending upon thermodynamic, chemical and geometrical considerations. They may overlap. Thus, when chemical detonation has started, physical detonation may still occur, but not conversely. Both of these mechanisms may occur in the Duchêne apparatus. In the "Delft" window engine chemical detonation is usual, as in most engines. In tubes and bombs physical detonation usually occurs.

Fuel Economy in Petrol Engines. (W. T. David and A. S. Leah, J. Inst. Mech. Eng., Vol. 143, No. 5, Oct., 1940, pp. 289-312. J. Inst. Petrol., Vol. 27, No. 207, Jan., 1941, pp. 29-30A.) (87/22 U.S.A.)

Data are supplied from which may be estimated the possible margin of improvement in performance for any given engine in practice. Part I gives charts for indicated thermal efficiency, fuel consumption per I.H.P. hour, and I.M.E.P. attainable in a compact engine of any bore between 3 and 8 in. for compression ratios between 4:1 and 9:1, speeds from 1,000 r.p.m. upwards, and mixture strengths between 20 per cent. weak and 20 per cent. rich. Separate charts are given for octane, ethyl alcohol and benzene. The charts are based on accurate values of the gaseous internal energies, entropies and dissociation constants, allowances being made for heat losses during explosion and expansion, using heat-loss estimates deduced from closed-vessel explosion experiments and single-cylinder test results. Part II discusses phenomena associated with the working fluid and combustion of the charge, including turbulence and its effect on heat loss during explosion and expansion, the delay period after ignition, incomplete combusiton at the peak pressure and after-burning. In an engine of 4.5 in. bore running at 1,500 r.p.m., the heat loss would be about 1 per cent. (of the heat of combustion) during explosion, and about 5 per cent. during expansion. Under detonating conditions the rate of heat loss is greatly increased, mainly due to increased turbulence. Part III discusses actual engine performance compared with attainable performance. Apart from distribution difficulties in multi-cylinder engines, it is believed that improvement in charge-mixing within each cylinder would be one of the main directions in which progress could be made.

Curtiss-Wright Built-in Engine Torque Indicator. (Inter. Avia., No. 739, 12/12/40, p. 9.) (87/23 U.S.A.)

The Curtiss-Wright Corporation is now conducting its test flights, using built-in torque indicators, which serve for accurate supervision of the engine's power output to the airscrew in flight, and enable a correspondingly accurate calculation of the test results. The indicator installed on the Double Row Cyclone 14-cylinder engine consists of a torque arm mounted in front of the reduction gear system in the front portion of the crankcase; this arm transmits the reaction forces exerted by the revolving airscrew boss on the stationary parts of the sun gear to a balancing valve which is free to move to and fro. The latter, together with an oil booster pump, is mounted in a casing on the top of the front of the engine casing. The pressure required of the pump to maintain the balancing valve in the central position is controlled automatically and represents a direct measure of the engine torque. Thus the device enables the actual engine output to be determined during flight under all flying conditions and at all throttle positions. The principle is the same as that of the torque indicator developed by Pratt and Whitney some time ago.

On the Mechanism of Boundary Lubrication. I. The Action of Long Chain Polar Compounds. (O. Beeck, J. W. Givens and A. E. Smith, Proc. Roy. Soc., Vol. 177, No. 968, 31/12/40, pp. 90-102.) (87/24 U.S.A.)

The effect of long-chain polar compounds on the coefficient of kinetic friction under boundary conditions has been studied, using the Boerlage four-ball friction apparatus in various modifications. With steel balls of the highest grade, coefficients of friction for a great number of lubricants were measured as a function of the relative velocity of the rubbing surfaces.

The structure of thin films of these lubricants rubbed on polished mild steel surfaces was investigated by electron diffraction.

It was found that the lubricants showing little or no surface orientation had a constant coefficient of friction of about 0.1 over the available velocity range from 0 to 1 cm/sec. With oils which showed high surface orientation imparted by addition of long-chain polar compounds, a sudden decrease of the coefficient of the friction was observed at various velocities of the sliding surfaces, depending upon the compound used. Investigation of a great number of compounds gave a direct correlation of this effect with molecular orientation: those compounds causing the effect to occur at the lowest velocities were found to be most highly oriented with their carbon chains most nearly perpendicular to the surface. Since such a change of the coefficient of friction can only be explained by the wedging of oil under the surface (oil drag), the effect was termed the "wedging effect" leading to a type of lubrication which may be called "quasi-hydrodynamic."

By measuring the electrical resistance between the sliding surfaces it was found that the regions of sudden decrease of the coefficient of friction correspond to a change from metallic contact to extremely high resistance.

The investigation shows that long-chain polar compounds act primarily by inducing the "wedging effect" and not by giving a direct protection to the surface.

On the Mechanism of Boundary Lubrication. II. Wear Prevention by Addition Agents. (O. Beeck, J. W. Givens and E. C. Williams, Proc. Roy. Soc., Vol. 177, No. 968, 31/12/40, pp. 103-118.) (87/25 U.S.A.)

If two metal surfaces slide over each other in the presence of a lubricant and under high load, high pressures and temperatures prevail at those isolated spots which actually carry the load, leading to wear and possibly to breakdown.

The action of wear-preventing agents under these conditions has been studied in detail, and it has been found that such agents are effective through their chemical polishing action, by which the load becomes distributed over a larger surface and local pressures and temperatures are decreased. Especially effective are compounds containing phosphorus or other elements of group V of the periodic system. These have been found to form a metal phosphide or homolog on the surface which is able to alloy with the metal surface, lowering its melting-point markedly, and by this action aiding greatly in maintaining a polish.

The wear experiments were carried out with a highly sensitive and accurate method which used metal-plated steel balls as its sliding elements. Under the experimental conditions additions of 1.5 per cent. triphenyl phosphine or triphenyl arsine in white oil gave wear-prevention factors of 7.2 and 12.2 respectively (relative to pure white oil). A further addition of 1 per cent. of a long-chain polar compound is able to double the wear-prevention factor obtained with the polishing agents, and wear-prevention factors as high as 17.6 have been observed. The specifically physical action of the long-chain polar compounds is discussed in the preceding paper.

Study of Monolayers of Some Esters and Chlorinated Derivatives Possibly Useful as Lubricating Addition Agents. (G. L. Clark and J. V. Robinson, J. Amer. Chem. Soc., Vol. 62, 1940, pp. 1948-51. J. Inst. Petrol., Vol. 27, No. 207, Jan., 1941, p. 25A.) (87/26 U.S.A.)

An investigation into the mechanism of the action of polar organic compounds added to lubricating oil to increase its oiliness is based on the theory that the addition agent is absorbed on the metal, acting as a buffer between metal surfaces. X-ray diffraction has been used previously to show that such an absorption actually takes place, and in the present work the monomolecular film balance was selected to furnish quantitative data on the strength of absorption and the nature of the molecular packing of materials used as oiliness agents. The collapse pressure of monomolecular films measured on the hydrophil balance may possibly be correlated with the resistance to shear of the same substances on a metal surface in an engine bearing. It is suggested that a surface consisting of a close-packed array of hydrogen atoms attached to hydrocarbon chains should offer the minimum resistance to the hydrocarbon molecules of a lubricating oil slipping over it. Using an improved film balance under carefully controlled conditions, measurements are made of area per molecule and collapse pressure on water surfaces for monolayers of certain esters which have possible use as addition agents in lubricating oils, namely, Methyl Stearate, "L," Chlorostearate, Dichlorostearate, Oleate, Ricinoleate, and Chlororicinoleate; Ethylene Glycol Distearate and Ricinoleate and Tricresyl Phosphate.

Fiberglas. New Basic Raw Material. (G. Slayter, Ind. and Eng. Chem. (Industrial Ed.), Vol. 32, No. 12, 2/12/40, pp. 1,568-71.) (87/28 U.S.A.)

Glass fibres possess desirable properties not found in any other commercially available material. They are produced either as a wool-like fibre, largely used for thermal insulation, or as a textile fibre, employed to form yarns, threads and woven fabrics. Glass fibres are incombustible, non-absorptive, chemically stable and resistant, unattacked by fungus or vermin, and they possess extraordinary tensile strength, electrical properties and heat resistance. Their production, properties and uses are described.

The wool forms are used for insulation of houses, ships, trains, aircraft, etc., and for industrial insulation at temperatures from below 0° to over 1,000°F. Textile forms are used for electrical insulation, electrical storage battery retainer mats, chemical-and-fume filtration, etc.

Plane Braced Frames Loaded Perpendicularly to their Planes. A New Application of Cross' Method. (J. Drymael, J. Roy. Aer. Soc., Vol. 44, No. 359, Nov., 1940, pp. 827-43.) (87/27 Belgium.)

The article deals with the calculation of plane frames, each bar of which is able to withstand flexion perpendicularly to the main plane. After having shown that the stress corresponding to the loads parallel to that plane is independent of the stress corresponding to the perpendicular loads, the author develops for this latter a method of resolution based on Cross' principle. Fictitious supports are added to each knot and then successively removed, till the structure reaches the true form corresponding to the loading. A very important improvement of the original method—formerly not applied to a three-dimensional construction—consists in the use of adjustments—that is, appropriate movements of parts of the structure as a whole.

The method proved to have many advantages: difficulties independent of the degree of redundancy, no loss of accuracy between the beginning and the end of calculations, large number of verifications in the course of resolution, reliability of the results, easy understanding of the successive steps, possibility of simultaneous work for many contributors, and relative shortness of the amount of work required.

Rating of Aircraft Quality Steels. (J. B. Johnson, Metal Progress, Vol. 8, No. 4, Oct., 1940, pp. 382-3.) (87/29 U.S.A.)

The Aeronautical Materials Specifications published by the S.A.E. incorporate requirements for chemical composition, grain size, physical properties and surface condition, with the additional provision that the material must be "aircraft quality," *i.e.*, the finished parts must be tested by magnetic inspection. The only practicable process is the Magnaflux process, which will indicate any non-homogeneity in and just below the surface. Its most useful application is for detecting non-metallic inclusion, on the basis of which aircraft steel is accepted or rejected. The term "aircraft quality" does not necessarily have the same significance for all aircraft parts, since in some parts inclusions may be tolerated in low-stressed sections, while rigorously excluded from highly-stressed sections. Thus piston pins require a steel practically free from any non-metallic inclusions. At present there is no established standard for the rating of Magnaflux inspections, but one is now in course of preparation by the S.A.E.

Stress Distribution in, and Equivalent Width of Flanges of, Wide, Thin-Wall Steel Beams. (G. Winter, N.A.C.A. Tech. Note No. 784, Nov., 1940.) (87/30 U.S.A.)

The use of different forms of wide-flange, thin-wall steel beams is becoming increasingly widespread. Part of the information necessary for a rational design of such members is the knowledge of the stress distribution in, and the equivalent width of, the flanges of such beams.

The primary purpose of the investigation was to analyse the stress distribution in the flanges of wide, thin-wall beams of I-, T-, U- and box shape, and to obtain results suitable for direct application in design. It is shown that the magnitude of the bending stresses in the flanges of such beams varies across the width of the section, and that the amount of this variation depends upon the dimensions of the beam and upon the type of loading.

Therefore, in the determination of the magnitude of the maximum bending stress in design work, the equivalent width of such flanges should be used instead of the actual width. Curves are given from which this equivalent width can be read directly for any particular type of beam and loading.

For the purpose of facilitating the experimental verification of the analytical results, further curves have been computed that give the ratios of the maximum to the minimum bending stress in the flanges. These ratios have been checked experimentally by means of strain measurements on eleven I-beams. The experimental data confirm very satisfactorily the analytical results.

It is further shown that the cross-sections of wide beams made of extremely thin sheets are subject to distortion that gives rise to additional stress concentration. Equations are given furnishing simple conditions for determining the limiting dimensions of beams for which the effect of this distortion may be neglected in practical applications. It may easily be verified numerically that practically all beams of structurally possible dimensions will satisfy these conditions.

The Impact of a Mass Striking a Beam. (E. H. Lee, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 129-138.) (87-31 U.S.A.)

In the first part of this paper a concise approximate solution is developed, making the assumptions that the duration of contact is small in comparison with the period of the fundamental mode of vibration of the beam, and that only the fundamental mode of oscillation of the beam need be considered. Results obtained by this method are checked against those determined by the lengthier numerical method. Good agreement is reached in some examples, but other results show large errors, both in the contact compression force and in the resulting motion.

Light was brought to bear on this difficulty by using a solution based on energy and momentum considerations, giving a curve which supplies a rapid determination of the distribution of energy among the various modes of vibration of the beam. This curve gives directly the condition for the vibrational energy developed in the beam, due to the impact, to be confined mainly to the fundamental mode. This is shown by examples to be the required condition for the validity of the previous approximate method.

The solution using energy and momentum considerations is developed to give the motions of the beam and mass resulting from the impact (free vibrations in the beam and uniform velocity of the mass) so that the subsequent development of the impact can be ascertained and repeated impacts dealt with. The investigation also gives the deflection curves of the beam produced by the impact; these show a wide deviation from static-deflection curves.

Immediately after contact has ceased, the deflection is limited mainly to the central portion of the beam; near the supports the deflection is small and in the opposite direction. Later, the first mode of vibration dominates.

For simplicity, this paper has dealt solely with central impact on a beam simply supported at its ends. No difficulties are encountered in generalising the method for impact at any point along a beam which is supported in any way. This general theory is developed briefly in Appendix 1, the procedure being identical with that adopted for the specialised problem.

The Orthogonally Stiffened Plate Under Uniform Lateral Load. (H. A. Schade, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 143-146.) (87/33 U.S.A.)

The problem here discussed may be described as follows:—A rectangular grid of orthogonally intersecting beams rests on rigid supports on all four edges. The grid may be plated on one or both of its surfaces and supports a uniformly distributed lateral load. On two parallel edges, termed the "transverse edges," the beams are fixed. On the other two edges, termed the "longitudinal edges," the beams are freely supported. The beams in the longitudinal system are all identical and equally spaced, except the central longitudinal beam, which may be stiffer than the others in the system. The beams in the transverse system are all identical and equally spaced, but their size and spacing are not necessarily the same as in the other direction.

The problem of deflection under a uniform lateral load was solved in previous papers (Proc. Int. Congress of Applied Mechanics, 1938, p. 140), approximately by means of the infinite-strip method, whereby the solution for a strip of such stiffened plating, infinitely long, freely supported on the edges, an with a single transverse support, was obtained. The solution for the single transverse support was then simply superimposed upon the solution for another such transverse support, which gave an approximation to the solution for the plate included between two such transverse supports. In the previous papers this method of solution was applied to the double-bottom structure of a ship. It is equally applicable to deck structure and many other elements of a ship, and also to many aeroplane structural problems. Under certain conditions, where the side ratio—that is, the ratio of the longitudinal dimension to the transverse dimension—is small, the approximate solution is inadequate; consequently, the following exact solution, applicable to all side ratios, has been developed. It follows, in general, the method used by Huber for the orthotropic plate.

Analysis of Clamped Rectangular Plates. (D. Young, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 139-142.) (87/32 U.S.A.)

The bending of rectangular plates which are clamped at all four edges and subjected to the action of lateral loads is a problem which has received considerable attention because of its technical importance. Two main methods of attack have been used for obtaining solutions, namely, (*a*) Ritz's energy method, a recent discussion of which has been given by G. Pickett, and (*b*) the superposition method proposed by S. P. Timoshenko as a generalisation of Hencky's solution. These methods are approximate in the rigorous mathematical sense, but, practically, the results may be obtained to any desired degree of accuracy by taking sufficient terms in the infinite series of simultaneous equations which occur in both these methods. To date, complete analyses are available only for the case of a uniform load, and for the case of a central concentrated load. In this paper Timoshenko's method is applied to a number of loadings which have not been treated before.

For the plates treated in this paper it is assumed that all four edges are perfectly fixed, so there is no deflection or change in slope at the edges under the action of the lateral loads.

Some Observations on the Theory of Contact Pressures. (S. Way, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 147-157.) (87/34 U.S.A.)

Some of the observations that can be made regarding stresses and displacements in a semi-infinite elastic solid with given normal surface loading are briefly as follows:—

(*a*) There are a number of cases in which an infinite number of different load distributions inside a region R of the surface produce the same system of stresses and horizontal displacements in the surface outside R.

(*b*) The horizontal displacements in the surface are shown to stand in a simple proportionality relation to the slopes in the x and y directions of a stretched membrane loaded in the same way as the elastic solid. The stresses in the surface are related to the second derivatives of the membrane deflection.

(*c*) An analogy can be set up between the stresses in the surface of the semi-infinite solid, when it carries a loading $q=f(x)$ along a line segment from $x=-c$, $y=0$ to $x=c$, $y=0$, and the shearing stresses on certain planes in a semi-infinite solid in a plane state of strain loaded by the pressure distribution $p=f(x)$ along the band between $x=-c$ and $x=+c$. The same analogy also holds when the latter body is a thin sheet in a state of plane stress.

Convergence of Hardy Cross's Balancing Process. (R. Oldenburger, J. App. Mech., Vol. 7, No. 4, Dec., 1940, pp. 166-170.) (87/35 U.S.A.)

Hardy Cross has introduced a process of structural analysis by balancing moments against each other in successive steps, this process being part of an infinite procedure. It has been used by many engineers, as for example by Grinter. Southwell has given an equivalent method, the convergence of which was considered in a paper by Temple. Using energy considerations, Temple gave two convergent methods of applying the Southwell process to a given structure.

One can easily show that the Cross method may be applied to a given structure in such a manner that the process does not converge. In the present paper the author gives necessary and sufficient conditions for the convergence of the Cross method, and exhibits a convergent process of balancing any given structure. In particular, he shows that a balancing process P can be described by real linear transformation—that is, by a matrix composed of real numbers, and that the process P converges in the sense of this paper if, and only if, the infinite power of this matrix exists and is zero. The existence and vanishing of the infinite power of a real matrix has been treated elsewhere. For a discussion of matrices and their applications, the reader is referred to a book by Frazer, Duncan and Collar.

The study in this paper is restricted to a continuous beam. The argument for a network of beams is similar to that given here.

Strength of Spot Welds. (Neuman and McCreery, Weld. Engr., Dec., 1940, pp. 28-31 and 42.) (87/36 Great Britain.)

Investigations have been carried out by the authors on the strength determination of spot-welded joints. Such joints are found to be similar in many respects to riveted joints, but can carry more load. Resistance welding, with button electrodes, was used on the test pieces, attention being paid to correct pressure and timing. Certain conclusions are drawn from the data given, regarding the design of spot-welded joints and the factor of safety to be employed.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Reports of Investigations on Selected Types of High Tensile Steels. (Reeve, Trans. Inst. Welding, Oct., 1940, pp. 177-202.) (87/37 Great Britain.)

This report gives details of tests carried out by a Sub-Committee on the Weldability of High Tensile Structural Steels. After chemical analyses of the eleven steels used, there are tensile, bend and impact test results for unwelded and butt-welded specimens. Data is also drawn from Reeve crack tests and quench-hardening tests made on ½in. and 1in. plate. Conclusions drawn from the work are discussed.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Selection and Welding of Low Alloy Structural Steels. (Dearden and O'Neill, Trans. Inst. Welding, Oct., 1940, pp. 203-214.) (87/38 Great Britain.)

A discussion is given on the effect of alloying elements on the tensile properties and hardenability of steel. An examination is made of factors causing decreased weldability, and precautions to be taken during metallic arc welding to prevent cracking are also considered. Empirical expressions are given by the authors for calculating the yield strength, maximum stress and weld-hardening of structural steels from their chemical composition.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Aluminium Casting Alloys for Internal Combustion Engines. (Engineering, Vol. 151, No. 3,917, 7/2/41, p. 120.) (87/39 Great Britain.)

Two publications issued by Messrs. Aluminium Union Ltd. describe recent developments in Al-alloys for internal-combustion engines. These include a piston alloy containing 10 per cent. Cu, with small additions of Fe and Mg. It is easier to machine and cheaper than the material previously used, containing 4 per cent. Cu, 2 per cent. Ni, and 1.5 per cent. Mg. Both alloys are used in the heat-treated condition and are stable and mechanically strong at temperatures up to 400°C.

Amongst the corrosion-resistant magnesium-aluminium casting alloys, one containing 1 per cent. Mg is amenable to heat-treatment and is suitable for sand and gravity die castings of simpler forms. An alloy containing 4 per cent. Mg is employed in the as-cast condition for carburettor bodies. There is now a tendency to replace the wrought components of internal-combustion engines by castings in alloys giving the required mechanical properties. An example is an alloy containing 4-5 per cent. Cu, up to 0.9 per cent. Si, up to 0.7 per cent. Fe and 0.25 Ti, which after heat-treatment has an ultimate tensile strength of 26 tons/sq. in.

Titanium and Some Properties of Cr-Mo Steel for Aeroplane Tubing. (G. F. Comstock, Metals and Alloys, July, 1940, pp. 21-6.) (87/40 U.S.A.)

In these forged and normalised S.A.E. X 4130 steels, welded lengthwise, machined flat and bent cold with the weld outside, the presence of titanium improved the bending quality even when accompanied by higher manganese or 0.31 per cent. Cu. Steels with 0.15 per cent. Ti and with 0.09 per cent. Ti and 0.31 per cent. Cu bent most easily after welding, without cracking. Presence of over 0.1 per cent. Ti in these samples produced a softer steel, but did not decrease the degree of hardening by welding. With 0.85 per cent. Mn and 0.093 per cent. Ti the steel was harder than with the normal manganese content, but there was no greater hardening by welding than in the untreated steel. The microstructure showed a narrower hardened and coarsened zone in the titanium steels than in the untreated, especially without copper or increased manganese.

Improved ductility, impact value and microstructure produced by titanium or Ti+Al in the normalised test-bars is reflected by a similar improvement in the weld-bend tests. With the manganese increased to about 0.85 per cent. and 0.09-0.10 per cent. Ti in this S.A.E. X 4130 steel, the strength in the normalised condition is satisfactory, the hardening by welding is not excessive, and the ductility after welding and resistance to impact are definitely improved as compared with the regular or untreated X 4130 steel. The investigation is described and results of welding tests are summarised.

The Chemical Exploration of the Stratosphere. (F. A. Paneth, Chemistry and Industry, Vol. 60, No. 1, 4/1/41, pp. 8-9.) (87/42 Great Britain.)

The sampling is carried out by sounding balloons, some of which have reached altitudes of more than 30 km.

It appears from the results of analyses subsequently carried out on the ground that at altitudes above 20 km. the He content of the air increases, while the O_2 content decreases. This seems to indicate the absence of wind and the consequent separation of the gases according to their density.

Blast Tests on Glass. (Plastics, Vol. 5, No. 45, Feb., 1941, pp. 23-5.) (87/41 Great Britain.)

A laboratory apparatus has been devised in which glass can be subjected to the same degree of blast in various tests. The apparatus consists of a Celastoid vacuum chamber connected through a gate valve to a reserve vacuum chamber, and thence to a vacuum pump. The glass under test, coated with anti-shatter material, forms the base plate closing the mouth of the Celastoid jar. With the gate valve closed, air is pumped out of the reserve vacuum chamber until a negative pressure of 20 inches of mercury is obtained. The gate valve is then opened quickly, sudden partial vacuum is formed, and the glass breaks. The value of the anti-shatter material with which it has been treated is assessed from the number and velocity of the flying fragments. Results obtained with adhesive tapes and textile netting show that the area of glass covered must exceed 50 per cent., as below this figure a dangerously high percentage of the glass flies. Viscose film affords good protection, but is difficult to apply. Anti-shatter lacquers have an estimated useful life of only three months.

On the Right- and Left-Handedness of Quartz and its Relation to Elastic and Other Properties. (K. S. Van Dyke, Proc. I.R.E., Vol. 28, No. 9, Sept., 1940, pp. 399-406.) (87/43 U.S.A.)

The confusion concerning the elastic properties of quartz which exists in the literature of the Piezo-electric resonator is pointed out. Emphasis is placed on the accepted definitions of right and left quartz and of right- and left-handed optical rotation, the disregard of which by authors, together with a rather free use of axial systems of their own choosing, sometimes obscurely defined, is responsible for the confusion.

An independent experimental investigation is made of the interrelations between Piezo-electric polarisation, optical rotatory power, elastic compressional compliance, and characteristic etch markings, and thereby with the natural face forms of the quartz.

Particular care is taken to avoid any possible errorss in sign in relating these properties, and a number of such errors in the literature are pointed out.

The etch pattern on a quartz sphere is described, as well as its use as a reference standard in determining the orientation of quartz resonators by means of the etch patterns on their faces.

Electrical Transmission of Flow and Level Records. (Linford, B.E.A.M.A. J., Dec., 1940, pp. 97-101.) (87/45 Great Britain.)

Principles involved in the use of electrical circuits for the remote recording of fluid levels, rates of flow, pressures, etc., are explained. Any of three ways may be used to transform the mechanical function into an electric one. A float movement may operate the contact arm of a resistance, affecting the flow of current in a circuit, or may be made to influence an inductance bridge, or send impulses along line wires to a receiver. Some circuits of general character employing these methods are described. The article is to be continued.

(Abstract supplied by Research Department, Metropolitan-Vickers.)

Field Strength of Motor Car Ignition Between 40 and 450 Megacycles. (R. W. George, Proc. I.R.E., Vol. 28, No. 9, Sept., 1940, pp. 409-12.) (87/44 U.S.A.)

Measurements of motor-car ignition peak field strength were made on frequencies of 40, 60, 100, 140, 180, 240 and 450 megacycles. Propagation was over Long Island ground, and the receiving antennas were 35 feet high and 100 feet from the road. Under these conditions, the average field strength varied about 2 to 1 over the frequency range. Curves show the maximum field strength versus frequency for 90, 50 and 10 per cent. of all the measurements. Vertical and horizontal polarisation are compared, showing slightly greater field strength, in general, for vertical polarisation. New cars, old cars and trucks are compared, showing no large differences of ignition field strength.

Some of the factors involved in motor-car ignition radiation are mentioned. Theoretical propagation curves are included and the measuring system is briefly discussed. Although these data are not comprehensive of the subject, they do show that appreciable motor-car ignition interference can be expected at frequencies up to 450 megacycles.

There are several factors which are favourable to the production of ignition interference at the higher frequencies. More or less obvious, these are improved propagation conditions due to increased phase difference between direct and reflected waves at a given point, except for short distances; and the metal sections of the car and the ignition leads are more comparable in size with short wavelengths, thus acting as less effective shields and more effective radiators.

LIST OF SELECTED TRANSLATIONS.

NOTE.—Applications for the loan of copies of translations mentioned below should be addressed to the Secretary (R.T.P.), Ministry of Aircraft Production, and copies will be loaned as far as availability of stocks permits. Suggestions concerning new translations will be considered in relation to general interest and facilities available.

Lists of selected translations have appeared in this publication since September, 1938.

AIRCRAFT AND ACCESSORIES.

TRANSLATION NUMBER AND AUTHOR.	TITLE AND REFERENCE.
1148 Molokov, V. S....	*The Civil Air Fleet of the U.S.S.R.* (Civil Aviation, U.S.S.R., Vol. 8, Aug., 1938, pp. 1-6.)
1150 Pirath, C. ...	20 *Years of Regular Air Services and Problems of Commercial Flight. I.* 20 *years of Regular Air Services.* (Forschungsergebnisse des Verkehrswissenschaft lichen Instituts für Luftfahrt an der Technischen Hochschule Stuttgart, No. 14, 1940, pp. 12-42.)
1151 Kaul, H. W. ...	*Statistical Observations of Service or Operational Stresses in Aeroplane Wings.* (Jahrbuch der deutschen Luftfahrtforschung, 1938, Supplement, pp. 307-313.)

ENGINES AND ACCESSORIES.

1137 Riggi, A. ...	*Variation of Aircraft Engine Power at Altitude.* (Riv. Aeron., Vol. 16, No. 1, Jan., 1940, pp. 1-32.)
1139 Benz, H. ...	*Fluid Couplings for Vehicle Propulsion with Particular Reference to the Voith Turbo Couplings.* (A.T.Z., Vol. 41, No. 9, 10/5/38, pp. 242-8. Translated by the Bristol Aeroplane Company, Limited.)
1149 Weise, A. ...	*Energy Transformation in the Radiator.* (Lilienthal Society Lectures, 1937, pp. 269-76.)
1152 Nüll, W. von der	*Centrifugal Compressors.* (Die Kreiselrad-Arbeitsmaschinen, 1937, pp. 73-84.)

MATERIALS.

1136 Fomin, N. ...	*Design of Riveted Connections.* (Trans. C.A.H.I., Moscow, No. 205, 1935.)
1138 Heyer, H. O. ...	*The D.V.L. Testing Machine for Bearing Metals under Dynamic Loads.* (L.F.F., Vol. 14, No. 1, 20/1/37, pp. 14-25.)

TITLES AND REFERENCES OF ARTICLES AND PAPERS SELECTED FROM PUBLICATIONS RECEIVED IN R.T.P.3 DURING JANUARY, 1941, TOGETHER WITH LIST OF NEW TRANSLATIONS RENDERED AVAILABLE.

Theory and Practice of Warfare.

ITEM NO.		TITLE AND JOURNAL.
73/1	Italy ...	*Cant Z 1007 bis Bomber.* (Aeroplane, Vol. 59, No. 1,542, 13/12/40, p. 680.)
73/2	Germany ...	*F.W. 187 "Destroyer" (Photographs).* (Aeroplane, Vol. 59, No. 1,542, 13/12/40, p. 681.)
73/3	Great Britain	*The Slip Wing Fighter.* (N. Pemberton-Billing, Flight, Vol. 38, No. 1,669, 19/12/40, pp. 524-5.)
73/4	Great Britain	*High Explosive Bombs.* (B. Brady, Aeronautics, Vol. 3, No. 5, Dec., 1940, pp. 36-7.)
73/5	Great Britain	*Bomb Hazards Assessed.* (Aeronautics, Vol. 3, No. 5, Dec., 1940, pp. 52-3.)
73/6	Great Britain	*Midget Military Aeroplanes.* (W. O. Manning, Aeronautics, Vol. 3, No. 5, Dec., 1940, pp. 62-6.)
73/7	Great Britain	*Illusions by Camouflage.* (Aeronautics, Vol. 3, No. 5, Dec., 1940, pp. 68-69.)
73/8	Italy ...	*Italian Dive Bomber S.M. 85.* (Aeroplane, Vol. 59, No. 1,544, 27/12/40, p. 740.)
73/9	Germany ...	*New German 5.2 in. A.A. Gun.* (Aeroplane, Vol. 59, No. 1,544, 27/12/40, p. 742.)
73/10	Great Britain	*The Slip Wing Fighter.* (N. Pemberton-Billing, Flight, Vol. 38, No. 1,670, 26/12/40, pp. 550-2.)
73/11	Great Britain	*The Physics of Air Raids. (Effects of Blast; Protection of Shelters.)* (D. Bernal, Engineering, Vol. 150, No. 3,911, 27/12/40, p. 514.)
73/12	Italy ...	*Savoia Marchetti S.M. 79 Bomber.* (Aeroplane, Vol. 59, No. 1,543, 20/12/40, p. 704.)
73/13	Germany ...	*Me 110 (Photographs).* (Aeroplane, Vol. 59, No. 1,543, 20/12/40, pp. 696-705.)
73/14	U.S.A. ...	*Douglas Dive Bombers S.B.D.* (Inter. Avia., No. 734, 5/11/40, p. 7.)
73/15	Italy ...	*Italian Torpedo Carrying Aircraft S.79.* (Inter. Avia., No. 735, 12/11/40, p. 7.)
73/16	U.S.A. ...	*Boeing B-17 Flying Fortresses.* (Inter. Avia., No. 735, 12/11/40, p. 8.)
73/17	U.S.A. ...	*Twin-Engined Attack Bomber Martin 187 (Baltimore).* (Inter. Avia., No. 735, 12/11/40, p. 9.)
73/18	U.S.A. ...	*U.S.A. Bomb Sight.* (Inter. Avia., No. 735, 12/11/40, p. 12.)
73/19	Great Britain	*Aerial Navigation Applied to Bombing Raids on Unseen Targets.* (F. Chichester, Aeronautics, Vol. 3, No. 6, Jan., 1941, pp. 50-56.)
73/20	Great Britain	*British Military Aircraft Types Illustrated.* (Aeroplane, Vol. 59, No. 1,541, 6/12/40, pp. 632a-639 and 641-652.)

ITEM NO.		TITLE AND JOURNAL.
73/21	Great Britain	*American Views on New British Military Types.* (Aeroplane, Vol. 59, No. 1,545, 3/1/41, pp. 4-5.)
73/22	Italy ...	*Breda 88 Italian Fighter-Bomber.* (Aeroplane, Vol. 59, No. 1,545, 3/1/41, p. 14.)
73/23	Great Britain	*New British Military Aircraft and Engines.* (L. Engel, Flight, Vol. 39, No. 1,671, 2/1/41, pp. 10 and 16.)
73/24	Great Britain	*Quantity Production of Whitley Bombers.* (Flight, Vol. 39, No. 1,671, 2/1/41, pp. 13-16.)
73/25	Italy ...	*Fiat G.50 Single-Seat Fighter.* (Aeroplane, Vol. 60, No. 1,546, 10/1/41, p. 40.)
73/26	Great Britain	*Identification of Aircraft Simplified (Comparison of Hurricane and Me 109 Single-Seat Fighters).* (Flight, Vol. 39, No. 1,672, 9/1/41, p. 27.)
73/27	U.S.A. ...	*Consolidated B.24 Four-Engined Bomber.* (Flight, Vol. 39, No. 1,672, 9/1/41, p. 28.)
73/28	Great Britain	*Aircraft Carriers: Dimensions, Performance and Aircraft Capacity.* (Flight, Vol. 39, No. 1,672, 9/1/41, pp. a-e.)

AERO- AND HYDRODYNAMICS.

73/29	Italy ...	*New Italian Wind Tunnel at the Breda Works.* (Inter. Avia., No. 734, 5/11/40, p. 6.)
73/30	Italy ...	*Experimental Results with Aerofoils Tested in the High Speed Tunnel at Guidonia.* (A. Ferri, Atti di Guidonia, No. 17, 20/9/39. N.A.C.A. Tech. Memo. No. 946, July, 1940.) (Abstract available.)
73/31	Germany ...	*A Simple Approximation Method for Obtaining the Spanwise Lift Distribution.* (O. Schrenk, Luftwissen, Vol. 7, No. 4, April, 1940, pp. 118-120. N.A.C.A. Tech. Memo. No. 948, Aug., 1940.) (Abstract available.)
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73/33	U.S.A. ...	*Wind Tunnel Tests of an N.A.C.A. 23021 Aerofoil Equipped with a Slotted Extensible and a Plain Extensible Flap.* (T. A. Harris and R. S. Swanson, N.A.C.A. Tech. Note No. 782, Nov., 1940.) (Abstract available.)

AIRCRAFT AND AIRSCREWS.

73/34	Great Britain	*Note on the Determination of the Drag of Retractable Undercarriages in Flight.* (J. A. C. Williams, J. Roy. Aer. Soc., Vol. 44, No. 360, Dec., 1940, pp. 862-864.)
73/35	Great Britain	*Timm P.T. 160K "Plastic" Trainer (Photograph).* (Aeroplane, Vol. 59, No. 1,542, 13/12/40, p. 684.)
73/36	Great Britain	*Air Screw Spinners.* (K. B. Gillmore, Flight, Vol. 38, No. 1,669, 19/12/40, p. 526.)
73/37	Great Britain	*The Beating Noise of Aircraft.* (T. S. Littler, Aeronautics, Vol. 3, No. 5, Dec., 1940, p. 35.)
73/38	U.S.A. ...	*Some American Blind Approach Systems.* (Aeronautics, Vol. 3, No. 5, Dec., 1940, pp. 40-41.)
73/39	Great Britain	*Flotation Altitude during Forced Landings at Sea.* (J. A. Medhurst, Flight, Vol. 38, No. 1,670, 26/12/40, p. 553.)

https://doi.org/10.1017/S036839310014012X Published online by Cambridge University Press

ITEM NO.		TITLE AND JOURNAL.
73/40	Great Britain	*Vibration Pattern of Propeller Blades.* (G. S. Baker, Engineering, Vol. 150, No. 3,911, 27/12/40, pp. 518-519.)
73/41	Great Britain	*Feathering Airscrews.* (L. B. Greensted, Aeroplane, Vol. 59, No. 1,543, p. 711.)
73/42	Great Britain	*Rotol V.P. Airscrew with Blade Setting by Electric Motor.* (Inter. Avia., No. 734, 5/11/40, pp. 4-5.)
73/43	Italy ...	*New Italian Transport Plane Ca-216.* (Inter. Avia., No. 734, pp. 5-6.)
73/44	Japan ...	*Japanese Flying Boat Kawasaki.* (Inter. Avia., No. 735, 12/11/40, p. 7.)
73/45	U.S.A. ...	*Curtiss-Wright Substratosphere Airliner C.W.20.* (Inter. Avia., No. 735, pp. 8-9.)
73/46	Great Britain	*The Prediction of Performance.* (W. Stepniewski, Airc. Eng., Vol. 12, No. 142, Dec., 1940, pp. 361-365.)
73/47	Great Britain	*Prevention of Ice on Windscreen.* (N.A.C.A. Tech. Note 754. L. A. Rodert, Airc. Eng., Vol. 12, No. 142, Dec., 1940, pp. 366-369.)
73/48	U.S.A. ...	*Instrument Landing in the U.S.A. with Special Reference to the Indianapolis System.* (Airc. Eng., Vol. 12, No. 142, Dec., 1940, pp. 370-77.)
73/49	U.S.A. ...	*Standardisation in Aeroplane Design.* (J. T. Thompson, Airc. Eng., Vol. 12, No. 142, pp. 373-4 and 882.)
73/50	Great Britain	*Vibration of Propeller Blades (Account of the Work of the N.P.L.).* (Nature, Vol. 146, No. 3,713, 28/12/40, p. 843.)
73/51	Great Britain	*Plastic Wings Over the Empire (Editorial Discussing the Vidal Process).* (Plastics, Vol. 5, No. 44, Jan., 1941, pp. 1-2.)
73/52	Great Britain	*Flight without Power: The Art of Gliding and Soaring (Book Review).* (L. B. Barringer, London; Sir Isaac Pitman and Sons, Ltd., 1940, 251 pp., price 17/6. Nature, Vol. 147, No. 3,715, 11/1/41, pp. 38-9.)
73/53	Great Britain	*Undercarriages.* (R. Hadekel, Aeroplane, Vol. 59, No. 1,545, pp. 23-26.)
73/54	Great Britain	*Bristol Blenheim—Quantity Production Methods.* (B. Foster, Airc. Prod., Vol. 3, No. 27, Jan., 1941, pp. 7-16.)
73/55	U.S.A. ...	*A Flight Investigation of Exhaust Heat De-Icing.* (L. A. Rodert and A. R. Jones, N.A.C.A. Tech. Note No. 783, Nov., 1940.) (Abstract available.)
73/56	U.S.A. ...	*Mechanism of Flutter. A Theoretical and Experimental Investigation of the Flutter Problem.* (T. Theodorsen and I. E. Garrick, N.A.C.A. Report No. 685, 1940.) (Abstract available.)
73/57	U.S.A. ...	*Air Forces on Radial Air-Cooled Engine Cowlings as Determined from Pressure Distribution Tests.* (R. R. Higginbotham, J.S.A.E., Vol. 47, No. 3, Sept., 1940, pp. 370-96.)

Engines and Accessories.

73/58	Great Britain	*The Development of the Brown Boveri Axial Compressor.* (Seippet, Brown Boveri Review, May, 1940, pp. 108-113. Met. Vick. Tech. News Bull., No. 742, 20/12/40, p. 9.) (Abstract available.)

ITEM NO.		TITLE AND JOURNAL.
73/59	Great Britain	*The Application of the Two-Stroke Heavy Oil Engine to Aircraft Propulsion (with Discussion).* (W. S. Burn, Flight, Vol. 38, No. 1,670, 26/12/40, pp. a-545 and 552.)
73/60	U.S.A. ...	*Allison V-710-015 12-Cylinder Engine.* (Inter. Avia., No. 734, 5/11/40, pp. 7-8.)
73/61	U.S.A. ...	*Lycoming Flat Twelve Engine* o-1230. (Inter. Avia., No. 734, 5/11/40, p. 8.)
73/62	Great Britain	*Dimensionless Characteristics of Turbines and Pumps.* (J. Jennings, Engineer, Vol. 170, No. 4,434, 3/1/41, p. 12.)
73/63	Great Britain	*Rotary Vane Vacuum Pump.* (Engineering, Vol. 151, No. 3,912, 3/1/41, pp. 6-7.)
73/64	Great Britain	*British Aero Motors.* (Aeroplane, Vol. 59, No. 1,541, 6/12/40, pp. 653-658.)
73/65	Germany ...	*Tests of Lead-Bronze Bearings in the D.V.L. Bearing Testing Machine.* (G. Fischer, L.F.F., Vol. 16, No. 7, 20/7/39, pp. 370-383. N.A.C.A. Tech. Memo. No. 943, June, 1940.) (Abstract available.)
73/66	Italy ...	*Italian High-Speed Aeroplane Engines.* (C. F. Bona, Paper presented at the 5th Volta Congress at Rome, Sept. 30th-Oct. 6th, 1935. N.A.C.A. Tech. Memo. No. 944, June, 1940.) (Abstract available.)
73/67	Germany ...	*Experiments on Ball and Roller Bearings under Conditions of High Speed and Small Oil Supply.* (G. Getzlaff, Jahrbuch der deutschen L.F.F., Vol. 2, 1938, pp. 110-118. N.A.C.A. Tech. Memo. No. 945, July, 1940.)
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73/69	U.S.S.R. ...	*Determination of Free Oscillation Frequency of Turbine Blades.* (I. K. Chernishevsky, Sov. Kotloturbo, No. 8, 1940, pp. 269-73. Met. Vick. Tech. News Bull., No. 743, 3/1/41.) (Abstract available.)
73/70	U.S.A. ...	*Problem of Valve-Stem and Valve-Head Deposits.* (A. T. Colwell, J.S.A.E., Vol. 47, No. 3, Sept., 1940, pp. 358-65.) (Abstract available.)
73/71	U.S.A. ...	*Design and Shop Problems in High Pressure Hydraulic Systems.* (H. W. Adams, J.S.A.E., Vol. 47, No. 3, Sept., 1940, pp. 367-9.)
73/72	U.S.A. ...	*Guiberson Aero Diesel.* (Flight, Vol. 39, No. 1,671, 2/1/41, p. 9.)
73/73	Great Britain	*A New Vacuum Pump (Fenton-Smith Bros.).* (Aeroplane, Vol. 60, No. 1,546, 10/1/41, pp. 54-6.)

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73/74	Great Britain	*New Lubricant for Precision Instruments.* (Nature, Vol. 146, No. 3,712, 21/12/40, p. 810.)
73/75	U.S.A. ...	*Modern Fuels and Lubricants for Diesels (Review of Papers presented at November S.A.E. Meeting).* (P. M. Heldt, Autom. Ind., Vol. 83, No. 11, 1/12/40, pp. 582-587 and 616.)

ITEM NO.		TITLE AND JOURNAL.
73/76	U.S.A. ...	*Diesel Fuels for Easy Starting.* (L. A. Blane, Autom. Ind., Vol. 83, No. 11, 1/12/40, p. 616.)
73/77	Great Britain	*Town's Gas Fuel for Petrol Engines.* (Engineer, Vol. 170, No. 4,434, 3/1/41, p. 12.)
73/78	Great Britain	*Gas Filling Stations for Motor Transport.* (Engineer, Vol. 170, No. 4,434, 3/1/41, p. 12.)
73/79	U.S.A. ...	*On the Mechanism of Boundary Lubrication I. The Action of Long-Chain Polar Compounds.* (O. Beeck, J. W. Givens and A. E. Smith, Proc. Roy. Soc., Vol. 177, No. 968, 31/12/40, pp. 90-102.) (Abstract available.)
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73/81	Great Britain	*Some New Developments in the Petroleum Industry.* (W. D. Williams, Chem. and Ind., Vol. 60, No. 2, 11/1/41, pp. 22-4.)
73/82	U.S.A. ...	*Estimating Oil Viscosity at Zero Degrees.* (J.S.A.E., Vol. 47, No. 3, Sept., 1940, p. 397.)

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73/83	Great Britain	*The Mark IX Sextant.* (F. Chichester, Aeroplane, Vol. 59, No. 1,542, 13/12/40, pp. 669-670.)
73/84	U.S.A. ...	*Pyrometry, especially of Molten Steel.* (Metal Progress, Vol. 38, No. 4, Oct., 1940, p. 549.)
73/85	Great Britain	*Electrical Tachometers.* (Baker, Electrical Review, 27/12/40, pp. 179-80. Met. Vick. Tech. News Bull., No. 743, 3/1/41.)

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73/86	Great Britain	*Analysis of Rigid Jointed Framework.* (E. H. Lewitt, J. Roy. Aer. Soc., Vol. 44, No. 360, Dec., 1940, pp. 849-861.)
73/87	Great Britain	*Resistance Welding.* (Nature, Vol. 146, No. 3,711, 14/12/40, p. 784.)
73/88	Great Britain	*Application of X-Rays to the Study of Alloys.* (H. Lipson, Nature, Vol. 146, No. 3,712, 21/12/40, pp. 798-801.)
73/89	Great Britain	*Some Modern Electrical Insulating Materials.* (H. Warren, J. Inst. Elec. Engrs., Vol. 87, No. 528, Dec., 1940, pp. 588-96.)
73/90	Great Britain	*Review of Recent Papers on Magnesium Alloy Construction for Aeroplanes.* (Light Metals, Vol. 3, No. 36, Jan., 1941, pp. 3-6.)
73/91	Great Britain	*Test Bars for Light Alloy Castings.* (F. A. Allen and J. Morgan, Light Metals, Vol. 3, No. 36, Jan., 1941, pp. 17-18.)
73/92	Great Britain	*Age Hardening Magnesium Alloys.* (W. F. Chubb, Light Metals, Vol. 3, No. 36, Jan., 1941, pp. 19-20.)
73/93	Great Britain	*Compressed Impregnated Timber.* (R. M. Lloyd, Aeroplane, Vol. 59, No. 1,542, pp. 682-684.)
73/94	Great Britain	*Welding Metal to Glass.* (Aeroplane, Vol. 59, No. 1,542, 13/12/40, p. 688.)

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73/95	Great Britain	*Specification for Wire Rope for Kite Balloons.* (Aeroplane, Vol. 59, No. 1,542, 13/12/40, p. 688.)
73/96	Great Britain	*Non-Destructive Production Tests for Steel Tubing.* (Steel, 21/10/40, pp. 38-40 and 75. Met. Vick. Tech. News Bull., No. 742, 20/12/40, p. 6.) (Abstract available.)
73/97	Great Britain	*Development in Wood Technology.* (D. Brownlie, Engineering, Vol. 150, No. 3,911, 27/12/40, pp. 502-3.)
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73/101	Great Britain	*Application of Anodised Aluminium. A Review of Patents.* (Metal Industry, Vol. 57, No. 26, 27/12/40, pp. 502-5.)
73/102	U.S.A. ...	*Spotwelding in Aircraft Construction. Details of American Equipment and Design. (Paper to Amer. Welding Socy.)* (C. F. Marschner, Metal Industry, Vol. 57, No. 24, 13/12/40, pp. 506-9.)
73/103	Belgium ...	*Plane Braced Frames Loaded Perpendicularly to their Planes. A New Application of Cross' Method.* (J. Roy. Aer. Soc., Vol. 44, No. 359, Nov., 1940, pp. 827-43.) (Abstract available.)
73/104	Germany ...	*New Equipment for Testing the Fatigue Strength of Riveted and Welded Joints.* (W. Müller, Special Reprint of Schweizer Archiv., No. 10, 1937. N.A.C.A. Tech. Memo. No. 947, July, 1940.) (Abstract available.)
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73/106	U.S.A. ...	*Fiberglas. New Basic Raw Material.* (G. Slayter, Ind. and Eng. Chem. (Ind. Ed.), Vol. 32, No. 12, Dec., 1940, pp. 1,568-71.) (Abstract available.)
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73/114	U.S.A.	...	*Plating of Aircraft Parts.* (G. E. Stoll, Metal Progress, Vol. 38, No. 4, Oct., 1940, p. 435.)
73/115	U.S.A.	...	*Developments in Surface Finish.* (J. M. S. Hutchinson and J. M. Lessells, Metal Progress, Vol. 38, No. 4, Oct., 1940, p. 435.)
73/116	U.S.A.	...	*Stainless Steel—The Next Step for Aircraft.* (W. B. Stout, Metal Progress, Vol. 38, No. 4, Oct., 1940, pp. 461-2.)
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73/130	Great Britain		*Creep Properties of a Carbon Molybdenum Cast Steel.* (Tapsell and Prosser, Proc. Inst. Mech. Eng., Dec., 1940, pp. 91-6. Met. Vick. Tech. News Bull., No. 743, 3/1/41.)
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73/139	Great Britain	*Optical Flats.* (Airc. Prod., Vol. 3, No. 27, Jan., 1941, pp. 34-5.)
73/140	U.S.A. ...	*Stress Distribution in, and Equivalent Width of Flanges of, Wide, Thin-Wall Steel Beams.* (G. Winter, N.A.C.A. Tech. Note No. 784, Nov., 1940.) (Abstract available.)
73/141	Great Britain	*Protective Coating on Tin Plate by Chemical Treatment.* (R. Kerr, J. Soc. Chem. Ind. (Absts. " B "), Vol. 59, No. 12, Dec., 1940, pp. 259-265.)
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73/151	Great Britain	*Factory Lighting in War Time.* (Engineer, Vol. 170, No. 4,436, 10/1/41, p. 37.)

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73/153	Great Britain	*R.A.F. Night Photography.* (Flight, Vol. 170, No. 4,433. 27/12/40, p. 415.)