Russian and Japanese Aerospace Literature

During 1994 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Jets and Wakes from Russia and Antenna Design from Japan.

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Russian Aerospace Literature
This month: *Jets and Wakes*

A93-55026   Determination of the N2(+)+e recombination rate constant from ballistic experiments (Opredelenie kostanty skorosti rekombinatsii N2/+/+e iz ballisticheskikh ehksperimentov). N. N. PILYUGIN and A. V. PRONIN, Moskovskij Gosudarstvennyj Univ., Moscow, Russia, *Teplofizika Vysokikh Temperatura* (ISSN 0040-3644), Vol. 31, No. 2, April 1993, pp. 163–168. 18 Refs. Documents available from Aeroplus Dispatch.

Methods of nonlinear regression analysis and results of microwave measurements of the electron concentration in the wake of a body moving at a hypersonic velocity in pure nitrogen are used to obtain the ambipolar Schmidt number, constants determining temperature distribution along the wake axis, initial wake diameter, and temperature dependence of the N2(+)+e dissociative recombination rate constant. Based on the constants and solutions obtained, calculations are made of temperature distributions, electron concentrations, and wake width increase. Good agreement is obtained between the numerical and experimental results.

A93-53333   Construction of wakes in the discrete vortex method (O postroenii sledov v metode diskretnykh vikhrej). I. K. LIFANOV, Voenno-Vozdushnaya Inzhenernaya Akademiya, Moscow, Russia, *Rossijskaya Akademiya Nauk, Doklady* (ISSN 0869-5652), Vol. 330, No. 5, June 1993, pp. 574–578. 4 Refs. Documents available from Aeroplus Dispatch.

The use of the discrete vortex method for solving problems of flow of an ideal (nonviscous) fluid past a body is discussed. In particular, attention is given to the calculation of wakes and jets behind bodies of various configurations. Some characteristic phenomena associated with wake and jet flows are briefly examined.

A93-51912   Calculation of a plane supersonic jet simulating the exhaust jet of a hypersonic flight vehicle engine (Raschet ploskoj sverkhzvukovoj strui, modeliruyushchej vykhlopnuyu struyu dvigatelya giperzvukovogo LA). V. V. SILAEV, In *Problems in the Aerodynamics of Flight Vehicles and Their Components* (A93-51901 22-02), Moscow, Russia, Moskovskij Aviatsionnyj Institut, 1992, pp. 70–75. 5 Refs. Documents available from Aeroplus Dispatch.

The main differential equation of gas dynamics for a plane steady state potential nonviscous flow is solved by the layer-by-layer method of characteristics. The method combines the properties of orthogonal grid methods and those of the traditional version of the method of characteristics. A full system of equations is then derived which includes differential equations of characteristics, compatibility conditions, the Bernoulli equation, and the equation of state. Based on this approach, a program has been developed for calculating plane supersonic jets simulating the exhaust flow of the engines of hypersonic flight vehicles. A calculation example is included.

A93-51901   Problems in the aerodynamics of flight vehicles and their components (Voprosy aehrodinamiki letatel'nykh apparatov i ikh chastej). YU. A. RYZHOV, ED., Moscow, Russia, Moskovskij Aviatsionnyj Institut, 1992, p. 91 (For individual items see A93-51902 to A93-51914). Documents available from Aeroplus Dispatch.

The papers presented in this volume provide an overview of recent theoretical and experimental work in the field of flight vehicle aerodynamics and general aeromechanics. In particular, attention is given to the calculation of compressed gas flows on optimal difference grids, spline-collocation solution of a Fredholm equation of the second kind in the problem of flow past an air-

foil, a study of the aerodynamics of a wing with end slots, and aerodynamic characteristics of airship models of different shapes. Other topics discussed include determination of the aerodynamic characteristics of a thin body of revolution with a piecewise linear distribution of singularities at its axis, calculation of a plane supersonic jet *simulating the exhaust jet* of a hypersonic flight vehicle engine, and a stability condition for the motion of a continuous incompressible medium.

A93-51822   Effect of the parameters of an external feedback loop on the characteristics of self-oscillations during the impingement of an underexpanded jet on a finite obstacle (Vliyanie parametrov vneshnej tsepi obratnoj svyazi na kharakteristiki avtokolebanij pri natekanii nedorasshirennoj strui na konechnuyu pregradu. S. G. MIRONOV, *PMTF— Prikladnaya Mekhanika i Tekhnicheskaya Fizika* (ISSN 0044-4626), No. 1, Jan.–Feb. 1993, pp. 94–100. 16 Refs. Documents available from Aeroplus Dispatch.

The effect of the velocity of acoustic waves traveling from the obstacle to the nozzle and their intensity near the nozzle edge on the amplitude-frequency and phase characteristics of self-oscillations generated during the impingement of an underexpanded jet on the end of a finite cylinder is investigated experimentally. The results obtained are analyzed from the standpoint of the two principal mechanisms of sustained self-oscillations in such jet systems: feedback through waves in the shock layer between the obstacle and the central shock wave and feedback through acoustic waves propagating in the ambient medium.

A93-51780   Supersonic flow past a cone with heat transfer near its tip (Sverkhzvukovoe obtekanie konusa pri teplopodvode v okrestnosti ego vershiny). V. A. LEVIN and L. V. TERENT'EVA, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 2, Mar.–Apr., 1993, pp. 110–114. 12 Refs. Documents available from Aeroplus Dispatch.

Supersonic flow past a cone in the wake of a spherical heat source is investigated analytically. The problem is reduced to that of solving a system of gas dynamics equations written in nondimensional form. The equations are solved numerically using the McCormack method. It is shown that heat transfer toward the nose of the body effectively reduces its wave resistance.

A93-51774   Numerical modeling of the inhomogeneous breakup of capillary jets (Chislennoe modelirovanie neodnorodnogo raspada kapillyarnykh struj). V. E. EPIKHIN and V. YA SHKADOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 2, Mar.–Apr. 1993, pp. 12–17. 4 Refs. Documents available from Aeroplus Dispatch.

The problem of jet surface evolution up to the stage where the jet breaks up into drops is investigated numerically for two initial wave perturbations. The wave number of one of the perturbations corresponds to that of the perturbation with the greatest growth rate in accordance with the linear theory; the wave number of the other varies. The effect of the wave numbers and of the amplitude ratio of the initial perturbations on the breakup time and manifestations of the breakup inhomogeneity is examined.

A93-51767   Modification of turbulence models for an axisymmetric jet flow (Modernizatsiya modelej turbulentnosti dlya osesimmetrichnogo

strujnogo techniya) V. E. KOZLOV, *PMTF—Prikladnaya Mekhanika i Tekhni-cheskaya Fizika* (ISSN 0869-5032), No. 2, Mar.–Apr. 1993, pp. 43–48. 8 Refs. Documents available from Aeroplus Dispatch.

Modification of 1D and 2D turbulence models based on the Prandtl theory for plane and axisymmetric jet flows is proposed to obtain high-accuracy descriptions of axisymmetric jet mixing. The modification is based on replacing the modulus of a velocity gradient with its effective value. The modified models are verified by applying them to an axisymmetric isobaric flooded jet in an incompressible flows.

A93-51078   Ionospheric effects due to the injection of a high-velocity cumulative air-plasma jet (Ionnosfernye ehffekty pri inzhektsii vysokoskorostnoj kumulyativnoj vozdushno-plazmennoj strui). M. B. BELOTSERKOVSKIJ, A. V. GURVICH, A. M. EVTUSHEVSKIJ, YU. N. KISE-LEV, G. P. MILINEVSKIJ, YU. A. ROMANOVSKIJ, B. D. KHRISTOFOROV, and V. M. FEJGIN, *Kosmicheskie Issledovania* (ISSN 0023–4206), Vol. 31, No. 2, Mar.–Apr. 1993, pp. 32–42. 12 Refs.

Results of experimental investigations of artificial plasma structures generated at 140–150 km heights in the night midlatitude ionosphere are presented. A cumulative explosive air-plasma jet generator was used. Using distant optical and radiophysical observations, such as in situ measurements, the following effects are discussed in detail: the dynamics of an artificial plasma cloud, generation of electric fields and low frequency emissions, disturbances of the magnetic field and increases of soft and energetic electron fluxes. Experimental data on the effects observed are interpreted in a preliminary manner using a specially developed model. (Author)

A93-50176   On the subject of 'ecologically clean' rocket propellants. A. P. TISHIN and A. V. RODIONOV (TsNII Mashinostroeniya, Kaliningrad, Russia). *AIAA, SAE, ASME, and ASEE, Joint Propulsion Conference and Exhibit,* 29th, Monterey, CA, June 28–30, 1993, 6 pp. 13 Refs. Documents available from Aeroplus Dispatch.

The paper compares the amount of ecologically harmful pollutants emitted into stratosphere from three types of rocket propellants (LOX-kerosene, N2O4–(CH3)2N2H2, and LOX-liquid H2) used with three engines: the RD-170 engine of the Energiya first-stage rocket system, the RD-253 engine of the Proton first-stage system, and the RD-0120 engine of the Energiya second-stage rocket system. It is shown that, to assess the harmful effect of the rockets' product emission on the environment, it is necessary to consider the following three factors: the impurities contained in the propellant components, the chemical nonequilibrium at the nozzle expansion, and the nonequilibrium chemical reactions taking place where the reaction jet mixes with the atmospheric air. It was found that the values of the hazardous exhaust computed for the Shuttle and Energiya launching systems are an order of magnitude lower than the values previously published in the USA and USSR.

A93-48849   Effect of the size of a plane obstacle on self-oscillations generated in an underexpanded supersonic jet (Vliyanie razmera ploskoj pregrady na avtokolebaniya, voznikayushchie pri ee obtekanii sverkhzvukovoj nedorasshirennoj struej). V. N. GLAZNEV and V. YU. POPOV, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 6, Nov.–Dec. 1992, pp. 164–168. 8 Refs. Documents available from Aeroplus Dispatch.

Results of an experimental study of self-oscillations generated in an underexpanded supersonic jet flowing around a cylinder end are reported. An analysis of the results obtained indicates that the intensity of the generated oscillations depends in a noticeable and nonmonotonic manner on the obstacle size. The results are presented in graphic form.

A93-48846   Atmospheric aerosols due to aircraft and ecological problems (Atmosfernye aehrozoli aviatsionnogo proiskhozhdeniya i ehkoiogicheskie problemy). A. B. VATAZHIN and A. A. SOROKIN, *Rossijskaya Akademiya Nauk, Izvestiya, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 6, Nov.–Dec. 1992, pp. 57–72. 35 Refs. Documents available from Aeroplus Dispatch.

Problems related to the formation and evolution of atmospheric aerosol produced by the jets of subsonic aircraft are examined. Analysis is made of the hydrodynamic and physicochemical processes occurring in the combustion chamber, exhaust system, wake jet, and ambient atmosphere that lead to the heterogeneous and homogeneous condensation and formation of disperse phases of different compositions in the upper troposphere and lower stratosphere. The amount of aircraft-related aerosol at these altitudes is predicted on the basis of the available data.

A93-46975   Heat transfer on blunt cones in nonuniform supersonic flow in the presence of gas injection from the surface (Teploobmen na zatuplennykh konusakh pri sverkhzvukovom neravnomernom obtekanii i nalichii vduva s poverkhnosti). N. N. PILYUGIN and R. F. TALIPOV, (Moskovskij Gosudarstvennyj Univ., Moscow, Russia), *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 31, No. 1, Feb. 1993, pp. 97–104. 18 Refs. Documents available from Aeroplus Dispatch.

The parameters of laminar flow and heat transfer on a blunt cone in a nonuniform supersonic flow are calculated using the equations of the total viscous shock layer (TVSL) model, with particular consideration given to the characteristics of the oncoming wake-type flow and to the effect of gas injection from the surface. The results of TVSL calculations of the flow and heat-transfer parameters are compared with other numerical and a symptotic solutions. It is shown that the efficiency of gas injection at the critical point of the model for the purpose of lowering the heat flow intensity can be significantly increased by using the nonuniformity of the oncoming flow.

A93-46556   Analysis of mechanisms and the nature of radiation from aluminum oxide in different phase states in solid rocket exhaust plumes. N. A. ANFIMOV, G. F. KARABADYAK, B. A. KHMELININ, Y. A. PLASTININ and A. V. RODIONOV (Central Research Inst. of Machine-Building, Kaliningrad, Russia), *AIAA Thermophysics Conference,* 28th, Orlando, FL, July 6–9, 1993, p. 12. 22 Refs.

We discuss issues of mechanisms and the nature of A1203 radiation in the plume of solid-propellant rocket motors. It was disclosed that the A1203 optical constants responsible for liquid and solid particle radiation in the plume can be specified from a single point of view in terms of liquid semiconductor properties with the zone structure having a forbidden handwidth around 4 eV near the melting point, and A1203 metastable solid gamma-phase without a jumpwise change of the short-range order during the liquid-solid transition. It was noticed that, for a slow cooling at a rate less than 1000 K/sec, the metastable phase transforms to a stable alpha-phase with drastic reduction of radiative properties. The computational results of spectral radiance of solid-propellant motor exhaust jets obtained on our model of A1203 optical properties conform to available published data on UV and visual characteristics measured in experiments with aluminized propellants. (Author)

A93-44025   Magnetic field, reconnection, and particle acceleration in extragalactic jets. M. M. ROMANOVA (Russian Academy of Sciences, Inst. of Space Research, Moscow, Russia) and R. V. E. LOVELAC, (Cornell Univ., Ithaca, NY), *National Aeronautics and Space Administration,* Washington, DC. Source: Astronomy and Astrophysics (ISSN 0004–6361), Vol. 262, No. 1, Aug. 1992, pp. 26–36. 94 Refs.

Extra-galactic radio jets are investigated theoretically taking into account that the jet magnetic field is dragged out from the central rotating source by the jet flow. Thus, magnetohydrodynamic models of jets are considered with zero net poloidal current and flux, and consequently a predominantly toroidal magnetic field. The magnetic field naturally has a cylindrical neutral layer. Collisionless reconnection of the magnetic field in the vicinity of the neutral layer acts to generate a non-axisymmetric radial magnetic field. In turn, axial shear-stretching of reconnected toroidal field gives rise to a significant axial magnetic field if the flow energy-density is larger than the energy-density of the magnetic field. This can lead to jets with an apparent longitudinal magnetic field as observed in the Fanaroff-Riley class II jets. In the opposite limit, where the field energy-density is large, the field remains mainly toroidal as observed in Fanaroff-Riley class I jets. Driven collisionless reconnection at neutral layers may lead to acceleration of electrons to relativistic energies in the weak electrostatic field of the neutral layer. A simple model is discussed for particle acceleration at neutral layers in electron/position and electron/proton plasmas. (Author)

N93-29090   Science and technology. Central Eurasia: Engineering and equipment. *Joint Publications Research Service,* Arlington, VA, May 1993, 19 pp.

Translated abstracts cover the following areas: optics, nuclear energy, fluid dynamics, and industrial technology. Some specific topics include internal source optimization in problem of sphere in MHD flow; on development of oblique waves in planar subsonic boundary layer; variational method of plotting subsonic airfoil profiles; and gas dynamics of pulsed jets and pressure oscillations on laser-irradiated target.

A93-39202   Flight efficiency theory (Teoriia poletnogo KPD). V. D. ZA-KHAROV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 4, 1992, pp. 102–107. 8 Refs. Documents available from Aeroplus Dispatch.

The principal concepts of a flight efficiency theory for a flight vehicle with a jet engine are presented from the standpoint of the principle of thrust generation (in coordinates tied to the medium in which the flight takes place). The inadequacy of the existing concepts of flight efficiency is demonstrated.

A93-39123   Underexpanded boundary jet in a wake flow (Pristenochnaia nedorasshirennaia struia v sputnom potoke). E. G. ZAITSEV, "Rossiiskaia Akademiia Nauk," Izvestiia, Mekhanika Zhidkosti i Gaza (ISSN 0568-5281), No. 1, Jan.–Feb. 1993, pp. 196–199. 10 Refs. Documents available from Aeroplus Dispatch.

The flow characteristics of a planar underexpanded boundary jet discharged from an acoustic nozzle along the channel wall was experimentally investigated. A relationship is obtained between the magnitude of the first pulsation of the jet and the pressure differential. It is shown that, as the jet flows along the channel, a substantial axial gradient is formed in the initial section of the wake flow, resulting in a significantly changed geometry of the boundary jet.

A93-39114   Disturbance of self-similarity in turbulent axisymmetric twisted wakes (Narushenie avtomodel'nosti v turbulentnykh osesimmetrichnykh sledakh s zakrutkoi). A. G. GUMILEVSKII, *Rossiiskaia Akademiia Nauk, Izvestiia, Mekhanika Zhidkosti i Gaza* (ISSN 0568-5281), No. 1, Jan.–Feb. 1993, pp. 41–47. 9 Refs. Documents available from Aeroplus Dispatch.

The effects of momentum imbalance and background turbulence on the features of self-similarity in twisted axisymmetric wakes were investigated. Using the Reynolds equation to describe the evolution of an axisymmetric wake in the framework of a two-parameter turbulence model, the laws predicting the evolution of the characteristics of zero-momentum twisted wakes were deduced. However, the predictions obtained did not agree with laws derived by Kostomakha and Lesnova (1991) using experimental data, indicating that the existing turbulence models need to be modified.

A93-36770 **Multiplicity and uniqueness in the theory of the Rayleigh-Taylor instability-Possible steady state solutions and solution choices (Mnozhestvennost' i edinstvennost' v teorri relei-teilorovskoi neustoichivosti—Vozmozhnye statsionarnye resheniia i vybor sredi nikh).** N. A. INOGAMOV and A. V. CHEKHLO (RAN, Inst. Teoreticheskoi Fiziki, Moscow, Russia), "Rossiiskaia Akademiia Nauk," Doklady (ISSN 0869-5652), Vol. 328, No. 3, Jan. 1993, pp. 311–314. In Russian. 12 Refs. Documents available from Aeroplus Dispatch.

The paper is concerned with the problem of the analysis of steady state solutions in the theory of the Rayleigh-Taylor instability. By using computer algebra methods, it is demonstrated that the totality of these solutions forms a one-parameter family, F. By using a new two-dimensional hydrodynamic numerical method, it is then determined which of the solutions in F originates from a periodic initial perturbation. It is found that this solution has the smallest curvature radius and is limiting in F. The harmonic spectrum is calculated. The existence of a nonperiodic steady state solution with a solitary jet under certain boundary conditions is demonstrated.

A93-35340 **Gas dynamics of pulsed jets and pressure oscillations on a laser-irradiated target (Gazodinamika impul 'snykh strui i ostsilliatsii davleniia na obluchaemoi lazerom misheni).** N. M. BULGAKOVA and L. I. KUZNETSOV, *PMTF—Prikladnaia Mekhanika i Tekhnicheskaia Fizika* (ISSN 0044-4626), No. 6, Nov.–Dec. 1992, pp. 14–21. In Russian. 19 Refs. Documents available from Aeroplus Dispatch.

The irradiation of solid targets by high-power millisecond laser pulses may give rise to pressure oscillations in the frequency range of the order of 10 kHz. Several hypotheses have been proposed to explain the mechanism of these oscillations. Here, in order to test these hypotheses, the gas dynamics of an erosion jet on the target is modeled numerically, and the results are compared against experimental data over a wide range of laser radiation intensities. It is found that the main mechanism of the observed pressure oscillations on the target involves the induced motion of the gas in the sumberged space and its effect on the nonirradiated edges of the target.

A93-35266 **Unsteady supersonic flow around a blunt body in thermal inhomogeneities in turbulent shock layer flows (Nestatsionarnoe sverkhzvukovoe obtekanie zatuplennogo tela v teplovykh neodnorodnostiakh pri turbulentnom rezhime techeniia v udarnom sloe).** IU. P. GOLOVACHEV and V. V. ZEMLIAKOV, *Zhurnal Vychislitel 'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 33, No. 1, Jan. 1993, pp. 151–155. In Russian. 15 Refs. Documents available from Aeroplus Dispatch.

Unsteady turbulent supersonic flow around a sphere moving through thermal inhomogeneities is investigated numerically using a viscous shock layer model. It is shown that the flow is characterized by significant changes in the shape of the head shock, occurrence of internal shock waves and high-temperature jets in the shock layer, and substantial changes in the distribution of drag and heat transfer parameters on the body surface. The behavior of the heat flow on the body surface is affected to the greatest extent by the laminar-turbulent transition.

A93-33346 **Self-oscillations during the parallel outflow of two supersonic nonisobaric jets (Avtokolebaniia pri parallel'nom istechenii dvukh sverkhzvukovykh neizobaricheskikh strui).** S.G. MIRONOV, *PMTF—Prikladnaia Mekhanika i Tekhnicheskaia Fizika* (ISSN 0044-4626), No. 5, Sept.–Oct. 1992, pp. 29–36. In Russian. 20 Refs. Documents available from Aeroplus Dispatch.

The generation of self-oscillations in a system of two parallel supersonic nonisobaric jets is examined with reference to new experimental results obtained by schlieren photography using a stroboscopic lamp synchronized by acoustic pressure pulses. Models are proposed which describe the directional characteristics of acoustic emission and the conditions of excitation of self-oscillations. The validity of the models is demonstrated experimentally.

A93-31223 **A study of the acoustic characteristics of a gas jet burning in coflow of an oxidizer with varying turbulence parameters (Issledovanie akusticheskikh kharakteristik strui gaza, goriashchei v sputnom potoke okislitelia s razlichnymi parametrami turbulentnosti).** K. V. LYSENKO (NII Khimicheskogo Mashinostroeniia, Zagorsk, Russia). *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 30, No. 6, Nov.–Dec. 1992, pp. 1232–1235. In Russian. 20 Refs.

The effect of the turbulence scale and intensity in coflow of an oxidizer on the acoustic noise parameters during the combustion of coaxial gas jets was investigated experimentally. The inner fuel channel was 3 mm in diameter; the outer oxidizer channel was 10 mm in diameter; the fuel components were oxygen and methane. In the range of parameters investigated, the level of acoustic noise during gas jet combustion is found to be independent of the macroscale of the oxidizer flow turbulence. An exponential relation is found to exist between the noise level and the oxidizer turbulence intensity.

A93-31174 **Determination of the internal thrust of jet engines from measured static gas pressures (Opredelenie vnutrennei tiagi VRD po izmerennym staticheskim davleniiam gaza).** I. G. TSYBALOV and V. N. STEPANENKO, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1992, pp. 88–92. In Russian. 3 Refs.

A formula for the thrust of jet engines is derived as a function of static pressure. Static pressures are measured at two sections of the air intake and at two sections of each engine nozzle. Results of experimental studies aimed

at the verification of the proposed method for determining the engine thrust are presented.

A93-31163 **Selection of the parameters and operating conditions of laser cutter nozzles (Vybor parametrov i rezhimov raboty sopel dlia gazolazernoi rezki).** V. I. PANCHENKO and F. K. SMORODIN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 3, 1992, pp. 54–57. In Russian. 4 Refs.

The interaction between a gas jet and a target during laser cutting was investigated experimentally for nozzles with different pressure differentials and Mach numbers at the exit section. Based on an analysis of the experimental data obtained, the optimal parameters of laser cutter nozzles are determined. Nozzles with a zero pressure differential or a pressure differential that does not produce a Mach disk in the jet or slow separation within the nozzle are shown to be particularly suitable for laser cutting.

A93-27658 **Effect of combustion on the interaction of an underexpanded wall hydrogen jet with supersonic flow in a plane duct (Vliianie goreniia na vzaimodeistvie pristennoi nedorasshirennoi strui vodoroda so sverkhzvukovym potokom v ploskom kanale).** O. M. KOLESNIKOV, *Fizika Goreniia i Vzryva* (ISSN 0430-6228), Vol. 28, No. 6, Nov.–Dec. 1992, pp. 11–17. In Russian. 8 Refs.

Results of analytical studies of the combustion of an underexpanded wall hydrogen jet, injected into high-temperature supersonic flow along the wall of a plane duct, are reported. Parabolized Navier-Stokes equations are solved by a marching algorithm using global iterations in terms of pressure. Particular attention is given to the effect of combustion on the interaction of the turbulent wall jet with the generated compression shocks. It is shown that combustion leads to a significant increase in the inhomogeneity of the static pressure field, formation of subsonic waves within the supersonic flow, and, in some cases, to the separation in the region of interaction between the strongest compression shock and the boundary layer.

A93-27627 **Consideration of the completeness of combustion and dissociation and recombination processes in mathematical models of jet engines for high supersonic flight velocities (Uchet polonoty sgoraniia, protsessov dissotsiatsii i rekombinatsii v matematicheskikh modeliakh VRD bol 'shikh sverkhzvukovykh skorostei poleta).** V. I. BAKULEV and V. V. KOZLIAKOV, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 2, 1992, pp. 102–105. In Russian. 4 Refs.

Mathematical models are developed for calculating the thermodynamic parameters of gas flow in the combustion chambers of jet engines for oxidizer excess coefficients equal to or greater than 1 and less than 1. The models allow for the dissociation of combustion products and the completeness of combustion. Models of a supersonic jet nozzle are also developed with allowance for recombination processes in gas flow. The thermodynamic parameters and composition of the working medium are calculated by using a modified version of the HNOC program.

A93-27613 **Control of jet breakup in a gas-liquid mixer (Upravlenie razrusheniem strui v gazozhidkostnom smesitele).** M. E. RUDIAK, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 2, 1992, pp. 51–55. In Russian. 13 Refs.

Methods of controlling the breakup of a liquid jet in subsonic cross flow of a gas are developed experimentally. It is shown that, despite the presence of competing jet breakup mechanisms and the chaotic nature of fractionation processes, the phenomena investigated here have sufficiently deterministic characteristics which can be used for control purposes. The effeciency of the jet breakup control methods considered here is estimated.

A93-43017 **Numerical modeling of the interaction of liquid drops and jets with shock waves and gas jets (Chislennoe modelirovanie vzaimodejstviya kapel', struj zhidkosti s udarnymi volnami i gazovymi struyami).** V. S. SUROV (Chelyabinskij Gosudarstvennyj Univ., Chelyabinsk, Russia),*Sibirskij Fiziko-Tekhnicheskij Zhurnal* (ISSN 0869-1339), No. 1, Jan.–Feb. 1993, pp. 116–125. 10 Refs. Document available from Aeroplus Dispatch

The motion of a liquid drop (jet) and of the ambient gas is described, in the general case, by Navier-Stokes equations. An approximate solution to the interaction of a plane shock wave with a single liquid drop is presented. Based on the analysis, the general system of Navier-Stokes equations is reduced to two groups of equations, Euler equations for gas and Navier-Stokes equations for liquid; solutions to these equations are presented. The discussion also covers the modeling of the interaction of a shock wave with a drop screen, interaction of a liquid jet with a counterpropagating supersonic gas flow, and modeling of processes in a shock layer during the impact of a drop against an obstacle in gas flow.

A93-35302 **Stress on the surface of a cylinder parallel to the axis of an underexpanded low-density jet (Napriazhenie na poverkhnosti tsilindra, raspolozhennogo parallel'no osi nedorasshirennoi strui nizkoi plotnosti).** B. F. PANOV, *Sankt-Peterburgskii Universitet, Vestnik, Seriia 1-Matematika, Mekhanika, Astronomiia* (ISSN 0024-0850), No. 4, Oct. 1992, pp. 75–80. In Russian. 7 Refs. Documents available from Aeroplus Dispatch.

Results of an experimental study of pressure and tangential stress distributions on the surface of a cylinder in the path of a strongly underexpanded low-density jet are reported. The measurement results are analyzed on the basis of the local interaction hypothesis. It is shown that the use of this hypothesis provides a high degree of generalization in experimental data analysis.