the jet. In order to investigate the mechanism and behavior of the shock waves, the pressure and velocity distributions in the jets were measured, and these results were compared with schlieren photographs. The inner diameters of the pipes used in these experiments were approximately 9, 13, and 16mm, and the length was over sixty times each diameter. The experiments were carried out for mean Mach numbers, ranging from 1 to 1.6, at the pipe exit. In this investigation, the general mechanism and length of pseudo-shock waves and the correlation between the static pressure and velocity distributions in the jet were clarified for various Mach numbers and three kinds of pipe diameters.

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Analysis of the Deflection of the Main Jet of the Fluid Amplifier by the Finite Element Method

by Tyozi HORIKOSI For an analysis of the deflection mechanism of the main jet by control jet, the analysis by Schwarz-Christoffel's transformation is only able to give an approximate solution. In this study, the mechanism of the deflection of the main jet by the control jet has been analyzed by the finite element method, and the obtained results were examined by the Hele-Shaw flow.

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An Experimental Study on the Flows in a Jet Pump

by Hiroshi NARUI and Susumu INAGAKI An experiment on the mixing flows in the suction port of a jet pump was made analogically, using air in place of water. The mixing took place in a converging bell-mouth inlet and in a successive constant-diameter pipe. Measurements were made of (1)the wall static pressure, (2)the mean velocity profiles, and (3)turbulence for different velocity ratios and nozzle-throat spaces. The mean static pressure distribution on the throat inlet section was obtained by integrating the Reynolds equation in a radial direction.

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An Investigation on the Oscillation Modes of the Rectangular Jet

by Tyozi HORIKOSI, Toshiko IKEDA*, Xiuren LI and Itirō ASANO* The structure of oscillation modes I, II, III of the rectangular jet has been investigated using the color tracer injection method. It was found that the wave-form of mode I has two nodes and one loop, the wave-form of mode II has four nodes and three loops, and the wave-form of mode III has six nodes and five loops. The amplitude of mode I increases with the splitter distance, while the amplitude is constant regardless of the Reynolds number. In addition, comparison of the oscillation characteristics due to the difference of the velocity distribution at the nozzle exit has been made and the difference of the splitter shape has been investigated.

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Two-Dimensional Compressible Flow Analysis in Cascades of Airfoils Based on a Two-Equation Turbulence Model (2nd Report, Investigation on Flow Prediction)

by Susumu NAKANO, Masahiro IKEGAWA, Yoshio SHIKANO* and Yoshiaki YAMAZAKI** A new numerical technique for the analysis of the two dimensional compressible turbulent flow in axial flow turbomachinery, in which a two-equation turbulence model was employed, was presented in the first report. In this paper, the effect of the artificial viscosity, grid refinement and boundary condition of turbulent energy on the resultant solution are discussed in comparison with experimental results (surface pressure distribution, exit flow angle, kinetic energy loss coefficient). It is shown that the present method gives encouraging results for estimating energy loss in cascade flow.

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The Effects of a Flow Obstacle on Liquid Film Flowing Concurrently with Air in a Horizontal Rectangular Duct

by Tohru FUKANO, Kengo MORIKAWA** and Akira TOMINAGA** The aspect of a liquid film flowing near a flat plate type obstacle was observed, and the liquid film thickness and the entrainment were measured over a wide range of gas and liquid flow rates. The results are summarized as follows: (1)The configurations of film flows near the obstacle are classified according to whether (a) the liquid film climbs over the obstacle or not, (b)the air flows under the obstacle or not, or (c)the liquid film swells or sinks just upstream or downstream of the obstacle. (2)The lower the liquid flow rate, the larger the effect of the obstacle on the film thickness. (3) The generation of entrainment is regulated by the obstacle when the air volumetric flux is high and by the disturbance wave when it is low.

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Flow Around a Vertical Cylinder at Various Spacings to a Horizontal Flat Plate

by Ken-ichi OKUI and Fusao MIKAMI The flow around a semi-infinite circular cylinder placed at various spacings to a flat plate has been investigated experimentally. The cylinder was aligned with its axis normal to both the flat plate and to the free stream. Then, the pressure distributions along the plate and

on the cylinder surface were measured and the velocity distributions were measured in the field of the flow behind the cylinder. The flow patterns on the plate and on the end face of the cylinder were visualized using the oil-film-technique, and the flow visualization around the cylinder was done using the liquid-parafin-mist-technique. When the spacing was small, three flow patterns were observed around the cylinder: a horseshoe-like vortex, a symmetrical vortex and a Kármán vortex; and one or two separation points along the plate were observed, too.

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A New Type of Manometer Using Magnetic Fluid

by Shigeaki KURODA and Kenji KASAI A new type of manometer which uses magnetic fluid is developed and its characteristics as a pressure transducer are examined. The displacement of magnetic fluid in a U-type manometer is detected by using a differential transformer. As the differential transformer gives voltage output corresponding to an applied pressure, we can read the pressure with a digital voltmeter. The pressure-voltage coefficient is evaluated as 6.713MPa/Volt for the tested manometer. Though there are still many problems to be solved, this new type of manometer can be used for measuring very low pressures.

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Comparison of Third-Order Upwind Schemes at High Reynolds Numbers

by Masafumi KAWAI and Yasunori ANDO Comparison of three third-order upwind differencing schemes is carried out using the driven flow in a square cavity as the model flow field with Reynolds numbers as high as 5 000. The schemes considered here are those of (a) Leonard(QUICK), (b) Agarwal and (c) Kawamura and Kuwahara. Evaluation is made with respect to accuracy, stability and the CPU time required. As the result, Leonard's scheme shows the best accuracy of the solution, while there is no significant difference in the CPU time among the schemes. Leonard's scheme also shows the best stability both with fine(61×61)and coarse (21×21)grids; stable solutions for Reynolds numbers up to 5 000 can be obtained by this scheme, while other schemes are unstable for Reynolds numbers above 1 000.

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The Flow Around an Oscillating Flat Plate with a Splitter (Numerical Analysis by the Discrete Vortex Model)

by Eiji HATAYAMA and Hitoshi NAKATANI The discrete vortex model together with the conformal mapping method has been applied to analyze the flow around an oscillating flat plate with a splitter in the uniform stream, as the approach to analyze the flow past a deforming and/or moving body. Numerical calculations are performed for four different splitter lengths at three amplitudes and three frequencies, then vortex patterns and unsteady forces are obtained. The vortex pattern by calculations has been compared with the flow visualization using the hydrogen-bubble method. From the calculations, it has been found that the vortex pattern shows good agreement with the flow visualization, and that the forces on the plate show remarkable tendencies in some cases.

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Discrete-Vortex Simulation of a Two-Dimensional Turbulent Impinging Jet

by Seiji SHIMIZU and Atsushi YAMAGUCHI A discrete-vortex model is used to simulate a two-dimensional turbulent impinging jet. The analysis is applied to predict the mean velocity distribution, the turbulent intensity and the pressure distribution on the wall. The results compared favorably with the available experimental data. It is found that the pressure fluctuation on the wall is closely related to the large-scale structures developed in the shear layers of the jet.

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Second Order Correction in Super-Cavitating Hydrofoil Cascade Theory by Singular Perturbation Expansion

by Tetsuo NISHIYAMA and Takeshi ARAI Singular perturbation expansion techiques are applied to the flow field of a super-cavitating hydrofoil cascade for estimating the characteristics to second order accuracy. A coupled integral equation with respect to the two kinds of higher order pressure doublet is derived from the boundary conditions in every stage of approximation and also a method for obtaining the cavity and hydrofoil characteristics based on the semi-closed model determined by the conservation law of momentum is presented. Second order effects on the characteristics are clarified by some numerical examples and then the second order correction curves are presented in the short cavity region for a super-cavitating flat plate hydrofoil of high stagger angle and low pitch chord ratio.

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Melted Flow Behavior in a Crucible of a Crystal Growth Pulling System

by Shigeo NONAKA, Shinichiro TAKASU Melted flow behavior under Czochralski crystal-growth has been simulated by our original code based upon FEM. Important factors were considered, such as crucible bottom shape, crystal diameter, crystal rotation, crucible rotation and kinematic viscosity of fluid, which would influence the flow