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Effects of an axisymmetric contraction on a turbulent pipe flow. (English) Zbl 1241.76255

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Summary: The flow in an axisymmetric contraction fitted to a fully developed pipe flow is experimentally and numerically studied. The reduction in turbulence intensity in the core region of the flow is discussed on the basis of the budgets for the various turbulent stresses as they develop downstream. The contraction generates a corresponding increase in energy in the near-wall region, where the sources for energy production are quite different and of opposite sign compared to the core region, where these effects are caused primarily by vortex stretching. The vortices in the pipe become aligned with the flow as the stretching develops through the contraction. Vortices which originally have a spanwise component in the pipe are stretched into pairs of counter-rotating vortices which become disconnected and aligned with the mean flow. The structures originating in the pipe which are inclined at an angle with respect to the wall are rotated towards the local mean streamlines. In the very near-wall region and the central part of the contraction the flow tends towards two-component turbulence, but these structures are different. The streamwise and azimuthal stresses are dominant in the near-wall region, while the lateral components dominate in the central part of the flow. The two regions are separated by a rather thin region where the flow is almost isotropic.

MSC:

76F10 Shear flows and turbulence
76F40 Turbulent boundary layers
76-05 Experimental work for problems pertaining to fluid mechanics

Cited in **5** Documents

Keywords:

pipe flow boundary layer; shear layer turbulence; vortex interactions

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