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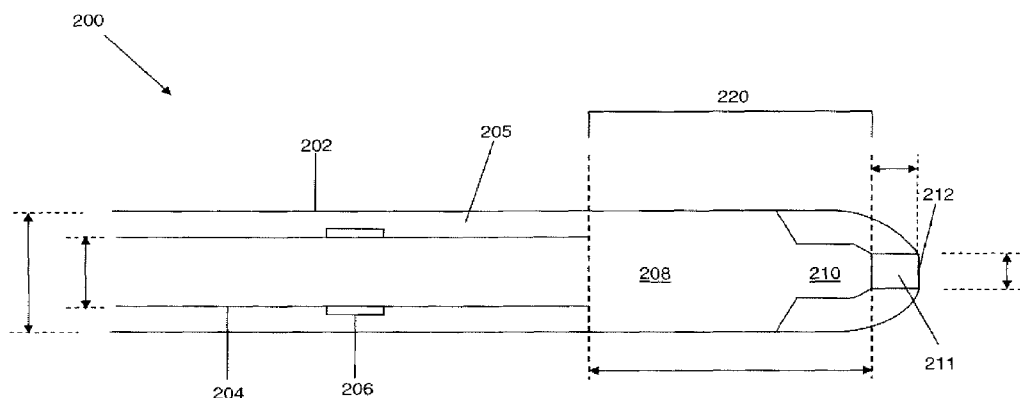


FIG. 2

(57) Abstract: Disclosed is a catalyst injection nozzle that comprises an outer tube with an open end, a nozzle tip with a diameter connected to the outer tube open end, an orifice connected to the nozzle tip internal to the outer tube, an internal mixing zone connected to the orifice internal to the outer tube, an inner tube residing within the outer tube further comprising an open end connected to the internal mixing zone, where a steady-state, uniform two-phase flow regime between an atomizing gas and at least one liquid catalyst feed does not form in the internal mixing zone at an atomizing gas to liquid catalyst feed flow ratio of about 0.05 to about 10.