Force dipole asymptotic for a pore with a crack emanating from it in a compressed elastic material for diagnostics

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Diagnostics of relatively small subsurface defects, such as pores and cracks, possibly filled, is known to be of paramount importance for modern technology and engineering. In the work to be presented, the issue of elaboration of a mathematical model intended for diagnostics of defects of this kind presented by pores with cracks emanating from them and capable to grow either parallel or perpendicularly to the traction-free nominally plane rough surface of the material is addressed. These cracks are assumed capable to grow, in their original planes under: (i) the lateral instantaneous compressive stresses appearing due to sufficiently rapid heating concentrated on the material surface that are resulted, in particular, from electromagnetic energy dissipation when the pulse-like high-frequency radiation acts on or similarly time-dependent electric current flows along this surface and (ii) the pressure of the gas appearing due to thermal destruction or/and evaporation of the substance originally present in the pores. The presence of initial homogeneous field of lateral compressive stresses in the material is also presumed. The defects under consideration are assumed to be: (i) located in the material sparsely enough to allow neglecting the overlap of their effects on the displacement field on the material surface and (ii) small enough to make it possible treating their effect on the displacement field on the material surface as the one resulted from some force dipoles equivalent to the defects. Using this approximation the defects are examined from the point of view of the possibility of their diagnostics with help of performing measurements (by means, say, of Laser Doppler Coordinate or/and Speckle Interferometer method, as considered in [1]) and investigation (conducted following the general scheme considered in [2]) of the transient displacement field disturbance these growing defects bring about on the material surface. The fact that the defects under consideration are assumed to be growing will make it possible to reveal them by means of measuring the displacement field disturbance resulted on the material surface from all defects in the interims chosen so that the transient effects from the defects, remaining stationary, may be neglected. The just outlined way of diagnostics of the growing defects under consideration is particularly important for early diagnostics of appearing in, say, an engineered item under loading, the situations approaching to those threatening by imminent fracture of the item. Note that the above method of solving the problem under consideration may be applied to solve the problem, in which the cracks tending to grow laterally are nucleated at the edges of pre-existing cracks that are moderately inclined to the lateral direction and have their opposite lips capable to experience mutual sliding under loading (as in [3]).

The work to be presented is a part of the work [4] extended by its authors. The author thanks R.L. Salganik and K.B. Ustinov.

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