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(54) MONITORING MATERIALS FOR STRAINS AND CRACKS

(71) We United Kingdom Atomic Energy Authority, London, a British Authority do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to methods of monitoring materials for strains and cracks caused by tensile loading.

Many engineering components, for example, pressure vessels, are subject to strains due mainly to tensile loading and thermal cycling. Such strains may induce cracking, and where the strains are cyclic they may induce fatigue, and consequently ultimate failure of the component. It is therefore desirable to be able to monitor straining of a component so that the onset of failure can be detected and precautionary measures taken. Methods of detecting failures by cracking using acoustic emission techniques have been proposed for use in testing pressure vessels but, because pressure vessels are fabricated from relatively ductile materials, the acoustic emissions from the material caused by straining and cracking are not easily detected. Conventional techniques used for testing are therefore not adequate for long term monitoring of strains, cracks and defect propagation in a material.

According to the invention a method of monitoring a material for strains and cracks used, for example, by tensile loading, comprises attaching a stress detecting member to the material in such manner that elongation of the material imparts a tensile strain on the detecting member, transforming acoustic energy emissions from the member into electrical signals and displaying the signals on an oscilloscope. The stress detecting member may comprise a metallic tube containing compacted ceramic powder and it has been found that relatively hard ceramic powders such as alumina and silica are superior to relatively soft powders such as magnesia because the hard powders produce more pronounced acoustic emission signals with less background noise. The cracking of the compacted powder due to strain complementary to that of the material gives rise to the acoustic emissions and the tube serves as a wave guide for transmitting those emissions to suitable transducers.

Conveniently, it has been found that metal sheathed mineral insulated cable is suitable as a stress detecting member especially for use in the detection of the onset of cracking in pressure vessels. Therefore, from another aspect the invention can be said to reside in a pressure vessel having at least one piece of metal sheathed mineral insulated cable attached to its surface in such manner that elongation of the surface imparts a tensile strain on the cable, an amplifier for signals generated by the transducers and apparatus arranged for the display and recording of the amplified generated signals. By attaching acoustic transducers one at each end of the cable the location of a signal emitting crack in the cable can be located by timing and also allows spurious signals to be rejected by known acoustic emission techniques. Preferably, for monitoring pressure vessels, a plurality of cables is attached to the vessel in the form of a grid and a corresponding array of transducers is provided.

The invention finds particular use in the nuclear art for monitoring tensile strain and cracking in fast reactor primary vessels, pressure vessels for boiling water and pressurised water reactors, steam drums and pressure tubes for the pressure tube kind of water cooled nuclear reactor.It is envisaged that the invention will find application in monitoring strain and irradiation growth in reactor components.

WHAT WE CLAIM IS:

1. A method of monitoring a material for

strains and cracks comprising attaching a stress detecting member to the material in such manner that elongation of the material imparts a tensile strain on the detecting member, transforming acoustic energy emissions from the member into electrical signals and displaying the signals on an oscilloscope.

2. A method according to claim 1 wherein the stress detecting member comprises a metallic tube containing compacted ceramic powder.

3. A method according to claim 2 wherein the compacted ceramic powder is alumina or silica.

4. A pressure vessel having at least one piece of metal sheathed mineral insulated cable attached to its surface in such a manner that elongation of the surface imparts a tensile strain on the cable, there being acoustic transducers attached one at each end of the cable, an amplifier for signals generated by the transducers of the amplified generated signals.

5. A pressure vessel according to claim 4 whereon a plurality of metal sheathed mineral insulated cables is attached in the form of a grid there being provided a corresponding array of transducers.

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