

- [54] METHOD FOR FABRICATING AND INSERTING REINFORCING SPIKES IN A 3-D REINFORCED STRUCTURE
- [76] Inventor: Constant V. David, 4952 Field St., San Diego, Calif. 92110
- [21] Appl. No.: 37,512
- [22] Filed: Apr. 13, 1987
- [51] Int. Cl.⁴ B65H 54/00
- [52] U.S. Cl. 156/173; 156/175; 156/425
- [58] Field of Search 156/173, 175, 425, 428, 156/429, 180; 428/105, 107, 109, 113, 367, 377; 242/7.02, 7.21

for insertion in a preferential direction into a structure reinforced in three directions substantially orthogonal. The structure is substantially a body of revolution and the reinforcements are provided by filaments made of high-strength high-elasticity-modulus materials. Strands made with such continuous filaments are wound helically in two generally perpendicular directions along a surface substantially parallel to both the external and internal body surfaces of revolution. The distance between these two surfaces is variable and defines the body thickness which may reach an appreciable percentage of the body diameter at certain stations. The spikes are made of parallel fiber segments bonded by a resin matrix so as to be stiff, and have two pointed ends. The spikes are forced to partially penetrate the structure during the strand winding process along a direction substantially perpendicular to a plane tangent to the structure surface where the spike is to penetrate the yet uncompleted structure. Winding of additional strands subsequently takes place between embedded spikes. The fibers of the radially-oriented spikes then constitute the third-dimensional reinforcing mode of the structure.

- [56] **References Cited**
- U.S. PATENT DOCUMENTS**
- 3,577,294 5/1971 David 156/173
- 4,080,915 3/1978 Bompard et al. 242/7.21 X
- 4,328,272 5/1982 Maistre 428/367 X
- 4,366,658 1/1983 Maistre 428/105 X
- 4,394,203 7/1983 Bompard et al. 242/7.21 X
- 4,495,231 1/1985 Laskaris et al. 428/113 X

Primary Examiner—Michael W. Ball
 Assistant Examiner—Jeff H. Aftergut

[57] **ABSTRACT**

Method and apparatus for fabricating reinforcing spikes

13 Claims, 5 Drawing Sheets

