



US005354392A

United States Patent [19]

Santo et al.

[11] **Patent Number:** 5,354,392[45] **Date of Patent:** Oct. 11, 1994

[54] **METHOD FOR CONNECTING A WIRING
ARRANGED ON A SHEET WITH ANOTHER
WIRING ARRANGED ON ANOTHER SHEET
BY ULTRASONIC WAVES**

[75] Inventors: **Kouichi Santo**, Osaka; **Naohiro
Nishioka**, Kyoto; **Kenji Otomo**; **Kouji
Tanabe**, both of Osaka; **Futoshi
Matsui**, Tsuyama, all of Japan

[73] Assignee: **Matsushita Electric Industrial Co.,
Ltd.**, Osaka, Japan

[21] Appl. No.: **3,913**

[22] Filed: **Jan. 13, 1993**

[30] **Foreign Application Priority Data**

Jan. 24, 1992 [JP] Japan 4-010681
Jan. 27, 1992 [JP] Japan 4-011690

[51] Int. Cl.⁵ **B32B 31/16**

[52] U.S. Cl. **156/73.1**; 156/291;
156/292; 156/308.4; 156/311; 156/580.1;
264/23; 228/110.1; 29/830; 29/832

[58] Field of Search 156/73.1, 73.4, 311,
156/580.1, 580.2, 291, 292, 295, 308.4; 264/23;
228/1.1, 110.1; 29/830, 832

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,886,012 5/1975 Slater 156/73.1
4,554,033 11/1985 Dery et al. 29/832 X
5,058,800 10/1991 Yoshizawa et al. 228/110.1 X

FOREIGN PATENT DOCUMENTS

61-114419 6/1986 Japan .
63-262894 10/1988 Japan .
360095 3/1991 Japan .
4186697 7/1992 Japan .

Primary Examiner—David A. Simmons

Assistant Examiner—J. Sells

Attorney, Agent, or Firm—Lowe, Price, LeBlanc &
Becker

[57] **ABSTRACT**

A method for electrically connecting an upper wiring with a lower wiring consists of the steps of arranging the upper wiring mixed with thermo-softening material on an upper insulating sheet, arranging the lower wiring mixed with thermo-softening material on a lower insulating sheet, putting the upper insulating sheet on the lower insulating sheet to bring the upper wiring into contact with the lower wiring, and providing ultrasonic vibration to the upper and lower wirings and the upper insulating sheet while pushing the upper insulating sheet toward the lower insulating sheet. In these steps, the upper and lower wirings and the upper insulating sheet are heated and melted because friction heat is generated by the ultrasonic vibration. Thereafter, the upper insulating sheet is pushed into the upper and lower wirings while pushing these wirings aside and is bonded with the lower insulating sheet. Also, the upper wiring is bonded with the lower wiring so that these wirings are electrically connected.

22 Claims, 13 Drawing Sheets

