Designation: D 2563 – 94 (Reapproved 2002)ε1

An American National Standard

Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts[1]

This standard is issued under the fixed designation D 2563; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε1 NOTE Editorially revised 1.2 in March 2002.

1. Scope

1.1 This practice covers acceptance criteria for visual inspection of parts made from glass-reinforced plastic laminates.

1.2 This practice presents word descriptions of possible defects to serve as a guide for contracts, drawings, product specifications, and final inspection.

1.3 This practice also categorizes different inspection requirements for levels of product quality.

1.4 The allowable size and frequency of permitted defects within the acceptance level categories of this specification are general and not related to specific service requirements. A Level IV of allowable defects which defines allowable size, frequency, and permitted repair procedures should be established for specific service requirements as agreed upon between the purchaser and the supplier.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this practice.

2. Acceptance Criteria

2.1 The method and frequency of sampling and the allowable defects may be previously agreed upon between the purchaser and the seller.

2.2 *Dimensions and Tolerances*—Parts shall be inspected for conformance with dimensions and tolerances specified on the drawings. Any dimensions falling outside the specified limits shall be cause for rejection.

2.3 *Inserts*—All inserts, nuts, studs, and lugs shall not be damaged in any way, nor coated with laminate materials in such a way as to impair function or mechanical fit. Threads in molded-in inserts shall be clean, smooth, free of nicks, tears, or other damage. There shall be no laminate materials or flash on the threads. If necessary, threaded inserts may be retapped to clean them or remove flash. Threads containing locking features or coated for corrosion resistance shall not be retapped.

2.4 *Molded-In Threads or Cored Holes*— Molded-in threads or cored holes shall be free of visible defects such as chips, cracks, shorts, etc. Molded-in threads may be retapped or repaired unless otherwise specifically noted on the product drawings.

2.5 *Workmanship*—Workmanship shall be in accordance with good commercial practices as listed in Table 1 for applicable acceptance levels.

2.6 *Critical Area*—Some portions of a part may be considered more critical than others. A critical area is here defined as an area in which the presence of imperfections is considered to be most detrimental. The areas of parts that are critical structurally, aerodynamically, or electrically shall be uniform and free of defects as listed in Table 1, if so stated on the product drawing. Critical areas may be designated on the product drawing by one of the following methods:

2.6.1 Encircle critical areas, or

2.6.2 Cross-hatch areas to designate areas of various levels, or

2.6.3 Word description.

2.7 *Allowable Defects, Visual*—The defects in noncritical areas which by nature, content, or frequency do not affect serviceability of the part are designated as allowable defects. Allowable defects shall be fully described as to type, size, number, extent allowed, and spacing. The appropriate acceptance level (Table 1) for defects in these areas must be specified. Where Level IV is used the defects must be fully described on the product drawing. Defects greater than those listed in the product specifications, drawings, or contracts for the part shall be cause for rejection.

2.8 *Repairable Defects*—Repairable defects, if any, shall consist of those which can be repaired without affecting the serviceability of the part unless prohibited in the product drawing or in the contract. Acceptable methods of repair shall be agreed upon between the purchaser and the seller and shall

[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

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be only as specified in the product drawing or contracts for the part.

2.9 *Surface Finish*—The over-all surface finish of laminates may vary with the process used and the type of reinforcement. Unless surface finish is specified on part drawings, contracts, or orders from the purchaser, parts shall not be rejected for any reading less than 150 rms. Defects shall be considered as not included in over-all surface finish.

2.10 *Surface Appearance*—The surface appearance or color, or both, of laminated parts can vary considerably depending on the process used to make the laminate, thickness, type of reinforcement, type of resin, resin-to-reinforcement ratio and the presence of defects. Any questions concerning surface appearance and its influence on the properties of the part should be brought to the attention of the responsible materials engineer.

3. Acceptance Levels

3.1 *Visual Inspection*—Each part shall be checked visually without the aid of magnification. Defects shall be classified as to type and level as shown in Table 1 (see Note 2). The acceptable quality level shall be determined by reference to the part drawing for the applicable acceptance level for allowable defects. If none of the first three levels (Level I, II, III) is considered applicable, the level shall be Level IV, and allowable defects must be specified on the product drawing. Any excess of defects as specified under the required level shall be cause for rejection. Unless otherwise specified, dimensions are surface dimensions.

NOTE 2—Typical defects as outlined in the word descriptions of Table 1 are illustrated in Figs. 1-21.[2]

3.2 *Acceptance Level I*—Presence of any defects in excess of those listed in Table 1, Level I, shall be cause for rejection, unless otherwise specified in Table 1, Level I.

3.3 *Acceptance Level II*—Presence of more than one defect of those listed in Table 1, Level II, for each estimated 10 $in.^2$ of surface shall be cause for rejection, unless otherwise specified in Table 1, Level II. No defect area shall be less than 2 in. from another.

3.4 *Acceptance Level III*—Presence of more than two defects of those listed in Table 1, Level III, for each estimated 13 mm (5 $in.)^2$ of surface shall be cause for rejection, unless otherwise specified in Table 1, Level III. No defect area shall be less than 1 in. from another.

3.5 *Acceptance Level IV*—To be specified on the product drawing.

4. Keywords

4.1 reinforced thermosetting plastics; visual defects

[2] Full-size (8 by 10-in.) glossy prints of these typical defects are available at a nominal charge from ASTM Headquarters. Order Adjunct: ADJD2563.

TABLE 1 Allowable Defects

Name	Definition	Visual Acceptance Levels		
		Level I	Level II	Level III
Chip	a small piece broken off an edge or surface	none	maximum dimension of break, 3.0 mm (⅛ in.)	maximum dimension of break, 6.5 mm (¼ in.)
Crack	an actual separation of the laminate, visible on opposite surfaces, and extending through the thickness	none	none	none
Crack, surface	crack existing only on the surface of the laminate	none	maximum length, 3.0 mm (⅛ in.)	maximum length 6.5 mm (¼ in.)
Crazing	fine cracks at or under the surface of a laminate	none	maximum dimension of crazing, 13 mm (½ in.) frequency and location to be determined by customer	maximum dimension of crazing, 25 mm (1 in.).
Delamination, edge	separation of the layers of material at the edge of a laminate	none	maximum dimension, 3.0 mm (⅛ in.)	maximum dimension, 6.5 mm (¼ in.)
Delamination, internal	separation of the layers of material in a laminate	none	none	none
Dry-spot	area of incomplete surface film where the reinforcement has not been wetted with resin	none	maximum diameter, 9.5 mm (⅜ in.)	maximum diameter, 14 mm (9⁄16 in.)
Foreign inclusion (metallic)	metallic particles included in a laminate which are foreign to its composition	none	none, if for electrical use; maximum dimension, 0.8 mm (1⁄32in.), 1/0.09 m^2(1 ft^2), if for mechanical use	none, if for electrical use; maximum dimension, 1.5 mm (1⁄16 in.), 1/0.09 m^2(1 ft^2), if for mechanical use
Foreign inclusion (nonmetallic)	nonmetallic particles of substance included in a laminate which seem foreign to its composition	none	maximum dimension, 0.8 mm (1⁄32in.), 1/0.09 m^2(1 ft^2)	maximum dimension, 1.5 mm (1⁄16 in.); 1/0.09 m^2(1 ft^2)
Fracture	rupture of laminate surface without complete penetration	none	maximum dimension, 21 mm (13⁄16in.)	maximum dimension, 29 mm (1⅛ in.)
Air bubble (void)	air entrapment within and between the plies of reinforcement, usually spherical in shape	none	maximum diameter, 1.5 mm (1⁄16 in.); 2/$in.^2$	maximum diameter, 3.0 mm (⅛ in.); 4/$in.^2$
Blister	rounded elevation of the surface of a laminate, with boundaries that may be more or less sharply defined, somewhat resembling in shape a blister on the human skin	none	maximum diameter, 3.0 mm (⅛ in.); height from surface not to be outside drawing tolerance	maximum diameter, 6.5 mm (¼ in.); height from surface not to be outside drawing tolerance
Burned	showing evidence of thermal decomposition through some discoloration, distortion, or destruction of the surface of the laminate	none	none	none
Fish-eye	small globular mass which has not blended completely into the surrounding material and is particularly evident in a transparent or translucent material	none	maximum diameter, 9.5 mm (⅜ in.)	maximum diameter, 13 mm (½ in.)

Name	Definition	Visual Acceptance Levels		
		Level I	Level II	Level III
Lack of fillout	an area, occurring usually at the edge of a laminated plastic, where the reinforcement has not been wetted with resin	none	maximum diameter, 6.5 mm (¼ in.)	maximum diameter, 9.5 mm (⅜ in.)
Orange-peel	uneven surface somewhat resembling an orange peel	none	maximum diameter, 14 mm (9⁄16 in.)	maximum diameter, 29 mm (1⅛ in.)
Pimple	small, sharp, or conical elevation on the surface of a laminate	none	none	maximum diameter, 3.0 mm (⅛ in.)
Pit (pinhole)	small crater in the surface of a laminate, with its width approximately of the same order of magnitude as its depth	none	maximum diameter, 0.4 mm (1⁄64 in.); depth less than 1 percent of wall thickness	maximum diameter, 0.8 mm (1⁄32 in.); depth less than 20 percent of wall thickness
			frequency and location to be determined by customer	
Porosity (pinhole)	presence of numerous visible pits (pinholes)	none	maximum of 25 pits (pinholes) in porous area of size listed in Level II	maximum of 50 pits (pinholes) in porous area of size listed in Level III
Pre-gel	an unintentional extra layer of cured resin on part of the surface of the laminate (This condition does not include gel coats.)	none	maximum dimension, 6.5 mm (¼in.); height above surface not to be outside drawing tolerance	maximum dimension, 13 mm (½ in.); height above surface not to be outside drawing tolerance
Resin-pocket	an apparent accumulation of excess resin in a small localized area within the laminate	none	maximum diameter, 3.0 mm (⅛ in.)	maximum diameter, 6.5 mm (½ in.)
Resin-rich edge	insufficient reinforcing material at the edge of molded laminate	none	maximum, 0.4 mm (1⁄64in.) from the edge	maximum, 0.8 mm (1⁄32 in.) from the edge
Shrink-mark (sink)	depression in the surface of a molded laminate where it has retracted from the mold	none	maximum diameter, 9.5 mm (⅜ in.); depth not greater than 25 percent of wall thickness	maximum diameter, 14 mm (9⁄16 in.); depth not greater than 25 percent of wall thickness
Wash	area where the reinforcement of molded plastic has moved inadvertently during closure of the mold resulting in resin-rich areas	none	maximum dimension, 21 mm (13⁄16 in.)	maximum dimension, 29 mm (1⅛ in.)
Wormhole	elongated air entrapment which is either in or near the surface of a laminate and may be covered by a thin film of cured resin	none	maximum diameter, 3.0 mm (⅛ in.)	maximum diameter, 6.5 mm (¼ in.)
Wrinkles	in a laminate, an imperfection that has the appearance of a wave molded into one or more plies of fabric or other reinforcement material	none	maximum length surface side, 13 mm (½in.); maximum length opposite side, 13 mm (½ in.); depth less than 10 percent of wall thickness	maximum length surface side, 25 mm (1 in.); maximum length opposite side, 25 mm (1 in.); depth less than 15 percent of wall thickness
Scratch	shallow mark, groove, furrow, or channel caused by improper handling or storage	none	maximum length, 25 mm (1.0 in.); maximum depth, 0.125 (0.005 in.)	maximum length, 25 mm (1.0 in.); maximum depth, 0.255 (0.010 in.)
Short	in a laminate, an incompletely filled out condition NOTE—this may be evident either through an absence of surface film in some areas, or as lighter unfused particles of material showing through a covering surface film, possibly accompanied by thin-skinned blisters	none	none	none

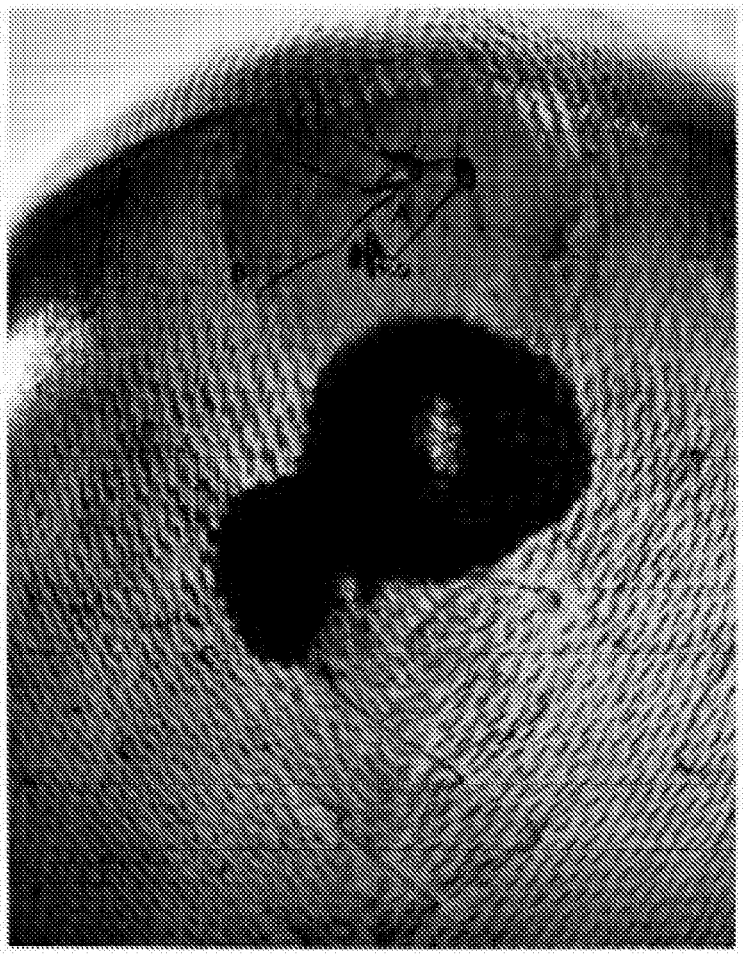

FIG. 1 Chips (A), Surface Cracks (B), Interply Delamination (C)

FIG. 2 Crazing

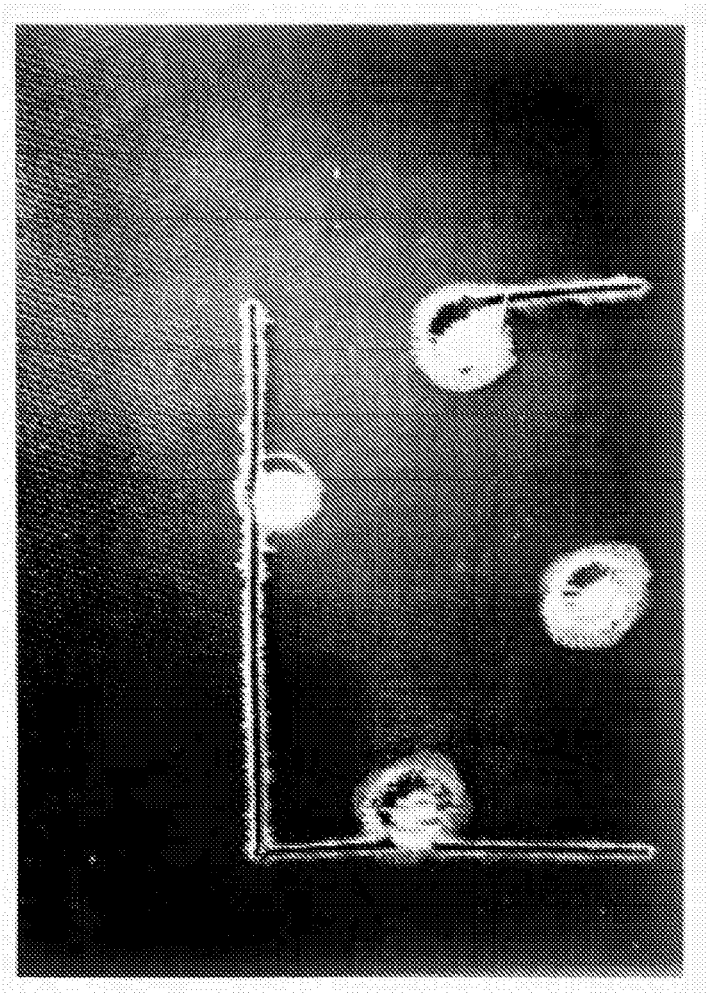

FIG. 3 Delamination by Improper Machining

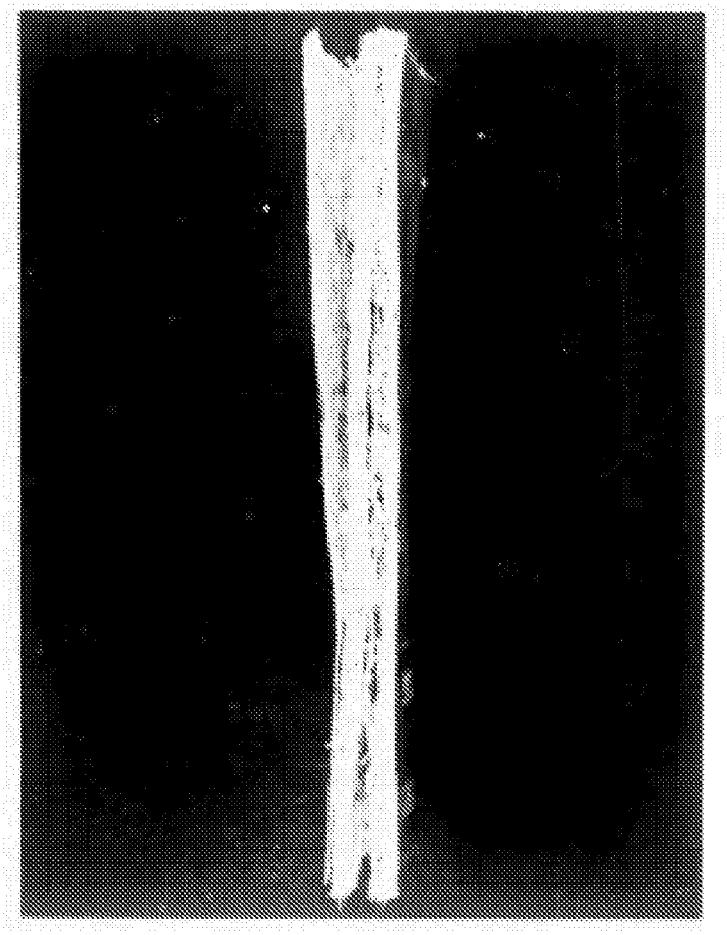

FIG. 4 Delamination

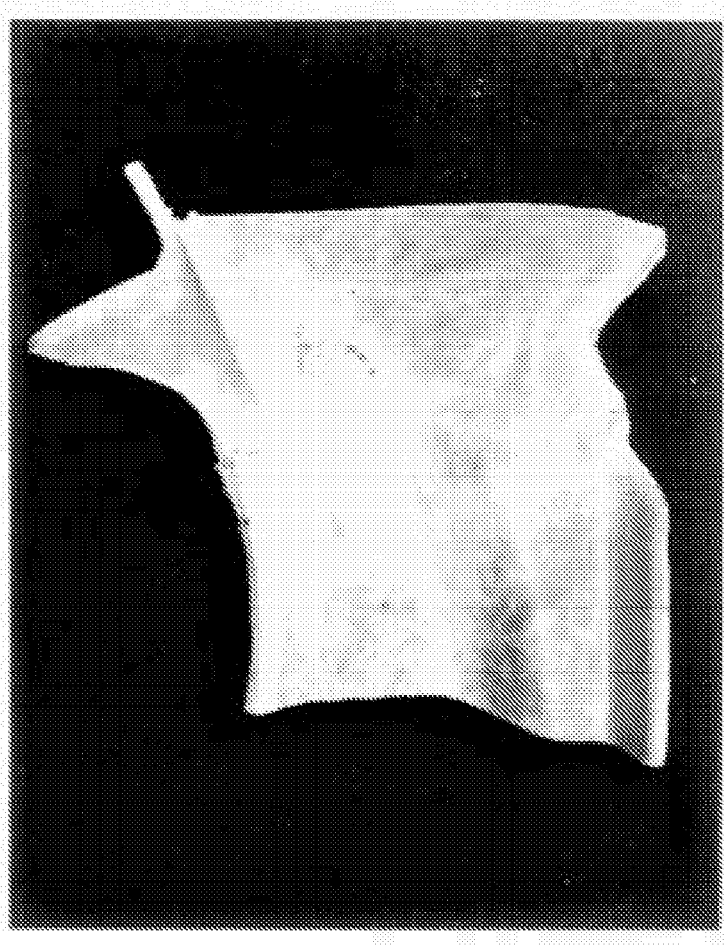

FIG. 5 Dry-Spot

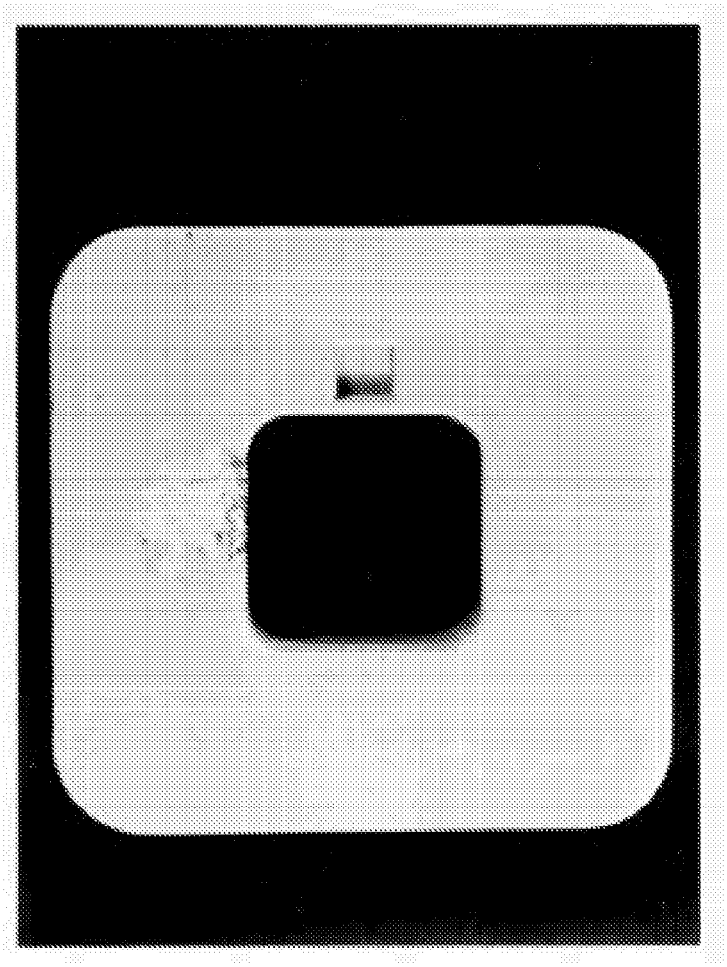

FIG. 6 Foreign Inclusion

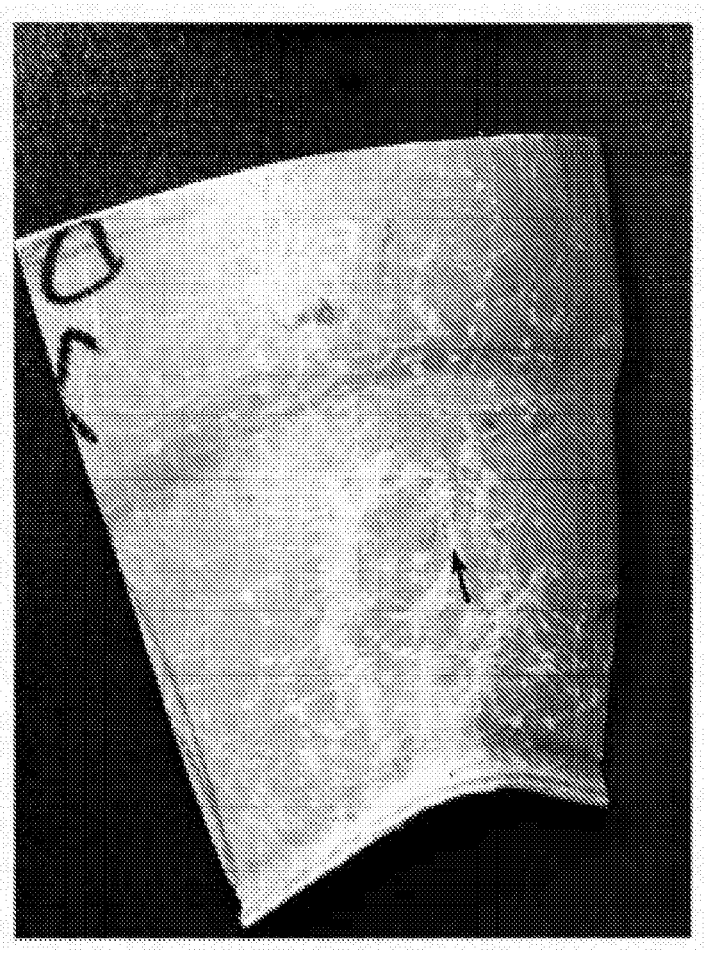

FIG. 7 Fractures

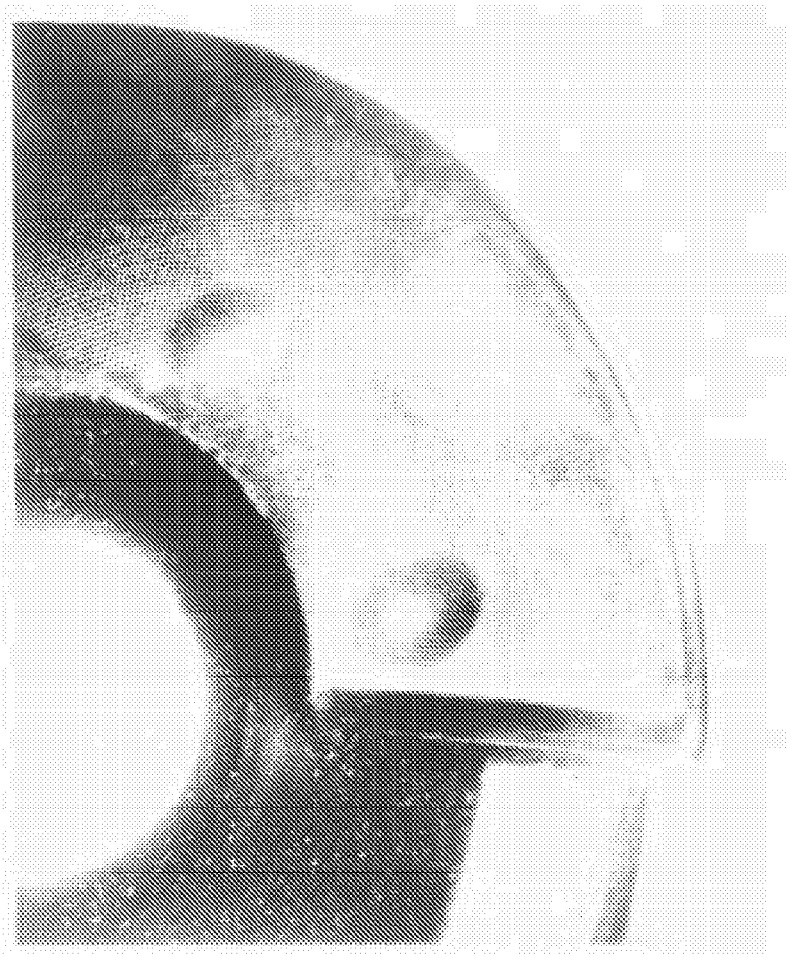

FIG. 8 Blister

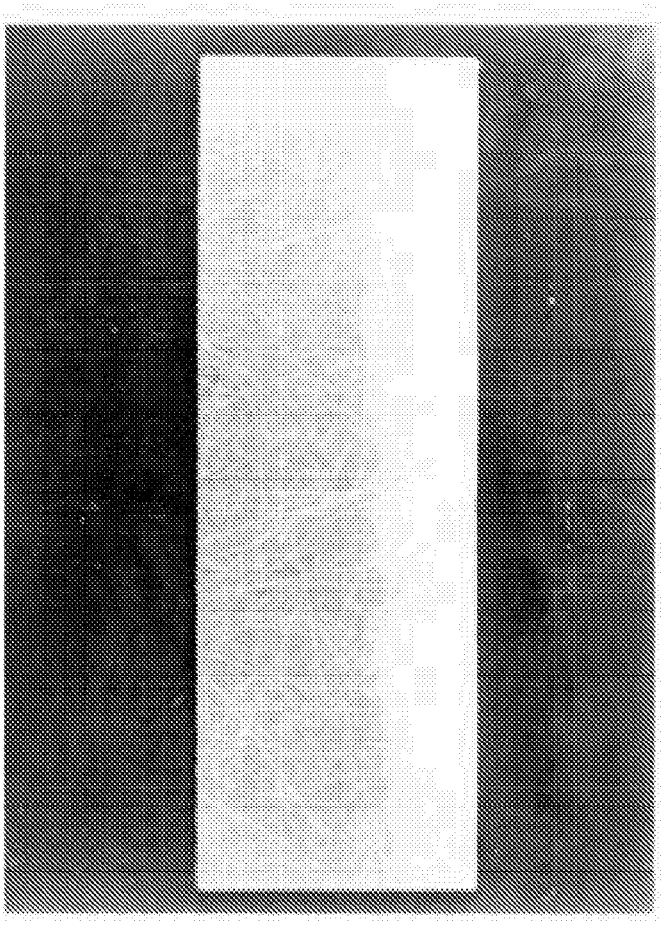

FIG. 9 Edge Segregation

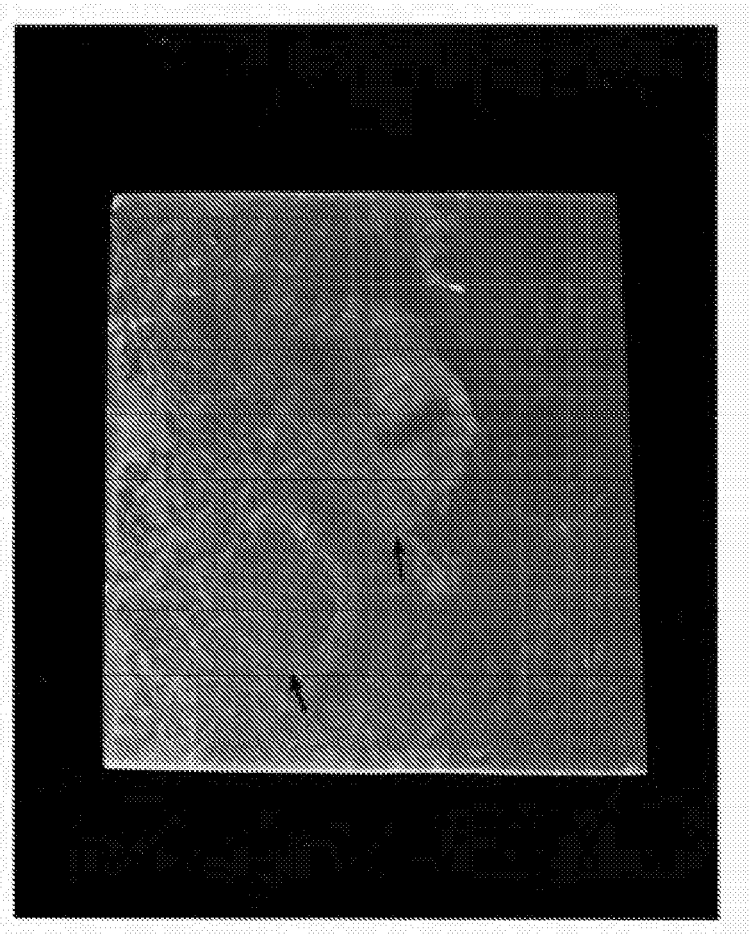

FIG. 10 Fish Eye

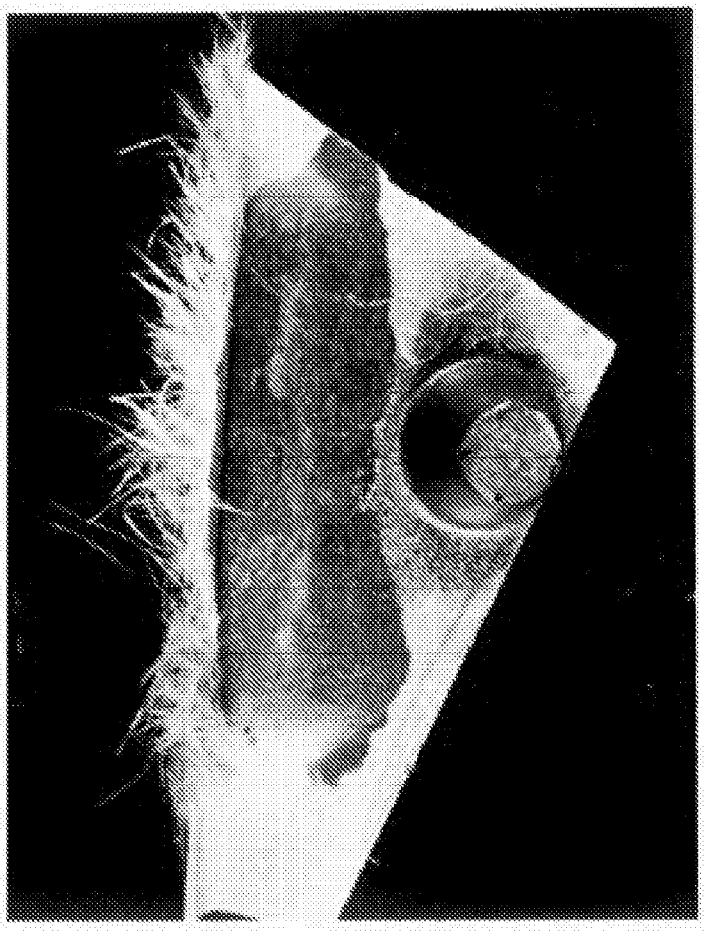

FIG. 11 Lack of Fillout

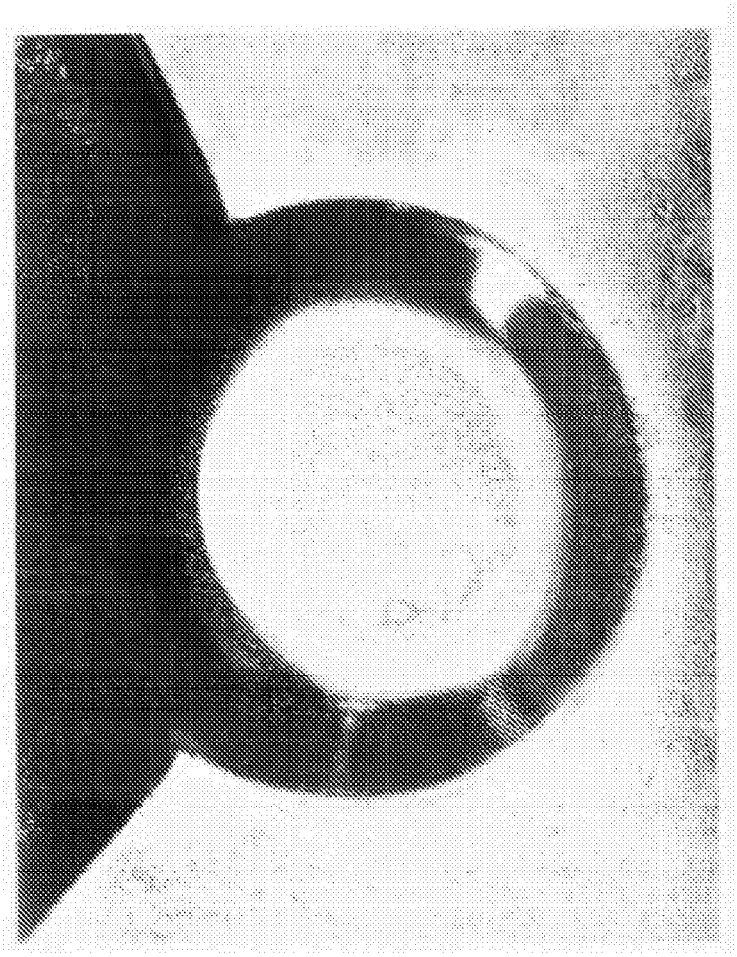

FIG. 12 Porosity

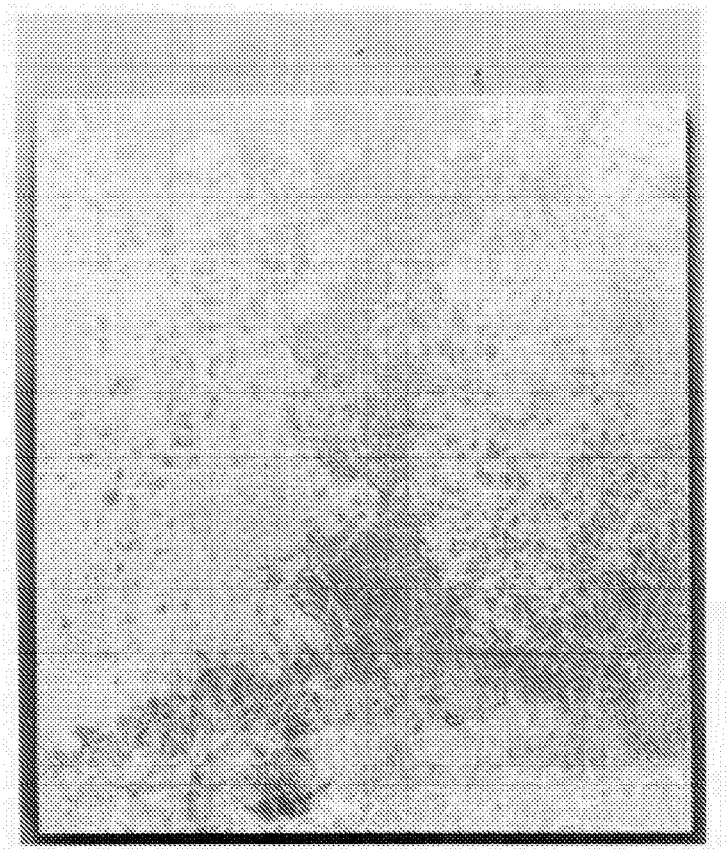

FIG. 13 Pre-Gel

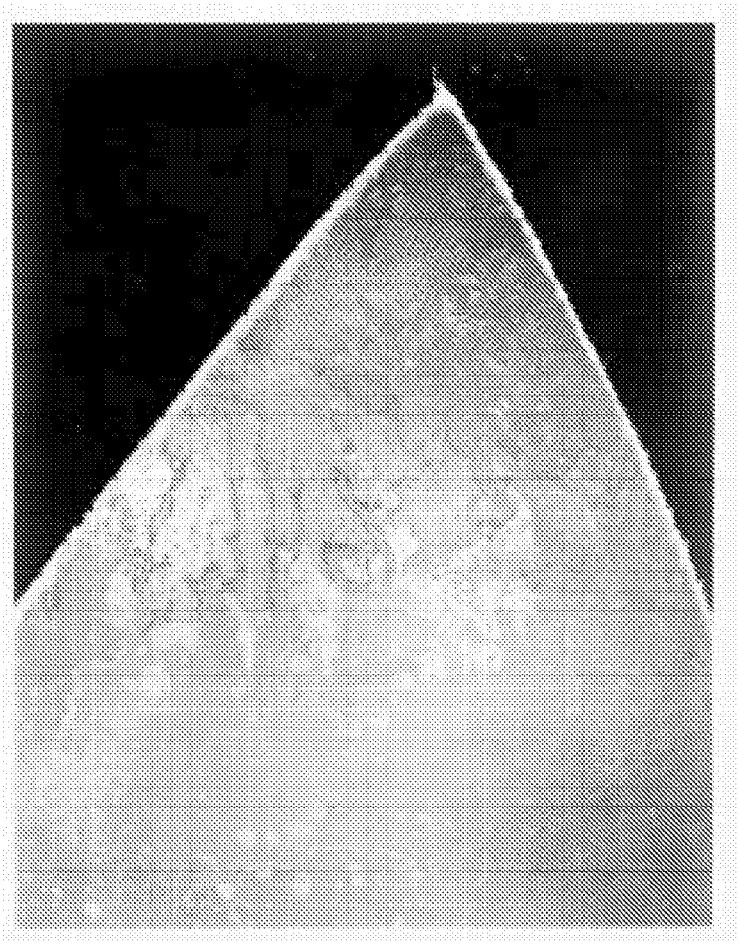

FIG. 14 Resin-Pocket

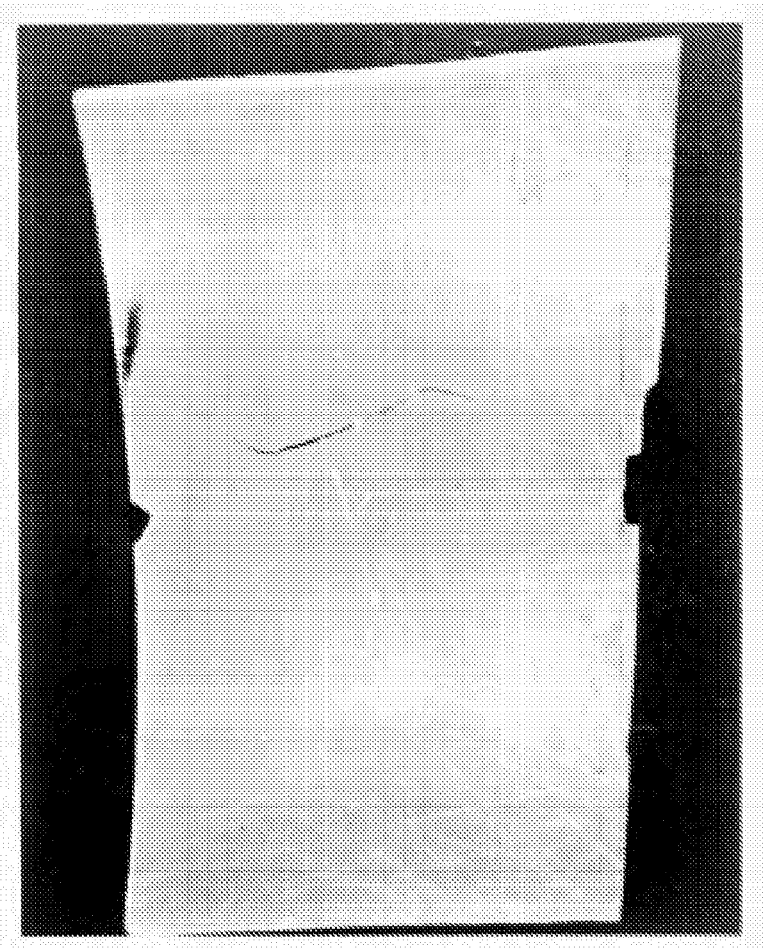

FIG. 15 Resin-Rich Crack

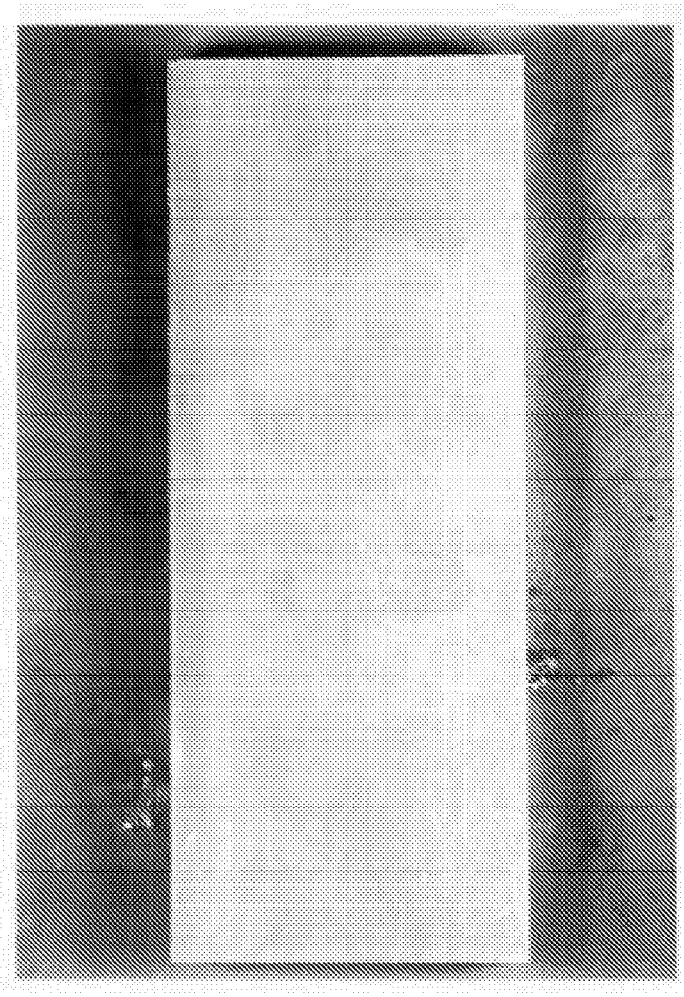

FIG. 16 Resin-Rich Edge

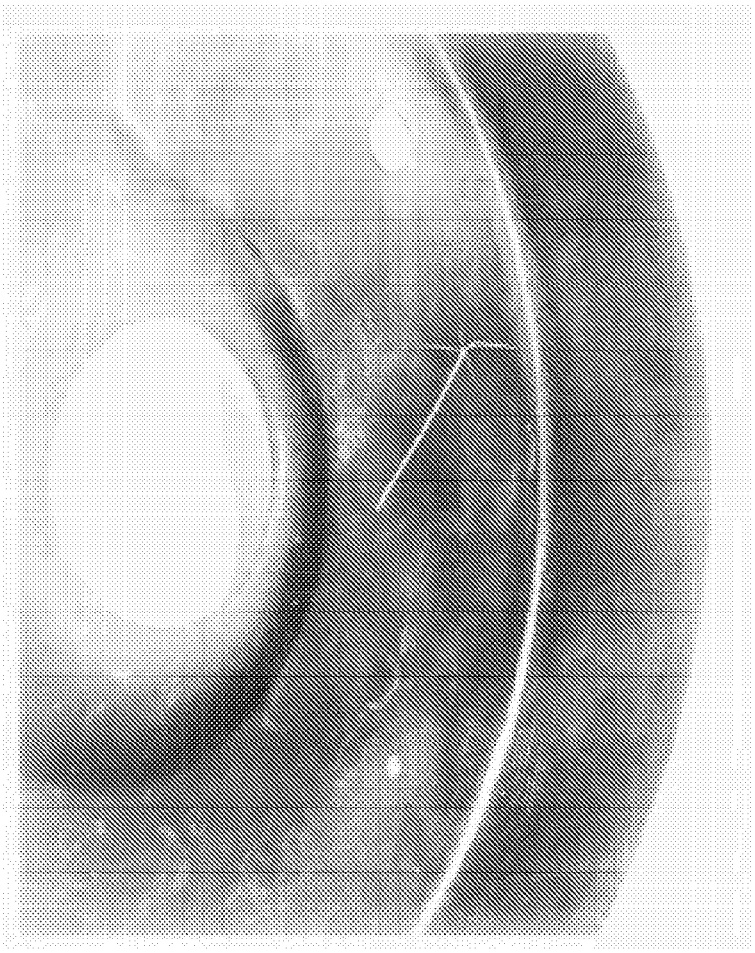

FIG. 17 Scratch

FIG. 18 Shrink Marks

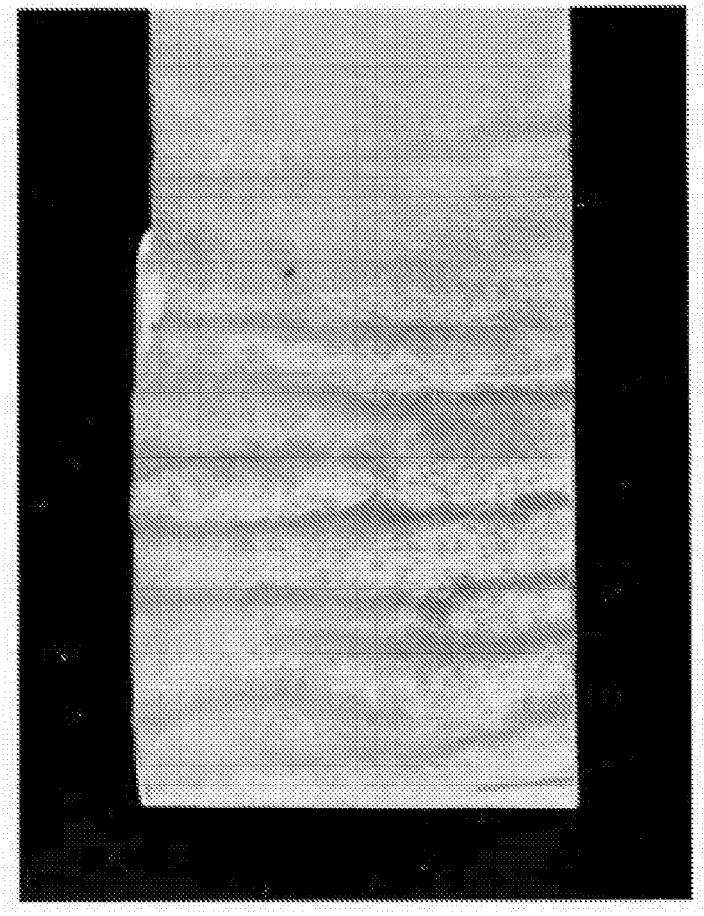

FIG. 19 Wash

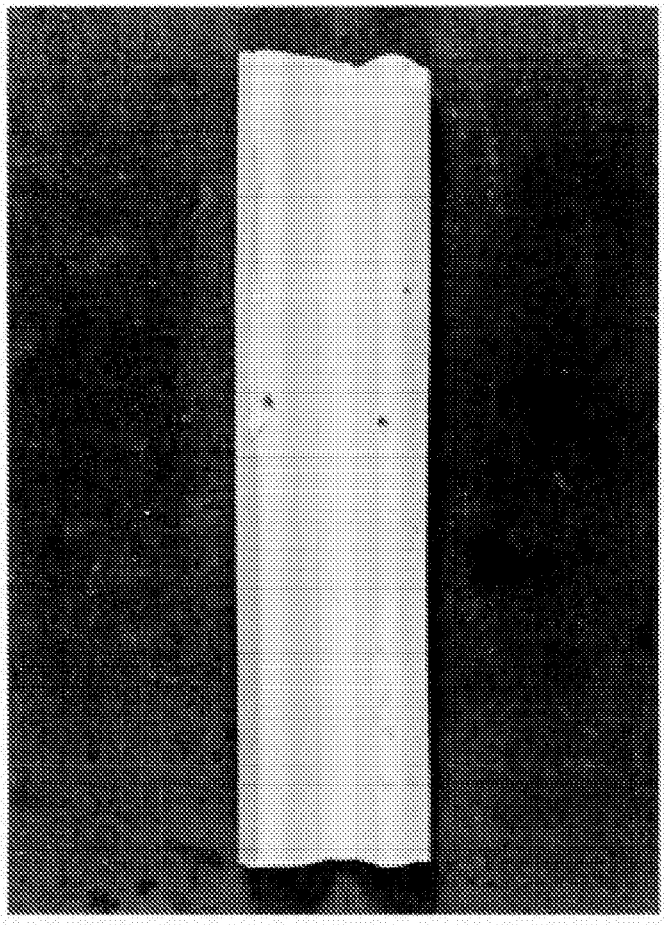

FIG. 20 Worm Hole

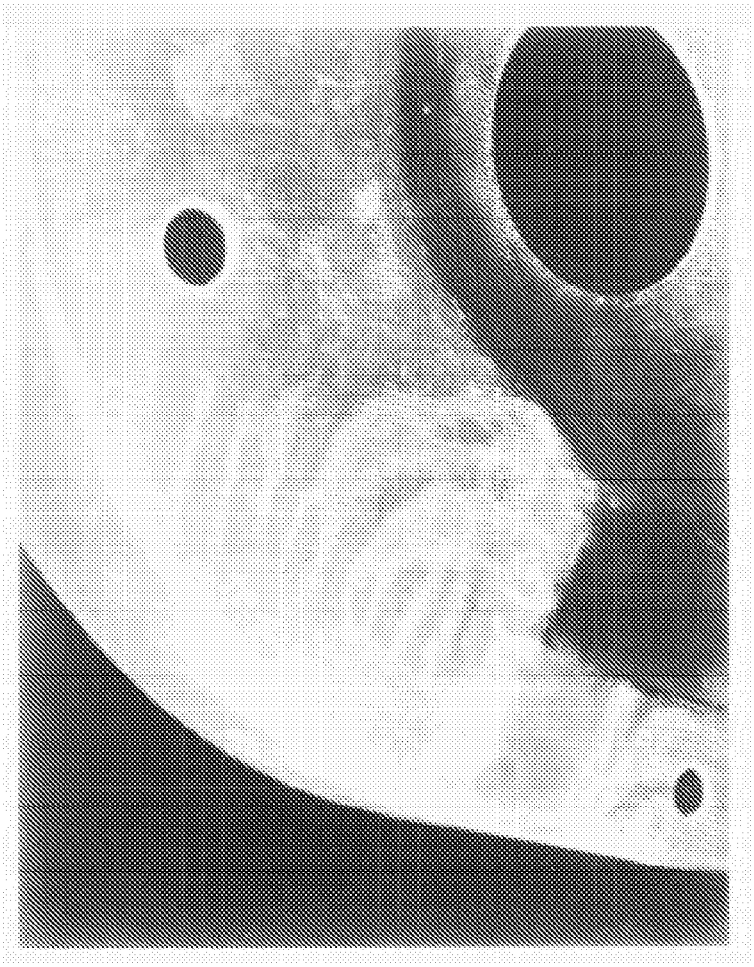

FIG. 21 Wrinkles