



US007067952B2

(12) **United States Patent**
Neal

(10) **Patent No.:** **US 7,067,952 B2**
(45) **Date of Patent:** **Jun. 27, 2006**

(54) **STATOR ASSEMBLY MADE FROM A MOLDED WEB OF CORE SEGMENTS AND MOTOR USING SAME**

(75) Inventor: **Griffith D. Neal**, Alameda, CA (US)

(73) Assignee: **Encap Motor Corporation**, Alameda, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 248 days.

(21) Appl. No.: **10/383,219**

(22) Filed: **Mar. 5, 2003**

(65) **Prior Publication Data**

US 2004/0034988 A1 Feb. 26, 2004

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/798,511, filed on Mar. 2, 2001, now Pat. No. 7,036,207.

(51) **Int. Cl.**

H02K 1/18 (2006.01)

H02K 15/02 (2006.01)

H02K 15/10 (2006.01)

(52) **U.S. Cl.** **310/259**; 310/42; 310/45; 310/218

(58) **Field of Classification Search** 310/42-43, 310/45, 216-218, 254, 259; 244/432, 433, 244/433.4; 29/596
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 2,607,816 A * 8/1952 Ryder et al. 310/42
- 3,348,302 A * 10/1967 Foerster 29/605
- 3,590,328 A 6/1971 Frescura
- 3,638,055 A 1/1972 Zimmermann
- 3,802,066 A 4/1974 Barrett
- 3,827,141 A * 8/1974 Hallerback 29/596

- 3,874,073 A 4/1975 Dochterman et al.
- 3,908,138 A 9/1975 Shieh
- 3,942,054 A 3/1976 Kristen et al.
- 3,979,530 A 9/1976 Schwider et al.
- 4,015,154 A * 3/1977 Tanaka et al. 310/42
- 4,128,527 A 12/1978 Kinjo et al.
- 4,173,822 A 11/1979 Futterer et al.
- 4,352,897 A 10/1982 Ogata et al.
- 4,365,180 A 12/1982 Licata et al.
- 4,372,035 A 2/1983 McMillen

(Continued)

FOREIGN PATENT DOCUMENTS

BE 870878 1/1979

(Continued)

OTHER PUBLICATIONS

LNP Engineering Plastics, Advertisement entitled "Konduit™ Thermally Conductive Composites," undated (2 pages).

(Continued)

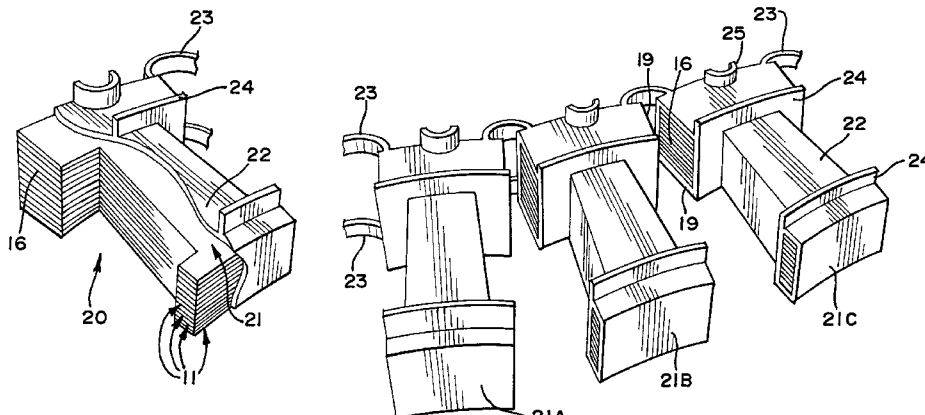
Primary Examiner—Burton Mullins

(74) *Attorney, Agent, or Firm*—Steven P. Shurtz; Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

A plurality of stator arc segments 20 are linked together by a phase change material 22 enabling simplified winding and higher slot fill. Once wound this continuous structure can be formed into a toroidal core 17 for a stator assembly 40 used to make a motor 100. In a preferred embodiment, a monolithic body 42 of phase change material substantially encapsulates the conductors and holds the stator arc segments 20 in contact with each other in the toroidal core 17. Hard disc drives using the motor 100, and methods of constructing the motor 100 are also disclosed.

14 Claims, 5 Drawing Sheets



U.S. PATENT DOCUMENTS

4,387,311 A 6/1983 Kobayashi et al.
 4,492,889 A 1/1985 Fukushi et al.
 4,572,979 A 2/1986 Haar et al.
 4,643,346 A 2/1987 Gotoh
 4,679,313 A 7/1987 Schultz et al.
 4,712,035 A 12/1987 Forbes et al.
 4,760,299 A 7/1988 Dickie et al.
 4,801,833 A 1/1989 Dye
 4,818,911 A * 4/1989 Taguchi et al. 310/259
 4,853,576 A 8/1989 Mayumi et al.
 4,858,073 A 8/1989 Gregory
 4,868,970 A 9/1989 Schultz et al.
 4,954,739 A 9/1990 Schultz et al.
 4,990,809 A 2/1991 Artus et al.
 5,008,572 A 4/1991 Marshall et al.
 5,036,580 A 8/1991 Fox et al.
 5,073,735 A 12/1991 Takagi
 5,075,585 A 12/1991 Teruyama et al.
 5,121,021 A 6/1992 Ward
 5,134,327 A 7/1992 Sumi et al.
 5,142,103 A 8/1992 Stine
 5,147,982 A 9/1992 Steffen
 5,191,698 A 3/1993 Sumi et al.
 5,206,554 A 4/1993 Perrot
 5,268,607 A 12/1993 McManus
 5,334,897 A 8/1994 Ineson et al.
 5,345,129 A 9/1994 Molnar
 5,382,852 A 1/1995 Yuhi et al.
 5,396,210 A 3/1995 Purohit et al.
 5,400,218 A 3/1995 Val
 5,414,317 A 5/1995 Reid et al.
 5,459,190 A 10/1995 Nakamura et al.
 5,461,772 A 10/1995 Puri
 5,500,780 A 3/1996 Boutaghou et al.
 5,506,458 A 4/1996 Pace et al.
 5,541,787 A 7/1996 Jabbari et al.
 5,548,458 A 8/1996 Pelstring et al.
 5,558,445 A 9/1996 Chen et al.
 5,579,188 A 11/1996 Dunfield et al.
 5,587,617 A 12/1996 Dunfield et al.
 5,592,731 A 1/1997 Huang et al.
 5,598,048 A 1/1997 Dunfield et al.
 5,610,463 A 3/1997 Dunfield et al.
 5,619,083 A 4/1997 Dunfield et al.
 5,619,389 A 4/1997 Dunfield et al.
 5,621,372 A 4/1997 Purohit
 5,633,545 A 5/1997 Albrecht et al.
 5,666,242 A 9/1997 Edwards et al.
 5,668,427 A 9/1997 Morita
 5,672,927 A 9/1997 Viskochil
 5,675,196 A 10/1997 Huang et al.
 5,694,268 A 12/1997 Dunfield et al.
 5,698,919 A 12/1997 Obara
 5,728,600 A 3/1998 Saxelby, Jr. et al.
 5,729,072 A 3/1998 Hirano et al.
 5,729,404 A 3/1998 Dunfield et al.
 5,742,450 A 4/1998 Moser
 5,751,085 A 5/1998 Hayashi
 5,751,514 A 5/1998 Hyde et al.
 5,766,535 A 6/1998 Ong
 5,783,888 A 7/1998 Yamano
 5,806,169 A 9/1998 Trago et al.
 5,814,412 A 9/1998 Terada et al.
 5,850,318 A 12/1998 Dunfield et al.
 5,859,486 A 1/1999 Nakahara et al.
 5,875,540 A 3/1999 Sargeant et al.
 5,880,179 A 3/1999 Ito et al.
 5,881,447 A 3/1999 Molnar
 5,898,252 A 4/1999 Tanaka et al.

5,949,172 A 9/1999 Katagiri
 5,958,466 A 9/1999 Ong
 5,973,424 A 10/1999 Engelberger et al.
 5,982,057 A 11/1999 Imada et al.
 5,986,365 A 11/1999 Kuwert et al.
 5,986,377 A 11/1999 Yamada et al.
 5,990,247 A 11/1999 Terada et al.
 6,002,185 A 12/1999 Nakao et al.
 6,019,516 A 2/2000 Leuthold et al.
 6,020,661 A 2/2000 Trago et al.
 6,034,841 A 3/2000 Albrecht et al.
 6,043,583 A 3/2000 Kurosawa et al.
 6,049,153 A 4/2000 Nishiyama et al.
 6,071,014 A 6/2000 Lee et al.
 6,075,304 A 6/2000 Nakatsuka
 6,081,059 A * 6/2000 Hsu 310/179
 6,111,334 A * 8/2000 Horski et al. 310/254
 6,153,959 A 11/2000 Lorenzo
 6,163,952 A 12/2000 Takehara
 6,167,610 B1 1/2001 Nakahara et al.
 6,201,334 B1 3/2001 Sargeant et al.
 6,265,800 B1 7/2001 Kimura et al.
 6,265,804 B1 7/2001 Nitta et al.
 6,300,695 B1 10/2001 Neal
 6,362,554 B1 3/2002 Neal
 6,437,464 B1 8/2002 Neal
 6,501,616 B1 12/2002 Neal
 6,617,721 B1 9/2003 Neal
 6,658,721 B1 * 12/2003 Kazama et al. 29/596
 6,753,628 B1 6/2004 Neal
 6,844,636 B1 1/2005 Lieu et al.
 6,892,439 B1 5/2005 Neal et al.
 6,911,166 B1 6/2005 Neal
 6,941,640 B1 9/2005 Neal et al.
 2003/0081347 A1 5/2003 Neal
 2005/0134124 A1 6/2005 Lieu

FOREIGN PATENT DOCUMENTS

BE 891258 3/1982
 DE 25 39 492 A1 3/1977
 EP 0 747 943 A2 12/1996
 EP 0 883 171 A1 12/1998
 FR 2 647 958 12/1990
 JP 11-38937 * 8/1988
 JP 04295256 A * 10/1992
 JP 05336722 12/1993
 JP 10070870 3/1998
 JP 410271719 10/1998
 JP 11082508 3/1999
 SU 1334297 8/1987
 SU 1494148 7/1989
 WO WO 92/06532 4/1992
 WO WO 96/20501 7/1996
 WO WO 96/33533 10/1996
 WO WO 97/39870 10/1997

OTHER PUBLICATIONS

Product Information from Dupont Engineering Polymers entitled "Electrical/Electronic Thermoplastic Encapsulation," undated, Publ. Reorder No.: H-58633 (R, 96.7), 20 pages.
 LNP Engineering Plastics, Press Release entitled "LNP Introduces First-Ever Line of Thermally Conductive Compounds," Jan. 28, 1999 (2 pages).
 Buchanan Motor Works, Inc., article from the Internet entitled "Epoxy Seal—Prevents Down Time and Keeps

US 7,067,952 B2

Page 3

The Epoxylite Corporation, article from the Internet entitled "Vacuum Pressure Impregnation (VPI) Systems", Nov. 19, 1999, <<http://www.epoxylite.com/EpoxyliteEquipment.htm>>, 3 pages.

Neeltran Inc., article from the Internet entitled "Vacuum Pressure Impregnation (VPI)", Nov. 19, 1999, <<http://www.neeltran.thomasregister.com/olc/neeltran/neel9.htm>> 2 pages.
* cited by examiner

FIG. 1
PRIOR ART

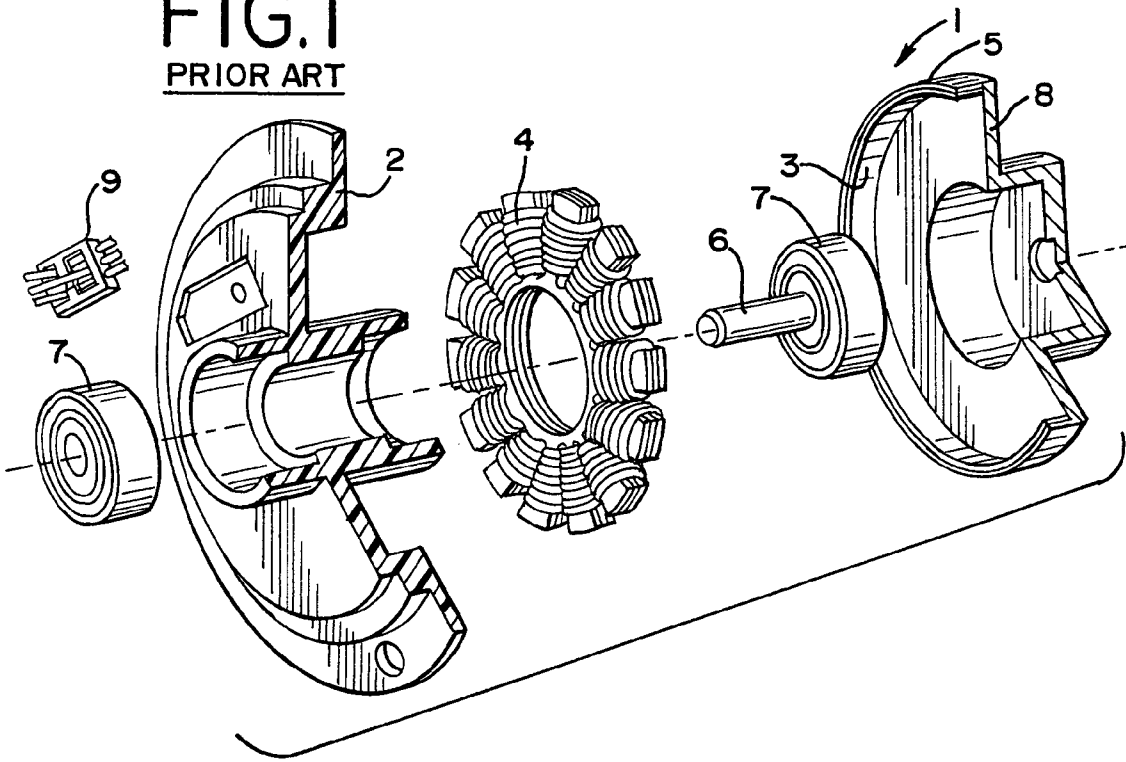


FIG. 2

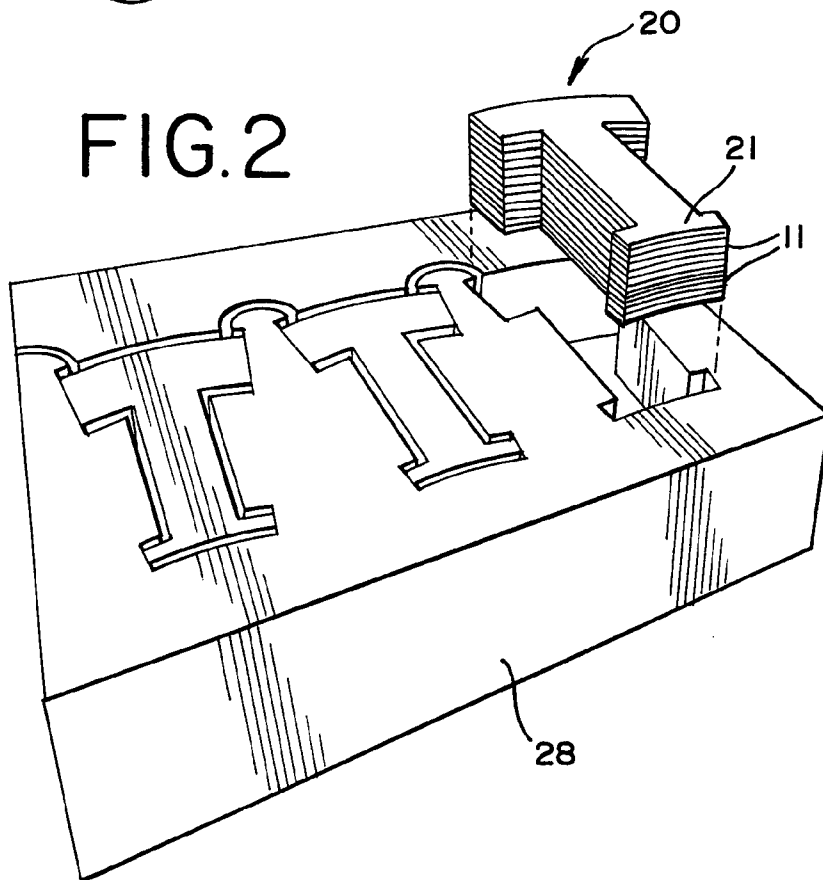


FIG.3

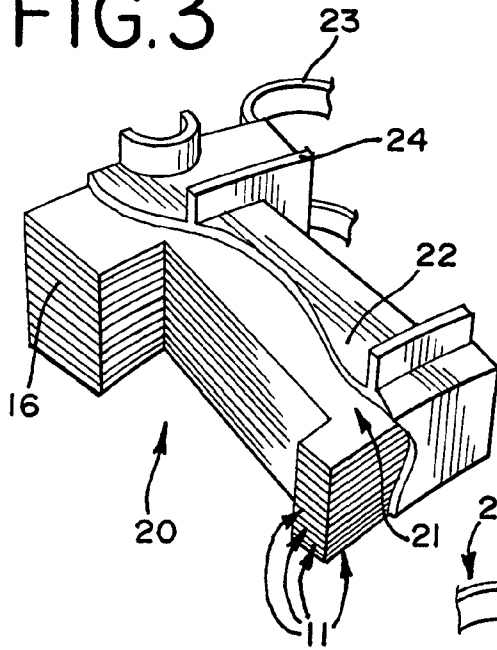


FIG.4

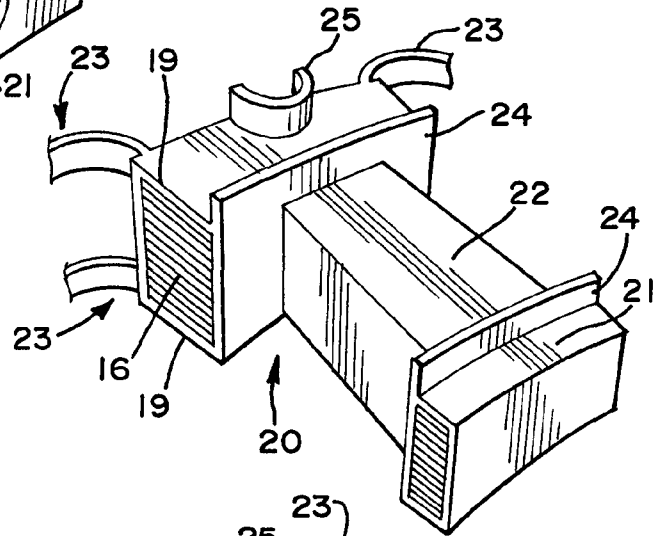
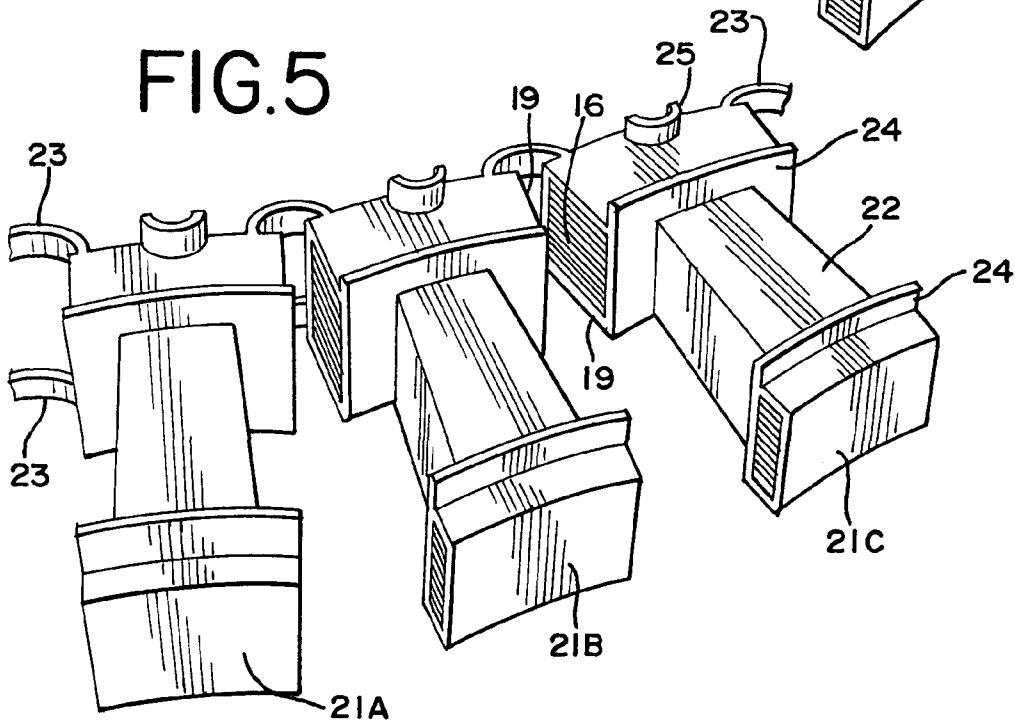


FIG.5



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