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Brown et al.

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(54) **MOTION CONTROL SYSTEMS**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

(63) Continuation of application No. 09/191,981, filed on Nov. 13, 1998, which is a continuation of application No. 08/656,421, filed on May 30, 1996, now Pat. No. 5,867,385, which is a continuation-in-part of application No. 08/454,736, filed on May 30, 1995, now Pat. No. 5,691,897.

(51) **Int. Cl.**[7] **G05B 19/18**
(52) **U.S. Cl.** **700/56**; 700/87
(58) **Field of Search** 700/56, 1, 87, 700/67; 703/25

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,159,417	A	6/1979	Rubincam	235/375
4,418,381	A	11/1983	Molusis et al.	700/2
4,531,182	A	7/1985	Hyatt	700/2
4,713,808	A	12/1987	Gaskill	370/314
4,767,334	A	8/1988	Thorne et al.	434/29
4,809,335	A	2/1989	Rumsy	704/266
4,840,602	A	6/1989	Rose	446/175
4,846,693	A	7/1989	Baer	434/308
4,855,725	A	8/1989	Fernandez	345/173
4,857,030	A	8/1989	Rose	446/303
4,887,966	A	12/1989	Gellerman	463/38
4,897,835	A	1/1990	Gaskill	370/314
4,937,737	A	6/1990	Schwane et al.	709/310
5,095,445	A	3/1992	Sekiguchi	709/246
5,120,065	A	6/1992	Driscoll et al.	273/237

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

EP	0442676 A2	8/1991
EP	0 281 427 B1	8/1992
EP	0508912 A1	10/1992
EP	0 583 908 A2	2/1994
EP	0275826 A1	7/1998
GB	2 224 896 A	12/1991
JP	59 228473	6/1983
WO	WO 92/11731	7/1992
WO	WO 93/08654	4/1993
WO	WO 95/07504	3/1995

OTHER PUBLICATIONS

Wosa Backgrounder: Delivering Enterprise Services to the Windows–based Desktop, Jul. 1993, Microsoft Development Library; pp. 1–19.

(List continued on next page.)

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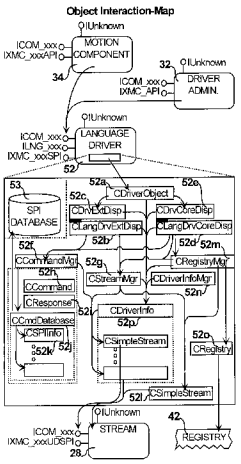
(57) **ABSTRACT**

A system for motion control in which an application is developed that is independent from the actual motion control hardware used to implement the system. The system comprises a software system that employs an application programming interface comprising component functions and a service provider interface comprising driver functions. A system programmer writes an application that calls the component functions. Code associated with the component functions relates these functions to the driver functions. A hardware designer writes driver code that implements the driver functions on a given motion control hardware product. The driver functions are separated into core and extended driver functions. All software drivers implement the core driver functions, while the software drivers need not contain code for implementing the extended driver functions. If the software driver does not contain code to implement an extended driver function, the functionality of the extended driver function is obtained through a combination of core driver functions. The system programmer may also select one or more streams that allow the control commands to be communicated to, and response data to be communicated from, motion control hardware.

10 Claims, 64 Drawing Sheets



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U.S. PATENT DOCUMENTS

5,126,932	A		6/1992	Wolfson et al. 709/202
5,168,441	A	*	12/1992	Onarheim et al. 700/17
5,175,817	A		12/1992	Adams et al. 709/236
5,245,703	A		9/1993	Hubert 710/105
5,247,650	A		9/1993	Judd et al. 703/20
5,377,258	A		12/1994	Bro 379/106.02
5,390,330	A		2/1995	Talati 717/104
5,392,207	A	*	2/1995	Wilson et al. 700/64
5,402,518	A		3/1995	Lowery 704/201
5,412,757	A	*	5/1995	Endo 706/52
5,450,079	A		9/1995	Dunaway 341/23
5,453,933	A		9/1995	Wright et al. 700/181
5,465,215	A	*	11/1995	Strickland et al. 700/180
5,491,813	A		2/1996	Bondy et al. 709/323
5,493,281	A		2/1996	Owens 340/825.24
5,596,994	A		1/1997	Bro 600/545
5,604,843	A		2/1997	Shaw et al. 358/1.1
5,607,336	A		3/1997	Lehensfeld et al. 446/297
5,608,894	A		3/1997	Kawakami et al. 717/162
5,617,528	A		4/1997	Stechmann et al. 707/517
5,636,994	A		6/1997	Tong 434/308
5,652,866	A		7/1997	Aldred et al. 703/23
5,655,945	A		8/1997	Jani 446/175
5,666,161	A		9/1997	Kohiyama et al. 375/240.18
5,670,992	A		9/1997	Yasuhara et al. 345/173
5,707,289	A		1/1998	Watanabe et al. 463/40
5,733,131	A		3/1998	Park ..... 434/307 R
5,737,523	A		4/1998	Callaghan et al. 713/201
5,746,602	A		5/1998	Kikinis 434/169
5,752,880	A		5/1998	Gabai et al. 463/1
5,764,155	A		6/1998	Kertesz et al. 700/295
5,790,178	A		8/1998	Shibata et al. 348/14.07
5,800,268	A		9/1998	Molnick 463/40
5,801,946	A		9/1998	Nissen et al. 700/95
5,846,132	A		12/1998	Junkin 463/42
5,867,385	A	*	2/1999	Brown et al. 700/56
5,907,704	A	*	5/1999	Gudmundson et al. 717/1
5,914,876	A	*	6/1999	Hirai 700/87

OTHER PUBLICATIONS

Wosa Inside Windows 95; pp. 348–351.

Software Products for Industrial Automation, ICONICS; 6 pages.

Web 3.0 Product Brochure, Trihedral Engineering Ltd. (1994); 6 pages.

The Complete, Computer–Based Automation Tool (IGSS) Seven Technologies A/S; 6 pages.

Oregon Micro Systems Product Guide: pp. 1–20.

Aimax–Win Product Brochure, TA Engineering Co., Inc.; 8 pages.

Xanalog Model NL–SIM Product Brochure, Xanalog, 4 pages.

ExperTune PID Tuning Software, Gerry Engineering Software; 6 pages.

PMAC Product Catalog, p. 43.

Paragon TNT Product Brochure, Intec Controls Corp.; 6 pages.

Aerotech Motion Control Product Guide; pp. 233–234.

OpenBatch Product Brief, PID, Inc.; 6 pages.

PC/DSP–Series Motion Controller C Programming Guide; pp. 1–54.

FIX Product Brochure, Intellution (1994); 6 pages.

Precision Motion Controls Product Guide; p. 17.

Compumotor Digiplan (1993–94) Catalog pp. 10–11.

Sue Chen, Jonathon Lin; "Computer Numerical Control: Essentials in Programming and Networking"; Part 5, Chapter 27; pp. 824–848.

Pritschow et al.; "Open System Controllers: Challenge for the Future of the Machine Tool Industry"; pub. Jan. 15, 1993; pp. 449–452.

William E. Ford; "What Is an Open Architecture Robot Controller"pub. Aug. 16, 1994; pp. 27–32.

Chu and Wang; "Development of a Practical SFC System for CNC Machine Shop"; pub. 1994; pp. 362–367.

Microsoft; "The Microsoft Object Technology Strategy"; pub. Mar. 1994; pp. 1–33.

Microsoft; "Open Systems: Technology, Leadership, and Collaboration"; pub. Mar. 1994; pp. 1–15.

Microsoft; Microsoft OLE Today and Tomorrow: Technology Overview; pub. Dec. 1993; pp. 1–9.

Microsoft; "Object Linking and Embedding 2.0 Backgrounder"; pub. Sep. 1993; pp. 1–15.

Robert Anderson; "SMART: A Modular Architecture for Robotics and Teleoperation"; pub. 1993; pp. 416–421.

Proctor et al.; "Validation of Standard Interfaces from a Machine Control"; pub. 1996; pp. 659–664.

Altintas et al.; "Design and Analysis of a Modular CNC System"; pub. Mar. 4, 1990; pp. 305–316.

Wright et al.; "Open Architecture Manufacturing: The Impact of Open–System Computers on Self–sustaining Machinery and the Machine Tool Industry"; pp. 41–47.

Fedrowitz; IRL–Based Expansion of the Commonly Used High–Level Language C for Robot Programming: pub. Oct. 1995; 5 pages.

McGraw et al.; "A Friendly Command, Control, and Information System for Astronomy"; pub. 1996; pp. 356–367.

Jackman; "Robotic Control Using Sequential Function Charts"; pub. 1996; pp. 120–128.

Sperling et al.; "Enabling Open Control Systems: An Introduction to the OSACA System Platform"; pub. May 1996; pp. 1–8.

"Requirements of Open Modular Architecture Controllers for Applications in the Automotive Industry"; pub. Dec. 13, 1994; pp. 1–13.

Open, Modular Architecture Controls at GM Powertrain; pub. May 14, 1996; pp. 1–33.

"Technologies Enabling Agile Manufacturing (TEAM) Intelligent Closed Loop Processing"; pub. Jan. 11, 1996; 30 pages.

* cited by examiner

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FIG. 1A

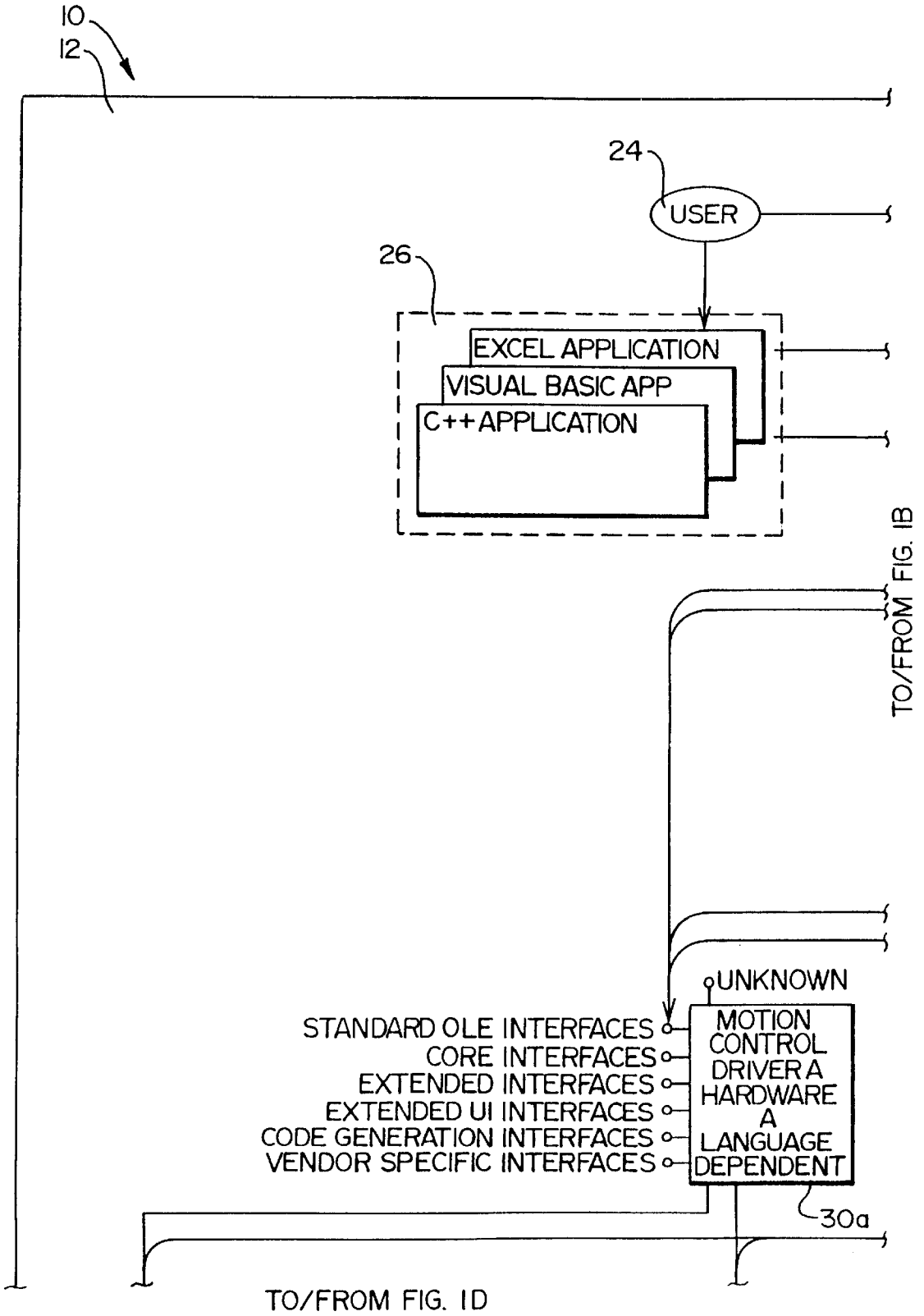

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FIG. 1B

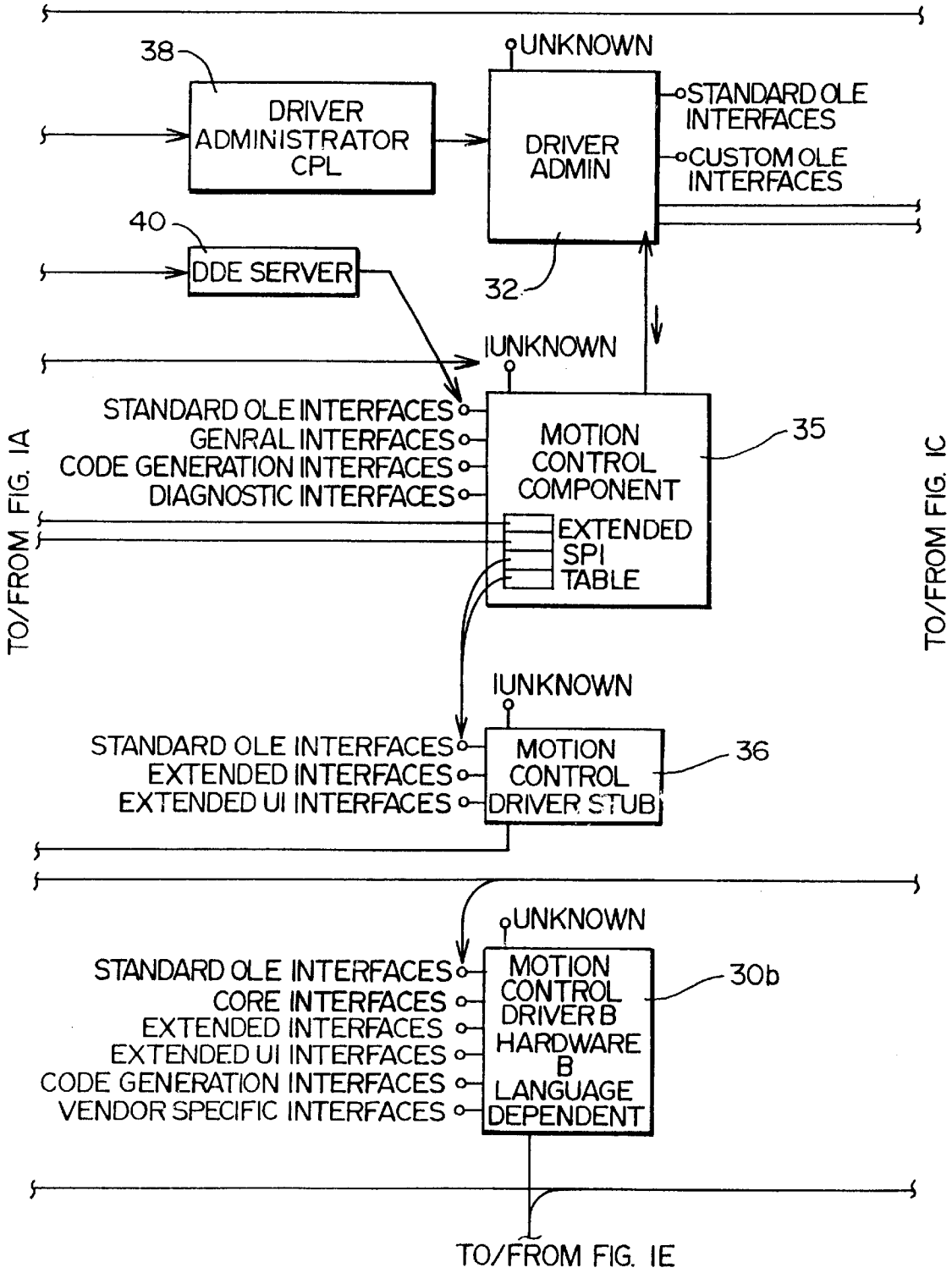

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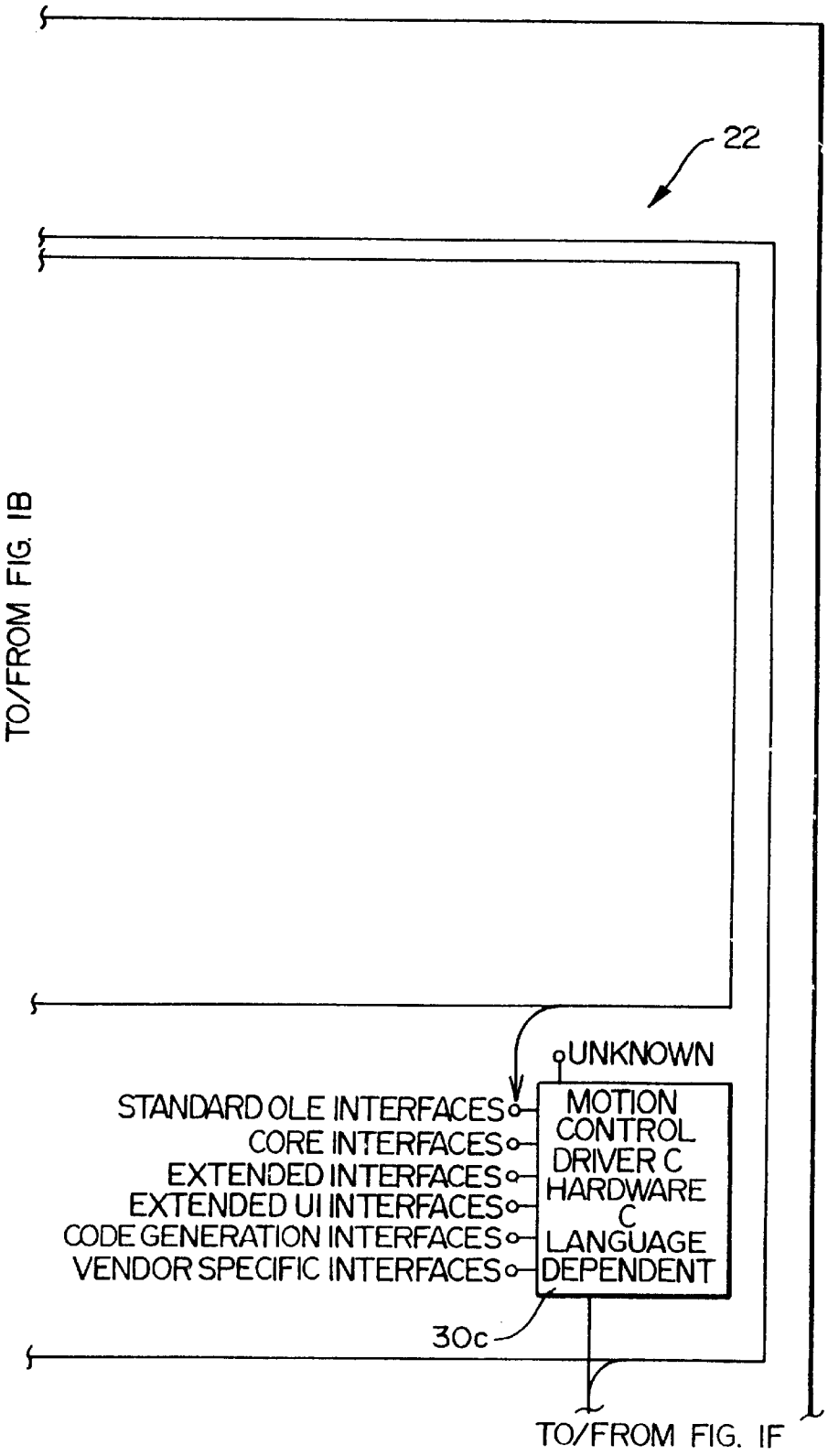
FIG. IC



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