CONVENTION

AUSTRALIA

Patents Act 1990

NOTICE OF ENTITLEMENT

We, **O.C.S. GROUP LIMITED** of 79 Limpsfield Road, Sanderstead, Surrey CR2 9LB, United Kingdom state the following in connection with Australian Application No. 40850/93:

1. We are the nominated person.

2. The nominated person is the assignee of the actual inventors.

3. The nominated person is the applicant of the basic application listed in the declaration under Article 8 of the PCT.

4. The basic application is the application first made in a Convention country in respect of the invention.

Dated: 2 November 1994

By **PHILLIPS ORMONDE & FITZPATRICK**
Patent Attorneys for the Applicant
By:

David B Fitzpatrick

.....

To: The Commissioner of Patents

PHILLIPS ORMONDE & FITZPATRICK
367 Collins Street
Melbourne, Australia, 3000

Our Ref: 388957

1925x

AU9340850

(12) PATENT ABRIDGMENT (11) Document No. AU-B-40850/93
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 673830

(54) Title
WINDOW CLEANING APPARATUS

International Patent Classification(s)
(51)[5] **A47L 001/02**

(21) Application No. : **40850/93** (22) Application Date : **26.05.93**

(87) PCT Publication Number : **WO93/24044**

(30) Priority Data

(31) Number	(32) Date	(33) Country
9211146	**26.05.92**	**GB UNITED KINGDOM**

(43) Publication Date : **30.12.93**

(44) Publication Date of Accepted Application : **28.11.96**

(71) Applicant(s)
O.C.S. GROUP LIMITED

(72) Inventor(s)
CHARLES ALLEN; RICHARD PAWSON; MOHAMMED [illegible]; PETER JOHNSON

(74) Attorney or Agent
PHILLIPS ORMONDE & FITZPATRICK , 367 Collins Street, MELBOURNE VIC 3000

(56) Prior Art Documents
FR 2647371
FR 2662378

(57) Claim

1. A cleaning apparatus for cleaning windows, including an elongate wiper element and a robotic control means operatively coupled to said wiper element to control movement of said wiper element across the surface area of the window, wherein said robotic control means is specifically adapted to cause said wiper element to make a continuous sweep across the entire surface area of a window for to move a body of cleaning liquid across said window for ultimate disposal, whereby only one side of said wiper element contacts the cleaning liquid being removed.

OPI DATE 30/12/93 APPLN. ID 40850/93
AOJP DATE 10/03/94 PCT NUMBER PCT/GB93/01084

AU9340850

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : A47L 1/02

A1

(11) International Publication Number: WO 93/24044

(43) International Publication Date: 9 December 1993 (09.12.93)

(21) International Application Number: PCT/GB93/01084

(22) International Filing Date: 26 May 1993 (26.05.93)

(30) Priority data:
9211146.7 26 May 1992 (26.05.92) GB

(71) Applicant *(for all designated States except US)*: O.C.S. GROUP LIMITED [GB/GB]; 79 Limpsfield Road, Sanderstead, Surrey CR2 9LB (GB).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)* : ALLEN, Charles [GB/GB]; 132 Meadway, Forrest Hall, Newcastle upon Tyne NE12 9RE (GB). PAWSON, Richard [GB/GB]; 169 Reading Road, Henly on Thames, Reading, Oxon RG9 1DP (GB). FARSI, Mohammed [GB/GB]; 8 Warcop Court, Kingston Lodge, Newcastle upon Tyne NE3 2TA (GB). JOHNSON, Peter [GB/GB]; Farmdale, Butlers Dene Road, Woldingham, Surrey CR3 7HX (GB).

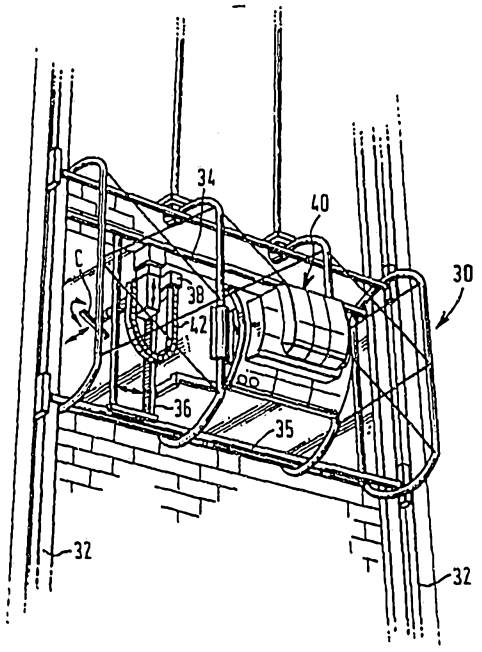
(74) Agents: SMITH, Norman, Ian et al.; F.J. Cleveland & Company, 40-43 Chancery Lane, London WC2A 1JQ (GB).

(81) Designated States: AT, AU, BB, BG, BR, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

673830

(54) Title: WINDOW CLEANING APPARATUS



(57) Abstract

A cleaning device for cleaning windows comprises an elongate wiper element (C) which is robotically controlled to move across the surface of the window to apply and remove cleaning fluid therefrom. The robotic control can be so arranged that the movement of the wiper element corresponds to that which it would follow if used manually by a skilled window cleaner.

Window Cleaning Apparatus

DESCRIPTION

This invention relates to the cleaning of windows. The cleaning of a window involves washing, usually with water and detergent, followed by wiping to remove liquid. Manually this is typically achieved with a sponge wet with cleaning liquid followed by a flexible blade or squeegee. An automatic cleaning arrangement has been proposed wherein an elongate wiping blade of the dimensions of the window moves in a rectilinear path across the window. Such an arrangement has constructional and operational disadvantages.

According to the invention there is provided a cleaning apparatus for cleaning windows, including an elongate wiper element and a robotic control means operatively coupled to said wiper element to control movement of said wiper element across the surface area of the window, wherein said robotic control means is specifically adapted to cause said wiper element to make a continuous sweep across the entire surface area of a window to move a body of cleaning liquid across said window for ultimate disposal, whereby only one side of said wiper element contacts the cleaning liquid being removed. It is preferred that the cleaning device include an elongate wiper which has a length less than any side of the window and is robotically controlled to move across the entire surface area of the window to remove cleaning liquid therefrom. To achieve this one side only of the elongate member, hereinafter called the blade, contacts the cleaning liquid being removed, a continuous sweep being made to define a moving body of liquid.

The robotic control means will be preferably such as to cause the blade to simulate the movements made by the human arm and the hand rather than to describe strictly rectilinear movements parallel to the sides of the window.

AUSTRALIAN PATENT OFFICE
A 3

Preferably the robotic control means will initially act, using the blade as a sensing means, to sense the dimensions of the window to be cleaned. A computer will then establish the pattern of movements of the blade over the window. The wiping blade should have longitudinal compliance so that its ends can contact the window margin and be moved to actuate sensing means. Compliance normal to the blade length is also desirable to enable the blade to contact the window with the desired force. This compliance will preferably have two modes a first datum mode to sense by contact as set out above and a second stiffer cleaning mode.

Although a cleaning head including the blade may comprise a liquid applicator, for example a jet or spray, separate from the wiping blade it is presently preferred to incorporate washing means such as a brush and the wiping blade in an elongate cleaning head. Preferably this head will include a vacuum space between the brush and blade for removing cleaning liquid during and particularly at the finish of cleaning.

The robotic control means will be of any suitable form but we have found it possible to provide an effective cleaning pattern using a robot with Cartesian mountings, i.e. a robot which allows movement of the head in the three axes at right angles a horizontal lateral X axis, a Z axis normal to the X axis allowing horizontal movement towards and away from the window and a vertical Y axis. The cleaning head is rotatable about the Z axis to provide the full range of movements required with operational simplicity and robustness. The head may also be mounted for limited

tilting movement to allow for inclination of the window pane.

The invention will now be described by way of example and with reference to the accompanying drawings wherein:-

Figure 1 is a schematic view of a control robot with a rotatably mounted cleaning head;

Figures 2A and 2B illustrate respectively datum and positioning and cleaning paths according to one operating plan;

Figure 3 is a view of a cleaning apparatus incorporating the present invention mounted on the exterior of a building;

Figure 4 is a plan view partly in section of one form of cleaning head mounting;

Figure 5 is a front view of the cleaning head;

Figure 6 is a sectional view of the cleaning head;

Figure 7 is a side view of the cleaning head mounting;

Figure 8 is a block scehmatic diagram of the robot control circuitry, and

Figures 9 to 11 are flow charts illustrating the software strucutre for the robotic control.

Referring initially to Figure 1 of the drawings a cleaning device is diagrammatically illustrated and comprises an frame support with a vertical leg along the X axis and upper and lowere horizontal cross-members along the Y axis. A support for the cleaning blade extends forwardly along the Z axis. Robotically controlled drive means allow the device to be moved along all three axes whilst an elongate cleaning head C is rotatable about the Z axis.

The cleaning head C has two modes of operation a datum mode and a cleaning mode. A cleaning head adapted to operate in these modes will be described hereinafter with reference to Figures 4 to 7, but initially these modes will be referred to functionally with reference to Figures 2A and 2B to explain how, in accordance with the invention, cleaning of a window is carried out.

Referring to Figure 2A the head in the datum mode and upright finds and contacts the window W at 1. It then moves up to 2 to find the top margin of the window down to 3 to find the bottom margin to 4 to find the left margin and then to 5 to find the right margin. Electrical signals arising from these contacts 1 to 5 allow the dimensions of a rectangular window to be established and these are fed into a micro-computer which works out the cleaning path of Figure 2B. An increased force is applied to the head which is then in the cleaning mode and the head performs the cleaning pattern illustrated by numbers 1 through 14 sequentially.

This pattern simulates that which a skilled window cleaner would perform manually with his squeegee starting (1) at the top right and finishing with the head horizontally disposed (14) at the bottom left. With this pattern one side only of the wiping part of the head contacts cleaning liquid thereby moving a body of liquid across the window for ultimate disposal.

Naturally the paths described and illustrated could be achieved by a revolute robot with a universally mounted head, i.e. a robot having full freedom of movement of the blade. However, the Cartesian robot capable of moving about the three axes with rotation only about the Z axis is simple and robust and is presently preferred for the present invention.

Figure 3 shows a cleaning device mounted on a frame 30 on the exterior of a building, the windows of which are to be cleaned. The frame structure 30 can be moved vertically up and down the outside of the building between guides 32. At the upper end of its travel the frame structure can be moved laterally (by means not shown) so that it can be located between a different pair of guides to enable a different part of the building to be cleaned.

The frame structure includes upper and lower spaced parallel beams. A generally vertical beam 36 extends between the upper and lower beams 34, 35. Motors which operate through a rack and pinion arrangement can be energised to move the beam 36 along the length of the upper and lower beams 34, 35. This provides the movement along the X axis referred to above.

An arm 38 is carried by the vertical beam 36 and a further motor operating through a rack and pinion arrangement can be energised to move the arm upwardly and downwardly along the vertical beam 36. This provides movement along the Y axis referred to above.

The arm 38 is also mounted on the vertical beam 36 such that a further motor operating again through a rack and pinion arrangement can be energised to move the arm in its axial direction to thereby provide movement the Z axis.

The arm 38 carries at one end the cleaning head C which is shown schematically in Figure 1 and which will be described in more detail below. The head is so mounted on the arm 38 that it can be rotated about the axis of the arm by energisation of a further motor.

The frame structure also carries a housing which is shown generally at 40. The housing 40 accommodates the robotic control circuitry which will be described in more detail below. The housing 40 also accommodates a container or containers for cleaning fluid which is supplied to the cleaning head C when the window cleaning operation is carried out. Suitable electrical cabling and fluid conduits 42 extend from the housing 40 to the motors and the cleaning head C. The cables inter alia can transmit control signals from the robotic control to the motors to effect energisation of the motors and hence the required movement of the cleaning head. The cables also carry signals from motor control circuits and the cleaning head to the robotic control.

The fluid conduits are used to deliver cleaning fluid to and from the cleaning head C.

An example of a suitable form of cleaning head will now be described with reference to Figures 4 to 7. Referring to these Figures the cleaning head C is generally elongate and carries a forwardly extending wiper blade 60 which projects from one side edge of the front face of the cleaning head C. On the opposite side edge of the front face the head carries a cleaning brush 62 which also extends along the opposite end portions of the head to terminate adjacent opposite ends of the wiper blade 60. The brush 62 can be formed from suitable material such as bristles.

The head is formed with a first passage 64 which is connected to a pipe 65 which in turn is coupled to the supply of cleaning fluid by the fluid conduits referred to above. The cleaning fluid can be any appropriate cleaning fluid. The passage 64 terminates in a narrow bore 66 which is disposed so that cleaning fluid existing therefrom impregnates the bristles as illustrated in Figure 6.

The head also has a further passage 70 which is coupled by a pipe 71 to a vacuum source. This is used to retrieve cleaning fluid from the front of the head and return it to the fluid supply. In this respect it will be seen that when the cleaning head is pressed against the surface 74 of a window the blade 60, the brush 62, and the front surface of the head form with the window a chamber into which the fluid flows from the passage 66 and from which it can be retrieved by vacuum retrieval. The fluid path includes a filter

(not shown) which is used to clean fluid returning from the cleaning head. It will be seen that as the head is moved relative to the glass surface fluid from the impregnated brush 62 cleans the glass and the blade 60 acts to wipe the surface of the glass thereby ensuring that excess fluid is not left on the surface but maintained within the chamber and returned to the fluid supply by the vacuum retrieval referred to above.

As can be seen in Figure 5 the head includes a series of passages 70 which are connected to the vacuum source.

The mounting arrangement for the cleaning head which allows the datumming and cleaning mode will now be described with reference to Figure 4.

As can be seen the head C is mounted on a holder 80 which is in turn mounted for limited forward and rearward pivotal movement within a support 82. The holder 80 is pivotally mounted on a pin 84 and connected to the support through springs 85. A microswitch 88 is mounted on the support 82 so that its contact arm is close to the rear face of the holder 80. The arrangement is such that rearward movement of the holder 80 against the light bias of the springs 85 is sensed by the microswitch 88 which in turn transmits a signal to the robotic control circuitry. This occurs when the head C initially contacts its window. That is to say the contact pressure of the head C allows the holder 80 to actuate the microswitch and hence the robotic control. The holder 80 is mounted on the support 82 so that it can also move longitudinallyby a small distance relative

to that support 82. Proximity sensors (not shown) sense such movement when the head C is used to locate the edge of a window, the holder moves by a small distance on encountering the edge and the proximity detector transmits a signal to the control circuitry. This in effect constitutes the datumming mode which takes effect when the head is used as a sensor to locate the extremities of a window which is to be cleaned.

The support also has three rearwardly extending rods 90, 91, 92 each of which is received pistonwise in a cylinder in a structure 94 which is mounted on the end of the arm 38. The outer rods 90, 92 act as guides and are received in bearings 95. The centre rod 91 locates within a coil spring 98 which acts to urge the holder 80 forwardly towards a window. The coil spring 98 is substantially stiffer than the springs 85 used in the datumming mode. The robotic control can thus operate to exert an increased force during cleaning through the sprung connection to the robot head.

Figure 8 is a block schematic diagram of the robotic control circuitry. It comprises a PMAC motion control card 100 which operates in conjunction with a 286 CPU 101. The CPU has associated ROM/RAM 102 which is provided on a memory card. The memory card is connected to an input/output card 104 which has connections to a communications unit 100 for the roof trolley of the apparatus and to sensors 108 which identify the limits of the motion of the frame structure carrying the robotic control. The PMAC motion control card 100 can receive inputs from the cleaning head C acting in its datumming mode and also from encoders 110 associated with the motors. These

are feedback signals from the motors which inform the motion control card of the current position and state of the motors. The PMAC motion control card 100 has outputs to the pump and vacuum system 112 and also to amplifiers 114 which are used to drive the motors which control the robot. The CPU has a link with a block 118 which is intended to represent programming and maintenance interface. The PMAC 100 is a conventionally available controller card whose operation and structure will be known to those skilled in the art. All the circuitry is commercially available.

The software required by the system shown in Figure 8 is considered to be within the competence of a man skilled in the art of robotics and will vary according to the specific movements required of the cleaning head C. Figures 9 to 11 give flow charts which illustrate the basic structure of the software which can be used by the robotic control circuits. Figure 9 shows the general structure of the software whilst Figure 10 is a flowchart showing in more detail that part of the software shown as the datum window 110 in Figure 9. This represents the function of the software during the datumming operation referred to above. Similarly Figure 11 represents in more detail the clean window block shown on Figure 9. This represents the function of the software required for the cleaning window operation.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A cleaning apparatus for cleaning windows, including an elongate wiper element and a robotic control means operatively coupled to said wiper element to control movement of said wiper element across the surface area of the window, wherein said robotic control means is specifically adapted to cause said wiper element to make a continuous sweep across the entire surface area of a window for to move a body of cleaning liquid across said window for ultimate disposal, whereby only one side of said wiper element contacts the cleaning liquid being removed.

2. A cleaning apparatus according to claim 1, wherein the wiper is carried by a frame structure which permits movement of the wiper along the X-axis, the Y-axis, and the Z-axis of a Cartesian coordinate system.

3. A cleaning apparatus according to claim 2, wherein the wiper is also rotatable about the Z-axis.

4. A cleaning apparatus according to any one of the preceding claims, wherein the robotic control means is arranged to initially act, using the wiper element as a sensor, to sense the dimensions of the window to be cleaned.

5. A cleaning apparatus according to any one of the preceding claims wherein the robotic control includes processing means for establishing a pattern of movement to be followed by the wiper element during cleaning.

6. A cleaning apparatus according to any one of the preceding claims wherein the wiper element is mounted so that it has longitudinal compliance whereby its end can contact a window margin and actuate sensing means.

7. A cleaning apparatus according to any one of the preceding claims wherein the wiper element is mounted so that it has compliance normal to its length whereby it can be arranged to contact the window with a desired force during cleaning.

AUSTRALIAN PATENT OFFICE
13

8. A cleaning apparatus according to claim 7, wherein the compliance has two modes, a first datum mode during which the window margins are sensed, and a second shifter mode during which cleaning occurs.

9. A cleaning apparatus according to any one of the preceding claims including a cleaning head including a body, and an elongate cleaning portion carried by said body, said cleaning portion having projecting parts which when pressed into contact with a window form with the window a chamber, said body being formed with passages through which cleaning fluid can be applied to said chamber to clean said window.

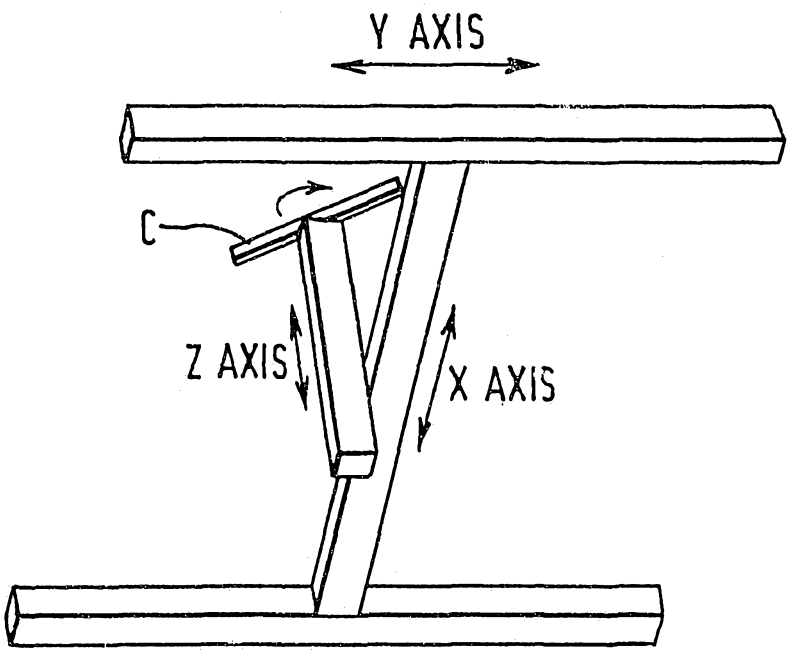
10. A cleaning apparatus according to claim 10, wherein said cleaning portion is formed by an elongate cleaning brush and an elongate wiper blade.

11. A cleaning apparatus substantially as hereinbefore described and illustrated.

DATED: 9 July 1996
PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
O.C.S. GROUP LIMITED

AUSTRALIAN PATENT OFFICE
14 3

FIG. 1



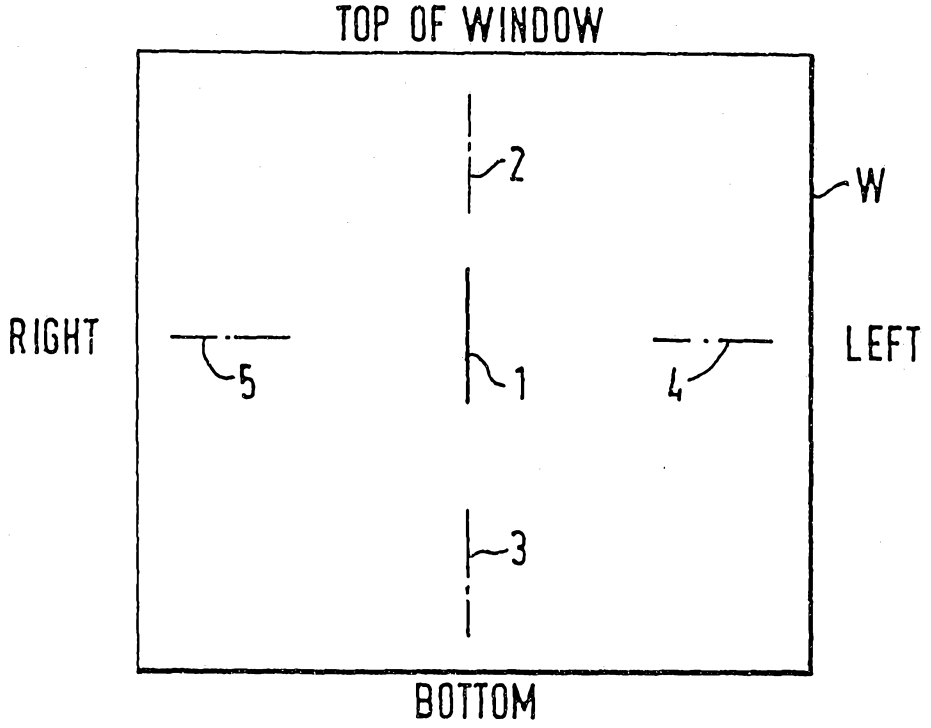

TOP OF WINDOW
2
W
RIGHT
5
1
4
LEFT
3
BOTTOM

FIG. 2A

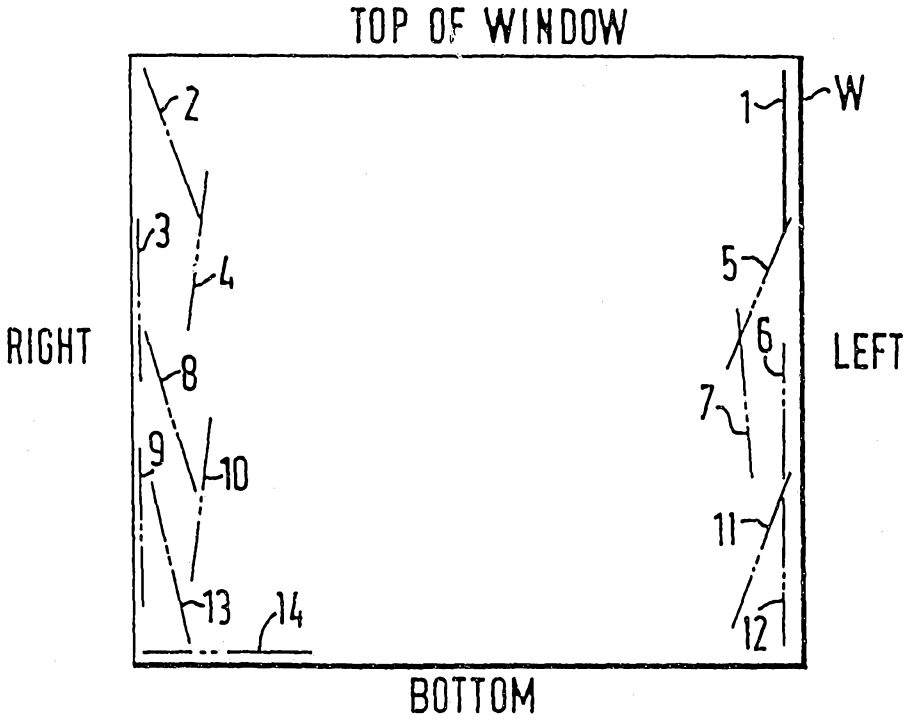

TOP OF WINDOW
2
1
W
3
4
5
RIGHT
8
6
LEFT
7
9
10
11
13
14
12
BOTTOM

FIG. 2B

FIG. 3

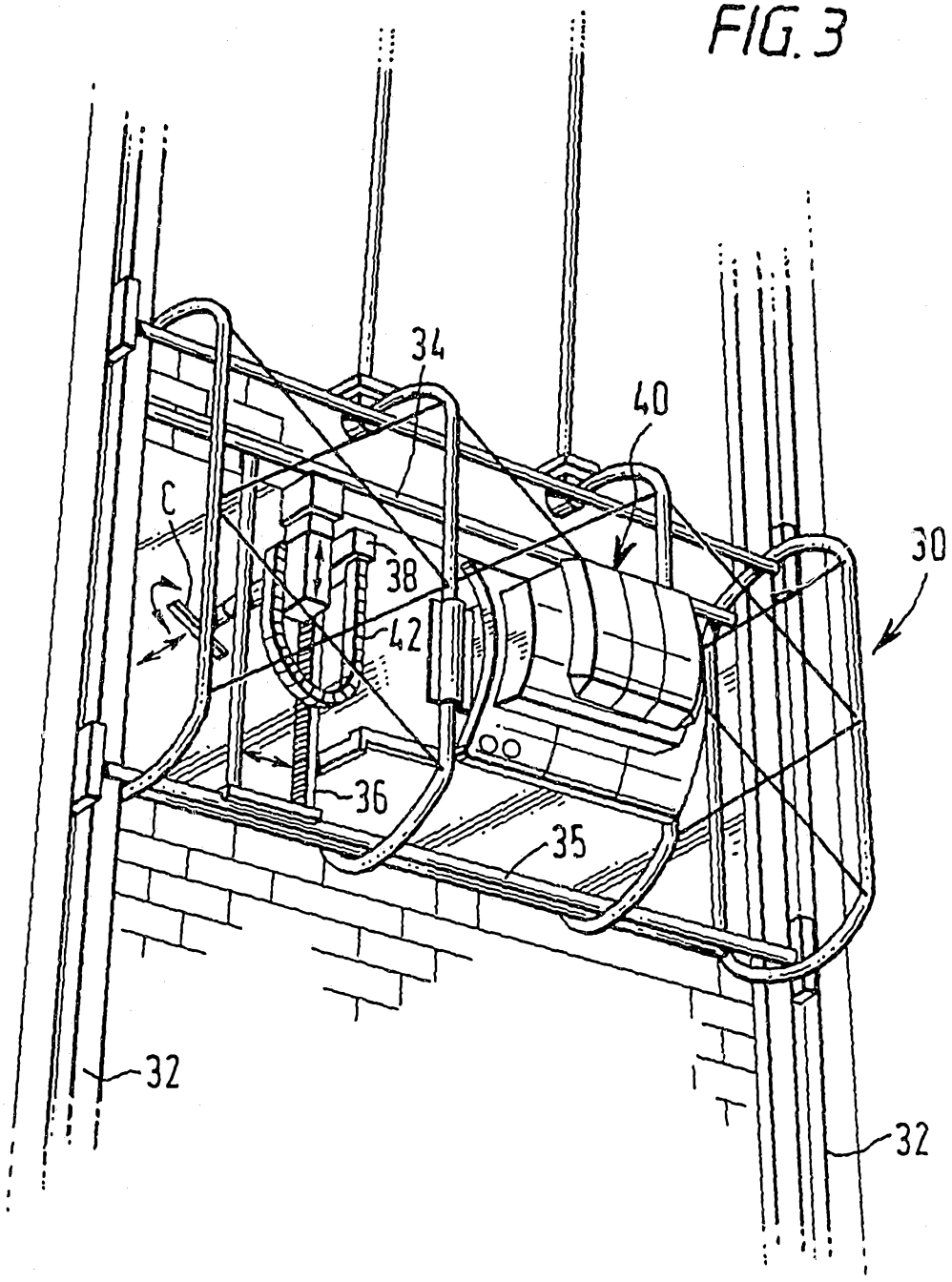
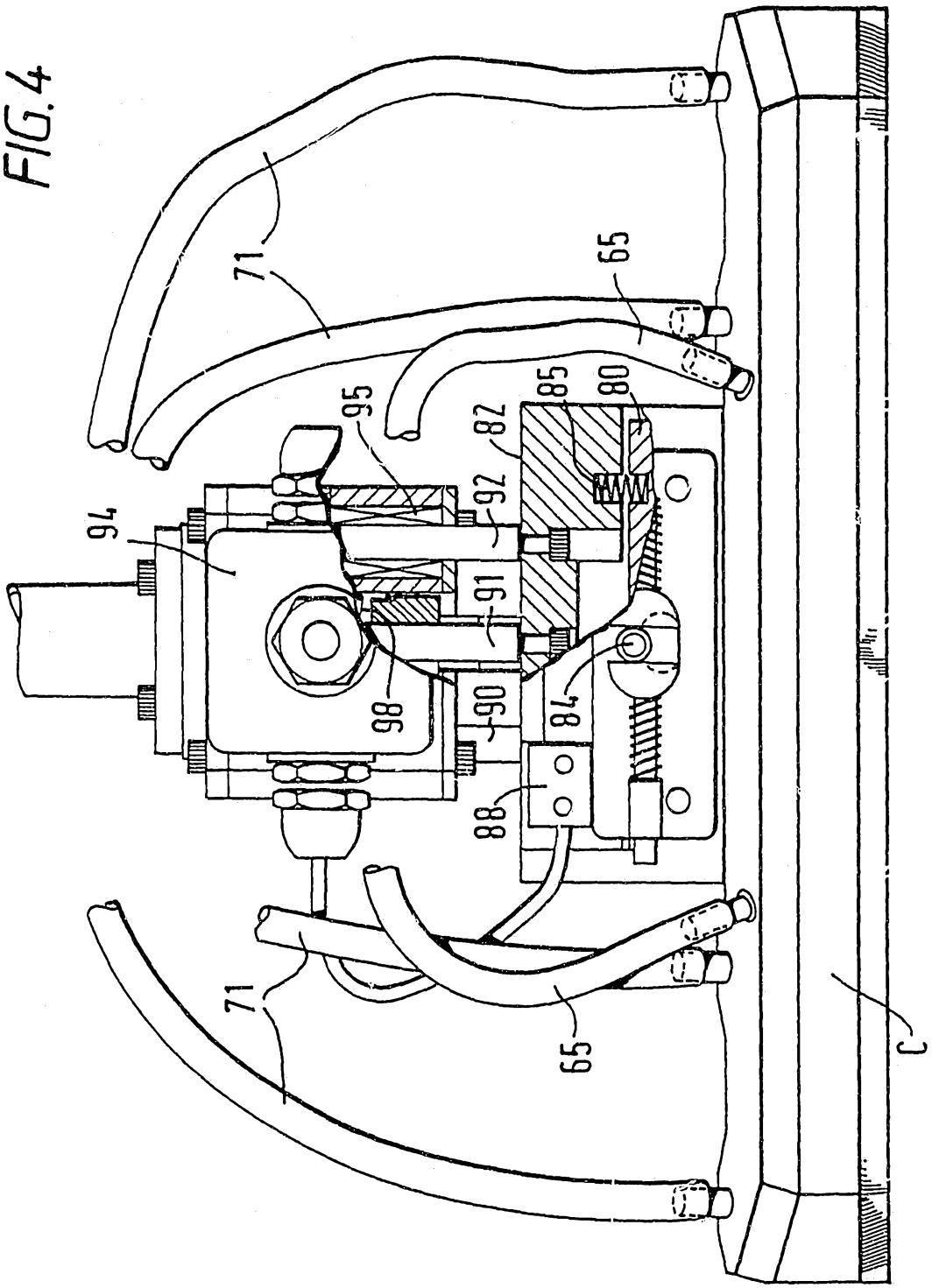


FIG.4



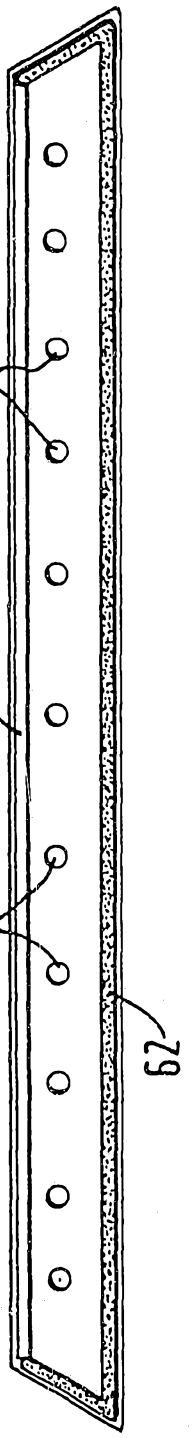


FIG.5

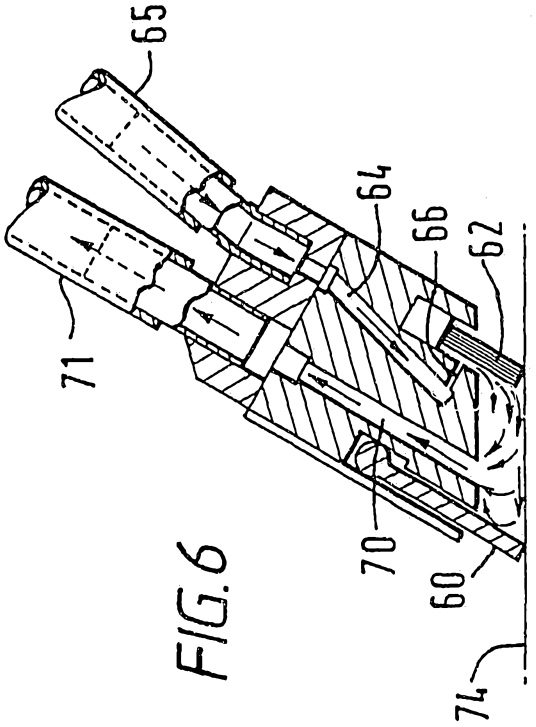
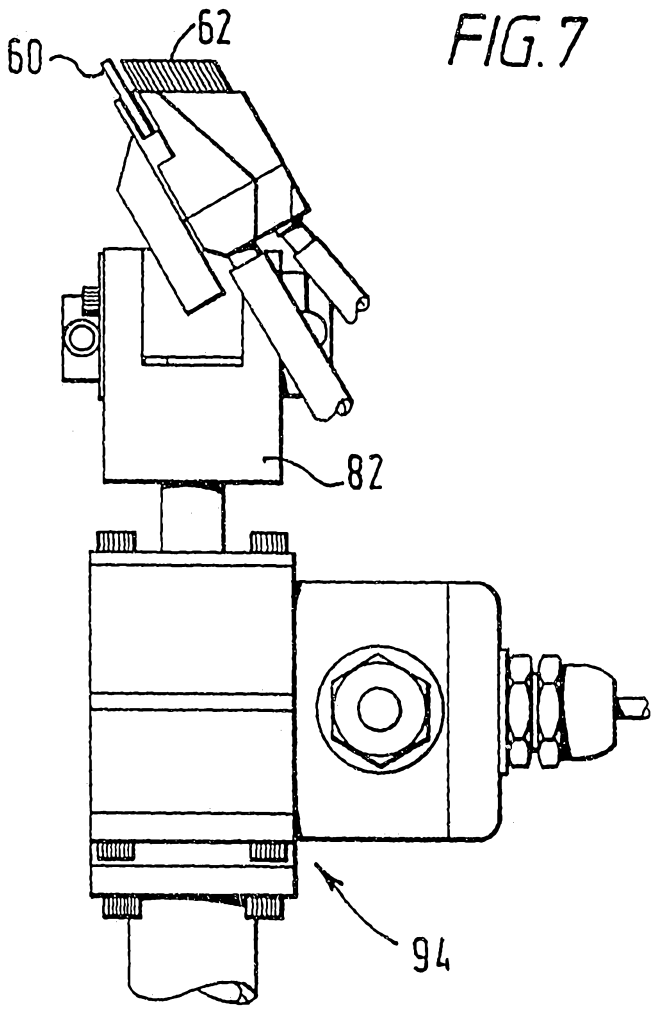


FIG.6

FIG. 7



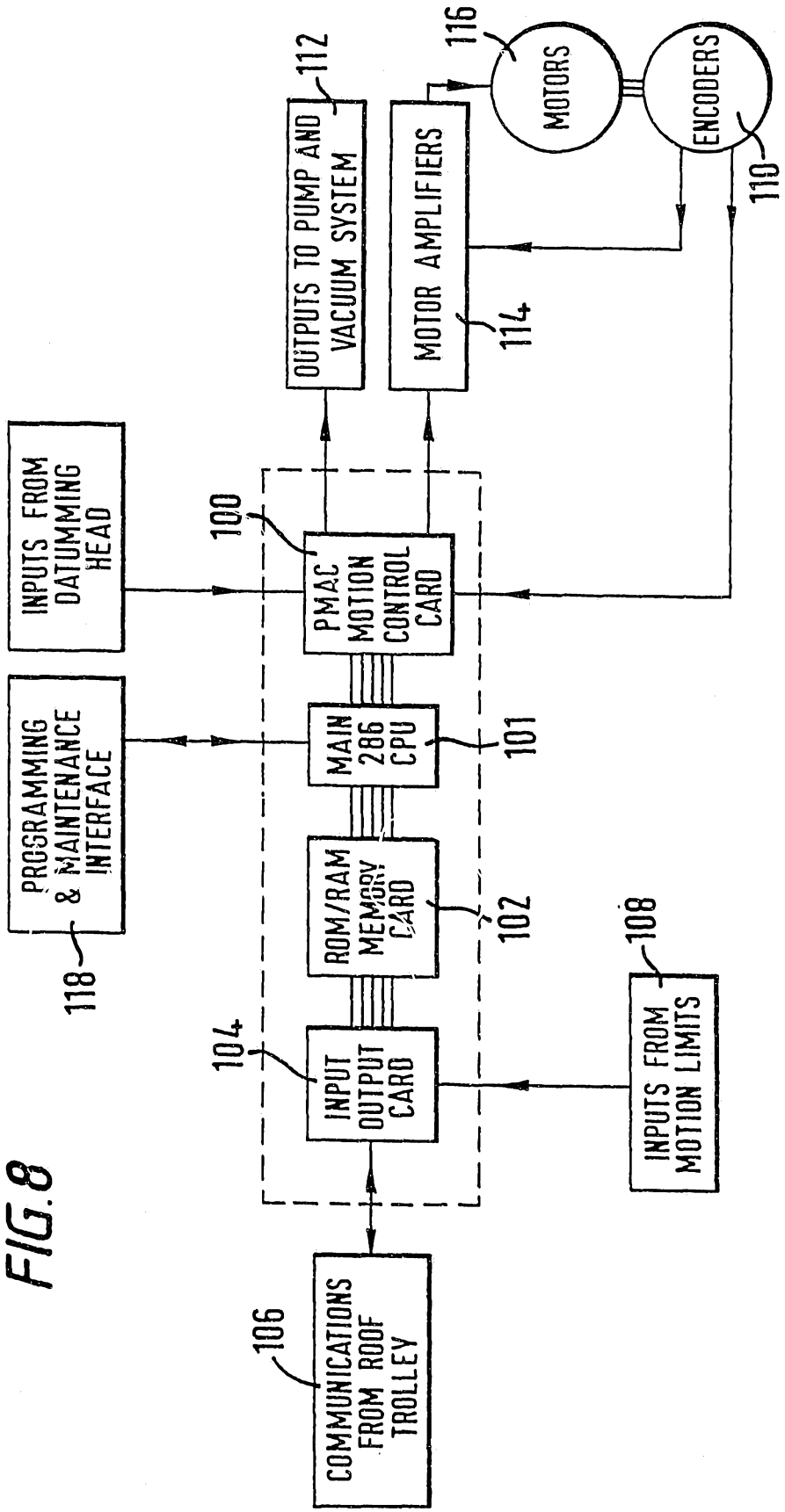
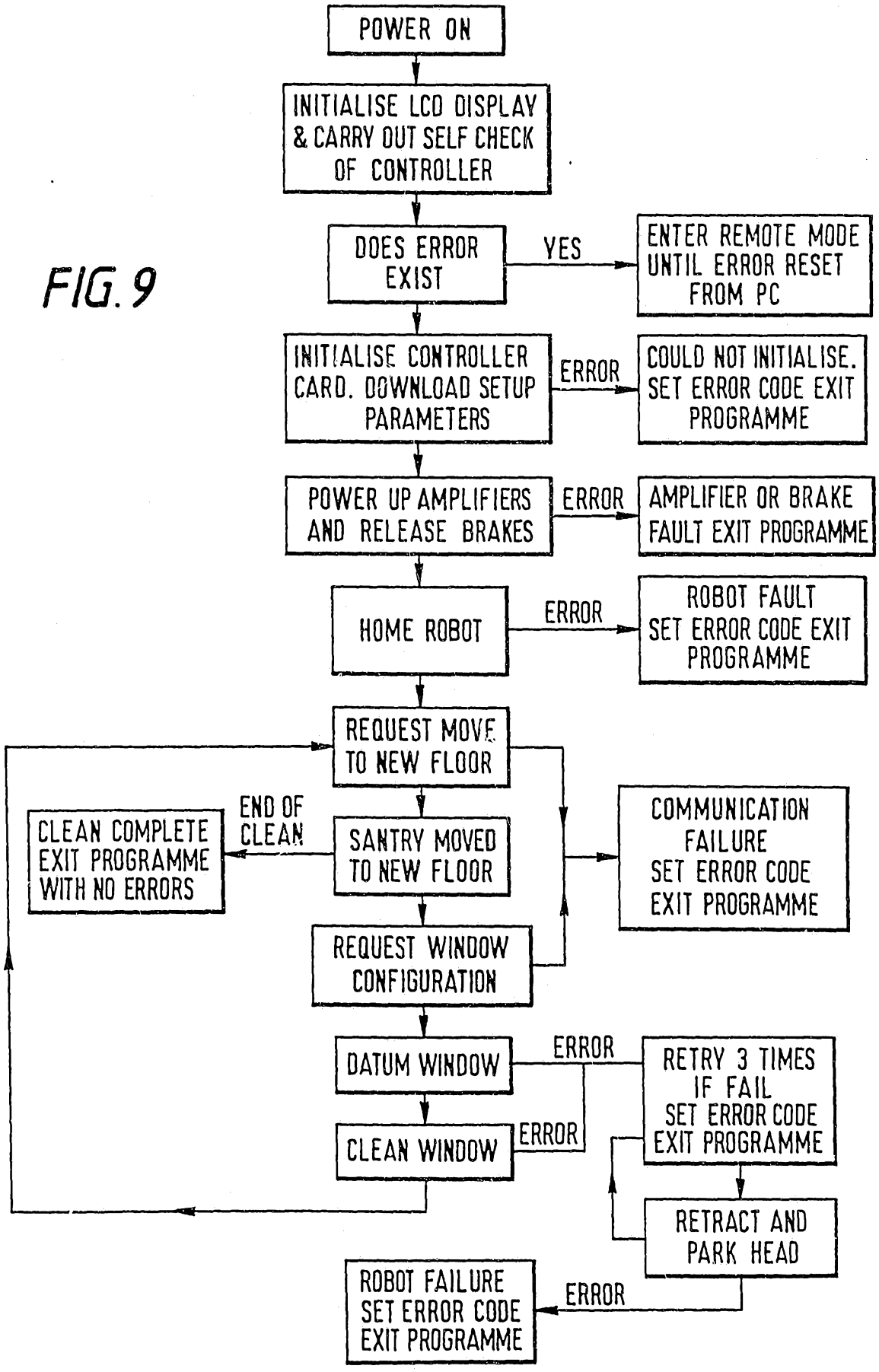

INPUTS FROM DATUMMING HEAD
PROGRAMMING & MAINTENANCE INTERFACE
118
100
PMAC MOTION CONTROL CARD
MAIN 286 CPU
101
ROM/RAM MEMORY CARD
102
INPUT OUTPUT CARD
104
COMMUNICATIONS FROM ROOF TROLLEY
106
INPUTS FROM MOTION LIMITS
108
OUTPUTS TO PUMP AND VACUUM SYSTEM
112
MOTOR AMPLIFIERS
114
MOTORS
116
ENCODERS
110

FIG.8

FIG. 9


POWER ON
INITIALISE LCD DISPLAY & CARRY OUT SELF CHECK OF CONTROLLER
DOES ERROR EXIST
YES
ENTER REMOTE MODE UNTIL ERROR RESET FROM PC
INITIALISE CONTROLLER CARD. DOWNLOAD SETUP PARAMETERS
ERROR
COULD NOT INITIALISE. SET ERROR CODE EXIT PROGRAMME
POWER UP AMPLIFIERS AND RELEASE BRAKES
ERROR
AMPLIFIER OR BRAKE FAULT EXIT PROGRAMME
HOME ROBOT
ERROR
ROBOT FAULT SET ERROR CODE EXIT PROGRAMME
REQUEST MOVE TO NEW FLOOR
END OF CLEAN
CLEAN COMPLETE EXIT PROGRAMME WITH NO ERRORS
SANTRY MOVED TO NEW FLOOR
COMMUNICATION FAILURE SET ERROR CODE EXIT PROGRAMME
REQUEST WINDOW CONFIGURATION
DATUM WINDOW
ERROR
RETRY 3 TIMES IF FAIL SET ERROR CODE EXIT PROGRAMME
CLEAN WINDOW
ERROR
RETRACT AND PARK HEAD
ROBOT FAILURE SET ERROR CODE EXIT PROGRAMME
ERROR

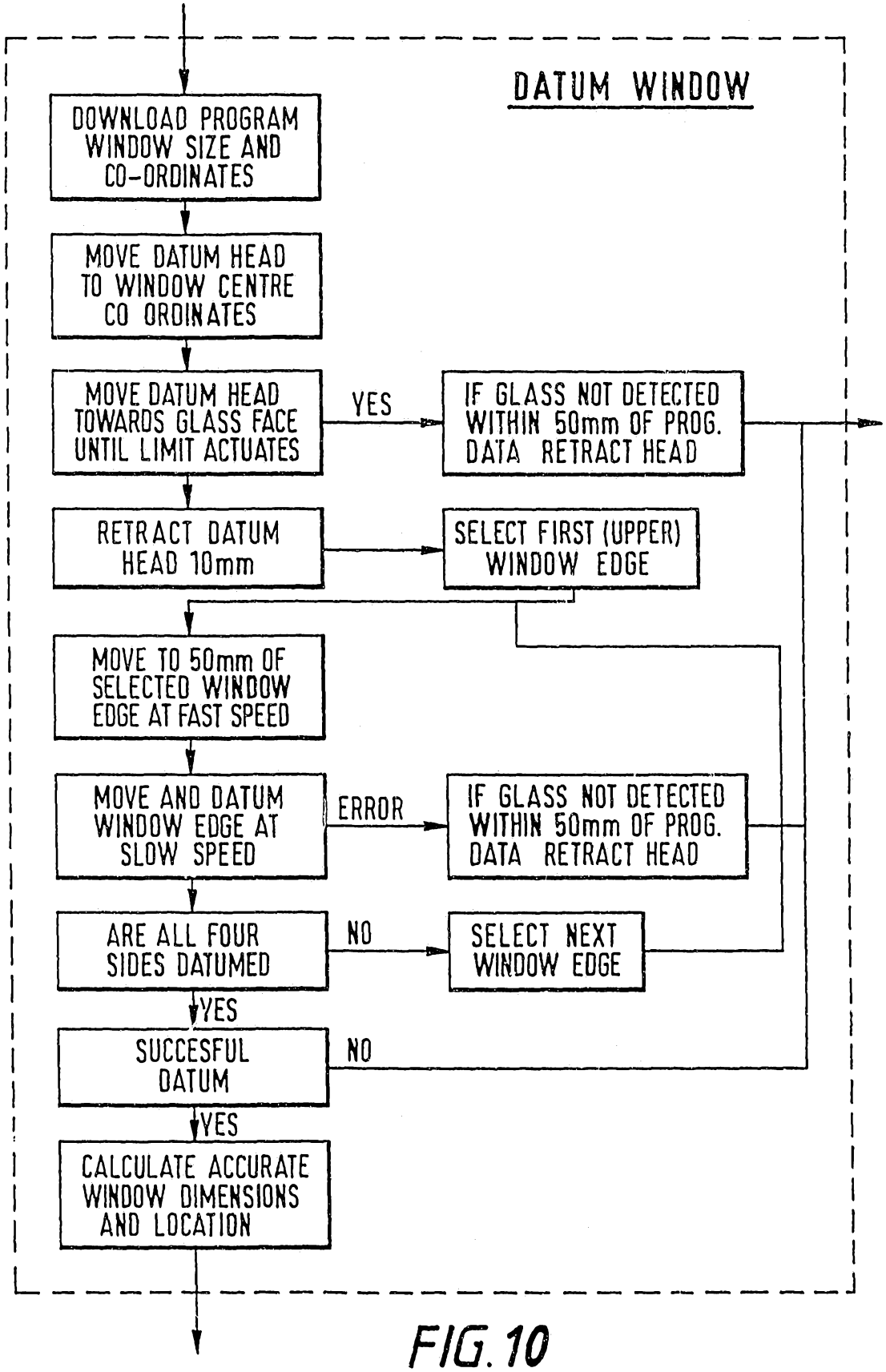

DATUM WINDOW
DOWNLOAD PROGRAM WINDOW SIZE AND CO-ORDINATES
MOVE DATUM HEAD TO WINDOW CENTRE CO ORDINATES
MOVE DATUM HEAD TOWARDS GLASS FACE UNTIL LIMIT ACTUATES
YES
IF GLASS NOT DETECTED WITHIN 50mm OF PROG. DATA RETRACT HEAD
RETRACT DATUM HEAD 10mm
SELECT FIRST (UPPER) WINDOW EDGE
MOVE TO 50mm OF SELECTED WINDOW EDGE AT FAST SPEED
MOVE AND DATUM WINDOW EDGE AT SLOW SPEED
ERROR
IF GLASS NOT DETECTED WITHIN 50mm OF PROG. DATA RETRACT HEAD
ARE ALL FOUR SIDES DATUMED
NO
SELECT NEXT WINDOW EDGE
YES
SUCCESFUL DATUM
NO
YES
CALCULATE ACCURATE WINDOW DIMENSIONS AND LOCATION

FIG. 10

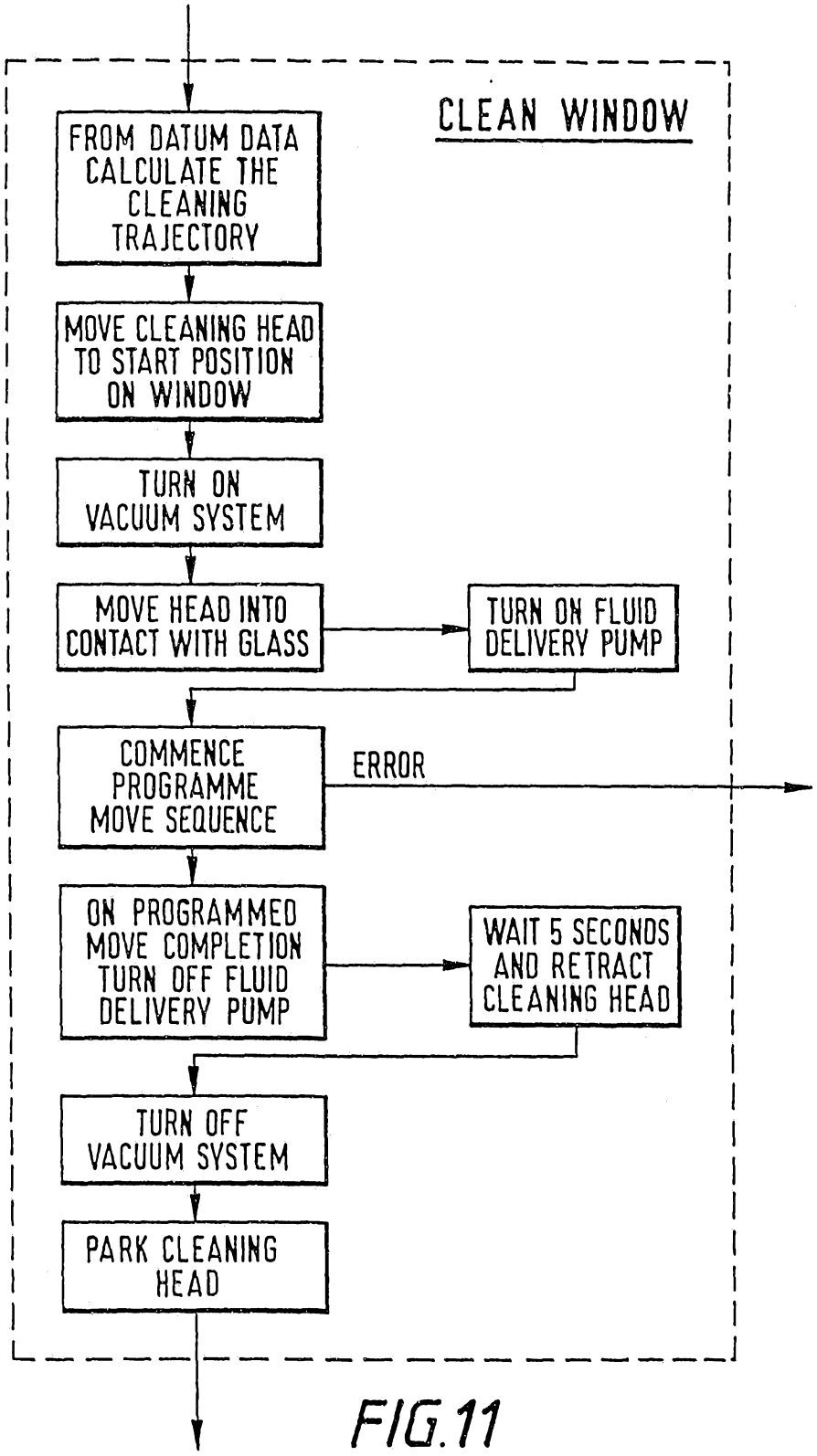

CLEAN WINDOW
FROM DATUM DATA CALCULATE THE CLEANING TRAJECTORY
MOVE CLEANING HEAD TO START POSITION ON WINDOW
TURN ON VACUUM SYSTEM
MOVE HEAD INTO CONTACT WITH GLASS
TURN ON FLUID DELIVERY PUMP
COMMENCE PROGRAMME MOVE SEQUENCE
ERROR
ON PROGRAMMED MOVE COMPLETION TURN OFF FLUID DELIVERY PUMP
WAIT 5 SECONDS AND RETRACT CLEANING HEAD
TURN OFF VACUUM SYSTEM
PARK CLEANING HEAD

FIG.11

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 93/01084

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 A47L1/02

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	A47L

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	FR,A,2 647 371 (NIHON BISO CO LTD) 30 November 1990	1-9
A	see the whole document	10,11
X	FR,A,2 662 378 (CHAMBRE DE COMMERCE ET DiINDUSTRIE DE BAYONNE) 29 November 1991 see page 1 - page 26; figures 1,11	1,10,11
X	ROBOTICS ENGINEERING no. 12, 8 December 1986, PETERBOROUGH,USA pages 27 - 30 'the skywalker'	1
X	BE,A,895 276 (J.H. SELIS) 31 March 1983 see the whole document	1,5-8

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
13 AUGUST 1993	27.08.93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. VANMOL

Form PCT/ISA/210 (second sheet) (January 1985)

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	NL,A,7 216 411 (J.E. LEICHEL) 6 June 1974 see the whole document	1
X	FR,A,2 067 491 (CEGOSERAI, INSTITUT POUR LA RECHERCHE SCIENTIFIQUE ET TECHNIQUE) 20 August 1971 see the whole document	10
A	PATENT ABSTRACTS OF JAPAN vol. 14, no. 146 (C-704)20 March 1990 & JP,A,20 17 959 (MAZDA MOTOR CO) 22 January 1990 see abstract	1-3

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9301084
SA 74398

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 13/08/93

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR-A-2647371	30-11-90	JP-A- 3109016	09-05-91
		DE-A- 4016719	29-11-90
		US-A- 5020180	04-06-91
FR-A-2662378	29-11-91	None	
BE-A-895276	31-03-83	None	
NL-A-7216411	06-06-74	None	
FR-A-2067491	20-08-71	None	