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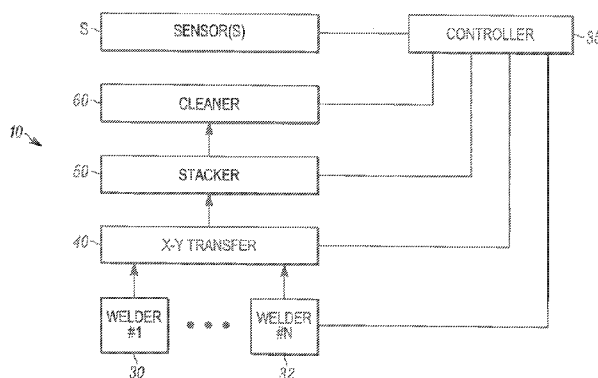


FIG. 1

(57) Abstract: A disclosed robot system enables an operator of an articulating arm used in fabricating window or door frames to re-
cover the position of the tools during the cleaning process with minimal knowledge or training on a robot. The disclosed robot sys-
tem also gives the operator the ability to edit a tool cleaning path with simple commands from an operator interface (e.g., HMI) to
bring flexibility in customizing the use of the articulating arm.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2015/060110

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - B29C 37/04 (2016.01)

CPC - B29C 37/04 (2016.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC(8) - B23C 3/12; B24B 9/20, 27/04; B29C 37/00, 37/02, 37/04; G06F 11/00, 15/00 (2016.01)

CPC - B23C 3/12; B24B 9/20, 27/04; B29C 37/00, 37/02, 37/04; G06F 11/00, 15/00 (2016.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
UPC - 15/3; 264/39; 408/69; 409/132, 140; 706/12, 62; 901/41 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Orbit, Google Patents, Google Scholar, Google, ProQuest.

Search terms used: window, frame, remove, clean, abrading, tool, robot, arm, modify, adjust, coordinate, controller, programmable, input, user.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/0083193 A1 (MCGLINCHY et al) 10 April 2008 (10.04.2008) entire document	1-6, 11-13
---		14
Y		
Y	US 2006/0236840 A1 (MCGLINCHY et al) 26 October 2006 (26.10.2006) entire document	14
A	US 5,655,247 A (ALLEN et al) 12 August 1997 (12.08.1997) entire document	1-6, 11-14
A	US 20120054972 A1 (MCGLINCHY et al) 08 March 2012 (08.03.2012) entire document	1-6, 11-14

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

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

"E" earlier application or patent 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 when the document is taken alone

"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

Date of the actual completion of the international search

22 February 2016

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2015/060110

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
See supplemental page

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-6, 11-14

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Continued from Box No. III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-6,11-14, drawn to removing material from regions of a window or door frame.

Group II, claim 7, drawn to a non-transitory computer readable medium storing instructions executable by an associated processor to perform a method for implementing a tool path recovery program.

Group III, claims 8-10, drawn to a method for use in abrading regions of a window or door frame.

The inventions listed as Groups I, II and III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: depicting spatial coordinates of the tool with the tool positioned at the one or more immediate positions along the initial tool path relative to a fixed reference as claimed therein is not present in the invention of Groups II and III. The special technical feature of the Group II invention: writing a path recovery file; and writing a path recovery program from the recorded line numbers as claimed therein is not present in the invention of Groups I or III. The special technical feature of the Group III invention: generating a reverse path control program based on the initial tool path that retraces one or more sub-paths of the tool movement in reaching the location where movement was suspended; and transmitting the reverse path control program to the programmable controller to cause said tool to traverse all or part of the initial path in a reverse direction as claimed therein is not present in the invention of Groups I or II.

Groups I, II and III lack unity of invention because even though the inventions of these groups require the technical feature of abrading regions of a window or door frame comprising: defining a sequence of movements for an abrading tool which bring said abrading tool into contact with one or more regions of a window or door frame and converting said sequence of movements into a control program for a programmable controller coupled to a drive for moving said abrading tool along an initial tool path; a tool associated with an articulated robotic arm, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2012/0054972 A1 (MCGLINCHY et al) 08 March 2012 (08.03.2012) teaches abrading regions of a window or door frame (Para. 41) comprising: defining a sequence of movements for an abrading tool which bring said abrading tool into contact with one or more regions of a window or door frame and converting said sequence of movements into a control program for a programmable controller coupled to a drive for moving said abrading tool along an initial tool path (the path of movement is displayed on a region 430 of the viewing or user monitor depicted in the screen shot 412. This viewing set up procedure is performed in manual mode and allows programming of the tool to follow a proper cleaning sequence during production. The graphical depiction illustrates multiple cleaning paths 432 followed by an appropriate tool next to a profile of the particular frame that has been identified either automatically or entered by the operator Para. 85 and Fig. 18); a tool associated with an articulated robotic arm (Paras. 37 and 70).

Since none of the special technical features of the Group I, II or III inventions are found in more than one of the inventions, unity of invention is lacking.