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UNEQUAL LINK SCARA ARM

Applicant:
Brooks Automation, Inc.

Headword:

Relevant legal provisions:
EPC Art. 56

Keyword:
Inventive step - main request and first and second auxiliary requests (no)

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Catchword:

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Case Number: T 1913/13 - 3.2.07

D E C I S I O N
of Technical Board of Appeal 3.2.07
of 15 February 2017

Appellant: (Applicant)	Brooks Automation, Inc. 15 Elizabeth Drive Chelmsford, MA 01824 (US)
Representative:	Ipside 7-9 Allées Haussmann 33300 Bordeaux Cedex (FR)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 2 April 2013 refusing European patent application No. 06774577.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	V. Bevilacqua
Members:	G. Patton
	I. Beckedorf

Summary of Facts and Submissions

I. The applicant lodged an appeal against the decision of the examining division to refuse the European patent application No. 06 774 577.8.

II. The following documents of the examination proceedings are relevant for the present decision:

D1: JP-A-2002 137 181;
D3: EP-A-1 498 228; and
D4: US-B-6 400 115.

The decision of the examining division was to refuse the application on the basis of lack of inventive step of the subject-matters of claims 1 of the then requests, starting from D4 (figures 6 and 7) as closest prior art in view of the teachings of D1 (figures 1, 4 and 7) and D3 (figure 13).

III. In an annex to the summons to oral proceedings the Board provided its preliminary opinion that the subject-matters of claims 1 of all requests filed by the appellant with the statement setting out the grounds of appeal (main request and two auxiliary requests) were regarded as lacking inventive step. In addition, the Board expressed its negative preliminary opinion in respect of the appellant's request for reimbursement of the appeal fee pursuant to Rule 103(1) (a) EPC.

In reaction the appellant filed with letter dated 3 February 2017 a new main request and new first and second auxiliary requests. It also informed the Board that it would not attend the oral proceedings.

Oral proceedings were held as scheduled on 15 February 2017 in the absence of the appellant pursuant to Rule 115(2) EPC and Article 15(3) RPBA.

The present decision was announced at the end of the oral proceedings.

IV. The appellant requested in writing that the decision under appeal be set aside and that a patent be granted on the basis of one of the sets of claims filed with letter of 3 February 2017 and that the appeal fee be reimbursed.

V. Independent claim 1 of the main request reads as follows (in bold the amendments with respect to claim 1 on the basis of which the appealed decision was taken; emphasis added by the Board):

"A substrate transport apparatus comprising:
a drive section (204, 204', 1168, 1170);
a controller (208) operably connected to the drive section; and
a substrate transport arm with an upper arm (201), forearm (202) and substrate holder (203), a proximate end of the upper arm being rotatably mounted to the drive section at a shoulder joint (652), a proximate end of the forearm being rotatably mounted to a distal end of the upper arm at an elbow joint (646), the substrate holder being rotatably mounted to a distal end of the forearm at a wrist joint (698), characterized in that the upper arm and the forearm being unequal in length from joint center to joint center; and
the substrate transport arm being a three joint **(646, 652, 698)** arm ~~**(646, 652, 698)**~~**, each joint (646, 652, 698) of the three joint arm having a corresponding**

dependent link (201, 202, 203) so that the three joint arm is configured to effect ~~adapted to~~ substrate transport **~~substrate~~, as a three joint three link transport arm,** to and from three spaced inline substrate holding areas that are disposed side by side and facing the same direction (105e, 105d) with the drive section of the transport apparatus remaining in a fixed position relative to the holding areas and the wrist travels along parallel paths to each of the three substrate holding areas."

Independent claim 1 of the first auxiliary request reads as follows (in bold the amendments with respect to claim 1 of the main request; emphasis added by the Board):

"A substrate transport apparatus comprising:
a drive section (204, 204', 1168, 1170);
a controller (208) operably connected to the drive section; and
a substrate transport arm with an upper arm (201), forearm (202) and substrate holder (203), a proximate end of the upper arm being rotatably mounted to the drive section at a shoulder joint (652), a proximate end of the forearm being rotatably mounted to a distal end of the upper arm at an elbow joint (646), the substrate holder being rotatably mounted **with one support shaft** to a distal end of the forearm at a wrist joint (698),
characterized in that the upper arm and the forearm being unequal in length from joint center to joint center; and
the substrate transport arm being a three joint (646, 652, 698) arm, each joint (646, 652, 698) of the three joint arm having a corresponding dependent link (201, 202, 203) so that the three joint arm is configured to

effect substrate transport, as a three joint three link transport arm, to and from three spaced inline substrate holding areas that are disposed side by side and facing the same direction (105e, 105d) with the drive section of the transport apparatus remaining in a fixed position relative to the holding areas and the wrist travels along parallel paths to each of the three substrate holding areas."

Independent claim 1 of the second auxiliary request reads as follows (in bold the amendments with respect to claim 1 of the main request; emphasis added by the Board):

"A substrate transport apparatus comprising:
a drive section (204, 204', 1168, 1170);
a controller (208) operably connected to the drive section; and
a substrate transport arm with an upper arm (201), forearm (202) and substrate holder (203), a proximate end of the upper arm being rotatably mounted to the drive section at a shoulder joint (652), a proximate end of the forearm being rotatably mounted to a distal end of the upper arm at an elbow joint (646), the substrate holder being **fixedly mounted on a support shaft that is** rotatably mounted to a distal end of the forearm at a wrist joint (698),
characterized in that the upper arm and the forearm being unequal in length from joint center to joint center; and
the substrate transport arm being a three joint (646, 652, 698) arm, each joint (646, 652, 698) of the three joint arm having a corresponding dependent link (201, 202, 203) so that the three joint arm is configured to effect substrate transport, as a three joint three link transport arm, to and from three spaced inline

substrate holding areas that are disposed side by side and facing the same direction (105e, 105d) with the drive section of the transport apparatus remaining in a fixed position relative to the holding areas and the wrist travels along parallel paths to each of the three substrate holding areas."

VI. The arguments of the appellant are essentially as follows:

Decision under appeal

The examining division committed a first error in taking into consideration D1 for assessing the inventive step of the three link arm apparatus of claim 1 since D1 discloses only a four link arm apparatus.

The examining division committed a second error in improperly combining the disclosure of D3 of a three link arm (shown in figures 10-12) with that of a four link arm (shown in figures 1, 13 and 15), only the latter disclosing the transfer of substrates to each of the three FOUPs ("Front Opening Unified Pod" 104).

According to D3 a three link arm involves some disadvantages over a four link arm. D3 therefore teaches away from a three link arm. The skilled person would then not consider the teaching of D3 relating to a three link arm for combining with the disclosure of D4.

Further, the robot arms of D3 and D4 cannot be combined since the arms are not activated independently in D3, while they are in D4.

The examining division committed a third error in treating the distinguishing features independently for dealing with the assessment of inventive step of the claimed subject-matter, since they have synergetic effects.

This is because increasing the access range of a transport arm is linked with increasing its maximum length extension.

The examining division committed a fourth error in failing to consider the teaching of both D1 and D4 that a transport arm with unequal length for the forearm and the upper arm has four links, i.e. not three links, in order for the rotatable joint of the substrate holder, i.e. the fourth link, to travel along a straight line.

Main request

The features added to claim 1 of the main request with respect to claim 1 of main request underlying the impugned decision (see point V above) enable to further clarify that the claimed apparatus is a three joint / three link transport arm. This is a clear distinction over in particular the four joint arm apparatus disclosed in D1.

In view of that, and of the the above errors committed by the examining division, the inventive step of the subject-matter of claim 1 of the main request should be acknowledged.

First auxiliary request

With respect to claim 1 of the main request, claim 1 of the first auxiliary request further comprises that the

substrate holder is rotatably mounted **"with one support shaft"** to a distal end of the forearm (feature iii).

This additional feature iii is neither disclosed nor suggested in the available documents D1, D3 or D4 so that the combination of their teachings cannot lead to the claimed subject-matter. The distinguishing feature iii has the technical effect that the substrate holder rotates as a unit about a common shaft that couples the substrate holder to the forearm at the wrist joint. Inventive step should hence be recognized for the subject-matter of claim 1 of the first auxiliary request.

Second auxiliary request

With respect to claim 1 of the main request, claim 1 of the second auxiliary request further comprises that the the substrate holder is **"fixedly mounted on a support shaft"** that is rotatably mounted to a distal end of the forearm (feature iv).

Like for the first auxiliary request, this additional feature iv is neither disclosed nor suggested in the available documents D1, D3 or D4, so that their teachings, even if combined, cannot lead to the claimed subject-matter.

Reasons for the Decision

1. Procedural issues

Although the appellant did not attend the oral proceedings, the principle of the right to be heard

pursuant to Article 113(1) EPC is observed since that article only affords the opportunity to be heard and, by absenting itself from the oral proceedings, a party gives up that opportunity (see the explanatory note to Article 15(3) RPBA cited in T 1704/06, not published in OJ EPO, see also the Case Law of the Boards of Appeal, 8th edition 2016, section III.B.2.7.1 and III.B.2.7.3).

2. Claim 1 of the main request - inventive step

Since the Board considers that the subject-matter of independent claim 1 of the main request lacks inventive step (see below), there is no need to discuss in the present decision whether the main request fulfils the other requirements of the EPC.

2.1 The Board shares the examining division's view that D4 is to be considered as the closest prior art, and that the only distinguishing features of claim 1 of the main request vis-à-vis the transport arm with three link arm (and three link joint) shown in figures 6 and 7 of this document are as follows (impugned decision, points II. 1.1 and II.1.2):

i) the upper arm and the forearm are **unequal in length** from joint center to joint center; and

ii) the substrate transport arm is "adapted to transport substrate to and from **three** spaced inline substrate holding areas that are disposed side by side and facing the same direction" (...) "and the wrist travels along parallel paths to each of the **three** substrate holding areas".

This has not been contested by the appellant.

As discussed hereafter, the appellant argues that the examining division committed four errors when assessing inventive step of the subject-matter of claim 1.

2.2 Alleged first error

2.2.1 The appellant holds the view that the examining division erred in taking into consideration D1 for assessing the inventive step of the claimed **three** link arm apparatus of claim 1 since D1 discloses only a **four** link arm apparatus.

For the appellant the following features of claim 1 of the main request make clear that the claimed transport arm is a three joint arm with three links, thereby rendering the transport arm disclosed in D1 irrelevant for assessing the inventive step of the claimed subject-matter:

"the substrate transport arm being a three joint arm, each joint of the three joint arm having a corresponding dependent link so that the three joint arm is configured to effect substrate transport, as a three joint three link transport arm".

This is particularly true for figures 1 and 7 of D1 showing a four joint arm with four links, *i.e.* not a three link arm as claimed (statement setting out the grounds, point I.3; letter dated 3 February 2017, points 1 and 2). The appellant holds the view that the support body (60) in D1 has to be considered as a link since it influences the kinematics of the disclosed transport arm.

2.2.2 Contrary to the appellant's view and as already mentioned in the Board's preliminary opinion that is

maintained also in view of the appellant's reply to said opinion, the Board considers that D1 discloses a three link arm apparatus, like in claim 1 of the main request.

As a matter of fact, D1 discloses a substrate transport arm with an upper arm ("arm" 12), a forearm ("arm" 14) and a substrate holder ("arm" 16 and "support body" 60). In D1, the substrate holder comprises an elongated revolving portion (16) and a rotating element ("support body" 60) mounted on the distal end of said revolving element (16).

The Board does not refute the appellant's view that the support body (60) has an influence on the overall kinematics of the apparatus. However, the support body (60) in D1 is merely rotating, not revolving. It has therefore no influence on the extension of the arm, as appearing from figure 4. It merely ensures that the substrate is oriented in a predetermined direction. This is further illustrated in figures 1 and 7 and paragraph [28]. Already for this reason, D1 is relevant for assessing the inventive step of the claimed subject-matter.

Further, the Board considers that the configuration of D1 is not excluded from claim 1 of the main request since claim 1 does not specify a transport arm having **only** three links, or **only** three joints.

Finally, in the apparatus of D1, the proximate end of the upper arm (12) is rotatably mounted to the drive section ("base" 24) at a shoulder joint ("shaft" 36), the proximate end of the forearm (14) is rotatably mounted to a distal end of the upper arm (12) at an elbow joint ("shaft" 46), and the substrate holder (16,

60) is rotatably mounted, like a hand, to a distal end of the forearm (14) at a wrist joint ("shaft" 56), the upper arm (12) and the forearm (14) **being unequal in length** from joint center to joint center (see paragraphs [17] to [24]; figures 1, 3, 4 and 7). D1 therefore discloses feature i and also its advantage of reducing the arm's swing diameter as explained in paragraph [28] (see point 2.1 above).

2.2.3 Consequently, the Board cannot find fault in the impugned decision in this respect (impugned decision, point II.1.3).

2.3 Alleged second error

2.3.1 The appellant holds the view that the embodiment of figures 10-12 of D3 does not comprise a transfer of substrates to three side by side FOUPs ("Front Opening Unified Pod" 104). Such a transfer is done in D3 with the apparatus according to figures 1 and 15, i.e. with a **four** link arm apparatus. Consequently, D3 neither discloses nor suggests that a three link arm as shown in figures 10-12 is capable of transferring substrates to each of the three FOUPs (104) of figure 13.

The appellant also holds the view that D3 teaches away from a three link arm since it requires more space and is slower for the production. In addition, the kinematics of a three link arm is very different than that of a four link arm. For these reasons, the skilled person would immediately prefer, in order to transfer substrate to three side by side FOUPs, a four link arm.

In other words, he would not think of replacing the four link arm of figure 13 of D3 by a three link arm as shown in figures 10-12 in D3.

Finally, the appellant argues that the robot arms of D3 and D4 cannot be combined since in D3 the arms do not rotate independently, see paragraph [89], contrary to D4 where they are independently driven (statement setting out the grounds, point I.4; letter dated 3 February 2017, point 3).

2.3.2 The Board cannot follow the appellant's view for the following reasons that were already mentioned in the Board's preliminary opinion and that are maintained when taking into account the appellant's reply to said opinion.

D3 (see paragraphs [92] to [94] and figure 14) describes a substrate transport apparatus (with four joints) which transports substrate to and from **three** spaced inline substrate holding areas that are disposed side by side and facing the same direction (feature ii, see point 2.1 above).

What is derivable for the skilled person from D3 is that the FOUPs (104) (see figures 13 and 14) are spaced inline and disposed side by side and facing the same direction.

In fact, the person skilled in the art, using his common general knowledge, will immediately realize that a three link arm apparatus as shown in figures 6 and 7 of the closest prior art **D4** is unambiguously adapted to transport substrate to and from **three** spaced inline substrate areas with the wrist traveling along parallel paths to each of the **three** substrate holding areas. He will not regard the configuration of figures 6 and 7 as being limited to only two holding areas. This has not been contested by the appellant.

As a consequence, the Board is of the opinion that the appellant's arguments relating to the disclosure of D3 with respect to the three link arm is irrelevant since what matters is that D3 discloses the distinguishing feature ii relating to the FOUPs and that the three link arm of the closest prior art D4 is unambiguously adapted to serve said disclosed three FOUPs in accordance with claim 1.

2.3.3 Consequently, the Board cannot find fault in the impugned decision in this respect (impugned decision, point II.1.4).

2.4 Alleged third error

2.4.1 The appellant holds the view that the distinguishing features i and ii cannot be treated independently for dealing with the assessment of inventive step of the claimed subject-matter as they have a **synergetic** effect. For the appellant, increasing the access range of the transport arm (feature ii) is linked with increasing the maximum length extension problem (feature i). The single problem to be solved can hence be seen as in "*increasing the access range in order to transport a substrate from three inline substrate holding areas while minimizing the swing diameter in order to remain outside the central holding areas in the three holding areas alignment*" (statement setting out the grounds, point I.5; letter dated 3 February 2017, point 4).

2.4.2 The Board cannot share the appellant's view and maintains its preliminary opinion after having taken into consideration the appellant's reply to it.

2.4.3 The appellant has failed to show where in the application as originally filed the effect of increasing the access range of the transport arm (i.e. the number of holding areas) is described as being linked with increasing the maximum length extension (i.e. increasing the containment to extension ratio, in other words minimizing the swing diameter, see paragraphs [2], [3] and [26]).

As a matter of fact, the application taken as a whole is silent on how the difference in length between the upper arm and the forearm (distinguishing feature i) is related to the increase in the number of substrate holding areas (distinguishing feature ii), in particular in comparison with the upper arm and the forearm having the same length. As already mentioned above, it is derivable for the skilled person using his common general knowledge that the configuration of figures 6 and 7 of D4 is not limited to only two substrate holding areas E and H.

The Board concurs with the unrelated technical effects associated to the distinguishing features i and ii and the corresponding partial technical problems derived therefrom as specified in the impugned decision, points II.1.3 and II.1.4.

Consequently, the Board shares the finding of the impugned decision, point II.1.5 that the distinguishing features i and ii can be treated independently from each other when assessing inventive step of the claimed subject-matter.

2.4.4 Consequently, the Board cannot find fault in the impugned decision in this respect.

2.5 Alleged fourth error

2.5.1 The appellant holds the view that both D1 and D4 teach that a transport arm **with unequal length** forearm and upper arm links has **four links**, i.e. not three, in order for the rotatable joint of the substrate holder, i.e. the fourth link, to travel along a straight line (statement setting out the grounds, point I.6).

2.5.2 In respect of this view the Board maintains its preliminary opinion after having taken into consideration the appellant's reply to it. The Board does not share the appellant's view for the same reasons as those already given under point 2.2.2 above. The substrate body (60) of the apparatus of D1 is not a revolving link, i.e. acting as an arm, but a rotating one which is not excluded from claim 1 of the main request.

It is also referred to the reasons given under point 2.3.2 above with respect to D3.

Finally, the disclosure of D4 (figures 6 and 7) taken as closest prior art for the assessment of the inventive step of the claimed subject-matter is a transport arm having three links as claimed in which the third link (5) travels along a straight line (see point 2.1 above).

2.6 Lack of inventive step

Consequently, even taking account of the amendments introduced in claim 1 of the main request with respect to claim 1 of the main request underlying the impugned decision, the subject-matter of claim 1 of the main

request lacks inventive step for the same reasons as those of the impugned decision (Article 56 EPC).

3. Claim 1 of the first auxiliary request - inventive step

Since the Board considers that the subject-matter of independent claim 1 of the first auxiliary request lacks inventive step (see below), there is no need to discuss in the present decision whether the first auxiliary request fulfils the other requirements of the EPC.

3.1 With respect to claim 1 of the main request, claim 1 of the first auxiliary request further comprises that the substrate holder is rotatably mounted **"with one support shaft"** to a distal end of the forearm (feature iii).

3.2 The Board is of the opinion that this feature iii is a further distinguishing feature of claim 1 of the first auxiliary request vis-à-vis the closest prior art D4 (figures 6 and 7), in addition to those discussed for claim 1 of the main request (features i and ii, see point 2.1 above), since D4 is silent on the detailed construction of the apparatus.

3.3 The appellant argues that the technical effect associated with said additional distinguishing feature iii is that the substrate holder rotates as a unit about a common shaft that couples the substrate holder to the forearm at the wrist joint (appellant's letter dated 3 February 2017, point 5).

3.4 The Board cannot see a synergy of this technical effect with the other technical effects of the distinguishing features i and ii discussed for the main request. Further, the Board considers that the effect is also

achieved in the closest prior art D4 since the substrate holder ("robot hand" 5) obviously rotates as claimed about the forearm at the wrist joint ("third part" 4) in figures 6 and 7.

Therefore, the partial objective technical problem associated with this additional distinguishing feature iii can be seen as to provide a specific design for rotatably mounting the substrate holder onto the forearm.

The Board considers however that feature iii concerns a mere design option which is known and usual in the present technical field, as illustrated for instance by D1 (see "fundamental shaft" 56, paragraph [20], figure 3). Hence, it cannot justify inventive step (Article 56 EPC).

The Board notes that, contrary to the appellant's view and as already discussed under point 2.2.2 above with respect to the interpretation of the disclosure of D1, the substrate holder disclosed therein comprises the elongated revolving portion ("arm" 16) and the rotating element ("support body" 60) mounted on the distal end of the said revolving portion (16). The two elements represent the support body of claim 1 which is **fixedly mounted** on a support shaft ("shaft" 56) that is rotatably mounted to a distal end of the forearm (14) at a wrist joint. Feature iii is hence unambiguously disclosed in D1.

4. Claim 1 of the second auxiliary request - inventive step

Since the Board considers that the subject-matter of independent claim 1 of the second auxiliary

request lacks inventive step (see below), there is no need to discuss in the present decision whether the second auxiliary request fulfils the other requirements of the EPC.

4.1 With respect to claim 1 of the main request, claim 1 of the second auxiliary request further comprises that the the substrate holder is **"fixedly mounted on a support shaft"** that is rotatably mounted to a distal end of the forearm (feature iv).

4.2 The appellant's arguments for the second auxiliary request being in substance identical to those given for the first auxiliary request, the above reasoning and conclusion for the first auxiliary request apply *mutatis mutandis* to the second auxiliary request (see again D1, paragraph [20], figure 3) so that the added feature iv cannot justify inventive step (Article 56 EPC).

5. Reimbursement of the appeal fee

The request for reimbursement of the appeal fee is rejected because, as discussed above, the Board cannot find fault in the reasoning of the examining division put forward in the impugned decision. Moreover, since the appeal is not found allowable for the reasons set out above the requirements of Article 103(1)(a) EPC for ordering a reimbursement are clearly not fulfilled.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

G. Nachtigall V. Bevilacqua

Decision electronically authenticated