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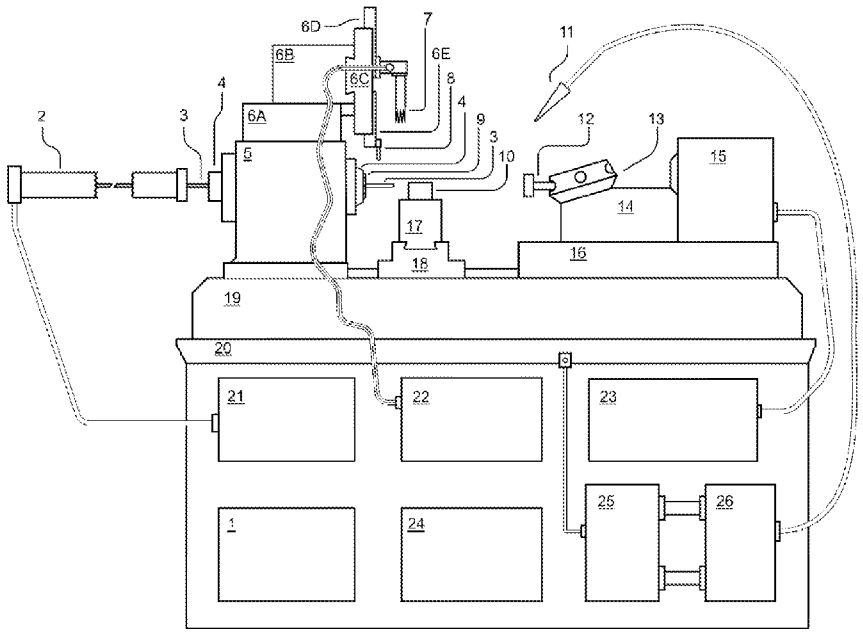
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(54) Title: SYSTEM AND METHOD TO PERFORM DISSIMILAR OPERATIONS IN A SINGLE MACHINE

FIG. 3A



(57) **Abstract:** A spatially coherent machine for manufacturing comprises, in one example, a workpiece holder configured to secure a workpiece, a toolholder with at least one axis of motion control configured to perform a subtractive machining operation on the workpiece using a machining tool, a heating element configured to perform a heating operation on the workpiece, and a forming element configured to perform a forming operation in which force is applied to the workpiece in an amount that causes plastic deformation of the workpiece material. The workpiece holder secures the workpiece during the heating, forming, and subtractive operations such that the forming and subtractive operations are performed in a spatially coherent manner.

[Continued on next page]

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 22/38076

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. B23Q 39/00, B33Y 40/00, B21J 1/06 (2022.01)
ADD. B23Q 39/04, B33Y 30/00, B21D 22/00, B21J 13/00 (2022.01)

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ADD. B25J 9/1682, B33Y 40/20, B23Q 39/04, B33Y 30/00, B21D 22/00, B21J 13/00

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)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/0351617 A1 (Diabase Engineering LLC) 21 November 2019 (21.11.2019), entire document, especially Fig. 1, 2, 12, 13, 17, 18; para[0029]; para[0030]; para[0032]; para[0061]; para[0038]; para[0071]; para[0036]; para[0049];	1-7
A	EP 1,837,133 A1 (ABB AB) 26 September 2007 (26.09.2007), entire document	1-7
A	US 2015/0290701 A1 (WFL Millturn Technologies GmbH & Co. KG) 15 October 2015 (15.10.2015), entire document	1-7
A	US 2021/0060856 A1 (Huazhong University of Science and Technology) 04 March 2021 (04.03.2021), entire document	1-7
A	US 2013/0019649 A1 (Slattery et al.) 24 January 2013 (24.01.2013), entire document	1-7
A	EP 0,191,739 A2 (INNSE INNOCENTI SANTEUSTACCHIO S.p.A.) 20 August 1986 (20.08.1986), entire document	1-7

☐ 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
"D" document cited by the applicant in the international application
"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	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 22/38076

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:
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 searched, the appropriate additional search fees must be paid.

Group I: Claims 1-7 directed to a spatially coherent machine for manufacturing.

Group II: Claims 8-20 directed to a method for producing an advantageous physical and/or chemical material transformation in a titanium part.

The inventions listed as Groups I-II 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:

--- Continued in Supplemental Box ---

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.:
1-7

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.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 22/38076

--- Continuation of Box No. III Observations where unity of invention is lacking ---

SPECIAL TECHNICAL FEATURES

The invention of Group II includes the special technical features of a method for producing an advantageous physical and/or chemical material transformation in a titanium part comprising heating the part to a temperature in the range of about 500 C to about 1500 C; and treating the heated part with a toughening fluid comprising a naturally-occurring oil mixture being largely composed of triacylglycerols; and having physical properties including a specific gravity, a viscosity, a specific heat, a thermal conductivity, a dielectric constant, a density, a thermal diffusivity, a boiling point and a smoke point, not required by the claims of Group I.

COMMON TECHNICAL FEATURES

The inventions of Groups I-II share the technical features of a machine comprising a heating element. Specifically, Groups I and II are related as an apparatus (Group I) and methods for using the apparatus (Group II). The apparatus is known in prior art as shown in US 2019/0351617 A1 to Diabase Engineering LLC (hereinafter 'Diabase'). Therefore, Groups I and II lack unity since the shared technical features do not represent a contribution over Diabase:

Diabase discloses a machine (Fig. 1; para[0029], 'FIG. 1 shows one embodiment of a machine tool incorporating 3D printing capabilities designed to be placed on a table or workbench') comprising a heating element (23, Fig. 1, 2, 12, 13, 17, 18 - see heating elements comprising the flat heating element 23 and the heating element for heating tool 140; para[0032], 'at least one flat heating element 23 adhered to the lower surface 18 of the print bed 17'; para[0071], 'A heated rubbing tool 140 may be used for the forging process').

As the common technical features were known in the art at the time of the invention, these cannot be considered special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.