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(54) Title: AUTOMATIC DOCUMENT ALIGNMENT

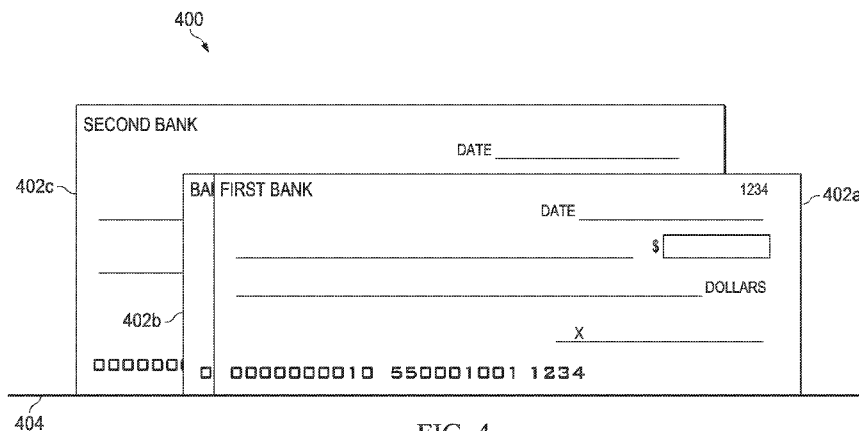


FIG. 4

(57) Abstract: The present disclosure involves systems and methods for performing automatic document alignment. One example system includes a document staging area including an alignment surface extending in a document feed direction; an alignment roller supported to rotate about an axis and intermittently contact a document in the document staging area while rotating to move the document to abut the alignment surface; and a feed roller support to rotate in the document feed direction to feed the document in the document feed direction after the alignment roller has rotated to move the document to abut the alignment surface.

AUTOMATIC DOCUMENT ALIGNMENT**CLAIM OF PRIORITY**

[0001] This application claims priority to U.S. Patent Application No. 14/318,335 filed on June 27, 2014, the entire contents of which are hereby incorporated by reference.

BACKGROUND

[0002] The present disclosure involves systems and methods for performing automatic document alignment.

[0003] In document processing systems, multiple documents may be loaded into the system at once, such as by loading the documents into an input location. The documents may then be moved one-by-one from the input location to a second location where document processing (e.g., scanning) is performed. This document movement may be performed by feeding mechanisms that move each document from the input location to the second location.

SUMMARY

[0004] The present disclosure involves systems and methods for performing automatic document alignment. In one general aspect, an example system includes a document staging area including an alignment surface extending in a document feed direction; an alignment roller supported to rotate about an axis and intermittently contact a document in the document staging area while rotating to move the document to abut the alignment surface; and a feed roller support to rotate in the document feed direction to feed the document in the document feed direction after the alignment roller has rotated to move the document to abut the alignment surface.

[0005] In another general aspect, an example method includes for each of a plurality of documents in a document staging area, the document staging area including an alignment surface extending in a document feed direction: rotating an alignment roller to intermittently contact a document in the document staging area to move the document to abut the alignment surface; and rotating a feed roller in the

document feed direction to feed the document in the document feed direction upon the alignment roller completing a rotation.

[0006] The details of these and other aspects and implementations of the present disclosure are set forth in the accompanying drawings and the description
5 below. Other features, objects, and advantages of the disclosure will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

[0007] FIG. 1 is a block diagram illustrating an example system for performing automatic document alignment.

10 [0008] FIG. 2 is a perspective view of an example document scanning system that performs automatic document alignment.

[0009] FIGs. 3A-B are diagrams illustrating example configurations including documents that are misaligned vertically.

15 [0010] FIG. 4 is a diagram illustrating an example configuration including documents that are aligned vertically.

[0011] FIG. 5 is a perspective view of an example document alignment module.

20 [0012] FIG 6A is a side view of an example roller for use in a document alignment module. FIG. 6B is a perspective view of the example roller from an opposite side.

[0013] FIGs. 7A-E are cross-sectional views of an example document scanning system showing the operation of an example document alignment module.

[0014] FIG. 8 is flow chart showing an example method for performing automatic document alignment.

25

DETAILED DESCRIPTION

[0015] The present disclosure involves systems and methods for performing automatic document alignment.

30 [0016] Generally, document processing systems are designed to perform processing tasks on multiple documents. Each document may be fed individually from an input location to another location for processing. In some cases, it may be desirable to process documents of different lengths and widths at once. For example, in check

processing, checks and other payment instruments may not be a standard size, and therefore each document may have a different length and width. In some cases, a user may be required to align or “jog” documents prior to feeding to ensure that the leading and/or bottom edges are aligned. If such jogging is not done or done improperly, document skew may result, which may lead to double feed errors (i.e., two or more documents being fed at once), jam errors involving documents being lodged in the feeding mechanism, misread of magnetic account information in the case of checks or other financial documents, or other processing errors.

[0017] Accordingly, the present disclosure describes techniques configured to reduce or eliminate jogging requirements in document processing systems. Although the present disclosure generally describes vertical alignment of documents, the techniques described herein may be applied to aligning documents in other ways (e.g. horizontally). In one example implementation, document alignment is performed by a set of alignment rollers on the both sides of a feed roller. The feed roller is operable to feed documents individually in a feed direction into a processing location in the document processing system. Before each document is fed by the feed roller, the alignment rollers rotate to contact the document and force a bottom edge of the document to contact an alignment surface.

[0018] One example method for performing document alignment includes, for each of a plurality of documents in a document staging area including an alignment surface extending in a document feed direction, rotating an alignment roller to intermittently contact a document in the document staging area to move the document to abut the alignment surface. A feed roller is then rotated in the document feed direction to feed the document in the document feed direction upon the alignment roller completing a rotation.

[0019] Implementations according to the present disclosure may provide several advantages over prior techniques. By automatically performing document alignment, time-consuming and error-prone manual alignment processing may be avoided, leading to cost savings. Further, by avoiding feed and jam errors during processing, more documents can be processed leading to greater efficiency. Manual intervention to address such errors may also become less frequent, leading to even greater cost savings. Also, the compact alignment module and roller designs described herein may allow the present techniques to be incorporate into document processing

systems without greatly increasing the footprint of those systems. Costs associated with having to rerun the document at a later time in the process may also be reduced or avoided. Monetary charges associated with rejected documents may also be avoided or reduced.

5 [0020] FIG. 1 is a block diagram illustrating an example system 100 for performing automatic document alignment. As shown, example system 100 includes a document processing system 102. The document processing system 102 includes a document alignment module 106, and the document processing module 110. The controller 108 is communicatively coupled to the document alignment module 106 and
10 the document processing module 110. In operation, the document processing system 102 is presented with one or more documents 104. The document alignment module 106 aligns the documents 104 for the documents 104 mechanically fed to the document processing module 110. The document processing module 110 performs processing operations on the documents 104. In some implementations, the document
15 processing module 110 may produce one or more products of its processing operations associated with the documents 104, such as, for example, one or more images 112 corresponding to the one or more documents 104.

[0021] In some cases, the documents 104 may include magnetic ink to be read by a magnetic head within the document processing module 110. The magnetic ink
20 may encode, for example, an account number or other information related to the document. If a document 104 is not aligned correctly, the document processing module 110 may not be able to read the magnetic ink, leading to processing errors.

[0022] As shown, example system 100 includes a document processing system 102. In some implementations, the document processing system 102 may be
25 automated system operable to receive the one or more documents 104, and physically move the documents 104 along a path to be processed by the document processing module 110. In some cases, the document processing system 102 may process each document of the one or more documents 104 individually, such that each document is moved along the path by itself. Such operation may allow the document processing
30 module 110 to perform its processing operations on each document individually. The document processing system 102 may include mechanical components operable to move each of the one or more documents 104 along the path, such as, for example, rollers, belts, gears, stepper motors, or other components.

[0023] One or more documents 104 are introduced to the document processing system 102 for processing. In some cases, the one or more documents 104 may be tangible, physical paper documents, such as, for example, checks, currency, agreements, sales drafts, or other types of documents. The one or more documents 104
5 may be introduced to document processing system 102 in an unaligned state, such that the respective bottom edges of the one or more documents 104 are not aligned.

[0024] The document processing system 102 includes a document alignment module 106. In operation, the document alignment module 106 may be operable to align the bottom edges of the documents 104 with an alignment surface of the
10 document processing system 102. In some cases, the alignment surface may be a bottom surface of a staging area adjacent to the document alignment module 106 into which the documents 104 are introduced. The document alignment module 106 may include one or more mechanical components operable to perform this alignment on the one or more documents 104. The mechanical components may include rollers, belts,
15 stepper motors, gears, or other components. The document alignment module 106 is described in greater detail in relation to FIGs. 2-7.

[0025] Document processing system 102 also includes a document processing module 110. The document processing module 110 may be operable to receive the one or more documents 104 individually from the document alignment module 106 after
20 the one or more documents 104 have been aligned by the document alignment module 106. The document processing module 110 may perform processing actions on each document as it is received from the document alignment module 106. The processing actions may include, but are not limited to, scanning each document to produce a corresponding image, physically altering each document (e.g., hole-punching,
25 stamping, etc.), shredding each document, analyzing and routing each document, or other processing actions. The document processing module 110 may include one or more mechanical components operable to receive each of the one or more documents 104 for processing, and to eject each of one or more documents 104 after processing so a next document can be processed. Ejecting each document may include moving the
30 document further along the path within the document processing system 100.

[0026] In some cases, the document processing module 110 may produce results corresponding to each document. For example, in a case where the document processing module 110 scans each of the documents 104, the document processing

module 110 may produce one or more images 112 corresponding to the one or more documents 104. For example, the document processing system 102 may be a check scanning system, and the document processing module 110 may produce the one or more images 112 for use in an automated check clearing process. In some cases, the
5 images 112 may be included within the containing file structure, such as, for example, a cash letter file.

[0027] The document processing system 102 also includes a controller 108. In operation, the controller 108 may control operations of the document alignment module 106 and the document processing module 110. In some cases, the controller
10 108 may direct mechanical components associated with the document alignment module 106 to perform alignment on the one or more documents 104. The controller 108 may direct mechanical components in response to an indication that the documents 104 had been introduced into the document processing system 102. In some cases, this indication may be provided by an optional sensor 107 included in a
15 document staging area in the document processing system 102, and monitoring the document staging area for the presence of documents. The controller 108 may also direct the document processing module 110 to perform its processing operations after a document is fed to it. In some implementations, the controller 108 may include one or more processors. Each processor may be a central processing unit (CPU), an
20 application specific integrated circuit (ASIC), a field-programmable gate array (FPGA), an embedded processor, or other type of processor. Optionally, the controller 108 may be coupled to a sensor 107 for detecting the presence of the documents 104 for processing.

[0028] FIG. 2 is a perspective view of an example document scanning system
25 200 that performs automatic document alignment. The document scanning system 200 includes a document staging area 202, a document alignment module 204, a spring-loaded mechanism 206, and a document scanning module 208. In operation, documents to be scanned or inserted into the document staging area 202. The spring-loaded mechanism 206 (e.g., a plunger) is actuated to press the documents in the
30 document staging area 202 against the document alignment module 204. The document alignment module 204 operates to align the bottom edge of each document with a bottom surface of the document staging area 202. As described in greater detail below, the document alignment module 204 may include rollers that rotate to align the

documents. The documents may be pressed against the rollers by the spring-loaded mechanism 206. After each document is aligned, the document is fed out of the document scanning system to document scanning module 208, where it is scanned and then ejected to make room for the next document. In some implementations, the document scanning system 200 may perform other processing operations on the documents, such as, for example, stamping, shredding, punching, or other operations. The components of the document scanning system 200 are described in greater detail below.

[0029] FIGs. 3A-B are diagrams illustrating example configurations 300, 310 including documents 302a-c and 304a-c, some of which are misaligned vertically. In FIG. 3A, documents 302a and b are misaligned with respect to an alignment surface 304. Document 302b abuts the alignment surface 304, and therefore is properly vertically aligned with respect to the alignment surface 304. As shown, the documents 302a-c include documents with different dimensions, as document 302c has different dimensions than the other two documents 302a-b. Although the documents 302a-c are shown as checks and FIG. 3A, documents 302a-c may include any kind of tangible physical document. FIG. 3B shows three documents 312a-c that are also misaligned with respect to an alignment surface 314. Document 312a is also skewed with respect to documents 312b-c. FIG. 4 is a diagram illustrating an example configuration 400 including documents 402a-c that are vertically aligned with an alignment surface 404. As shown, the bottom edges of the documents 402a-c abut the alignment service 404. Although FIG. 4 shows the documents 402a-c vertically aligned against the alignment service 404, the present disclosure contemplates aligning documents in any direction or combination of directions.

[0030] FIG. 5 is a perspective view of an example document alignment module 500. Document alignment module 500 includes alignment rollers 502a-b. The alignment rollers 502a-b are attached to roller gears 506a-b by snap mounts 504a-b. The roller gears 506a-b are mounted on axles 507a-b and engage with drive gears 508a-b. The drive gears 508a-b are connected to a sync shaft 510. The sync shaft 510 is connected to a motor 512. In operation, the motor 512 rotates the sync shaft causing the drive gears 508a-b to rotate. The drive gears 508a-b engage the roller gears 506a-b to rotate the attached alignment rollers 502a-b.

[0031] The document alignment module 500 includes the alignment rollers 502a-b. Although to alignment rollers 502a-b are shown in FIG. 5, some implementations may include a single alignment roller or more than two alignment rollers. In some cases, each alignment roller 502a-b includes contacting surface and a non-document contacting surface on its perimeter such that the distance from the axles 507a-b to the document contacting surface is equal to the distance from the axle to an adjacent document staging area (not shown). In such a case, the distance from the axle to the non-document contacting surface is less than that the distance from the axle to the document staging area, such that the document contacting surface intermittently engages a document in the document staging area when the alignment roller rotates to move the document. One example of such an implementation is shown in FIGURES 6A and 6B. In some cases, the document alignment module 500 may include mechanism to extend and retract the alignment rollers 502a-b into a document staging area positioned adjacent to the document alignment module 500.

[0032] As described previously, the roller gears 506a-b, engage with the drive gears 508a-b, and rotate as the sync shaft 510 is rotated by the motor 512. In some cases, the document alignment module 500 may include other mechanisms to rotate the alignment rollers 502a-b, such as, for example, belts, cams, axles, shafts, or other mechanisms.

[0033] The document alignment module 500 includes the motor 512. In some cases, the motor 512 may be electrical motor operable to rotate the sync shaft 510. In some cases, the motor 512 may be controllable by an external controller or processor. The motor 512 may also be a stepper motor.

[0034] The document alignment module 500 also includes a position flag 513 and an optical sensor 514. The position flag 513 rotates with the sync shaft to indicate the position of the alignment rollers 502a-b. The optical sensor 514 may detect the position of the position flag 513 and signal to other components (such as a controller) when the alignment rollers 502a-b have completed rotation and returned to their original starting point.

[0035] FIGs. 6A-B are opposite side views of an example alignment roller 600 for use in a document alignment module. The alignment roller 600 includes an O-ring 602, a curved O-ring post 604, and mounting clip 606. The opposite view in FIG. 6B shows a roller gear 608 formed on the opposite side of the alignment roller 600 from

the mounting clip 606. As shown, the O-ring 602 extends outward from a portion of the perimeter of the alignment roller 600. The alignment roller 600 may be configured to rotate such that the O-ring 602 extends outward into space further than the remainder of the perimeter of the alignment roller 600. For example, if a document is positioned such that is in contact with the O-ring 602, the O-ring will only contact the document during a portion of a full rotation of the alignment roller 600.

[0036] As shown, the curved O-ring post 604 extends around a portion of the perimeter of the alignment roller 600. The curved O-ring post 604 is designed to provide the desired shape to the O-ring 602. In some cases, the O-ring 602 may be stretched to fit around the curved O-ring post 604 and held in place by tension.

[0037] In some implementations, the O-ring 602 may be formed from a material selected to provide an amount of friction between the O-ring and a contacted document to cause the O-ring to stop moving the document once the document abuts an alignment surface. In some cases, the O-ring 602 may be formed from silicon, rubber, plastic, or other materials or combinations of materials.

[0038] As shown, the alignment roller 600 includes a mounting clip 606. In some cases, the mounting clip 606 may be operable to connect the alignment roller 600 to the roller gear 608, which may be mounted within a document alignment module, and to allow the alignment roller 600 to be removed and serviced or replaced.

[0039] FIGS. 7A-E are cross-sectional views of an example document alignment module 700 showing its operation. As shown, the example document alignment module 700 includes a plunger 704 operable to press a document 702 within a document staging area 703 into a position where it can be contacted by an alignment roller 706. The alignment roller 706 is connected to an axle 710. Alignment roller 706 includes an O-ring 708 extending along a portion of its perimeter. As shown, the O-ring 708 extends a greater distance from the axle 710 than the remaining portion of the perimeter of the alignment roller 706. A feed roller 712 is operable to rotate in a different direction than the alignment roller 706 to feed the document 702 out of the document staging area 703.

[0040] In FIG. 7A, the alignment roller 706 is positioned such that the O-ring 708 is not contacting the document 702. In FIG. 7B, the alignment roller 706 has been rotated into a position in contact with the document 702. In FIG. 7C, the alignment roller 706 has rotated further while the O-ring 708 has maintained contact with the

document 702. This rotation of the alignment roller 706 causes the document 702 to be moved in the direction of the rotation (e.g., downwards) due to friction between the O-ring 708 and a document 702. In FIG. 7D, the alignment roller 706 has rotated further while the O-ring 708 maintains contact with the document 702. This rotation of the alignment roller 706 may cause the document 702 to move further in the direction of the rotation. If the document 702 abuts alignment surface (not shown) while the alignment roller 706 is rotating and the O-ring 708 is still in contact with the document 702, the movement of the document 702 in the direction of rotation will be stopped by the alignment surface due to the friction characteristics of the O-ring 708 previously described above. In FIG. 7D, the alignment roller 706 has rotated such that the O-ring 708 is no longer in contact with the document 702. At this point, the feed roller 712 may be engaged to move the document 702 out of the document staging area 703.

[0041] In some implementations, the activation of the feed roller 712 may be controlled by a controller connected to the feed roller 712 and the alignment roller 706. For example, the controller may determine the position of the alignment roller 706, and may activate the feed roller 712 when the alignment roller 706 reaches a position where the O-ring 708 is no longer in contact with the document 702. In some cases, the controller may determine the position of the alignment roller 706 by interfacing with a sensor configured to monitor the position. The controller may also determine the position of the alignment roller 706 based on control commands is set to a stepper motor controlling the rotation of the alignment roller 706.

[0042] In some cases, the O-ring 708 may be replaced by a structure besides an O-ring that has a friction coefficient appropriate to align the documents without causing damage to the documents.

[0043] FIG. 8 is flow chart showing an example method 800 for performing automatic document alignment. At 805, the process iterates through a plurality of documents in the document staging area including alignment surface extending in a document feed direction. At each iteration, an alignment roller is rotated to intermittently contact a document in the document staging area to move the documents about the alignment surface (810). The alignment roller may include an O-ring configured to extend along a portion of an outside surface of the alignment roller that contacts the document. In some cases, the O-ring includes a material selected to

provide an amount of friction between the O-ring and the document to cause the O-ring to stop moving the document once the document abuts the alignment surface. In some implementations, the alignment roller is shaped to extend into the document staging area when it is rotated. At 815, a feed roller is rotated in the document feed
5 direction to feed the document out of the document staging area upon the alignment roller completing a rotation.

[0044] In some implementations, the method 800 includes scanning the document to produce a digital image of the document after rotating a feed roller to feed the document. In some cases, the plurality of documents may include a tangible
10 payment instruments such as checks, deposit slips, money orders, or other tangible payment instruments.

[0045] In some implementations, a position sensor detects the position of the alignment roller to determine when the alignment roller has returned to its initial starting position. In some cases, the sensor may also monitor the alignment roller's
15 position as it rotates through the incorporation of an encoder wheel. In some cases, a spring-loaded force such as a plunger is activated to provide pressure on the document to force it to contact the alignment roller as it is rotating and further provide relief for the encoder wheel.

[0046] While this specification contains many details, these should not be
20 construed as limitations on the scope of what may be claimed, but rather as descriptions of features specific to particular examples. Certain features that are described in this specification in the context of separate implementations can also be combined. Conversely, various features that are described in the context of a single implementation can also be implemented in multiple embodiments separately or in any
25 suitable subcombination. A number of embodiments have been described. Nevertheless, it will be understood that various modifications can be made. Accordingly, other embodiments are within the scope of the following claims.

WHAT IS CLAIMED IS:

1. A system comprising:
a document staging area including an alignment surface extending in a document feed direction;
5 an alignment roller supported to rotate about an axis and intermittently contact a document in the document staging area while rotating to move the document to abut the alignment surface; and
a feed roller support to rotate in the document feed direction to feed the document in the document feed direction after the alignment roller has rotated to move
10 the document to abut the alignment surface.
2. The system of claim 1, wherein the roller includes an O-ring extending along a portion of an outside surface of the alignment roller that contacts the document when the alignment roller rotates.
15
3. The system of claim 2, wherein the O-ring traverses the alignment roller.
4. The system of claim 3, wherein the O-ring includes a material selected
20 to provide an amount of friction between the O-ring and the document to cause the O-ring to stop moving the document once the document abuts the alignment surface.
5. The system of claim 1, wherein the alignment roller has a non-circular with a circular portion shaped to extend into the document staging area when the
25 alignment roller is rotated.
6. The system of claim 1, further comprising a controller connected to the alignment roller and the feed roller and configured to control operations of the alignment roller and the feed roller in response to receiving an indication from a sensor
30 in the document staging area that the document has been introduced into the document staging area.

7. The system of claim 1, further comprising a document scanner configured to receive the document from the feed roller and scan the document to produce a digital image of the document.

5 8. The system of claim 1, further comprising a spring loaded plunger positioned in the document staging area and configured to hold the document in contact with the alignment roller as it is intermittently contacting the document.

9. A system comprising:
10 an alignment roller supported to rotate about an axis and intermittently contact a document in the document staging area while rotating to move a document in an adjacent document staging area to abut an alignment surface of the document staging area extending in a document feed direction.

15 10. The system of claim 9, further comprising an axle positioned adjacent to the document staging area, wherein the alignment roller is supported by the axle and includes a document contacting surface and a non-document contacting surface on its perimeter, wherein the distance from the axle to the document contacting surface is equal to the distance from the axle to the document staging area, the distance from the
20 axle to the non-document contacting surface is equal to the distance from the axle to the document staging area, and the alignment roller is positioned so that the document contacting surface intermittently engages the document in the document staging area when the alignment roller rotates to move the document to abut the alignment surface.

25 11. The system of claim 9, wherein the alignment roller includes an O-ring defining the document contacting surface.

12. The system of claim 11, wherein the O-ring does not extend along the entire outer surface of the alignment roller.

30 13. The system of claim 12, wherein the O-ring includes a material selected to provide an amount of friction between the O-ring and the document to cause the O-ring to stop moving the document once the document abuts the alignment surface.

14. The system of claim 9, further comprising a feed roller to feed document in the document feed direction after the alignment roller completes a rotation.

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15. The system of claim 14, further comprising a document scanner configured to receive the document from the feed roller and scan the document to produce a digital image of the document.

10

16. The system of claim 15, further comprising a controller connected to the alignment roller and the feed roller and configured to control operations of the alignment roller and the feed roller.

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17. The system of claim 15, further comprising a plunger positioned in the document staging area and configured to hold the document in contact with the alignment roller as it is intermittently contacting the document.

20

18. A method comprising:
for each of a plurality of documents in a document staging area, the document staging area including an alignment surface extending in a document feed direction:
rotating an alignment roller to intermittently contact a document in the document staging area to move the document to abut the alignment surface; and
rotating a feed roller in the document feed direction to feed the document in the document feed direction upon the alignment roller completing a rotation.

30

19. The method of claim 18, wherein the alignment includes an O-ring configured to extend along a portion of an outside surface of the alignment roller that contacts the document.

20. The method of claim 18, further comprising actuating a plunger to force the plurality of document into contact with the alignment roller before rotating the alignment roller.

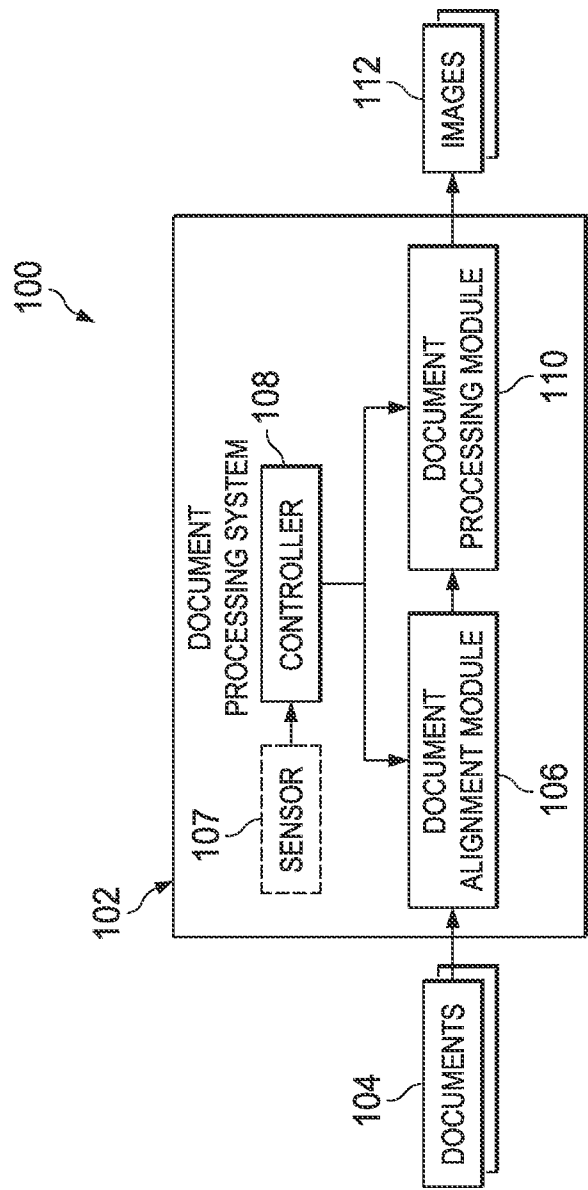
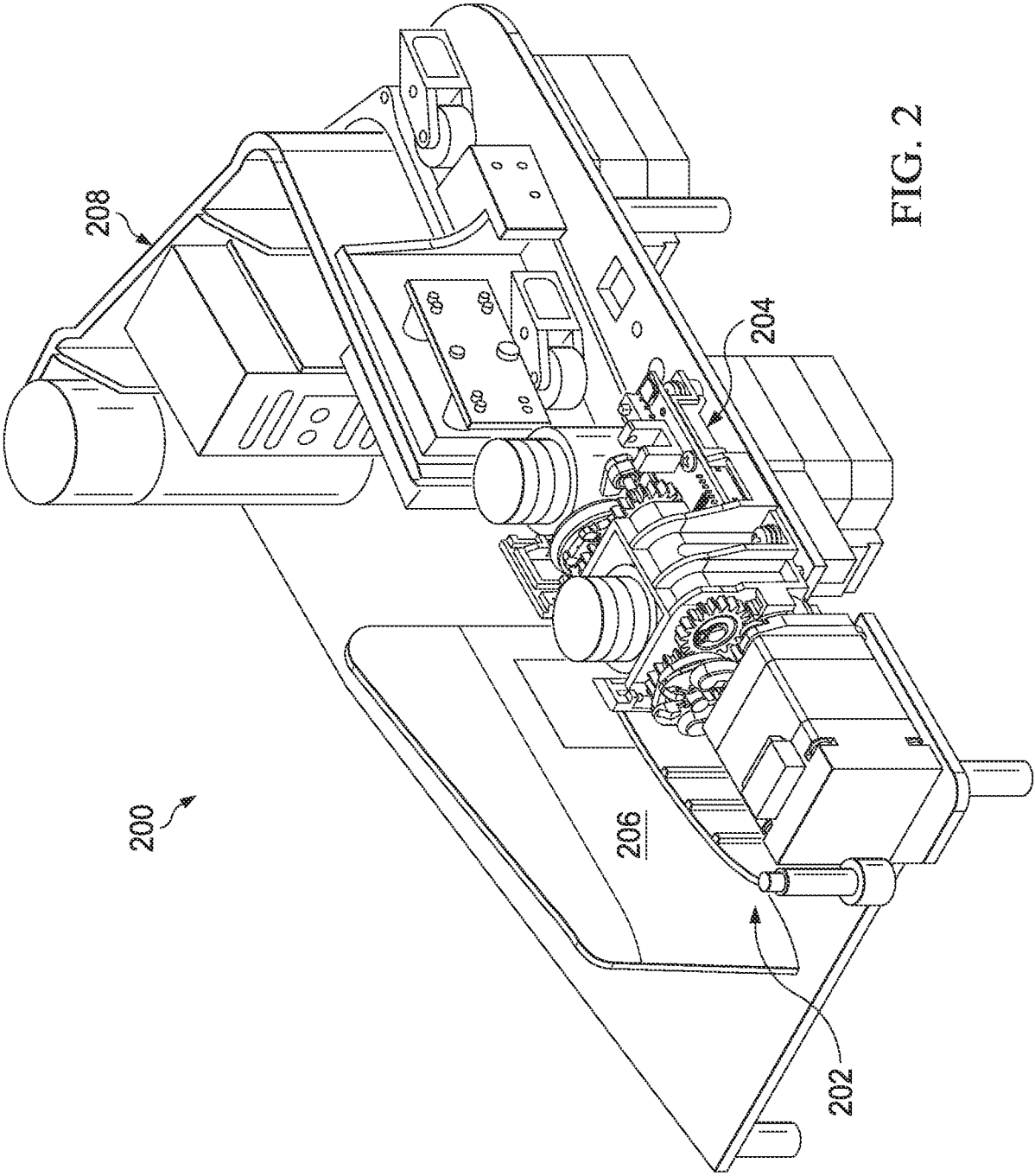
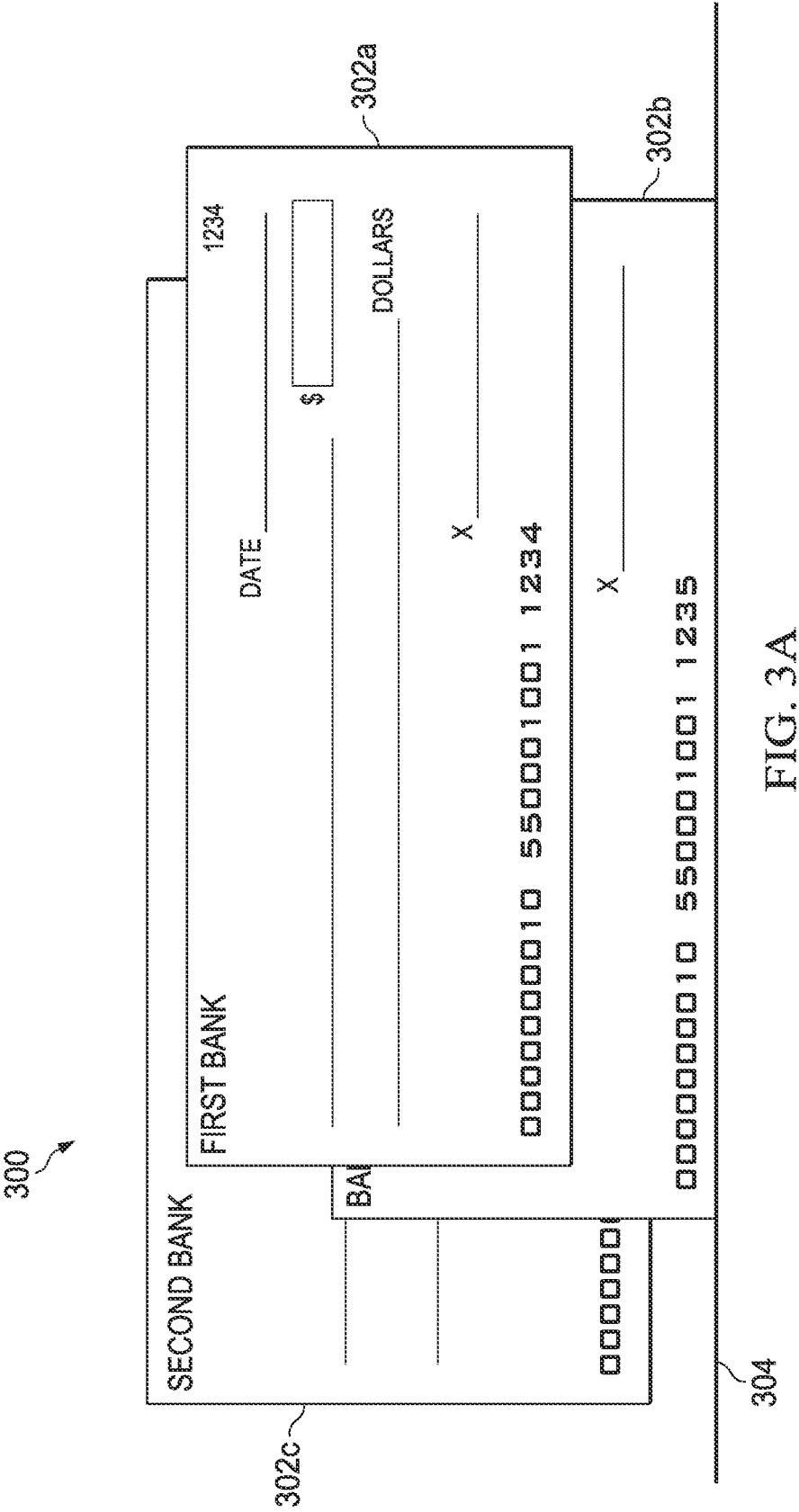
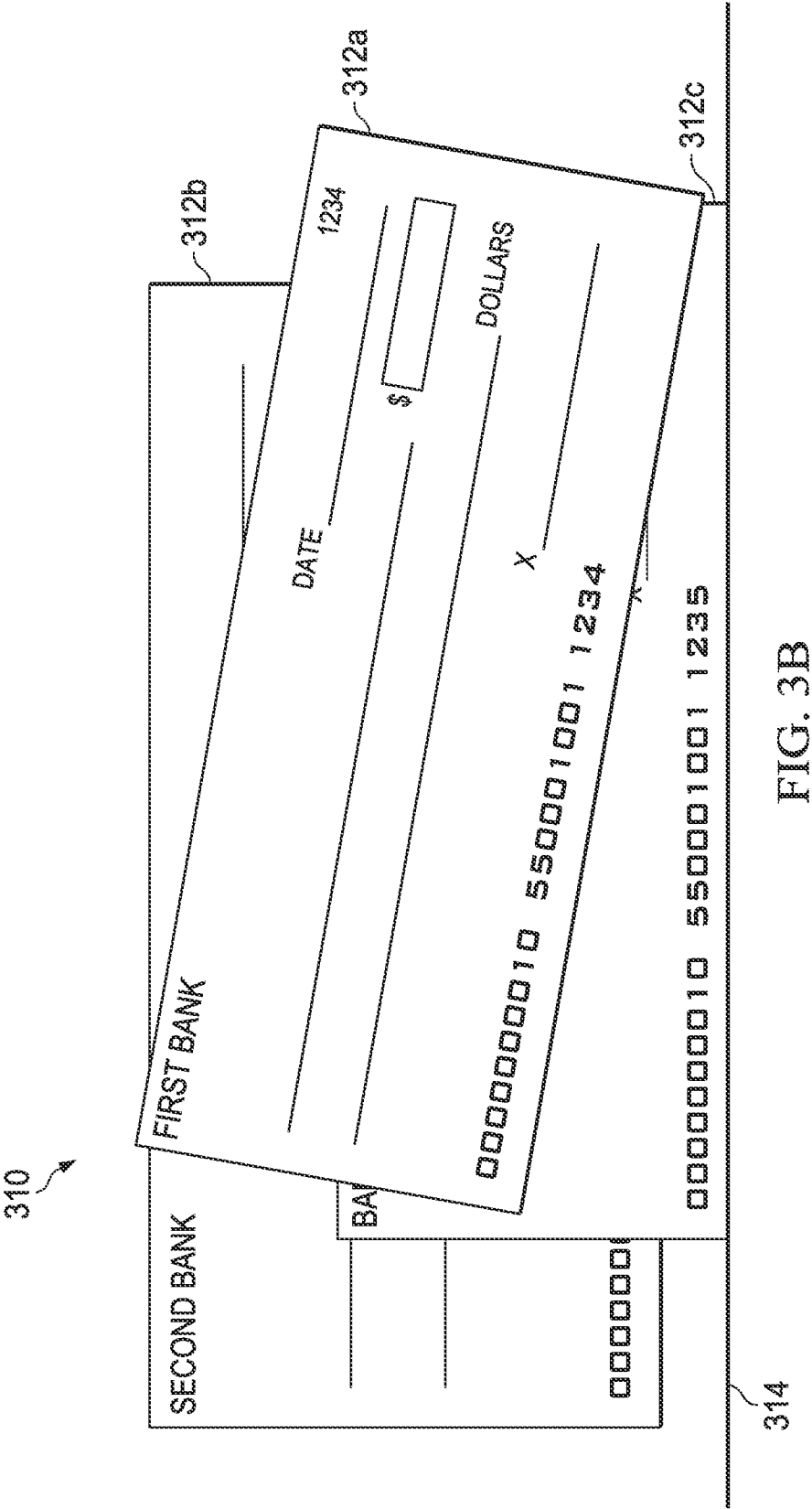


FIG. 1





4/11



5/11

400

SECOND BANK

DATE

402c

BAI FIRST BANK

DATE

1234

402a

402b

\$

DOLLARS

X

0000000010 550001001 1234

404

FIG. 4

6/11

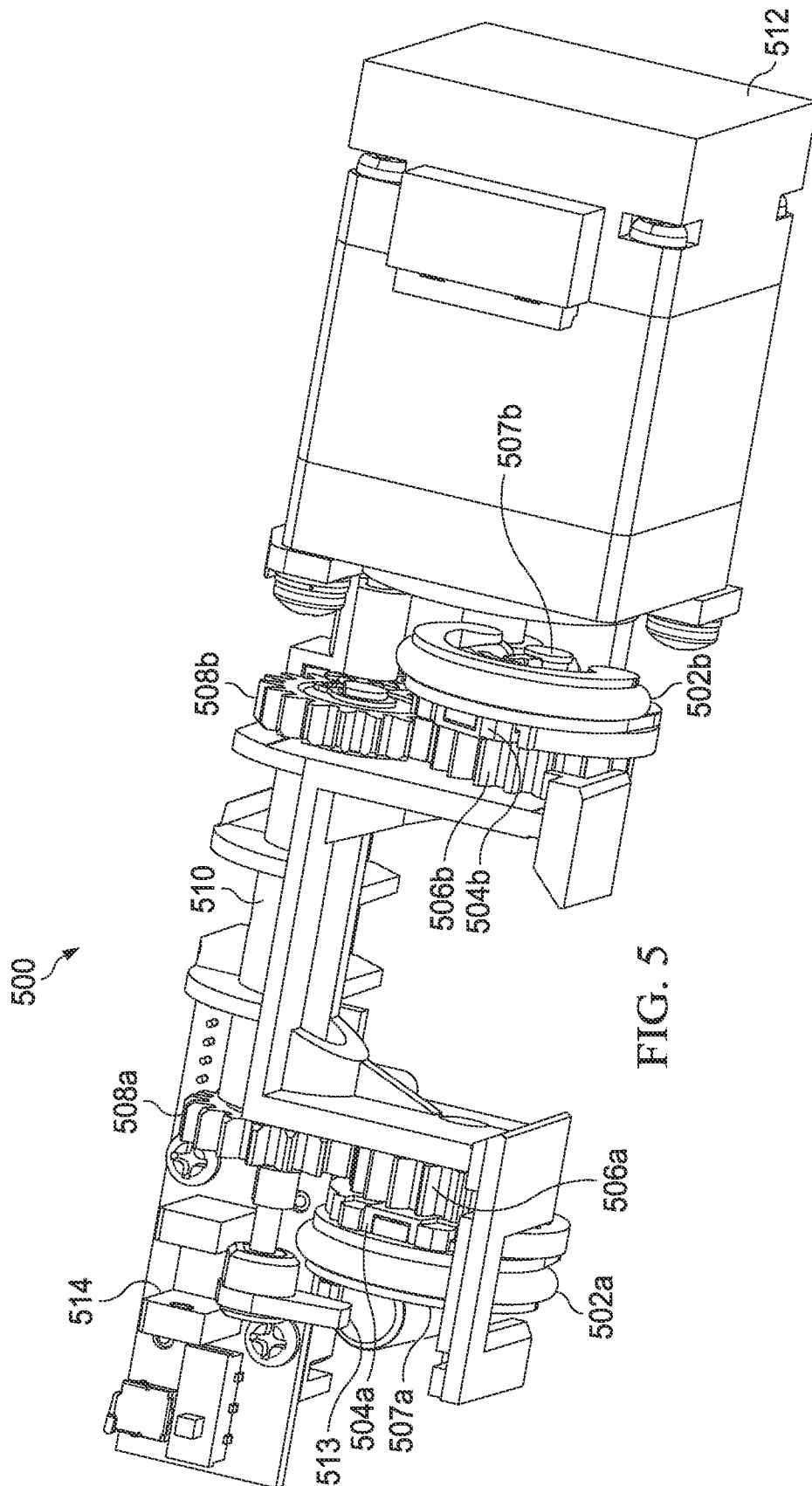


FIG. 5

7/11

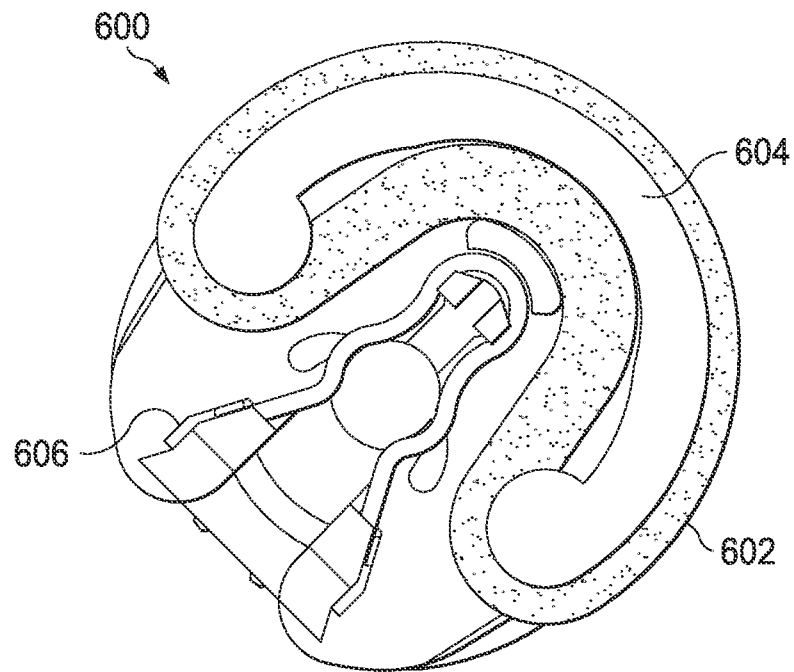


FIG. 6A

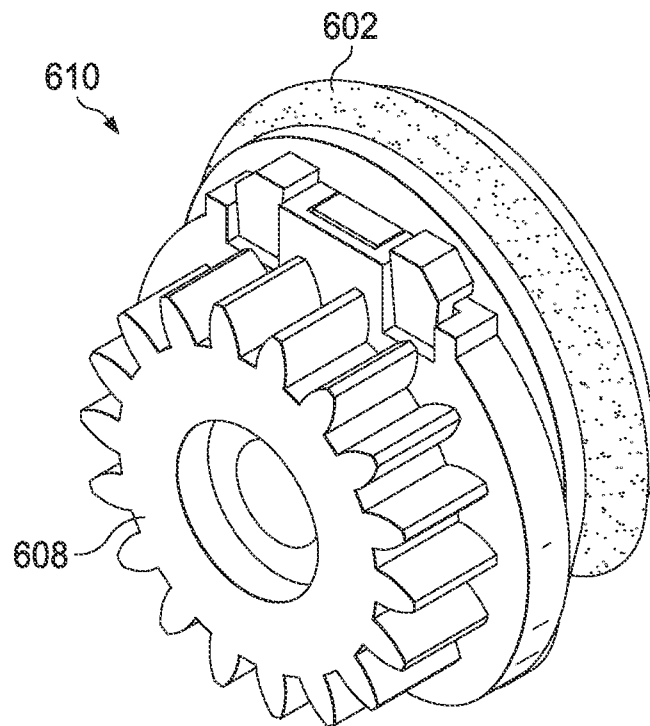
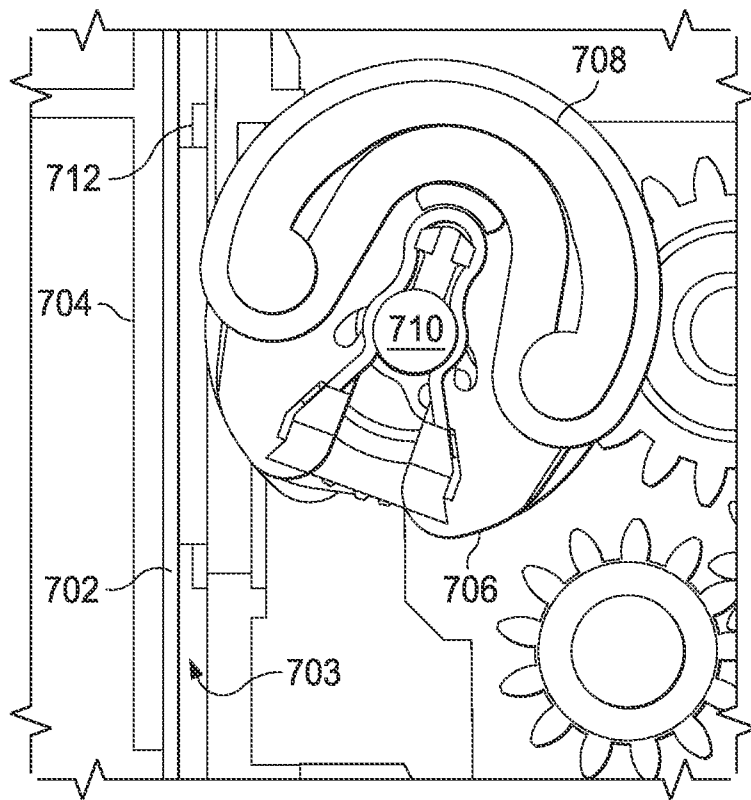


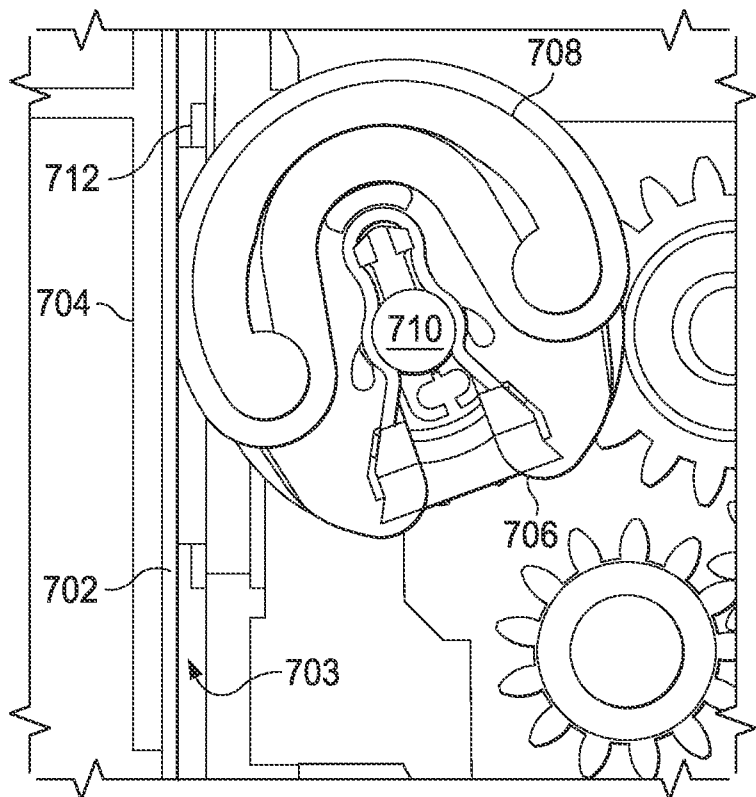
FIG. 6B

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700

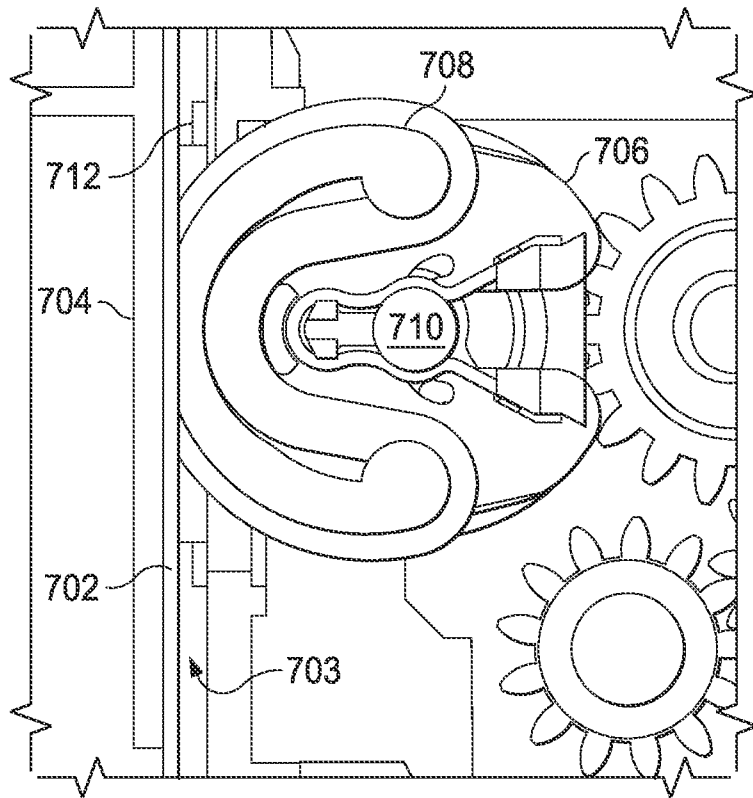
FIG. 7A



700

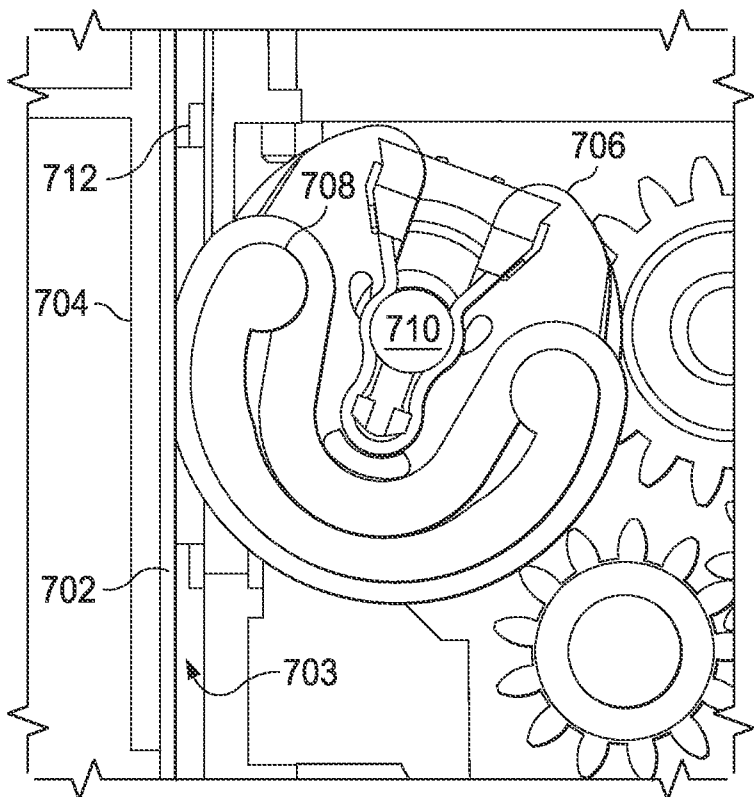
FIG. 7B

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700

FIG. 7C



700

FIG. 7D

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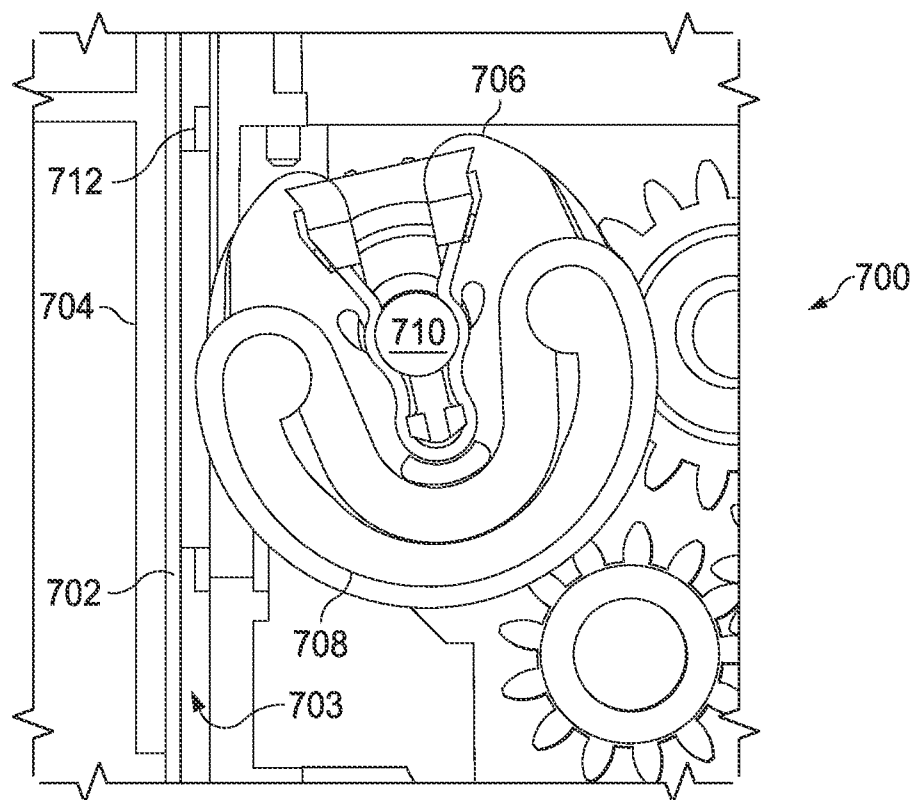


FIG. 7E

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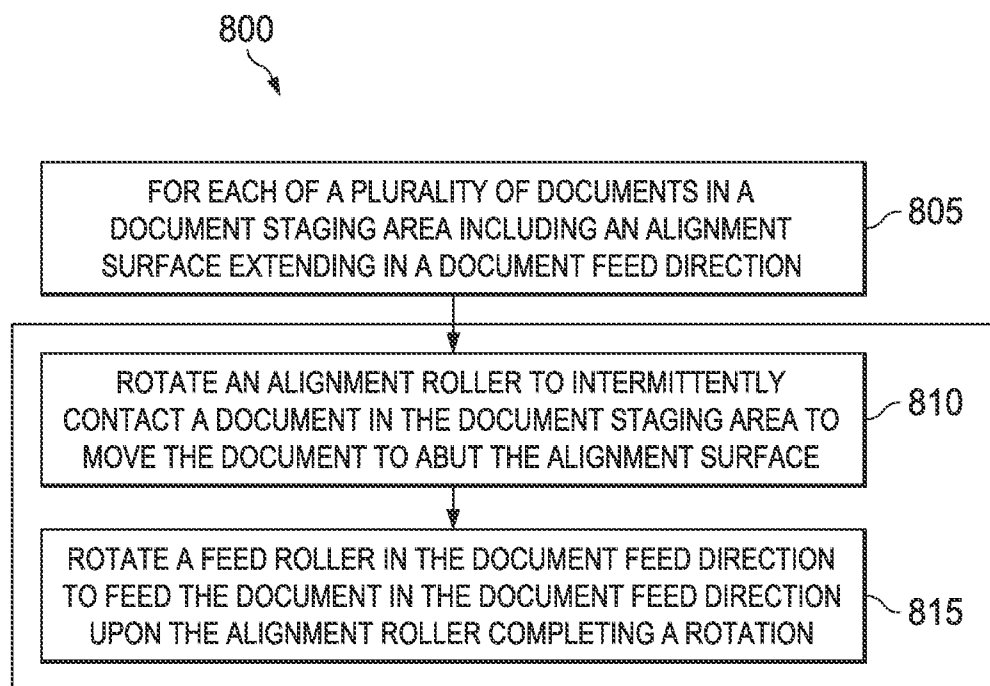


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/038300**A. CLASSIFICATION OF SUBJECT MATTER****G07D 11/00(2006.01)i, B65H 3/06(2006.01)i**

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)

G07D 11/00; G06F 17/00; H04N 1/00; B65H 7/02; B65H 9/16; B65H 29/00; B65H 3/06

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: document, scan, alignment, O-ring, roller, feed

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5577719 A (KENNETH A. NICOLL) 26 November 1996 See abstract; column 4, line 31 - column 5 line 33; claims 1-2, 6-10; and figures 4-6.	1-20
A	US 6042110 A (TORU INAGE) 28 March 2000 See abstract; column 3, line 10 - column 5, line 65; claims 1-16; and figures 3-4.	1-20
A	US 2009-0206152 A1 (GLENN R. EMBURY et al.) 20 August 2009 See abstract; paragraphs [0045]-[0067]; claims 1-15; and figures 2-7.	1-20
A	KR 10-2006-0023911 A (SAMSUNG ELECTRONICS CO., LTD.) 15 March 2006 See abstract; paragraphs [0030]-[0046]; claims 1-8; and figures 1-3.	1-20
A	US 2011-0024974 A1 (TOSHIYUKI SASAKI) 03 February 2011 See abstract; paragraphs [0035]-[0077]; claims 1-9; and figures 1-8.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

08 October 2015 (08.10.2015)

Date of mailing of the international search report

08 October 2015 (08.10.2015)

Name and mailing address of the ISA/KR

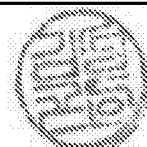
International Application Division
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/038300

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