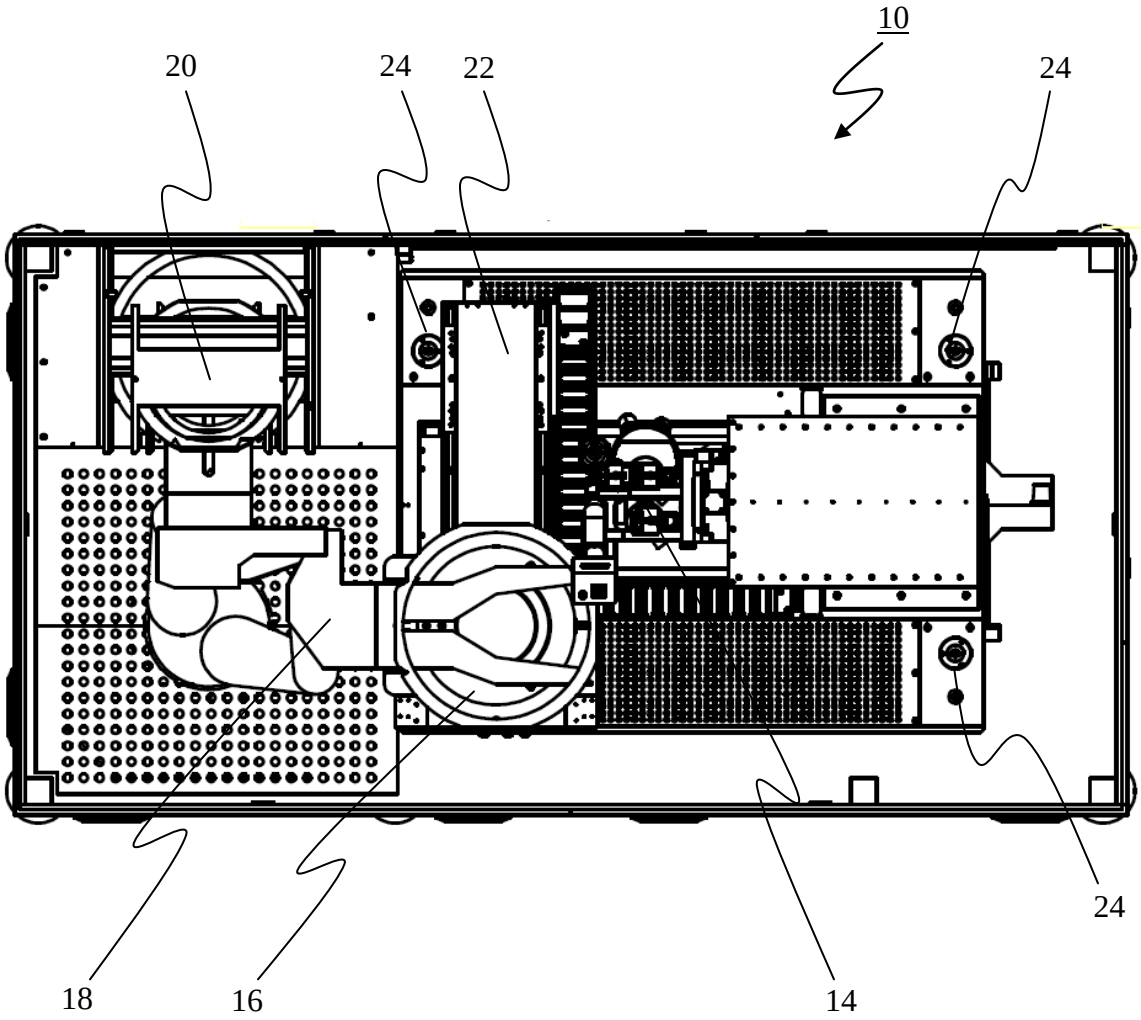



**FIG. 1**

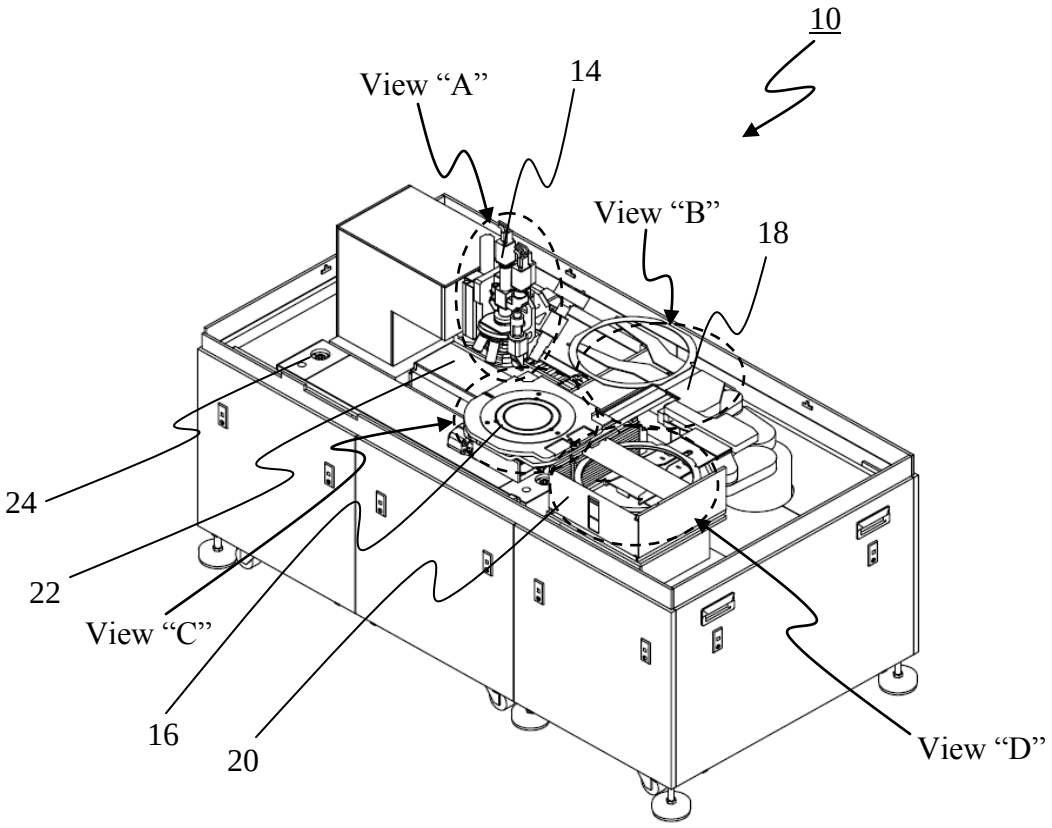



**FIG. 2**

**View “A”**

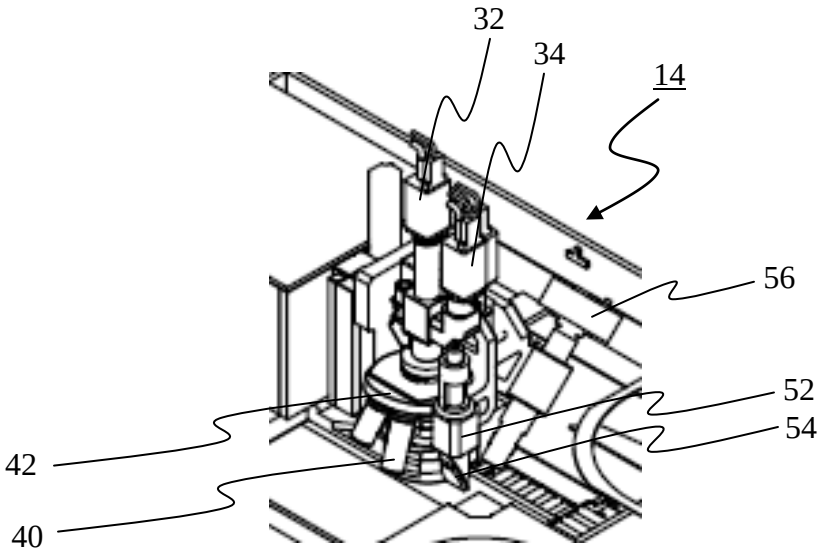



**FIG. 3**

**View “B”**

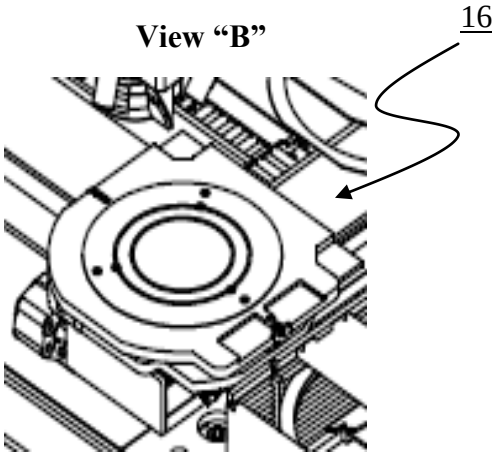



**FIG. 4**

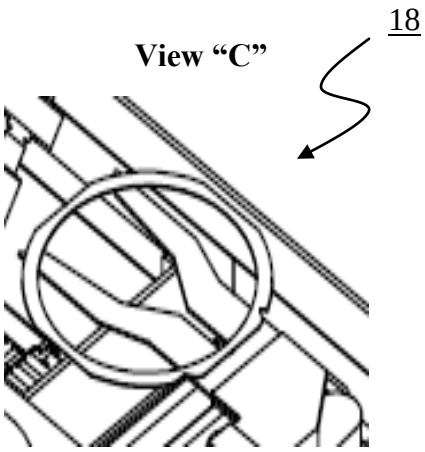



**FIG. 5**

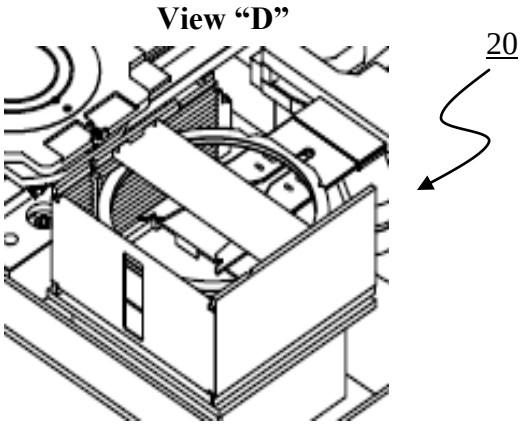



**FIG. 6**

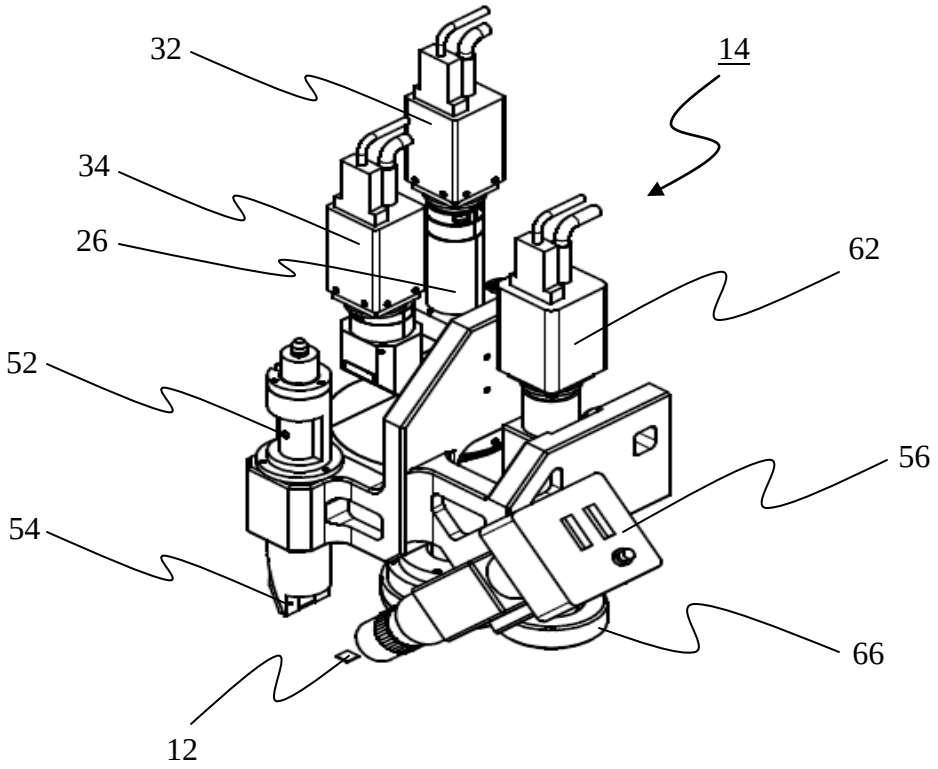



**FIG. 7**

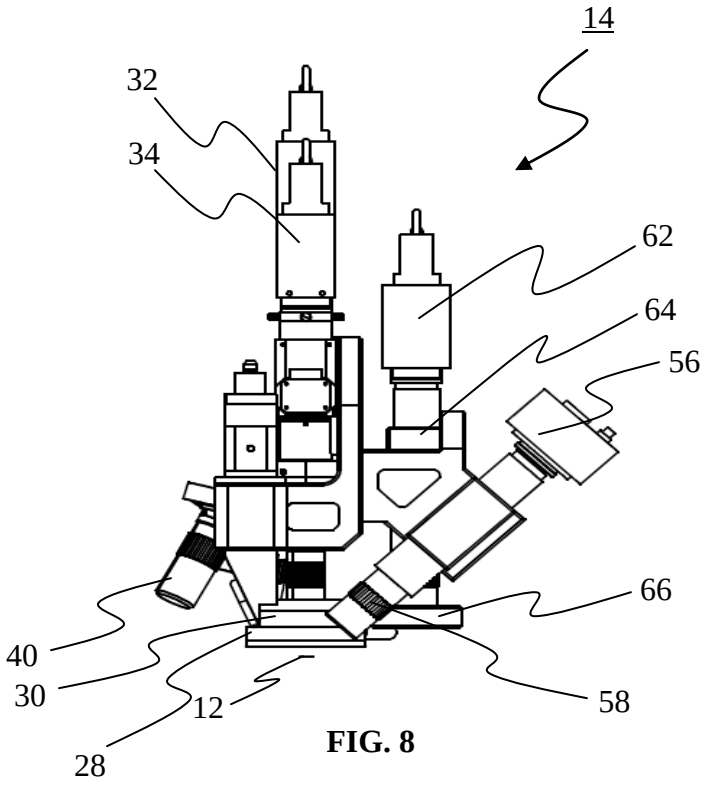



**FIG. 8**

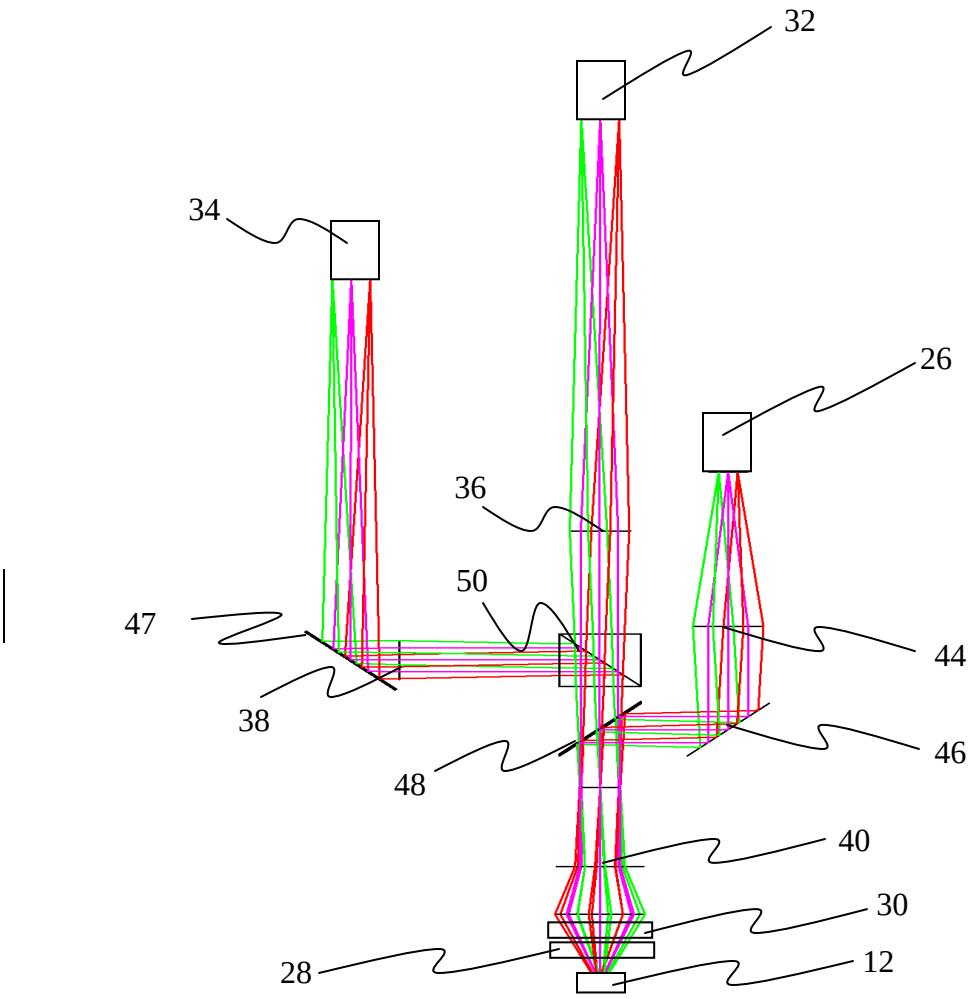



**FIG. 9**

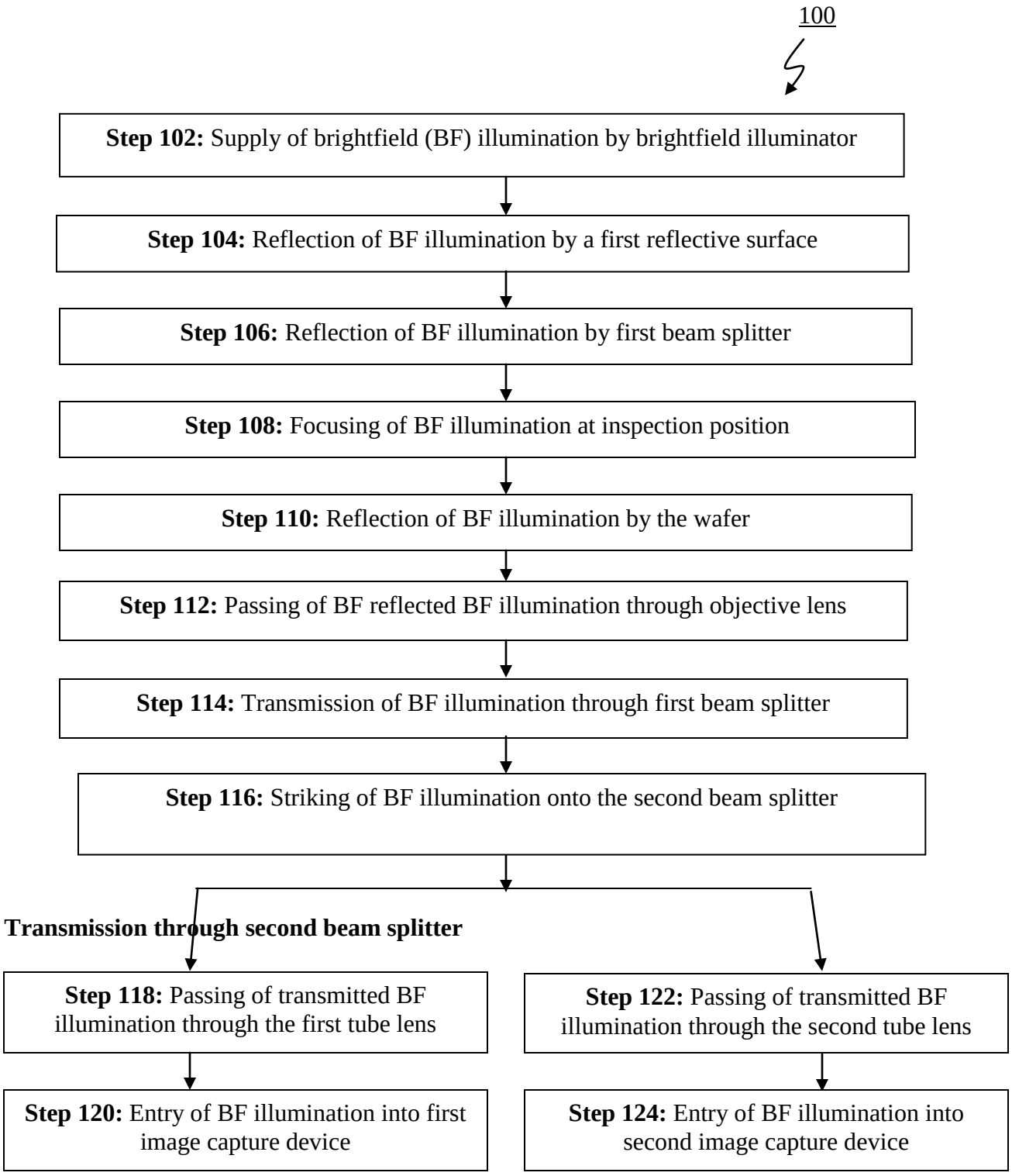

100
Step 102: Supply of brightfield (BF) illumination by brightfield illuminator
Step 104: Reflection of BF illumination by a first reflective surface
Step 106: Reflection of BF illumination by first beam splitter
Step 108: Focusing of BF illumination at inspection position
Step 110: Reflection of BF illumination by the wafer
Step 112: Passing of BF reflected BF illumination through objective lens
Step 114: Transmission of BF illumination through first beam splitter
Step 116: Striking of BF illumination onto the second beam splitter
Transmission through second beam splitter
Step 118: Passing of transmitted BF illumination through the first tube lens
Step 120: Entry of BF illumination into first image capture device
Step 122: Passing of transmitted BF illumination through the second tube lens
Step 124: Entry of BF illumination into second image capture device

**FIG. 10**

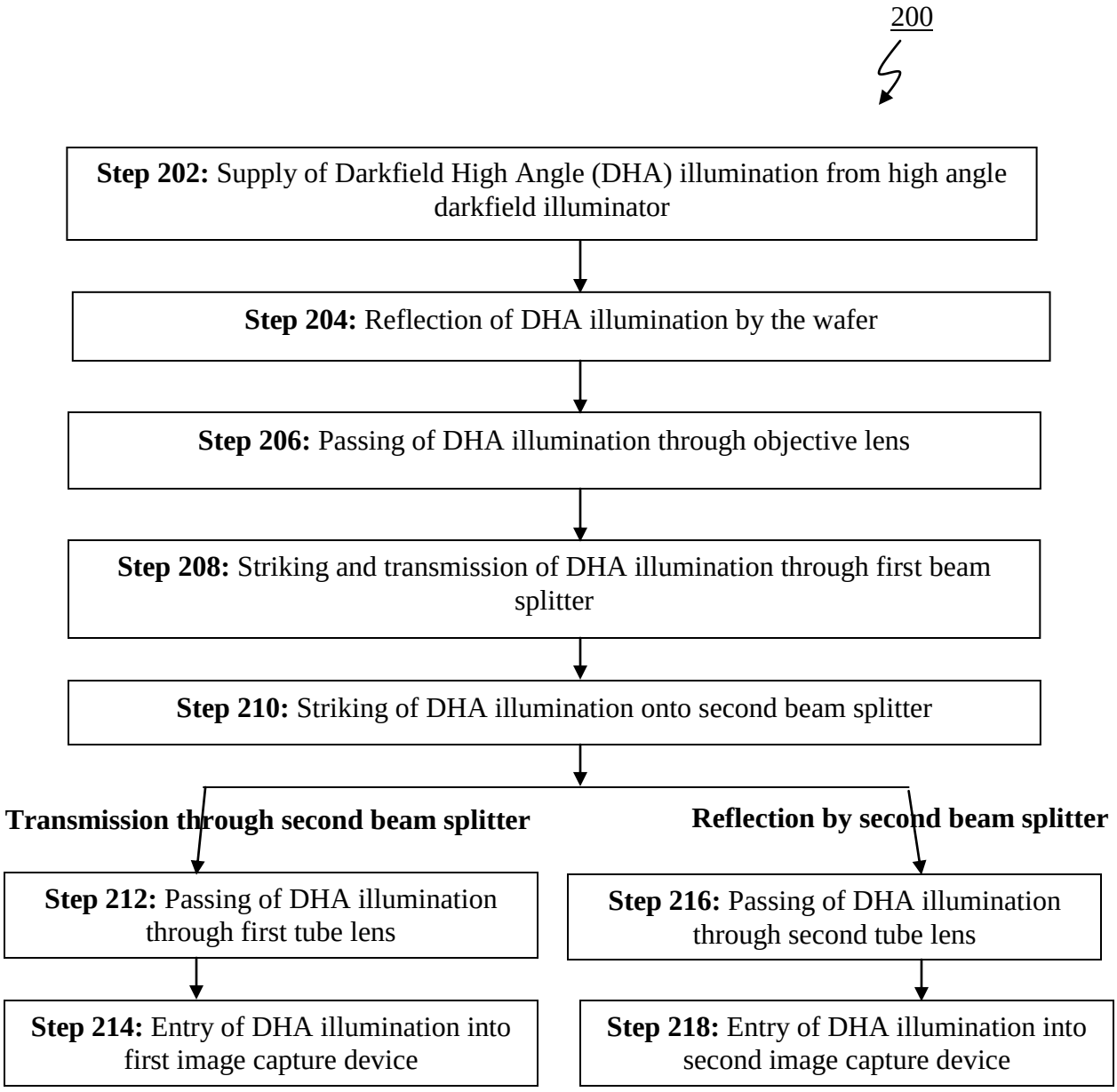

200
Step 202: Supply of Darkfield High Angle (DHA) illumination from high angle darkfield illuminator
Step 204: Reflection of DHA illumination by the wafer
Step 206: Passing of DHA illumination through objective lens
Step 208: Striking and transmission of DHA illumination through first beam splitter
Step 210: Striking of DHA illumination onto second beam splitter
Transmission through second beam splitter
Reflection by second beam splitter
Step 212: Passing of DHA illumination through first tube lens
Step 216: Passing of DHA illumination through second tube lens
Step 214: Entry of DHA illumination into first image capture device
Step 218: Entry of DHA illumination into second image capture device

**FIG. 11**

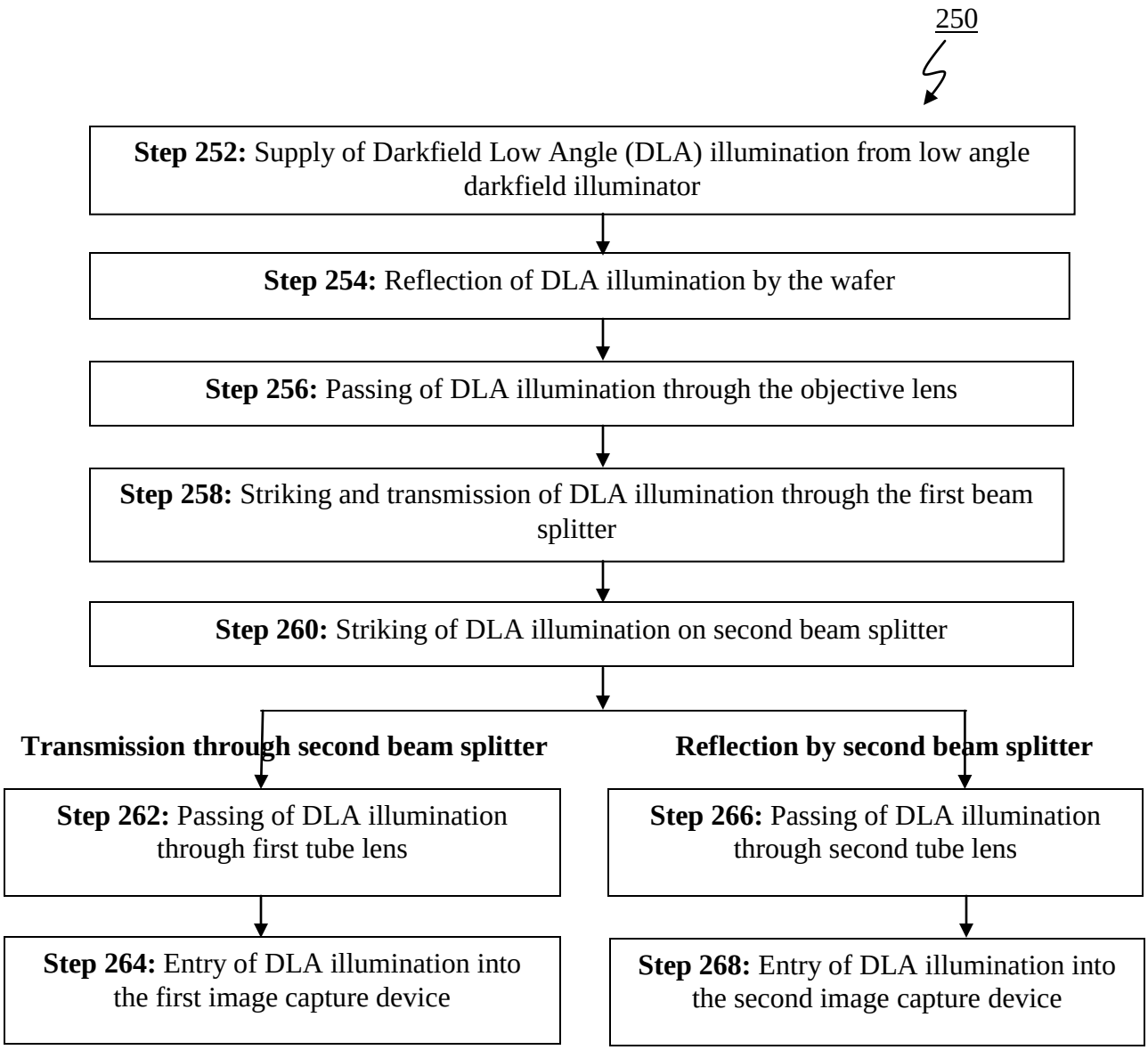

250
Step 252: Supply of Darkfield Low Angle (DLA) illumination from low angle darkfield illuminator
Step 254: Reflection of DLA illumination by the wafer
Step 256: Passing of DLA illumination through the objective lens
Step 258: Striking and transmission of DLA illumination through the first beam splitter
Step 260: Striking of DLA illumination on second beam splitter
Transmission through second beam splitter
Reflection by second beam splitter
Step 262: Passing of DLA illumination through first tube lens
Step 264: Entry of DLA illumination into the first image capture device
Step 266: Passing of DLA illumination through second tube lens
Step 268: Entry of DLA illumination into the second image capture device

**FIG. 12**

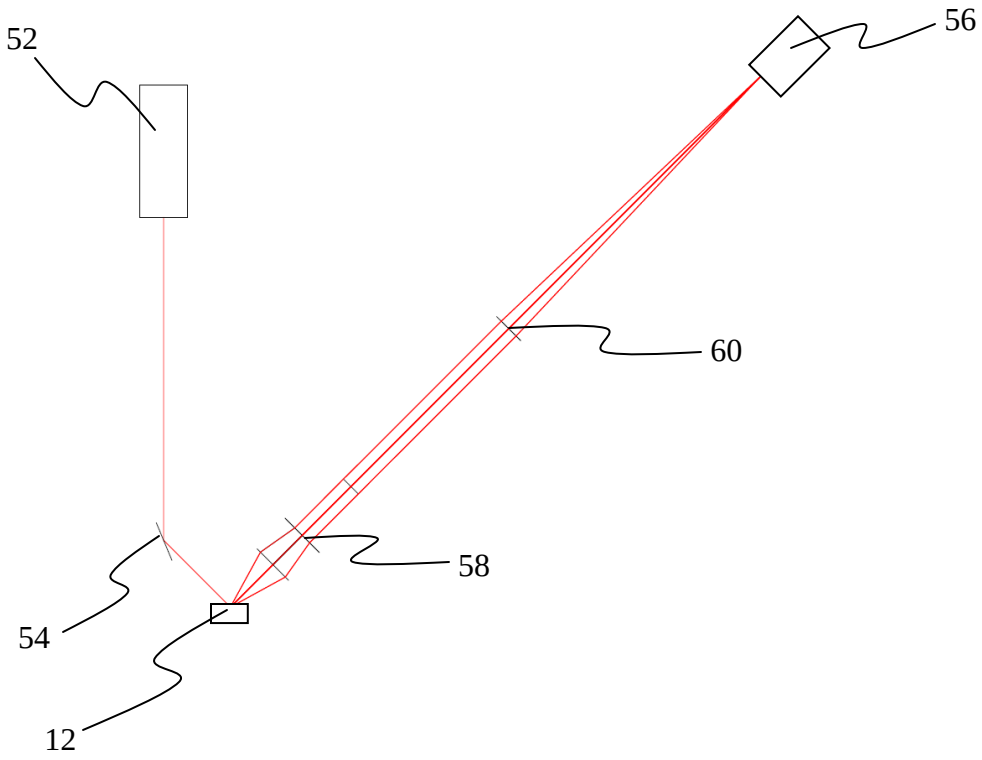



**FIG. 13**

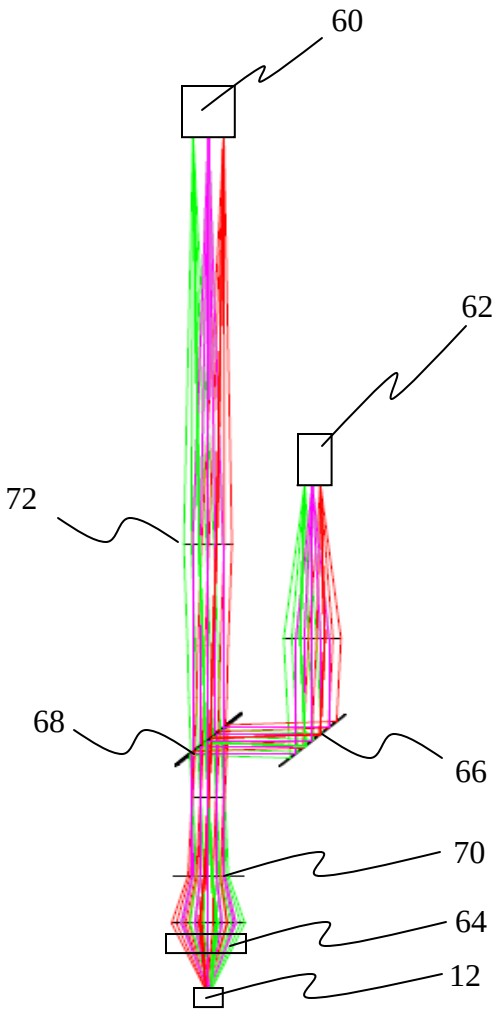



**FIG. 14**

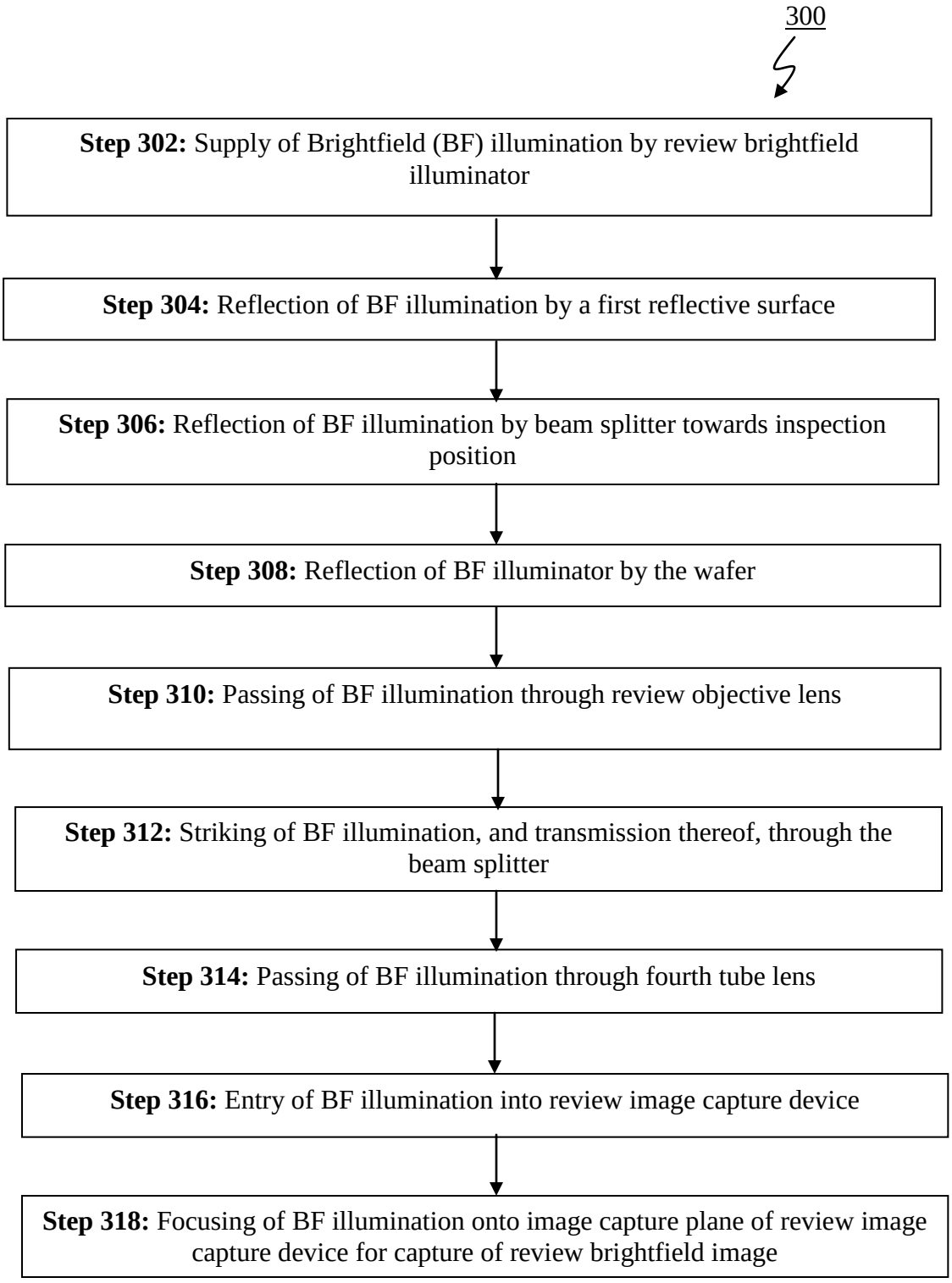

300
Step 302: Supply of Brightfield (BF) illumination by review brightfield illuminator
Step 304: Reflection of BF illumination by a first reflective surface
Step 306: Reflection of BF illumination by beam splitter towards inspection position
Step 308: Reflection of BF illuminator by the wafer
Step 310: Passing of BF illumination through review objective lens
Step 312: Striking of BF illumination, and transmission thereof, through the beam splitter
Step 314: Passing of BF illumination through fourth tube lens
Step 316: Entry of BF illumination into review image capture device
Step 318: Focusing of BF illumination onto image capture plane of review image capture device for capture of review brightfield image

**FIG. 15**

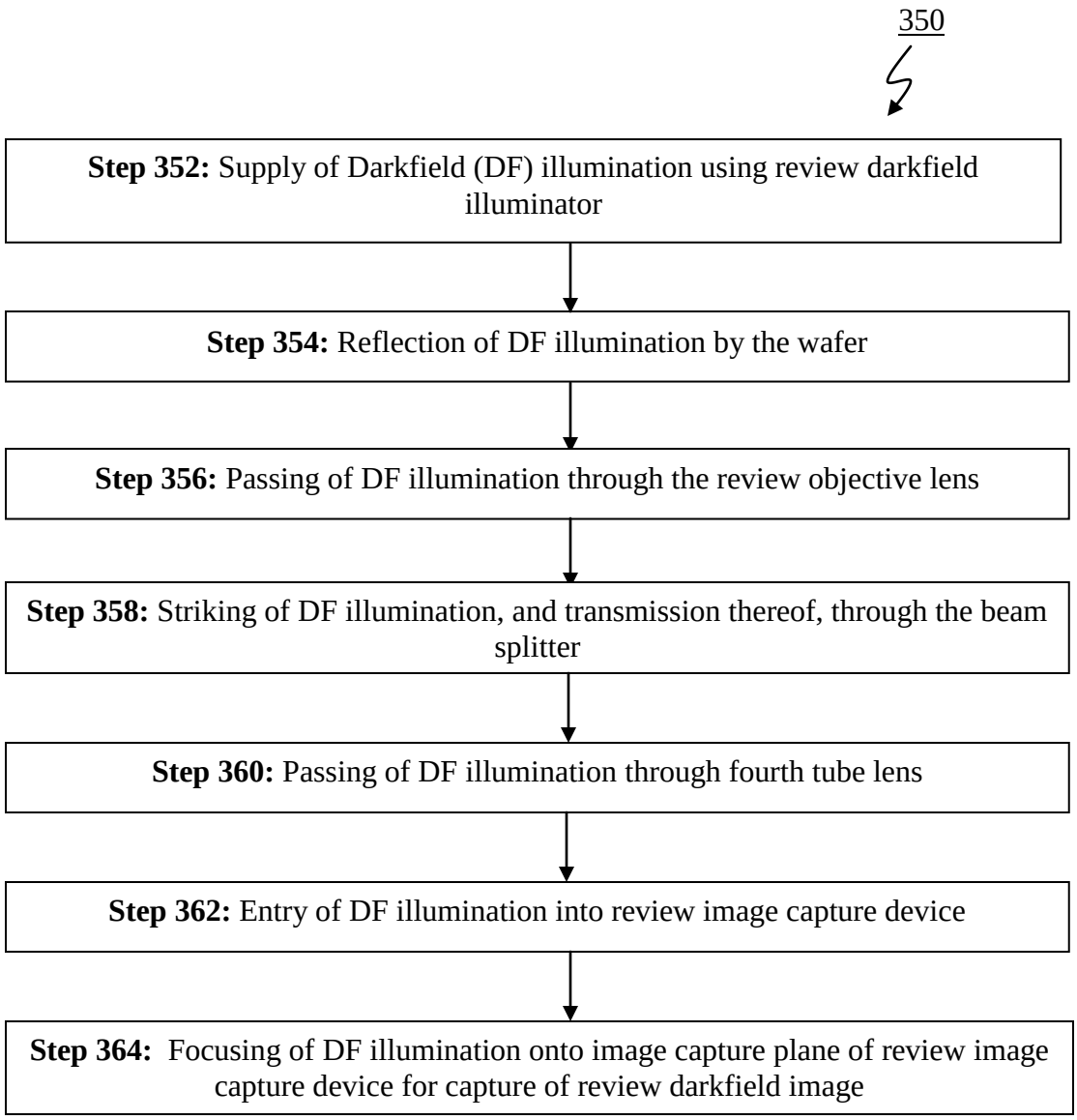

350
**Step 352:** Supply of Darkfield (DF) illumination using review darkfield illuminator
**Step 354:** Reflection of DF illumination by the wafer
**Step 356:** Passing of DF illumination through the review objective lens
**Step 358:** Striking of DF illumination, and transmission thereof, through the beam splitter
**Step 360:** Passing of DF illumination through fourth tube lens
**Step 362:** Entry of DF illumination into review image capture device
**Step 364:** Focusing of DF illumination onto image capture plane of review image capture device for capture of review darkfield image

**FIG. 16**

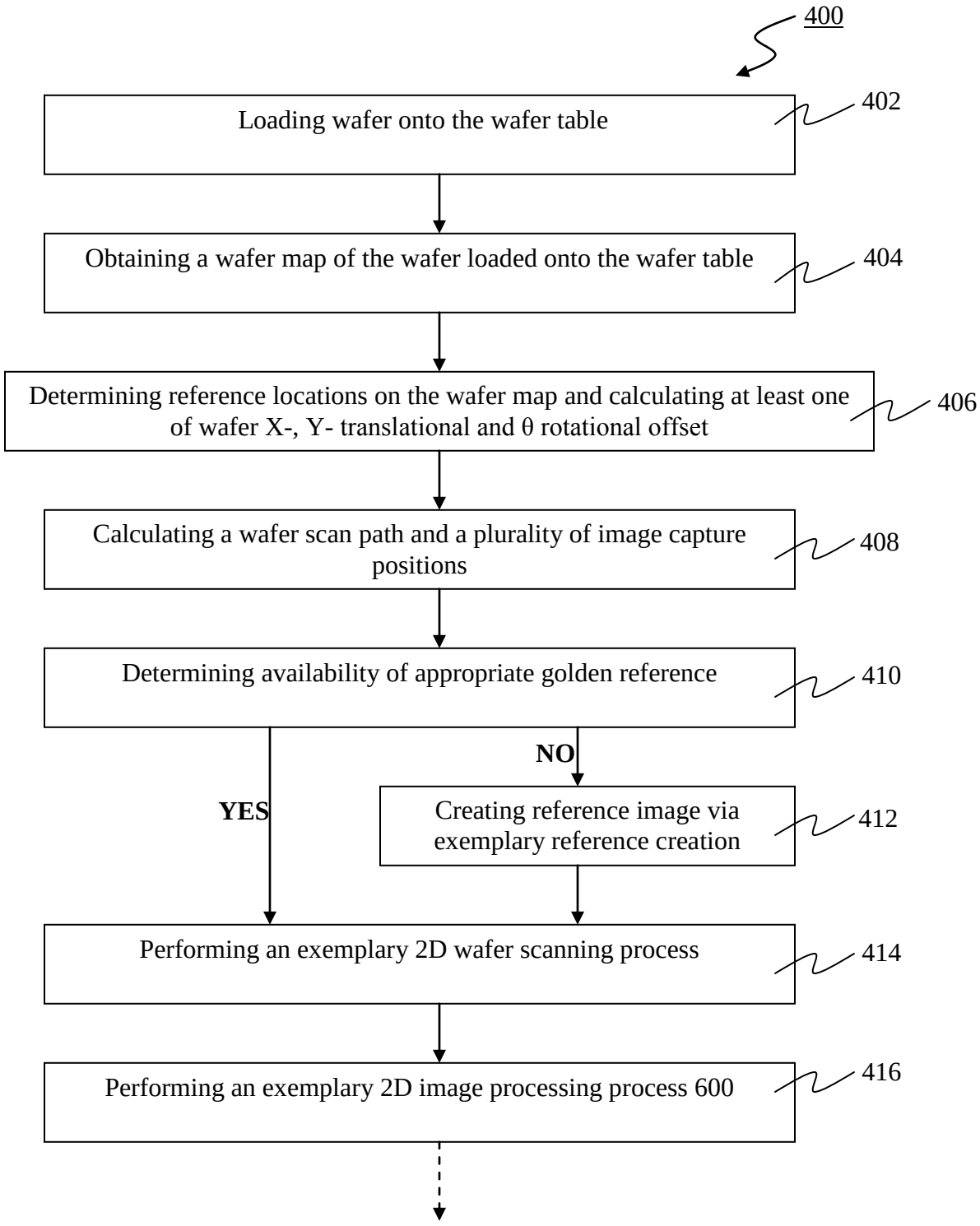

400
Loading wafer onto the wafer table
402
Obtaining a wafer map of the wafer loaded onto the wafer table
404
Determining reference locations on the wafer map and calculating at least one of wafer X-, Y- translational and θ rotational offset
406
Calculating a wafer scan path and a plurality of image capture positions
408
Determining availability of appropriate golden reference
410
NO
YES
Creating reference image via exemplary reference creation
412
Performing an exemplary 2D wafer scanning process
414
Performing an exemplary 2D image processing process 600
416

**FIG. 17**

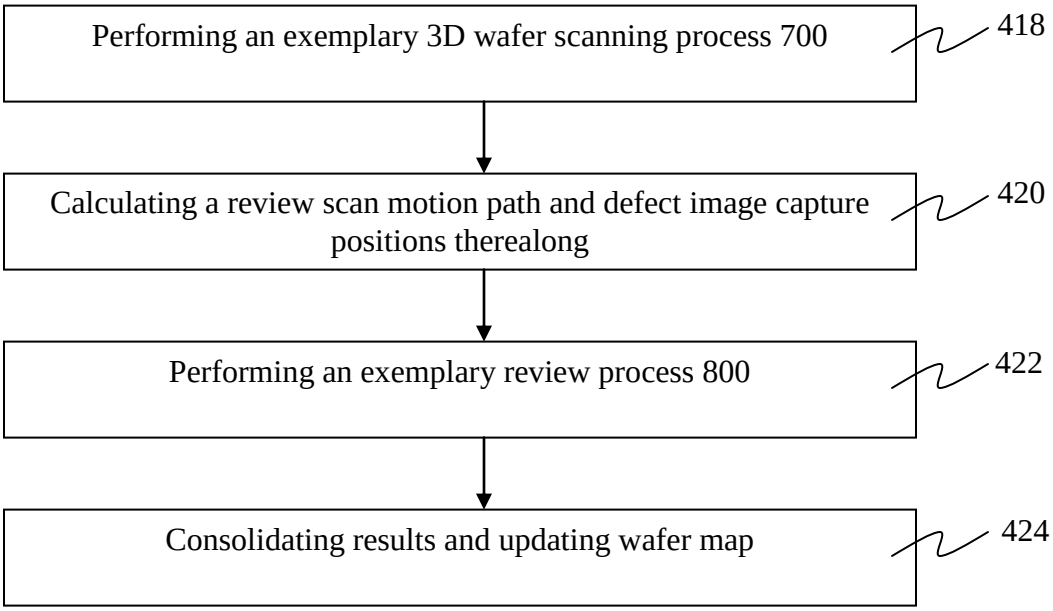

Performing an exemplary 3D wafer scanning process 700
418
Calculating a review scan motion path and defect image capture positions therealong
420
Performing an exemplary review process 800
422
Consolidating results and updating wafer map
424

**FIG. 17**

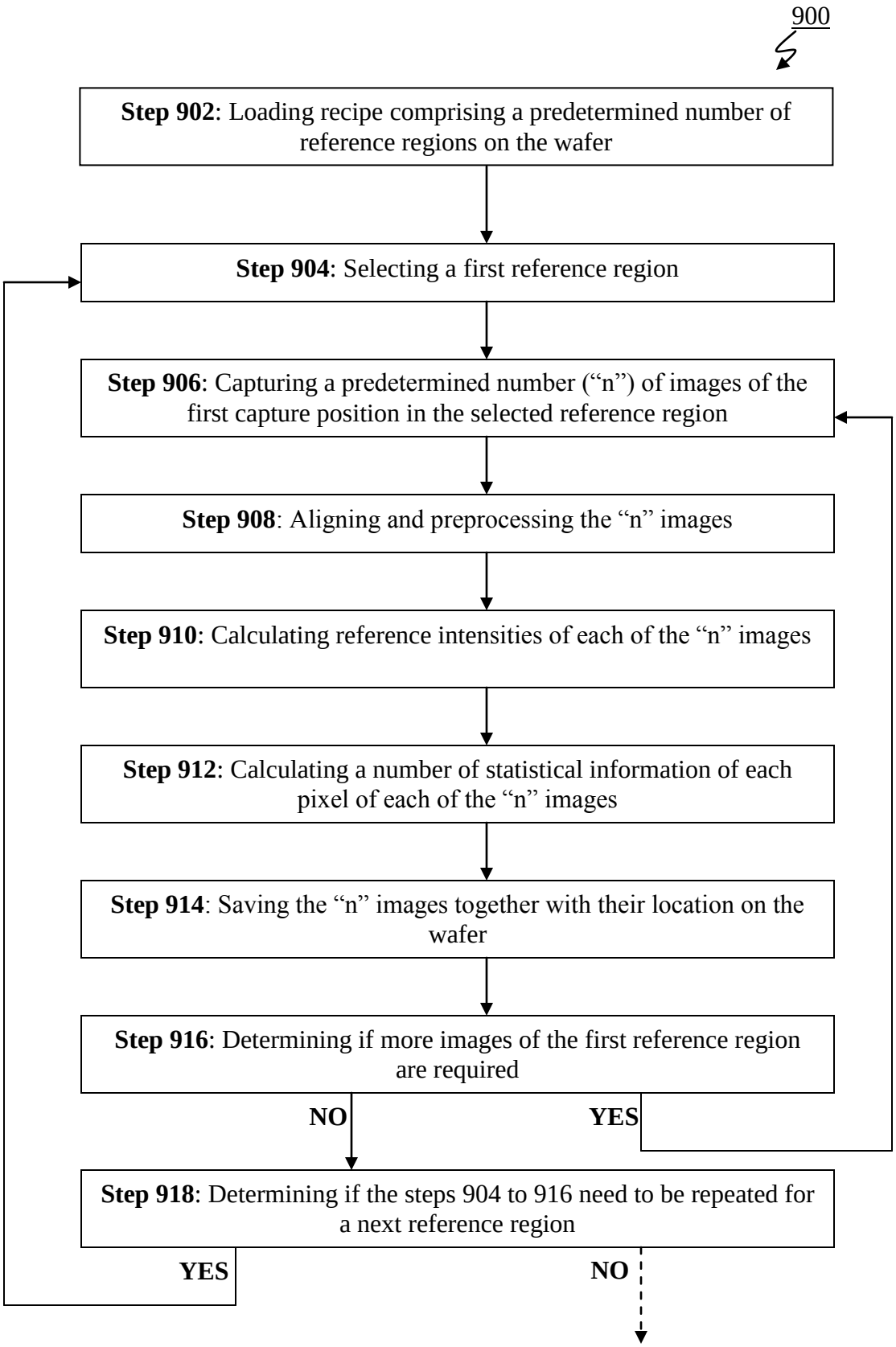

900
**Step 902**: Loading recipe comprising a predetermined number of reference regions on the wafer
**Step 904**: Selecting a first reference region
**Step 906**: Capturing a predetermined number ("n") of images of the first capture position in the selected reference region
**Step 908**: Aligning and preprocessing the "n" images
**Step 910**: Calculating reference intensities of each of the "n" images
**Step 912**: Calculating a number of statistical information of each pixel of each of the "n" images
**Step 914**: Saving the "n" images together with their location on the wafer
**Step 916**: Determining if more images of the first reference region are required
NO
YES
**Step 918**: Determining if the steps 904 to 916 need to be repeated for a next reference region
YES
NO

**FIG. 18**

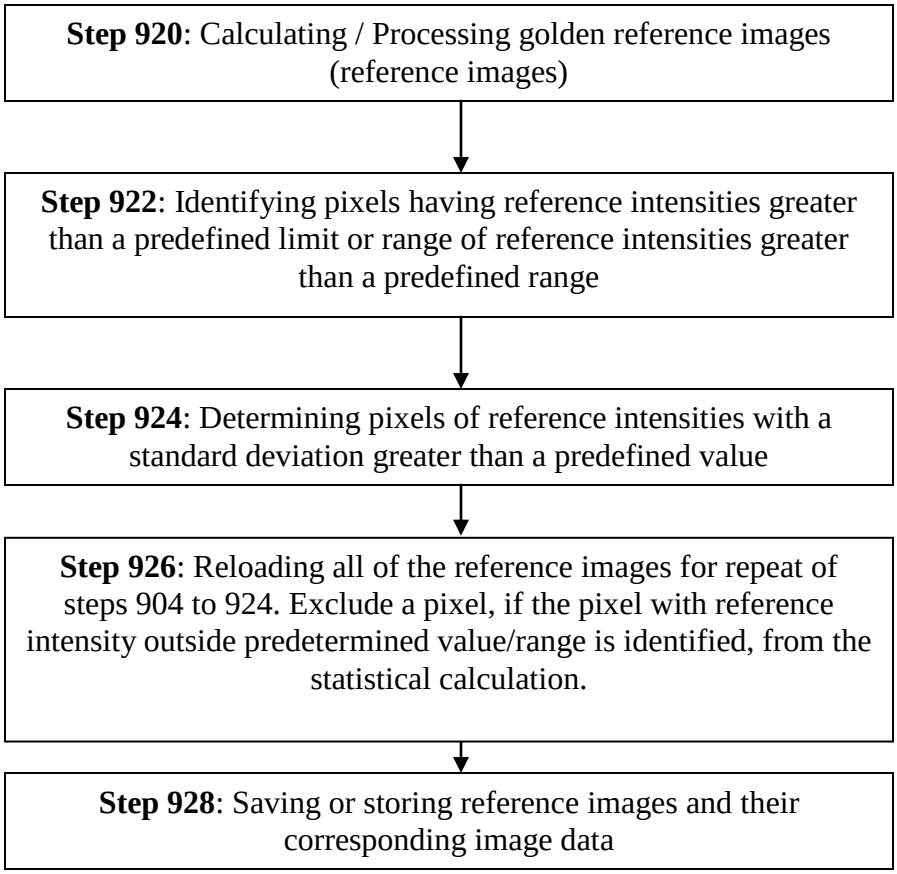

**Step 920**: Calculating / Processing golden reference images (reference images)
**Step 922**: Identifying pixels having reference intensities greater than a predefined limit or range of reference intensities greater than a predefined range
**Step 924**: Determining pixels of reference intensities with a standard deviation greater than a predefined value
**Step 926**: Reloading all of the reference images for repeat of steps 904 to 924. Exclude a pixel, if the pixel with reference intensity outside predetermined value/range is identified, from the statistical calculation.
**Step 928**: Saving or storing reference images and their corresponding image data

**FIG. 18**

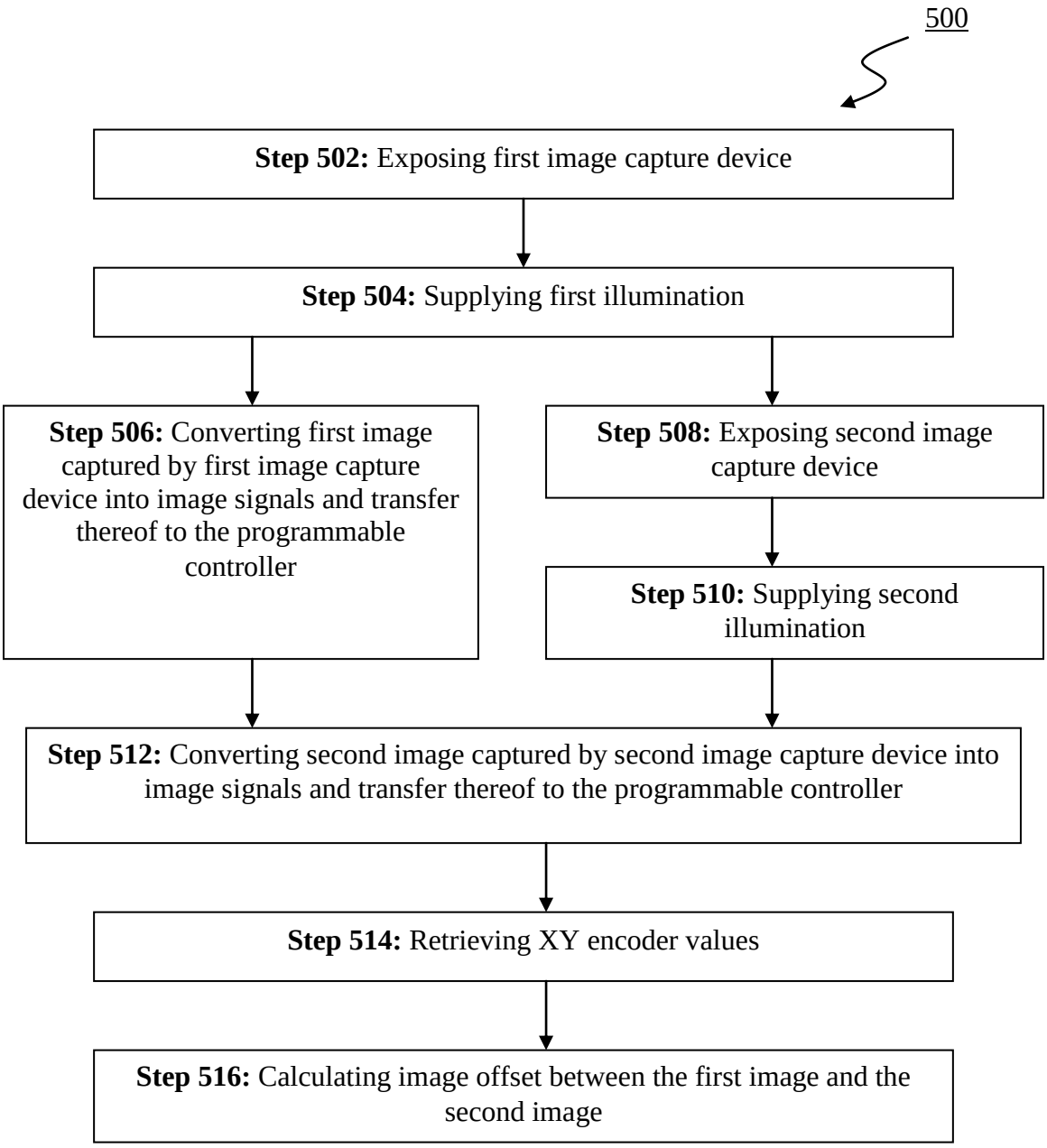
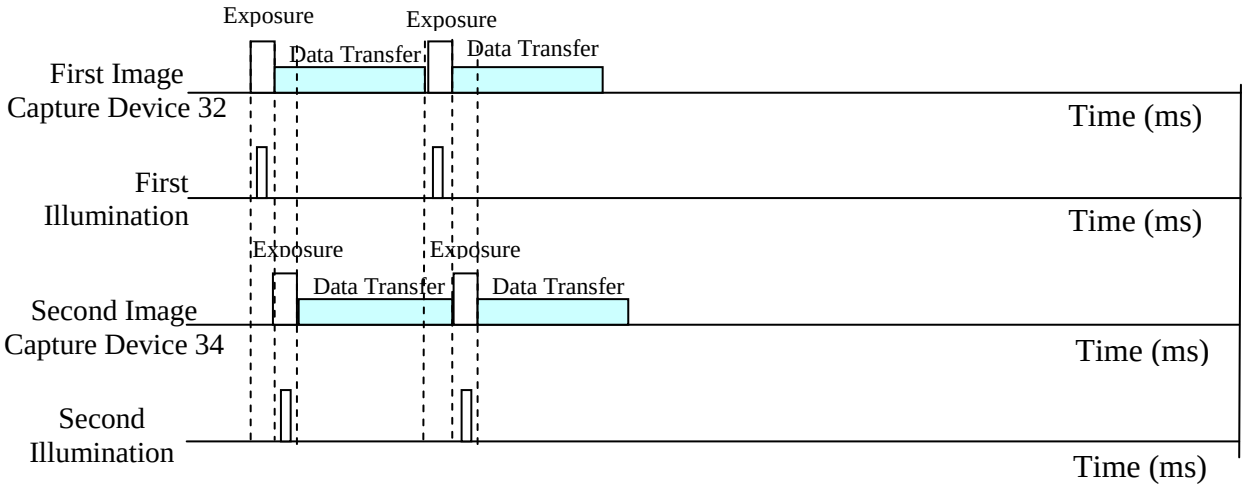

500
Step 502: Exposing first image capture device
Step 504: Supplying first illumination
Step 506: Converting first image captured by first image capture device into image signals and transfer thereof to the programmable controller
Step 508: Exposing second image capture device
Step 510: Supplying second illumination
Step 512: Converting second image captured by second image capture device into image signals and transfer thereof to the programmable controller
Step 514: Retrieving XY encoder values
Step 516: Calculating image offset between the first image and the second image

**FIG. 19**

**Table of Illumination Configurations Selectable by Illumination Configurator**

| Configuration | First Illumination Supplied | Second Illumination Supplied |
|---|---|---|
| 1 | Brightfield | High Angle Darkfield |
| 2 | Brightfield | Low Angle Darkfield |
| 3 | Brightfield + High Angle Darkfield | High Angle Darkfield |
| 4 | Brightfield + High Angle Darkfield | Low Angle Darkfield |
| 5 | Brightfield | High Angle Darkfield + Low Angle Darkfield |
| 6 (with same illumination but varying intensity level) | Brightfield with intensity level (e.g. 50%) | Brightfield with intensity level (e.g. 25%) |
| 7 | High Angle Darkfield | Brightfield |
| 8 | Brightfield + High Angle Darkfield | Brightfield + Low Angle Darkfield |
| 9 | High Angle Darkfield with intensity level (e.g. 60%) | High Angle Darkfield with intensity level (e.g. 50%) |

**FIG. 20**




**Timing chart of 2D image acquisition from first and second image capture devices**

**FIG. 21**

**FIG. 22a First Image**

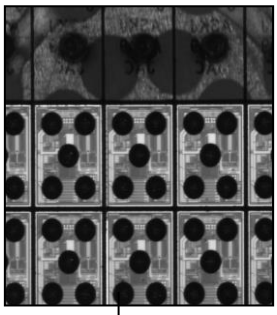
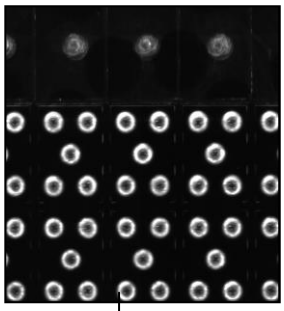


**FIG. 22b Second Image**



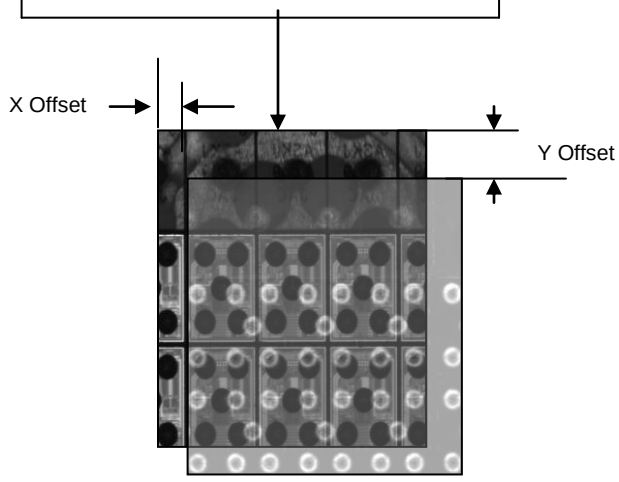



**FIG. 22c Combined first Image and second image demonstrating image offset due to image capture while wafer is moving**

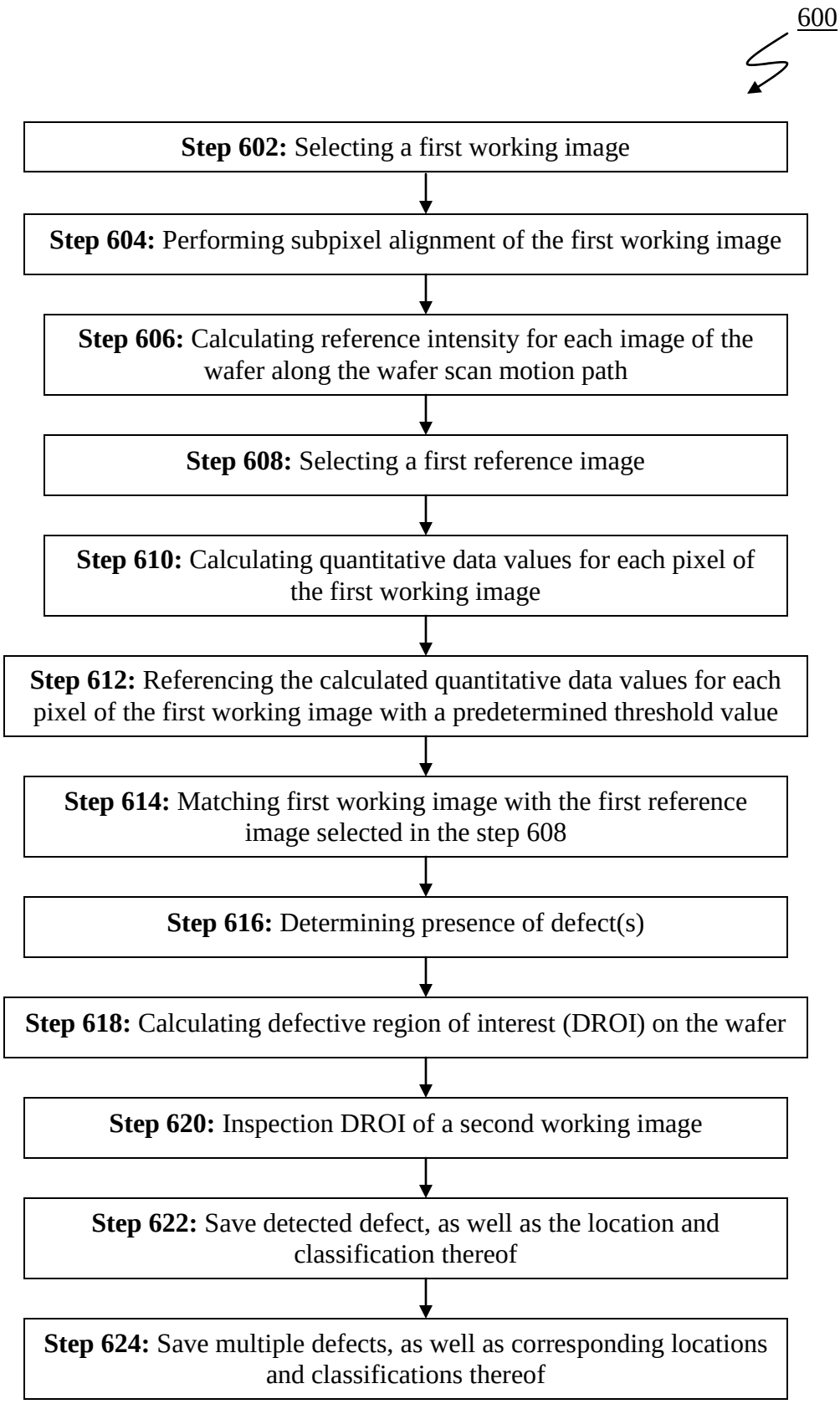

600
**Step 602:** Selecting a first working image
**Step 604:** Performing subpixel alignment of the first working image
**Step 606:** Calculating reference intensity for each image of the wafer along the wafer scan motion path
**Step 608:** Selecting a first reference image
**Step 610:** Calculating quantitative data values for each pixel of the first working image
**Step 612:** Referencing the calculated quantitative data values for each pixel of the first working image with a predetermined threshold value
**Step 614:** Matching first working image with the first reference image selected in the step 608
**Step 616:** Determining presence of defect(s)
**Step 618:** Calculating defective region of interest (DROI) on the wafer
**Step 620:** Inspection DROI of a second working image
**Step 622:** Save detected defect, as well as the location and classification thereof
**Step 624:** Save multiple defects, as well as corresponding locations and classifications thereof

**FIG. 23**

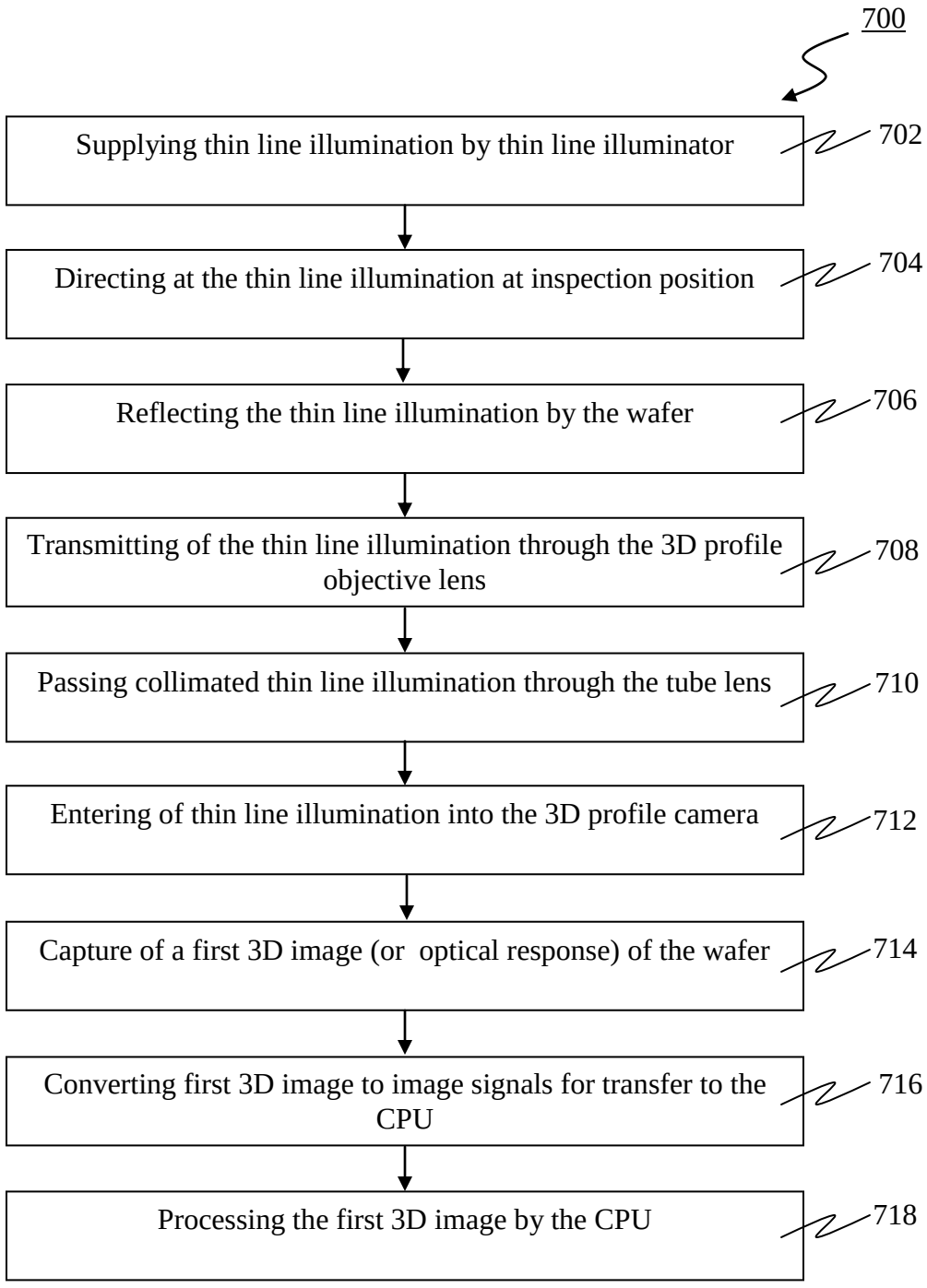

700
Supplying thin line illumination by thin line illuminator
702
Directing at the thin line illumination at inspection position
704
Reflecting the thin line illumination by the wafer
706
Transmitting of the thin line illumination through the 3D profile objective lens
708
Passing collimated thin line illumination through the tube lens
710
Entering of thin line illumination into the 3D profile camera
712
Capture of a first 3D image (or optical response) of the wafer
714
Converting first 3D image to image signals for transfer to the CPU
716
Processing the first 3D image by the CPU
718

**FIG. 24**

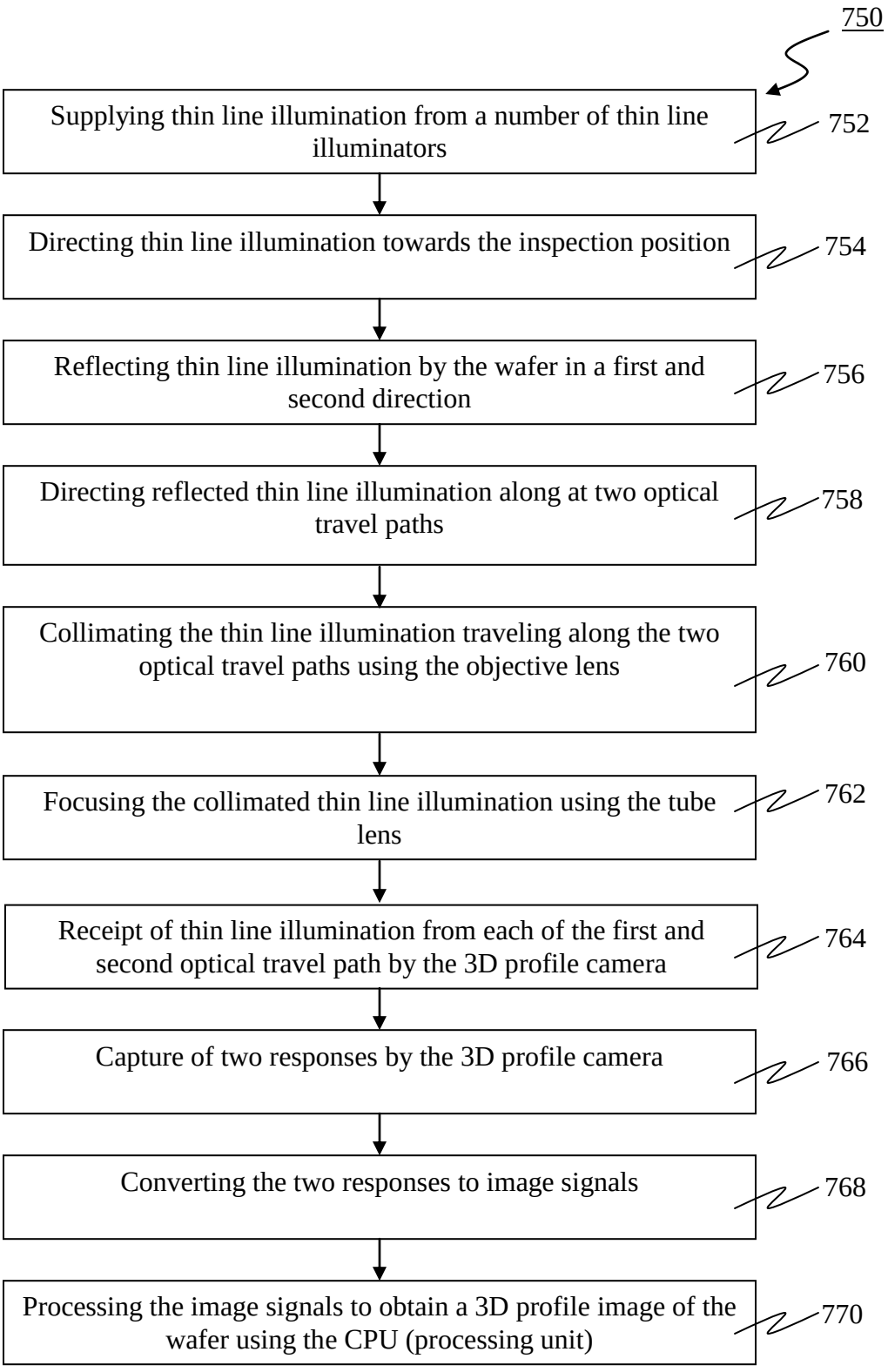

750
Supplying thin line illumination from a number of thin line illuminators
752
Directing thin line illumination towards the inspection position
754
Reflecting thin line illumination by the wafer in a first and second direction
756
Directing reflected thin line illumination along at two optical travel paths
758
Collimating the thin line illumination traveling along the two optical travel paths using the objective lens
760
Focusing the collimated thin line illumination using the tube lens
762
Receipt of thin line illumination from each of the first and second optical travel path by the 3D profile camera
764
Capture of two responses by the 3D profile camera
766
Converting the two responses to image signals
768
Processing the image signals to obtain a 3D profile image of the wafer using the CPU (processing unit)
770

**FIG. 25**

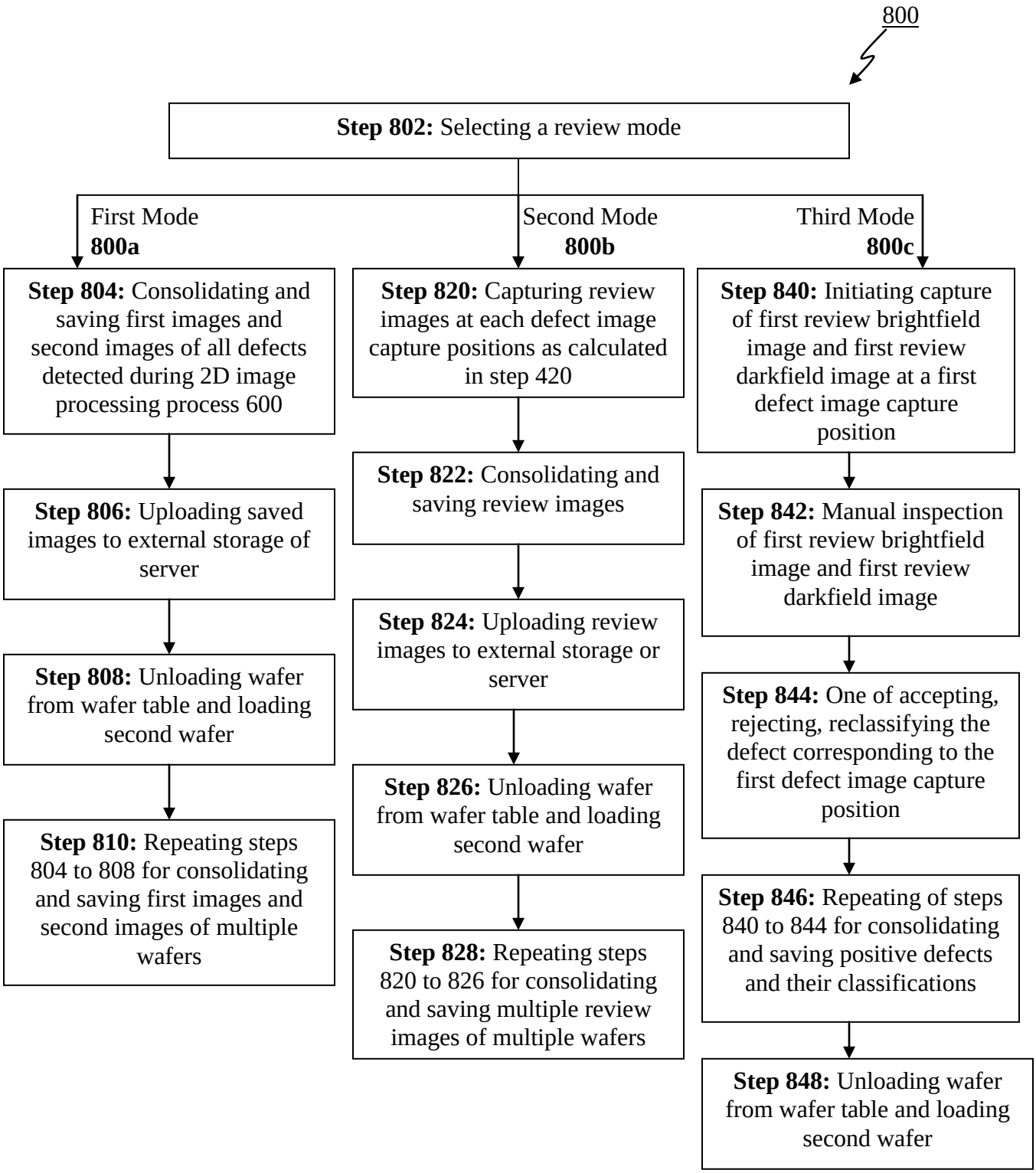

800
Step 802: Selecting a review mode
First Mode
800a
Second Mode
800b
Third Mode
800c
Step 804: Consolidating and saving first images and second images of all defects detected during 2D image processing process 600
Step 806: Uploading saved images to external storage of server
Step 808: Unloading wafer from wafer table and loading second wafer
Step 810: Repeating steps 804 to 808 for consolidating and saving first images and second images of multiple wafers
Step 820: Capturing review images at each defect image capture positions as calculated in step 420
Step 822: Consolidating and saving review images
Step 824: Uploading review images to external storage or server
Step 826: Unloading wafer from wafer table and loading second wafer
Step 828: Repeating steps 820 to 826 for consolidating and saving multiple review images of multiple wafers
Step 840: Initiating capture of first review brightfield image and first review darkfield image at a first defect image capture position
Step 842: Manual inspection of first review brightfield image and first review darkfield image
Step 844: One of accepting, rejecting, reclassifying the defect corresponding to the first defect image capture position
Step 846: Repeating of steps 840 to 844 for consolidating and saving positive defects and their classifications
Step 848: Unloading wafer from wafer table and loading second wafer

**FIG. 26**

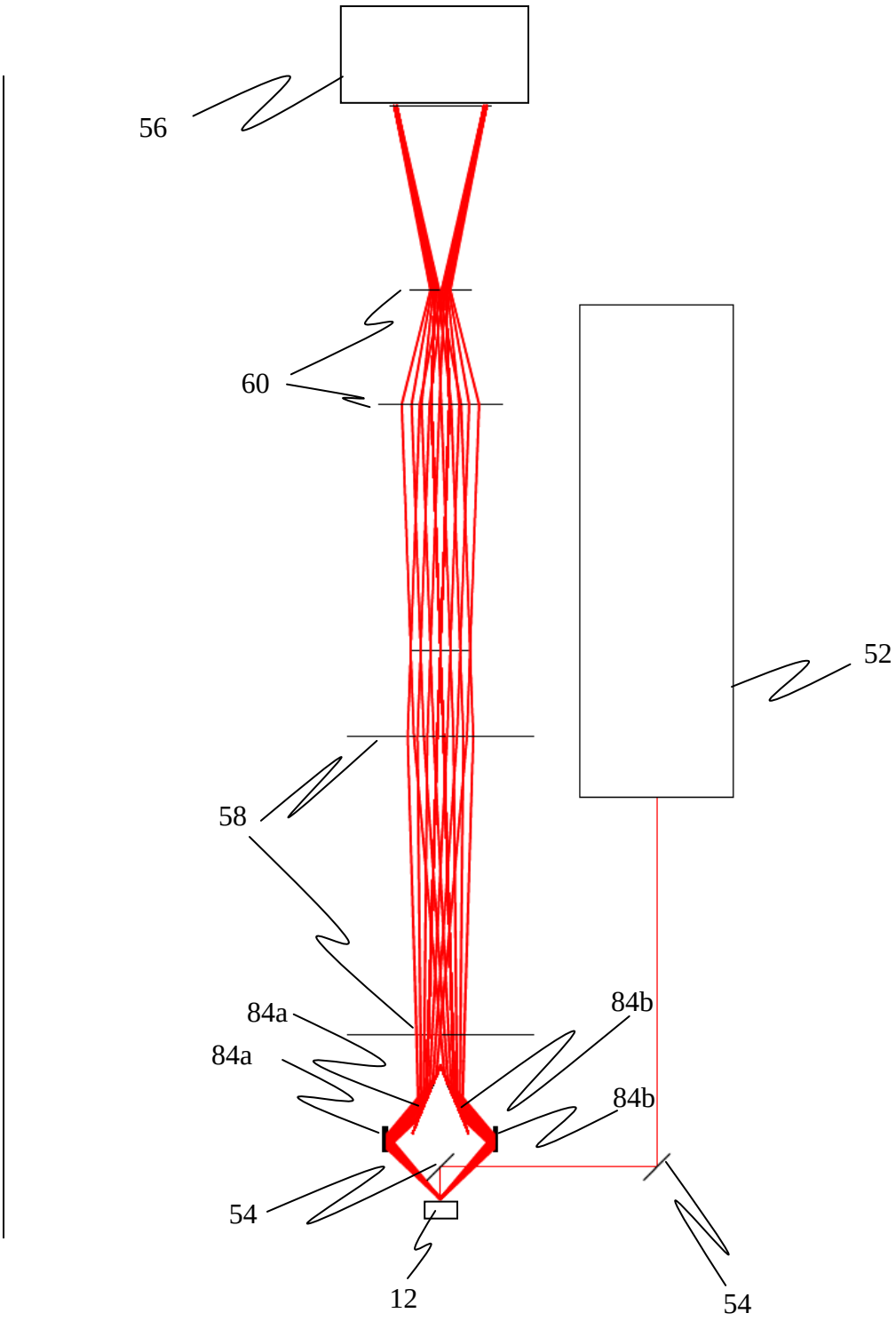



**FIG. 27a**

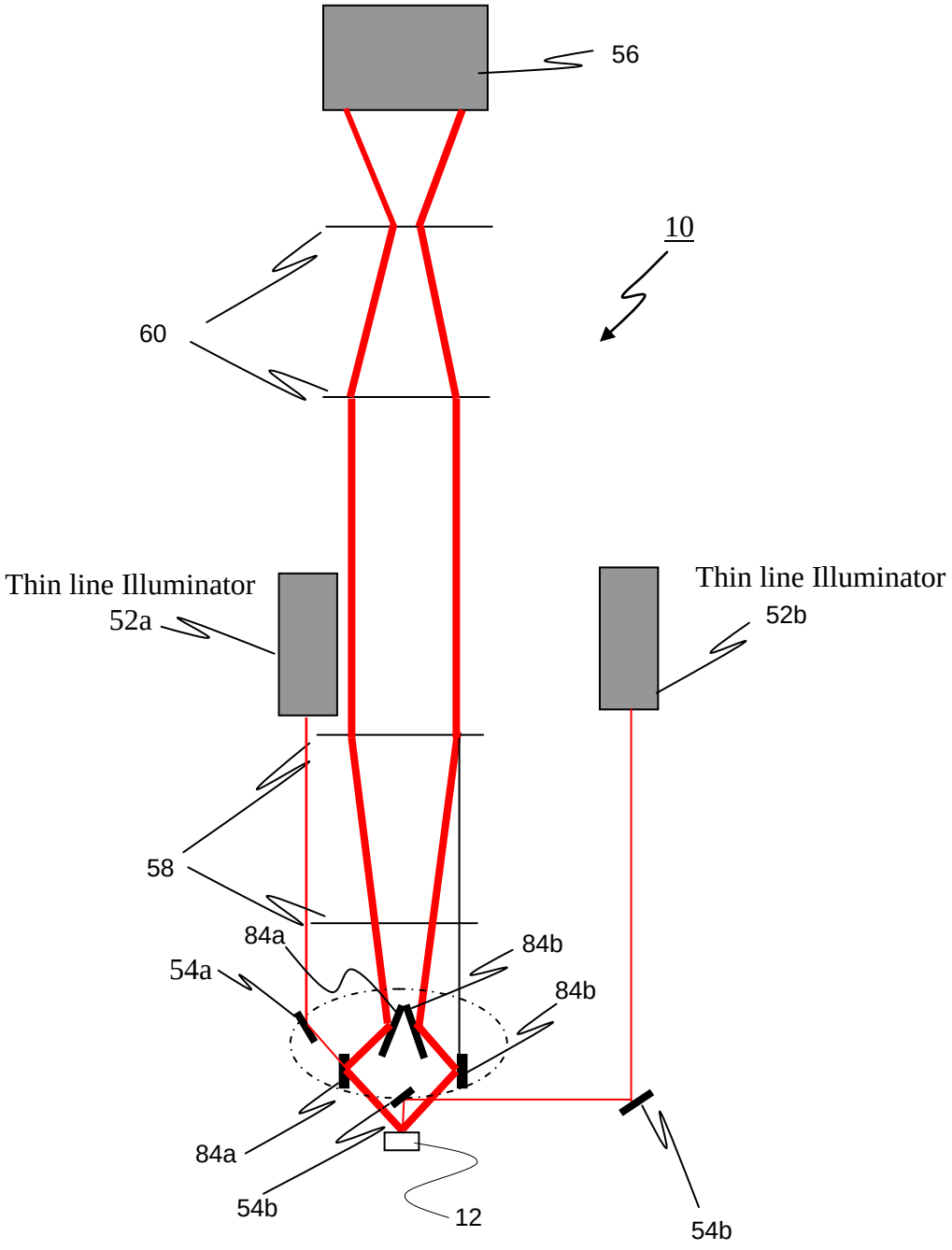

56
10
60
Thin line Illuminator
52a
Thin line Illuminator
52b
58
84a
84b
54a
84b
84a
54b
12
54b

**FIG. 27b**

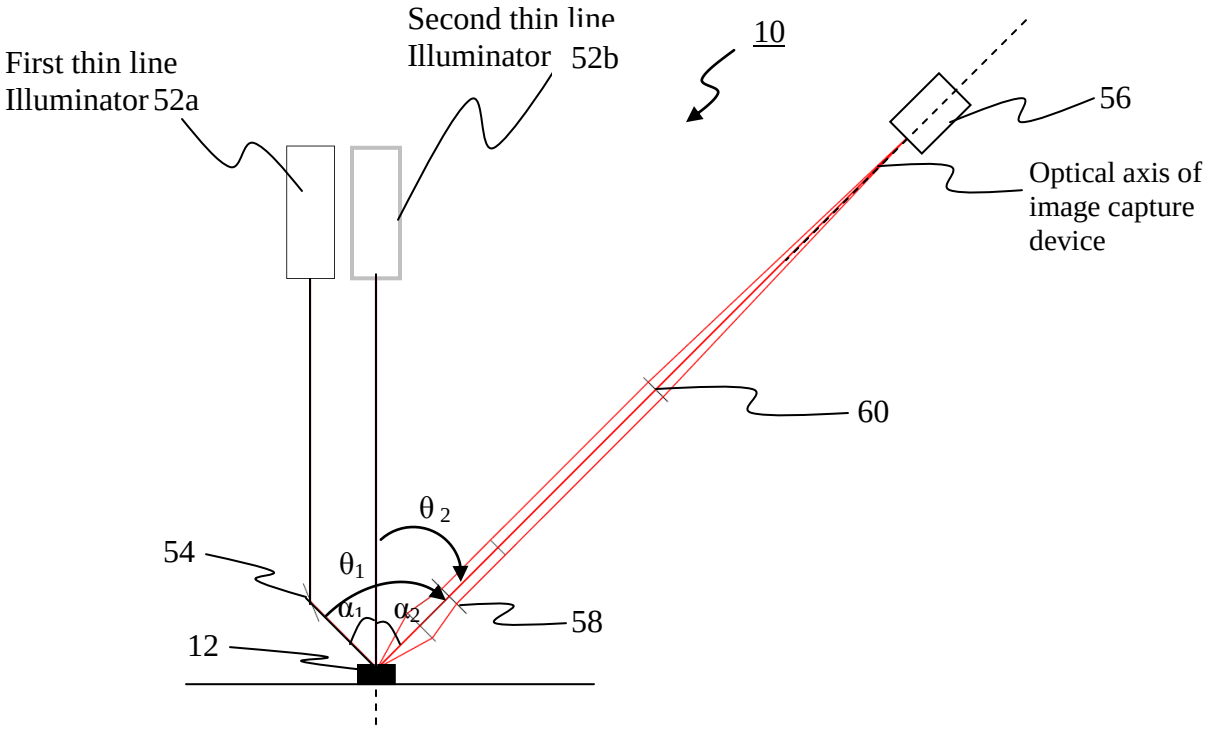

First thin line
Illuminator 52a
Second thin line
Illuminator 52b
10
56
Optical axis of
image capture
device
60
θ 2
54
θ1
α1
α2
58
12

**FIG. 27C**

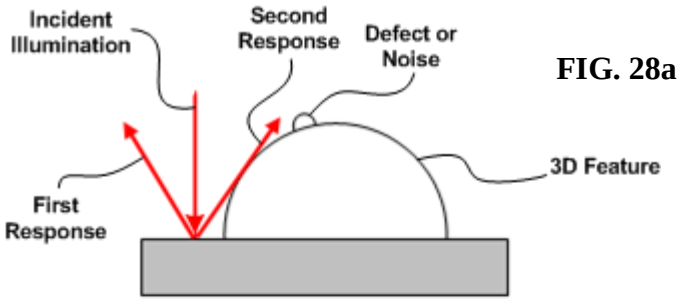



FIG. 28a

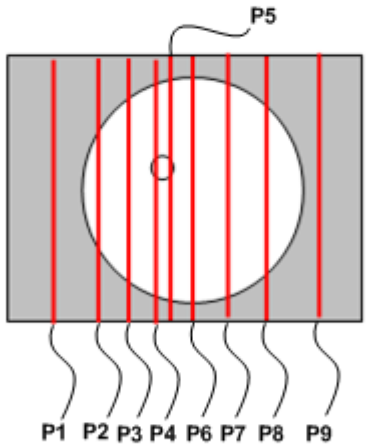



FIG. 28b

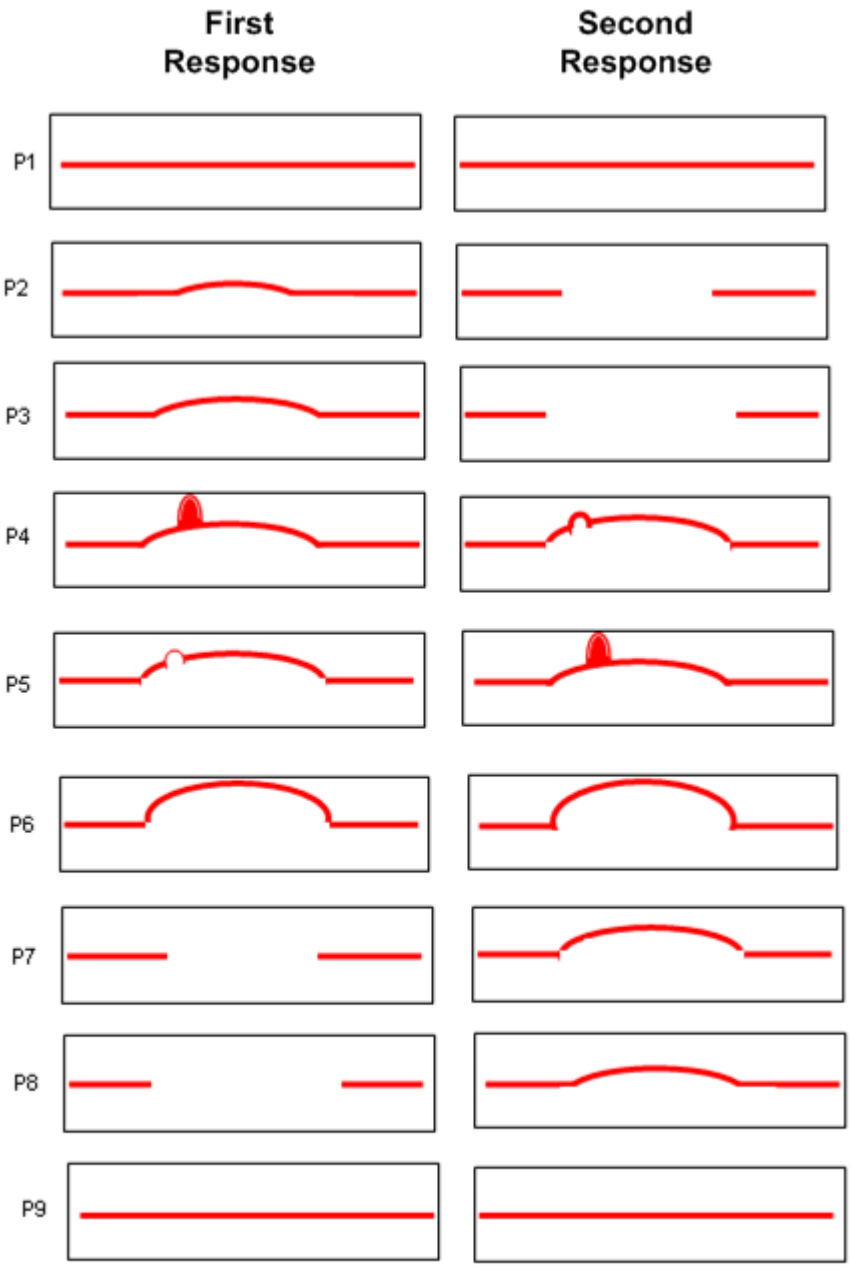



**FIG. 29**

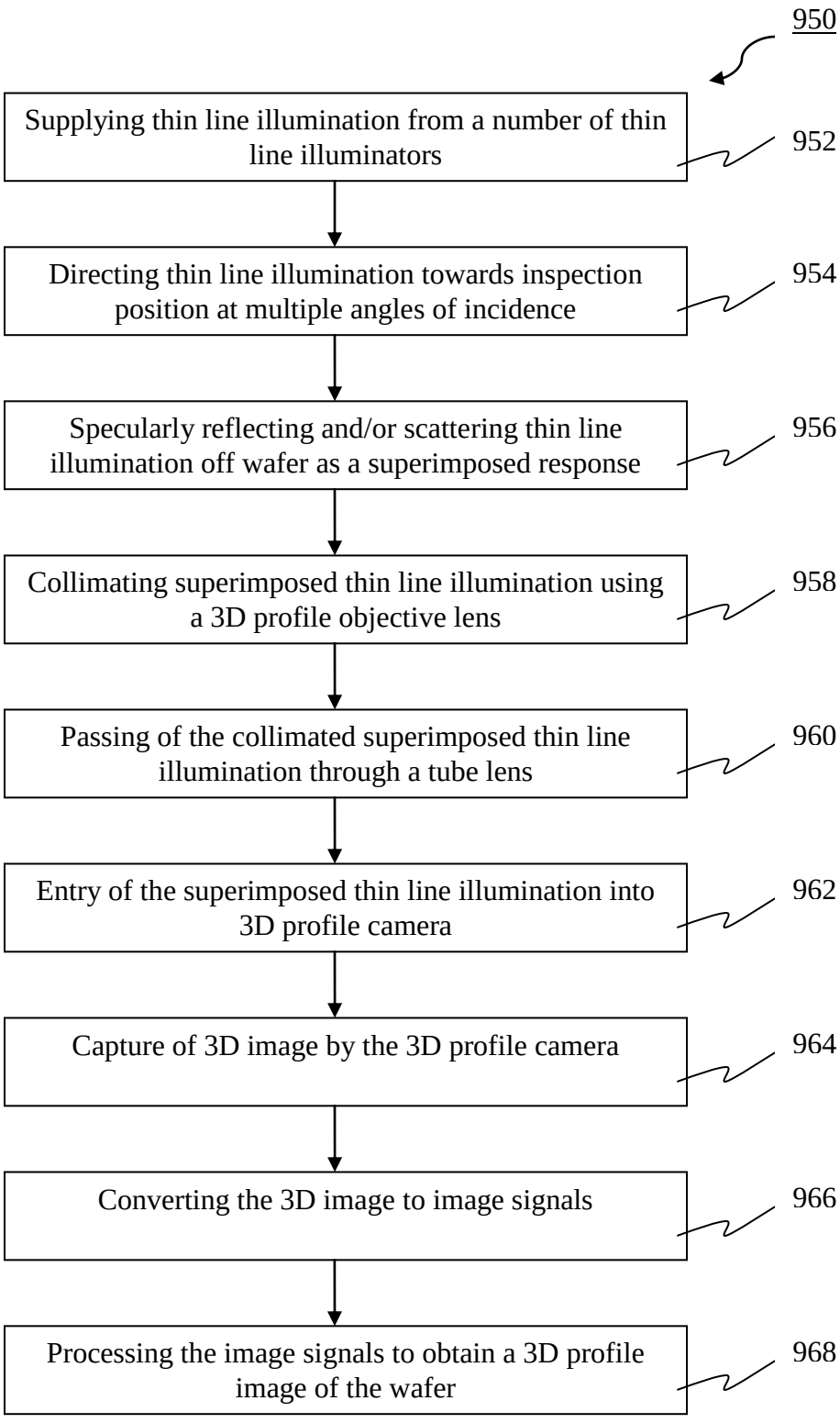

950
Supplying thin line illumination from a number of thin line illuminators
952
Directing thin line illumination towards inspection position at multiple angles of incidence
954
Specularly reflecting and/or scattering thin line illumination off wafer as a superimposed response
956
Collimating superimposed thin line illumination using a 3D profile objective lens
958
Passing of the collimated superimposed thin line illumination through a tube lens
960
Entry of the superimposed thin line illumination into 3D profile camera
962
Capture of 3D image by the 3D profile camera
964
Converting the 3D image to image signals
966
Processing the image signals to obtain a 3D profile image of the wafer
968

**FIG. 30**