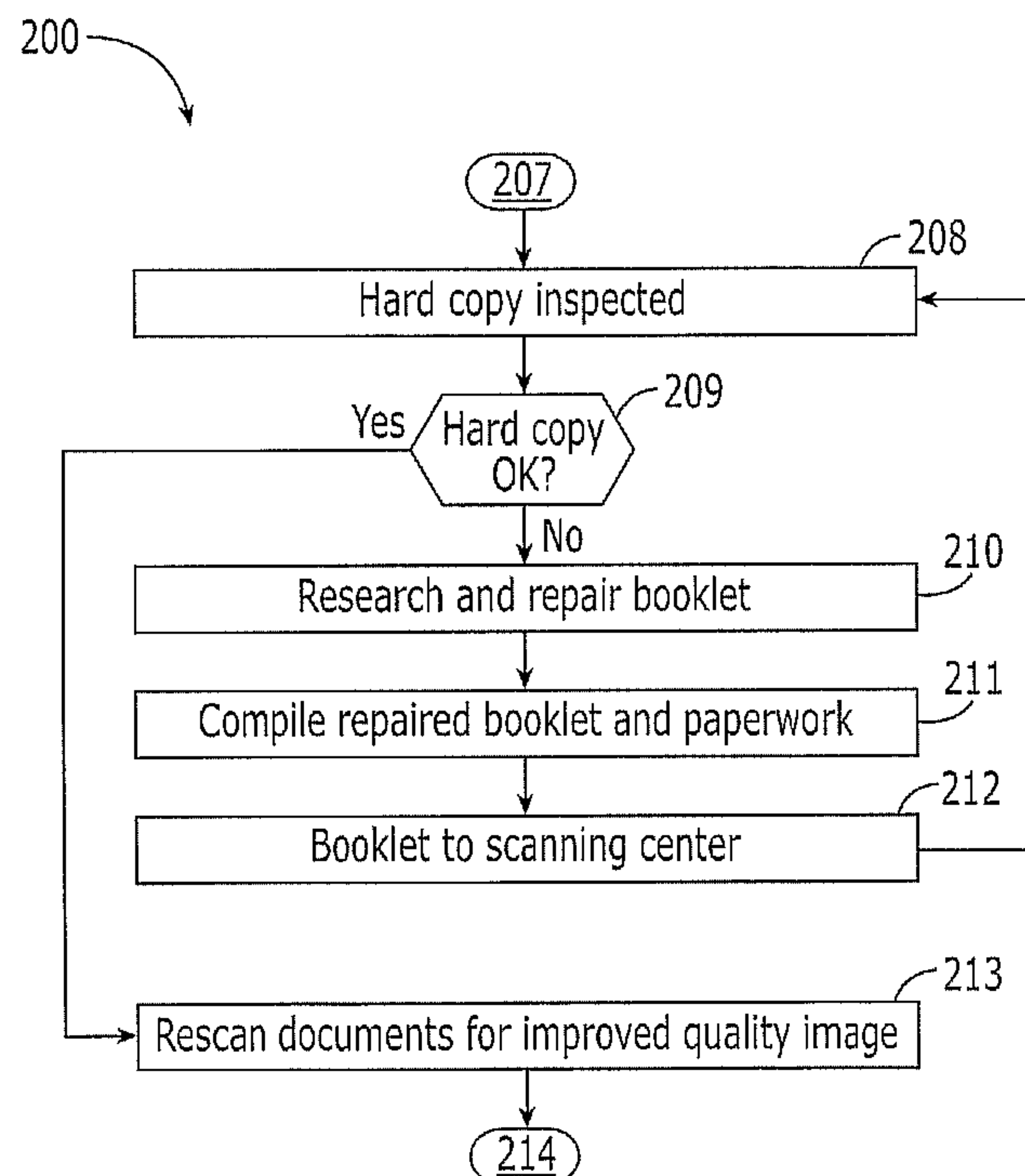




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(71) Demandeur/Applicant:
HARCOURT ASSESSMENT, INC., US
(72) Inventeurs/Inventors:
MOULTHROP, SCOTT E., US;
REZNICK, TOM, US;
BARTH, LOIS L., US;
BOYD, DAVID K., US
(74) Agent: MACRAE & CO.

(54) Titre : SYSTEME ET PROCEDE ELECTRONIQUES D'AMELIORATION DE LA QUALITE DE L'IMAGE DES
EPREUVES ENREGISTREES
(54) Title: ELECTRONIC TEST ANSWER RECORD IMAGE QUALITY IMPROVEMENT SYSTEM AND METHOD



(57) **Abrégé/Abstract:**

A method for improving a scoring process includes displaying an original scanned image of a hard copy page of an answer to a scorer. If the scorer determines that the image is of insufficient quality to read, an electronic request for an improved image is received from the scorer and routed electronically to an archive containing the hard copy page, from which the page is retrieved. The retrieved page is rescanned to form a new image, which is then electronically transmitted to the scorer for scoring. A system includes hardware and software elements, including a processor and a database accessible by the processor containing original scanned images of answer pages. A scorer display and an input device are located at a scoring site, and an archive display and a scanner at an archive site. Software as described above is resident on the processor for implementing the method steps.

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(71) Applicant (for all designated States except US): **HARCOURT ASSESSMENT, INC.** [US/US]; 19500 Bulverde Road, San Antonio, TX 78259 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **MOULTHROP,**

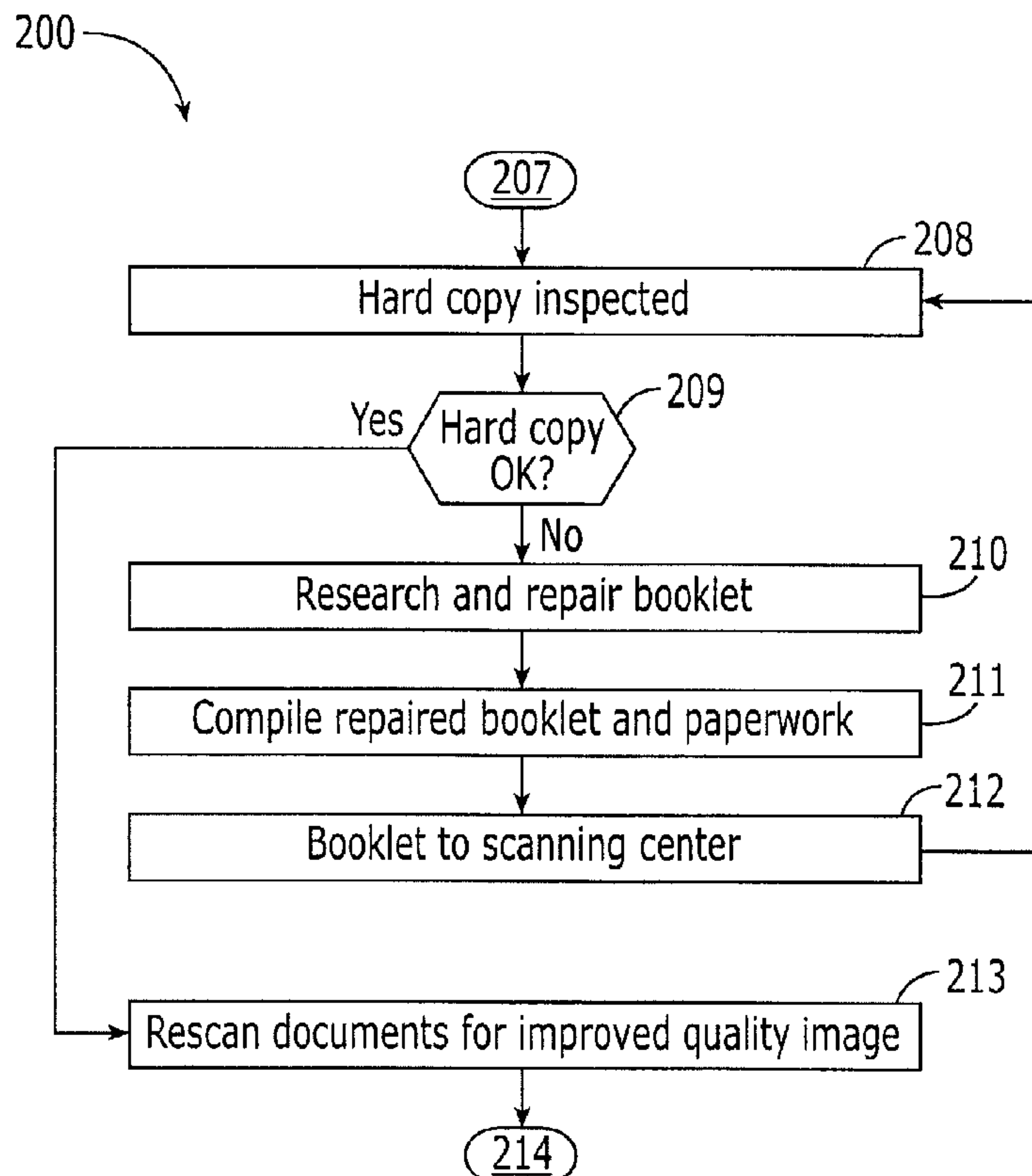
Scott E. [US/US]; 7607 Gander Park, Converse, TX 78109 (US). **REZNICK, Tom** [US/US]; 9719 Kashmir Drive, San Antonio, Texas 78251 (US). **BARTH, Lois L.** [US/US]; 10138 Sandbrook Hill, San Antonio, TX 78254 (US). **BOYD, David K.** [US/US]; 2011 Shoreham, San Antonio, TX 78260 (US).

(74) Agents: **HARTT, Jacqueline E.** et al.; 255 South Orange Ave., Suite 1401, P.O. Box 3791, Orlando, FL 32802-3791 (US).

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[Continued on next page]

(54) Title: ELECTRONIC TEST ANSWER RECORD IMAGE QUALITY IMPROVEMENT SYSTEM AND METHOD



(57) Abstract: A method for improving a scoring process includes displaying an original scanned image of a hard copy page of an answer to a scorer. If the scorer determines that the image is of insufficient quality to read, an electronic request for an improved image is received from the scorer and routed electronically to an archive containing the hard copy page, from which the page is retrieved. The retrieved page is rescanned to form a new image, which is then electronically transmitted to the scorer for scoring. A system includes hardware and software elements, including a processor and a database accessible by the processor containing original scanned images of answer pages. A scorer display and an input device are located at a scoring site, and an archive display and a scanner at an archive site. Software as described above is resident on the processor for implementing the method steps.

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ELECTRONIC TEST ANSWER RECORD IMAGE QUALITY IMPROVEMENT SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

5 Field of the Invention

The present invention relates to systems and methods for scoring test answers from optical images of answer pages, and, more particularly, to systems and methods for improving a work flow for such scoring applications.

10 Description of Related Art

The automation of test scoring is a complex problem that has brought to bear significant economic pressure to optimize efficiency and accuracy and to minimize human involvement.

The scanning and data collection from test answer sheets by visual imaging means is also known in the art, for example, in commonly owned U.S. Patent Nos. 15 6,173,154, 6,311,040, and 6,366,760, the disclosures of which are incorporated hereinto by reference. These patents teach a combination of OMR and visual imaging for capturing a full visual image of each answer page containing an answer to an open-ended question.

20 When large numbers of tests are to be graded at a scoring center, typically groups of physical test booklets are retained together based upon a particular criterion, such as individual grade levels from a particular school or school district, and a predetermined number are placed on a cart. Each test booklet is separated into individual answer sheets, and the cart is moved to a scanning area. The individual 25 answer sheets are then sent through a scanner, which creates a scanner output record for each test booklet. The record contains such data as identifier information and test answer data gleaned from the answer sheets.

The complete system includes integrated hardware elements and software applications for capturing optical mark and full visual images of an answer page, for 30 storing the images, for retrieving the images, for distributing the visual images to a reader for scoring, for assisting the reader in scoring, and for monitoring the reader's performance.

The scanning system comprises means for sequentially advancing each page of a plurality of answer pages along a predetermined path. Positioned along the path are mark imaging means (OMR, optical mark recognition; OCR, optical character recognition) for capturing a location of an optical mark on each answer page and visual
5 imaging means for capturing a full visual image of each answer page. A forms database in a server is provided that contains data on the physical location and type (e.g., multiple-choice or open-ended) of each answer on each page. Software means resident in the server operate with the forms database to determine whether the captured image contains an answer to an open-ended question. If such an open-ended
10 answer is supposed to be found on the page being imaged, the full visual image of the page is stored.

At present, if a scorer receives an optical image of an answer page that is of insufficient quality to be read, the physical answer page must be requested from storage. Then the physical answer page is distributed to the scorer for scoring. If a
15 particular answer booklet contains more than one page having insufficient image quality, each request for a page is handled separately, meaning that the same booklet is the subject of multiple search efforts. Typically, the cart of physical test booklets will by this time have been removed from the scanning area and archived. Clearly the handling of such multiple requests disturbs scoring work flow. Further, frequently the
20 scoring customer will have requested image data along with the assigned scores. If any of these answer page images is of poor quality, the customer cannot adequately review the scored answer.

In order to present the problem addressed by the present invention in detail, FIGS. 1A-1D are presented detailing the method steps currently known in the art to be
25 performed to provide a readable answer page to a scorer. In the prior art method **100**, if a scorer receives a poor-quality image of an answer page to be scored at a scoring site (block **101**), the scorer transmits a request up the management chain for a readable copy of the answer page. Such a request is routed to a scoring support area (block **102**), and scoring on the batch from which the answer page came is halted (block **103**).
30 A report containing the request is printed (block **104**), and the physical report is routed to an archiving center (block **105**), where the physical booklet containing the answer page is retrieved (block **106**). A photocopy of the answer page is made and sent to a

scoring storeroom (block **107**), where the copy is matched with the request report (block **108**).

At the scoring storeroom, the hard copy is checked for acceptable quality (block **109**). If the hard copy still has problems, it is sent to an "alert" center, the responsibility
5 of which is to research and repair answer booklets (block **110**). The repaired booklets are then compiled (block **111**), and the booklets are returned to the storeroom (block **112**).

If the hard copy is acceptable, it is routed from the storeroom to the scoring center and delivered to the scorer (block **113**). The scorer assigns a score using the
10 hard copy (block **114**), and the hard copy is returned to the storeroom (block **115**), where it is retained until scoring on that batch is complete (block **116**).

If the answer page belongs to a booklet that has been repaired (block **117**), the repaired booklet is transmitted to the alert center (block **118**). If electronic images have been requested by the customer (block **119**), the hard copy of the answer page is
15 transmitted to a scanning center (block **122**), where all documents are re-scanned (block **123**). The original images are manually deleted from the database (block **124**), and an image index is manually re-created (block **125**), and the new images are imported into the database (block **126**). The hard copy is then returned to the storeroom (block **120**) and from there to the archive center (block **121**), and the process
20 is complete.

If the answer page belongs to a booklet that has not been repaired (block **117**), or if electronic images have not been requested (block **119**), then, as above, the hard copy is returned to the storeroom (block **120**) and from there to the archive center (block **121**), and the process is complete.

25 It can be seen that six different locations are involved in this process: the scoring center, the scanning support center, the archive center, the storeroom, the scanning center, and the alerts center. Further, a hard copy of the problem answer page has to be physically routed through all these centers. This is clearly a labor- and time-intensive process that can cause significant delays in completing a scoring project.

SUMMARY OF THE INVENTION

The present invention is directed to a method for improving a scoring process, particularly a scoring of images of open-ended questions, although this is not intended as a limitation. The method comprises the steps of displaying an original scanned
5 image of a hard copy page of an answer to a scorer. If the scorer determines that the image is of insufficient quality to read, an electronic request for an improved image is received from the scorer.

The request is routed electronically to an archive containing the hard copy page, from which the hard copy page is retrieved. The retrieved hard copy page is rescanned
10 to form a new scanned image, which is then electronically transmitted to the scorer for scoring.

The present invention is also directed to a software application comprising code segments for performing the method steps outlined above.

The system of the present invention comprises hardware and software elements
15 for carrying out the method steps outlined above. In particular, the system comprises a processor and a database accessible by the processor containing original scanned images of answer pages. A scorer display is located at a scoring site, and an archive display at an archive site, both in signal communication with the processor. An input device is also located at the scoring site and is in signal communication with the
20 processor. A scanner is located at an archive site and is also in electronic communication with the processor. Software as described above is resident on the processor for implementing the method steps outlined above.

This system, software application, and method have been found beneficial, since improved images can be routed to a scorer in less time and with much less human
25 intervention than by other means known in the art. Further, multiple requests for new images from the same answer booklet can be handled expeditiously. In addition, since new images are integrated directly into the database, the step of providing customers with electronic images of the answer booklets is not delayed by the presence of one or more answer booklets of insufficient quality to read.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1A-1D (prior art) is a flow diagram of a currently used method for providing a readable answer sheet to a scorer.

FIGS. 2A-2C is a flow diagram of the present method for providing a readable
5 answer sheet to a scorer.

FIG. 3 is an exemplary system schematic for practicing the method of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 A description of the preferred embodiments of the present invention will now be presented with reference to FIGS. 2A-3. Aspects of the invention include a method **200** for improving a scoring process, a flowchart for which is illustrated in FIGS. 2A-2C, software for carrying out the method **200**, and a system **10** for scoring an answer page, a schematic of which is illustrated in FIG. 3.

15 The method **200** includes the steps of receiving a request from a scorer for an image of an answer page to score and transmitting an original image to the scorer (block **201**). If the original image is of insufficient quality to read, the scorer enters a request for a readable copy into an input device (block **202**). The system checks whether the answer page belongs to a booklet for which a new image has already been
20 requested (block **203**), in which case the present request is appended to the pre-existing request (block **204**). The request is then routed electronically to an archive center (block **205**). The requested hard copy is retrieved from storage (block **206**) and transmitted to a scanning location (block **207**), where the hard copy is inspected for quality (block **208**).

25 If the quality of the hard copy is insufficient for scoring (block **209**), the booklet to which the answer page belongs is researched and repaired (block **210**). The repaired booklet is compiled, attendant paperwork is prepared (block **211**), and the booklet is returned to the scanning location (block **212**).

30 When the quality of the hard copy is deemed sufficient (block **209**), any requested pages from the booklet are rescanned to obtain an improved quality image (block **213**). This new image is saved into the database, replacing the original, poor-quality image (block **214**), and the hard copy is returned to the archive center (block

215). Thus the database is updated contemporaneously with the rescanning process, so that the electronic record is always commensurate with the material seen by the scorer. If a project customer requests electronic images of their project, the database is available for copying without additional steps to update the image set.

5 The new image is released (block **216**), and the requested new image is electronically routed to the scorer (block **217**), who can then assign a score (block **218**), and continue to assign scores to a batch until the project is complete (block **219**).

10 The system **20** components of the invention (FIG. 3) include a processor **21** and a database **22** that is accessible by the processor **21** for housing original scanned images of answer pages **90**. At the scoring site **30** reside a scorer display **31** and an input device **32**, such as a keyboard, mouse, or touch screen, although these are not intended as limitations, both in signal communication with the processor **21**, for interaction with a scorer **33**.

15 At an archive site **40** resides a display **41** in signal communication with the processor **21** for interaction with retrieval personnel **42**. Hard copies of the answer booklets **91** are housed at the archive site **40**.

 At a scanning site **50** resides a scanner **51** in signal communication with the processor **21** for interaction with scanning personnel **52**.

20 Also in signal communication with the processor **21** is an electronic medium writing device **23**, such as, but not intended to be limited to, a CD writer, for making electronic copies of a selected portion of the database **22**. This writing device **23** may be used, for example, if a customer desires electronic image copies as in step **119** in FIG. 1C discussed above.

25 Software **24** is resident on the processor **21** having code segments for directing and/or carrying out the method steps **200** above, and for interacting with the various personnel **33,43,52** carrying out the manual steps of the method.

30 It may be appreciated by one skilled in the art that additional embodiments may be contemplated, including analogous systems and methods for processing questionnaires.

 In the foregoing description, certain terms have been used for brevity, clarity, and understanding, but no unnecessary limitations are to be implied therefrom beyond the

requirements of the prior art, because such words are used for description purposes herein and are intended to be broadly construed. Moreover, the embodiments of the apparatus illustrated and described herein are by way of example, and the scope of the invention is not limited to the exact details of construction.

- 5 Having now described the invention, the construction, the operation and use of preferred embodiment thereof, and the advantageous new and useful results obtained thereby, the new and useful constructions, and reasonable mechanical equivalents thereof obvious to those skilled in the art, are set forth in the appended claims.

What is claimed is:

1. A method for improving a scoring process comprising the steps of:
displaying an original scanned image of a hard copy page of an answer
to a scorer;
5 if the scorer determines that the image is of insufficient quality to read,
receiving an electronic request for an improved image from the scorer;
routing the request to an archive containing the hard copy page;
retrieving the hard copy page from the archive;
rescanning the retrieved hard copy page to form a new scanned image;
10 and
electronically transmitting the new image to the scorer for scoring.
2. The method recited in Claim 1, further comprising the steps of:
prior to the displaying step, retrieving the original image from a database
15 containing a plurality of scanned answer images; and
following the rescanning step, replacing the original image with the new
image in the database.
3. The method recited in Claim 2, wherein the plurality of scanned answer
20 images belong to a unitary project, and further comprising the step, following the
replacing step, of creating an electronic medium copy of the scanned answer images
belonging to the project.
4. The method recited in Claim 2, wherein the hard copy page comprises
25 one of a plurality of hard copy pages from a unitary answer booklet, original images of
which also reside in the database, and further comprising the steps of:
prior to the routing step, determining whether a request has been received
for an improved image of a second hard copy page from the answer booklet; and
if a request for an improved image of a second hard copy page has been
30 received, appending a supplemental request for an improved image of the one page to
the request for an improved image of the second hard copy page.

5. The method recited in Claim 1, further comprising the step, following the rescanning step, of returning the hard copy page to the archive.

6. An answer page scoring system comprising:

- 5 a processor;
a database accessible by the processor containing original scanned images of answer pages;
a scorer display at a scoring site and an archive display at an archive site, both in signal communication with the processor;
10 an input device at the scoring site in signal communication with the processor;
a scanner at a scanning site in signal communication with the processor;
software resident on the processor having:
a code segment for displaying an original scanned image of a hard
15 copy page of an answer to a scorer on the scorer display;
a code segment for receiving an electronic request for an improved image of the image from the scorer via the input device;
a code segment for routing the request to the archive display;
a code segment for receiving from the scanner a new scanned
20 image of the answer page;
a code segment for transmitting the new scanned image to the scorer display.

7. The system recited in Claim 6, wherein the software further has a code
25 segment for replacing the original image with the new image in the database.

8. The system recited in Claim 7, further comprising an electronic medium writing device in signal communication with the processor, and wherein:

- the plurality of scanned answer images belong to a unitary project; and
30 the software further has a code segment for directing a copy of the images in the unitary project to be written by the writing device.

9. The system recited in Claim 7, wherein the hard copy page comprises one of a plurality of hard copy pages from a unitary answer booklet, original images of which also reside in the database, and wherein the software further has:

a code segment for determining whether a request has been received for an improved image of a second hard copy page from the answer booklet; and

a code segment for, if a request for an improved image of a second hard copy page has been received, appending a supplemental request for an improved image of the one page to the request for an improved image of the second hard copy page.

10. Computer software for controlling a scoring of scanned answer page images, the software having:

a code segment for displaying an original scanned image of a hard copy page of an answer to a scorer;

a code segment for receiving an electronic request for an improved image of the image from the scorer via an input device;

a code segment for routing the request to an archive center display;

a code segment for receiving from a scanner a new scanned image of the answer page;

a code segment for transmitting the new scanned image to the scorer display.

11. The software recited in Claim 10, wherein the software further has a code segment for retrieving the original scanned image from a database.

12. The software recited in Claim 11, wherein the software further has a code segment for replacing the original image with the new image in the database.

13. The software recited in Claim 10, wherein the software further has a code segment for directing a copy of a plurality of answer page images to be written on an electronic storage medium.

14. The software recited in Claim 10, wherein the hard copy page comprises one of a plurality of hard copy pages from a unitary answer booklet, and wherein the software further has:

a code segment for determining whether a request has been received for
5 an improved image of a second hard copy page from the answer booklet; and

a code segment for, if a request for an improved image of a second hard copy page has been received, appending a supplemental request for an improved image of the one page to the request for an improved image of the second hard copy page.

15. A method for improving a scoring process of a previously scanned image of a hard copy of an answer, the image having been determined by a scorer to be of insufficient quality to score, the method comprising the steps of:

routing an electronic request from the scorer to an archive containing the
15 hard copy page;

retrieving the hard copy page from the archive;

rescanning the retrieved hard copy page to form a new scanned image;

and

electronically transmitting the new image to the scorer for scoring.

16. The method recited in Claim 15, further comprising the step, following the rescanning step, of replacing the previously scanned image with the new image in a database of scanned answer images.

17. The method recited in Claim 16, wherein at least a subset of the scanned answer images belong to a unitary project, and further comprising the step, following the replacing step, of creating an electronic medium copy of the scanned answer images belonging to the project.

18. The method recited in Claim 16, wherein the hard copy page comprises one of a plurality of hard copy pages from a unitary answer booklet, original images of which also reside in the database, and further comprising the steps of:

prior to the routing step, determining whether a request has been received for an improved image of a second hard copy page from the answer booklet; and

if a request for an improved image of a second hard copy page has been received, appending a supplemental request for an improved image of the one page to
5 the request for an improved image of the second hard copy page.

19. The method recited in Claim 15, further comprising the step, following the rescanning step, of returning the hard copy page to the archive.

10 **20.** A method for improving a scoring process of an original electronic image of an answer page, the method comprising the steps of:

receiving an electronic request for an improved electronic image of a hard copy page at an archive containing the hard copy page, an original electronic image of the hard copy page having been deemed by a scorer to be of insufficient quality to
15 score;

retrieving the hard copy page from the archive;

rescanning the retrieved hard copy page to form a new scanned image;

and

electronically transmitting the new image to the scorer for scoring.

20 **21.** The method recited in Claim 20, further comprising the step of replacing the original electronic image with the new image in a database of scanned answer images.

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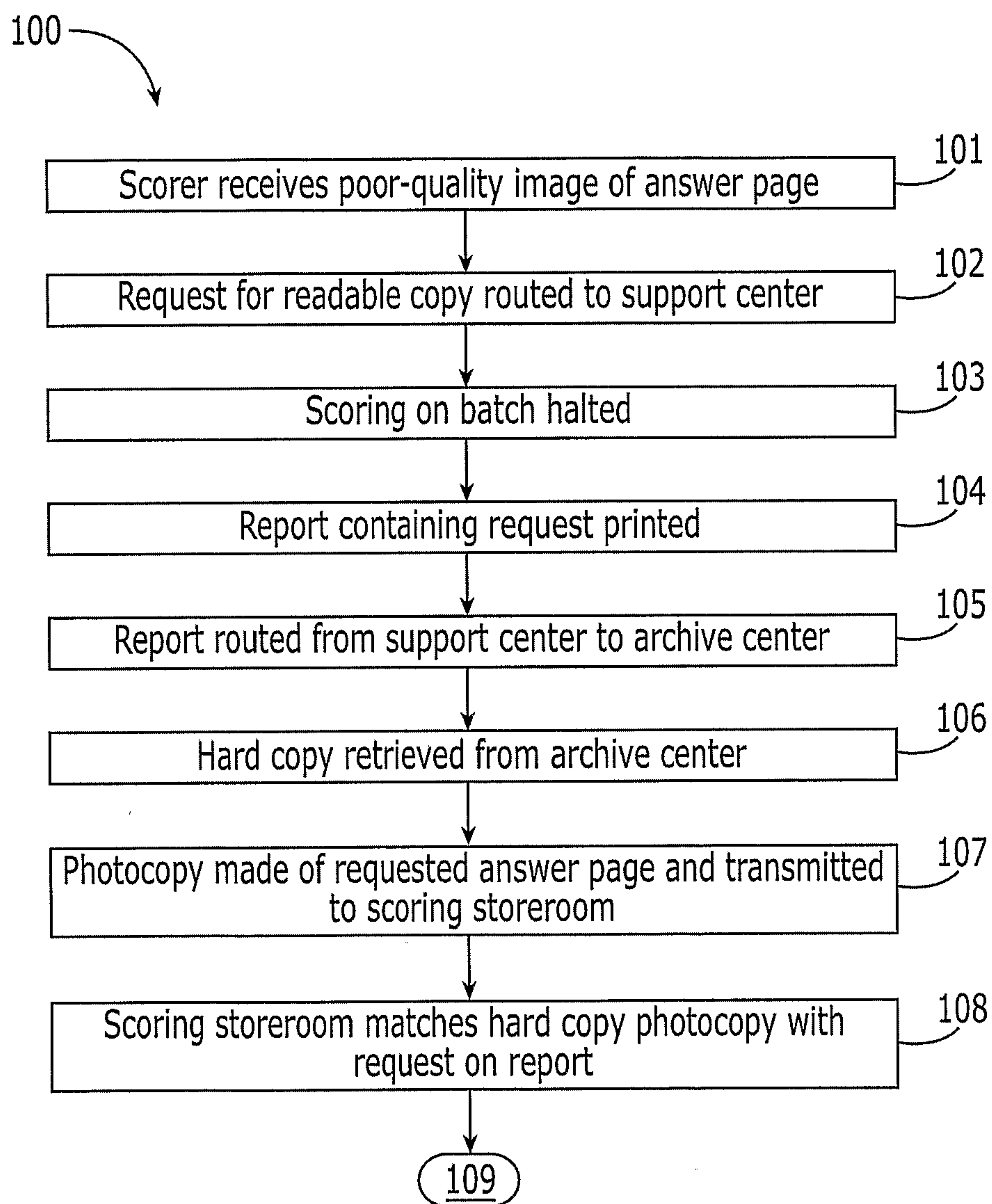


FIG. 1A
(PRIOR ART)

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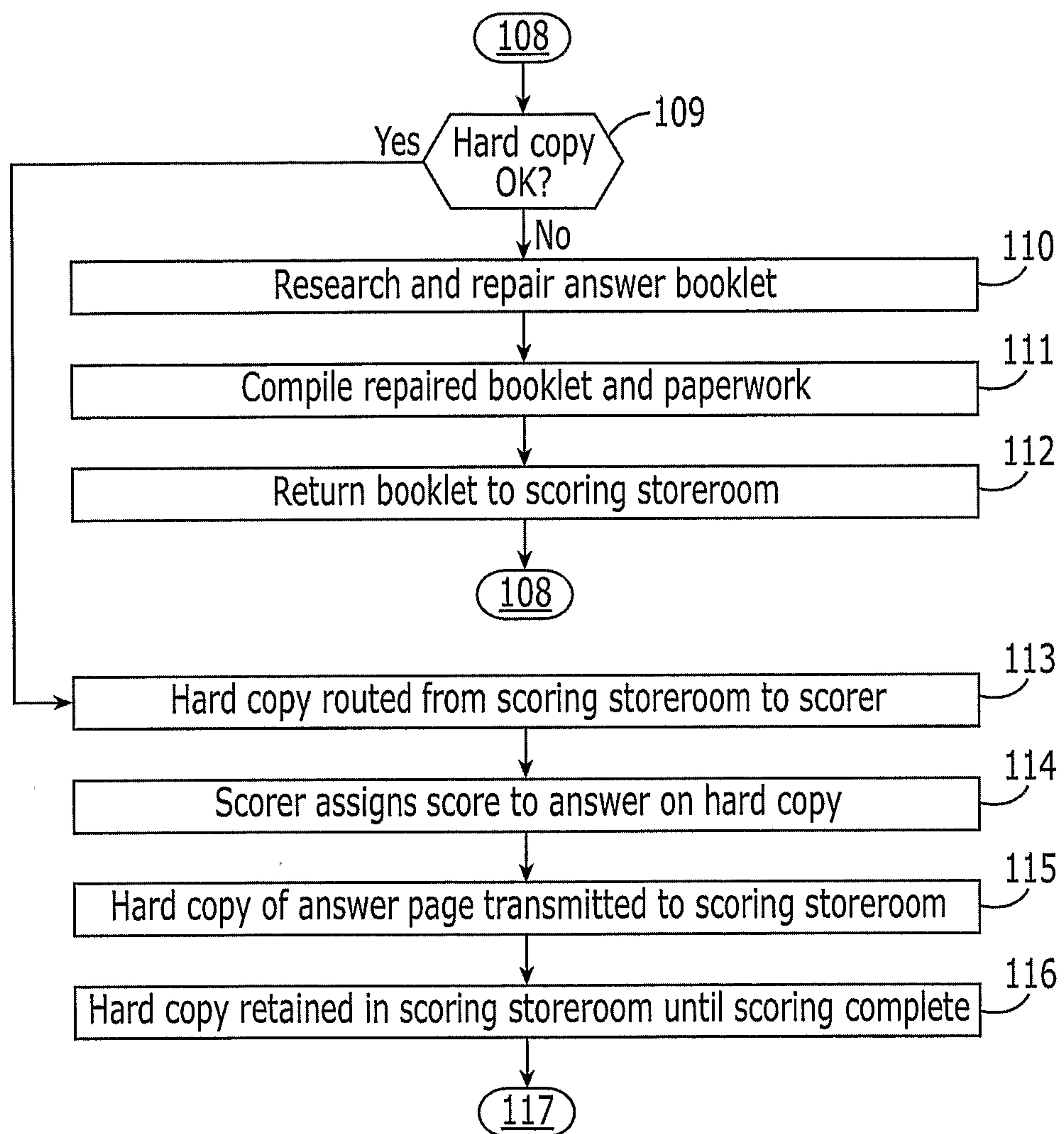


FIG. 1B
(PRIOR ART)

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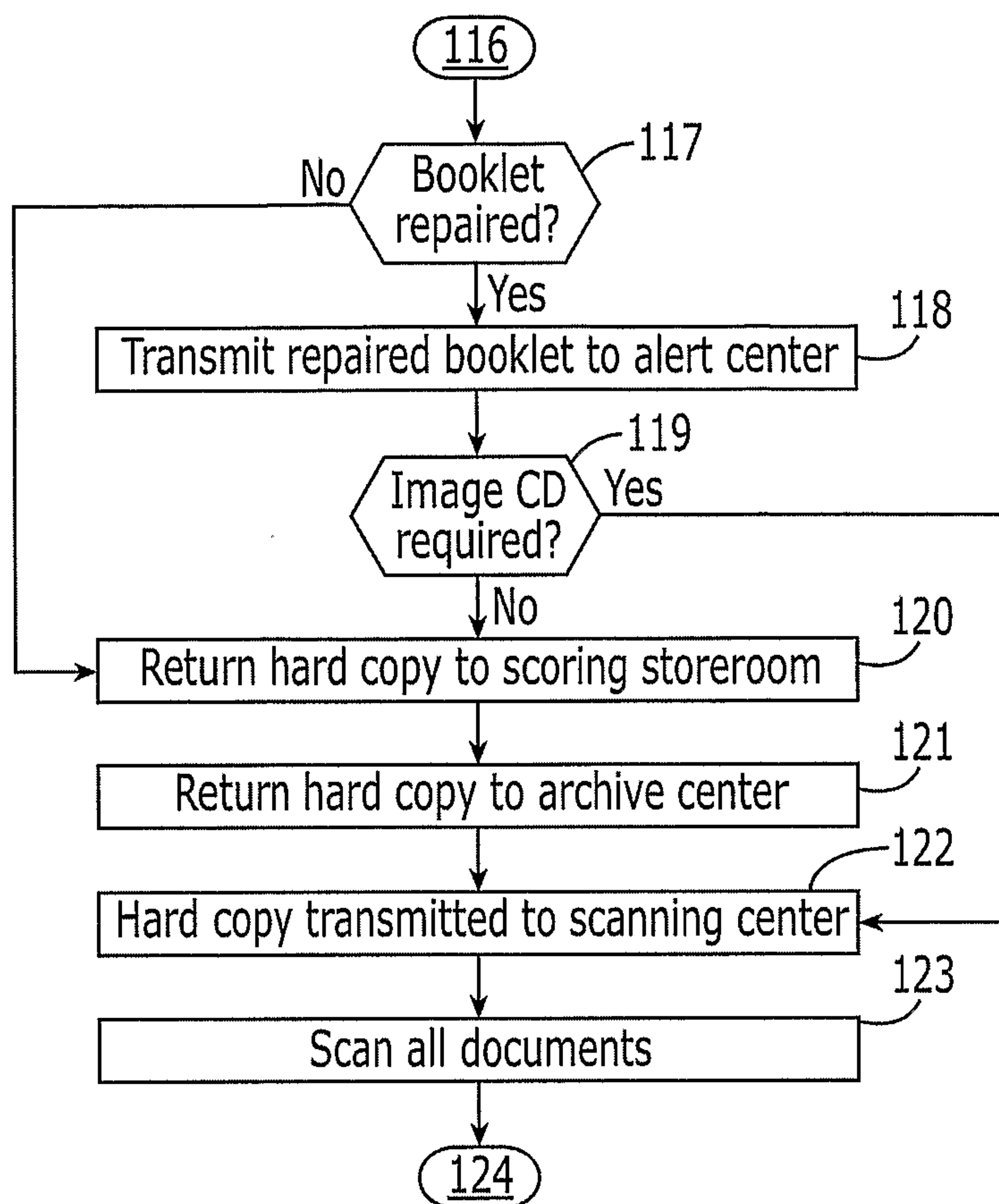


FIG. 1C
(PRIOR ART)

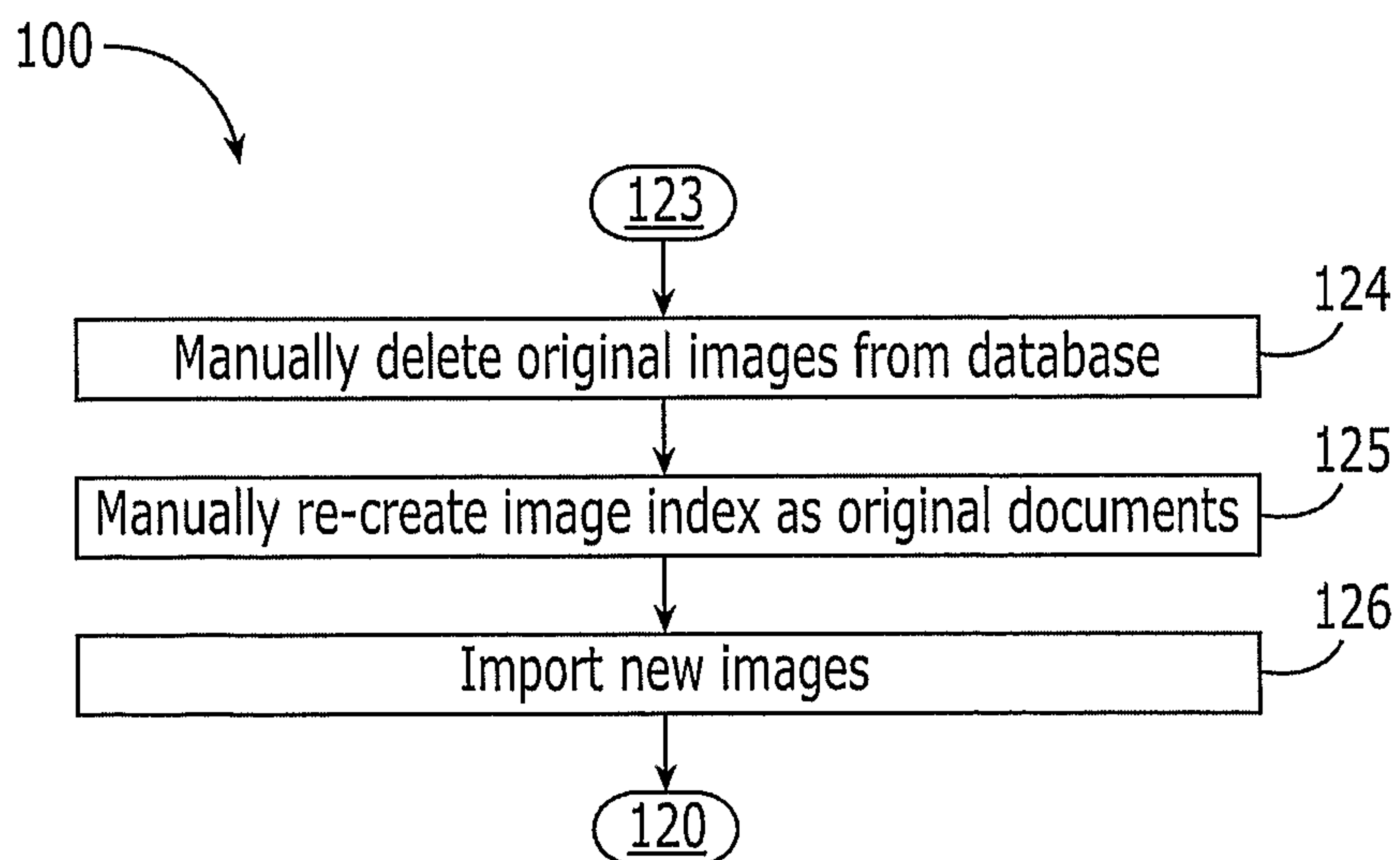
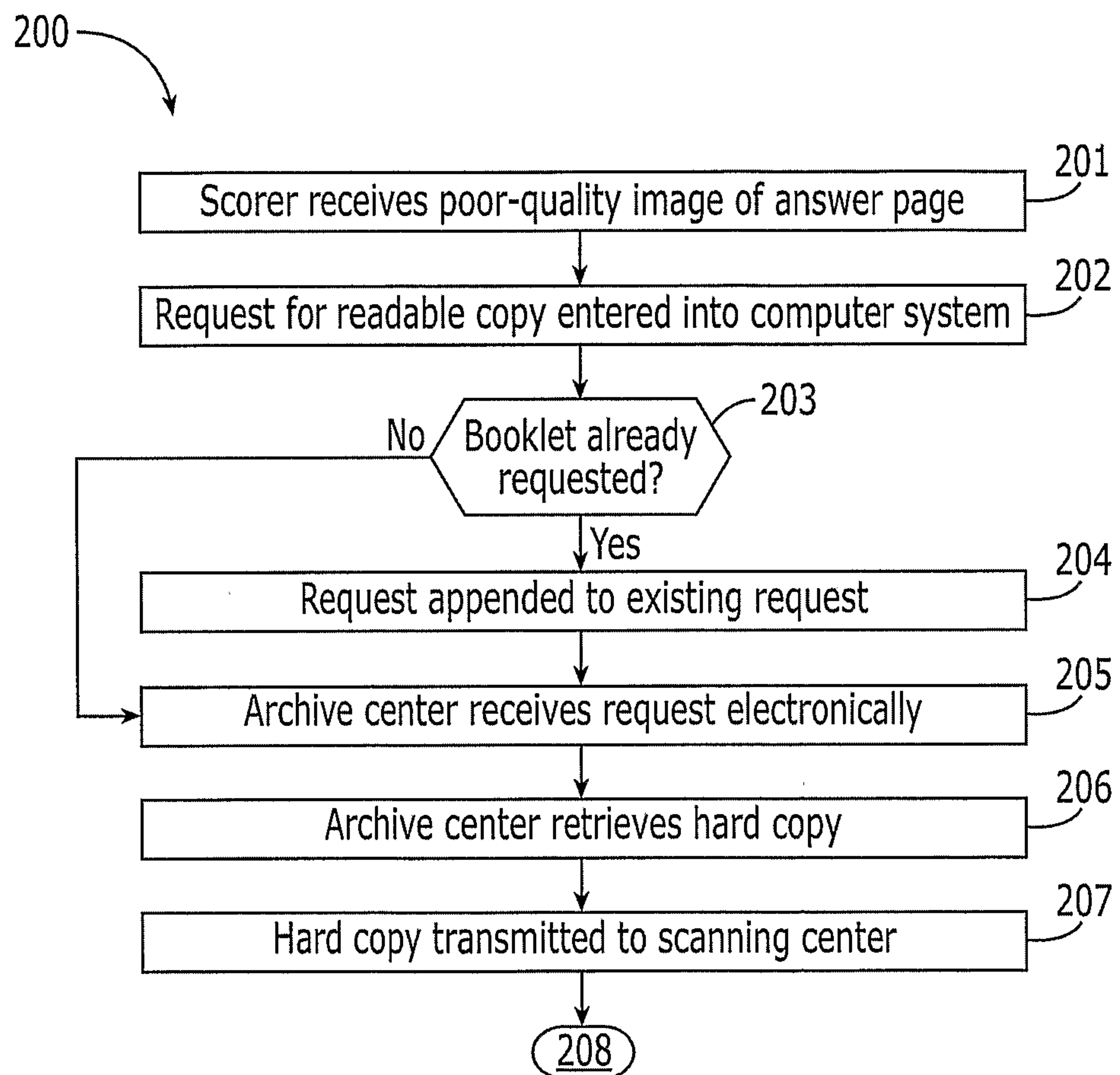
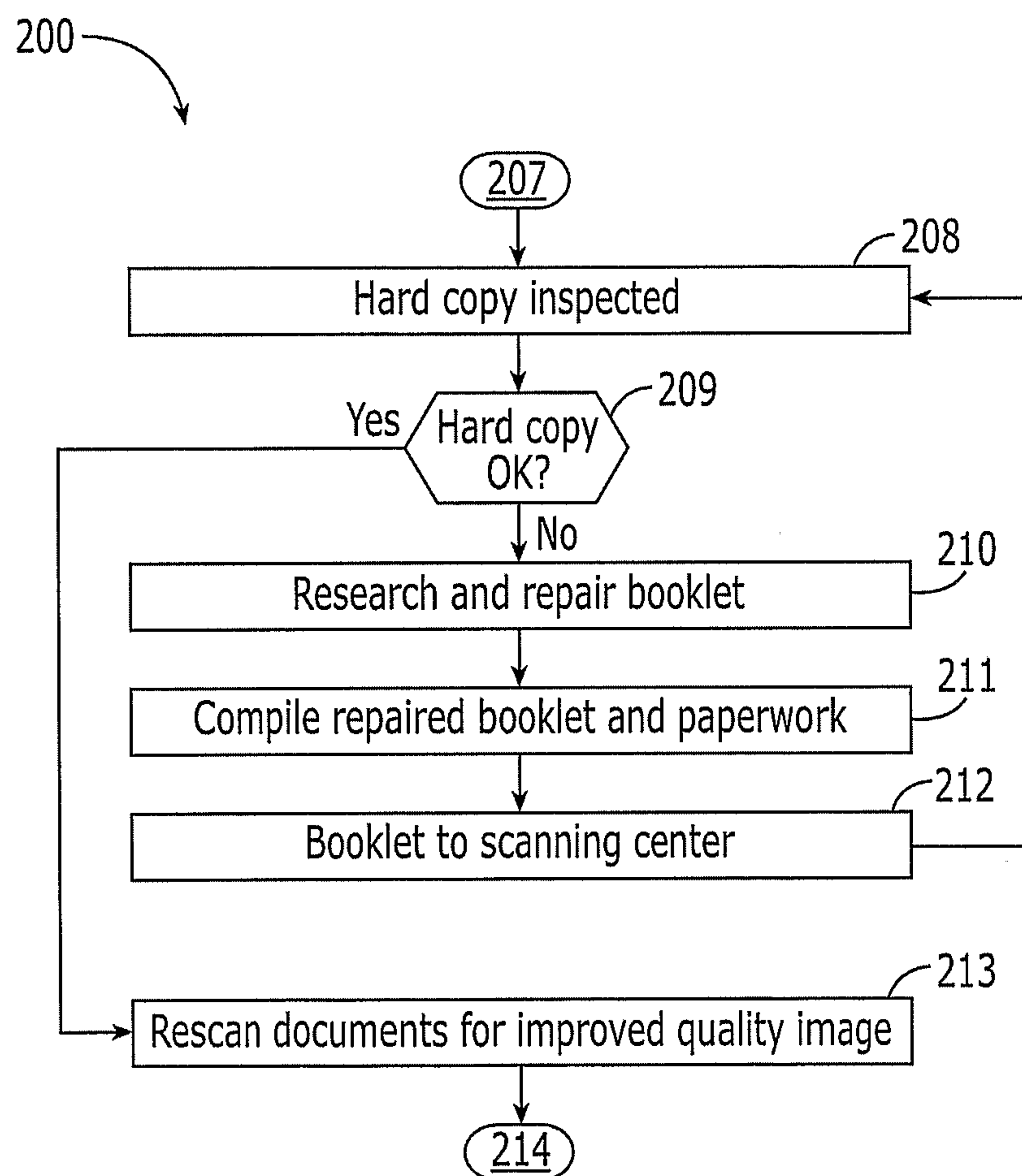


FIG. 1D
(PRIOR ART)

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FIG. 2A

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FIG. 2B

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