Abstract: A marker for use in determining the magnification of X-ray image and associated method are described. The marker comprises a circular member of a material imageable by x-rays and a support for holding the circular member away from the surface of a patient. The support bears an adhesive by which the marker can be releasably attached to the patient adjacent a body part to be imaged using x-rays. An x-ray image of the body part of the patient and the circular member is captured. The size of the largest dimension of the image of the member in the captured x-ray image is determined and used to calculate the magnification of the x-ray image.

FIG. 7

Title: X-RAY MARKER
The present invention relates to a marker and in particular to a marker which can be imaged using x-rays to determine the magnification of an x-ray image.

There are a number of applications in which it is necessary to determine the actual size of a body part from a captured x-ray image of the body part. The x-ray image of the body part is usually subject to a degree of magnification so that the size of the body part in the image is greater than, or lesser than, the actual size of the body part. For example, in the field of orthopaedics, it can be necessary accurately to know the size of a patient’s bone in order to determine the size of an orthopaedic implant. If the appropriate size of implant is not used, then the patient’s joint may not be reconstructed properly or the reconstruction can fail entirely.

It is known to use a circular disk of x-ray opaque material having a known diameter and placed on the patient’s skin when capturing an x-ray image of the body part. The diameter of the disk in the image can then be measured and compared with the known diameter in order to determine the magnification of the x-ray image. However, the image of the disk can often obscure an important part of the patient’s anatomy in the x-ray image.

Further, the size of the image of the disk only accurately determines the magnification of the image at the height position of the disk on the patient’s skin and not the actually magnification below the patient’s skin for the anatomical feature of interest.

Therefore, there is a need for an easy to use marker which allows the magnification of an x-ray image of a body part to be accurately determined without obscuring the patient’s anatomy in the image.

A first aspect of the invention provides a marker for determining the magnification of an X-ray image comprising: a circular member of a material imageable by x-rays; and a
support for holding the circular member away from the surface of a patient. The support can be releasably attachable to the patient adjacent a body part to be imaged using x-rays.

As the support holds the x-ray imageable circular marker away from the patient, it prevents the marker obscuring the x-ray image of the body part. Further as the support can be releasably attached to the body part it is possible to position the marker at a preferred position relative to the body part so that the magnification of the x-ray image at that preferred position can be accurately determined. Hence, the size of the patient's body part at the preferred position can be more accurately determined.

The support can bear an adhesive by which the marker can be releasably attached to the body part. The support can bear a single patch or portion of adhesive or can bear multiple portions or patches of adhesive. Preferably the adhesive can be releasably attached to skin, and more preferably human skin.

The marker can include a mechanism by which the marker can be releasably attached to the patient. The mechanism can be a mechanical mechanism. The mechanism can be in the form of a clip or a press or push fit mechanism. The mechanism can be a suction device, such as a suction cup or similar. The mechanism can be a strap or straps. The mechanism can be calipers or similar.

The mechanism can be attached to the support part of the marker. The support part of the marker can be movable relative to the mechanism. This can allow the position of the marker to be adjusted.

The circular member can have any form with a circular perimeter. For example the circular member can be a disc. Preferably, the circular member is a ring or loop as they are light weight and easier for the support to hold.

The circular member can have an outer diameter of between approximately 10mm and 50mm. Preferably the outer diameter is between about 20mm and 40mm and more
preferably the outer diameter is approximately 25mm or 30mm.

The circular member can be of a material which is substantially x-ray opaque. The material can be or include a metal. The material can be an alloy or substantially pure metal. For example, the material can be stainless steel, steel, zinc or lead or an alloy or compound including any of these materials.

The circular member can be made of sufficient material that the circular member is sufficiently non-transmissive to x-rays that the circular member will be discernable in an x-ray captured under typical x-ray imaging conditions.

The support can include at least one portion extending from the circular member and by which the marker can be attached to the patient. The at least one portion can extend from a side of the circular member. The marker can have a generally 'L' shape. A body of the support can bear the circular member and a foot part of the support can be releasably attachable to the patient.

The support can include a first portion extending from a first side of the circular member. A second portion can extend from a second opposed side of the circular member. A one or each of the first and second portions can bear an adhesive.

The support can be in the form of a strip of material.

The strip of material can be a length of medical or surgical tape.

At least a portion of the support can be flexible so that the portion of the support can conform to the shape of the patient's body part to which the marker is to be attached. This helps the part of the support bearing the circular member to stand generally erect and/or away from the surface of the body part.

The material is preferably sufficiently rigid to support the member away from the
patient's body part.

The support may include a flexible portion or portions which can conform to the shape of the patient's body part and another portion or portions which are less flexible and which bear the marker.

The strip of material can include at least one fold. The strip of material can include a plurality of folds. The or each fold can define a patient engaging portion, or portions, of the marker and a marker portion, or portions, which bear the circular member. The plurality of folds can have senses of folding which cause the strip to be foldable in a generally zig-zag or concertina form.

The strip of material can include three folds. A first fold can be located toward a first end of the strip of material. A second fold can be located at the centre of the strip of material. A third fold can be located toward a second end of the strip of material. The first and third fold can have the same sense of folding and the second fold can have an opposite sense of folding.

The marker can include adhesive on a first patient engaging surface of a portion of the strip of material between the first fold and the first end. The marker can include adhesive on a second patient engaging surface of a portion of the strip between the third fold and the second end.

The marker can further include a fastener for holding a first central portion of the strip between the first fold and the second fold and a second central portion of the strip between the second fold and the third fold together. The circular marker can be borne by the first central portion or the second central portion. The fastener can be a permanent fastener or a releasable fastener. The fastener can be a mechanical fastener, such as a push fit, press fit, snap fit or hook and eye type fastener.

The fastener can comprise an adhesive material borne by the first central portion or
second central portion so as to allow the first central portion and second central portions
to be secured together.

The fastener further can comprise a raised member which stands proud of the surface of
the strip and in registration with the adhesive. The raised member can be substantially as
thick as the thickness of the circular member. A free end of the raised member can bear
the adhesive.

The marker can further comprise a backing cover removable from the marker to allow the
marker to be releasably attached to the patient. Preferably, the backing cover covers the
adhesive material of the marker and is removable to expose the adhesive material.

A second aspect of the invention provides a method for determining the magnification of
an x-ray image of a body part of a patient, comprising: releasably attaching a marker
including a circular member of material imageable by x-rays to an outer surface of the
patient adjacent the body part and with the circular member standing away from the
surface of the patient; capturing an x-ray image including at least a part of the body part
of the patient and the circular member; determining the size of the largest dimension of
the image of the member in the captured x-ray image; and using the determined size of
the largest dimension to calculate the magnification of the x-ray image.

Preferably the whole of the circular member is imaged.

The method can further comprise releasably attaching the circular member using an
adhesive.

The circular member can be releasably attached to the skin of the patient.

The method can further comprise retrieving a marker from a dispenser storing a plurality
of markers.
The method can further comprise removing a backing cover from an adhesive part of the marker prior to releasably attaching the marker to the patient.

An embodiment of the invention will now be described in detail, by way of example only, and with reference to the accompanying drawings, in which:

Figure 1 shows a perspective view of a first embodiment of an x-ray marker according to the invention;
Figure 2 shows a schematic partial cross sectional view of the marker of Figure 1 attached to a patient’s limb in use;
Figure 3 shows a perspective view of a second embodiment of an x-ray marker according to the invention;
Figure 4 shows a side view of the marker of Figure 3 with a cover;
Figure 5 shows a schematic side view of a dispenser holding a plurality of markers as shown in Figure 4;
Figure 6 is a perspective view of the marker of Figure 3 during a stage of assembly prior to use;
Figure 7 shows a schematic perspective view of the marker of Figure 3 attached to a patient’s knee during use; and
Figure 8 shows a third embodiment of a marker according to the invention.

Like items in different Figures share common reference signs, unless indicated otherwise.

With reference to Figure 1 there is shown a first embodiment of a marker 100 according to the present invention. The marker 100 can be used to determined the magnification of an x-ray image of a patient’s body part, e.g. a leg. However, it will be appreciated that the marker can be used in connection with any body part for which it is useful to be able accurately to determine the degree of magnification of the x-ray image.

The marker includes a circular member 110 in the form of a circular ring or loop. The ring 110 is made of a material which is sufficiently opaque to x-rays that an image of the ring will be discernable in an x-ray image. The ring can be made of a number of
materials, including stainless steel, steel, lead, an alloy, solder or a zinc based material. The material is chosen to make the ring light while also ensuring that it will be clearly imaged under typical x-ray imaging conditions. The ring 110 can be made from a loop of wire in which the wire itself has a circular cross-section. A circular cross-section eliminates a possible penumbra effect which can occur when x-rays pass through the edges of a material.

The ring 110 is circular and has a diameter of approximately 25mm. It will be appreciated that rings of other dimensions can be used. However, a 25mm ring can be preferred as image processing algorithms already exist to identify images of 25mm diameter discs in x-ray images and therefore a 25mm diameter ring will allow images to be generated which can be processed using various existing algorithms and software routines.

The marker 100 also includes a support 120 in the form of a strip of adhesive tape. The support 120 acts to hold the ring 110 generally erect and away from the surface of the patient's limb when the marker is attached to a patient in use, as will be described in greater detail below. Holding the marker away form the patient's limb helps to prevent the image of the marker obscuring any of the anatomy of the patient which is being imaged.

The tape 120 can be a specially designed and fabricated product or can be a conventional medical tape as currently used and available, e.g. a micropore tape, a duopore tape, a claripore tape or a transpore tape. The width of the tape is much less than the length of the tape so that the tape only covers a small portion of the diameter of the ring. The length of the tape is chosen to be sufficient to allow sufficient adherence of the tape to the patient so as to prevent easy dislodgement of the marker when in position. This will also depend on the strength of the adhesive present on the underside of the tape and the weight of the ring 110.

Figure 2 illustrates use of the marker 100 during the capture of an x-ray image of a
patient's body part. As illustrated in Figure 2, an x-ray camera 210 acts as a source of x-rays 212 which pass through a patient's body part, e.g. thigh 214, and are captured by x-ray detector 216. X-ray detector 216 may be a digital device or an analogue device, such as a conventional x-ray film in a cassette. As illustrated in Figure 2, the x-rays 212 from the x-ray camera 210 diverge as they travel between the camera and x-ray imaging device 216. Hence, the degree of magnification of the patient's body part varies from the upper surface of the body part 218 (closer to the x-ray source) to the lower part of the body part 220 (further from the x-ray source).

10 The marker 100 of the present invention allows a more accurate determination of the magnification of the x-ray image at a preferred position within the patient's body part. For example, the marker 100 may be attached adjacent to a patient's knee and at a particular "height" position (in the anterior-posterior direction) so that the surgeon can more accurately size an orthopaedic implant to use in an arthroplasty procedure to be carried out on the knee. For example, as illustrated in Figure 2, the marker 100 has been attached to the skin at the side of the patient's leg with the ring 110 standing generally erect and away from the surface of the patient's leg and at a height corresponding generally to a plane represented by dashed line 222. As can be seen, the tape 120 is flexible and so can conform to the local curved shape of the patient's leg and allows ring 110 to stand away from the patient's leg and therefore the captured image of the ring will not obstruct or obscure any of the patient's anatomy in the captured image of the leg.

By measuring the size of the largest dimension of the ring in the captured image, a magnification factor for the x-ray image can be determined by comparison with the actual size of the largest dimension of the ring, which is known (2.5cm). Further, as the ring is a circle, no matter what angle relative to the plane of the circle the x-ray image is captured at, the largest dimension of the captured image of the ring (which will vary from a straight line, through ovals to a circle) will always correspond to the diameter of the circle. Therefore, even if the ring is not perfectly parallel to the imaging plane of the x-ray detector 216, it will always be possible to determine the magnification factor from the captured image of the ring.
With reference to Figure 3, there is shown a second embodiment of a marker 300 according to the present invention. The marker includes a circular ring or loop 310 of a substantially x-ray opaque material, similar to loop 110 of the first embodiment 100. The circular loop 310 is mounted on a support 320 in the form of a substrate 320 made of a flexible plastics material. The strip of plastics material has first 322, second 324 and third 326 fold lines. A first end of the substrate and the first fold line 322 define a first portion 328 of the substrate 320 which bears a first patch 330 of adhesive. The first fold line 322 and second fold line 324 define a second portion 332 of the substrate. The second fold line 324 and third fold line 326 define a third portion 334 of the substrate to which the ring 310 is attached. A portion of double sided sticky tape 336 is provided on the third portion of the substrate and toward the centre of ring 310. The third fold line 326 and second end of the substrate define a fourth portion 338 of the substrate on which a second patch of adhesive 340 is provided. The first and second fold lines have the same sense of folding which is opposed to the sense of folding of the second fold line 324 so that the substrate naturally has a slightly zig zag or concertina form, which facilitates assembly of the marker prior to use.

As illustrated in Figure 4, the marker can also include a cover 342 in the form of a releasable cover or backing strip which is mounted on and attached to the marker by the action of adhesive patches 330, 336 and 340. The cover strip facilitates easy use and handling of the marker prior to its assembly for attachment to a patient.

For example, Figure 5 shows a schematic side view of a dispenser 400 holding a plurality of separate markers 401, 402, 403 (and as represented by dashed lines within the dispenser). The dispenser 400 is generally in the form of a rectangular box having a similar length and width as the marker and cover assembly and having sufficient depth to hold a usefully large number of markers, e.g. several tens. A cut away lower corner 410 of the housing of the dispenser includes a flap portion 412 extending from a base of the housing of the dispenser. In use, a radiologist simply grips and pulls on one of the exposed marker/cover assemblies to remove it from the housing and the remaining markers are gravity fed to replace the removed one.
In an alternate embodiment, the marker/cover assembly can be provided joined together in a continuous strip, which can be in a roll, in which the cover and substrate are each provided as part of a continuous roll of material. The individual markers are defined by perforations across the width of the strip so that an end most marker/cover assembly can be removed from the free end of the roll by simply tearing off the marker and cover from the roll of marker/cover assemblies.

Use of the marker illustrated in Figures 3 to 5 will now be described in greater detail with reference to Figures 6 and 7. The radiographer removes a marker and cover assembly from the housing 400 and removes the backing strip 342 to expose the adhesive parts of the marker. As described above, the folds 322, 324, 326 are arranged to give the marker a slight zig zag or concertina shape, in order to assemble the marker for use, the second 332 and third 334 portions of the substrate are folded toward each other, as illustrated by arrows 350, 352, about fold line 324 as illustrated in Figure 6. Adhesive patch 336 is contacted with the mating surface of second portion 332 and holds the second and third portions together so that the marker has a generally "T" shape. Patch 336 extends slightly from the surface of the third portion 334 so as to compensate for the finite thickness of loop 310 of radio opaque material when in the form of a wire. However, in other embodiments, loop 310 maybe printed on substrate 320 and therefore have negligible thickness. The first and fourth portions of the support can be pushed outward about respective fold lines 322 and 326 if required.

Figure 7 shows the marker 300 attached adjacent the knee 500 of a patient's leg 502. Using adhesive portions 340 and 330, the marker 300 is attached to the patient's skin with the first portion 328 and fourth portion 338 of the substrate flexing to match the local curvature of the patient's leg. The marker 300 is attached with the ring 310 at a height corresponding generally to the part of the anatomy which the surgeon wants to image and accurately determine the size of. As can be seen in Figure 7, the ring 310 stands erect and away from the surface of the patient's skin and does not obstruct the anatomy to be imaged. Further, as parts 338 and 328 of the support can flex to match the local curvature of the surface of the patient's leg, this tends to allow the part of the support bearing ring
310 to stand generally perpendicular to the part of the leg to which it is attached rather than being inclined as tends to be the case if the support parts 338, 328 can not flex or bend to match the curvature of the surface of the body part.

The marker can be attached before or after the patient is positioned on the x-ray imaging equipment. An x-ray image of the patient's knee and the marker is then captured, ensuring that the whole of the ring 310 is imaged. The plane of the ring 310 should be generally parallel to the imaging plane of the x-ray detection device 216. The marker can be removed and replaced on the patient's joint in a different position, if it is necessary to capture x-rays from different directions. Hence, it will be appreciated that the adhesive used on the marker is preferably a reusable adhesive. Also, the adhesive should be sufficient to allow the marker to be robustly attached to the patient's skin, or to a covering or outer garment of the patient, so as to allow the marker to be self-supporting, but while also allowing the marker to be removed without hurting or harming the patient.

The x-ray image can then be processed as normal and the size of the image of the ring can be measured either using automated image processing techniques or manually, for example using a ruler or a template. By comparing the measured size of the ring in the image with the known diameter of the ring, the magnification factor for the x-ray image can be accurately determined.

Figure 8 shows a perspective view of a third embodiment of the marker 600. Marker 600 includes a circular ring 610 of substantially x-ray opaque material similar to that used in the other embodiments. The support 620 is in the form of a strip of flexible plastics material having a single fold 622 which defines a patient engaging portion 624 and a ring bearing portion 626. A patch of adhesive material 628 is provided on a skin engaging side of the first portion 624. As illustrated in Figure 8, the marker has a generally L shaped configuration and similarly to the second embodiment can be provided in a generally flat initial configuration with a cover which is removed prior to attachment of the marker to the skin of a patient.
As will be apparent from the above discussion, use of the marker is not limited to imaging knees but can be used with any part of the body. Although in the above two embodiments, a circular ring or loop has been used, it will be apparent that a circular disc, or any other form having a circular perimeter can be used. For example, as described above, ring 310 could be replaced by a disc of substantially x-ray opaque material deposited by printing, e.g. a lead based ink or paint. However, it can be beneficial to use a ring or loop as that reduces the weight and therefore the strength of the support structure and/or adhesive used to attach the marker to the patient. As also described above, the marker can be attached directly to the patient's skin but could also be attached to a cover or clothing of the patient provided that does not move relative to the patient during imaging.

It will be apparent from the above that various modifications and changes to the specific embodiments described will be readily apparent to a person of ordinary skill in the art from the above discussion. For example, features of the invention described in relation to any one of the embodiments can be used in combination with features of the invention described in connection with others of the embodiments.
Claims:

1. A marker for determining the magnification of an X-ray image comprising:
   a circular member of a material imageable by x-rays; and
   a support for holding the circular member away from the surface of a patient, the
   support being releasably attachable to the patient adjacent a body part to be imaged using
   x-rays.

2. A marker as claimed in claim 1, wherein the support bears an adhesive by which
   the marker can be releasably attached to the patient.

3. A marker as claimed in claim 1 or 2, wherein the support includes a first portion
   extending from a first side of the circular member and a second portion extending from a
   second opposed side of the circular member and each of the first and second portions
   bearing an adhesive.

4. A marker as claimed in any preceding claim, wherein the support is in the form of
   a strip of material.

5. A marker as claimed in any preceding claim, wherein at least a portion of the
   support is flexible so that the portion of the support can conform to the shape of the
   patient's body part to which the marker is to be attached.

6. A marker as claimed in claim 4 or 5, wherein the material is sufficiently rigid to
   support the member away from the patient's body part.

7. A marker as claimed in claim 4, wherein the strip of material includes a plurality
   of folds which define patient engaging portions of the marker and marker portion which
   bears the circular member.

8. A marker as claimed in claim 7, wherein the strip of material includes three folds,
and wherein a first fold is located toward a first end of the strip of material, a second fold is located at the centre of the strip of material and a third fold is located toward a second end of the strip of material.

9. A marker as claimed in claim 8, wherein the marker includes adhesive on a first patient engaging surface of a portion of the strip of material between on first fold and first end and on a second patient engaging surface of a portion of the strip between the third fold and second end.

10. A marker as claimed in claim 9, wherein the marker further includes a fastener for holding a first central portion of the strip between the first fold and the second fold and a second central portion of the strip between the second fold and the third fold together and wherein the circular marker is borne by the first central portion or the second central portion.

11. A marker as claimed in claim 10, wherein the fastener comprises an adhesive material borne by the first central portion or second central portion so as to allow the first central portion and second central portions to be secured together.

12. A marker as claimed in claim 11, wherein the fastener further comprises a raised member which stands proud of the surface of the strip and in registration with the adhesive.

13. A marker as claimed in claim 12, wherein a free end of the raised member bears the adhesive.

14. A marker as claimed in any preceding claim, the marker further comprising a backing cover removable from the adhesive material to expose the adhesive material.

15. A method for determining the magnification of an x-ray image of a body part of a patient, comprising:
releasably attaching a marker including a circular member of material imageable
by x-rays to an outer surface of the patient adjacent the body part and with the circular
member standing away from the surface of the patient;
capturing an x-ray image including at least a part of the body part of the patient
and the whole of the circular member;
determining the size of the largest dimension of the image of the member in the
captured x-ray image; and
using the determined size of the largest dimension to calculate the magnification
of the x-ray image.

16. The method as claimed in claim 15, further comprising releasably attaching the
circular member using an adhesive.

17. The method as claimed in claim 15 or 16, wherein the circular member is
releasably attached to the skin of the patient.

18. The method as claimed in any of claims 15 to 17 and further comprising retrieving
a marker from a dispenser storing a plurality of markers.

19. The method as claimed in any of claims 15 to 18 and further comprising removing
a backing cover from an adhesive part of the marker prior to releasably attaching the
marker to the patient.

20. A marker substantially as hereinbefore described and as shown in the Figures.

21. A method for determining the magnification of an x-ray image substantially as
hereinbefore described and as shown in the Figures.
**INTERNATIONAL SEARCH REPORT**

**International application No**
PCT/GB2009/051650

### A. CLASSIFICATION OF SUBJECT MATTER

**INV.** A61B6/00 A61B19/00

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)
A61B

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

Electronic data base searched (name of data base and, where practical, search terms used)
EPO-Internal

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

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- 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
  - "E" earlier document 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
- "S" document member of the same patent family

Date of the actual completion of the international search: 22 February 2010

Date of mailing of the international search report: 02/03/2010

Name and mailing address of the ISA/
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Fax (+31-70) 340-3016

Authorized officer: De Ia Hera, German

Form PCT/IS/0210 (second sheet) (April 2005)
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Continuation of Box II.2

Claims Nos.: 20-21

The subject matter of claims 20 and 21 is defined by reference to the description and the drawings which is not allowed under the PCT (see Rule 6.2 PCT). The claims do not define any structural features or limitations. Consequently, the scope of the claims is not clear, contrary to the requirements of Article 6 PCT and a meaningful search is not possible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.
INTERNATIONAL SEARCH REPORT

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
   see FURTHER INFORMATION sheet PCT/ISA/210

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:

1. □ I As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ I As all searchable claims could be searched without effort justifying an 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.:

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.
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