PPII Final Examination
Spring 2001 — Prof. Jepson

Exam No. _____

Instructions:

Put your Examination number on this booklet, on the Scantron™ answer sheet, and on every Blue Book in Part 2. Turn in all of these.

This Exam is CLOSED BOOK. You may NOT use the MPEP, course materials, notes, outline, or anything else. You may not use a computer.

This exam has two parts. Part 1 is 60 short multiple-choice questions. Part 2 is a performance exam requiring you to answer two questions and draft two documents. Part 1 is worth 50 percent. Part 2 is worth 50 percent. You may divide your time any way you wish. YOU HAVE THREE HOURS (or more).

Check now that you have **48** consecutively numbered pages.

Abbreviations

"OA" means Office action. "SSP" means shortened statutory period. "Final" a Final Office Action. "POSA" means a person having ordinary skill in the art.

Alex is the Applicant.
Brent is Alex' buddy, who works at the same plant.
Chris is a reference.
David is a registered patent attorney.
Examiner is a patent application examiner in the United States Patent and Trademark Office (PTO).
Gwyneth is a registered patent attorney.

Instructions for Part 1

Fill in completely the bubble on your Scantron™ answer sheet that you believe corresponds to the BEST choice.

Use only a No. 2 pencil to fill in the bubbles. Make no stray mark. Erase completely. Incomplete erasures and stray marks are counted as incorrect responses by a machine. We will not hand check. There will be no hand recount. THIS IS YOUR RESPONSIBILITY.

Your score will be the number correct. There is no penalty for guessing.

If you wish to explain an answer, do so in this booklet.

Instructions for Part 2

Draft according to accepted practice the required documents for filing in the PTO based on the materials provided. Answer the two Questions.

You may separate the attached materials.

Good Luck!

Exam No. _____

Part 1 — Multiple Choice — Fill in the Bubble on the Scantron sheet.

1) While on a golf vacation in Scotland, Alex conceived of a new ball-washing device on July 25, 1994. Alex returned to Maine in August. Alex' roommate Brent built the device and successfully washed Alex' balls on August 3, 1994. Alex filed an Application for a United States patent on December 23, 1996. Examiner rejected all the claims based on an Application to Chris filed in the United States on January 3, 1996 and issued August 6, 1996. The Chris Application properly claims domestic priority based on an earlier abandoned Application filed August 4, 1994. Which of the following, if any, is true.

   a) Alex may be able to beat the Chris reference because Scotland is a WTO country.

   b) Alex may be able to beat the Chris reference because Brent reduced to practice before Chris.

   c) Alex can beat the Chris reference because Alex conceived before Chris.

   d) Alex cannot beat the Chris reference.

   e) None of the above is true.

2) While on a golf vacation in Scotland, Alex conceived of a new ball-washing device on July 4, 1994. Alex returned to Maine in August. Alex filed an application for a United States patent on December 23, 1996. Examiner rejected all the claims based on an application to Chris filed in the United States on January 3, 1996 and issued August 6, 1996, which properly claims domestic priority based on an earlier abandoned application filed July 24, 1994.

   a) Alex may be able to beat the Chris reference because Scotland is a WTO country.

   b) Alex may be able to beat the Chris reference because Alex reduced to practice before Chris.

   c) Alex can beat the Chris reference because Alex conceived before Chris.

   d) Alex cannot beat the Chris reference.

   e) None of the above is true.

3) Alex conceived of a new golfball-washing device on vacation in Scotland on July 2, 1994. Alex immediately overnighted a detailed drawing to David his United States attorney asking David to immediately file a design patent application. After returning to Maine, on August 3, 1994, Alex filed an Application for a United States utility patent on December 23, 1995 using the same detailed drawings overnighted before. Examiner rejected all the claims based on a description in American Golf Today magazine by Chris dated July 15, 1994.

   a) Alex may be able to beat the Chris reference because Scotland is a WTO country.

   b) Alex may be able to beat the Chris reference because Alex reduced to practice before the Chris publication.

   c) Alex can beat the Brent reference because Alex conceived before Chris.

   d) Alex cannot beat the Chris reference.

   e) None of the above is true.

4) Alex files an Application with informal drawings on July 15, 2001, which he knows will need to be corrected. Which of the following, if any, is true:

   a) If the Application is for a plant patent, the Application will not be placed on the files for examination until objections to the drawings have been corrected.

   b) If the Application is for a utility patent, Alex will not get a filing date until he files formal drawings.

   c) If the Application is for a utility patent, Alex has 2 months to get on file formal drawings or the Application goes abandoned.

   d) If the Application is for a utility patent, Alex will not get a filing date until he files formal drawings if drawings are necessary to an understanding of the invention.

   e) None of the above is true.

5) In Alex' Application, all the section headings are done just as the PTO prefers them to be done. The section headings are:

   a) Upper case, without underlining or bold type.

   b) Upper case, with underlining and in bold type.

   c) Upper case, with underlining NOT in bold type.

   d) Title case, bold.

   e) Lower case except for the first letter of each word, which is upper case.

6) In Alex' Application, the title of the invention may not exceed ___1__ in length and must be as __2__ as possible.

   a) (1) 7 words; (2) short and sweet.

   b) (1) 500 characters; (2) short and specific.

   c) (1) 7 words; (2) technically accurate.

   d) (1) 500 characters; (2) technically accurate.

   e) (1) 2 lines of printed text; (2) short and specific.

7) The Abstract in an Application filed under 35 U.S.C. §111 may not __1__ in length. The purpose of an Abstract is to enable the USPTO and the public generally to determine quickly from a cursory inspection the nature and gist of the technical disclosure. The Abstract __2__ be used for interpreting the scope of the claims in the PTO.

a) (1) exceed 150 words; (2) will not.

b) (1) exceed five sentences; (2) will.

c) (1) exceed 150 words; (2) will.

d) (1) exceed five sentences; (2) will not.

e) (1) exceed 150 words; (2) is intended to.

8) Before drafting the Specification, it is most important to

a) Draft the claims.

b) Draft the drawings.

c) Review the Search Report with the inventor.

d) Understand the invention.

e) Draft the Background.

9) Alex receives a rejection under 35 U.S.C. § 102(b) based on a United States patent to Chris that discloses and claims the same invention that Alex claims. Which of the following, if any, will overcome the rejection?

a) A declaration showing that Chris is not the true inventor.

b) A declaration showing commercial success of Alex' invention.

c) A declaration containing an argument and evidence that Alex' invention has been a commercial success.

d) A declaration from Alex swearing behind the Chris patent.

e) None of the above.

10) Alex wants to add a sentence between the second and third sentence of the fifth paragraph of his Application before it is filed in the PTO. David is Alex' registered patent attorney. Such alterations are permitted if each is initialed and dated by:

a) David, even if Alex is available to sign the oath or declaration.

b) Alex, before the oath or declaration is signed by David.

c) Alex, at any time after the oath or declaration is signed.

d) Alex, before he signs the declaration.

e) David before the oath or declaration is signed by Alex.

11) The date to overcome using a Rule 131 Affidavit is:

a) The filing date.

b) The issue date.

c) The invention date.

d) The disclosure date.

e) The effective date.

12) Which, if any, of the following is true:

a) If David cancels a claim, and adds a new claim, then he should use the number previously assigned to the canceled claim.

b) David can properly incorporate by reference, for purposes of satisfying the requirements of 35 U.S.C. § 112, from any U.S. patent or U.S. patent application.

c) David can file an authorization with the PTO under which the PTO will automatically tap David's account for all fees he owes on any applications or patents he prosecutes.

d) The subject matter disclosed in a claim that is part of the original Application can enable a later added claim, even if the detailed description and drawings, taken alone, are inadequate to enable the later added claim.

e) None of the above.

13) Alex files a Preliminary Amendment. The preliminary amendment will not be disapproved if it is filed no later than:

a) Three months from the filing date of The original Applicatio.

b) The filing date of the Continued Prosecution Application.

c) Three months from the date the national stage was entered on the International Application.

d) All the above.

e) None of the above.

14) Rule 111 applies to

a) Replies

b) Reexaminations

c) Certificates of Correction

d) Petitions

e) Appeals

15) The time in which Alex must file a Brief is:

a) Two months from the date of receipt of the Notice of Appeal.

b) Two months from the date on the Certificate of Mailing under 37 CFR 1.8.

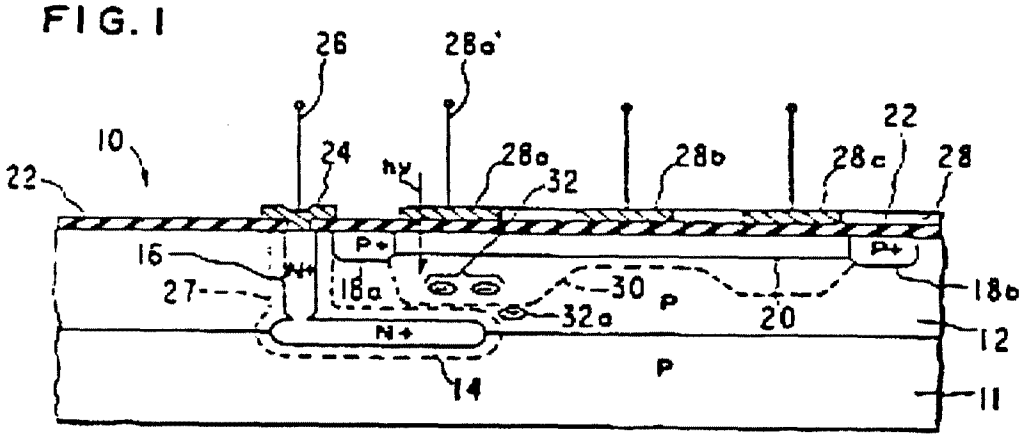
c) Within time allowed for reply to action from which appeal was taken.

d) Five months.

e) The later of (a) or (c), which may be extended under 37 CFR 1.136(a), and if 37 CFR 1.136(a) is not available, under 37 CFR 1.136(b).

The following 5 questions (16-20) are drawn from your *Loral Fairchild Corp. v. Sony Corp.*, 181 F.3d 1313 (Fed. Cir. 1999) (the CCD array case) reading, for which please make reference to Fig. 1 below.

FIG. 1



As you recall, the district court construed the "charge sink means" of claim 1 of Loral's patent as a means-plus-function limitation and held that the charge sink means is a region of semiconductor material doped opposite to the surrounding semiconductor material. In Fig. 1, the charge sink means is the elliptical region (14) with a N+ doping. The surrounding semiconductor material is a P-type substrate. The charge sink region extends from the ohmic contact region (16) toward the light sensing element (28a). The electrical lead (26) is connected to the metallic conducting material (24) so that external electrical contact may be established with the buried charge sink region (14). The electrons (32) are accumulated in the potential wells defined by the dashed lines (30). When excess electrons (32a) accumulate in the potential wells, they will overflow into the charge sink region (14). The court held that the charge sink means of claim 1 of the *'485* patent is a separate and distinct structure surrounded by and submerged in the semiconductor material.

Sony's CCDs also permit excess charge accumulation to drain vertically beneath the pixels. In Sony's device, however, the entire N-type substrate acts as a vertical overflow drain.

16) If Sony is correct that its device has no equivalent to the charge sink means of claim 1 of the '485 patent, then the district court should:

a) Find no infringement under the All Elements Rule.

b) Find no infringement under the All Advantages Rule.

c) Find no infringement under the Doctrine of Equivalents if there is Prosecution History Estoppel.

d) Find no infringement under the Rule of Nines.

e) Leave it to the Jury.

17) Loral limited the scope of claim 1 to overcome prior art during prosecution. Loral limited its claim scope to a charge sink that is a separate structure buried within the substrate, extending parallel to the surface from a contact toward the light sensor. Therefore:

a) Prior to ***Festo***, the prosecution history would likely have estopped Loral from claiming that Sony infringes under the doctrine of equivalents.

b) Prior to ***Festo***, the file wrapper estoppel would likely prevent Sony from claiming that Loral infringes under the doctrine of equivalents.

c) Both "a" and "b" are likely true if ***Festo*** is controlling.

d) Both "a" and "b" are true if ***Festo*** is NOT controlling.

e) If ***Festo*** controls, "a" is true, unless "b" is true.

18) When referring to Fig. 1 above in the Brief Description of the Drawings, Loral would have likely referred to:

a) The lead lines.

b) An embodiment of the invention.

c) "Item (30)."

d) "The invention."

e) The function of item (28a).

19) Fig. 1 is a:

a) Cross-sectional View.

b) Partial View.

c) Dorsal View.

d) Exploded View.

e) Core View.

20) The following sentence would be the best one to start the Abstract of the Disclosure:

a) Charge sink regions are buried within the semiconductor material of a charge-coupled imaging device for sinking excess charges accumulated within the device.

b) By locating the charge sink regions a given depth within the substrate, a limited amount of charge can be allowed to accumulate in the light sensing elements while any additional charge will transfer to the charge sink region.

c) Also, by varying a potential applied to the charge sink region charge accumulation within the light sensing elements can be controlled.

d) Charge sink regions do not require any space on the surface area of the array; and can prevent saturation of charge within a CCD array.

e) In accordance with another embodiment of this invention, charge sink regions are formed on the surface of a first substrate constructed from semiconductor material, and an epitaxial layer of semiconductor material constituting a second substrate is formed over the first substrate.

21) The Statute, 35 USC §§ 111, 112, requires for a complete patent application:

a) A Specification, including a Claim, any necessary Drawing, an Oath, and any required Fee.

b) A Specification, Oath, Claim, and any necessary Drawing.

c) A Specification, Claim, and any necessary Drawing.

d) A Specification, and any necessary Drawing.

e) None of the above.

22) Which event below is NOT a statutory bar to the granting of a patent on Alex' Application filed August 30, 2001, claiming a paint roller?

a) Alex reduced to practice in June, 2000, and sold the claimed paint rollers to Sherwin Williams on July 30, 2000. The sale was conditioned on Sherwin Williams's satisfaction.

b) Alex reduced the invention to practice in June, 2000, sold the claimed paint rollers to Sherwin Williams beginning on July 30, 2000. Alex' research and development costs exceeded his licensing income from the sales and Alex made no money.

c) Alex reduced to practice in June, 2000, and on July 30, 2000, assigned to Sherwin Williams his patent rights to the claimed paint roller invention for good and valuable consideration.

d) Alex reduced to practice in June, 2000, and on July 30, 2000, offered to sell his inventory of the claimed paint rollers. The sale was not consummated until September 3, 2000.

e) Alex reduced to practice in June, 2000, and offered, on July 30, 2000, to sell the claimed paint rollers to Sherwin Williams, but the offer was delayed in the mail and not received until September 10, 2000.

23) Applicant received a Final with a mail date of Tuesday, February 29, 2000, which set a 3 month SSP. Applicant files an Amendment and a Notice of Appeal on Monday, March 27, 2000. Examiner indicates in an Advisory Action, mail date Wednesday, May 31, 2000, that the Amendment will be entered for appeal purposes, and how the individual rejection(s) set forth in the final Office action will be used to reject any added or amended claim(s). Which is the last date for filing a Brief on Appeal without an extension of time?

a) Saturday, May 27, 2000.

b) Monday, May 29, 2000 (a Federal holiday, Memorial Day).

c) Tuesday, May 30, 2000.

d) Wednesday, May 31, 2000.

e) Tuesday, August 29, 2000.

24) Can inventorship be corrected in Reexamination?

a) Never.

b) Always.

c) Yes, if the error arose without deceptive intent, by Petition under Rule 324.

d) Yes, if the error arose without deceptive intent, by Petition under Rule 48.

e) It is within the discretion of the Examiner.

25) A section 134 Appeal is to:

a) The Court of Appeal for the Federal Circuit.

b) The United States District Court for the District of Columbia.

c) The Board of Patent Appeals and Interferences.

d) The Patent Judge Advocate.

e) Truth and Reason.

26) When used in the Patent Office Rules, the term "affidavit" means:

a) An oath.

b) An affidavit.

c) A 35 USC §25 Declaration.

d) A 28 USC §1746 Declaration.

e) All the above.

27) Information Disclosure Statements __1__ permitted in provisional applications. Any such statement filed in a provisional application will be __2__ at the option of the Office.

a) (1) are not; (2) returned or destroyed

b) (1) are not; (2) filed but ignored

c) (1) are; (2) considered if timely

d) (1) are (2) entered

e) (1) are not; (2) destroyed

28) Information Disclosure Statements __1__ permitted in design applications. Any such statement filed in a design application will be __2__ .

a) (1) are not; (2) returned or destroyed.

b) (1) are not; (2) filed but ignored.

c) (1) are; (2) considered if timely.

d) (1) are (2) entered if timely.

e) (1) are not; (2) destroyed.

29) Assume that a Rule 48(a) Petition was not granted for technical reasons. Assume further that the admission therein regarding the error is uncontroverted. The Examiner could issue a rejection based on:

a) 35 U.S.C. §102(g).

b) 35 U.S.C. §102(f).

c) 35 U.S.C. §102(e).

d) 35 U.S.C. §102(d).

e) 35 U.S.C. §102(c).

30) "Inventorship" of a claim in an application for a Design patent arises from:

a) Conception.

b) Development.

c) Actual Reduction to Practice.

d) Constructive Reduction to Practice.

e) Diligence.

31) If the reference required by 35 U.S.C. § 120 is presented in a nonprovisional application after the time period provided by the Rules, any claim under 35 U.S.C. 120, 121, or 365(c) for the benefit of a filing date of the prior filed co-pending nonprovisional application:

a) May be accepted if the reference identifying the prior application by application number was unintentionally delayed.

b) May be accepted if the delayed reference identifies the prior application by application number.

c) Must be accepted if the reference identifying the prior application by application number was unintentionally delayed.

d) May be accepted if a Petition to Accept under 35 U.S.C. 120, 121, or 365(c) seeking the benefit of the prior filed application is accompanied by the required fee.

e) Must be accepted if a Petition to Accept under 35 U.S.C. 120, 121, or 365(c) seeking the benefit of the prior filed application is accompanied by the required fee.

32) An application other than for _____ may claim an invention disclosed in one or more prior filed provisional applications.

a) A design patent.

b) A continuation.

c) A divisional.

d) A nonprovisional.

e) A provisional.

33) In order to obtain the benefit of an earlier foreign filing date, the United States design patent application must be filed _____ any foreign application for the same design was filed.

a) within 6 months of the earliest date on which

b) within one year of the earliest date on which

c) within 18 months of the earliest date on which

d) during the pendency of

e) within one year of the latest date on which

34) Alex wants a design patent on his new typeface. He can

a) Forget it!

b) Get it if the design is new, useful, and not obvious.

c) Get it if the design is new, useful, and ornamental.

d) Get it if he disclaims concurrent copyright protection.

e) Get it if the design is new, original, ornamental, and not obvious.

35) Design patents expire:

a) 14 years after the date granted.

b) 17 years after the date granted.

c) 14 years from the earliest filing date.

d) 20 years from the earliest filing date.

e) 20 years from the earliest filing date if filed on or after June 8, 1995, otherwise 14 years from issue date.

36) Alex fires a round from his 56-caliber rifle through his neighbor's (previous, now shattered) ceramic gnome lawn ornament. Alex recovers the slug, notes the attractive shape and swirly pattern, and decides to get a design patent on it.

a) Alex can get a design patent.

b) Alex cannot get a design patent because the pattern is inseparable from the article to which it is applied.

c) Alex cannot get a design patent because the pattern exists alone merely as a scheme of surface ornamentation.

d) Alex cannot get a design patent because the pattern must be a definite, preconceived thing, capable of reproduction and not merely the chance result of a method.

e) Alex cannot get a design patent because the pattern is functional.

37) The Abstract of the Disclosure ___1___ refer to the purported merits of the invention; and ___2___ compare the invention with the prior art.

a) (1) should not; (2) should not

b) (1) should ; (2) should not

c) (1) should not; (2) should

d) (1) should ; (2) should

e) (1) must; (2) may

38) The phrase: "The compounds are of the class of alkyl benzene sulfonyl ureas, useful as oral anti-diabetics."

a) Would make a nice Abstract of the Disclosure.

b) Would be appropriate in an Abstract of the Disclosure.

c) Would be appropriate as a Title of the Application.

d) Would be appropriate as a statement of the Field of the Invention.

e) Would not be appropriate in an Abstract of the Disclosure.

39) Alex invents a method of converting software source code to object code. David files broad claims and narrows those claims during prosecution in order to get claims allowed. Gwyneth files narrow claims on exactly the same invention, but for Brent, and gets those claims allowed without amendment. David sees the issued patent Gwyneth got and files a broadening reissue to amend the claims to the identical scope claimed in Brent's patent. Under ***Festo***:

a) Alex gets no DOE.

b) Brent gets the full benefit of the DOE.

c) Alex gets the full benefit of the DOE.

d) Brent gets no DOE.

e) Both "a" and "b".

40) David convinces Gwyneth not to tell Examiner about the source of the claims, and she never does.

a) Gwyneth's patent is invalid for inequitable conduct.

b) David's patent is invalid for inequitable conduct.

c) Gwyneth has violated the PTO Code of Professional responsibility.

d) Both "b" and "c".

e) All "a" "b" and "c".

41) Examiner rejected as "self-serving" (because the declaration was from Alex) David's first attempt to draft an acceptable Rule 132 Declaration to overcome a §112 rejection. David then drafts a more convincing Rule 132 Declaration from Brent, a software engineer, but does not disclose the Brent's relationship with Alex and the fact that Brent had been working with the software invention for years. With respect to inequitable conduct, which of the following is true?

a) David's conduct clearly satisfies the intent to deceive prong.

b) David's conduct satisfies the intent to deceive threshold .

c) David's conduct clearly satisfies the materiality prong.

d) David's conduct satisfies the materiality threshold.

e) Both "b" and "d".

42) If in the above situation, Alex and Brent had not told David about their prior relationship, and David had not asked, then with respect to inequitable conduct, which if any, of the following is true?

a) David's conduct likely satisfies the intent to deceive threshold.

b) David's conduct likely satisfies the materiality threshold.

c) Both "a" and "b".

d) It is not possible to conclude either "a" or "b" on the given facts.

e) None of the above.

43) CPAs, RCEs, Amendments, Declarations, Petitions, Issue Fee Transmittals, and Authorizations to charge deposit accounts, all have in common:

a) They can be fax filed.

b) They cannot be fax filed.

c) They require an original signature.

d) The Applicant(s) must sign them.

e) None of the above.

44) David receives a first action on the merits dated February 12, 2001. Examiner, with whom David has had issues in the past: (i) rejected all of the claims under 35 USC§112, ¶2; (ii) objected under 35 USC § 132 to matter added to the specification by a preliminary amendment; and (iii) required a substitute specification that includes a revised summary of invention, abstract, and an additional drawing showing the prior art. David is just livid, disagrees with all these, and thinks they are unfair. David's friends and cohorts agree. What should David do?

a) Petition the Commissioner asking for Supervisory Authority.

b) File a Response responding to the rejections and objections and requesting reconsideration and presenting arguments distinctly and specifically pointing out every supposed error in Examiner's requirements.

c) Appeal.

d) Amend to overcome Examiner's rejection under 35 U.S.C.§112; appeal the objection to the specification.

e) Change Examiners.

45) Which of the following statements, if any, is NOT true?

a) The Commissioner will entertain a Petition for Reconsideration of a claim rejected under 35 U.S.C.§112.

b) A Petition to Vacate a Final, filed within two months after the mailing date of the Final, will not stay the period for filing a §111 Response.

c) A Petition filed 45 days after an adverse decision by Examiner on a Request for Reconsideration of a petitionable matter should not be dismissed as untimely.

d) Examiner's Objection to the dependency of a claim on a rejected claim, when the dependent claim is otherwise allowable, is petitionable.

e) All the above are true; none of the above statements is NOT true.

46) David's client is an expert in the baseball trainer art. Neither Client nor David did a prior art search before filing, however, a prospective licensee provided Client with a Reference, of which Client had not been aware. Prospective licensee hoped to lower the licensing fees. Client believes the claim in the application may not be patentable over Reference. David believes that the pending claim need not be amended in view of Reference. If David pays any requisite fee, he can ask for Expedited Examination if he submits the following.

a) A statement that a careful and thorough search of the prior art has been made.

b) Drawings in compliance with Rule 84 and item "a".

c) A Request and the items in "a" and "b".

d) An IDS and the items in "a" and "b" and "c".

e) None of the above; Dave cannot ask for Expedited Examination on these facts.

47) Which of the following is true regarding interviews?

a) Examiners may not be interviewed by an attorney who has not passed the Patent Bar Exam, even if the attorney is the applicant.

b) A request for an interview on the merits prior to the filing of a first filed original patent application normally is permitted.

c) A request for an interview on the merits prior to a first action in a continuation application is ordinarily granted.

d) A complete written statement as to the substance of a face-to-face or telephone interview with regard to the merits of an application must be made of record in the application, unless Applicant and Examiner have come to an agreement regarding the language of the claims.

e) If a registered practitioner, not the attorney of record, seeks an interview and has a copy of the application file, Examiner should reject the practitioner's statement that he is authorized to represent the applicant and should report the practitioner to the Office of Enrollment and Discipline.

48) An interview with the responsible patent examiner:

a) May be had as a matter of right, during normal Office business hours, any time claims are pending.

b) Must be made of record in writing only if agreement cannot reached with Examiner and reconsideration is requested by Applicant.

c) Is normally granted prior to filing the original application where requested for the purpose of filing allowable claims.

d) Must be memorialized in writing by the Practitioner where the interview discusses only procedural matters.

e) Must always be memorialized in writing by the examiner, who sets forth the substance of the interview, unless the examiner and the practitioner agree the practitioner will record the substance of the interview.

49) Alex and Brent invent something. David files an original patent application containing claim 1 in independent format and dependent claims 2-21. Examiner rejects all the claims over patent X in view of patent Y. David disagrees and thinks the Examiner is being unfair. Which of the following responses, if any, would be fully responsive if David does so timely?

a) File a notice of appeal, followed one month later by an appeal brief.

b) File Petition with the Commissioner requesting waiver of the rejection.

c) File an Amendment, without remarks, rewriting the claims to define over patents X and Y.

d) File a Request for Reconsideration specifically pointing out how the language of the claims patentably distinguishes them from patents X and Y.

e) None of the above is advisable.

50) Which of the following is true regarding David's rights in regard to amendments he filed after Final?

a) An Amendment is entitled to entry, if and only if, it substantively narrows.

b) An amendment is entitled to entry, if and only if, it amends only the claims that were Finaled.

c) An amendment is entitled to entry if it cancels claims, adopts suggestions made by Examiner, or removes issues for appeal.

d) An amendment is entitled to entry if it cancels claims and adds new claims that clearly set forth a previously unclaimed embodiment of the invention.

e) Applicant cannot make any amendments, but may submit remarks and a Notice of Appeal.

51) In terms of design patent subject matter the term "article of manufacture" likely means:

a) A mass-produced article.

b) Anything that is not a Composition of Matter.

c) Manufactured articles that do not have moving parts.

d) The physical item upon which the visual characteristics of the design are displayed.

e) Any useful piece of industrial design.

52) The holding of the Supreme Court of the United States of America in ***TrafFix Devices, Inc.*** v. ***Mktg. Displays, Inc.***, 149 L. Ed. 2d 164 (2001) (the Dual-Spring Sign case) is:

a) Where a utility patent claimed the features for which trade dress protection is asserted, the proponent must carry the heavy burden of showing that the feature is not functional.

b) Where a feature was described in a utility patent, that feature cannot be protected as trade dress after the patent has expired.

c) Where a feature was claimed in a utility patent, that feature cannot be protected as trade dress after the patent has expired.

d) Where a feature was an element in a claim in a utility patent, that feature cannot be protected as trade dress after the patent has expired.

e) Where the central advance claimed in the expired utility patent is the dual-spring design; and the dual-spring design is the essential feature of the trade dress MDI seeks to protect, that protection is barred.

53) As the proponent of trade dress protection for a feature claimed in a design patent, David should argue:

a) There is a presumption in favor of no functionality and the burden should rest on the opponent to show that the feature is functional.

b) There is a presumption in favor of no functionality so there should be no burden on the proponent to show that the feature is not functional.

c) There is a presumption in favor of functionality, but that presumption is overcome by existence of the design patent.

d) There is a presumption in favor of functionality, but the design patent is evidence of no functionality.

e) The standard for "functionality" of a design patent is legally different from the standard for "functionality" of trade dress.

54) If David opposes trade dress protection for a feature that had been protected by a design patent, David should argue:

a) Just because a design feature is ornamental does not mean that it is not also functional.

b) Just because a design is ornamental does not mean that a feature of the design is not functional.

c) The level of "functionality" that would have invalidated the design patent, at least in this particular case, is higher than the level that should be required to say that the trade dress is legally "functional."

d) Just two of the above

e) All the above

Exam No. _____

55) Which of the following, if any, is true:

a) 37 CFR § 1.55(a) no longer permits a Petition for Entry of a foreign priority claim after the issue fee has been paid.

b) After payment of the issue fee, a priority claim, even filed with the required processing fee, will not be reviewed for compliance with 35 USC §119(a)-(d) and the patent will not publish with a priority claim.

c) Patentee who find himself in the situation in "b" above must then request a Certificate of Correction to place the foreign priority on the patent.

d) All the above are true.

e) None of the above is true.

56) Which of the following, if any, is true with regards to Rules 84 and 85 (patent drawings):

a) The new focus of the Rules is scan ability.

b) The period of time to file corrected or formal drawings after Allowance is not extendable under § 1.136(a) or (b).

c) Fewer corrected or formal drawings will be filed after Allowance in view of the up front requirement to file formal drawings before substantive examination will begin.

d) The new rules replaced the Petition to accept photographs with a list of examples where a photograph is acceptable, but still allows Examiner to require a drawing where a drawing would better illustrate the invention.

e) All the above are true.

57) When filing an IDS under the new rules, which of the following if any, must be included:

a) Copy of any cited United States Application.

b) Copy of any cited United States Patent.

c) Copy of an English language translation of any cited foreign language publication.

d) All the above.

e) None of the above.

58) The recent change to Rule 311:

a) Allows authorizations to charge issue fee to be filed only after the mailing of the Notice of Allowance and Issue Fee Due.

b) Allows authorizations to charge issue fee to be filed only before the mailing of the Notice of Allowance and Issue Fee Due.

c) Allows authorizations to charge issue fee to be filed only after the mailing of the Notice of Allowance and within three months of the Issue Fee Due.

d) Authorizes payment of an incorrect issue fee or submission of a completed fee transmittal form without payment to operate as a valid request to charge the correct issue fee to a previously authorized deposit account.

e) Both "a" and "d".

59) The Director may Not issue a Certificate of Correction to correct a mistake which is clearly disclosed in the records of the Office:

a) At the request of the patentee.

b) At the request of the assignee.

c) Acting sua sponte.

d) Acting on information supplied by a third party.

e) None of the above; the Director may issue a Certificate in any of the above situations.

60) Previously a __1__ was required in single column format; still required in single column format __2__.

a) (1) Copy of patent for which Reissue is applied for; (2) copy of patent for which Reexamination is requested.

b) (1) Copy of patent for which Reissue is requested; (2) copy of patent for which Reexamination is applied for.

c) (1) Copy of patent for which Reissue is applied for; (2) original patent specification.

d) (1) Copy of patent for which Reexamination is applied for; (2) copy of patent for which Reissue is requested.

e) (1) Copy of patent for which Reexamination is requested; (2) copy of patent for which Reissue is applied for.

PPII Final Examination
Spring 2001 — Prof. Jepson

Exam No. _____

PART 2: **Performance**

Answer the questions in your Blue Book. Clearly and unequivocally indicate what question you are answering.

Draft the documents in your Blue Book. Quality is more important than quantity!

Chanterelle, Morel & Porcini

From: Partner
To: Ace Associate
Re: Borra Reexamination

The Borra patent you prosecuted several summers past has been thrown into Reexamination. The PTO granted Reexamination on February 26, 2001. Examiner Hoards O. Mungo mailed the first Office Action in Reexamination on Monday, April 30, 2001 rejecting claims 6 and 12. Client does not want to amend. The earliest and most significant reference relied on by Examiner Mungo, and as it happens, the Requestor is the Redcap '650 patent filed June 8, 1998, and issued July 7, 1999. I have to say the disclosure totally anticipates Claim 6 and Claim 12, if the Redcap '650 patent is prior art.

1. **List** by correct title all the documents that we, meaning you, will need to prepare. (5 points)
2. **Explain** to me, concisely, precisely, but fully, the significance here of Dr. Borra's foreignness. (5 points)
3. You will find attached the Borra patent and some documents from the client, which you should find helpful. You should use them all.
4. **Prepare** the declaration, complete, and ready for signing. I want you to mail these papers to the PTO on the very last possible day — without in anyway compromising any of our client's rights, of course. Put the right dates on the documents for that future filing. Prepare also our reply or whatever, which will refer to the Declaration. (40 points)

Just leave everything ready for signatures on my chair before you leave today. Thanks, and sorry about calling you back from your little Honeymoon thing or whatever.

New York City Los Angeles Seattle
Ibiza Chaiminoux Antibes

US006022115A

United States Patent [19]

Borra et al.

[11] **Patent Number: 6,022,115**

[45] **Date of Patent: Feb. 8, 2000**

[54] **OPTICAL SYSTEM FOR OPTICAL BEAM SCANNING**

[75] Inventors: **Ermanno Borra**, St-Ferreol; **Simon Thibault**; **Stan Szapiel**, both of Ste-Foy, all of Canada

[73] Assignee: **Université Laval**, Ste-Foy, Canada

[21] Appl. No.: **09/097,262**

[22] Filed: **Jun. 15, 1998**

[51] **Int. Cl.**[7] **G02B 5/10**; G02B 7/182

[52] **U.S. Cl.** **359/859**; 359/860; 359/858; 359/861; 359/862; 359/863; 359/865

[58] **Field of Search** ..... 359/859, 860, 359/861, 862, 863, 864, 865, 858, 871, 872, 857; 343/761, 755, 758, 766, 781 P, 781 CA

[56] **References Cited**

U.S. PATENT DOCUMENTS

2,697,379	12/1954	Walker	359/858
4,042,933	8/1977	Lapp	343/761

OTHER PUBLICATIONS

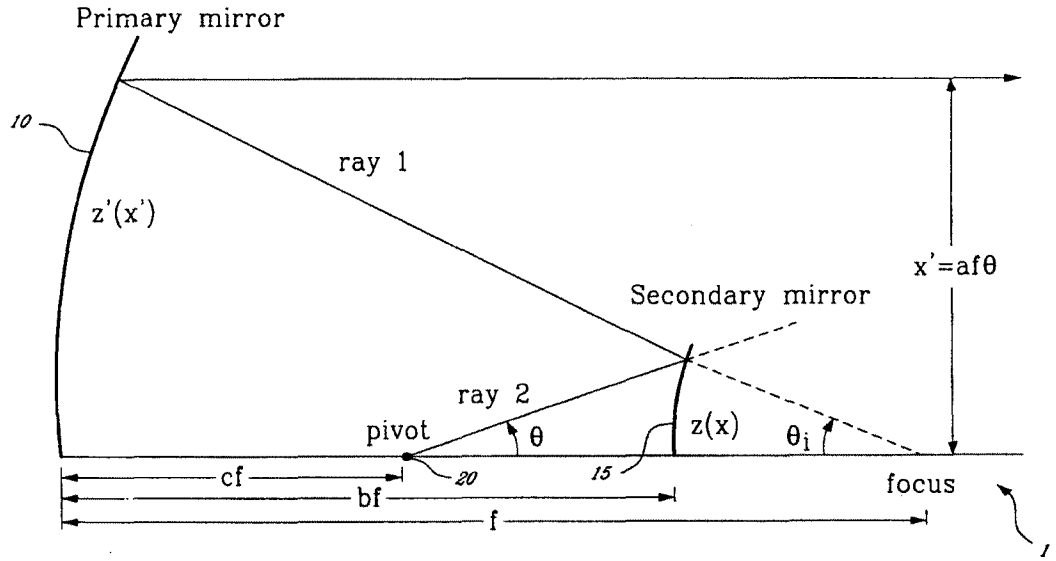
Proceedings of SPIE "Sensors, Sensor Systems, and Sensor Data Processing", vol. 3100—Jun. 16–17, 1997—Munich, FRG.

Primary Examiner—Cassandra Spyrou
Assistant Examiner—Mohammad Y. Sikder
Attorney, Agent, or Firm– Chanterelle, Morel & Porcini

[57] **ABSTRACT**

The present invention is directed to an optical system for measurement of a three dimensional device. The optical system is designed and configured to meet telecentric and f-θ requirements. The system employs primary and secondary mirrors operating in conjunction with a tertiary deflector mounted on a pivot. Light from a light source produces a beam which is deflected off the deflector and the secondary and primary reflectors respectively. The beam is then transmitted to the surface of the object to be measured. Deflection of the tertiary deflector on the pivot results in scanning of the light beam across the surface of the object to be measured.

14 Claims, 5 Drawing Sheets



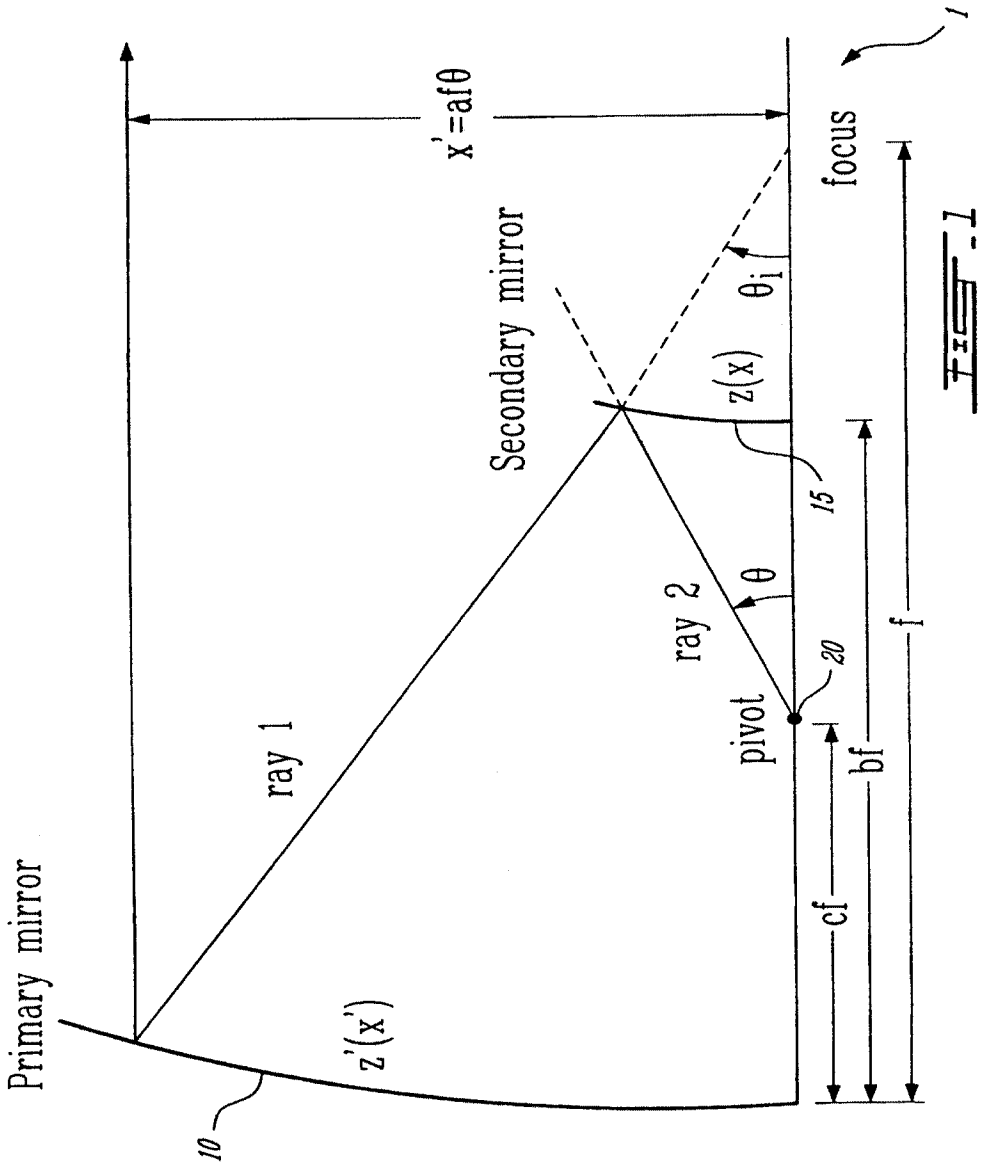

1
x'=afθ
focus
Secondary mirror
θi
z(x)
15
θ
ray 2
20
pivot
bf
f
cf
ray 1
Primary mirror
z'(x')
10

FIG. 1

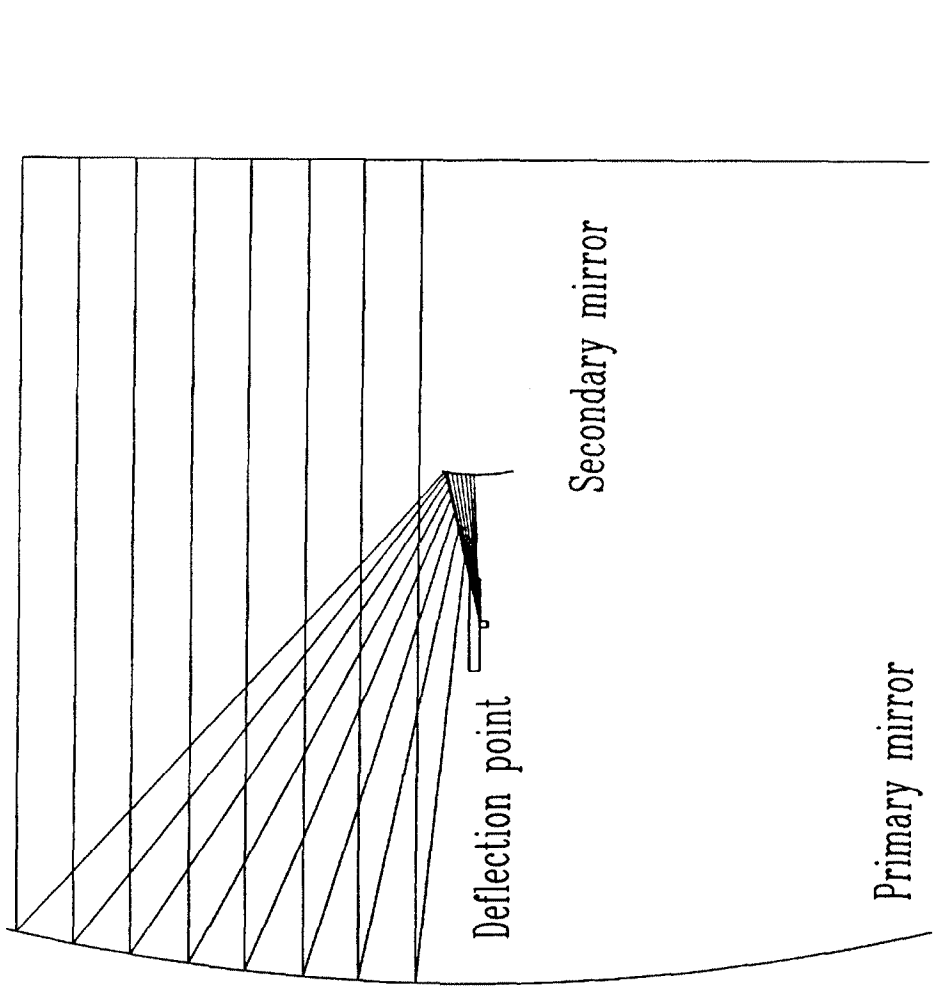

Scanning surface
Secondary mirror
Deflection point
Primary mirror

FIG. 2

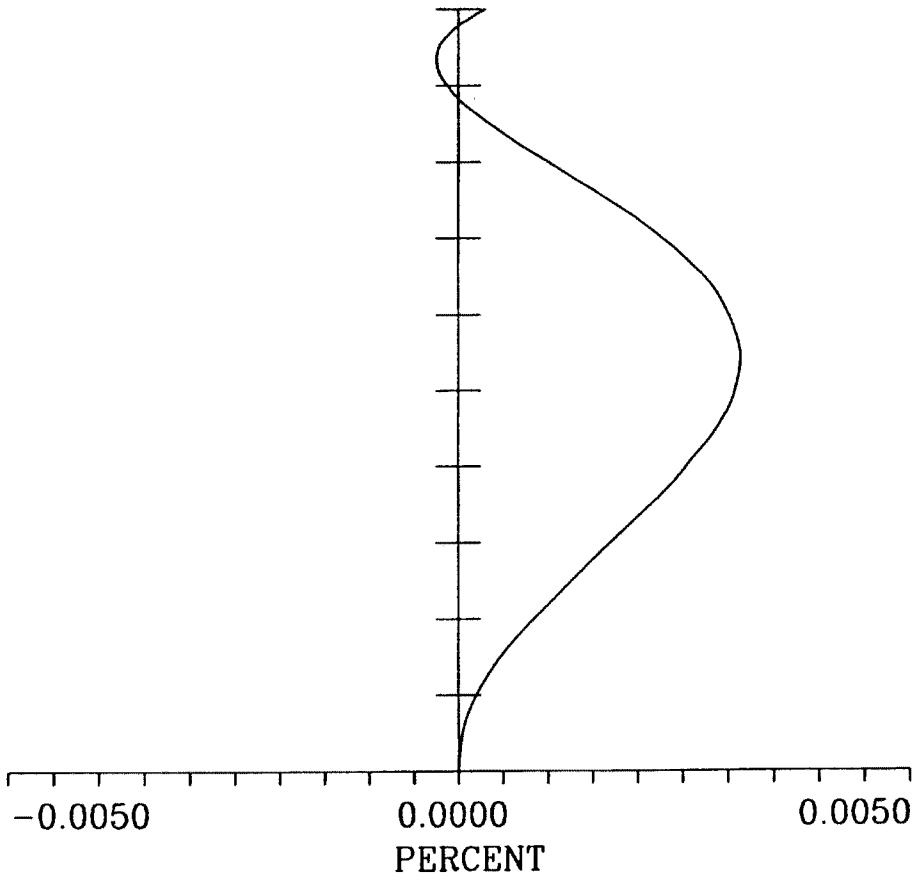


FIG 3

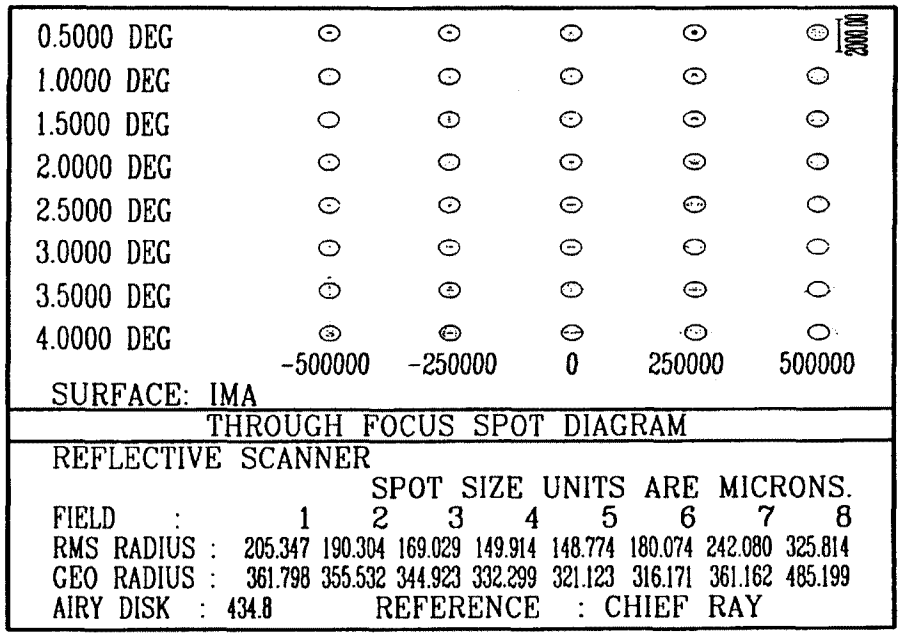

0.5000 DEG
1.0000 DEG
1.5000 DEG
2.0000 DEG
2.5000 DEG
3.0000 DEG
3.5000 DEG
4.0000 DEG
-500000
-250000
0
250000
500000
2000.00
SURFACE: IMA
THROUGH FOCUS SPOT DIAGRAM
REFLECTIVE SCANNER
SPOT SIZE UNITS ARE MICRONS.
FIELD : 1 2 3 4 5 6 7 8
RMS RADIUS : 205.347 190.304 169.029 149.914 148.774 180.074 242.080 325.814
GEO RADIUS : 361.798 355.532 344.923 332.299 321.123 316.171 361.162 485.199
AIRY DISK : 434.8 REFERENCE : CHIEF RAY

Fig. 4

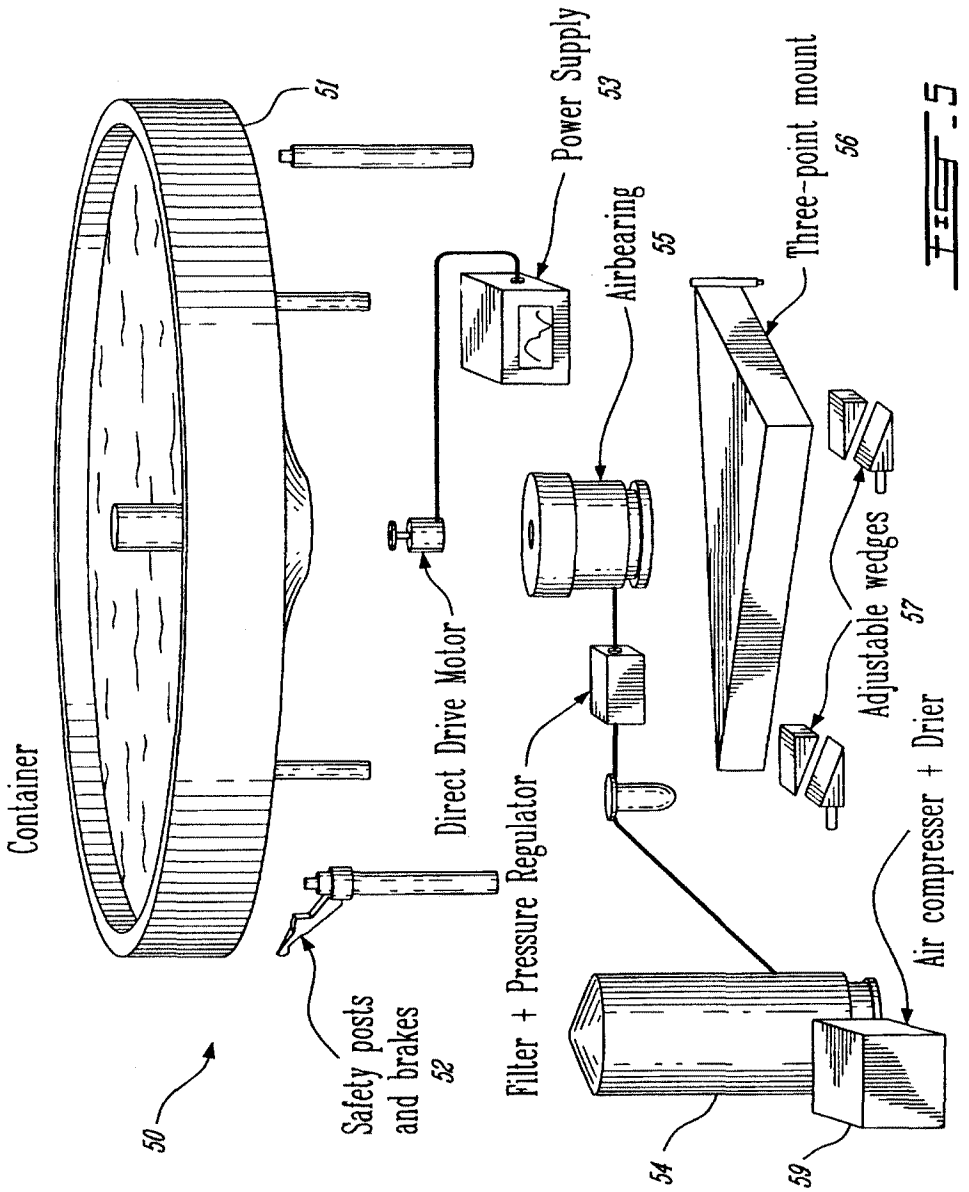

Container
51
Power Supply
53
Airbearing
55
Three-point mount
56
Direct Drive Motor
Adjustable wedges
57
Filter + Pressure Regulator
Air compresser + Drier
Safety posts and brakes
52
50
54
59

FIG. 5

OPTICAL SYSTEM FOR OPTICAL BEAM SCANNING

FIELD OF THE INVENTION

The present invention relates to an optical system for beam scanning of a surface, and in particular, an optical system which uses beam scanning for measurement of an object, which meets the definition of an f-θ and telecentric system.

BACKGROUND OF THE INVENTION

This invention relates to a reflective optical system that allows a focused beam to scan a surface while respecting simultaneously the f-q and the telecentric conditions. The f-θ condition is one in which the scanning angle has a linear relationship with the position of the focused beam on the surface to be scanned. The telecentric optical system is characterized by the fact that the scanning beam has a constant direction and shape. Driven by practical applications, there has been enormous progress in optical scanning over the past several years. However, while much effort has gone to improving the software, relatively little has been done to improve the optical scanning systems themselves. On the other hand, it is possible to simplify considerably the task of the software by designing more sophisticated optical systems which operate at higher speeds and greater accuracy. An f-q telecentric optical system constitutes such a desirable hardware improvement. By introducing the desired amount of distortion in the optical system it is possible to obtain a nearly linear relation between the scanning angle q and the position of a focused beam on the surface to be scanned. If the direction and shape of the beam can also be maintained constant, the systems meets both the f-θ and telecentric requirements.

BRIEF SUMMARY OF THE INVENTION

It is a feature of the present invention to provide a large volume three dimensional measurement system which maintains the above described f-θ and telecentric conditions, so as to permit fast and accurate scanning.

In accordance with the above features, from a broad aspect, the invention provides an optical system for large volume three dimensional measurement. The optical system incorporates a primary reflector, a secondary reflector means and a light source wherein said primary reflecting means and said secondary reflecting means are fixed in position relative to each other. The system also includes a tertiary deflector that it is capable of pivoting. The light source projects a light beam which reflects off the tertiary deflector, secondary reflector and primary reflector for transmission to the surface of the object to be measured. The light source projects the light beam to the secondary reflector at an angle to a predetermined axis. This angle has a linear correspondence with the position of the beam on the object. Pivoting of the tertiary deflector permits the scanning of the light source across the object to be measured.

In accordance with the above features, from a second broad aspect, the optical system further includes primary and secondary reflectors, and a tertiary deflector for reflecting a light beam such that it is transmitted to the surface of an object to be measured. The tertiary deflector includes a system for pivoting this deflector in response to a control signal. The reflectors are arranged in such a manner that the position of the light beam on the object to be measured has a linear relation with the control signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** discloses the basic elements of the of the optical system, along with the various design parameters.

FIG. **2** show the paths of light beams in the optical system of the present invention.

FIG. **3** is a graph illustrating the deviation in percent from the perfect linearity between the scan angle θ and the position of the beam on the object being scanned.

FIG. **4** is a diagram illustrating the variation in the beam spot sizes as they appear at various positions on the object being measured and at various scan angles.

FIG. **5** is an exploded diagram illustrating the mechanical elements necessary for the liquid mirror operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The main optical elements of the f-q telecentric system **1** consists of a concave primary mirror **10** facing a smaller convex mirror **15**. The mirror **15** faces the pivot **20** so that the pivot is placed between the two mirrors. The pivot **20** supports a pivoting mirror or deflector, which receives and reflects a beam of light from a light source (not shown). The pivoting mirror may also be driven motorized system that responds to a control signal from the operator. The beam of light is preferably a laser source, and is preferably positioned below the pivot **20** as shown in FIG. **1**. However, the position of the source of light and the nature of the light source may vary, and the invention is not intended to these particular preferred embodiments.

The optical system of the present invention operates by transmitting a light beam from the light source which reflects off the pivoting deflector, the secondary convex mirror and the primary concave mirror for transmission to the surface of the object to be measured. Pivoting the pivotally mounted deflector at **20** causes the light beams to scan across the measured object along the vertical length x'.

The relation z'(x') describes the surface of the primary mirror and the relation z(x) the surface of the secondary mirror. The position x' is the position of the scanning beam along the object to be measured. The constant "a" is a constant that, while preserving the f-q and telecentric conditions, allows one to introduce a correction to the optical magnification. The constant "a" and its implications in this optical system are further discussed with respect to the mathematical equations which follow.

The optical ray **2** comes from the pivot at an angle q with respect to the optical axis of the system. The optical ray **1** reflected from the secondary is at an angle q_i with respect to the optical axis of the system. The distance between the primary and secondary mirror is a fraction b of the focal length f of the primary and the distance from the center of the primary to the pivot is a fraction c of f. To satisfy the f-q condition, there must obtain a linear relation between the scanning angle q and the position x' with a slope given by "a x f" the product of "a" and "f" which were previously defined. To satisfy the telecentric condition, the exit pupil of the system must be at infinity so that the stop of the system must coincide with the focus at distance f. In such an optical configuration the light rays coming from the focus will be reflected by the mirror parallel to each other.

If the pivoting mirror is driven by a motor or transducer, which is controlled by a control signal, then it is also possible, in the f-θ design condition, to have the position of the light beam on the object related linearly to the magnitude of the control signal. The deflecting mirror can also be

replaced by any optical element that allows the deviation of a beam of light. The element could be a polygon, a galvanometer, an electro-optical system, a holographic element a diffractive element, or other types of deflective elements known and understood in the art. In addition, the secondary mirror can be replaced by a refractive optical element, a diffractive optical element or a hybrid refractive-diffractive element.

Considering the above discussion, the invention can be described mathematically, within the paraxial approximation, so that a choice of primary mirror imposes, mathematically, a shape for the secondary mirror. On the secondary mirror, ray **1** is described by

$$x=[(1-b)f-z]\tan\theta_i. \quad (1)$$

Ray **2** is described by

$$x=[(b-c)f+z]\tan\theta. \quad (2)$$

From these 2 equations one can then obtain the surface of the secondary mirror described by

$$z=\frac{[(1-b)\tan\theta_i-(b-c)\tan\theta]}{\tan\theta_i+\tan\theta}, \quad (3)$$

with

$$\theta_i=2\tan^{-1}\left(\frac{a\theta}{2}\right). \quad (4)$$

The surface of the secondary mirror only makes physical sense if the condition

$$a=\frac{b-c}{1-b} \quad (5)$$

is respected. One can therefore see that one has a large number of possible solutions depending on the values chosen for b and c provided the condition in equation 5 is respected. One obtains the shape of the secondary mirror by converting the dependence on q to a dependence on x with equations 1 and 2. It is possible to obtain a polynomial solution

$$z(x)=Ax^2+Bx^4+Cx^6+ \quad (6)$$

by a least squares fit to the solution. The constants A, B, C are the aspheric coefficients describing the surface. Most optical design software packages can handle an aspheric term described by equation 6.

The invention allows reflecting systems having arbitrary dimensions. A reflective optical system allows a large spectral range. These two very important characteristics allows one to apply the invention to RGB (Red, Green, Blue) white light scanning systems that can scan large objects.

Example of Preferred Embodiment

In the preferred embodiment of the present invention, the primary mirror is a liquid mirror having a diameter of 1.2 meters and a focal length of 1 meter. A parabolic mirror is an ideal choice since it is naturally telecentric. We chose a liquid mirror for the main reasons that it is a parabolic mirror and that the technology allows one to construct large reflecting mirrors at low costs. Using a solid mirror (such as one made out of glass or metal) is possible and would not have made any significant change to the embodiment. The secondary mirror is aspheric. It has a diameter of 100 millimeters. The shape of its surface has been computed with the equations defined in the brief summary of the invention. The parameter A, B, C used are given in the table.

Parameter	Primary mirror	Secondary mirror
Radius of curvature (mm)	−2000	—
Conic constant	−1	—
A	—	2.45 × 10-4
B	—	−2.16 × 10-8
C	—	1.44 × 10-12

The pivot consists of a flat circular mirror having a diameter of 25.4 millimeters mounted on a rotating stage. A He—Ne laser emitting at a wavelength 632.8 nanometers is placed at 165 millimeters from the pivot. The beam emitted by the laser is sent perpendicularly to the optical axis of the system. The distance between the pivot and the secondary mirror is 350 millimeters. The distance between the primary mirror and the secondary mirror is 933 millimeters. A 5 millimeter thick biconcave lens made of BK7 glass and having a focal length of −90 millimeters is placed between the pivot and the secondary mirror at a distance of 85 millimeters from the pivot. This lens allows one to obtain a diffraction-limited spot size of 0.87 millimeters over the surface to be scanned. Without this lens the spot size, still diffraction-limited, would be 1 millimeter.

The system thus described obeys the relations given by equations (1) and (2) and therefore obeys the f-q condition and is telecentric. FIG. **3** gives a curve that shows the deviation (in percents) with respect to the perfect linear relation on the scanning surface 1.5 meters from the primary mirror in the direction of propagation. Telecentricity is observed by computing the position of the exit pupil of the system. The stop is defined by the width of the beam on the flat mirror at the pivot point. For the system described in this embodiment, the exit pupil is placed 1.1 kilometers above the primary mirror in the direction of propagation of the beam. The angular spread of the beam is within 0.2 arc minutes.

FIG. **4** shows spot diagrams inside a scanning volume 1 meter deep and 0.85 meters wide. Inside that volume, the spot is almost always diffraction-limited.

FIG. **5** illustrates a preferred embodiment for the reflecting mirrors utilized in the present invention. The reflecting mirror system **50** includes a container **51** containing a liquid reflective material. The liquid reflective material is preferably mercury, although other types of liquid reflective materials may be utilized. The container **51** containing the liquid reflective material is connected to a powered drive motor **52** which drives the container **51** containing the liquid. The container **51** is in turn supported on an air bearing **55** which is pressurized by an air compressor **59** and pressure regulator/filter **54**. The air bearing **55** is in turn mounted on a three point mount **56** which is supported at a level position by adjustable wedges **57**.

The rotation of the container **51** by the drive motor **53** applies centrifugal forces to the liquid of the mirror. These forces, combined with the normal gravitational forces cause the mirror to assume a parabolic shape, without distortion. Such liquid mirrors are also extremely economical to use, since they cost far less to set up and manufacture than solid mirrors.

What is claimed is:

1. An optical system for large volume three dimensional measurement, comprising:

a large surface area primary reflection means for reflecting a beam of light toward a three dimensional object;

Proc. Nat. Acad. Science
1998 May 1, v. 288, pp 98

Emanno Borra, Ph.D.

What is a liquid mirror?

As we all know, a perfect reflecting parabola represents the ideal contour for a mirror to focus parallel rays of light into a single point.

It is therefore of the greatest importance to have realized that a rotating liquid surface takes the shape of a parabola under the constant pull of gravity and a centrifugal acceleration, which grows stronger as the distance from the central axis increases (E. Cappoci, 1850). The parabolic shape occurs because a liquid surface always sets it local surface perpendicular to the net acceleration it experiences, which in this case becomes stronger and less inclined with distance from the central axis (see **Figure 1**).

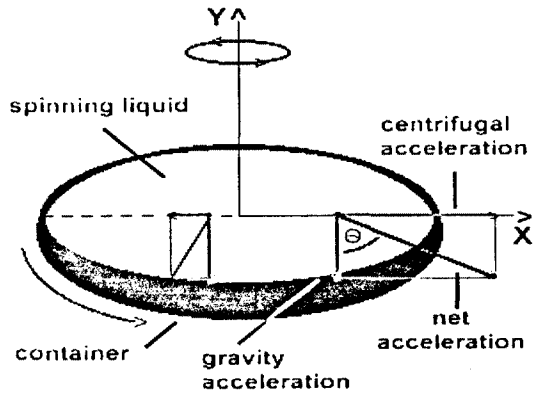


Figure 1: Acting forces on a liquid set in a rotating container

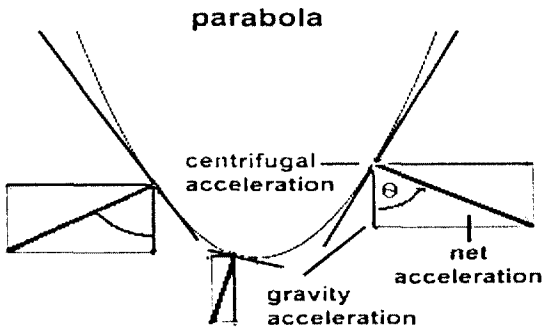


Figure 2: Parabolic shape of the spinning liquid with the distribution of forces acting on a single liquid particle

Indeed, inspection of the above figure clearly shows that the tangent dy/dx to the liquid surface may be expressed as (see **Figure 2**)

$$dy/dx = tg(\theta) = \omega^2 x / g, \qquad (1)$$

where $\omega^2 x$ and g represent the centrifugal force and gravity acting on a mass unit (see the red dot in **Figure 1** and **Figure 2**). Integration of the above differential equation leads to the solution

$$y = \omega^2 x^2/(2g), \qquad (2)$$



Laboratory Notebook of:
Prof. Ermanno Borra
Feb 15, 1998 – May 15, 1998

43

A secondary mirror would be like

$$X = [(1-b)f - z]\tan\phi$$

Ray 2 $= X = [(b-c)f + z]\tan\theta$

So, $$z = \frac{[(1-b)\tan\theta_i - (b-c)\tan\theta]}{\tan\theta_i + \tan\theta}$$

with $\theta_i = 2\tan^{-1}\left(\frac{a\theta}{2}\right)$



particularly when $a = b-c/1-b$

wow! I am brilliant!

EB

12/150

E. Barr 15/2/98

hp invent

Economist.com

OPINION

Mirror, mirror

Telescopes with mirrors made from rapidly spinning liquids could redefine the economics of astronomy



ON THE face of it, a telescope with a liquid mirror sounds about as useful as a chocolate teapot. The enormous rigid mirrors that capture and focus light inside large telescopes weigh several tonnes, and take many years of painstaking effort to cast, grind and polish—a process that shapes their surfaces to within a few billionths of a metre. So how could a pool of liquid mercury do the same job? The answer is surprising. Pour any liquid into a cylindrical container, rotate the container at a constant speed, and the surface of the liquid will become a paraboloid, which just happens to be the perfect shape for a telescope's mirror.

This idea is not new. Indeed, it may go back as far as Sir Isaac Newton, the inventor of the reflecting telescope. But liquid-mirror telescopes (LMTs) were, for a long time, seen as of theoretical interest only. Over the past decade, however, the idea has looked increasingly attractive, for both economic and technical reasons. A few LMTs were constructed during the 1990s, and the largest yet made, with a mirror six metres across, will soon capture its first light in the forest east of Vancouver, Canada. Advocates of LMTs believe the technology has now come of age—and that it could even spell the end of conventional telescopes.

Causing a stir

Compared with making a rigid mirror, making a liquid mirror is a picnic. The main ingredient is a small amount of mercury, which is placed inside a strong yet light container made of a composite material such as Kevlar. This container is a paraboloid, but its shape does not need to be made as accurately as a rigid mirror. Once the container is spinning at the correct speed (typically a few revolutions per minute), the mercury spreads out to form a layer less than a millimetre thick, and in such a way that variations in the thickness of the mercury layer compensate for the imperfect shape of the container. The result is a liquid mirror as accurately shaped as a conventional rigid one—but at about 1% of the cost.

There is more to a telescope than its mirror, of course. But when the other components and housing are taken into account, an LMT still comes in at around 5% of the cost of a comparable conventional telescope. The Large Zenith Telescope—as the six-metre LMT that is being constructed by Paul Hickson and his team at the University of British Columbia, in Vancouver, is known—is being built on a shoestring, and is expected to cost less than $1m. In comparison, the construction cost for the two eight-metre Gemini telescopes in Hawaii is $184m, and the 4.2-metre Southern Astronomical Research telescope being built in Brazil will cost $28m.

The ability to construct large telescopes for a fraction of the usual cost could transform astronomy. It would mean that individual research groups could have their own telescopes, instead of having to book time on shared instruments months in advance, as they do now. Having sole use of a dedicated telescope would make new kinds of research possible, too. At the moment it is not feasible to dedicate all the observing time on a six- or eight-metre telescope to search for exploding stars known as supernovae in other galaxies. This is a pity since, in an ideal world, such searches would involve repeated observations of the same galaxies every few days. But with an LMT, using a large telescope for such specialised research would become possible.

There is, however, a catch: LMTs can only point straight upwards. Tilting the spinning container causes the mirror to lose its shape, so it is not possible to point an LMT at a particular spot in the sky—and even when an object of interest is directly overhead, it is not possible to track it by moving the telescope to compensate for the rotation of the earth.

This restriction is not as limiting as it sounds, though, at least for certain kinds of astronomy. Cosmologists investigating the structure of the universe do not really mind which direction a telescope is pointing, since the universe is isotropic and homogeneous—which is a fancy way of saying that it looks the same in all directions. Similarly, long-term sky surveys and supernova searches can be done with a zenith-pointing telescope: over the course of a year, the telescope can observe an entire band of the sky.

Another drawback of LMTs has been solved by the advent of digital sensors. Use a photographic plate to record an image from a zenith-pointing telescope, and you will end up with a streaky image, as a result of the earth's rotation. Use a digital sensor, however, and it is possible to shuffle the image across the sensor in such a way that it is exactly in step with the earth's rotation.

One of the leading proponents of the liquid-mirror approach is Ermanno Borra, a physicist at Laval University in Quebec. It was Dr Borra's team that worked out how to coax mercury into forming a film less than a millimetre thick. (Normally, surface tension causes the metal to form much thicker blobs.) Dr Borra also carried out a series of key experiments in the 1990s to show that LMTs would actually work. His research prompted scientists at America's space agency, NASA, to build a three-metre LMT. This is now the 17th-largest telescope in the world and is used to track space debris—another application where the inability to point the telescope does not really matter that much.

Dr Borra is eager to point out that the Large Zenith Telescope, and a proposed four-metre telescope called the International LMT, are being built to do real science, rather than merely to investigate the properties of LMTs. He is particularly excited by the prospect of being able to dedicate a large telescope to the search for supernovae, since these are used as intergalactic yardsticks by astronomers. The puzzling finding in 1999 that the universe's expansion seems to be accelerating was based on observations of a few dozen supernovae. An LMT ought to be able to find several thousand supernovae over the course of a year, and confirm or disprove this result beyond doubt.

As well as spreading the word about the advantages of LMTs, Dr Borra is doing his best to overcome their inability to point. A liquid mirror spins once every few seconds, so provided the liquid is sufficiently viscous to stay put for half a revolution when the mirror is tilted, it will not lose its shape. Dr Borra worked out just how viscous the liquid would need to be, and found that it had to be the consistency of thick honey. The problem is that mercury is far less viscous than this; and honey does not reflect light, and so would not work as a mirror. The search thus began for a liquid that was both viscous and highly reflective.

As luck would have it, Dr Borra came across a suitable class of materials. They are called metal liquid-like films. Tiny particles of silver are coated with organic molecules so that they float, and are then added to silicone oil. The result is a thin reflective layer that floats on the surface of the oil.

So far, Dr Borra has achieved a reflectivity of 50% (that is, half of the light falling on the mirror is reflected), but he is confident that he will be able to equal the 80% reflectivity of mercury. At this point it will be feasible to build a tilting LMT. And he reckons that, if he can build a four-metre or

larger LMT that can tilt by at least 30°, that will spell the end of the classical telescope.

This is a bold claim. But suppose it were possible to build a telescope that could do everything a conventional telescope can do for a fraction of the price—around 10%, by Dr Borra's estimate. The impact of his crazy-sounding spinning mirrors on the economics of astronomy would be nothing less than, well, revolutionary.

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