United States District Court,
E.D. Michigan, Southern Division.

RENISHAW plc,
Plaintiff.
v.
MARPOSS SOCIETA' PER AZIONI and Marposs Corporation,
Defendants.

Aug. 13, 1997.

Patentee brought action against competitor for infringement of patents for touch probes. Following bench trial, the District Court, Gadola, J., held that: (1) accused probes did not infringe patents, and (2) competitor was not entitled to award of attorney fees.

Judgment entered in favor of defendants.

Evidence of an utter lack of care is sufficient to support finding of exceptional patent infringement case that warrants award of attorney fees to prevailing party. 35 U.S.C.A. s. 285.

James A. Samborn, Dickinson, Wright, Moon, Vandusen & Freeman, Bloomfield Hills, MI, James A. Oliff, Oliff & Berridge, Edward P. Walker, Alexandria, VA, for plaintiff.

Charles W. Saber, Thomas J. D'Amico, James W. Brady, Jr., Gabrielle, S. Roth, Dickstein, Shapiro, Morin & Oshinsky, Washington, DC, J. Michael Huget, Butzel Long, Detroit, MI, for defendants.

OPINION AND JUDGMENT

GADOLA**, District Judge.**

This is a patent infringement action in which the liability and damages issues have been bifurcated. Beginning on March 10, 1997 and continuing through March 27, 1997, this Court held a bench trial on the matter of liability. During the course of the trial, this Court received testimony and documentary evidence as well as dozens of physical exhibits. Post trial briefing was completed on May 30, 1997.

This Opinion represents the Court's findings of fact and conclusions of law with respect to all issues. These findings of fact and conclusions of law result from a careful consideration of all of the evidence and the documentary and physical exhibits in light of the pertinent law and the Court's observation of the witnesses and its evaluation of their demeanor, qualifications and credibility. Every finding of fact that may be construed to incorporate a conclusion of law is hereby adopted as a conclusion of law. Every conclusion of law that may be construed to incorporate a finding of fact is hereby adopted as a finding of fact. The sub-headings used herein are for convenience only. If a finding of fact or conclusion of law is pertinent to any

determination other than that indicated by the heading under which it appears, it is deemed adopted as a finding of fact or conclusion of law applicable to such other determination or determinations as may be appropriate.

FINDINGS OF FACT

I. *NATURE OF THE ACTION AND PARTIES*

1. This is a patent infringement action with federal jurisdiction based upon 28 U.S.C. s. 1338(a).

2. Plaintiff, Renishaw plc ("Renishaw"), is an English corporation with its principal place of business in New Mills, Wotton-under-Edge, Gloucestershire, England. PO 13. FN1 corporation with its principal place of business in Via Saliceto, Bentivoglio, Italy. PO 13.

FN1. The abbreviations "PO," "Tr," "DX," and "PX," correspond to the Joint Final Pretrial Order, the Trial Transcript, Defendants' Exhibits, and Plaintiff's Exhibits, respectively.

3. Defendant Marposs Societa' Per Azioni is an Italian corporation with its principal place of business in Via Saliceto, Bentivoglio, Italy. PO 13.

4. Defendant Marposs Corporation is a New York corporation with its principal place of business in Auburn Hills, Michigan. PO 13. Marposs Corporation is the U.S. subsidiary of Marposs Societa' Per Azioni and acts as a distributor of Marposs products in the United States. Tr 1022-23.

5. Marposs Societa' Per Azioni and Marposs Corporation are collectively referred to herein as "Marposs."

6. Renishaw filed suit against Marposs on July 21, 1994, alleging willful infringement of three Renishaw patents by Marposs' MIDA touch probes. The initial patents asserted were U.S. Patent No. 4,153,998 (the "'998 patent"), U.S. Patent No. 4,270,275 (the "'275 patent"), and U.S. Patent No. 5,253,428 (the "'428 patent").

7. Renishaw, with Marposs' consent, filed a Stipulated Amended Complaint on November 30, 1994, further alleging the infringement by Marposs of U.S. Patent No. 5,353,514 (the "'514 patent").

8. On December 8, 1994, on the parties' joint motion, the Court issued an order bifurcating liability and damages issues.

9. Renishaw sought and was granted leave to file a Second Amended Complaint on August 12, 1996, further alleging infringement by Marposs of U.S. Patent No. 5,491,904 (the "'904 patent").

10. Marposs, of course, denied all of Renishaw's allegations of infringement and has asserted that Renishaw's suit is in bad faith and seeks an award of attorneys' fees pursuant to 35 U.S.C. s. 285. PO 7-13.

11. The '998, '275, '428, '514 and '904 patents are wholly owned by Renishaw. PO 11, 19. Tr 340, 368.

12. It is uncontested that the accused MIDA probes were made, and sold in the United States, after the applicable patent issue dates. Tr 1199-1200, 1203-04; PX 87, PX 575, pp. 64-65.

13. Renishaw claimed that the Marposs MIDA probes infringed claim 12 of the ' 998 patent, claims 1-5 of the '275 patent, claims 1-28 of the '428 patent, claims 1-28, 38-49 and 51-55 of the '514 patent, and claims 1-6 of the '904 patent in this action. PO 1.

14. Prior to trial, Renishaw designated as representative claims 1 and 4 of the '275 patent, claims 3, 6 and 55 of the '514 patent, and claim 2 of the '904 patent. Renishaw did not choose any representative claims from the '998 or ' 428 patents. PO 1. Pursuant to a stipulation between the parties, claims 3 and 6 of the '514 were subsequently dropped from consideration.

15. Thus, by agreement, the case was tried on the basis of representative claims 1 and 4 of the '275 patent, claim 55 of the '514 patent, and claim 2 of the '904 patent. Both parties agreed that the resolution of these claims will constitute a final resolution of all the asserted patents as if the case had been tried without representative claims. PO 1.

II. *OVERVIEW OF TECHNOLOGY*

A. *Touch Probes*

16. Touch probes are mechanical devices that have been used for many years for very accurately checking dimensions on coordinate measuring machines ("CMMs") and on lathes, mills, machining centers, and other machining tools (collectively, "machining centers"). In the typical touch probe application, the touch probe is mounted on an arm that is part of the CMM or machining center. To measure, the arm is moved in order to bring the stylus of the touch probe into contact with the object to be measured. '904, col. 1, l. 21-27.

17. Touch probes do not measure objects by themselves. In general, a touch probe is simply a sophisticated switch that generates a repeatable signal. The repeatability of a probe is the ability of that probe to signal or trigger at the same point each time. All viable touch probes produce such repeatable trigger signals. The microprocessors and software within the CMM or machining center use the repeatable trigger signal of the touch probe to produce an accurate measurement. Tr 521, 1632; DX 245, Bates No. 112341; '904, col. 1, l. 15-28.

18. Modern touch probes produce trigger signals that are repeatable to the level of a single micron or less. A micron is one-millionth of a meter; a typical human hair has a thickness of 50 to 100 microns. Tr 156, 847, 850, 1094, 1308.

19. The patents in suit do not involve the microprocessors or software of the CMM or machining centers or what use these machines make of the repeatable trigger signal from the touch probe. Rather, it is the structure of the mechanical parts of the touch probe, and the way these parts function and interact together to produce such a highly repeatable signal, that are at issue. Tr 521; DX 987, Bates No. 011340; Stiftung v. Renishaw PLC, 945 F.2d 1173, 1177-78 (Fed.Cir.1991) (hereinafter " *Zeiss* " litigation).

20. CMMs generally operate in laboratory-like environments that are dry, clean, quiet, and vibration free. Tr 1064. Machining center environments, on the other hand, are generally harsh, dirty, and wet. The touch probe may be exposed to vibration and shocks, streams of liquid coolant, and chips of metal generated by cutting operations. Tr 204-05, 1026-27, 1064-65.

21. Prior to Mr. McMurtry's invention of the omnidirectional touch trigger probe, the metrology and

machine tool industries utilized either hard probes, relatively complicated analog probes that were used for tracing operations, or probes that permitted stylus deflection in only a limited number of directions. Tr 117-19, 341, 343-45.

22. Hard probes are simply rigid styli mounted on the end of a movable arm of a CMM. An operator would manually move the arm holding the stylus until the stylus contacted a workpiece. Then, while the stylus was held against the workpiece, the operator would instruct the machine to take a reading of the position of the movable arm, thus determining the position of the surface of the workpiece. These hard probes required constant operator control to accomplish measurement, thus effectively eliminating the possibility of automation. In addition, damage to the probe or the workpiece could result if the probe collided with the workpiece with sufficient force. Moreover, because hard probes could deflect the part being measured, the measurements taken with hard probes were prone to errors. Tr 117-19, 341.

23. Analog probes were also designed to be mounted on the end of a movable arm of a CMM. Analog probes have a stylus that is movable relative to the probe housing. An analog probe outputs an electrical signal that is proportional to the amount of displacement of the stylus relative to the probe housing. Such probes were slow, complex, expensive, unreliable, and many were operable in only a single deflection direction. Tr 118, 341.

24. None of the devices that existed prior to Mr. McMurtry's invention allowed cost-effective, rapid omni-directional position measurements to be taken. Many prior art devices did not permit the stylus to deflect large amounts after contacting the workpiece (known as "overtravel"). Overtravel is essential for automated systems because such systems cannot immediately stop movement of the probe (or workpiece) upon output of the trigger signal. Tr 113-15, 536.

25. In 1972, David McMurtry was a design engineer working at Rolls-Royce on the development of the Concorde jet engine. Mr. McMurtry was using a CMM equipped with a hard probe to measure delicate fuel system pipes used in the jet engine. Mr. McMurtry was experiencing a problem with use of the hard probe because contact between the hard probe and the fuel pipes would deflect the fuel pipes to an extent that the measurement became inaccurate. Tr 340-341.

26. To solve this problem, in 1972, Mr. McMurtry invented and built the first omnidirectional touch trigger probe, which was similar to the ones shown in Figures 1-3 of the '998 and '275 patents (*see* App. A). Tr 340.

27. The probes invented by Mr. McMurtry include a stylus-holding member that is movable omnidirectionally with respect to the probe housing. The probe is mountable on a movable arm of a machine tool or CMM that includes a computer for monitoring the position of the arm, and hence the probe. The computer of the CMM or machine tool uses the trigger signal to determine the position of the surface contacted by the stylus tip. Tr 113-15, 340-45, 533-34.

28. After inventing the first design of a touch trigger probe, Mr. McMurtry went on to invent additional alternative embodiments in 1972-1973. Tr 340, 346; PX 107, 108.

29. Because very little force was required to deflect the stylus of Mr. McMurtry's new probe, the part being measured was not deflected or damaged. In addition, unlike prior art electronic probes, the stylus was deflectable omnidirectionally to provide an electronic trigger signal. Tr 340-45.

30. Mr. McMurtry's invention of the omnidirectional touch trigger probe allowed rapid, highly accurate measurements to be taken with a relatively simple and inexpensive probe. In addition, because Mr. McMurtry's probes allowed for generous amounts of overtravel, the probes could be used in completely automated processes. Tr 113; PX 335 at Bates Nos. 368-375.

31. After inventing the omnidirectional touch trigger probe, Mr. McMurtry teamed up with a colleague at Rolls-Royce, Mr. John Deer, and the two formed a company to make and sell touch trigger probes. The company originally traded under the name Shephard & Adams, and later became Renishaw plc. Tr 346, 353-55.

32. Touch trigger probes embodying Mr. McMurtry's invention were first introduced to the marketplace in 1973. In the years immediately following their introduction, sales of the probes grew rapidly. Probes embodying Mr. McMurtry's invention quickly displaced hard probes and analog probes in the coordinate measuring machine industry. In addition, because Mr. McMurtry's touch trigger probes were highly reliable and could be used in fully automated operations, Mr. McMurtry's probes enabled coordinate measuring machine builders to develop a wealth of new automated products that increased the speed and accuracy of measuring. Tr 134-38, 145, 152, 340, 353-55, 361-62; PX 282-83, 286-91, 293, 533 and 534.

33. In approximately 1977, Renishaw also began selling touch trigger probes to manufacturers of machine tools for use in the harsher machine tool environment. The machine tool industry also rapidly embraced touch trigger probes. Touch trigger probes enabled machine tool builders to develop a wealth of new automated machines that increased the speed and accuracy of machining operations. The touch trigger probe helped to spawn an automation revolution that has resulted in the fully automated machining and measuring systems that are sold today. Tr 134-38, 152, 340, 353-63, 1167.

34. Mr. McMurtry received a great deal of recognition for his invention of the touch trigger probe, and the subsequent development of probing and automation products. Tr 143-44, 355-60, 362-66; PX 282-83, 286-91, 293-96 and 298-305.

35. Renishaw's sales of touch trigger probes increased rapidly since the original sales in 1973. In 1996, Renishaw sold more than 23,000 probes throughout the world, with sales of machine tool probes outnumbering sales of CMM probes. The two-man company started by Mr. McMurtry and Mr. Deer has now grown to a large multinational corporation employing more than 1,000 employees. Tr 134-38, 144-45, 362-66; PX 533 and 534.

B. The '998 and '275 Patents**-Renishaw's *Rest Position, Signal Upon Contact Touch Probes***

36. The touch trigger probe Mr. McMurtry invented in the early 1970's for use in his work as an engineer for Rolls Royce eventually resulted in two U.S. patents, the '998 and '275 patents. Tr 339-41; DX 290, Bates No. 006132.

37. The '998 and '275 patents are part of the same family of patents. Both patents are based upon the same disclosure and contain identical specifications and figures. PX 335, 336.

38. The '998 and '275 patents disclose seven embodiments of touch probes which are designed to provide a signal when the stylus of the touch probe contacts an object. DX 954, Bates No. 012727. All the

embodiments contain structure for repeatedly and accurately defining a "rest position" for the stylus and "movable member" of the probe, for reliably and immediately detecting a departure from that "rest position," and for returning the movable member to the "rest position". Id. The term "rest position" appears in the patents in suit hundreds of times. Tr 625. Renishaw sometimes refers to the "rest position" as "mechanical zero," the "zero position" or simply "zero." Tr 256-57, 399, 656.

39. Although the term "rest position" was not added to distinguish the claims of the '998 and '275 patents from prior art references, during prosecution of the '998 and '275 patents, the patent applicant repeatedly stressed the fundamental importance of ensuring that the stylus of the touch probe positively and accurately returns to its unique rest position or zero position:

a. The accuracy of the subject probe arises essentially from the way in which the stylus is seated on convergent surfaces. This ensures that the stylus is positively and accurately seated in the zero position.... As regards the accuracy of seating, this has been measured by a repeatability test in which the stylus is displaced and allowed to return to zero a large number of times, the zero position attained after each displacement being compared with the original zero position. Using a laser test instrument, it has been found that the probe has a repeatability tolerance of one millionth of an inch (0.000001 inch) [*i.e.*, 0.025 micron]. PX 334, Bates No. 000581 [Remarks, Amendment filed Oct. 7, 1976 in the '634 application, p. 6, l. 20-31].

b. It is the cooperation between the bias means, the convergent surfaces on one of the members and the member engaging the convergent surfaces which assures that the movable member will be positively held in its rest position when no force is acting on the movable member. These same elements cooperate to assure that the movable member is restored to its rest position after a force has been applied to the movable member and then removed. PX 335, Bates No. 000310 [Remarks, Amendment filed Jan. 16, 1978 in the '139 application, p. 13, l. 16-23].

c. It is fundamental to the invention that one of the movable or fixed members is caused by the bias means to slide on the convergent surface of the other part into a position in which all these surfaces are engaged. In this way a positive uniquely defined rest position is attained. PX 335, Bates No. 00310 [Remarks, Amendment filed Jan. 16, 1978 in the '139 application, p. 13, l. 24-28].

d. [T]he problem to which the present invention is addressed is ... one ... of positively locating a stylus. PX 334, Bates No. 000567 [Remarks, Amendment filed Feb. 3, 1976 in the '634 application, p. 6, l. 25-27].

e. There is no suggestion in Melvin, Jr., that this rest position of the structure 11 need be positively defined and in view of the clearances it cannot be positively defined. In any case it cannot be said that the springs 37 urge the structure into contact with any surfaces, convergent or otherwise with a view to positively defining a rest position for the structure 11. PX 335, Bates No. 000312-13 [Remarks, Amendment filed Jan. 16, 1978 in the '139 application, p. 15, l. 28-p. 16, l. 4 (distinguishing a prior art reference cited by the Examiner)].

f. The convergent surfaces ensure that the single movable part is located in the required rest position positively and without the possibility of mechanical slack; yet it is displaceable omni-directionally. One has to handle the probe to appreciate the ease in which the stylus can be displaced and the positive action with which the stylus returns into the rest position after a displacement. The convergent surfaces are therefore the basis of the merits of the probe. PX 335, Bates No. 000374-75 [Remarks, Declaration submitted with

Supplemental Amendment filed Jan. 20, 1978 in the '139 application para. 17].

g. [T]he stylus must be mounted in such a way that it is accurately reseated if it has been displaced from its rest position. PX 336, Bates No. 000033 [Remarks, Amendment filed Apr. 18, 1979 in the '139 application, p. 8, l. 14-16].

40. The accuracy of measurement for the Renishaw patent touch probes is keyed to the rest position of the touch probe's stylus, Tr 442, 853-58, 1312.

41. In a preferred embodiment (which is also the basis for Renishaw's commercial probes), a mechanical structure which includes three rods and three pairs of balls supports the stylus in the required rest position. Tr 643-45, 350, 381-83, 1305-07. As illustrated in Figures 1-3 of the '275 patent (*see* App. A), the rods (4) are rigidly connected to the stylus or movable member, and extend out in the form of a tripod. Each leg of the tripod rests in the V-shaped crevice formed between a pair of balls (9 and 10). Tr 1305-07; DX 1134; '275, Fig. 3, col. 2, l. 33-46.

42. This configuration, called a "kinematic support" or "kinematic mount" by Renishaw, has been well-known for over a century for its ability to provide extreme precision and stability. Tr 303, 383-84, 1305-06, 1339; DX 1060, p. 38-39 (p. 8-9 of translation); '904, col. 1, l. 31-36.

43. Renishaw's "kinematic mount" is also known as a "Boys joint" kinematic clamp. Tr 1305-07; DX 1060, p. 38-39 (p. 8-9 of translation). The name arises from its inventor, Sir Charles Vernon Boys, a 19th century physicist. DX 1092. The Boys joint provides a stable and extremely repeatable support for the stylus of the Renishaw patent probes. Tr 388, 1303-08; DX 1060, p. 38-39 (p. 8-9 of translation), 1101.

44. Any object can have at most six degrees of freedom of movement. With respect to the well-known "x-y-z" Cartesian coordinates, it can have an x translation (move left and right), y translation (move back and forth), z translation (move up and down), x rotation (cartwheel back and forth), y rotation (cartwheel left and right) or z rotation (spin like a top). All movement can be described in terms of one or a combination of one or more of the above movements or "degrees of freedom." Tr 1299-1301; DX 1122.

45. A body can be prevented from moving in one or more degrees of freedom by application of constraints. The word constraint has a definite meaning in kinematic design. Tr 677-78, 1400; DX 1148, p. 309, l. 13-18. Where there is physical contact between objects, there is constraint. If the objects are not in contact, there is no constraint. Tr 673, 677-78, 1301, 1400; DX 1148, p. 306-10, 1149, p. 194-200.

46. An example of a constraint of a single degree of freedom is a ball resting on a flat surface. Tr 1301-02. An example of three degrees of freedom constrained is a ball sitting on three points of contact. Tr 1302-03. A kinematic equivalent of three such constraints is a ball sitting in a cone. Tr 1315-1316.

47. When an object is completely supported in a kinematic manner, all six of the degrees of freedom are constrained against movement. In such "kinematic clamps," the number of points of contact equals the number of degrees of freedom constrained, that is, six. Tr 1304-05; DX 1120.

48. As shown in Figures 1-3 of the '998 and '275 patents, a spring (5) presses, or "biases," the three tripod legs or rods (4) against the six balls (9 and 10), which rest on the floor of the probe housing. Tr 645; '275, col. 2, l. 33-46. The "kinematic mount" rigidly supports the stylus at precisely six points of contact, two at

each leg of the three-legged tripod. These six points of contact provide constraint of the six degrees of freedom and secure the unique and extremely repeatable rest position for the stylus of the Renishaw probes. Tr 419; '904, col. 1, l. 29-44.

49. Renishaw's kinematic mount probes return the stylus to its rest position with extreme accuracy. As earlier mentioned, Renishaw has reported to the U.S. Patent and Trademark Office (the "PTO") repeatability tests for return of the stylus tip to its rest position to be one millionth of an inch. PX 334, Bates No. 000581. Renishaw has reported a rest position repeatability in commercial probes of less than 0.1 of a micron. Tr 387; DX 1060, p. 39 (p. 9 of translation). These reported variances are extremely small; indeed, they are negligible when compared to the accuracy of the touch probes themselves, which are typically on the order of 1 micron. Tr 1311.

50. Marposs' technical expert, Dr. Daniel DeBra, explained that the reported variation in the rest position of the Renishaw probes is a very small fraction of the accuracy to which the probe is designed to measure and therefore the rest position is appropriately referred to as a single position. Tr 1311.

51. With real world materials and manufacturing, no rest position is perfectly precise. Because the variance of the rest position of the Renishaw probe is negligible compared to the accuracy required of the probe, however, one of ordinary skill in the art would consider it to be a single, precise, repeatable position. FN2 Tr 1311; PX 334, Bates No. 000581.

FN2. *See* para. 211, infra.

52. Renishaw, on the other hand, points out that certain of the patent figures in the '275 patent are not constrained in all six degrees of freedom and therefore, in theory, may have somewhat less precise rest positions. Tr 350-52.

53. For instance, the embodiments of Figures 4-8 of the '275 patent (*see* App. A) disclose probes where rotation about the vertical axis of the probe is not constrained, leaving only the other five degrees of freedom constrained. Tr 1488-89, 1512. In particular, three spheres 31-33 attached to the bottom of the housing limit axial and some rotational movements of the movable member, while other spheres limit lateral movements. A pin 46 attached to the housing extends into a bore 47 in the movable member with a clearance 48 to limit rotation of the moveable member around the housing axis. As a result, the touch trigger probes shown in Figures 4-8 have a larger tolerance on the precision of the rest position than those of Figures 1-3. Tr 346-48, 351, 1182-83, 1487-91.

54. However, the vertical symmetry of the probe in the embodiment of Figures 4-8 causes the probe to be insensitive to variation in rotation about the probe's vertical axis. Tr 1512-14. Simply put, with a straight stylus, there will be nothing to cause the stylus to spin, and even if it does, the effective position of the center of the stylus tip will not change because it is round. More importantly, to the extent that the variance in the rest position of these embodiments might increase due to the absence of the z-axis rotational constraint, it still remains a rest position probe because any increase in the rest position variance will be matched by a corresponding decrease in the probe's accuracy. In other words, any greater variation in the return to the rest position will still be negligible when compared to the accuracy of the particular embodiment. Thus, the probe's rest position remains a single, precise, repeatable position. Tr 400, 1309, 1311, 1512-14.

55. Renishaw also suggests that Figure 8 of the '275 patent includes a tolerance with respect to the "close fit" between the curved ends of the movable member and the inside wall of the housing at 70. Tr 348, 542-43. This contention, however, was previously contradicted by Renishaw and its expert, Dr. Duffie, who told this Court the exact opposite in the *Valeron* litigation.

56. In the early 1980s, Renishaw and Rolls Royce (then patent co-owners) brought suit against GTE Valeron for, among other things, infringement of the ' 998 patent. The suit involved claim 15 of the '998 patent. PX 107. See Rolls-Royce Limited and Renishaw PLC v. GTE Valeron Corp., 625 F.Supp. 343 (E.D.Mich.1985), *aff'd,* 800 F.2d 1101 (Fed.Cir.1986) (hereinafter " *Valeron* " litigation).

57. Dr. Duffie testified in *Valeron* that in order to have a constraint there must be no gap. Tr 652-54, 676-78; DX 1148, 1149. He further testified that there was no gap in Figure 8. Tr 653. Renishaw submitted post trial findings to Judge Gilmore indicating that the surfaces shown in Figure 8 were in "direct engagement," DX 954, p. 8, and the court made a specific finding of no gap and a friction fit for Figure 8 on the basis of the testimony of Dr. Duffie. Valeron, 625 F.Supp. at 349.

58. Even if this Court permitted Renishaw to change its position with respect to Figure 8 in this case, any resulting theoretical increase in the variation of Figure 8's rest position would again be matched by a corresponding decrease in the probe's accuracy. Thus, the probe's rest position would still be properly considered a single, precise, repeatable position. Tr 1311, 1514.

59. Similarly, the embodiments of Figures 11-14 of the '275 patent (*see* App. A) disclose a probe wherein the possibility exists that an electrical contact may create a condition of overconstraint. Tr 352. In particular, the hairpin spring 5 for limiting rotation of the movable member about its axis is less precise than the mechanism shown in Figures 1-3. In addition, Figure 14 incorporates an electrical contact 110 that would result in the movable member not fully contacting all of the inclined needle rollers (an overconstrained condition), causing some stylus tilting. As a result, the embodiments shown in Figures 11-14 would also have a greater tolerance on the precision of the rest position than those of Figures 1-3. Tr 348-50, 352, 396-98, 647-48, 1493-95.

60. Where such an overconstraint condition exists, however, either the contact itself, or one of the elements of the seating, will be rendered ineffective, leaving six degrees of freedom constrained. Tr 1514-16. Moreover, to the extent that the variance in the rest position of this embodiment increases due to the "extra" contact, it still remains a rest position probe because any increase in the rest position variance will be matched by a corresponding decrease in the probe's accuracy. Thus, the probe's rest position remains a single, precise, repeatable position. Tr 639, 1311, 1514-16.

61. In short, all of the embodiments shown in the '998 and '275 patents have single, precise, repeatable rest positions and there is nothing in the specification, figures or claims to indicate otherwise. Tr 408, 638-39, 860; DX 945, Bates No. 012727.

62. In Renishaw's commercial probes, and in several of the embodiments of the patents in suit, signaling is provided by an electric current running through all of the balls (9 and 10) and rods (4). '275, Fig. 2, col. 2, 1. 60-col. 3, 1. 6. The instant that contact with the object to be measured begins to move the stylus away from its precise "rest position," one or more of the rods begins to move out of engagement with its associated pair of balls and the electric current is affected, thus providing a signal. Tr 1308; '275, col. 3, 1. 1-6. After the

probe is moved away from the object, the coil spring returns the stylus to its "rest position" with extreme repeatability and precision as a result of the "kinematic mount" arrangement. Tr 388-89, 1310-11.

63. In the embodiment shown in Figure 14 of the '275 patent, an electrical contact that is separate from the seating elements is located on the fixed member such that deflection of the movable member also breaks an electrical circuit to provide a trigger signal. Tr 343, 349-53.

64. The 1998 and '275 patents disclose other potential signaling devices, including fluidic, optical projectors and other known switches. '275, col. 7, l. 10-18. Regardless of the type of detector employed, the common thread is that the signal is provided as soon as possible upon contact with an object. Tr 386.

65. Although the patent applicant never argued that the claims were allowable over the references of record because the signaling means provides a position indicating signal at the instant of contact, in the prosecution history of the '275 patent, the applicant explained that the probes were "for determining the exact point at which contact is established between a stylus. and an object to be measured." PX 334, Bates No. 000579. Test results cited to the PTO showed displacements of 0.0001 of an inch triggered a signal. Id. at Bates No. 000582. Mr. McMurtry acknowledged that all of the patented probes are designed to trigger as soon as practically possible after contact and that any delay in signaling is a negative in the error budget for Renishaw probes. Tr 420-21.

66. In the latter 1980s, Renishaw and Carl Zeiss Stiftung brought suits against one another in the Southern District of New York regarding, among other things, Zeiss' infringement of Renishaw's '998 and '275 patents. The involved claims were claims 2 and 15 of the '998 patent and claims 1 and 3 of the '275 patent. See *Carl Zeiss* Stiftung v. Renishaw PLC, 945 F.2d 1173 (Fed.Cir.1991) (hereinafter " *Zeiss* " litigation).

67. The preamble claim language "for providing a signal when said stylus engages said object thereby indicating the position thereof" was subject to judicial scrutiny in the *Zeiss* litigation. Renishaw admitted that the signal was provided "when the stylus engages the object" and that the claim language imposed "a requirement that a stylus/object engagement-position be indicated." DX 986, 1140. The Federal Circuit, while noting that there is no signaling device disclosed in the '998 specification that is activated immediately upon contact of the stylus with the workpiece prior to the stylus being deflected, nonetheless stated that the coordinates of the stylus tip "at the point of contact" are recorded and that it was "crucial" that the probe signal "as quickly as possible when the stylus makes contact." The Federal Circuit further noted that "reading the specification makes clear that ' *thereof* ' [in the claim language] must refer to the position of the *stylus* (which moves) when it contacts the object, not the position of the *object* (which remains stationary)." 945 F.2d at 1174-75, 1177 n. 2 (first emphasis added).

68. In the second family of Renishaw patents, Mr. McMurtry reiterated that when the stylus of the '998 patented probe contacts a workpiece, a trigger signal is generated by the probe, producing a reading of the instantaneous position of the stylus. "Because of the repeatability of the stylus rest position, this is an accurate measure of the position in space of the point of contact between the stylus and the workpiece." '904, col. 1, l. 28-42.

69. In *Valeron* and *Zeiss,* both Renishaw and its technical expert, Dr. Neil Duffie, confirmed the well understood meaning of the term "rest position" as used in the patents and the fundamental importance of the rest position to the operation of Renishaw's patented probes. DX 945, p. 106-07, 954, p. 5-6, 965, p. 869-70.

Q.-What does the term "positively defined rest position" mean to you?

A.-It means there is only one.

Q.-One what?

A.-There is only one position in which the stylus can exist when no force is applied to deflect it.

Q.-What happens when a force is applied to deflect it?

A.-There is a tendency to move the stylus out of its rest position away from its rest position.

Q.-And upon cessation of that force, where does the stylus end up?

A.-It comes back exactly to the rest position.

Q.-And its (sic) that ability of the probe that gives it accuracy?

A.-Yes, sir, that is one of the major accuracy contributions in this device. DX 945, *Valeron,* p. 107, 1.1-12.

Q.-What if anything is the most important aspect of a touch trigger probe?

A.-The most important aspect I would say is its ability to accurately seat in a positively defined, accurate, known position and be able to move in and out of that position and obtain the same level of accuracy each time that cycle occurs. DX 965, *Zeiss,* p. 868, 1. 24-p. 869, 1. 5.

70. Dr. Duffie further confirmed how the accuracy of the Renishaw patent probe is inextricably tied to its rest position:

Q.-What would be the effect of having an unrepeatable rest position for a stylus in the touch trigger probe?

A.-It would have a corresponding impact, decrease inaccuracy (sic). However much uncertainty there was in where the probe stylus returned, that would immediately add that much uncertainty in the measurements being taken on the object.

Q.-Could that uncertainty be eliminated by increasing the immediacy of signaling?

A.-I don't believe so.

Q.-Why not?

A.-Because by definition the uncertainty is unpredictable. So since you could not know where you were you could not predict where you were, therefore, you could not use any means to try to improve that measurement.

Q.-Can you further explain that in connection with the concept of repeatability?

A.-Well, it's really the same thing. Repeatability refers to-if you repeat some operation, whether it's the triggering of the probe against an object or the constant reseating of the seats, it refers to accuracy with which this stylus tip comes back to exactly the same point. If it doesn't come back to exactly the same point, then you don't know where the tip is when you trigger it. DX 965, *Zeiss,* p. 869, 1. 14-p. 870, 1. 12.

C. ***Problems With The '998 and*** '275 Patent ***Technology***

71. In the 1980's, certain less desirable characteristics of Renishaw's probes designed according to the '998 and '275 patents began to be noticeable. These problems included (1) "lobing" and (2) occasional failure to reseat ("hysteresis"). '904, col. 2, 1. 1-7, 33-35.

72. During probing operations, the stylus of a touch probe will bend very slightly upon contact with the workpiece. Although styli are typically made of steel or ceramic materials, even these extremely rigid materials are not infinitely rigid and will bend. Although this bending is extremely small, at the precision standards expected of touch probes, any variation in this bending can adversely affect the accuracy of measurements. Tr 452-55, 1354; '904, col. 2, 1. 6-24.

73. Because of the triangular structure of the "kinematic mount" of the '998 and '275 patent touch probes, the stylus will bend a different amount depending on different directions of contact. If the amount of bending in each direction is plotted, a triangular, three-lobed pattern will result. Variation in stylus bending depending on direction of contact is known as "lobing." Tr 452-55, 1354; '904, col. 2, 1. 15-21; DX 1136.

74. Frictional forces can also occasionally affect the precise reseat position of the "kinematic mount" of the '998 and '275 patent touch probes. Tr 1354-56. This behavior is referred to in the Renishaw patents as "hysteresisupon reseat." '904, col. 2, 1. 33-35. Friction between the rods and associated ball pairs may cause one or more of the rods not to seat fully in the convergent surfaces of the ball pair. Tr 865, 1354-56; ' 904, col. 2, 1. 35-38.

75. The degree to which a re-seating error is a problem depends on the orientation of the error. Because of the length of the stylus, certain types of re-seating errors are magnified. For example, a "sideways" or lateral error of 0.3 of a micron at the kinematic mount will cause a lateral error of 0.3 of a micron at the stylus tip. This error is not magnified. However, a "tilting" or vertical error of 0.3 of a micron at the kinematic mount will result in a lever effect due to the length of the stylus, thus magnifying the error of 0.3 of a micron to an error of about 0.9 of a micron or more at the stylus tip. Since it is the tip of the stylus that contacts the workpiece, the lever effect and magnified error in the Renishaw probes can result in an error in the rest position of the stylus tip and thus contribute to an error in the measurement. This is particularly problematic when probing curved, beveled or inclined surfaces. Tr 370-74, 458-60, 539-40, 865-67, 1354-56; DX 1138.

76. Moreover, in a limited number of applications, certain of Renishaw's commercial touch trigger probes made in accordance with '275 patent Figures 1-3 experienced false triggering when used in certain high vibration environments. Tr 149, 317.

D. ***The '691 Family of Patents***

77. David McMurtry, the inventor of the '998 and '275 patent probes, addressed the twin problems of lobing and hysteresis in a second family of Renishaw patents, specifically the U.S. Patent No. 5,146,691 (the "'691 patent"), the ' 428, '514, and '904 patents. Tr 492, 864.

78. The first patent application to be filed by Renishaw for the subject matter of the '691 patent was filed February 23, 1990 as a United Kingdom patent application. PO 15.

79. The corresponding U.S. patent application was filed February 25, 1991, which subsequently issued as the '691 patent. PO 15. Thus, the original disclosure of Mr. McMurtry's improvement patent occurred before Renishaw first obtained a Marposs MIDA probe in July of 1992. Tr 240-41; DX 247. None of the claims of the '691 patent were ever asserted by Renishaw against any Marposs probe. Tr 783-84, 437-38.

80. After learning of the Marposs MIDA probes, Renishaw pursued a series of continuation applications from the '691 patent. Tr 436-38; DX 1150, p. 9-12. Generally, a continuation application contains the exact same disclosure, specification, and figures of the original patent. The only thing that changes is the claims. Tr 721-22. Both Mr. McMurtry and Renishaw's U.S. patent counsel acknowledged that their purpose in pursuing these continuation applications was to attempt to write claims that could be asserted against the Marposs MIDA probes. Tr 438-39; DX 1150, p. 18-20.

81. Three U.S. patents resulted from these continuation applications; specifically the '428 patent issued on October 19, 1993, the '514 patent issued on October 11, 1994 and the '904 patent issued on February 20, 1996. All three continuation patents were asserted against Marposs in this litigation, although no representative claims were chosen from the '428 patent. PO 1.

82. All of the patents in the '691 patent family have the exact same specification and figures, with the exception of the '904 patent, where three paragraphs were added to the summary of the invention at the request of the Patent Examiner. DX 1150, p. 73-78. At the time of the original disclosure of the '691 patent family, no prototype or other physical device was created by Mr. McMurtry. Tr 482. Rather, the invention involves Mr. McMurtry's ideas for improving on the '998 and '275 patent probes. Tr 482.

83. The '691 family of patents can be understood with reference to the embodiment shown in Figures 1 and 2 of the '904 patent (*see* App. B).

84. The stylus is supported by two independent supports. Tr 883; '904 col. 3, 1. 7-16. The first is the axial constraint. In the axial constraint, an inverted cup (stylus holder 12) rests on the floor 20 of the probe housing 10. The stylus 14 is rigidly connectedto the cup. The cup resting on the floor of the housing provides a precise axial rest position for the stylus holder and depending stylus. Tr 1357; '904 col. 3, 1. 65-col. 4, 1.5. Because the stylus holder has a circular, rather than triangular, shape, lobing was expected to be virtually eliminated. Id. at col. 4, 1. 62-col. 5, 1.2. It was also expected that "hysteresis" would be reduced by very carefully matching the confronting surfaces of the skirt of the stylus holder and the floor of the housing. This would, in theory, minimize any "up and down" or "tilting" re-seating irregularities of the stylus holder. Tr 477-78, 875-78, 1364. Hysteresis is also reduced by reducing the force (and thereby reducing the friction) holding the skirt and the floor of the housing together. In the Figure 1 embodiment, this is achieved by prestressing the planar spring 30 against the action of the biasing spring 24. In other embodiments, two biasing springs are employed, one with lower force than the other. Tr 906, 1385; '904 col. 4, 1. 40-51, col. 5, 1. 7-19, col. 7, 1. 50-57, col. 8 1. 45-49.

85. The second independent support is the lateral constraint, consisting of a traditional Renishaw kinematic mount (34 and 36) attached to a ring 32. A diaphragm-like planar spring 30 is secured at its outer edges to the ring and centrally to the stylus holder 12. The planar spring, in combination with the kinematic mount, holds the stylus holder and depending stylus in a precise lateral rest position. Tr 479-80, 886, 1358, 1368;

'904, col. 4, l. 6-24.

86. The combination of constraints provides a precise axial rest position and a precise lateral rest position, which holds the stylus in a single, precise, repeatable rest position, with all six degrees of freedom constrained. Tr 1361, 883, 943-44; '904, col. 4, l. 25-27.

87. In operation, according to the teachings of the '691 patent family, when the stylus of the touch probe contacts the workpiece, the stylus holder immediately tilts about a point on the stylus holder's skirt at the floor of the housing. Tr 882. This initial tilting is accommodated by flexure of the planar spring, allowing the elements of the kinematic mount to remain engaged. Tr 480, 919; '904, col. 4, l. 52-58. At the instant of contact and tilt, a light beam projected through a hole in the stylus holder is impinged, or one of the alternate detection schemes is triggered, and a signal is sent to the measurement system. The signal always occurs at the initiation of tilting, as close as possible to the instant of first contact when the stylus is in its rest position, and always while the kinematic mount is still engaged. Tr 483-84, 494, 1387.

88. The design of the '691 patent family thus isolates the triggering event from any movement of the kinematic mount. Tr 484, 493, 1387. In theory, this tends to insulate the signaling caused by the initial tilting of the stylus holder and the return of the stylus holder to its rest position, from the lobing and hysteresis problems that accompanied Renishaw's traditional kinematic mount probes. Tr 905-06, 493-94, 1385; '904, col. 4, l. 62-col. 5, l. 2.

89. Additional movement of the stylus after a signal is generated is called "overtravel." In the '691 family of patent probes, further overtravel is accommodated by the disengagement of the kinematic mount. Tr 495, 920. This disengagement protects the relatively delicate planar spring from damage. Tr 1358-59; '904, col. 9, l. 22-30.

90. As the probe moves away from the workpiece, the stylus holder returns to its rest position. The elements of the kinematic mount first re-engage, then the tilting of the skirt on the floor of the housing decreases until the skirt is fully re-engaged with the housing and the stylus holder and depending stylus assume a single, precise, repeatable rest position. '904, col. 5, l. 3-7.

91. Although their mechanical configurations vary slightly, all of the embodiments of the '691 family of patents operate on the same principles. All have a stylus holder and stylus that is fully constrained by a combination of two independent supports, an axial constraint and a lateral constraint. Tr 494, 872-75, 883-84.

92. The axial constraint in each of the embodiments is achieved by abutting surfaces, either annular rings abutting flat surfaces or, with respect to the Figure 10 embodiment, three balls or a ring of balls resting on a flat surface. Tr 494, 880-81. The axial constraint in each embodiment constrains z-axis translation and x- and y-axis rotation. Tr 873-74, 1361.

93. The lateral constraint is in each instance achieved through a combination of a kinematic mount combined with a planar spring. Tr 874, 1361. The lateral constraint in each embodiment constrains x-and y-axis translation and z-axis rotation (the planar spring, a flexure, transmits only those three of the six constraints afforded by the kinematic mount). Tr 874, 1358, 1361.

94. Thus, in each and every embodiment in the '691 patent family, all six degrees of freedom are constrained

in order to provide a precise rest position. Tr 874-75, 1361. This precision is characterized as an improvement upon the prior '998/'275 touch probes, which improvement is achieved by reducing hysteresis and avoiding the tilting and error magnification that occurs due to the occasional failures of the '998/'275 patent probes to re-seat. Mr. McMurtry acknowledged that one of his objectives was to improve upon the rest position by reducing as much as possible the hysteresis causing errors in the rest position. Tr 459-60.

95. In the Figure 7 embodiment of the '904 patent (*see* App. B), hysteresis caused by friction between the cylinders 92 and balls 90 will cause the stylus holding movable member to tilt relative to the housing 88. Thus, the embodiment shown in Figure 7 suffers from greater hysteresis than the Figure 1 embodiment, resulting in a less precise rest position. Nevertheless, because the Figure 7 embodiment signals by tilting about points on annular surfaces, it has improved lobing characteristics. Tr 457-61, 492, 967.

96. Like the '275 patent probes, all of the '691 family of patent probes are signal-on-contact probes. The specifications unambiguously provide that the probes are designed to detect "the instant at which the stylus tip first contacts a workpiece." '904, col. 6, l. 10-11. All of the various arrangements for detection, including piezo-electric detectors, strain gauges, electrical circuits, and photo-electric are intended for "detecting the instant of contact between the stylus tip and the workpiece." '904, col. 9, l. 16-19; Tr 494, 907.

97. In all cases, the signaling structure is completely separate from the kinematic lateral movement constraining seating structure, thus reducing lobing. Although some of the disclosed signaling mechanisms are relatively quick, none provides a trigger signal at the absolute instant of contact of a stylus with an object. Tr 372-73, 621-22, 903, 1253, 1457-58; PX 499, col. 6, l. 18-25.

98. While it is of course true that the laws of nature dictate that no detection device can be "absolutely instantaneous," the claims, specifications, figures, and Mr. McMurtry's testimony confirm that the patented probes signal as soon as possible when the stylus tip contacts the workpiece. The quicker the Renishaw probes trigger, the better their performance. In short, the patents teach the quickest signaling possible, and there is no suggestion otherwise. In fact, Mr. McMurtry stated that he taught good probes with quick signals, and "wouldn't do anything but that, but to teach the best." Tr 386, 484, 850-53, 904.

99. For the '691 family of patent probes, a delayed signal would also defeat a major objective of the invention, which is insulating the signaling from the effect of disengagement of the kinematic mount. If a signal was delayed, the kinematic mount would disengage before the signaling and the probe would again be susceptible to hysteresis and lobing. Tr 484, 1387.

100. Renishaw never commercialized the '691 family of patents. Renishaw now sells an electronic filter, which it claims is more cost effective, for dealing with false triggering situations and a new strain gauge probe which reduces lobing. Tr 146-151.

E. *The Accused MIDA Probes*

101. In the 1980s Marposs marketed a touch trigger probe known as the A-Series probe. PX 506. That probe was introduced to the United States in 1986. The A-Series probe did poorly in the marketplace because it was too complex and costly, did not have sufficient overtravel, could not be made in small sizes, and generally did not perform as well as Renishaw's probes to be successful. Tr 1034-37, 1156-64, PX 20 at Bates Nos. I050115-17 and I050129-32, PX 113.

102. Mr. Possati, the president of Marposs, was unhappy with the lack of commercial success of the A-Series probe, and accordingly called a meeting in September 1989 to initiate development of a competitive machine tool probe. Mr. Possati set up a working group consisting of himself, Mr. Danielli, Mr. Dall'Aglio and Mr. Miniucchi, with himself as the coordinator. Tr 1156, 1163-64; PX 20 at Bates Nos. I050115-17 and I050129-32.

103. By the time the Mida project got underway in September 1989, Marposs was already aware of the internal structure of Renishaw's LP and MP FN3 machine tool probes and had reviewed written descriptions of Renishaw's machine tool probes. Marposs knew that those probes contained three elements spaced 120 (deg.)> apart and resting in three pairs of balls forming a convergent surfaces kinematic mount. At the commencement of the MIDA project, Marposs also reviewed the results of tests of Renishaw machine tool probes, and those test results were subsequently utilized to evaluate the performance of the prototype MIDA probes. Marposs also reviewed Renishaw's '998 and ' 275 patents, and knew that they showed the use of three elements spaced 120 degrees apart and resting in pairs of convergent surfaces. Tr 1164-70, 1174-78; PX 130; PX 575, pp. 90-99, 125-26.

FN3. LP and MP are designations given to certain of Renishaw's machine tool probes.

104. Marposs allocated substantial resources to studying existing probes and probe patents, including Renishaw's, and endeavored to design around the concepts employed by Renishaw in its '998 and '275 patents and other commercial touch probes. Tr 1027, 1066-67. Marposs invested approximately two and one-half million dollars on research and development of the MIDA probes. Tr 1084.

105. From this study, Marposs learned that nearly all touch trigger probes, including Renishaw's patented and commercial probes, utilized the same basic operational principle. Tr 1066-67. The principle was to establish a rest position for the probe's stylus, and to signal on contact between the stylus and object, thus producing a signal that is an accurate measure of the point of contact. Tr 442, 852-53, 902, 1067. Essential to this principle is that the probes have a unique, repeatable rest position in order to achieve required accuracies. Thus, the conventional wisdom in the art was that a single, precise, repeatable rest position was critical to a touch probe. Tr 1066-67, 1311-14; DX 840, col. 1, 1. 29-38.

106. As mentioned supra, para. 76, a problem with these rest position, signal on contact type probes is that they are subject to "false triggering" in harsh machining center environments. False triggering can occur because the vibration and shocks encountered in machining centers causes sufficient displacement of the probe stylus to generate a signal even though no contact with an object has occurred. Tr 1027, 1064-65, 1068; DX 49, 71, 98. Machining center operations are often unmanned. Consequently, false triggers can result in a complete halt in operations. Tr 311-12.

107. Marposs ultimately developed a new probe technology which resulted in U.S. Patent No. 5,299,360, assigned to Marposs, and in Marposs' launching its patented MIDA line of touch probes in 1992. Tr 1070-72, 1083-84; DX 408. Marposs subsequently developed four additional versions of the Marposs MIDA probes. PX 550-53. The MIDA line of touch probes consists of five different versions which have been sold under the designations T18, T25G, T25S, TL25, T36G, T36S, TL36G, T60G and T60S in the United States.

108. The MIDA machines tool probes are fully interchangeable with Renishaw's commercial machine tool probes, and in many instances are identical in size and shape and fully utilizable with the same software and

interfaces. Tr 159-62, 1029, 1037-41; PX 20, PX 365 A, C, D, E, PX 366 A, B, D, E, PX 556 and PX 356.

109. The patented MIDA touch probes, however, provide a repeatable trigger position sometime *after* contact between the stylus and workpiece, without relying upon any single, precise, repeatable rest position. Tr 1069-72, 1331-32.

110. Without the necessity of a rest position there was no need to constrain the stylus in a manner that resulted in a single precise repeatable rest position such as that provided by Renishaw's kinematic mount or any other type of kinematic clamp. Instead, Marposs decided to base its new generation of probes on a simple ball and cone type support for the probe stylus. Tr 1072-74; DX 1105, 1114.

111. The MIDA probe technology can be likened to a bell. In a bell, the position of the clapper within the bell is not important; it has no single, precise, repeatable position. What matters is the engagement of the clapper with the rim of the bell, which is a repeatable event. At the moment the bell rings, the clapper is at a defined and repeatable angle relative to the central axis of the bell. The stylus in the Marposs probe works on the same principle. Tr 1070-71.

112. All MIDA touch probes (*see* App. C) have a spherical armset to which a stylus is rigidly connected. The armset is supported by the housing through the engagement of a ball-shaped surface of the armset and a conical surface of the housing. The armset is biased into engagement with the housing by a coil spring. The armset also has a disc-shaped extension. There is a shelf in the housing that faces the underside of the disc. The disc and shelf are separated by a small, but distinct, gap measuring 1-5 microns. Tr 883, 1087, 1090-92; DX 395, 397. A precision microswitch is located directly above the armset. Tr 1077; DX 1111. In versions 2, 4, and 5, a flexible bellows is attached to the top of the armset and to the housing to prevent the armset from spinning on its vertical axis. Versions 1 and 3 of the MIDA probes had a flexible twin-lamina assembly, instead of a bellows, for the same purpose. Tr 1154, 1318, 1322; DX 1132, 1133. The fifth version is similar to the fourth version, except that the coil spring is located inside the anti-rotation bellows. Tr 558-59; PX 548 and 553.

113. In operation, when the MIDA touch probe approaches and contacts a workpiece from the side, the stylus tip will begin to deflect sideways. This initial movement of the stylus tip causes the armset to rotate about a point at its center, due to the spherical shape of the armset within the conical housing. After a period of rotation (like a ball and socket), the disc and shelf touch at a point. The surfaces of the disc and shelf were previously separated by the gap, but rotation of the armset brings them into contact. It is this point of contact between the disc and the shelf that is the repeatable event to which the accuracy of the MIDA probe is tied. Additional movement of the stylus then causes tilting of the armset about the point of contact between the disc and shelf, and the armset lifts up out of the conical portion of the housing. As the stylus continues to move, the armset continues to tilt, causing the top of the armset to rise up to contact the pin of the microswitch and then to push the pin upward. Upon sufficient movement of the pin, the microswitch generates a signal. Tr 950-51, 1074-80, 1330-31; DX 1122.

114. In the accused probes, the specification for the gap between the disc and the shelf was originally 1-10 microns but was later changed to 1-5 microns. Tr 1092; DX 395, 397. Renishaw does not dispute the existence of the gap between the shelf and the disc of the MIDA armset. Tr 289, 883.

115. The reduction in the gap size resulted in improved performance in measuring curved or inclined surfaces and small, deep bores. Tr 1225-30, 1235-36, 1238; PX 177, PX 362.

116. For an average three micron gap between the disc and shelf, and depending on the play in the microswitch and the length of the stylus, the diameter of the triggering points can be anywhere from 153 to 801 microns using typical stylus lengths. Tr 923; DX 1145.

117. After a signal is sent, the MIDA touch probe is moved away from the workpiece and the spherical surface of the armset and conical portion of the housing re-engage. The armset of the MIDA touch probe is not supported by a Boys joint or other kinematic clamp. It does not return to a single, precise, repeatable rest position. Instead, the armset returns to an indeterminate position. Tr 1082; DX 247. The center of the stylus tip can be anywhere at random within a circular area, which Marposs calls the "neutral zone." The diameter of the neutral zone is determined by the size of the gap, the length of the stylus, and the radius of the disc. Tr 866, 1083-84; DX 1144. The neutralzones in the accused MIDA touch probes may range from as little as approximately 7 microns to as many as approximately 280 microns in diameter using typical stylus lengths. DX 1144.

118. Tests of MIDA probes conducted by Renishaw concluded that MIDA probes had an indeterminate mechanical zero. Tr 1325-26; DX 247, 133.

119. MIDA probe versions 1 and 2 had a safety device on top of the twin lamina and bellows, respectively, opposite the armset. The safety device consisted of three balls set in the top of the housing which engaged three V-shaped grooves in a plastic or metal detent plate attached to the top of the twin lamina or bellows. The safety device, no longer manufactured, was present to protect the twin-lamina or bellows from damage during twisting of the stylus when the stylus is removed from or screwed into the armset. In such an overtorque situation, the safety device released (like ski bindings); that is, the top plate would twist out of engagement with the balls mounted on the underside of the top of the housing, thus saving the bellows or twin-lamina from damage. Tr 1111-13, 1321-22.

120. The safety device had the purpose of releasing the internal assembly from the probe housing during an overtorque (twisting) situation, not of returning the armset or stylus to any rest position and played no function during normal probing operations. Marposs ultimately discontinued use of the three ball/three V-groove kinematic mount in the more current versions 3-5 of the Marposs MIDA probe for several reasons. Marposs found it unnecessary and disadvantageous from a performance perspective, found a less costly way of protecting the internal assembly of the probe during an overtorque situation, and because of the ongoing litigation with Renishaw. Tr 1048-49, 1111-13, 1119-25, 1149-51, 1199-1200, 1202-04; PX 87, PX 362, PX 575, pp. 285-91.

121. Renishaw contends that the safety device may disengage if used with a "cranked" stylus, meaning an offset stylus shaped like a capital letter L. Tr 666-67. However, Mr. Danielli testified that the safety device probes were not intended to be used with cranked styli. Tr 1152-53, 1184-85. This fact is confirmed by Renishaw's own tests which concluded that the Marposs safety device probe would not perform accurately when used with a cranked stylus. DX 142, Bates No. 104941, 133; Tr 236-37.

122. On August 2, 1994, shortly after Renishaw instituted this lawsuit, Marposs decided to immediately stop sending MIDA probes having the safety device to the United States. Tr 1046-47, 1049-50, 1052-53; PX 198; PX 575, pp. 280-84.

123. Renishaw asserts claims 1 and 4 of the '275 patent against MIDA touch probes with safety devices, but

not against any other MIDA probes. PO 23-24. In this regard, Renishaw proffered proofs that were limited to the theory that the safety device MIDA probes literally infringed these claims. Tr 591-606.

124. Although Renishaw asserted claim 55 of the '514 patent and claim 2 of the '904 patent against all MIDA probes, PO 23-25, it only presented evidence of alleged infringement by Marposs probes *without* safety devices, i.e., by MIDA versions 3, 4, and 5. Tr 571-82, 607-19. Evidence as to alleged infringement was further limited to probes with bellows (as opposed to twin-lamina), i.e., MIDA versions 2 and 4, with respect to claim 2 of the '904 patent. Tr 590-91. Renishaw's proffered proofs were limited to a contention of literal infringement, except with respect to the "planar spring" limitation of claim 55 of the '514 patent, where Renishaw claims infringement under the doctrine of equivalents with respect to the MIDA probes with bellows.

III. *THE MIDA PROBES ARE FUNDAMENTALLY DIFFERENT*

A. *The MIDA Probes Do Not Have The Rest Position Of The Renishaw Patent Probes.*

125. In the MIDA probes, the stylus is constrained in four degrees of freedom through the use of two mechanisms: (1) the engagement of the spherical armset with the conical surface of the housing, and (2) the bellows or twin-lamina assembly. Tr 669, 1315-18. In contrast to all of the Renishaw patent probes, the armset of the MIDA probe is unconstrained with respect to rotations about its x and y axes. Tr 1315-16. These two degrees are left free. Tr 1323. In other words, it is designed to permit tilting or rocking, the very behavior which Renishaw strives so hard to avoid. Tr 648-51, 866-67, 1354-56.

126. As Renishaw's expert, Dr. Duffie, explained in the *Valeron* litigation:

Q.-Why is it important to have kinematics in the axial direction?

A.-The axial direction FN4 is the most important direction, and it's most important because rocking motion generates-rocking motion of the plate would generate corresponding motion back and forth of the stylus, and the length of the stylus magnifies whatever small motions might occur in a device, let's say, that didn't have three-point support.

FN4. "Axial" refers to z-axis translation and x-and y-axis rotation, while "lateral" refers to x-and y-axis translation and z-axis rotation. *See* para.para. 92-93, *supra*.

So it is the length of the stylus and the fact that the stylus is considerably longer that generates this amplification or magnification effect, if you will. Tr 649-50. [*Valeron,* p. 406.]

127. Consequently, because of the lack of x-and y-axis rotational constraints, the MIDA probe stylus cannot be understood to have a single, precise, repeatable rest position. Tr 1323, 1328, 1340-42, 1376-77; DX 1142.

128. The lack of x-and y-axis rotational constraints allows variance of the position of the stylus tip when not in contact with an object which is orders of magnitude greater than the accuracy of the probe. The neutral zone is relatively a very large number compared to the one micron or less benchmark of probe accuracy and therefore cannot be considered a single position. Tr 860, 1094, 1311, 1325, 1328, 1340-42.

129. The MIDA probes are fundamentally different from the patented Renishaw probes. The MIDA probes

are not rest position probes. Because the center of the stylus tip of the MIDA probe can be anywhere in the neutral zone, neither the armset nor stylus of the MIDA probe has a single, precise repeatable position. Tr 241-43, 1328, 1340-42, 1363; DX 247, 133, 1054.

B. ***The MIDA Probes Do Not Signal On Contact Like All Of The Renishaw Patent Probes.***

130. The signal of the MIDA probe is generated after a first rotation, after establishment of a fulcrum point between disc and shelf, after tilting until contact is made with the microswitch pin, and also after a further tilting until the microswitch pin is lifted enough to activate. Tr 950-51. In all of the Renishaw patent probes, a signal is transmitted upon virtually the instant of contact with the workpiece. In a MIDA probe, a signal is transmitted after a significant, nonpredictable amount of movement of the stylus, which is, relatively speaking, well *after* contact with the workpiece. The MIDA probes are not signal on contact probes. Tr 921, 1079-82, 1312-13, 1330-31, 1369.

131. In questioning of Mr. Taylor concerning why the Marposs probe showed an immunity to false triggering, he admitted that the Marposs probes did not trigger off the "rest position" and that the Marposs probe "works differently." Tr 323-24.

132. Were the MIDA probes to signal at the virtual instant of contact between the stylus and the workpiece, such signals would produce wildly inaccurate measurements. Tr 860, 1334-35. Even Renishaw's expert, Dr. Duffie, had to concede that if the Marposs probe generated a signal at contact, while the stylus tip center was still in the neutral zone, the signal would not be repeatable to the degree required of a modern touch probe. Tr 689. The reason this is indisputable is that at the moment of contact, the center of the stylus tip of the MIDA probe may be at any random location within the neutral zone, which can be hundreds of microns in diameter. Tr 683, 1082, 1334-35.

133. Detection is accomplished in the Renishaw patent probes through either a photo-electric device, piezoelectric detectors, strain gauges, completion of an electric circuit between stylus and workpiece, or interruption of an electric circuit routed through the engageable support structure. '904, col. 6, l. 10-18, col. 6, l. 66-col. 7, l. 2. Detection is accomplished in the MIDA probe through contact of the armset with a precision microswitch located in the housing above the armset and along the vertical axis of the probe. Although a microswitch was a "known switch" as referenced in the '275 patent, Dr. DeBra testified that one skilled in the art would not consider a microswitch the structural equivalent for engagement position signaling. Tr 1344. Microswitches, by design, have a certain inherent delay which precludes the nearly instant signaling required in the Renishaw probes. This delay cannot be adjusted or accommodated by moving the microswitch closer to the part that activates it. If the microswitch was positioned to detect the instant of contact, thermal expansion alone could cause the switch to open. Tr 1344-45, 1372.

C. ***Other Important Differences***

134. Because the MIDA probe is not a rest position, signal-on-contact probe, it has different operational characteristics from Renishaw patented probes. Because it has a delayed signal and there is no rest position from which the stylus may be displaced due to shock or vibration, the MIDA probe is significantly less subject to false triggering than Renishaw patented probes. Renishaw's own tests confirmed the substantial immunity to false triggering afforded by the design of the Marposs MIDA probe. Tr 224-27, 255, 283-85, 320-24, 1144; DX 30, 50, 71, 88, 98, 133, 142.

135. The operational characteristics of the MIDA probes are not always positive. For instance, the lack of a

rest position and delayed signal means that there are certain applications involving measurement of inclined surfaces and measurements in deep holes with small bores for which the MIDA probe is unsuited, unlike Renishaw patented probes. Tr 522-23, 1145-46.

136. In the '691 family patent probes, the surfaces providing axial constraint (either annular surfaces or balls on flat surfaces) are completely engaged, and partially disengage upon contact with the workpiece. In contrast, the annular surfaces in the MIDA probe are disengaged-are separated by a gap-in the nontriggered condition, and partially engage after contact with the workpiece. It is because of this gap that the MIDA probes have a neutral zone. Tr 680, 883, 944-45, 1076, 1087, 1091, 1366-67.

137. The function of the kinematic mount of the '275 patent probes is to provide a positively defined rest position for the movable member, displacement from which immediately generates a trigger signal. It is an integral part of the normal metrological operations of the probe. The function of the Boys joint employed as a safety device in certain early MIDA probes was to disengage during nonmetrological operations, such as replacement of the stylus, in order to protect the twin-lamina or bellows from damage. The safety device was not designed to play a role in metrological operations and provided no rest position for the armset or stylus of the early Marposs probes. Tr 1338-41, 1111-13, 1118-25; DX 1055.

138. In the probes of the '691 family, the structure providing axial constraints is independent and distinct from the structure providing lateral constraints. In the MIDA probe, the axial z-axis constraint and lateral constraints are provided by one mechanism, the engagement of the stylus holder with the housing. The Marposs probe has no axial x-or y-axis rotational constraints. Tr 494, 874-75, 883-85, 943-44, 1076-78, 1315-18, 1361, 1368-70, 1668.

139. In the probes of the '691 family, the lateral constraints are explicitly provided through the planar spring. In the MIDA probe, there is no planar spring. Neither the bellows nor the twin-lamina assembly are planar springs. By definition they are not planar and, unlike Renishaw's planar spring, neither the bellows nor twin-lamina assembly provide any lateral constraint. Tr 890, 941, 1373-76, 1392-93; DX 1143.

140. In the MIDA probes, lateral constraint is provided by the direct engagement of the stylus holding armset with the conical seat of the housing. There is no "device acting between" FN5 for lateral constraint and no second constraining spring in the MIDA probe. Tr 890, 941, 1368, 1390-91. The bellows and the twin-lamina act as elastic elements constraining z-axis rotational movement in the MIDA probes. Tr 1317-21. Neither the bellows nor the twin-lamina serve as a spring in the MIDA probe. Having no second spring, the MIDA probes have no differential forces applied to any element. Tr 924-25, 1373-76, 1392-93.

FN5. *See* discussion infra,para.para. 261-265.

IV. *MARPOSS' BAD FAITH/EXCEPTIONAL CASE CLAIM FINDINGS*

141. Renishaw is the largest seller of CMM probes in the world and has virtually no competition for such probes in the United States. Its gross profit margins on such probes exceed 85 percent. Tr 201-02.

142. Renishaw is also the largest seller of machine tool probes in the world. With some competition in this area, its gross profit margins still range from 65 to 80 percent. Tr 203-04.

143. In approximately 1982, Renishaw first became aware that Marposs was marketing touch trigger probes. At that time, Marposs was marketing its commercially unsuccessful A-Series probe, which was made up of a series of stacked hinges. Tr 182-83; PX 506.

144. In August of 1989, Renishaw identified a big problem with its number one machine tool customer and its number one machine tool probe, the LP2. The LP2 probe is a kinematic mount probe built in accordance with the '998 and '275 patents. The problem was that the LP2s were false triggering due to vibrations on the newest generation of machine tools. Renishaw recognized that its number one customer, and others, could be lost if a competitor solved the problem before Renishaw. Tr 204-06; DX 338.

145. Renishaw's traditional solution for false triggering was to increase the force of the bias spring holding the kinematic mount in place. Tr 207-08, 1068-69, 457. Renishaw's LP2H probe employed a "heavy" spring for that purpose. However, the traditional solution provided only marginal improvement and by 1991 a number of Renishaw's machine tool customers were experiencing false trigger problems. Tr 208-09, 216-18; DX 49.

146. Early in 1992, Renishaw learned that Marposs had a new machine tool probe, the MIDA probe, that was competing with Renishaw's product. An executive group was formed within Renishaw, including Ben Taylor and David McMurtry, Renishaw's assistant chief executive and chief executive, respectively, to formulate a strategy in response to the threat posed by Marposs. Tr 218-19; DX 86. The action items called for included obtaining Marposs MIDA probes for testing and developing a new probe to compete with the Marposs MIDA probe in the machine tool market. Tr 221-24, 226-27; DX 260.

147. Renishaw's new probe development was called the LP3 project. Tr 224-25. The project was put on an accelerated development plan and documents within Renishaw underscored the immediate need for a probe with high vibration resistance to compete with the Marposs MIDA probe. DX 71, 142; Tr 224-30.

148. In July of 1992 Renishaw obtained its first Marposs MIDA probe for testing, a T36G. Dr. David Wilson, head of Renishaw's Technical Development Laboratory, was charged with the responsibility to evaluate the probe. DX 59, 247; Tr 239-40. In the middle to latter part of 1992, Renishaw came to an understanding of the internal configuration of the Marposs MIDA probe. As Renishaw continued to purchase additional Marposs MIDA probes, Renishaw became aware of the different configurations of the various versions of the MIDA probes. Tr 185-91.

149. In a preliminary report on the Marposs probe's performance, Dr. Wilson's first observation was that the probe had an "indeterminate mechanical zero." DX 247; Tr 241. Renishaw uses the terms zero, mechanical zero, zero position and rest position interchangably. Tr 256-57, 399, 656. Mr. Taylor admitted that he understands that the word "indeterminate" means a parameter that can have "more than one value and that value is not necessarily known." Tr 245.

150. Dr. Wilson's report was circulated to Renishaw's executives, including Mr. Taylor and Mr. McMurtry, who specifically discussed Dr. Wilson's report, the finding of an indeterminate mechanical zero, how it differed from the Renishaw probe's rest position, and the structure of the MIDA probe design that caused this difference. Tr 241-43.

151. Dr. Wilson followed up his preliminary findings with a detailed report comparing two Marposs MIDA T36 probes with Renishaw's MP7, a traditional kinematic mount probe. DX 133; Tr 255. A battery of

standard Renishaw tests was conducted on both Marposs probes and Renishaw's MP7 probe. Tr 254. Dr. Wilson continued to report that the Marposs MIDA probes had "poor mechanical repeatability," a "poor mechanical zero," and that the data collected from the Marposs probes had no "true zero position." DX 133. Attached to Dr. Wilson's report was a copy of a patent drawing of the Marposs MIDA probe taken from Marposs' international patent application. DX 712; Tr 262-63. The drawing plainly illustrated the existence of the gap between the disc and shelf of the Marposs MIDA probe. Tr 263.

152. Dr. Wilson conducted mechanical repeatability tests which are intended to measure the probe stylus' return to the mechanical zero position when deflected in one direction at a constant speed. Tr 254-55, 260. The data showed a one to two order of magnitude difference between the range of mechanical repeatability values of the Marposs probes versus the Renishaw probe, with the Renishaw values all being in the submicron range. DX 133; Tr 259-60.

153. Dr. Wilson conducted mechanical hysteresis tests which are intended to measure the probe stylus' return to the mechanical zero position when deflected in opposite directions. Tr 261. Again the data showed a one to two order of magnitude difference between the range of values of the Marposs probes versus the Renishaw probe. Again all values for the Renishaw probe were in the submicron range. DX 133; Tr 261-62.

154. Renishaw's first attempt to build a LP3 probe to compete with the Marposs probe was abandoned in December 1992, based on the design's inability to meet performance requirements in terms of resistance to shock and vibration. DX 25; Tr 237-38.

155. In late February of 1993, Renishaw filed an infringement action against Marposs in Italy based upon the Italian counterpart to the '275 patent. Renishaw sought and received an *ex parte* seizure order from the Court of Bologna to shut down Marposs' production of MIDA probes in Italy. Tr 293-94. At a hearing held shortly after the seizure, Mr. Danielli demonstrated to the Italian court and Renishaw's representatives how the MIDA probe worked and why the safety device had nothing to do with the measuring operations of the probe. Tr 1117-23. After learning how the Marposs probe worked, the Italian judge reversed the seizure order on March 12, 1993. Tr 294, 1125; DX 1055.

156. Renishaw then went back to work trying to develop an LP3 probe built in accordance with the teachings of the '691 patent family. Tr 296; DX 121. These probe designs had abutting annular surfaces, a kinematic mount and a planar spring. Tr 233. Renishaw made continued attempts to reduce hysteresis. DX 194; Tr 297-98.

157. As Renishaw expressed it, the basic concept behind the LP3 was to produce a machine tool probe with non lobing characteristics and high resistance to vibration and shock. DX 160. After five different planar springs had been tried and rejected, Renishaw concluded that the basic concept appeared "unworkable." Id.

158. By June of 1993, Renishaw's marketing department was forced to report that design problems in terms of technical performance had resulted in an inability to create a successful solution for the LP3. DX 64. This was viewed as a major concern at Renishaw, as the LP3 was considered a vital product to combat the Marposs threat. DX 64; Tr 309-10.

159. Gerry Darlington, Renishaw's Manager of Product Strategy and Planning, wrote to Mr. Taylor, "very concerned about the Marposs threat." DX 276. She reported that Renishaw's sales and marketing departments were feeling "very exposed," that Renishaw was continuing to lose customers to Marposs and

that there was a definite lack of confidence within the organization regarding the LP3. Id.

160. Renishaw was forced to adopt a marketing "policy of containment," admitting that "fundamentally Renishaw does not have a product which can compete with the MarpossMIDA probe in a high production machine tool environment." DX 58. Renishaw's marketing department wrote that "[t]he successful introduction of the LP3 ... is absolutely critical if Renishaw is to maintain its position in this market." Id.

161. Gerry Darlington prepared a full report on the Marposs threat to the Renishaw Board of Directors and the heads of all of Renishaw's subsidiaries. DX 471. She reported that 1) Marposs was starting to pose a serious threat to Renishaw's machine tool business, 2) that Marposs was gaining market share in Japan, Germany, and the U.S., and 3) that long standing end user customers were highly dissatisfied with Renishaw's products. She called for urgent action on the LP3 program. Id.; Tr 326-29.

162. A sixth attempt was made to produce an LP3 probe in accordance with the teachings of the '691 patent family. DX 111; Tr 329-32. The LP3 "Mark 6" was also a failure and all work on a '691 patent family probe was halted in June of 1994. DX 68; Tr 332-33.

163. One month later, in July of 1994, after both inside and outside patent counsel were consulted, Renishaw brought suit against Marposs, claiming infringement of the '998, '275, and '428 patents. Tr 199; *See* Complaint.

164. In the *Valeron* litigation Renishaw took the position that the term rest position, as used in the patents, means "[t]here is only one position in which the stylus can exist when no force is applied to deflect it," that the stylus "comes back exactly to the rest position" and that the rest position is "one of the accuracy contributions [of the patented Renishaw probes]," DX 945, Bates No. 012728, that "the movable member has one and only one rest position to which it must return," DX 954, Bates No. 012728, and that repeatability "refers to the accuracy with which the stylus tip comes back to exactly the same point." DX 965, Bates No. 008871.

165. In this litigation, Renishaw took the contrary position that the term "rest position" as used in the claims simply means anywhere that the stylus happens to stop when not in contact with an object. Tr 626-30; Magistrate's Report and Recommendation, p. 8. Renishaw's stance in this lawsuit also runs directly contrary to its multiple representations to the PTO of the fundamental importance of a defined rest position, how Renishaw's rest position distinguished it from the prior art and the direct contribution of the rest position to the accuracy of the patented probes. PX 334, Bates Nos. 000581, 000567; PX 335, Bates Nos. 000310, 000312-13, 000374-75; PX 336, Bates No. 000033.

166. When the Court, on motions for summary judgment, construed the term rest position to be a single, precise, repeatable position, Renishaw claimed that, notwithstanding the gap, the MIDA probe had "sufficient constraint" for a rest position. Tr 596-98. This new argument required that Renishaw abandon positions taken in this Court in previous proceedings, that constraints require direct contact, and cannot exist if there is any gap at all. Tr 653-55, 671-78.

167. In the Italian litigation, the Italian court, at Renishaw's suggestion, appointed an independent technical expert to assist it in determining whether the MIDA probe infringed the Italian patent. Tr 1125. Two questions were referred to the Polytechnic Institute of Milan by the independent technical expert. One, whether a gap between the disc of the armset and the plane of the housing existed in the MIDA probes and

two, the repeatability of the position of the stylus tip when in an untriggered state. DX 1054, p. 1 (p. 28 of translation). In a report issued April 17, 1996, the Institute concluded that a gap between 7 and 11 microns existed in the two MIDA probes tested and that there was "quite a broad range of uncertainty" (up to 100 microns) in the return position of the stylus tip. DX 1054, p. 7 (p. 40 of translation). Thereafter, Renishaw sought the removal of the independent technical expert it had suggested. Tr 295. That effort was rejected by the Italian court. DX 1056.

168. There has been no final determination in the Italian litigation between the parties. Tr 335-36, 1129-30.

169. Renishaw did not inform Dr. Duffie of the Italian suit, including the report of the Institute. Tr 624. He first learned about the report when confronted by Marposs' counsel in a deposition held on October 25, 1996. Tr 624-25.

170. The evidence at trial also confirmed that Renishaw changed infringement contentions without even consulting with Dr. Duffie. In his expert's report, Dr. Duffie took the position that the "device acting between" limitation of claim 2 of the '904 patent read on the surfaces of the armset and housing of the MIDA probes. DX 1087; Tr 931. After receipt of Marposs' noninfringement contentions, Renishaw reversed field, without the knowledge of Dr. Duffie, claiming that the "device acting between" could be found by arbitrarily dissecting elements already claimed, to wit: portions of the armset and housing. DX 108; Tr 934-37.

171. Renishaw has also argued to this Court that one of ordinary skill in the art, an engineer, would construe the movable, stylus holding member, the "movable member" or "stylus holder" as used in five different claims, to read on five different combinations of MIDA probe parts to suit the requirements of the different claims. Tr 661-64, 809-18; PX 517, 519, 525, 526, 532.

V. *CREDIBILITY OF WITNESSES*

172. Before trial, the Court denied Marposs' Motion for Summary Judgment, in part because it was unable to assess the credibility of the experts. Magistrate's Report and Recommendation, p. 18.

173. Dr. Duffie has a long history with Renishaw. He has represented Renishaw since the early 80's in a variety of patent cases. Tr 623-24. He has never used a Marposs MIDA probe, or conducted any tests on any of the accused probes. Tr 529.

174. Dr. DeBra, on the other hand, has used and conducted tests on both Marposs and Renishaw probes. Tr 1287-88, 1326-27. He never met or worked with Marposs, however, until being contacted by Marposs' counsel in this litigation and only agreed to participate after coming to the conclusion there were substantial differences between the Marposs device and the Renishaw patent probes. Tr 1296-98.

175. Dr. Duffie submitted a Declaration in opposition to Marposs' Motion for Summary Judgment stating that "rest position" means any position that the stylus returns to when it is not in contact with a workpiece. Tr 626; Magistrate's Report and Recommendation, p. 8. Similarly, at his deposition in this case on December 18, 1995, he testified that it merely means "a position at which the stylus comes to rest." Tr 627. The trial of this matter has shown those statements to be inconsistent with Dr. Duffie's prior sworn testimony in the *Valeron* and *Zeiss* litigations. DX 945, p. 105-07, 965, p. 869-70. Dr. Duffie's testimony concerning rest position in *Valeron* and *Zeiss* is, however, consistent with Dr. DeBra's testimony in this

litigation. Tr 1309-14.

176. Dr. DeBra also challenged Dr. Duffie's use of engineering terms, such as "tolerance" and "constraint." Tr 1399-1401. Dr. Duffie, who was present during Dr. DeBra's testimony, and was also present during Renishaw's rebuttal case, never retook the stand to defend his position.

177. Dr. Duffie also testified in *Valeron* that "constraint has a very definite meaning" and in order to have a constraint there must be no gap. DX 1148. This is the exact meaning of the term "constraint" that Dr. DeBra testified to in this litigation. That is, if there is contact between objects, they are constrained; if the objects are not in contact, there is no constraint. Tr 1301. Dr. Duffie effectively retreated from what he told Judge Gilmore in *Valeron* and instead described the gap in the MIDA probe as being a "sufficient constraint" which, according to Dr. DeBra, contradicts well established discipline in kinematic design. Tr 597-98, 1400-01.

178. Dr. Duffie also testified before Judge Gilmore in *Valeron* that the axial direction is the most important direction for constraint, because a lack of axial constraint would permit rocking motion which would be magnified by the length of the probe stylus. Tr 649-50. Dr. Duffie also testified in *Valeron* that a constraint would prevent any motion at all, even a 10 thousandth of an inch (*i.e.,* 2.5 microns). Tr 672-78; DX 1149, p. 197. Yet, the gap in the MIDA probe allows the very rocking or tilting decried by Dr. Duffie in the prior litigation, and results in a neutral zone of up to 280 microns. Tr 679-83.

179. In the face of his testimony in *Valeron* and *Zeiss,* Dr. Duffie's opinion that the Marposs probe has a single, precise, repeatable rest position is simply not credible. Dr. DeBra's testimony, on the other hand, was credible, contained no inconsistent statements, and assisted the Court in deciding the issues involved in this litigation.

180. Renishaw's lead witness, Mr. Taylor, was also less than fully credible. For instance, Mr. Taylor disagreed with the explanation set forth in Renishaw's own Glossary of Terms that the repeatability of the Renishaw probe's signal reflects the ability of the patented probe mechanism to return the stylus to its reseat or rest position. DX 245; Tr 213-15, 225-26. This Glossary was distributed as a working document to the Renishaw subsidiaries and original equipment manufacturer engineers. Mr. Taylor's refusal to acknowledge the document's accuracy is particularly troublesome given that Mr. McMurtry subsequently testified that the Glossary does in fact correctly describe the relationship between repeatability and rest position in the Renishaw probes. Tr 446-48.

CONCLUSIONS OF LAW

I. GENERAL

181. Infringement of a U.S. patent occurs when a person or entity, without authority of the patentee, makes, uses, offers to sell or sells the patented invention within the United States, or imports the patented invention into the United States. 35 U.S.C. s. 271(a).

[1] 182. Plaintiff bears the burden of proof to establish infringement by a preponderance of the evidence. ZMI Corp. v. Cardiac Resuscitator Corp., 844 F.2d 1576, 1582 (Fed.Cir.1988).

[2] 183. Determination of the issue of infringement requires a two-step analysis. First, each of the asserted claims must be construed to determine its meaning. Second, each properly construed claim must be

compared with the accused devices to determine whether the accused devices include each and every element called for by each properly construed claim. Charles Greiner & Co. v. Mari-Med Mfg., Inc., 962 F.2d 1031, 1034 (Fed.Cir.1992); ZMI, 844 F.2d at 1578.

[3] [4] 184. Absence of a single limitation of a claim is sufficient to avoid infringement of that claim. Laitram Corp. v. Rexnord, Inc., 939 F.2d 1533, 1535 (Fed.Cir.1991). Each limitation of the claim must be met by the accused device exactly, any deviation from the claim precluding a finding of literal infringement. Lantech, Inc. v. Keip Mach. Co., 32 F.3d 542, 547 (Fed.Cir.1994).

II. ***CLAIM CONSTRUCTION***

[6] [7] 186. The claims of a patent are to be construed in light of its specification and prosecution history, the prior art and, where necessary, relevant testimony of expert witnesses. Arachnid, Inc., v. Medalist Mktg. Corp., 972 F.2d 1300, 1302 (Fed.Cir.1992); LaBounty Mfg., Inc. v. United States Int'l Trade Comm'n, 867 F.2d 1572, 1574 (Fed.Cir.1989), Markman, 52 F.3d at 980. Among these, the specification is the single best guide to the meaning of a claim. Vitronics Corp. v. Conceptronic. Inc., 90 F.3d 1576, 1582 (Fed.Cir.1996). It is usually dispositive. *Id*. Reliance on the analysis of the specification for claim construction complies with the standard construction rule that terms can be defined only in a way that comports with the instrument as a whole. Markman v. Westview Instruments, Inc., 517 U.S. 370, ----, 116 S.Ct. 1384, 1395, 134 L.Ed.2d 577 (1996). This reliance also fosters the policy that the public is entitled to rely on the intrinsic record, including the specification, to ascertain the scope of, and design around, an invention. Vitronics, 90 F.3d at 1583. The limits of a patent must be known for the protection of the patentee, the encouragement of the inventive genius of others, and the assurance that the subject of the patent will be dedicated ultimately to the public. Markman, 517 U.S. at ----, 116 S.Ct. at 1396. What is patented is not limited to the examples described in the specification, but rather is defined by the words in the claims. Specialty Composites v. Cabot Corp., 845 F.2d 981, 987 (Fed.Cir.1988).

[8] 187. Arguments made by a patentee to the Patent Examiner to obtain allowance of a patent claim limit the scope of the claim, consistent with the patentee's arguments. E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co., 849 F.2d 1430, 1438 (Fed.Cir.), *cert. denied,* 488 U.S. 986, 109 S.Ct. 542, 102 L.Ed.2d 572 (1988).

[9] [10] [11] 188. Prosecution history estoppel requires a close examination of not only what was surrendered, but also the reason for such a surrender. Warner-Jenkinson Co. v. Hilton Davis Chem. Co., --- U.S. ----, ----, 117 S.Ct. 1040, 1049, 137 L.Ed.2d 146 (1997). An estoppel normally arises when an amendment to the claim is made to overcome prior art cited by the Patent Examiner. *Id*. On the other hand, a non-substantive change or a change that did not affect patentability does not create an estoppel. *Id.;* Pall Corp. v. Micron Separations, Inc., 66 F.3d 1211, 1219 (Fed.Cir.1995). Thus, an amendment may have a limiting effect on claim scope within a spectrum from great to small to zero. Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1363 (Fed.Cir.1983).

[12] 189. Patent claims must be interpreted as they would have been by one of ordinary skill in the art in light of the specification and prosecution history. Intellicall, Inc. v. Phonometrics, Inc., 952 F.2d 1384, 1387 (Fed.Cir.1992).

[13] 190. A court, in its discretion, may consider extrinsic evidence, consisting of evidence external to the

patent and the prosecution history, such as expert and inventor testimony, dictionaries and learned treatises, as an aid to understanding the patent and coming to a correct conclusion as to the true meaning of the language employed in the patent. Markman, 52 F.3d at 979-81.

[14] 191. Extrinsic evidence, including expert testimony of how those skilled in the art would interpret the claims, is to be used to aid in the Court's understanding of the patent, not for the purpose of varying or contradicting the terms of the claims. Markman, 52 F.3d at 979, 981; Vitronics, 90 F.3d at 1583-84.

[15] [16] 192. Exact identity of results between the claimed and accused devices is not required. The fact that the accused device is not capable of performing all the same functions as the disclosed embodiments, or the fact that the accused device does not work as well as the disclosed embodiments under the same conditions, does not affect the infringement analysis if the claims are satisfied literally, or under the doctrine of equivalents. Inefficient infringement is still infringement. Laitram Corporation v. Cambridge Wire Cloth Company, 863 F.2d 855, 859 (Fed.Cir.1988). Shamrock Technologies, Inc. v. Medical Sterilization, Inc., 903 F.2d 789 (Fed.Cir.1990). Conversely, if an infringing device performs the same function as a patented device, it is immaterial that it also performs some other function. American Hospital Supply Corp. v. Travenol Laboratories, 745 F.2d 1, 9 (Fed.Cir.1984).

[17] 193. Claims cannot be construed broadly during infringement analysis and then narrowly to maintain their validity. Claims are to be given the same interpretation for validity and infringement determinations. Tandon Corp. v. United States Int'l Trade Comm'n, 831 F.2d 1017, 1021 (Fed.Cir.1987).

[18] 194. In litigation, claims are generally construed so as to sustain their validity, if possible. Whittaker Corp. v. UNR Indus., Inc., 911 F.2d 709, 712 (Fed.Cir.1990).

195. An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. 35 U.S.C. s. 112 (sixth paragraph).

[19] 196. Patentees are required to disclose in the specifications some enabling means for accomplishing the function set forth in the "means plus function" limitation. At the same time, there is and can be no requirement that applicants describe or predict every possible means of accomplishing that function. D.M.I., Inc., v. Deere & Co., 755 F.2d 1570, 1574 (Fed.Cir.1985).

197. An element of a claim described as a means for performing a function, if read literally, would encompass *any* means for performing that function, but the sixth paragraph of 35 U.S.C. s. 112 operates to *cut back* on the types of *means* which could literally satisfy the claim language. Johnston v. IVAC Corp., 885 F.2d 1574, 1580 (Fed.Cir.1989).

[20] [21] 198. Under 35 U.S.C. s. 112 (sixth paragraph), to satisfy a means-plus-function limitation literally, the accused device must perform the identical function required by the limitation and must incorporate the structure disclosed in the specification, or its substantial structural equivalent, as the means for performing that function. Intellicall, 952 F.2d at 1388-89. Interchangeability is a useful consideration when determining whether two specific structures are equivalents under s. 112. Rite-Hite Corp. v. Kelley Co., Inc., 819 F.2d 1120, 1124 (Fed.Cir.1987) (citing Graver Tank and Manufacturing Co. v. Linde Air Products Co., 339 U.S. 605, 609, 70 S.Ct. 854, 856-57, 94 L.Ed. 1097 (1950)).

[22] 199. Under the judicially developed claim differentiation doctrine, a difference in meaning and scope is presumed when different words or phrases are used in separate claims. U.S. v. Telectronics, 857 F.2d 778, 783-84 (Fed.Cir.1988). Tr 758-59.

[23] [24] [25] 200. The preamble of a claim is given the effect of a limitation in those cases where the introductory phrase is deemed essential to point out (give "life, meaning and vitality to") the invention defined by the claim. Bell Communications Research Inc. v. Vitalink Communications Corp., 55 F.3d 615, 621 (Fed.Cir.1995). The transitional term "comprising" denotes a patent claim as being "open," meaning that the recitation of structure in the claim is open to additional structural elements not explicitly mentioned. Whether the recitation of structure limits a claim depends on the language of the claim, specification, prosecution history, and other claims. Moleculon Research Corp. v. CBS, Inc., 793 F.2d 1261, 1271 (Fed.Cir.1986).

[26] 201. It is long-established hornbook law that modification by mere addition of elements of functions, whenever made, cannot negate infringement if the accused device has otherwise adopted the basic features of the patent. Amstar Corp. v. Envirotech Corp., 730 F.2d 1476, 1482 (Fed.Cir.) *cert. denied,* 469 U.S. 924, 105 S.Ct. 306, 83 L.Ed.2d 240 (1984).

202. The doctrine of equivalents permits recovery for infringement where the accused device does not fall within the literal scope of the claim. ZMI, 844 F.2d at 1581.

[27] [28] 203. The essential inquiry under the doctrine of equivalents is whether the accused product contains elements identical or equivalent to each claimed element of the patented invention. Warner-Jenkinson, --- U.S. at ----, 117 S.Ct. at 1054. The test for equivalents must be applied to individual elements of a claim, not to the invention as a whole. The doctrine of equivalents must not be based on *overall* similarities between a claimed invention and an accused device. Id. at ----, 117 S.Ct. at 1049.

204. The doctrine of equivalents is intended to prevent someone from making unimportant and insubstantial changes or substitutions to the patented device. Graver Tank, 339 U.S. at 607, 70 S.Ct. at 855-56.

[29] 205. The doctrine of equivalents does not permit the patent claims to be expanded to encompass more than an insubstantial change. Id. at 607-08, 70 S.Ct. at 855-56; Perkin-Elmer Corp. v. Westinghouse Elec. Corp., 822 F.2d 1528, 1532 (Fed.Cir.1987).

[30] [31] 206. The doctrine of equivalents does not mean that claim limitations can be ignored. Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 935 (Fed.Cir.1987), *cert. denied,* 485 U.S. 961, 1009, 108 S.Ct. 1226, 1474, 99 L.Ed.2d 426, 703 (1988). In applying the doctrine of equivalents, a court must avoid conflict with the fundamental principle that claims define the limits of patent protection. Application of the doctrine of equivalents is the exception and not the rule. Charles Greiner & Co., 962 F.2d at 1036; American Home Prods. Corp. v. Johnson & Johnson, 25 U.S.P.Q.2d 1954, 1956 (Fed.Cir.1992) (unpublished opinion); London v. Carson Pirie Scott & Co., 946 F.2d 1534, 1538 (Fed.Cir.1991).

207. Courts must guard against the doctrine of equivalents taking on a life of its own, unbounded by the patent claims. Warner-Jenkinson, ---U.S. at ---- - ----, 117 S.Ct. at 1048-49. When applied too broadly, the doctrine of equivalents conflicts with the definitional and public-notice functions of the statutory claiming requirement. Id. at ----, 117 S.Ct. at 1049.

[32] 208. An appropriate framework of analysis under the doctrine of equivalents is to inquire whether a substitute element performs substantially the same function, in substantially the same way, to achieve substantially the same result as the claimed element or whether the substitute element plays a role substantially different from claimed elements. Id. at ----, 117 S.Ct. at 1054. This "triple identity" test is particularly suitable for analyzing equivalence in mechanical cases. *Id*. In determining equivalence, if any one of these conditions is unsatisfied for any claim element, then there is no equivalence. Malta v. Schulmerich Carillons, Inc., 952 F.2d 1320, 1327 (Fed.Cir.1991), *cert. denied,* 504 U.S. 974, 112 S.Ct. 2942, 119 L.Ed.2d 566 (1992); Unique Concepts, Inc. v. Brown, 939 F.2d 1558, 1563-64 (Fed.Cir.1991).

[33] [34] 209. The fact that the accused device is patented does not avoid infringement, either literally or under the doctrine of equivalents. National Presto Industries, Inc. v. West Bend Co., 76 F.3d 1185, 1191 (Fed.Cir.1996). Although a patent on an accused device may be considered in assessing equivalency under the doctrine of equivalents, it is only relevant if, among other things, it is shown to have been granted after the Patent Examiner's consideration of the patents-in-suit as prior art. Zygo Corp. v. Wyko Corp., 79 F.3d 1563, 1570 (Fed.Cir.1996).FN6

FN6. Marposs U.S. Patent 5,299,360 (PX 106) on the MIDA probe is not relevant to the issue of equivalency here because, *inter alia,* none of the patents-in-suit were considered by the Examiner during examination of that patent.

IV. *INFRINGEMENT*

A. *Claims 1 and 4 of the* '275 Patent

1. Rest Position Limitation

210. Claims 1 and 4 of the '275 patent explicitly require a "rest position." Claim 1 of the '275 patent is illustrative, particularly the bias means clause:

bias means for urging said movable member into contact with said fixed member so that all of said convergent surfaces are engaged thereby positively defining a *rest position* for said movable member, said movable member being removed from said *rest position* in opposition to said bias means when a force is applied to said stylus, said bias means and convergent surfaces cooperating, on cessation of said force, to return said movable member to said *rest position* (emphasis added).

[35] 211. Based on the claims, specification, and prosecution history, the claimed "rest position" means "a single, precise, repeatable position" to which the stylus returns. August 12, 1996, Order Adopting Magistrate Judge Komives' May 24, 1996 Report and Recommendation.FN7

FN7. This court notes, with some dismay, that Renishaw has repeatedly misstated this court's definition of "rest position" by omitting "repeatable" and replacing "single" with "specific." While Renishaw's persistence is somewhat admirable, this court declines to alter its original construction of "rest position."

[36] 212. Marposs does not infringe claims 1 or 4 of the '275 patent because the claims require a single, precise, repeatable position to which the "movable member" and depending stylus returns. None of the MIDA probes used or sold by Marposs contains this feature. As explained more fully above, the movable member or armset of the MIDA probe is not axially constrained and is permitted to rock or tilt. The tip of the depending stylus assumes an indeterminate position within the area of the neutral zone. *See* para.para. 109, 117-18, 125-29 *supra*. Therefore, none of the MIDA probes literally infringe claims 1 and 4 of the '275 patent in suit, for at least this reason.

213. Renishaw's assertion that certain embodiments in the '275 patent may disclose a somewhat less precise rest position has no relevance here because Renishaw does not dispute that for all their embodiments any increase in the rest position variability will be matched by a corresponding decrease in the probe's accuracy. *See* para.para. 52-61 *supra*.

[37] 214. Renishaw is also judicially estopped from asserting any inconsistent interpretation of the term "rest position." This estoppel is a result of Renishaw's testimony and positions accepted by this Court in the *Valeron* litigation and in the subsequent appeal to the Federal Circuit.

215. The doctrine of judicial estoppel is based upon the proposition that where a party assumes a certain position in a legal proceeding, and succeeds in maintaining that position, he may not thereafter, simply because his interests have changed, assume a contrary position. Wang Laboratories, Inc. v. Applied Computer Sciences, Inc., 958 F.2d 355, 358 (Fed.Cir.1992). The doctrine is designed to protect the integrity of the judicial process and prevent parties from "playing 'fast and loose with the courts.' " Edwards v. Aetna Life Ins. Co., 690 F.2d 595, 598-99 (6th Cir.1982); Scarano v. Central R. Co., 203 F.2d 510, 513 (3d Cir.1953). It places a limit on litigants who argue whatever state of facts seems advantageous at a point in time, and who argue a contradictory state whenever self-interest may dictate a change. 1B James Wm. Moore, *Moore's Federal Practice* para. 0.405[8] (2d ed.1996).

[38] [39] [40] 216. This Circuit has established a rule for determining when judicial estoppel should be applied.FN8 In the Sixth Circuit, judicial estoppel forbids a party from taking a position inconsistent with one successfully and unequivocally asserted by the same party in a prior proceeding. United States v. Owens, 54 F.3d 271, 275 (6th Cir.), *cert. dismissed,* 516 U.S. 983, 116 S.Ct. 492, 133 L.Ed.2d 418 (1995). In order to invoke judicial estoppel, a party must show that the opponent took a contrary position under oath in a prior proceeding and that the prior position was accepted by the court. *Id*. The doctrine preserves the integrity of the courts by preventing a party from abusing the judicial process through cynical gamesmanship, achieving success on one position, then arguing the opposite to suit an exigency of the moment. Warda v. Commissioner of Internal Revenue, 15 F.3d 533, 538 (6th Cir.), *cert. denied,* 513 U.S. 808, 115 S.Ct. 55, 130 L.Ed.2d 14 (1994). Judicial estoppel only requires a finding of "judicial acceptance," i.e., that the first court adopted the position urged by the party, either as a preliminary matter or as a part of a final disposition. *Id*.

FN8. The law that governs application of the doctrine in this case is the law of the Sixth Circuit Court of Appeals. U.S. Philips Corp. v. Sears Roebuck & Co., 55 F.3d 592, 596 n. 3 (Fed.Cir.) (for matters not unique to patent law, such as the application of judicial estoppel, the Federal Circuit applies the law of the circuit in which the case was tried), *cert. denied,* 516 U.S. 1010, ----, 116 S.Ct. 567, 672, 133 L.Ed.2d 492, 522 (1995).

217. As noted above, in the *Valeron* litigation, both Mr. McMurtry and Dr. Duffie testified extensively as to the meaning of the "rest position" limitation, its fundamental importance to the patented probes and why the rest position distinguished the invention from the prior art. Tr 390-91, 632, 650; DX 945. Both this Court and the Federal Circuit adopted Renishaw's position with respect to the rest position. Valeron, 625 F.Supp. at 349; Rolls-Royce Ltd. v. GTE Valeron Corp.,, 800 F.2d 1101, 1105-06 (Fed.Cir.1986). Thus, Renishaw is judicially estopped from asserting an inconsistent position in the present action.

2. "A Movable Member" Limitation

[41] 218. Based on the specification and prosecution history of the ' 275 patent, the phrase "a movable member to which a stylus is connectable" as used in claims 1 and 4 of the '275 patent, and as the phrase would be understood by those skilled in the pertinent art, must be construed to mean a rigid connection between the stylus and a movable member. Even Dr. Duffie agreed that the connection must be rigid. Tr 644-45.

219. According to claim 1, the movable member is in turn supportable at a plurality of spaced-apart locations or, with respect to claim 4, at three spaced apart locations. It is the engagement of the "convergent surfaces" at the spaced-apart locations which positively define the rest position for the movable member and therefore also for the rigidly connected stylus. Tr 637, 643-45, 1305-08. *See* para.para. 38, 41, 43, 48, 53-61 *supra*.

220. Claims 1 and 4 of the '275 patent are only asserted against the early Marposs probes that had a safety device. Although the safety device is a classic Boys joint with convergent surfaces at spaced-apart locations,there is no rigid connection between it and the armset and stylus of the probe. only the MIDA armset has the rigid connection to the stylus, a requirement of the claimed "movable member." A flexible structure consisting of a twin-lamina assembly or bellows is between the safety device and the "movable member" armset. It is thus obvious that the "convergent surfaces" of the safety device do not positively define a rest position for a movable member nor is the detent plate of the safety device removed from any "rest position" when a force was applied to the stylus during normal probing operations. *See* para.para. 119-20, 137 *supra*. Therefore, none of the safety device probes literally infringe claims 1 or 4 of the '275 patent, for at least this reason.

221. The Court rejects Renishaw's assertion that for purposes of Claim 1 and 4 of the '275 patent the Marposs armset, twin-lamina assembly (or bellows) and safety device detent plate all constitute "a movable member." As earlier noted, Renishaw took inconsistent positions as to what constituted "a movable member" for various claims and Renishaw's interpretation is at odds with the unambiguous teaching of the '275 patent that the stylus is held in the rest position by the convergent surfaces arrangement. *See* para.para. 43, 48, 61, 171 *supra*. Even Mr. McMurtry acknowledged that there was no suggestion or teaching in the '275 patent that the stylus would be connected to the convergent surfaces arrangement by anything other than a rigid connection. Tr 393-95.

3. Engagement Position Signal Limitation

[42] 222. Claim 1 of the '275 patent includes the limitations of: (1) "providing a signal when said stylus engages said object thereby indicating the position thereof" and (2) "means for providing said signal when said stylus engages the object." The claims, specification, and prosecution history unambiguously indicate that the signal is generated at the time that the stylus first engages the object, thereby indicating the position of the stylus at contact. Tr 1334. *See* 11 62-68 *supra*. Accordingly, based on the specification and

prosecution history of the '275 patent, the term "when" as used in claim 1 of the '275 patent, and as the term would be understood by those skilled in the pertinent art, must be construed to have the ordinary meaning of "at the time that."

223. The Court's construction of the signaling limitation is consistent with the Federal Circuit's interpretation of the same preamble claim language in *Zeiss*. Moreover, Renishaw is judicially estopped from asserting a different interpretation in light of its position in the *Zeiss* case that the language imposed "a requirement that a stylus/object engagement-position be indicated" and the Court's acceptance of that position. *See* para. 67 *supra*.

224. Accordingly, Marposs does not literally infringe claim 1 of the '275 patent. The claim includes the limitation that the probe generate a signal at the time of initial engagement. None of the MIDA probes signal when the stylus engages a workpiece. Tr 1334. If they did so, the Marposs probe would be wildly inaccurate. *See* para.para. 113, 116, 130-32 *supra*.

4. Signaling Means Limitation

[43] 225. Based on the claim language, the "means for providing a signal" of claim 1 of the '275 patent is a means-plus-function limitation. This claim limitation must be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof for performing the identical recited function of "providing a signal when said stylus engages the object." Tr 1544-45.

226. Marposs does not infringe the "means for providing a signal when said stylus engages the object" language of claim 1 of the '275 patent. The ' 275 patent does not disclose the use of a microswitch. Although it does make reference to "other known switches," one skilled in the art would not consider a microswitch for such a signaling on contact probe. Tr 1344-45. *See* 133 *supra*.

227. Moreover, while the Renishaw probes generate a trigger signal "when," i.e., as soon as possible after the stylus engages a workpiece and the stylus is deflected, none of the MIDA probes perform a similar function. Instead, in the MIDA probe, a signal is transmitted after a significant, nonpredictable amount of movement of the stylus which is, relatively speaking, well *after* contact with the workpiece. Tr 386, 921, 1079-82, 1312-13, 1334-35, 1330-31, 1369. *See* para.para. 64, 112-13, 130, 132-33 *supra*.

B. *Claim 55 Of The* '514 Patent

228. '514 claim 55 depends from independent claim 51, and therefore must be construed as including all of the limitations of claim 51. 35 U.S.C. s. 112.

1. Rest Position Limitation

229. Claim 55 of the '514 patent also explicitly includes the rest position limitation, specifically:

bias means for biasing the movable member into a *rest position* relative to the fixed member, the movable member being movable out of the *rest position* against the action of the bias means when a force is applied to the stylus. Col. 18, 1. 22-26 (emphasis added).

[44] 230. For the same reasons given with respect to the '275 patent, the Marposs probes do not have the claimed rest position and therefore do not literally infringe claim 55 for at least this reason.FN9 *See*

para.para. 212-217 *supra*.

FN9. Renishaw's contention that Marposs' judicial estoppel argument, if in any way viable, could only be asserted regarding the '998 and '275 patents is misplaced. As discussed supra,para.para. 214-17, the doctrine of judicial estoppel forbids a party from taking *a position* inconsistent with one successfully and unequivocally asserted by the same party in a prior proceeding. United States v. Owens, 54 F.3d 271, 275 (6th Cir.). The fact that in prior litigation the Federal Circuit adopted Renishaw's position with respect to the meaning of "rest position" precludes Renishaw from asserting a contrary definition of that term in any subsequent litigation, even litigation involving a different patent employing that term.

2. Axially Confronting Surfaces Limitation

[45] 231. Based on the claim language and the specification of the '514 patent, the phrase "annular surfaces axially confronting each other" and as the phrase would be understood by those skilled in the pertinent art, must be construed to mean that the surfaces are fully engaged, *i.e.*, abutting, so that a precise axial rest position is achieved. *See* para.para. 84, 86, 91-92 *supra*.

232. None of the MIDA probes have "confronting" annular surfaces as properly construed in claim 55 of the '514 patent. Tr 1365-67. All MIDA probes have a gap and, accordingly, cannot literally infringe this claim limitation.

233. Further, the claim provides that the axially confronting surfaces are "engageable so as to permit tilting of the movable member when the stylus contacts a workpiece." As earlier observed, in the '691 family of patented probes, at the moment of first contact of the stylus with a workpiece, the movable member tilts about a point on the abutting surfaces. Therefore, the ' 514 patent claim 55 phrase, axially confronting surfaces "to permit tilting of the movable member when the stylus engages the workpiece," must be construed to mean that tilting of the axially confronting surfaces occurs at the time that the stylus first engages a workpiece. As with the signaling "when" clauses, the specification makes it plain that the tilting "when" the stylus contacts the workpiece would be understood by one skilled in the pertinent art to have the ordinary meaning of "at the time that." Tr 1394. *See* para. 1 87-88 *supra*.

234. None of the MIDA probes have axially confronting surfaces that tilt when the stylus engages the workpiece and, accordingly, cannot literally infringe claim 55 of the '514 patent. *See* para.para. 112-113, 136 *supra*.

3. Lateral Constraining Device Limitation

[46] 235. Based on the claim language, the specification of the '514 patent, and relevant testimony of expert witnesses, the "lateral constraining device," which includes a "support element and inclined surface ... distinct from said skirt and second annular surface" of claim 55 of the '514 patent, and as the language would be understood by those skilled in the pertinent art, must be construed to mean that the lateral constraint is distinct and independent from the axial constraint provided by the confronting annular surfaces of the patented probes. *See* para.para. 84-85, 88, 90-91 *supra*.

236. Marposs does not infringe claim 55 of the '514 patent because the lateral constraint of the MIDA probe is not distinct and independent from the axial constraint. Dr. Duffie admitted that the lateral constraint is not distinct from the axial constraint in the MIDA probe. Tr 885. Moreover, in terms of structure, the disc and

spherical surface of the MIDA armset are part of a unitary, monolithic, rigid structure, and the shelf and conical surface of the housing are also a unitary construct. Therefore, the MIDA probes do not infringe claim 55 of the '514 probe for at least this additional reason. Tr 1369-70, 970-71, 933-34. *See* para.para. 110, 112, 138 *supra*.

4. Planar Spring Limitation

[47] 237. Based on the claim's language, the specification of the '514 patent, and relevant testimony of expert witnesses, the "planar spring for constraining movement of the movable member relative to the fixed member" of claim 55 of the '514 patent, and as the language would be understood by those skilled in the pertinent art, must be construed to mean a planar flexure transmitting the lateral constraint set forth in the "lateral constraining device" element. Tr 1372-76.

238. Marposs does not infringe claim 55 of the '514 patent because the bellows or twin-lamina of the MIDA probes are not planar springs and do not transmit lateral constraint to the movable member of the MIDA probe. Therefore the MIDA probes do not infringe claim 55 of the '514 patent for at least this additional reason. Tr 1372-76. *See* para.para. 112, 139-40 *supra*.

239. Marposs does not meet this limitation under the doctrine of equivalents because the MIDA probes have no element, including the bellows or twin-lamina, that are substantially the same as the planar spring of the '514 patent claims. The bellows and twin-lamina have a substantially different function and result (they do not provide lateral constraint) and work in a substantially different way (they are not planar). Moreover, they would not be considered interchangeable by one of ordinary skill in the art. Tr 1372-79. *See* para.para. 112, 139-40 *supra*.

5. Detection Means Limitation

[48] 240. Based on the claim language, the "means for detecting deflection of the movable member out of the rest position" of claim 55 of the ' 514 patent is a means-plus-function limitation. This limitation must be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof for performing the identical recited function. Tr 1544-45.

241. The structure in the specification corresponding to the signal providing means and detector elements of claim 55 of the '514 patent consists of piezoelectric devices, strain gauges, completion of an electric circuit between the stylus tip and workpiece, electrical switching between balls on the movable member and the floor of the housing, and a photoelectric device. *See* para.para. 87, 96 *supra*. This detector and means clause of '514 patent claim 55 must therefore be construed to cover these structures and equivalent structure for performing the recited "when" and "rest position" signaling functions.

242. Marposs does not infringe claim 55 of the '514 patent because the microswitch of the MIDA probes is not, for the reasons set forth in detail above, the same as or equivalent under 35 U.S.C. s. 112 to the piezoelectric detectors, strain gauges, electric circuit between the stylus and workpiece, electric switching between balls on the movable member and the floor of the housing, and photoelectric device disclosed in the specification for the ' 514 patent. Nor does the MIDA microswitch perform the recited function of producing a signal "when" the stylus touches a workpiece or is deflected out of any "rest position." Tr 1388. *See* para.para. 112-13, 130, 132-33 *supra*.

C. *Claim 51 Of The* '514 Patent ***And The Prior Art***

243. That the construction of the rest position and axial confronting surfaces limitations of claim 55 of the '514 patent is correct is further supported by considering the interplay between claim 51, the independent claim on which claim 55 depends, and the Chudov prior art reference. Chudov is U.S.S.R. Inventors Certificate No. 1359640, published on December 15, 1987. DX 864.

244. The Chudov prior art reference serves as extrinsic evidence, i.e., evidence external to the patent and prosecution history, that demonstrates the state of the art at the time of the invention. Markman, 52 F.3d at 980. It is useful "to show what was then old, to distinguish what was new, and to aid the court in the construction of the patent." *Id*. (quoting Brown v. Piper, 91 U.S. 37, 23 L.Ed. 200 (1875)).

245. Renishaw has proposed a construction of the single, precise, repeatable rest position limitation that encompasses all of the MIDA probes, no matter what the size of the gap or neutral zone happens to be, and a construction of the axially confronting surfaces limitation that encompasses the disc and shelf of the MIDA probe notwithstanding the gap. Using Renishaw's proposed construction, these limitations, along with the rest of the elements of claim 51, literally read on the Chudov reference. Dr. Duffie admitted as much in his testimony. Tr 897-900.

246. To avoid rendering claim 51 invalid these limitations would have to be construed so as to exclude the Chudov reference, which in turn would require a finding of a gap in the Chudov reference but not in the Renishaw probe. These limitations must be construed the same for dependent claim 55. Accordingly, this is extrinsic evidence that the construction of the rest position and axial confronting surfaces limitations of claim 55 of the '514 patent is correct. *See* para.para. 229, 231 *supra*. Tr. 1545, 1559-64; Whittaker, 911 F.2d at 712.

D. *Claim 2 Of The* '904 Patent

1. Signaling Upon Contact Limitation

247. Claim 2 of the '904 patent includes the limitation of "the probe generating a trigger signal when said sensing tip contacts an object and said stylus holder is thereby deflected relative to said housing." Col. 10, 1. 37-39. Based on the '904 specification, there can be no doubt that the claimed signal generation must occur at the time of initial contact and deflection of the stylus:

"-The *instant* at which the stylus tip 15 first contacts a workpiece can be detected in various possible ways. For example, it is possible to mount piezo-electric detectors ... to detect the *initial contact* ..." [Id., col. 6, 1.10-13.]

-[T]he auto zero circuit 50 is responsive ... *when the stylus 14 begins to deflect* upon contact with a workpiece. [Id., 1. 31-35.]

-All of the embodiments ... may have any of the arrangements for detecting the *instant* of contact between the stylus tip and a workpiece, as discussed above in relation to the Fig. 1 embodiment. [Id., col. 9, 1. 16-20.]

The patented probes detect the "instant of contact." At this instant, the stylus is in its single, precise, repeatable rest position, thus providing a high level of repeatability for the signal generated by the probe. "Because of the repeatability of the stylus rest position, this is an accurate measure of the position in space

of the point of contact between the stylus and the workpiece." Id., col. 1, l. 36-41 (discussing advantageous features of the '998 prior art probe incorporated into preferred embodiments of the '904 invention. Id. col. 3, l. 2-5). r Tr 421, 902-04, 1312-13.

[49] 248. Accordingly, based on the specification of the '904 patent, the term "when" as used in claim 2 of the '904 patent, and as the term would be understood by those skilled in the pertinent art, must be construed to have its ordinary meaning of "at the time that" and the claim language must be construed to mean that the signal is generated at the time that the stylus first contacts the object and deflection begins. Tr 1386-87.

[50] 249. Marposs does not infringe claim 2 of the '904 patent because it does not meet the limitation of signaling when the stylus contacts a workpiece and is deflected. None of the MIDA probes signal at the time that the stylus contacts a workpiece and is deflected. Tr 1334. *See* para.para. 112-13, 130, 132-33 *supra*.

250. Renishaw points out that during cross-examination, Dr. DeBra admitted that "deflection" would apply to the MIDA probe if it were construed according to its popular usage. Tr 1441-42. For purposes of claim construction in this litigation, however, "deflection" has a much more specific meaning which does not apply to the MIDA probe.

2. Rest Position Limitation

[51] 251. Claim 2 of the '904 patent does not specifically use the term "rest position." Nevertheless, it is perfectly apparent from the patent as a whole, including the claim language, the specification and the prosecution history that claim 2 includes a rest position limitation, albeit with different words being used to define the same concept.

252. Claim 2 of the '904 patent includes both a lateral constraint and an axial constraint, the requisite components of the rest position. The "lateral constraint" component of the rest position is specifically recited as the function of the "device acting between" in claim 2. The "annular member" being "tiltable relative to the housing," the "transducer being actuable by tilting," and the "probe generating a trigger signal when said sensing tip contacts an object and said stylus holder is thereby deflected" can only be understood by one of ordinary skill in the art to require an axial constraint. Together, these constraints define a "rest position" for the stylus holder. *See* para.para. 84-87, 91-93, 96, *supra*.

253. In every embodiment disclosed in the '904 patent specification, the stylus "is held in a precisely defined rest position by a combination of an axial constraint and a lateral constraint." '904, col. 4, l. 25-27. It is "the axial and lateral constraints which define the rest position." (Id., col. 7, l. 18-19).

254. In the '904 patent specification, axial constraint is provided by an "annular" skirt, the bottom edge of which " *rests on* a flat internal surface ... of the housing." These surfaces are lapped together "so that they are extremely flat and conform with each other. This ensures that the stylus holder ... is supported in a precise axial rest position." Id., col. 3, l.64-col. 4, l. 5 (emphasis added).FN10 Thus "vertical movement and tilting of the stylus holder," i.e., translation along the z-axis and rotation around the x and y axes, are "constrained by the axial rest position." This axial constraint is provided by an annular member having an annular surface that is *in contact* and resting upon another surface. Id., col. 4, l. 21-24; Tr 477-78.

FN10. In an alternative embodiment of the '904 patent specification, "the annular lapped contact region

between the skirt ... and surface ... may if desired be replaced by three balls *engaging* against a plate, or by a ring of balls *engaging against* a plate." Col. 8, 1. 33-37 (emphasis added); *see also* col. 9, 1. 12-15. The balls are employed as an alternative to give "a very precise axial rest position without the need for lapping." Id., col. 6, 1. 53-59. *See. e.g.,* col. 7, 1. 26-33.

255. The '904 specification touts the annular member axial constraint as providing a distinct improvement over the prior art probes. The annular member of the '904 patent abuts against another surface and consequently prevents tilting in the rest position, thus overcoming the problem of tilting "as in the case of the prior art." In the prior art probes "the leverage effect caused by the length of the stylus 14 would greatly magnify the mispositioning of the stylus tip 15 when the stylus 14 tilts." '904, col. 5, 1.37-44; Tr 477-79.

256. Thus, the '904 specification relies upon abutting annular surfaces to obtain and "ensure" a "precise axial rest position" for the stylus holder. Tr 477-79. The critical importance of the rest position, particularly the axial component of the rest position, is repeatedly stressed throughout the specification and claims:

-This *ensures* that the stylus holder 12 is supported in a precise axial rest position. ['908, col. 4, 1. 1-3.]

-When the deflecting force on the stylus 14 ceases ... the stylus member 12 is returned to its axial and lateral rest position. [Id., col. 5, 1. 3-6.]

-[S]ince the surfaces 20 and 22 are flat, there is no resistance preventing the skirt 18 from moving into the axial rest position. [Id., 1. 17-19.]

-The ceramic materials are preferred because they can be lapped against each other to produce a seating having a very high degree of flatness, and thus precision. [Id., col. 6, 1. 49-52.]

257. Nowhere is there any discussion in the '904 specification of "an annular member" "tiltable relative to the housing ... about a point on said annular surface" (claim 2) other than an annular member that abuts against another surface to provide a precise axial rest position. The patent specification never discloses or suggests any means for carrying out the invention without the precise, accurate axial rest position provided by the abutting annular surfaces disclosed in the specification. Tr 880-81. Renishaw's constructionof the claim to encompass a probe without an axially constrained stylus is a notion that runs contrary to the substance and fundamental features of the disclosure as originally filed with the PTO.

258. The function recited in claim 2, including tilting "about said point on said annular surface" to actuate a signal "when said sensing tip contacts an object and said stylus holder is thereby deflected," can only occur if the annular member is abutting against another surface (as shown in the specification) at the moment the stylus contacts the workpiece. Thus, the annular surface must be in contact, *i.e.,* have no gap, for this additional reason. If it were not in contact, the function of the claimed probe, tilting about a point on said annular surface to actuate a trigger signal "when" the stylus contacts a workpiece, would not be performed. Tr 1394-96.

259. Because claim 2 specifically recites a lateral constraint, together with an "annular member," "annular surface" and other limitations which can only be interpreted as requiring axial constraint, claim 2 of the '904 patent also defines a probe having a rest position. Consistent with any reasonable reading of the patent specification, and the terms actually present in claim 2 of the ' 904 patent, claim 2 must be interpreted to

require a rest position. FN11 *See* para.para. 251-258 *supra*. *See, e.g.,* Autogiro Co. of Am. v. United States, 181 Ct.Cl. 55, 384 F.2d 391, 397 (1967) ("[W]ords must be used in the same way in both the claims and the specification."); 37 C.F.R. s. 1.75(d)(1):

FN11. Requiring that accused devices meet limitations that are inherent, rather than expressed, is not unusual. See Insituform Technologies Inc. v. Cat Contracting, Inc., 99 F.3d 1098, 1106 (Fed.Cir.1996), *cert. denied,* 520 U.S. 1198, 117 S.Ct. 1555, 137 L.Ed.2d 703 (1997) (finding that the subject claim must be construed to have an inherent limitation of a "discontinuous vacuum" based on the components of the invention expressly recited in the claim, as those components were described in the subject patent specification, and that the accused device maintained a continuous vacuum that did not meet the claim's inherent limitation). *See also* Wiener v. NEC Elecs., Inc., 102 F.3d 534, 540-41 (Fed.Cir.1996) (construing the limitation "call[ing] on the columns for one byte at a time" within the context of the entire claim to require columns *on the claimed data matrix element,* and finding no literal infringement nor infringement under the doctrine of equivalents because the columns used in the accused device were elsewhere *external* to the data matrix in the accused device).

[T]he terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description; ...
260. Furthermore, during prosecution of the application that resulted in the ' 904 patent, the Patent Examiner required Renishaw to amend the specification. This amendment added further "rest position" language under the "Summary of The Invention" portion of the '904 patent specification:

[F]irst support means [*i.e.,* abutting annular surfaces] ... *and second support means* [*i.e.,* planar spring kinematic clamp arrangement] independent from the first support means ... The two support means co-operate with each other when all said elements are engaged to hold the first movable member in a *rest position* relative to the fixed member.

Both said pairs of elements are disengageable against the action of the bias means to permit displacement, in the same direction, of the first movable member relative to the fixed member out of said *rest position when* said stylus contacts a workpiece.

....

The touch probe further includes means for providing a signal *when* said stylus contacts a workpiece.

PX 501 (emphasis added). Any construction of claim 2 that did not require a "rest position" would be inconsistent with the very portion of the specification which was added in order to obtain allowance of the '904 patent.

3. "Device Acting Between" for Lateral Constraining

[52] 261. Based on the claim language, the specification of the '904 patent, and the prosecution history, the "device acting between said stylus holder and said housing for constraining said stylus holder ... the device including a seating and at least one constraining spring distinct from the biasing means ... and providing lateral constraint from the axial biasing" of claim 2 of the '904 patent must be construed to mean (1) a separate mechanical device ("a *device acting between* ") located between the stylus holder and housing, (2)

the device having a "seating," and (3) the device having at least one constraining "spring" distinct from the bias spring to constrain the stylus holder against lateral movement. Tr 1369, 1389-90. *See* para.para. 84-87, 91, 93 *supra*.

262. During prosecution of the application that resulted in the '904 patent, Renishaw amended the claims to add the "device acting between" language in order to locate the device and thus overcome an objection by the Patent Examiner. PX 500, 501; DX 1150, p. 63-64, 78-79.

263. With reference to the specification of the '904 patent, the "device acting between ... providing lateral constraint" and including a seating and at least one distinct constraining spring, corresponds in every embodiment to the Boys joint kinematic mount which includes a seating and a planar spring which constraints the movable member against lateral movement. These structures, together, constitute a separate mechanical device between the stylus holder and the housing and provide lateral constraint from axial biasing. Tr 928-29.

264. Accordingly, in view of the specification and prosecution history, the claimed "device acting between" cannot be construed to cover a touch probe which does not have a separate mechanical device located between the stylus holder and housing, or a touch probe that does not have a distinct laterally constraining spring as a part of the lateral constraint device. Tr 1390-93.

265. Marposs does not infringe claim 2 of the '904 patent. None of the MIDA probes have any device acting between the stylus holder and housing. There simply is no mechanical structure, apparatus, or device between the stylus holder and housing, except the bellows and the bellows does not include a seating. Renishaw's attempt to carve out a portion of the stylus holder and a portion of the housing and then call these portions a device acting between the stylus holder and the housing is sophistry and unsupportable. As Dr. Duffie admitted in his discussion of the structure of the MIDA probe, "the *seating occurs* at the bottom portion of the probe *where the stylus holder meets the housing*." Therefore, there can be no separate device acting between the stylus holder and housing. Tr 575-76 (emphasis added).

266. In addition, none of the MIDA probes include a second spring for providing lateral constraint. The bellows is not a spring, it is not acting as a spring, nor does it provide any lateral constraint. Therefore, the MIDA probes do not infringe the 1904 patent, for at least this additional reason. Tr 1392-93. *See* para.para. 112, 139-40 *supra*.

4. "Transducer" Limitation

[53] 267. Claim 2 of the '904 patent recites "a transducer for generating said trigger signal." A "transducer" is known to those of ordinary skill in the art as a device that converts one form of energy, e.g., mechanical, into another form of energy, e.g., electrical. Dr. DeBra testified that the MIDA microswitch converts mechanical movement into an electrical signal, i.e., acts as a transducer and may be considered to be a transducer according to popular usage. Tr 1397-98, 1466. Because, however, of the very broad nature of the term "transducer," one of ordinary skill in the art would construe it to include only various transducers and switches capable of signaling as soon as possible after initial contact between the stylus and an object so as to conform with the disclosure and teachings of the patent. Tr 1397-98.

268. Marposs does not infringe claim 2 of the '904 patent. Claim 2 of the ' 904 patent requires a "transducer" for detecting the "instant of contact" between the stylus and an object. The MIDA microswitch cannot do

this as set forth in detail above. Tr 1398. *See* para.para. 112-13, 130, 132-33 *supra*. Therefore, claim 2 is not infringed by any MIDA probe, for at least this reason.

V. *BAD FAITH LITIGATION/EXCEPTIONAL CASE*

[54] 269. While there is some evidence that Renishaw knew of the MIDA probe's different structure and operating principles, that Renishaw was unable to develop a new commercially successful probe to compete in the marketplace with Marposs, and that Renishaw's infringement contentions were contrary to positions previously advanced before the Patent Office and in prior litigations, this evidence is not sufficient to warrant a finding, by clear and convincing evidence, that this is an exceptional case under 35 U.S.C. s. 285 justifying an award of attorneys fees.

[55] [56] 270. The patent statute provides that the court may award reasonable attorneys' fees in exceptional cases. 35 U.S.C. s. 285. The standards governing such an award are well summarized in Machinery Corp. of America v. Gullfiber AB, 774 F.2d 467 (Fed.Cir.1985). Such an award is in the discretion of the district court upon a showing by clear and convincing evidence and may be made on (1) " 'a finding of unfairness or bad faith in the conduct of the losing party, or some other equitable consideration of similar force, which makes it grossly unjust that the winner of a particular law suit be left to bear the burden of his counsel fees,' " id. at 471 (citation omitted), and (2) a finding of gross injustice where there is proof of actual wrongful intent or of gross negligence, id. at 473; thus evidence of an utter lack of care is sufficient to support a finding of an exceptional case under 35 U.S.C. s. 285. *Id*.

271. Marposs relies primarily on *Machinery Corp*. in support of its contention that Renishaw acted in bad faith so as to make this case exceptional under 35 U.S.C. s. 285. A cursory examination, however, of the cases cited in *Machinery Corp*. which have found exceptional circumstances under s. 285 makes it apparent to this court that Marposs has failed to meet its burden. *See, e.g.,* Hughes v. Novi American, Inc., 724 F.2d 122 (Fed.Cir.1984) (affirming assessment of attorney fees against a patentee who made grossly negligent misrepresentations to the PTO and could not in good faith believe that defendant's device infringed "since even a cursory reading of the claims makes obvious the fact of non-infringement"); Loctite Corp. v. Fel-Pro, Inc., 667 F.2d 577, 584 (7th Cir.1981) (affirming a finding of exceptional case where patentee initiated suit with unconfirmed data to support its infringement claim, refused to produce any test results, and was proven to have conducted unreliable and tainted tests).

272. Given that this court has found no infringement by Marposs of the Renishaw patents '275, '514 or '904, there is no need for the court to address Marposs' affirmative defense of patent misuse.

273. Based upon the foregoing findings of fact and conclusions of law, this court concludes that Marposs has not infringed Renishaw's '275, '514, or ' 904 patents and therefore enters judgment in favor of Marposs on Renishaw's claim of infringement. Furthermore, because this court does not find this to be an exceptional case pursuant to 35 U.S.C. s. 285, it concludes that Marposs is not entitled to reimbursement of its attorneys' fees.

274. In accordance with this opinion, the Clerk of the Court is directed to enter **JUDGMENT** in favor of defendant MARPOSS SOCIETA' PER AZIONI and MARPOSS CORPORATION.

275. Plaintiff RENISHAW plc will take **NOTHING.**

SO ORDERED.

APPENDIX A

'275 PATENT, FIGURES 1-3

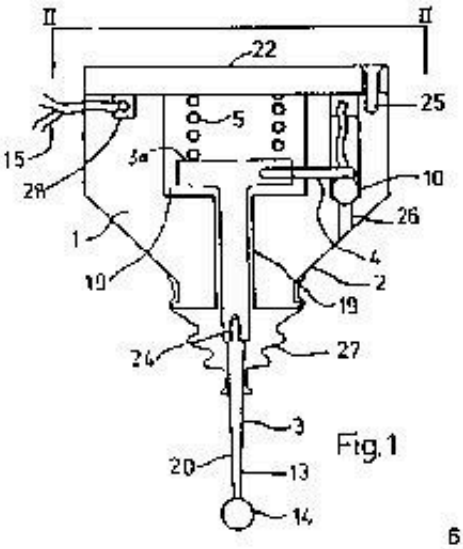


Fig. 1

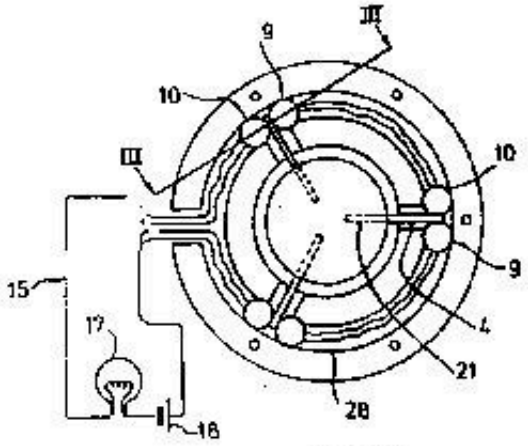


Fig. 2

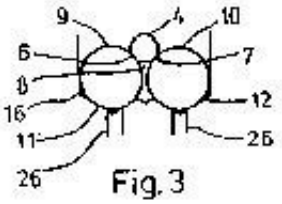


Fig. 3

***1095**

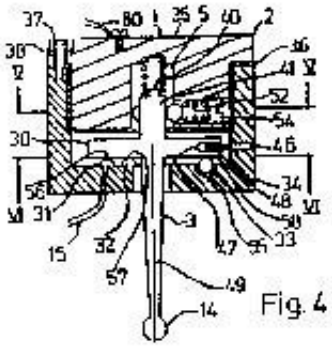


Fig. 4

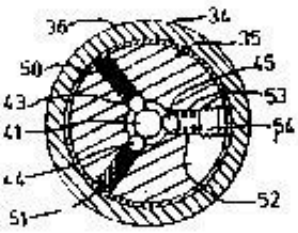


Fig. 5

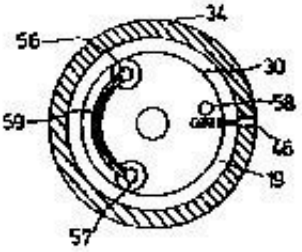


Fig. 6

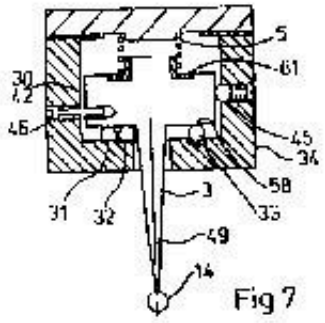


Fig 7

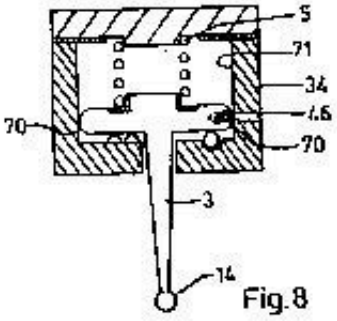


Fig. 8

***1096**

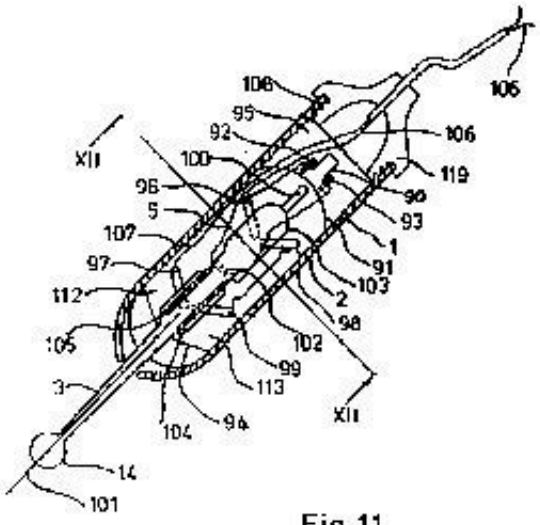


Fig. 11

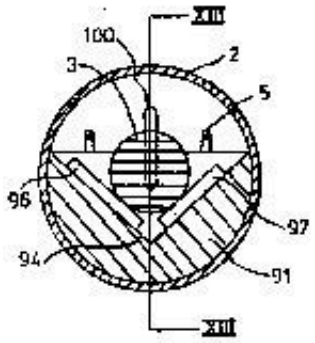


Fig. 12

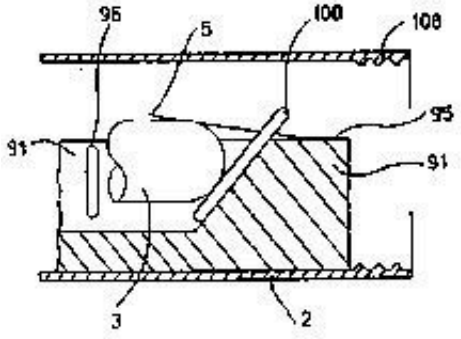


Fig. 13

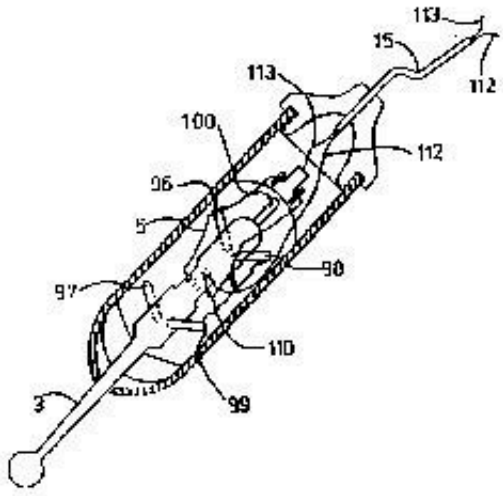


Fig. 14

APPENDIX B

Fig. 1.

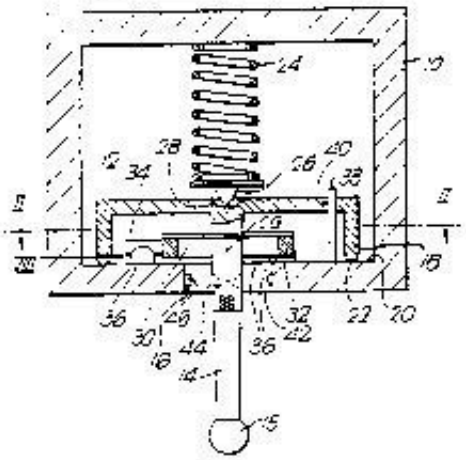


Fig. 2.

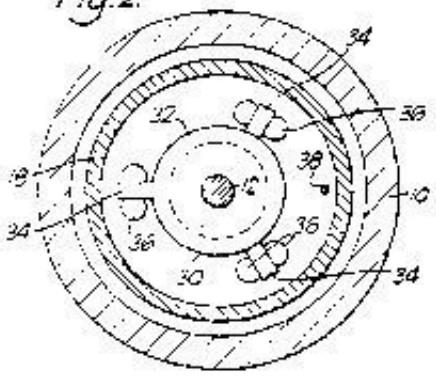
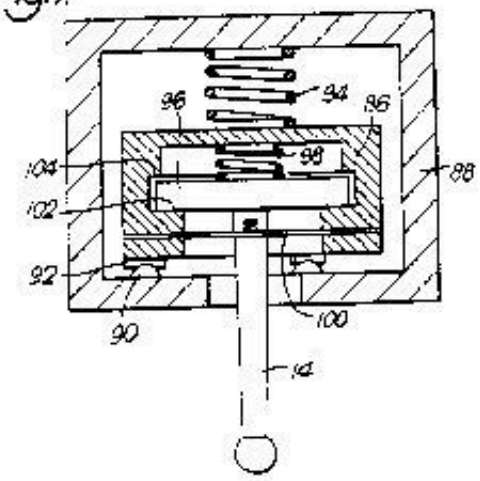
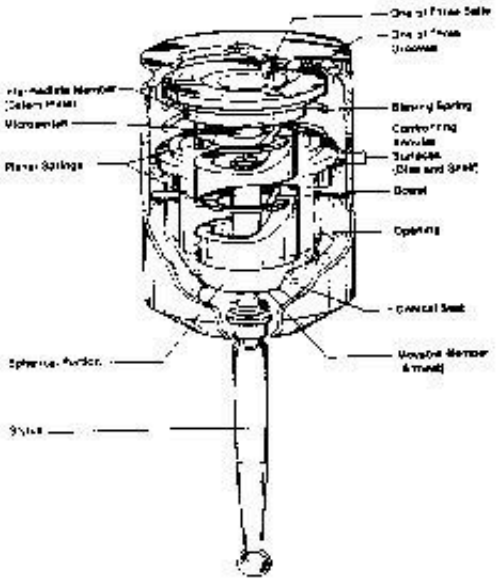


Fig. 7.

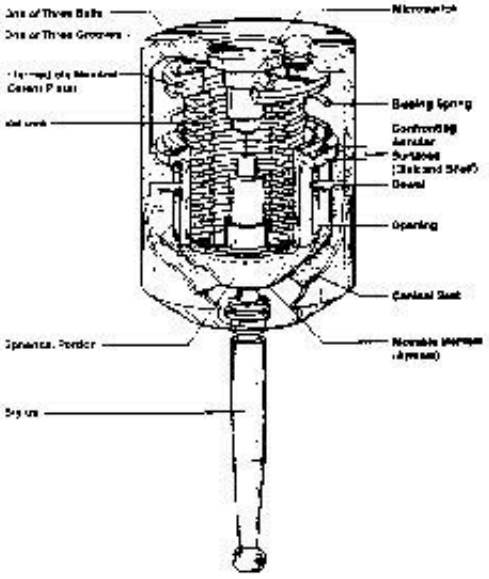


APPENDIX C

Version 1



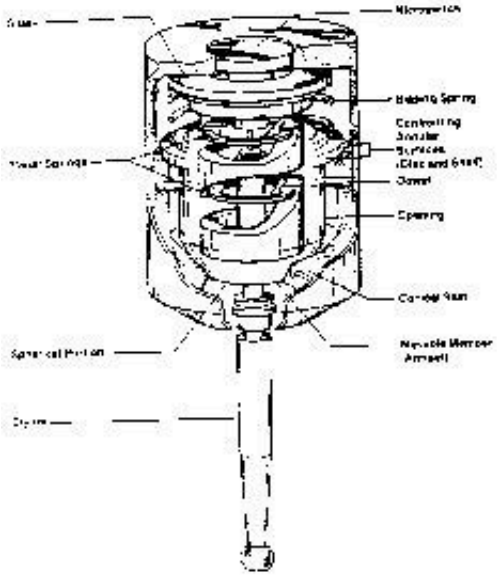
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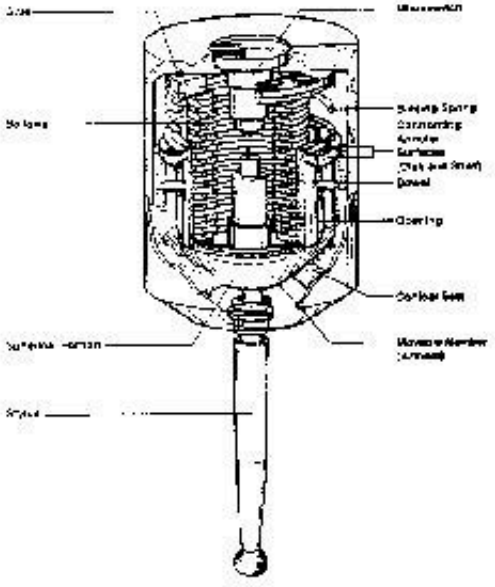
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MEDIA PROOF, VERSIONS 3-4

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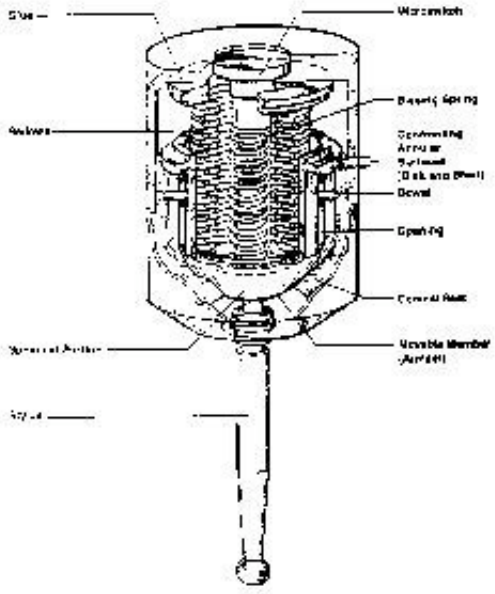


Version 4



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Version 5 (Current)



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