United States District Court,
D. South Carolina, Greenville Division.

RIETER INGOLSTADT SPINNERIMASCHINENBAU AKTIENGESELLSCHAFT,
Plaintiff.
v.
HOLLINGSWORTH SACO LOWELL CORPORATION,
Defendant.

Civ.A. No. 6:92-2207-3AK

Nov. 26, 1996.

ORDER

CATOE**, United States Magistrate Judge.**

In this action, the plaintiff, Rieter Ingolstadt Spinnereimaschinenbau Aktiengesellschaft ("Rieter") asserts that the defendant, Hollingsworth Saco Lowell Corporation ("HSL") made, used, and sold a modified autoleveling draw frame which infringes Claims 1 and 4 of Rieter's U.S. Patent No. 4,137,487 ("'487 Patent"), either literally or by application of the doctrine of equivalents. The parties presented argument on this matter in a bench trial on August 12, 13, and 14, 1996. Attorneys for the parties submitted pretrial briefs and, following trial, proposed findings of fact, conclusions of law and orders.

For reasons set forth herein, after full consideration of the testimony and evidence at trial, and pursuant to Rule 52 of the Federal Rules of Civil Procedure, this court determines that the defendant's Model 990 draw frame does not infringe the '487 Patent. In support of that determination, the court issues its findings of fact and conclusions of law set forth below.

FACTUAL BACKGROUND

The plaintiff, Rieter, has acquired eighty to ninety percent of the autoleveling draw frame market in the United States (402 II. 23-25 through 403 I. 1). The plaintiff's United States Letters Patent No. 4,137,487 is titled "Method and Device for Automatically Leveling Fleeces, Slivers, Roving and Like By Drawing" (PX-1). The patent was issued on January 30, 1979, on Application Serial Number 726,737 and filed in the United States Patent and Trademark Office on September 27, 1976, in the names of Heinrick Neistro and Peter Denz, both citizens of Germany. The '487 Patent has a foreign priority filing date of October 2, 1975, based on a corresponding German patent application. The '487 Patent was to expire on January 30, 1996; however, its term was extended eight months, to September 27, 1996, by legislation implemented through the General Agreement on Trade and Tariffs (GATT). 35 U.S.C. s.154(c)(3).

The '487 Patent pertains to an apparatus that automatically levels a band of fibers, such as sliver, by varying the drafting speed of a drafting mechanism responsive to variations in the thickness of the band. Referring to figure 1 of the '487 Patent, a scanner with a movable scanning roller 2 is provided for directly sensing changes in the thickness of the band of fibers 1 before the band of fibers is fed into a drafting mechanism, which includes two pairs of rolls 11 and 12. The movable roller 2 in turn moves a plunger of an electrical measuring device 3 that generates an analog voltage corresponding to fluctuations in the sliver thickness. The analog voltage is converted by an analog-to-digital converter 4 into a digital signal, such as a binary number (PX-1).

The digital signal exiting from the analog-to-digital converter 4 is fed to a digital value stepping storage register 5. In the particular embodiment of Figure 1, the digital value stepping storage register includes a register which has a plurality of storage elements 54 capable of storing the digital information in the form of a binary word. Each storage element 54 embraces a plurality of bytes for the individual binary numbers 1, 2, 4, 8, 16, 32, etc. In the embodiment of Figure 2 of the patent, the digital value stepping storage register is a digital shift register 55.

The digital signals from the analog-to-digital converter 4 are sequentially written into the storage elements 54. After the digital signals are stored in the storage elements 54 for a period of time sufficient to allow the sensed portion of the sliver 1 to move from the scanning roller 2 to the drafting zone 100, the digital word is sequentially read out of the storage cells 54 in the same sequence that they were written into the storage cells 54.

The digital signal that is read out of the digital value stepping storage register 5 (Figure 1), such as the digital shift register 55 (Figure 2), is converted by a digital-to-analog converter 41 into an analog signal. This analog signal is used for varying the drafting speed of the drafting mechanism by varying the speed of the delivery rollers 12 relative to the drafting rollers 11 (Figure 1) or varying the speed of the drafting rollers 11 relative to the speed of the delivery rollers 12 (Figure 2).

An impulse generator 40 is connected to the drafting mechanism for generating pulses having a frequency corresponding to the drafting speed. In other words, as the drafting mechanism speeds up or slows down, the frequency of the pulses generated by the impulse generator 40 will change accordingly. The pulses generated by the impulse generator 40 are used for sequentially writing the digital signals into and reading the digital signals out of the storage register in synchronism with the drafting speed. The impulse generator 40 can be connected to draft roller 11 (Figure 1) or driven in dependence upon the speed of delivery roller 12 (Figure 2). When a pulse is generated by the impulse generator 40, it causes a digital word representing the fluctuations in the thickness in the band of sliver to be written into a storage location in the register. After a predetermined period of time corresponding to the time it takes for the sliver to move from between the scanning rollers 2 into the drafting zone 100, the digital signal is read out of the storage register. As the drafting speed changes, the rate at which the digital signals are stepped into and out of the stepping storage register will vary accordingly.

Prior to 1994, the defendant produced Model DJ11B autoleveling draw frame. In 1992, the plaintiff claimed the defendant's prior DJ11B draw frame infringed the '487 Patent, and filed suit in this District (C.A. No. 6:92-2207-3). On April 23, 1994, the parties entered into a confidential Settlement Agreement (DX 1) with mutual releases for all claims, known and unknown, and an order dismissing all claims and counterclaims was issued on May 20, 1994 (PX-61).

In addition to monetary consideration, the Settlement Agreement included a provision which defined at least one type of autoleveling draw frame which would not be deemed to infringe the '487 Patent. The agreement labeled such machines as "NONINFRINGING DRAW FRAMES," and they were defined as "all draw frames made, used or sold by Hollingsworth incorporating an auto leveling device which does not convert the electrical signal of a sliver sensing component from an analogue signal to a digital signal" (Settlement Agreement, DX 1, 1.7).

The defendant alleges that the autoleveling system of the DJ11B was modified substantially in 1994 (Tr. 221, 488). The changes included replacement of an analog sensor, known as a linear variable displacement transducer ("LVDT"), with linear encoder components commercially acquired from the Heidenhain Corporation. These Heidenhain components include a "digital length gauge with pneumatic plunger activation," designated a Heidenhain-Metro MT12P/MT25P, and an EXE602E, sometimes referred to as an EXE box. The digital storage device in the DJ11B was also replaced with an off-the-shelf Axis Positioning Module ("APM"), having a new RAM storage device, manufactured by GE Fanuc. These alterations were incorporated into the defendant's Model 990 autoleveling draw frame several months prior to the Settlement Agreement. The newly-designed system was referred to at trial as the "Modified Autoleveling System."

The plaintiff became aware of the Modified Autoleveling System several months after the Settlement Agreement was completed and objected, alleging that the newly-employed linear encoder outputs an analog voltage, and thus was not a "non-infringing draw frame." On February 21, 1995, the plaintiff filed a motion for an order to show cause why the defendant should not be held in civil contempt or, in the alternative, to reopen the case for further litigation. After a hearing conducted by the court in March 1995, the plaintiff was instructed to, and did, file an amended complaint to re-initiate litigation on infringement of the '487 Patent by the Modified Autoleveling System. The defendant counterclaimed, alleging a breach of the Settlement Agreement and breach of an implied covenant of good faith and fair dealing.

APPLICABLE LAW AND CONCLUSIONS

The Law of Infringement

"[W]hoever without authority makes, uses, offers to sell or sells any patented invention, within the United States ... during the term of the patent ... infringes the patent." 35 U.S.C. s.271(a). The patent owner has the burden of proving infringement, whether literal infringement or infringement under the doctrine of equivalents, by a preponderance of the evidence. Hughes Aircraft Co. v. United States, 717 F.2d 1351, 1359 (Fed. Cir. 1983).

Determining infringement is a two-step process. The first step is to determine the meaning and scope of the patent claims asserted to be infringed. Markman v. Westview Instruments, Inc., 52 F.3d 967, 976 (Fed. Cir. 1995) (*en banc*), *aff'd,* 116 S.Ct. 1384 (1996). The second step is to compare the properly construed claim to that which is asserted to infringe. Markman, 52 F.3d at 976. Infringement requires that every limitation of a claim be met in the accused structure either exactly or by an equivalent. Pennwalt Corp. v. Durand-Wayland, Inc., 833 F.2d 931, 935 (Fed. Cir. 1987) (*en banc*), *cert. denied,* 485 U.S. 961 (1988). A means-plus-function claim limitation under 35 U.S.C. s. 112(6) covers the corresponding structure, material, or acts described in the specification and equivalents thereof. Valmont Industries, Inc. v. Reinke Mfg. Co., Inc., 983 F.2d 1039, 1041-42 (Fed. Cir. 1993).

An equivalent infringement may be found if the differences between the claimed invention and the accused device are merely "insubstantial." Hilton Davis Chemical Co. v. Warner-Jenkinson Co., Inc., 62 F.3d 1512 (Fed. Cir. 1995), *cert. granted,* 116 S.Ct. 1014 (1996). Each element in question in the accused device must perform substantially the same function in substantially the same way, to obtain substantially the same result. Pennwalt, 833 F.2d at 934. What constitutes equivalency must be determined against the context of the patent, the prior art, and the particular circumstances of the case. Graver Tank & Mfg. Co., Inc. v. Linde Air Products Co., 339 U.S. 605, 609 (1950). The range of equivalents extends beyond what is literally stated in the patent specification to be equivalent and encompasses any element which one of ordinary skill in the art would perceive as interchangeable with the claimed element. Thomas & Betts Corp. v. Litton Systems, Inc., 720 F.2d 1572, 1579 (Fed. Cir. 1983).

Construing the Claims

The construction of patent claims, as well as the meaning and scope of a disputed technical term or terms of art in a patent claim, must be construed by the court as a matter of law. Markman, 52 F.3d at 979. To ascertain the meaning of claims, the court must consider three sources: the claims, the specification, and the prosecution history. Markman, 52 F.3d at 979 (citing Unique Concepts Inc., v. Brown, 939 F.2d 1558, 1561 (Fed. Cir. 1991)). *Markman* concluded that extrinsic evidence, such as expert and inventor testimony, dictionaries and learned treatise, may be used to explain scientific principles, the meaning of technical terms, and terms of art. Such evidence may be used at the discretion of the court but may not vary or contradict the terms of the claims. Markman, 52 F.3d at 980-981.

The plaintiff alleges that the defendant has infringed Claim 1 and Claim 4 of the '487 Patent. This court finds it necessary to interpret only Claim 1 because Claim 4 is dependent upon Claim 1 and the court finds that Claim 1 has not been infringed. Claim 1 is as follows:

1. A device for automatically leveling a band of fibers such as fleeces, slivers, roving and the like by varying the drafting speed of a drafting mechanism, said device comprising:

(a) means for sensing the thickness of said band of fibers before said band of fibers are fed into said drafting mechanism and generating an analogue voltage corresponding thereto, ...
Interpretation: A sensor or measuring device which detects variations or deviations in a band of fiber and generates an analog signal which directly corresponds to the fiber's thickness (Patent Spec., PX-1, Col. 2, I.68 through Col. 3, I. 4; Col. 3, III. 66-68; Baxa dep. 64-65).
(b) an analog to digital converter converting said analogue voltage to a digital signal, ...

Interpretation: An analog to digital converter which changes the analog voltage generated by the sensor to a signal in digital or binary format.

(c) storage means for storing said digital signal,

(d) said storage means for storing said digital signal including,

(i) a digital value stepping storage register, and ...

Interpretation: A storage register in which digital signals are sequentially written into the register and sequentially read out of the register. The date is entered stepwise into the register, stored in the register, and stepped out of the register in the same sequence in which it was entered (Patent Spec., Col. 1, I.65 through Col. 2, I.4; Col. 3, I.68 through Col. 4, I.23; Col. 6, I.35).

(ii) means for stepping said storage register in synchronism with said drafting speed, ...

Interpretation: A mechanical system controlling the time between when a digital word is stepped into the storage register and stepped out of the storage register so that the storage time of the digital word in the storage register is synchronized with the speed of the drafting rollers (Patent Spec., PX-1, Col. 1, I.65 through Col. 2, I.4; Col. 3, I.68 through Col. 4, I.23; Col. 6, I.35; Col. 3, II. 9-11).

(e) means for reading out said stored digital signal from said storage means after a predetermined period of time, ...

Interpretation: extraction of the digital signal stored in the digital value stepping storage register, which was originally converted form the analog voltage generated by element a, after a predetermined period of time, which is the time corresponding to the conveyance of the measured point of the sliver (as measured by scanner 3) "up to and into" the draft zone 100 (PX-1 Col. 3, II. 25-27).

(f) means for converting said digital signal after being read-out to a converted analogue signal, ...

Interpretation: A digital to analog converter.

(g) means for varying the drafting speed of said drafting mechanism with said converted analogue signal in order to level said band of fibers, and ...

Interpretation: A control system which controls the speed of one of the sets of drafting rollers corresponding to the converted analog signal by adjusting the driving mechanism of the drafting rollers (PX-1, Patent Spec., Col. 1, II. 53-57).

(h) said means for stepping said storage register in synchronism with said drafting speed includes,

(i) an impulse generator operably connected to said drafting mechanism for generating pulses having a frequency corresponding to the drafting speed.

Interpretation: An impulse generator mechanism which generates pulses that have a frequency that corresponds to the draft speed (Patent Spec., Col. 5, II. 28-36).

Infringement Analysis

This court finds that the plaintiff has not met its burden of showing that the defendant's Modified Autoleveling System infringed the '487 Patent in violation of the Settlement Agreement or patent law. The Modified Autoleveling System is a "noninfringing" draw frame in accordance with the Settlement Agreement because the device does not generate an analog signal and does not convert the electrical signal of a sliver sensing component from an analog to a digital signal. Therefore, the defendant's modified system does not infringe each and every element of Claim 1. FN1

FN1. Therefore, it is not necessary to determine whether Claim 4 has been infringed. In the case of a dependent claim, that claim cannot be infringed unless every limitation of the independent claim upon which it depends is present in the accused device. Becton Dickinson & Co. v. C.R. Bard, Inc., 922 F.2d 792, 798 (Fed. Cir. 1990).

The plaintiff contends that the Heidenhain linear encoder generates analog signals responsive to fluctuations or changes in the sliver thickness. Further, the plaintiff argues that all of the literature from the manufacturer of the Heidenhain linear encoder identifies the signals as analog signals (PX-5; Mara, Tr. 607-608; PX-4 (pp. 8-9)). However, the defendant alleges that the modified autoleveling system uses a Heidenhain linear encoder for sensing incremental changes in sliver thickness. The encoder is shipped in a box labeled "Digitaler MeK*taster," a term which also appears on the instruction pamphlet shipped with the linear encoder. The description on the Heidenhain pamphlet is translated as "digital length gauge with pneumatic plunger activation." ("Digital Length Gauge") (DX-29, 29A and 22). Furthermore, the training manual to which the plaintiff points as labeling the signals as "analog" is also labeled as a "Digital Linear Meas. Technique, Meas. Method and Meas. Principles" (PX-5).

Second, the plaintiff points out that in 18 issued U.S. Patents, two German Patents, one published German patent application, and a published German book, Heidenhain describes or discusses the signals generated by photoelectric incremental length measuring devices identical to its MT linear encoder and describes the signals they outputted as analog signals (PX-168; PX-188). The IEEE Standard Dictionary of Electrical and Electronics Terms, published by the Institute of Electrical and Electronics Engineers, Inc., New York, New York (3 ed. 1984), relied upon by both parties at trial, defines "analog and digital data" as follows:

Analog data implies continuity as contrasted to digital data that is concerned with discrete states: *Many signals can be used in either the analog or digital sense, the means of carrying information is the distinguishing feature*. The information content of an analog signal is conveyed by the value or magnitude of some characteristics of the signal such as the amplitude, phase, or frequency of a voltage, the amplitude or duration of a pulse, the angular position of a shaft, or the pressure of the fluid. To extract the information, it is necessary to compare the value or magnitude of the signal to a standard. The information content of the digital signal is concerned with the discrete states of the signal, such as the presence or absence of a voltage, a contact in the open or closed position, or a hole or no hole in certain positions on a card. The signal is given meaning by assigning numerical values or other information to the various possible combinations of the discrete states of the signal. (*Emphasis added*.)

The plaintiff refers to previous patents, particularly the description of Figure 2 of Heidenhain's U.S. Patent No. 5,332,896 as compared to Heidenhain's MT encoder shown on page six of the Heidenhain brochure (see PX-185 (column 3 line 23 through line 44; Byrd, Tr. 120-123; PX-4)). Without more facts, this is not persuasive. The '896 describes and claims that its signals are analog. The '896 description provides:

The parallel light passes through the graduations 14, 18 of the graduated scale element 10 and the scanning plate 17, respectively, and finally strikes the photo element 19. Upon the motion of the scanning unit 12 containing the scanning plate 17 in the measuring direction X relative to the fixed graduated scale element 10, the stream of light is *modulated* by the graduations, so that the photo element 19 furnishes a periodic electrical analog signal S (X), which is evaluated, counted and displayed in digital form as a position of measurement value. (*Emphasis added*.)

This patent modulates or interpolates the signal, while the defendant has repeatedly provided uncontested testimony that the Heidenhain encoder in the 990 Model does not interpolate. As the IEEE definition states, many signals can be interpreted as analog or digital signals but the distinguishing characteristic is the character of the information. Kevin Mara, who has been the Technical Manager for Heidenhain Corporation in North America and Mexico for four years and has 12 1/2 years experience with Heidenhain, testified as a witness for the defendant. Mr. Mara testified that he had gone to HSL and observed the operation of the

Heidenhain devices. He stated that while the Digital Length Gauge has, in certain applications, the capacity for interpolation, the HSL application does not perform any interpolation and does not utilize analog information (Tr. 579, II. 6-13). No witness testified that the accused device performs interpolation, and numerous witnesses, including the plaintiff's own expert, Dr. Baxa, testified that the Modified Autoleveling System did not utilize the interpolation function (Tr. 323, I. 13 - 324, I. 4). The court thus finds that the accused device does not use any interpolation function, and the analog signal references concerning interpolation and inter-pulse analog signals in the other Heidenhain patents and materials presented at trial by the plaintiff are not sufficient to prove that the signal in the Modified Autoleveler System is an analog signal.

Third, the plaintiff contends that the Heidenhain device produces only one set of signals, and the defendant's Modified Autoleveling System uses only this set of signals. The information contained in the signals indicates how far the encoder plunger has moved, and the information in these signals is consistently identified by Heidenhain as analog signals, not digital signals. This court disagrees. Mr. Mara testified that the Digital Length Gauge was "absolutely a digital device" (Tr. 576, I.1). He further testified the EXE box receives the digital signal, merely squares it up, and, like the Digital Length Gauge, transmits only digital binary on/off signals. Mr. Mara testified that both the Digital Length Gauge and EXE box transmit digital signals (Tr. 576 I. 18 through 577, I. 3). Dr. Baxa, the plaintiff's expert, testified that the signal has analog information as it comes out of the photo detector and is ultimately converted to a digital number (Tr. 323-324). However, he also testified that it is possible for a signal to have both analog and digital information in it and that he had never actually gone into the EXE box to determine what it did (Tr. 331-332). If a signal can contain both analog and digital information, it is not inconsistent to find that the means of carrying the information, as the IEEE definition and several of the experts testified, should dictate whether the signal is analog or digital. Frank DeVita, a graduate electrical engineer licensed as a professional engineer in at least eight states who testified as an expert witness in electrical engineering, stated that the light is in discrete states. It is either on or off. The plaintiff contends the width and/or frequency of pulses output from the encoder (Digital Length Gauge) make them analog signals. This contention is not supported by the preponderance of the testimony.

Mr. Mara testified that he has had years of experience working with the GE Fanuc systems and the APM, which are digital devices. His testimony confirmed the APM is a digital device which does not use the pulse width in any way and that frequency is completely irrelevant (Tr. 580, II. 17-25, and Tr. 584, II. 7-22). Mr. Miller (further identified below) and the defendant's experts, Mr. Guth and Dr. McNeill, also testified pulse width is irrelevant to the HSL device (Miller, Tr. 219, II. 5-6; Guth, Tr. 634, II. 11-12, Tr. 637, I. 6, and Tr. 647, I. 23; McNeill, Tr. 665, II. 11-12, Tr. 671, II. 5-9, Tr. 679, II. 22-25, and Tr. 692, II. 5-7). Six witnesses, including Mr. Fowler, Mr. Miller, Mr. Mara, and the defendant's experts, Mr. DeVita, Mr. Guth, and Dr. McNeill, testified the pulse frequency is irrelevant to the HSL device (Fowler, Tr. 190, II. 8-16; Miller, Tr. 286, II. 22-24, and 304, II. 2-9; DeVita, Tr. 564, II. 14-17; Mara, Tr. 580, II. 8-11, 25, Tr. 588, II. 9-10, Tr. 589, II. 5-6, 15-16, and Tr. 596, II. 5-6; Guth, Tr. 634, II. 8-10; and McNeill, Tr. 665, II. 8-10, and Tr. 692, II. 1-4.) This court finds that the pulse width and pulse frequency do not indicate an analog signal is present because they are irrelevant to the defendant's modified autoleveling application.

Robin A. Fowler, a graduate electrical engineer and former HSL engineer who did work in designing the electrical controls for the Modified Autoleveling System, was called as a witness for the plaintiff. Mr. Fowler testified that the digital sensor was selected for the accuracy that could be obtained from it. He described the digital sensor as an optical encoder with a portion through which light passes and a portion through which light cannot pass. He indicated the result was that light was either passing or not and therefore either on or off, which indicated it was a digital signal (Tr., 187, I. 3 - 188, I. 7). Mr. Fowler further testified the Digital Length Gauge was emitting a digital pulse which went into the EXE box and that the signal out of the EXE box was also a digital signal (Tr. 138, II. 4-7).

Both of the plaintiff's experts, Mr. Byrd and Dr. Baxa, referred to observations on an oscilloscope; however, neither Mr. Byrd nor Dr. Baxa offered any testimony as to how the oscilloscope suggested an analog as opposed to a digital signal, and did not testify that the oscilloscope established the character of the signal. Mr. Byrd admitted that "you can't tell from a waveform alone whether [a signal] is an analog signal or a digital signal" (Tr. 198, II. 4-19). Dr. Baxa similarly testified:

The shape or appearance of the signal is not critical. You can have signals that look identical, one being an analog signal and one being a digital signal because they carry information in different forms (Tr. 318 II. 9-13).

The oscilloscope evidence was not very useful because it appears to be uncontested that one cannot determine whether a signal is analog or digital from the waveform.

Lee W. Miller, an HSL employee with a Bachelor of Science degree in electrical engineering and a Master's Degree in electrical engineering, with specialties in controls and robotics, was called as a witness by the plaintiff. Mr. Miller testified that he had examined, tested, and taken measurements directly off of the linear encoder and compared them directly to the output of the EXE box. He disassembled an EXE box to examine the internal components to see how they appeared and determine their function. He testified he "looked to see if there was any way to generate an analog signal and use any information within the APM system" used in the defendant's Modified Autoleveling System. The results, he testified, were negative. "I could not use it" as an analog device (Tr. 249, II. 9-13). Mr. Miller testified that the Digital Length Gauge transmits a digital pulse which goes into the EXE box and comes out still in digital form. He described the signal path as digital at the Gauge, digital at the EXE box, and digital going into and within the GE Fanuc computer (Tr. 254, II. 2-14; Tr. 257, II. 11-25).

One of the plaintiff's technical experts, Ben Byrd, concurred with the IEEE Dictionary definition of "digital device (control equipment)" as "a device which operates on the basis of discrete numerical techniques in which the variables are represented by *coded pulses or states*" (emphasis added) (Tr. 141, II. 15-20). The defendant's expert, Mr. DeVita, confirmed the finding that the modified autoleveling device operates on the basis of the discrete states. He testified as follows:

A. Well, the sensor's right here.

Q. Would you compare here the analog type of leveller (sic) with the Heidenhain linear digital length?

A. Do we have a drawing of the Heidenhain digital length gauge?

Q. Yes, we do.

A. Would it be appropriate for me to use that?

Q. Let me get that for you. I'm going to offer you what has been marked Defendant's Exhibit 17C. And I'll put it here so that it'll be right here beside the ---

A. The digital length gauge has a series of opaque and clear divisions. And there's several components in that gauge. *Very simply, you have a light source and you have some receptors that sense the light being alternately blocked and emitted through the grating*. And as the sliver passes through the machine, that plunger moves in and out. And as it moves in and out ---

Q. Go a little bit slower for us.

A. I'm going to do it slow in a second. But you have a transmission of light and dark. So on a very slow, scaled-down version, you have dark pulses. It goes up and it goes down. *And with that technology you sense this presence or absence of light*.

And so you have this change of state that is sensed by the device to determine whether or not whatever it is you're trying to measure has moved. You don't know how far it's moved, and you don't know whether it's moved up and down. You just know that there's a change.

And then there's several components that sense those same principles that have to be calculated that make sense of it. Now, you asked me about the analog. The analog device -- for example, if -- we have a nine-volt battery here so you can see that 150 doesn't relate to that voltage. But on a calibrated system -- we get the word "analog" from "analogous." We have a voltage that has been calibrated to a scale which voltage is analogous to some thickness so that -- this is obviously not a calibrated instrument. But if you had a thickness that you could measure as fifteen centimeters for a hundred and fifty divisions, and then as that comes down, that voltage comes down and you have, say, fifty divisions for possibly five centimeters. And at the same time you have some pulsing of light that -- you know, you have no relative measure of thickness as we do with the analog device. That's kind of a correction of the term there.

Did that answer your question?

Q. I believe so. So you're saying that the analog side will give you a one-to-one measurement of sliver thickness. Is it your testimony that the digital device will not measure sliver thickness?

A. My testimony is that in the analog system you have a voltage that's calibrated that directly relates to thickness. If you calibrate that instrument to give you five volts for a thickness of five units, then at two volts you will have a thickness of two units. Okay? *In the digital system you have -- you have digital discrete states, light or no light, that change relative to the change of thickness*. That information is then sent to a computer. Computer calculations are done to make changes in the machine. At no time that I'm aware of does that relate to a thickness. It's a control methodology as opposed to a measurement.

Q. Does it measure incremental -- does it sense incremental changes in the sliver?

A. Yes, that is an incremental encoder. In fact, it's good that you make -- the distinction should be made, I should say, that it is an incremental encoder, because there are a class of encoders referred to as absolute encoders. Absolute encoders are a different device that, while it still senses a change in state, it has a position orientation. *This device is an incremental encoder, and it has no relative position inherent with it. It simply produces that change in state with the sliding grate*. (Tr. at 527-531) (emphasis added).

Mr. DeVita's testimony was corroborated by the testimony of several other experts (Miller, Tr. 253-257;

Sturm, Tr. 511 I. 11-24; Fowler, Tr. 187, I. 24 to -188 I. 10; Mara, Tr. 580 I. 17-25 to 581 I. 1-14).

Finally, the plaintiff asserts that the electrical signal corresponds to the sliver thickness. This court does not find that the signal in the Modified Autoleveler System directly corresponds to the thickness of the sliver. The defendant's expert, Dr. McNeill, testified that the gratings on the glass plunger represent digital length information (Tr. 667, II. 19-22). As Mr. Mara testified should the plunger move less than ten microns, a new pulse would not be generated (Tr. 588, II. 2-5). The linear encoder transmits a signal dependent on whether or not a pulse has occurred. No unique voltage is produced by the encoder which represents the sliver's actual thickness. The sliver sensor of the Patent does not output such pulses (Tr. 330, II. 16-20). For example, whether the thickness of the object increases by one or more grating increments, the voltage outputs vary between the same repetitive, discrete levels. Significantly, the plaintiff's experts admitted that one could never determine actual thickness by examining the output of the Heidenhain encoder (Byrd Tr. 147 II. 1-20; Baxa, Tr. 333, I. 6 through 334, I. 20). By contrast, sliver thickness could be determined directly from output of the analog sensor in the device described in the '487 Patent. The witnesses, including the plaintiff's experts, admitted that, in contrast to the '487 Patent, the output of the Heidenhain encoder is not related to actual sliver thickness. Mr. DeVita testified that a linear encoder is considered in the electronics industry to be a digital device (Tr. 527, II. 7-11). Kevin Mara agreed (Tr. 577, II. 4-7). He further explained that the Digital Length Gauge consisted of a series of opaque and clear divisions which sense the light being alternatively blocked and emitted through the grating. Unlike an analog signal analogous to thickness, the digital signal consisted of digital discrete states, light or no light, that change relative to the change of thickness. His description was that "[i] t's a control methodology as opposed to measurement" (Tr. 530, II. 2-14).

This court finds that the output signal from the linear encoder used by HSL in its modified Autoleveling System does not directly correspond to the sliver thickness and is a digital signal. As even the plaintiff's experts admitted, the information content of the signal determines whether a signal is analog or digital (Byrd, Tr. 138, II. 4-12; Baxa, Tr. 317, I. 8 through 318, I. 13). Because only digital "pulse-no pulse" information is used in the Modified Autoleveling System, the court finds that the linear encoder signal is digital and any analog signal within the encoder (Digital Length Gauge) is not used by HSL. This court further finds that the encoder operates in a substantially different way, since it does not generate a voltage proportional or analogous to actual sliver thickness. The Modified Autoleveling System measures *only* incremental changes in sliver thickness.

Literal Infringement

The next issue is a discussion of Claim 1 of the '487 Patent and its individual elements. FN2

FN2. In finding that the Modified Autoleveling System does not generate an analog signal and therefore is a noninfringing device as defined by the Settlement Agreement, it is not necessary to discuss whether Claim 1 of the '487 Patent is infringed.

1. A device for automatically leveling a band of fibers such as fleeces, slivers, roving and the like by varying the drafting speed of a drafting mechanism, said device comprising:

(a) means for sensing the thickness of said band of fibers before said band of fibers are fed into said drafting mechanism and generating an analogue voltage corresponding thereto, ...
The "means for sensing" the thickness of the fibers (sliver) and generating a corresponding analog voltage is

a claim limitation written in "means-plus-function" form. The corresponding description in the '487 Patent specification (PX-1, col. 2, I. 52 - col. 3, I. 11), sets forth a "scanner" which includes an electrical measuring device 3 attached to different slide/roller mechanisms in the embodiments shown in Figures 1 and 2 of the '487 Patent.

The function for the "means for sensing ... and generating" is twofold: (1) to sense the thickness of the sliver and (2) to generate an analog *voltage* which corresponds to this thickness (PX-1, Col. 5, II. 5-8). The unambiguous claim language specifically recites that an *analog voltage* is generated *which corresponds to sliver thickness*. The specification of the patent recites that the voltage generated is "correspondingly large," i.e., analogous to, the movement of the scanner roller 2, which actually contacts the sliver (PX-1, Col. 2, I. 68 - Col. 3, I. 4; Col. 3, II. 66-68). The plaintiff's experts, Ernest G. Baxa, Jr., and Ben Ralph Byrd, Jr., both confirm that the analog voltage output by the patent specification's device would be proportional to the actual thickness of the sliver being measured (Tr. 65, II. 10-16; Tr. 138, II. 13-17; Tr. 329, II. 20-22; Tr. 330, II. 1-4), which means that a specific voltage reflects a specific thickness of sliver measured. In other words, the analog voltage is linearly related and mimics the sliver being measured; if the calibration of the instrument were known, given a particular voltage output of the sensor, the corresponding thickness could readily be obtained and *vice versa* (Tr. 138, I. 18 through 139, I. 8; Tr. 330, II. 5-11).

To infringe this limitation, the HSL device *must* have a sliver thickness sensor as described in the patent (or its structural equivalent) which generates an analog voltage directly proportional to actual sliver thickness. As previously discussed, the Modified Autoleveling System does not generate an analog voltage that is proportional to the actual sliver thickness.

(b) an analogue to digital converter converting said analogue voltage to a digital signal, ...

This limitation, not in "means-plus-function" format, requires use of an analog to digital converter 4, shown in both the Figure 1 and 2 embodiments. Converter 4 changes the analog voltage generated by the sensor to a signal in digital, or binary, format. To infringe, the HSL device *must* have the claimed analog to digital converter, and it does not.

The output from the Heidenhain Digital Length Gauge goes directly to the Heidenhain EXE box, and then goes directly to the input of the APM. The parties agree that the EXE box is not an analog to digital converter (Byrd, Tr. 146, II. 19-21). The defendant contends that no analog to digital conversion occurs because the signal from the EXE box is digital, and the APM will accept only a digital signal. The plaintiff was required to show by the preponderance of evidence not only that the output signal is first analog, but where and how the signal stored in the GE Fanuc computer is converted into a digital signal. This burden has not been met.

At trial, the plaintiff opined that analog to digital conversion occurs in the counter in the APM, yet both Mr. Byrd and Dr. Baxa referred to the counter as a "digital device" (Tr. 104, II. 12-15; Tr. 332, II. 11-14). Significantly, the plaintiff's experts admitted that they did not independently investigate the functioning of the APM, but based their opinions on depositions and testimony of others. The plaintiff introduced no portions of any depositions which it contends its experts relied upon (Byrd, Tr. 149, II. 18-24; Baxa, Tr. 331, II. 20-22, 332, II. 20-25). By contrast, the defendant's experts testified that the counter did not and could not perform an analog to digital conversion and confirmed this by independent investigations with the manufacturer of the APM. (DeVita, Tr. 533, II. 10-13, Tr. 534, I. 19 through 535, I. 8, and Tr. 569, II. 5-17; Guth, Tr. 630, II. 5-13; and McNeill, Tr. 661, I. 17 through 662, I. 4). HSL's engineers and employees, Sturm, Fowler, and Miller, who had actually worked with the electrical devices, unequivocally testified the signals were digital and no analog-to-digital conversion occurred in the counter (Sturm, Tr. 475, II. 17-22, and Tr. 517, II. 4-14; Fowler, Tr. 201, II. 10-24; and Miller, Tr. 259, II. 17-22). Dr. McNeill emphasized with reference to the encoder (Digital Length Gauge), that "they can't hook an analog-to-digital up to this thing." (Tr. 691, II. 6-9). Mr. DeVita testified that the HSL modified autoleveler did not have an A to D converter and that the G.E. Funuc computer could not accept an analog signal in its encoder port (Tr. 535-536).

The plaintiff has not met its burden of proving that an analog to digital converter is literally found in the HSL device, and I accordingly find this claimed element does not exist in the accused device.

This court does not find that the Modified Autoleveler System literally infringes the '487 Patent. The limitations in claim 1 (a) and (b) are not contained in the modified autoleveler. If even one claim limitation is missing from the accused device, then no infringement exists as a matter of law. London v. Carson Pirie Scott & Co., 946 F.2d 1534 (Fed. Cir. 1991); Moll v. Northern Telecom, Inc., 1996 WL 11355 (E.D. Pa. Jan 3, 1996). The plaintiff has not proven that the accused device includes each and every element in the claims of the patent in suit. *See* Southwall Technologies, Inc., v. Cardinal IG Co., 54 F.3d 1570, 1575 (Fed. Cir. 1995).

Infringement under the doctrine of equivalents

This court finds no infringement of the '487 Patent under the doctrine of equivalents. As with literal infringement, the patentee bears the burden of proving that each element of the patent, or its substantial equivalent, exists in the accused device. Lemelson v. United States, 752 F.2d 1538, 1551 (Fed. Cir. 1985). Proof of infringement by the doctrine of equivalents requires the plaintiff to demonstrate, by a preponderance of the evidence, that the accused device performs the same or substantially the same function, in the same way, and with the same result as the patented invention. Graver, 339 U.S. 605. The three *Graver* elements must be presented "in the form of particularized testimony and linking argument." Lear Siegler, Inc. v. Sealy Mattress Co. of Michigan, Inc., 873 F.2d 1422, 1426 (Fed. Cir. 1989). As the Federal Circuit explained in Hilton Davis, 62 F.3d 1512, the "function-way-result" inquiry is merely one objective method for determining whether there are only insubstantial differences between the claimed and accused devices. "Function-way-result" remains the primary determinant of infringement under the doctrine of equivalents; however, other factors, including evidence of copying, interchangeability, or designing around a patent may be relevant to the inquiry. Hilton Davis, 62 F.3d at 1518.

Robin Fowler, who participated in the design of the Modified Autoleveling System, and who had some drawings of the Rieter circuitry, testified Rieter's stepping storage register was outdated and "wasn't the new technology that you would use today" (Tr. 201, II. 1-4). He testified that none of the electrical circuitry on the Rieter machine was used in the HSL Modified Autoleveling System (Tr. 201, II. 7-9). James Sturm, Mr. Fowler's supervisor, also directly involved in the electrical design of the HSL Modified Autoleveling System, testified to the same effect (Tr. 492, II. 16-18).

Persuasive evidence has been provided to the court that the defendant designed around the '487 Patent. Mr. Sturm testified he had been hired by HSL and relocated from Illinois for the purpose of developing a digital autoleveling system that would avoid the '487 Patent (Tr. 467, I. 20 through 468, I. 1). He stated that he understood "designing around is not only allowable, but that it is desirable" (Tr. 480, II. 15-18). Mr. Sturm prepared a written comparison of the HSL devices to the claims of the '487 Patent which he submitted as evidence of designing around the Patent (DX-56). Andy Rasor, Vice President of Administration at John D. Hollingsworth on Wheels, Inc., confirmed that in undertaking to improve the autoleveling device, to make it quicker and more accurate, it was the intention to design around the '487 Patent (Tr. 699, I. 14 through 700, I. 5). Evidence of designing around therefore weighs against finding infringement under the doctrine of equivalents. Hilton-Davis, 62 F.3d at 1518.

In *Graver Tank,* the court held that in deciding whether there has been an infringement under the doctrine of equivalents "an important factor to be considered is whether persons reasonably skilled in the art would have known of the interchangeability of an ingredient not contained in the patent with one that was." Graver Tank, 339 U.S. at 609. This factor also weighs against the plaintiff. The uncontroverted testimony was that the '487 Patent device and the Modified Autoleveling System were not interchangeable. Five witnesses, including the defendant's expert witnesses, established by the greater weight of evidence that the devices were not interchangeable (Sturm, Tr. 488, II. 5-12); (Miller, Tr. 262, 1. 25 through 263, I. 3, and Tr. 263, II. 8-10; Baxa, Tr. 336, II. 10-13; DeVita, Tr. 536, II. 12-17; Guth, Tr. 634, I. 20 through 635, I. 3; McNeill, Tr. 666, II. 10-18).

The plaintiff has failed to demonstrate by a preponderance of the evidence presented in the form of particularized testimony and linking argument that the Modified Autoleveling System performs the same or substantially the same function, in the same or substantially the same way, with the same or substantially the same result as claimed elements of the patented invention. Further, the '487 Patent devices and the HSL devices are not interchangeable. In addition, the Settlement Agreement provided that an infringement would not occur if the system used a digital as opposed to an analog signal. The court finds there has been no infringement under the doctrine of equivalents.

Based on the above finding of no infringement of the '487 Patent either literally or under the doctrine of equivalents, it is not necessary to discuss willful infringement or damages.

Defendant's Counterclaim for Breach of Contract

By way of counterclaim in this action, the defendant asserted a breach of paragraph 7 of an April 23, 1994, Settlement Agreement between the parties, and a breach of the covenant of good faith and fair dealing.

In paragraph 7 of the April 23, 1994, Settlement Agreement between the plaintiff and the defendant, the plaintiff agreed that it "will not enforce or attempt to enforce the patent in connection with the manufacture, use, or sale of NONINFRINGING DRAWFRAMES." Paragraph 1.7 of the Agreement defined "NONINFRINGING DRAWFRAMES" as follows:

'NONINFRINGING DRAWFRAMES' means all drawframes made, used, or sold by Hollingsworth incorporating an autoleveling device which does not convert the electrical signal of a sliver sensing component from an analogue signal to a digital signal.

As discussed above, this court finds that the Modified Autoleveling System does not convert the signal generated by the Heidenhain digital length gauge from an analog signal to a digital signal. The signal is digital and remains digital throughout the Modified Autoleveling System, through the GE Fanuc Computer, until it is converted to an analog signal for transmission to the servomotor. No digital to analogue conversion occurs within the Modified Autoleveling System. The System qualifies as a "NONINFRINGING DRAWFRAME" within the meaning of the Settlement Agreement between the parties. Therefore, an issue arises as to whether the filing of this action by the plaintiff constitutes a breach of the Agreement.

The defendant assert that it should be awarded $316,000 on its first and second counterclaims for breach of the Settlement Agreement and breach of an implied covenant of good faith and fair dealing in light of the fact that, prior to pursuing litigation, the plaintiff failed to examined the electrical schematic of the Modified Autoleveling System (Tr. 149, II. 18-24). The plaintiff argues that there was no breach of the Settlement Agreement because the defendant failed to provide the plaintiff with an opportunity to examine the 990S draw frame despite three requests to do so, forcing them to bring suit (Tr. 718-721).

The court finds in favor of the plaintiff on the defendant's counterclaim. Despite a finding that the Modified Autoleveling System is a noninfringing draw frame, the plaintiff was forced to pursue litigation because the defendant failed to permit the plaintiff's representative to inspect the machine prior to the re-initiation of this litigation.

IT IS SO ORDERED.

D.S.C.,1996.
Rieter Ingolstadt Spinnerimaschinenbau Aktiengesellschaft v. Hollingsworth Saco Lowell Corp.