

DECLARATION OF STEPHEN G. EMERY

BACKGROUND INFORMATION

1. I, Stephen G. Emery, reside at 14 Harbourside, Havant, United Kingdom. The facts stated herein are true, or if based on information and belief, believed to be true. If called upon to do so, I would and could competently testify to the following:

2. I have been retained as a consultant by Hogan & Hartson, counsel for Amro-Asian Trading Company.

3. I have no financial interest in the outcome of this re-examination request.

4. I attended the University of Portsmouth in the United Kingdom, which was then called Portsmouth Polytechnic, between 1971 and 1975. During that time I followed a course of study that had a partly academic and partly industrial basis. I graduated in 1975 with a Bachelor of Science degree in Electrical and Electronic Engineering.

5. Post graduate, between 1975 and 1980, I worked on the design of systems for data transmission over radio links to and from vehicles. These systems employed microprocessors in both the mobile and central station equipment. The systems were used by UK emergency services, in 'Rapid Transit systems' and in flexible public transport applications in Europe and the United States.

6. From 1980 to 1985 I worked for De La Rue Systems Ltd., designing control electronics and software for banknote sorters. During that time I was the Principal Engineer on a major project to design a sub-system to allow the sorting of bills by their printed patterns. U.S. Patent No. 4,542,829 (the '829 patent), on which I am a named inventor, was filed as a result of our work on that project, and the patent was also filed in Europe and Japan. The first design according to that patent went into production and was used initially in cash centers in Scotland.

Subsequently the design was incorporated into the De La Rue 3000 Series sorters, and by about 1983 was marketed worldwide.

7. In 1984, two colleagues and I incorporated a company, The Vision Research Company Ltd, in the UK, to apply pattern recognition techniques to other applications, and found a market in CCTV (Closed Circuit Television) surveillance systems. From 1985 to 2001 I undertook various roles in technical and corporate management of that company.

8. Since 2001, I have been employed by Xyratex Technology Ltd., a computer storage and networking design and manufacturing business, as a Development Program Manager leading a multi-disciplinary team of engineers developing electronic hardware and software solutions. Xyratex is headquartered in the UK, and has offices across the United States and other countries.

9. For the preparation of this declaration, I have studied U.S. Patent No. 6,459,806 (the '806 Patent), including the claims, and the file history of the '806 Patent as well as all the other references listed in the declaration or the inter-partes submission.

10. All references to Exhibits in this Declaration correspond to the Exhibits to Amro-Asian's Request for Inter-partes Reexamination of the '806 Patent.

WORK ON THE DE LA RUE 3000 MACHINES

11. The De La Rue 3000 Series consisted of Models 3400, 3430, 3500 and 3530 as described in the "3000 Series User Guide" (Exh. G 0015). As these models share for the most part the same features, I will refer to them collectively in this declaration as the De La Rue 3000 Series, and I will refer to them separately only where those differences are relevant to a point made in my declaration

12. As noted above, I worked at De La Rue Systems Ltd., located in Portsmouth, U.K., from 1980 to 1985. During that time, I designed control electronics and software for a large banknote sorter known as the De La Rue 3000. At De La Rue, I designed and implemented the control software for the stacker

mechanisms used on the De La Rue 3000; including the software to measure the degree of soiling, and to detect and measure holes, tears and corner folds on notes fed into the machine. I was the Principal Engineer on a major project to design a sub-system comprising both electronic hardware and software to allow the sorting of bills by their printed patterns. As part of my duties at De La Rue, I assisted in incorporating this bill sorting sub-system into the De La Rue 3000 Series sorters. As a result, I have substantial personal knowledge about the structure, operation and features of the De La Rue 3000 Series.

13. Attached as Exhibit N to the Request for Inter-partes Reexamination is a copy of the '829 Patent, which issued September 24, 1985 from an application filed Nov. 2, 1982, entitled "Apparatus for Sorting Sheets According to their Patterns," On which I am a named inventor. The '829 Patent resulted from my design of a sub-system to allow the sorting of bills by their printed patterns that was incorporated into the 3000 Series. It accurately describes the operation of the 3000 Series machines at the time the application was first filed in the U.K in 1981, including the pattern recognition technique and, to the extent described, bill transport in the 3000 Series.

14. Attached as Exhibit G to the Request for Inter-partes Reexamination is a copy of the De La Rue 3000 Series User Guide. This 3000 User Guide dates to approximately 1981. I know this because the Product Development Timeline at ends at 1981 where it indicates that Pattern Detection and On-line banding capabilities were added to the 3000 Series. Likewise, the History of De La Rue at p., lists advances made in 1981 in its concluding paragraph. I was also employed at De La Rue in 1981, and the User Guide accurately describes the De La Rue 3000 Series as it existed in the early 1980's when I was employed at De La Rue. I will refer to this exhibit as the 3000 Series User Guide.

15. Attached as Exhibit P to the Request for Inter-partes Reexamination is an application note by Texas Instruments reference SPRA003 entitled "Implementation of FIR/IIR filters with the TMS32010/TMS32020". This describes the implementation of an algorithm related to correlation and allows estimates of

speed of operation to be made.

DENOMINATOR DESIGN FACTORS

Transport speed

16. Transport speed is largely determined by the design of the transport mechanism and is also a function of the condition of the media transported. Used currency poses particular issues since the structure of the paper becomes mechanically decomposed by repeated folding and crumpling during use. Hence the use of the term 'rag' to describe well used currency. Also, bills become torn, lose corners, and may have been repaired with tape, or other means.

17. There is a limit to the speed at which such sheets can be propelled through the machinery, and this is a largely a function of the manner in which the sheet is held during transport. Belt systems and vacuum drums were both in use in the 1980's.

18. The transport speed in conjunction with the spacing of the bills determines the maximum feed rate of the machine. The spacing of the bills is determined by the length of the bill in the direction of transport, so machines feeding bills parallel to the short edge can achieve a higher feed rate for a given transport speed than machines feeding parallel to the long edge. Also, there needs to be a defined gap between bills to allow the controlling mechanism to operate before the leading edge of the bill reaches the actuator.

19. Another factor is the design of the feed mechanism. Brand new bills, so called 'brick', are prone to stick together, and the design of the stripper will also influence the feed rate. Both friction and vacuum designs were in use in the 1980's. The output stacking system has to decelerate the bill in a controlled fashion. In machines with low transport speeds, a number of gravity or spring assisted designs were used and described in patents. As transport speeds increased, it became necessary to use a spiral system to decelerate the bill and stack it.

Transport direction

20. Speed can be expressed in two ways: The "feed rate" measured as the number of bills per minute, or the linear transport speed measured in, for example, feet per second.

21. As noted above, feeding bills parallel to their short edge allows a greater feed rate for a given linear transport speed. However, there are advantages in feeding parallel to the long edge. One such advantage is that it is easier to constrain the bill in transport, for example with belts, and this allows a higher reliable linear transport speed, maintaining an equivalent feed rate.

22. Another advantage of feeding bills parallel to their long dimension concerns the detector configuration and cost. In general, the design of the detectors can be made simpler and the detectors can be made more cheaply by feeding parallel with the long edge because the size of the scanning head can be narrower.

23. Still another advantage of short edge feeding design is easier location of authentication features. This is especially true if the design aim is to build a machine capable of authenticating and denominating any currency with minimum changes.

24. Long edge feeding (i.e., transporting bills parallel to their short dimension) design has its own advantages. For example, the transport path can be made shorter and less complex. Another advantage of long edge feeding is that the machine can be made more compact. Yet another advantage of such design is, as pointed out above, increased feeding rate.

DENOMINATOR, AUTHENTICATOR AND OTHER ELECTRONIC CONSTRAINTS

25. Detector design also has to be considered when assessing transport speed and feed rate. Notwithstanding that the paper can be moved faster, transport speed is limited by the speed at which notes can be scanned. Optical scanning systems are inherently faster than, say, magnetic systems used for authentication.

26. In the 1970's, the rate at which optical samples could be acquired was not a limitation. As one of ordinary skill in the art was well aware, rate of sample acquisition is a function of transport speed, and of the level of illumination versus detector sensitivity. Although the number of data samples used for identification of a bill was a factor in the 1970's, this was only due to the practical details of the implementation. Where high numbers of data samples were required, it was usual to implement acquisition using an array of Charge Coupled Devices (CCD). These devices generated a serial image signal, or video signal, and therefore were much simpler to implement than a parallel array of sensors.

27. The feed rate for a given transport speed and note size is determined by the length of the gap between bills fed into the transport, which in turn is determined by how long it takes to make a denomination decision and operate the diverter, or stop the transport. This latter mechanical constraint ultimately swamped the electronic constraint. Electronic constraints could be overcome by one or more of a combination of techniques known to one skilled in the art. These include, but are not limited to, software optimization; use of faster CPU's; offload of software processes into special purpose hardware; use of multiple CPU's; and use of parallel hardware sub-systems.

STATE OF THE ART IN THE 1980'S

28. Many patents issued prior to 1991 were devoted to improvements in performance of the feed, transport and stacking mechanisms, and feed rates of 20 bills per second were common in the early 1980's. As of 1981 bills could be denominated at that speed using cross correlation of 800 samples per bill, as well as other algorithms. With increases in processing speeds available by 1991, the denomination algorithm used and the electronic system capability were not constraining factors on feed rate.

29. Prior to 1991 different machines using either long edge or short edge feeding¹ orientations were marketed around the world, and these had similar feed rates and throughputs. For example, the De La Rue 3000 Series and the REI CVCS², large sorters, both had a feed rate of 20 bps, but used different feed orientations. Furthermore, machines were available from the same manufacturer using different feed orientations, and these were available on the market during the same time frame. For example, the De La Rue 3000 Series sorter transported bills parallel to their narrow dimension, whereas the DLR 3100 series, a desktop sorter, transported bills in a direction that was parallel to their long dimension.

30. As one of ordinary skill was well aware, prior art discrimination algorithms that required a large number of samples generally obtained such samples by scanning the bill in two dimensions, and not in a single (long) dimension. A strip of samples corresponding to the number of elements in the sensor would be captured, and then repeated at fixed intervals as the bill moved past the sensor to build up a two-dimensional image of the bill. Therefore, the same number of samples could be obtained regardless of the transport direction of the bill.

DESIGN CHOICES

31. The direction of feed and transport speed are design choices. Transport speed is influenced by detectors, denominators, authenticators and condition detectors. This influences, but does not solely determine, the choice of feed direction. One feed direction does not provide a clear improvement over another, and it is merely a design choice to be made on the basis of requirements.

32. The cost and bulk of machines owed more to their intended use than the direction of feed or the discrimination method. The De La Rue 3000 and REI CVCS sorters were intended for continuous processing of large volumes of cash at large banks, casinos, etc., rather than intermittent processing of a few hundred bills.

¹ In this declaration, I will refer to long edge feeding as transportation of bill in a direction that is parallel to their short dimension. Short edge feeding refers to transportation of bills in a direction that is parallel to their long dimension.

² The CVCS was manufactured by Recognition Equipment Inc.

The systems therefore had to be robust, and durable. The design had to be different to reduce the downtime due to replacement of wearing parts. For this reason friction feed methods were not favored, which increased the power requirements. The electrical systems had to be continuously rated, instead of light duty.

33. Given that by the early 1980's it had become technically feasible to transport and denominate currency in either feed direction at a speed of 1200 bills per minute or more, why were machines made later that operated below those speeds? The De La Rue 3100 series is a good example. De La Rue had the technology, had pioneered that technology, and owned IP protect it, but nevertheless chose to make the 3100 series operate at 420 bills per second transporting bills parallel to their long dimension.

34. This was clearly a design choice to be made based on the requirements of the market at that time. It would obvious to one of skill in the art to make a different choice given different market requirements.

THROUGHPUT

35. Notwithstanding the foregoing, the overall usable machine performance, the performance perceived by the user, is not determined by transport speed, or feed rate, but by throughput. Throughput is typically measured in bills per hour, and includes the downtime of the machine due to stoppages, either procedural or enforced by malfunction. Although throughput is a function of feed rate – the maximum throughput cannot exceed the feed rate – other factors act to reduce the throughput below that maximum. During the 1980's it would have been obvious to alter the mechanical gearing or motor speed to achieve greater transport speeds and feed rates. However, there becomes a point where the reliability of the paper feed with increasing feed rate can actually reduce throughput due to stoppages. Therefore, other means were used to improve throughput, for example, use of overflow or alternating output pockets allowed an operator to empty one pocket while filling another without stopping the machine.

36. Throughput is a measure of the productivity of the machine. When throughput is related to the cost of the machine, it gives a measure of the cost-effectiveness or payback on the investment in the machine. Throughput was therefore a major consideration in the design of expensive machines designed and rated for continuous operation, but arguably not such an important factor in lower cost desktop machines designed for intermittent use. There was a cost/performance trade-off to be made according to the intended use. Single pocket machines were potentially cheaper to build, but suffered diminished throughput compared to, say, a dual pocket machine having the same feed rate. While that was a price performance trade-off favored by one sector of the market in the early 1990's, increasing the feed rate on a single pocket machine from, say, 600 bpm to 800 or even 1000 bpm in an attempt to compensate for a need to keep stopping the machine was not a technically useful improvement on the state of the art.

MICROPROCESSORS

37. Before the introduction of microprocessors to the commercial market, there were sets of Integrated Circuits (IC's, or "chips") that were used to build mini-computers, for example by Digital Equipment Corporation's for its PDP8. Although in principle these could have been used in a standalone product by "embedding" them into the electronics, it was generally not cost-effective to do so. No doubt the military had chips that were more advanced, but these were not commercially available or cost effective either.

38. In April 1974 Intel introduced the 8080, which is generally considered to be the first truly usable "microprocessor" CPU design, even though Intel had introduced the 4040 in 1971. The 8085 was introduced a few years later and was a simplified version of the 8080. Other manufacturers, e.g. Motorola, MOS Technology and Zilog produced chips of similar performance.

39. The "microprocessor" was taken to be the first single chip CPU that could be combined with semiconductor memory and Input/Output (I/O) chips on a circuit board that could be embedded into a product that was not itself a computer.

40. The architecture of these first microprocessors supported 8 bit numbers, i.e. they worked on integers between 0 and 255. Typically they could only add, subtract, and perform logical operations. To work on bigger numbers required multiple operations. Multiplication and division were performed using a repeated series of additions and logical operations (shifts). Real numbers, or numbers with a floating decimal point, required more complex algorithms, and mathematical operations such as roots, trigonometric operations, etc., required still more complex algorithms, and much more time to execute. To speed up the software, these functions could be offloaded to external hardware. Special purpose chips were available to perform these functions outside of the microprocessor. It would have been feasible to make a special purpose chip to implement the correlation function, but this would have been cost-effective only for very high volumes. However, by the end of the 1980's special purpose chips could be made in low volumes using Field Programmable Gate Arrays (FPGA's).

41. The 8080 was rated at 0.64 MIPS (Millions of Instructions Per Second), but by 1978, Intel had released the 8086, which supported 16 bit numbers (integers from 0 to 65535), which although only rated at 0.75 MIPS, was said to have 10 times the performance of the 8080 due to its ability to process larger numbers in one instruction.

42. By 1985, Intel had released the 80386, with a rating of 11.4 MIPS, but capable of processing 32 bit numbers (0 to 4,294,967,295), and in 1989 released the 80486 rated at 41 MIPS and was also capable of processing floating point numbers on-chip. These were aimed at the Personal Computer (PC) market, but other versions that were aimed at embedded systems quickly followed.

43. In 1976, Texas Instruments introduced the 9900, which, like the 8080, was a 16 bit chip, but could do multiplication and division directly, although these operations took longer than addition and subtraction. The 9900 was the chip I used when I was designing the denominator for the DLR 3000 series machines in 1980 and 1981.

44. This chip was already at least an order of magnitude faster in practical terms than the 8 bit microprocessors of that era. Nevertheless, it was not fast enough to directly implement the correlation algorithm that was used on the DLR 3000, and I found it was necessary to add some more hardware to offload some of the calculations. To identify U.S. dollars, the DLR 3000 compared the pattern obtained from each bill to a master library of stored patterns that included 28 patterns (four patterns corresponding to various combinations of facing (up or down) and direction (right or left) for each of the seven U.S. denominations). To cross correlate an 800 point pattern with 28 reference patterns would require 134,400 multiply and add operations during the passage of the note, or 25ms. Assuming for the moment that multiply and add are separate instructions, this would have required a CPU with hardware multiply rated at more than 10.5 MIPS, or 18 times the power of the 8080 or 9900, but by 1989 general purpose microprocessors rated at 41MIPS, more than 4 times the required figure, were commercially available.

45. The late 1980's also saw wide availability to the market of so called digital signal processors. These were designed specifically for number-crunching (highly computationally intensive) applications rather than general purpose computation or control applications, and included circuits for multiplying and accumulating, since this is an operation used in many mathematical applications, including filters used in sending and recovering speech in a cell phone. An example was the Texas Instruments TMS320 range originally announced in 1982, and available in 1985. The Texas Instruments document "Implementation of FIR/IIR Filters with the TMS32010/TMS32020 - APPLICATION REPORT: SPRA003A" dated 1989 discusses the use of this chip to implement such filters. (Exh. P). The algorithm required computation of the sum of products terms. The TMS32020 had a 16 bit multiply and accumulate function that could execute in a single cycle of 200ns (see Figure 1 below, Exh. P at 0008) i.e. at a rate of 5 million per second; later versions of the chip ran faster. It is reasonable to assume that there would likely be

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a certain overhead in software associated with starting and stopping computations. If this reduced the throughput to 25% – a very conservative estimate – the computation for notes the size of U.S. currency with 288 points could still be completed in 22ms.

46. Therefore, the system that I implemented on a circuit card in 1981, could, by 1989, be implemented in a microprocessor for U.S. denomination sorting.

47. The cost of microprocessors was typically high at their introduction, but ultimately was related to the volume of production. DSP's were initially higher priced than general purpose CPU's for use in PC's since the volumes used were lower, but that was soon to change - there is a DSP in every cell phone sold.

48. Figure 1 below is a true and correct copy of a portion of page 0008 of Exh. P to the Request for Inter-partes Reexamination:

The Texas Instruments TMS320 digital signal processing family contains two generations of digital signal processors. The TMS32010, the first-generation digital signal processor,⁵ implements in hardware many functions that other processors typically perform in software. Some of the key features of the TMS32010 are:

- 200-ns instruction cycle
- 1.5K words (3K bytes) program ROM
- 144 words (288 bytes) data RAM
- External memory expansion to 4K words (8K bytes) at full speed
- 16 x 16-bit parallel multiplier
- Interrupt with context save
- Two parallel shifters
- On-chip clock
- Single 5-volt supply, NMOS technology, 40-pin DIP.

The TMS32020 is the second-generation processor⁶ in the TMS320 DSP family. To maintain device compatibility, the TMS32020 architecture is based upon that of the TMS32010, the first member of the family, with emphasis on overall speed, communication, and flexibility in processor configuration. Some of the key features of the TMS32020 are:

- 544 words of on-chip data RAM, 256 words of which may be programmed as either data or program memory
- 128K words of data/program space
- Single-cycle multiply/accumulate instructions

Figure 1 – extract from Texas Instruments document SPRA003A

TRANSPORT PATH

49. I know that the De La Rue 3000 Series transported bills, one at a time, from the input receptacle along a transport path to at least one output receptacle since at least 1981.

50. The 3000 Series User Guide accurately describes the transport path as controlled “document transport to move banknotes through a number of electric

counting and inspection stages and assemble them in batches according to the results.” (Exh. G, at page 0047, para.1). After placing notes in the “continuously loadable hopper,” each bill was then separated from the stack of bills by a vacuum peeler, so that each bill was fed one at a time along the transport path. (Exh. G, at page 0047, para. 3). Each bill was then guided by the front end belt section past an electronic opacity detector which inspected for physical defects and was then “fed synchronously into the transport with long edge leading. *Id.* After transport was accomplished by the belt assembly, transport was by means of a series of drums rotating on their horizontal axes [to] form a common drive. *Id.* The transport path, including the belt assembly and the series of drums is shown in the 3000 Series User Guide, Exh.G, at page 0052.

51. In operation, the 3000 Series thus included the step of “transporting the bills, one at a time, from the input receptacle along a transport path” as required by all the claims of the ‘806 Patent.

AUTOMATICALLY DENOMINATING

52. The De La Rue 3000 Series automatically denominated bills of a plurality of U.S. denominations.

53. The 3000 Series automatically denominated currency using the same technique described in the ‘806 Patent—the correlation technique. I know this because I adapted the correlation technique for use in currency handling devices at De La Rue, including the 3000 Series. This adapted correlation technique is described in the ‘829 patent, on which I am a named inventor.

54. The 3000 Series User Guide, Exh. G at page 0077, refers to using pattern recognition for denominating currency “in countries where each denomination of banknote has a significantly different pattern but a common size...” The pattern recognition technique referenced in this passage is the correlation technique that I adapted for use in the De La Rue currency denominators.

55. The '829 Patent, Exh. N, accurately describes the operation of the 3000 Series correlation technique and teaches those of ordinary skill in the art how to apply the correlation technique to currency denomination. For instance, the '829 Patent teaches a currency denominator in which a "digital correlator means for correlating the digital signals corresponding to the pattern on the sheet, pixel by pixel, with each of a number of previously stored sets of signals, each previously stored set of signals being representative of a different standard pattern, the correlating means generating a correlation output signal for each correlation of the pattern on the sheet with a standard pattern...." See '829 Patent, Exh. N, at col. 1, ll. 14-29.

56. De La Rue used the correlation technique in the 3000 Series as it has since been used by Cummins to automatically denominate bills of a plurality of U.S. denominations. This is evidenced, for example, in the 3000 Series User Guide Exh. G at page 0015 (stating the 3000 Series provides "denomination sorting") and at page 0019, (multiple denominations can be handled since "notes from a common source may be processed as one entity—for example, all the banknotes from a single commercial bank..."). The 3000 Series Sales Brochure, Exh. Q, at page 0005 shows a \$1 bill.

57. In operation, the 3000 Series thus included the step of "automatically denominating bills of a plurality of U.S. denominations" as required by all the claims of the '806 Patent.

58. In the De La Rue 3000, the sensor array extended past the edges of the bill, thus allowing appropriate samples to be selected from the full set available. This made the De La Rue 3000 less sensitive to lateral position errors of the bill, which in turn made it unnecessary to store multiple reference patterns to compensate.

59. Some claims of the '806 Patent require "automatically denominating and totaling bills of a plurality of U.S. denominations."

60. There is no definition in the Patent specification for this term. As a verb, 'to total' is defined in dictionaries to mean 'to add up in number or quantity,

determine the sum of (OneLook® online dictionary search). The limitation does not use the term “total value” as in “displaying a total value of bills” in, e.g., Claim 99 and 114. I conclude, as would those of ordinary skill in the art, that the term ‘totaling’ in this context does not mean only totaling the value. Therefore bills that are totaled may also be added up in number, but not value.

61. In operation, the 3000 Series thus included the step of “automatically denominating and totaling bills of a plurality of U.S. denominations” as required by all the claims of the ‘806 Patent.

DENOMINATING BILLS INDEPENDENTLY OF SIZE

62. Some of the dependent claims of the ‘806 Patent require automatically denominating, “wherein the denominating comprises denominating bills independently of the size of the bills.”

63. These dependent claims do not further limit the independent claims because all the claims require “automatically denominating bills of a plurality of U.S. denominations.” All denominations of U.S. currency are the same size, and therefore the denomination method must be independent of the size of the bills.

64. The 3000 Series User Guide, Exh. G, at page 0077, makes this clear. It discloses that the 3000 Series used a pattern detection technique for denominating currency “in countries where each denomination of banknote has a different pattern but a common size...” That technique is the correlation technique, which denominates bills based on the pattern on the bill and not on the size.

TRANSPORTING/DENOMINATING IN EXCESS OF 1000 BPM

65. Some of the claims of the ‘806 Patent require transporting and/or denominating bill at rates in excess of either 800 bpm (bills per minute) or 1000 bpm.

66. Although this may have been a major obstacle in the 1970’s, by the early 1980’s techniques had been developed sufficiently to enable processing of an

adequate number of data samples fast enough to support feed rates and denomination rates of 1200 bills per minute DLR 3000.

67. I know that the 3000 Series transported and denominated bills at 1200 bpm since at least 1981. The denominating technique used by the DLR 3000 was disclosed in detail in the '829 patent and implemented on the DLR3000 more than a decade before the filing date of the May 19, 1992 effective filing date of the '806 patent.

68. The specifications in the 3000 Series User Guide for the 3400, 3430, 3500 and 3530 each identify the feed rate of the 3000 Series as 20 notes/sec. 3000 Series User Guide, Exh. G, at pages 0053, 0057, 0061, and 0065 . A feed rate of 20 notes/second is 1200 bpm.

USING REFLECTED LIGHT

69. Some of the asserted claims require, "detecting light reflected off passing bills, generating a reflected light characteristic information output signal in response to detected characteristic information, and generating a denomination signal in response thereto."

70. Each denomination of U.S. currency has an image, or pattern, associated with it which is characteristic of its denomination. In identifying a bill, information from either side of the bill could be used. The choice would depend on presence of distinguishing features on one or the other side of the bill. In the case of U.S. currency the non-portrait (Green) side of the bill had more distinguishing criteria than the non-portrait (black) side of the bill, but data from other side of the bills could be used to identify U.S. currency.

71. As part of my work on the De La Rue 3000 Series, I know that the 3000 Series detected light reflected off passing bills, generated a reflected light characteristic information output signal in response to detected characteristic information, and generated a denomination signal in response thereto. The denomination signal was generated on the basis on reflected light information from either face of the bill.

72. I described such a process in the '829 Patent, Exh. N. In the '829 Patent, I taught that image signals (characteristic information output signals) corresponding to the scanned strip of the bill are stored in memory. '829 Patent, Exh. N at col.3, ll. 7-10. Then the image signal corresponding to the pattern on the sheet is correlated, pixel by pixel, with each of a number of previously stored sets of image signals, corresponding to each denomination, and a correlation output signal is generated for each correlation of the pattern on the sheet with a standard pattern. '829 Patent, Exh. N, at Col. 3, ll. 21-31. This "correlation output signal P" has a value no larger than 1 and the pattern corresponding to the highest value of P represents the most likely match with the target note. '829 Patent, Exh. N, at col. 3, ll. 50-53; See also, '829 Patent at col. 1, ll. 14-29, col. 2, ll. 18-25, Col. 2, ll. 63-65, col. 3, ll. 13-16, col. 3, ll. 21-22.

73. The 3000 Series used reflected light to generate these signals. 3000 Series User Guide, Exh. G, at page 0074 and page 0077 (use of reflected light for pattern detection).

74. The manner of focusing light is merely a design choice. The use of linear array sensors dictates that an optical system focused the light from the bill onto the sensor, rather than focusing the source of illumination. In the 1970's, before fast solid-state sensors were commonly available, an accepted method of scanning documents was to focus the light from a cathode ray tube (CRT) onto the document and collect the reflected light in a photomultiplier tube.

DELIVERY/RESTACKING OF BILLS IN OUTPUT RECEPTACLE

75. Most of the claims of the '806 Patent require either the delivery or restacking of the denominated bills in an output receptacle.

76. Models 3400/3500 of the 3000 Series had five denominated bill output receptacles (in the form of five stackers or stacking stations), whereas in Models 3430/3530, the fifth denominated bill output receptacle is not a stacking station but a granulator (destruction unit), whose purpose is to destroy bills to be removed from

circulation. See 3000 Series User Guide, Exhibit G, at pages 0053, 0057, 0061, and 0065.

77. Although the 3000 Series had five output receptacles, the 3000 Series was computer programmable to operate in a wide variety of "modes," each mode having different characteristics and features. Each mode was stored in the 3000 Series memory, and the 3000 Series could store over 100 different modes of operation. 3000 Series User Guide, Exh. G, at 0017. The number of stackers used by the 3000 Series and the contents of each stacker after processing bills, depended on the particular mode that was selected by the user. Some modes made use of all five output receptacles. Some modes used only one.

78. Thus, in operation, the method embodied by the De La Rue 3000 Series included restacking the bills in a denominated bill output receptacle, wherein after processing the entire stack of bills, the output receptacle contained a set of bills of a plurality of denominations, all of whose denominations were known.

DISPLAYING AND TOTALING

79. Some claims of the '806 Patent, such as claim 58 require "displaying a total value of bills contained in the output receptacle and the number of bills of each of the plurality of denominations contained in the output receptacle."

80. I know that the De La Rue 3000 Series displayed the number of bills of each denomination that has been denominated.

81. The De La Rue 3000 Series came equipped with a Video Display Unit ("VDU") and a Printer. (3000 Series User Guide, Exh. G, at 0015). The information displayed on the VDU or the printer included a list of denomination and the numbers of bills of each denomination in the output receptacle.

82. The only difference between the De La Rue 3000 Series and the claims relating to the display of information is the display of the total value of the bills. As a technical matter, it is just as easy to calculate the total value of the denominated bills as it is to calculate the total number of bills of each denomination. The difference is a simple matter of multiplication and addition. Likewise it is just as

easy to display the total value of the bills as it is to display the number of bills of each denomination. Both are inarguably within the skill of those of ordinary skill in the art of currency denomination.

83. There is also clear motivation to display either one or both of these data. As a precise accounting of the currency denominated was required by De La Rue's customers, it was a matter of customer choice as to whether to account by way of total value or total number of bills of each denomination, or both. The customers of which I am aware chose not account for total value; however, calculating the total value and displaying it was an obvious design choice which could have easily accommodated. As such, any claim which requires displaying the total value as well as the total number of bills of each denomination, if not anticipated, was entirely obvious in view of the De La Rue 3000 Series.

MOSLER-TOSHIBA CF-420

84. I have reviewed a reference known as the "Mosler CF-420 Operator's Manual," copyright 1989. The "Mosler CF-420 Operator's Manual" does not expressly describe a signal processing unit, and such a description would not be expected of a user's guide. However, the Manual does indicate the use of an optical scanning unit (page 7-10) and an optical scanning strip (page 7-11). One of ordinary skill in the art would understand from this information that the Mosler CF-420 machine, as described in the "Mosler CF-420 Operator's Manual," compares retrieved information from the optical sensor with a master characteristic pattern and generates an indication of the denomination of the bill when the retrieved information sufficiently matches the master characteristic information.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Dated this 10th day of January, 2008 at Havant, UK

A handwritten signature in black ink, appearing to read "S. Emery", with a horizontal line drawn underneath it.

Stephen G. Emery