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Claim Nos: HC06 C03919
HC07 C01551
HC07 C02890

**IN THE HIGH COURT OF JUSTICE**
**CHANCERY DIVISION**
**PATENTS COURT**

Royal Courts of Justice
Strand, London, WC2A 2LL

Date: 25/06/2008

**Before** :

**THE HON MR JUSTICE FLOYD**

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**Between :**

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| **ZIPHER LIMITED** | **Claimant** |
| **- and -** | |
| **(1) MARKEM SYSTEMS LIMITED** | |
| **(2) MARKEM TECHNOLOGIES LIMITED** | **Defendants** |

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**Mr Simon Thorley QC, Mr Adrian Speck and Mr Jonathan Hill** (instructed by **Eversheds LLP**) for the **Claimant**
**Mr Richard Arnold QC and Mr Brian Nicholson** (instructed by **Herbert Smith**) for the **Defendants**

Hearing dates: 17-18, 21-25 April, 6-9 May 2008

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# Judgment

**Mr Justice Floyd :**

1. This is the latest battle in the sequence of disputes between the Claimant in this action ("Zipher") on the one hand and companies in the Markem group, which includes both the Defendants ("Markem"), on the other. Earlier proceedings concerned the parties' entitlement to inventions disclosed in a number of patents and patent applications applied for by Zipher, including some which are now in issue in this action. The earlier decisions are chronicled in the law reports. Those of HHJ Fysh QC sitting as a deputy High Court Judge are *Markem Corp v Zipher Ltd (No 1)* [2004] RPC 10, *Markem Corp v Zipher Ltd (No 2)* [2004] RPC 11 and *Markem Corp v Zipher Ltd (No 3)* [2005] RPC 3.

2. HHJ Fysh QC held that Markem Corporation and the Second Defendant were entitled to a number of the wider claims of those patents and applications, but that narrower claims belonged to Zipher. In the course of the proceedings at first instance, Zipher's counsel offered an undertaking to the court as to what it would do with the wider claims if it was successful in establishing its claim to be entitled to them, which at first instance it was not. The Court of Appeal allowed Zipher's appeal: *Markem*

*Corp v Zipher Ltd* [2005] EWCA Civ 267, [2005] RPC 31. The Court of Appeal took the approach that in the absence of any allegation of breach by Zipher of a private law right, Markem's claim to entitlement could not succeed. The order of the Court of Appeal recited a concession made by Zipher's counsel that some of the wider claims as they stood then were invalid, or (in the case of one claim) invalid if construed in a particular way, but did not recite the undertaking offered to HHJ Fysh QC.

3. Having secured its claim to ownership of the inventions, Zipher now sues Markem for infringement, claiming that two versions of Markem's SmartDate 5 printer (the EV and LV) and its Series 18 printer infringe:

   i) UK Patent No. 2 369 602 ("602");

   ii) European Patent (UK) No. 1 317 345 ("345"); and

   iii) European Patent (UK) No. 1 767 375 ("375").

4. Markem deny infringement and counterclaim for revocation of each of the three patents sued on, and also for revocation of UK Patent No. 2 400 582 ("582") which is not alleged to be infringed.

5. Zipher has applied to amend 602. Markem contend that the court should not entertain the application to amend as it is not in conformity with the undertaking given to HHJ Fysh QC. The amendments are opposed by Markem on statutory grounds and because they say the court should not exercise its discretion to allow the amendments even if they are otherwise allowable. This latter point raises the question of whether the court retains (following the entry into force of the Patents Act 2004 on 13th December 2007) any discretion to refuse to allow amendments which would not offend against the grounds of objection under the statute, and, if so, on what principles that discretion is to be exercised.

6. In all, these disputes give rise to a very large number of issues and sub-issues, which I summarise as follows:

   i) Is Zipher's attempt to amend in breach of any undertaking it has given to the court?

   ii) Do Zipher's amendments to 602 add matter?

   iii) Are Zipher's amendments to 602 allowable in the exercise of any discretion retained by the court?

   iv) Are any claims in the four patents in suit invalid for lack of novelty over US Patent Specification No. 4 909 648 ("Datamax")?

   v) Was the information in a Markem document called "the Adkin Memorandum" made available to the public before the priority date of 602?

   vi) If so, do any claims lack novelty over the Adkin Memorandum?

   vii) Are any claims invalid for lack of inventive step over:

a) Datamax;

b) The information in the Adkin Memorandum;

c) US Patent Specification No. 5 490 638 ("IBM");

d) US Patent Specification No.4 093 149 ("Shroff");

e) Japanese Patent Application No. S60-211653 ("Ikenaga");

f) US Patent Specification No. 5 649 672 ("Wolff");

g) UK Patent Application No. 2 302 523 ("Markem")?

viii) Are any claims invalid for insufficiency? There are pleaded insufficiencies of three different types: classical insufficiency, *Biogen* insufficiency and insufficiency through ambiguity.

ix) Are any claims infringed by any of the three accused models of Markem printer?

7. In very broad terms the patents in suit are concerned with tape drives for use in printers, tape recorders and similar equipment. Although the claims are wider, the specific embodiments in the patents and the products which the parties make and sell are thermal transfer printers. Thermal transfer printing uses a ribbon with solid thermoplastic ink covering one side. The ink can be melted in specific regions if subjected from the other side to heat from the printing elements in a print head. Once heated, the ink transfers from the tape to the substrate onto which it is desired to print. A major application of this type of printing is in production lines, where it is necessary to add coded information onto a product, such as a "sell by" or "best before" date. For these reasons the machines are sometimes called "date coders" or just "coders".

## The witnesses

8. Zipher called two expert witnesses. The first was Dr Richard McMahon who is a Senior Lecturer in Electrical Engineering in the Department of Engineering at Cambridge University. His professional experience is broad. He has taught and researched the design and application of electrical machines (i.e. motors and generators) and the means of driving and controlling them. He has acknowledged that in the field of computer software he has relied on assistance from elsewhere within the Department.

9. I thought Dr McMahon was a careful but perhaps sometimes rather reluctant witness. He occasionally, perhaps unnecessarily, preferred to express answers in his own words rather than giving "yes" or "no" replies to propositions put to him. Nevertheless, overall, I found his evidence helpful. Mr Arnold QC, who appeared for Markem with Mr Brian Nicholson, said that Dr McMahon strayed in the course of his evidence into the realm of the advocate. I do not think that was a fair criticism. It is understandable in a dispute of this kind that a witness should wish to express himself in his own words rather than accept unreservedly lengthy propositions put to him. I do not think Dr McMahon was doing more than that.

10. Zipher's second expert was Mr Michael Nelson who is a Mechanical Design Engineer, with over 40 years experience working on a wide spectrum of engineering projects. For most of the last 30 years, he worked for Cambridge Consultants Limited. He is currently a freelance design engineer. As he explains in his report, when he started his career, mechanical engineers did not necessarily go to university, but often worked an apprenticeship instead. His own apprenticeship was 5 years with Cambridge Scientific Instruments Co. This included one day and one evening a week at the local technical college (which is now Anglia Ruskin University) learning the theoretical and mathematical side of the job. At the end of his apprenticeship he became a skilled Scientific Instrument Maker. Mr Nelson started his involvement with thermal transfer printers in 1995 and continued until 1999. He designed the SmartDate 2c, one of Markem's machines.

11. Mr Arnold said that Mr Nelson's evidence was only of marginal relevance, for reasons associated with his submissions about the skilled addressee, which I deal with elsewhere. He also faintly suggested that Mr Nelson's connection with Markem and its predecessor meant that he was not truly independent. This second point would only be of substance if I felt that Mr Nelson was influenced in any way by his past association. I formed the view that he was not, and that he was giving his evidence fairly and impartially. He was the only witness with practical experience of designing tape drives.

12. Markem called Richard Taylor as their only expert. He is an electrical engineer. He worked for EMI Electronics from 1967 to 1975 and then for Quantel, a company involved in the development of digital image processing techniques for the broadcast television industry, from 1975 to 2006. He has no experience of thermal transfer printers, although he has experience of a variety of printing and scanning devices and is familiar with tape drive systems through use.

13. Mr Taylor fairly recognised that he was not a mechanical engineer. His position as expert for Markem was justified by Mr Arnold on the basis that a specialist mechanical engineer was not a necessary part of the skilled team. Mr Taylor had, in any event, come up in the past with mechanical engineering solutions to problems which were encountered at Quantel (to do with flare in cathode ray tubes). To the extent that specialist mechanical engineering understanding is important, particularly of tape drive design, I think that Mr Nelson was better placed to assist me than Mr Taylor.

14. Mr Thorley QC, who appeared for Zipher with Mr Adrian Speck and Mr Jonathan Hill, had a further specific criticism of Mr Taylor. This was that he had approached the teaching of the specification in too critical a fashion. At times, when first reading his expert reports, I did feel that Mr Taylor was taking somewhat pernickety points about sentences in the patents. Nevertheless, even if they were not all legally important, they were technically correct. I see no reason not to give weight to Mr Taylor's evidence on this account.

15. In the end what matters with the experts is the reasoning underlying their opinions. I have no doubt that each of them was doing his best to help me to understand the underlying technology and the basis of the opinions which they have expressed. I also have no doubt that all their opinions were genuinely held.

16. There were also two factual witnesses from Zipher, Philip Hart and Steve Buckby.

17. Philip Hart is the Engineering Manager at Zipher. He gave his factual evidence fairly and accurately. Both sides encouraged me to find that he was an entirely reliable witness. I did.

18. Steve Buckby was a Director of Zipher from 2000 to 2004, when it was sold to Videojet Technologies Limited, but remains a consultant to Zipher. He was responsible for the conduct by Zipher of the entitlement proceedings brought against it by Markem. It was suggested by Mr Arnold that Mr Buckby was not prepared to agree to anything without seeing the very same words in a document. There is some force in this, but there is in the end not much in this case which turns on Mr Buckby's evidence.

## Technical background

19. The following is a summary of the technical background needed for an understanding of the patents and the case. In my judgment all of it would be common general knowledge to the skilled team.

*Electric motors*

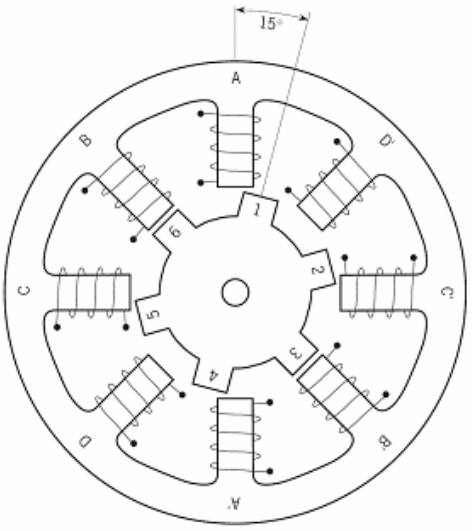
20. For present purposes two main classes of electric motor are relevant: DC motors and stepper motors. In their simplest form, DC motors work by mounting a rotating armature on a rotating spindle. The armature carries coils of wire which become electromagnets when an electric current is caused to flow in them. Fixed magnets, called the stator, surround the rotating armature. The interaction between the stator and the field generated by the current in the windings of the armature causes the armature to experience a rotational force. As the armature rotates, the current supplied to the windings is caused to reverse in polarity, so that the rotational force remains in the same direction. The reversal of current is called "commutation".

21. To change the angular velocity and torque exerted by a DC motor one changes the voltage and current supplied. So there is a relationship between the current through the motor and the torque, which can be used to measure and control the torque.

22. It was well known to measure the precise angular velocity of a DC motor by using a tachogenerator or rotary shaft encoder (which emits a stream of pulses).

*Stepper motors*

23. Stepper motors are, as their name suggests, electric motors which move in discrete steps. This stepping is achieved with the use of a stator consisting of multiple electromagnets ("teeth") arranged around a central gear shaped rotor. When current flows in the windings, the teeth of the stator line up with the teeth of the gear shaped rotor. Sequential energising of the teeth under the control of electrical circuitry enables the rotor to move stepwise into alignment with successive teeth of the stator. A diagram of a typical stepper motor looks like this:




24. A stepper motor thus has the advantage that angular position can be precisely controlled through the number of steps through which the motor is required to turn under the influence of the control circuitry. Equally, angular velocity can be easily controlled by controlling the stepping rate.

25. A stepper motor has the characteristic that, once the stator and rotor teeth are aligned in a particular position, it can hold that position against an external torque, provided that the windings remain energised with enough current.

26. Dr McMahon's evidence, which I accept, is that in the case of the stepper motor there is no simple equivalent to the straightforward means of measuring torque which is available in the DC motor. This is an important fact relied upon by Zipher in relation to validity.

*Back emf*

27. It is well known that mechanically rotating the spindle of a DC motor to cause the windings on the armature to rotate in the permanent magnetic field of the stator causes a back-electromotive force ("back emf") to be generated in the windings. A dynamo or electrical generator works on this principle. Some types of unexcited stepper motors also generate such a back-emf.

28. If an electrical load is placed across the terminals of a motor, a current will flow which will follow the commutation sequence, and accordingly have a waveform profile. The back-emf from a stepper motor will be pulsed.

*Pulse-width modulation*

29. Pulse-width modulation is a technique sometimes used in providing electrical devices with a variable voltage supply. Instead of applying a constant voltage, say 6V, to a device, the device can be supplied with a square-wave voltage which switches between 6V and 0. By varying the periods of 6V and 0V supply, the device can be supplied with voltage which, in average terms, is equivalent to intermediate voltage supplies. This is often much more convenient than using an analogue circuit to knock down the voltage.

30. When one first switches on the voltage to an electric motor, the inductance in the windings presents a very high impedance. This is because the windings present a large impedance to high frequencies: and the switching of the voltage from zero to full-on is recognised as a high frequency, even if it only represents part of a cycle. To force more current into the windings against this impedance, one has to increase the voltage. But this has the disadvantage that after a short period an excessively high current will start to flow. It is therefore desirable to switch the high voltage off and on again.

31. Given that circuitry is put in place to vary the supply voltage at start-up in this way, it was common to take the further step of controlling the average current in the windings by varying the on/off ratio of the pulsed supply. This is the width of the pulse to which the term "pulse width modulation" refers.

*Filtering and averaging of signals*

32. Monitoring of signals can be made more difficult by the presence in the signal of various types of interference or noise. A DC motor driven from an analogue circuit with a steady voltage will have a steady current in the motor. However, if such a motor is driven from a pulsed supply, the current will consist of a steady component together with a component related to the switching frequency. Consequently in order to monitor the current in the pulsed case, it is necessary to remove the components related to the switching frequency and other noise by filtering.

33. Filtering is the process of picking out a desired signal from noise.

34. Averaging is another signal processing function used to smooth out noise and other unwanted signals. Samples can be averaged in several ways. For example one can take 10 samples, add them up, and divide by the number of samples to produce *one* output value and proceed to the next 10. Alternatively one can apply a sliding window which involves samples 1-10 followed by 2-11 and so on.

*Control systems and Proportional-integral-derivative ("PID") control*

35. The simplest form of control for an electric motor is known as 'open loop' control. Open loop control systems assume that sufficiently precise information is known about the characteristics of the motor to enable the desired motor output to be achieved simply by applying the appropriate input conditions. A more sophisticated approach, which does not involve as many assumptions about the motor's characteristics, is a 'closed loop' control system. These systems operate by taking feedback from the output of the motor under control to the controller. This feedback signal is compared with the desired performance to produce an error signal. The input to the plant can then be altered to ensure that the desired performance is achieved.

36. Proportional-Integral-Derivative ("PID") control is a specific form of closed loop control. The error function is subjected to a proportional function, an integral function and a derivative function. Each of these has a parameter, called the gain, which alters the relative influence of that function. The tuning of these parameters fundamentally defines both the steady state and dynamic performance of the closed loop control system.

37. The proportional term controls the instantaneous reaction to an error in the desired output.

38. The integral term is used to stabilise the steady-state error and works by keeping track (by integration) of the history of the errors in the system over time.

39. The derivative term operates by monitoring the rate of change (i.e. the derivative) of the error signal. When the rate of change is large (indicating a high acceleration or deceleration rate of the motor), the derivative term is used to reduce the power to the motor to damp the system performance, ensuring that oscillations caused by a high proportional gain are reduced and in any event eliminated over time.

40. Sometimes it will not be necessary or desirable to use all these terms. Hence there are PI controllers, PD controllers and simple P controllers.

*Tape drives*

41. A wide range of equipment uses tape driven between spools. Computer tapes, video tapes, cine projectors, typewriters and printers are some examples.

42. The tape can be driven by motors connected directly to the spools. As anyone who has re-wound a tape recorder or watched a projector knows, the amount of tape wound on or off the spool by one revolution is not the same when the tape is nearly full as when it is nearly empty. To achieve a constant linear tape speed the angular velocities of the spools have to change.

43. One common way of ensuring constant linear tape speed is by means of a capstan roller which engages the tape directly and drives the tape at a constant speed.

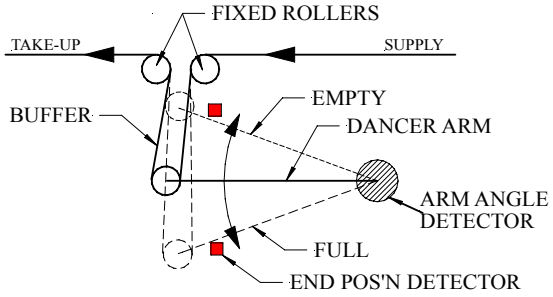
*Tension control*

44. A number of systems existed for keeping control of tape tension in a tape drive.

45. A common way is to provide the supply spool with a drag force. This can be done mechanically with a friction clutch or brake applied to the supply spool. An alternative method is electrical. A DC motor driving a spool may be used as an electrical brake for that spool by powering the motor connected to it to turn in the opposite direction to the turning of the spool. Another method of electrical braking is to use the DC motor so that a back emf will appear at its terminals. If a resistive load is applied to the motor it will exert a drag force on the tape. A controlled drag can be created by varying the resistance applied across the motor terminals.

*Tension arm systems*

46. A common component in tape drives is the tension or “dancer” arm. This is illustrated below:




47. This example works by gravity, but the same effect can be achieved with a constant force spring. The idea is to create a length of tape which acts as a buffer in the system, allowing the tension arm to set the tension in the tape.

48. The tension in the tape is set by the weight of the arm. Subject to a small angular effect due to the fact that the arm does not move vertically up and down, the tension in the tape when the arm is stationary or moving at constant velocity will be half the weight of the arm.

49. The arm has detectors placed at points before it reaches the extremity of its movement. These detectors can be used to signal the need for more tape to be fed into or withdrawn from the system. The steady-state tension in the tape will remain that set by the dancer arm.

50. There will, however, be instantaneous changes in the tension in the tape when the tape accelerates or decelerates.

51. What I have said thus far applies even if the tension arm is operated by a constant rate spring, as opposed to gravity.

52. It was common ground between the experts that a tension arm could be operated by gravity, by a constant rate spring or by a variable rate spring. Mr Nelson was the witness best placed to deal with this:

> Q. ... …it was well known, was it not, that dancer arms, to use your terminology, could be actuated by gravity, by a constant force spring or by a variable force spring?
>
> A. Yes, I agree with that.

*Tension sensor systems*

53. Pressure transducers may be placed in contact with the tape and used to derive a measure of tension. They operate on the piezo-electric or piezo-resistive principle. They are used in some of the cited prior art documents.

*Thermal transfer printing*

54. I have explained the basic nature of thermal transfer printing in paragraph 7 above.

55. Thermal transfer printers can be operated in two modes: continuous and intermittent. A continuous printer prints on a substrate that moves continuously. The continuous mode requires the printhead to be held stationary and the ribbon to be accelerated to

the speed of the substrate. The substrate is printed as it travels past the printhead. In intermittent mode the substrate is stopped. Printing is carried out by moving the printhead along the region to be printed. At the end of printing, the printhead is retracted and moved back to its starting position. The substrate moves on and the ribbon is wound on to the next region available for printing.

## The patents in suit

56. It is convenient to start with 602. It has a priority date of September 2000 and is entitled "Drive Mechanism". My page references are to 602 as proposed to be amended (as found in trial bundle A/3).

57. The specification makes it clear that its disclosure and its broader claims are not limited to thermal transfer printers, to transfer printers or indeed to printers at all. At page 5 lines 20 to 28 the specification makes this particularly clear:

> "The requirements in terms of ribbon acceleration, deceleration, speed and positional accuracy of high speed transfer printers is such that the known drive mechanisms have difficulty delivering acceptable performance with a high degree of reliability. Similar constraints also apply in applications other than high speed printers. Accordingly it is an object of the present invention to provide a tape drive which can be used to deliver printer ribbon in a manner which is capable of meeting the requirements of high speed production lines, although the tape drive of the present invention may of course be used in other applications where similar high performance requirements are demanded."

58. The initial discussion in the specification does however relate to transfer printers. Having explained the basic structure of a tape drive arrangement with supply and take-up spools, the patentee states at page 1 lines 22-25 that generally

> "the known arrangements drive only the spool on to which ribbon is taken up … and rely on some form of "slipping clutch" arrangement on the spool from which ribbon is drawn … to provide a resistive force so as to ensure the ribbon is maintained in tension ….."

59. The specification goes on to point out (at page 2 lines 1-8) a problem with these slipping clutch arrangements which arises from the fact that the diameter of the tape wound on each spool varies as tape is wound from the supply spool to the take-up spool. If the slipping clutch arrangement which is used to keep the tape in tension applies a constant resistive torque to the supply spool, the tape will have to be pulled harder as the diameter of the spool decreases[1]. This variation in diameter results in an increase in the tension in the tape as the supply spool is progressively unwound. The tension is inversely proportional to the diameter of tape on the spool[2].

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1 Imagine trying to undo a nut with a short spanner as compared with a longer one.

2 The patent says "proportional" not "inversely proportional", but the skilled reader would understand that inverse proportionality was meant.

60. There follows a discussion of a number of prior art printers, none of which are cited as prior art in this action. A number of deficiencies of these printers are pointed out, as are differences with the invention.

61. The specification then goes on (page 5 lines 20-28) to remind the reader of the heavy demands of continuous and intermittent transfer printing in terms of acceleration, deceleration and speed of the tape and the need for positional accuracy. The object of the invention is then spelt out in the terms which I have already quoted in paragraph 57 above.

62. An important passage comes amidst the consistory clauses for the new claims at page 6 lines 19-27:

> "A tape drive in accordance with the present invention relies upon both the motors which drive the two tape spools to drive the tape during tape transport. Thus the two motors operate in push-pull mode. This makes it possible to achieve very high rates of acceleration and deceleration. Tension in the tape being transported is determined by control of the drive motors and therefore is not dependent upon any components which have to contact the tape between the take-up and supply spools. Thus a very simple overall mechanical assembly can be achieved. Given that both motors contribute to tape transport, relatively small and therefore inexpensive and compact motors can be used."

63. Thus both motors are involved in driving the tape in push-pull mode, and the tension in the tape is controlled by the motors, thus dispensing with the need for additional tape-contacting components. Although "push-pull" is a term which is apparently widely used in this context, it is perhaps not the most technically exact way of describing what is going on, as the supply spool does not push the tape in any meaningful sense. What driving the supply spool achieves is to relieve the load on the take up spool, so that the system can accelerate more easily. The arrangement is similar to a car towing another car by a length of rope, as compared to the towed car having some power of its own.

64. The patent's suggestion that push-pull mode enables the use of smaller motors was a matter which divided the experts. Whilst there are points in the transfer of the tape from one spool to the other where less power is required (as compared with the single motor arrangement), I prefer the evidence of Mr Taylor that the *maximum* load condition remains the same. Accordingly the patent's suggestion that smaller motors could be used is incorrect. That this is so would not, I think, be apparent on merely reading the specification: it requires some thought.

65. The specification goes on to describe an embodiment of a tape drive for a thermal transfer printer. A feature of the embodiment described is that it can function in two directions and operate in both continuous and intermittent mode. At page 14 the specification gives a number of other advantages, which it must be remembered are claimed only for this embodiment:

> "The described printer arrangement provides a number of very significant advantages. Firstly, it is possible to use the same apparatus for both continuous and intermittent printing. Conversion of a production line from one form of printing to another does not therefore mean that new printers must be purchased. Secondly, by making relatively minor modifications involving only one additional component (the alternative print head carriages of Figures 10 and 11) the same apparatus can be used for both left hand and right hand applications, using these terms in the sense of Figure 2 (left hand) and Figure 12 (right hand). Thirdly, ribbon replacement is a simple matter given that when in the docked position the print head 4 is automatically pulled back away from the peel roller 33 so as to provide a wide track into which a replacement printer ribbon carried on a cassette can be inserted."

66. The specification then goes on (by reference to Figures 13 to 16) to describe ways of making more efficient use of printer tape. The details of these do not matter, but what follows from the discussion does:

> "The advantages described with references to Figures 13 to 16 can only be achieved if the print ribbon can be positioned relative to the substrate and the print head with great accuracy. The conventional approach to achieving accurate control of tape acceleration, deceleration, speed and position has relied upon a capstan roller positioned between feed and supply spools, but the present invention relies upon a completely different approach, that is the accurate control of the drive applied to the stepper motors … which drive the ribbon spools. The stepper motors operate in push-pull bi-directional mode, that is if the tape is travelling in one direction between the spools both stepper motors are driven in that direction, and conversely when the ribbon is being driven in the opposition direction both stepper motors are driven in that opposite direction. Coordination of the drive to the two stepper motors requires knowledge of the diameters of the spools and this is achieved using the light emitting devices…."

67. So the demands of the described method of economising on tape (in terms of positional accuracy) are approached from a new angle, namely that of using the motors in a co-ordinated push-pull arrangement.

68. The required knowledge of the diameters of the spools is described as being achieved with the use of light emitting devices. Ways of doing this are described firstly by reference to Figure 17:

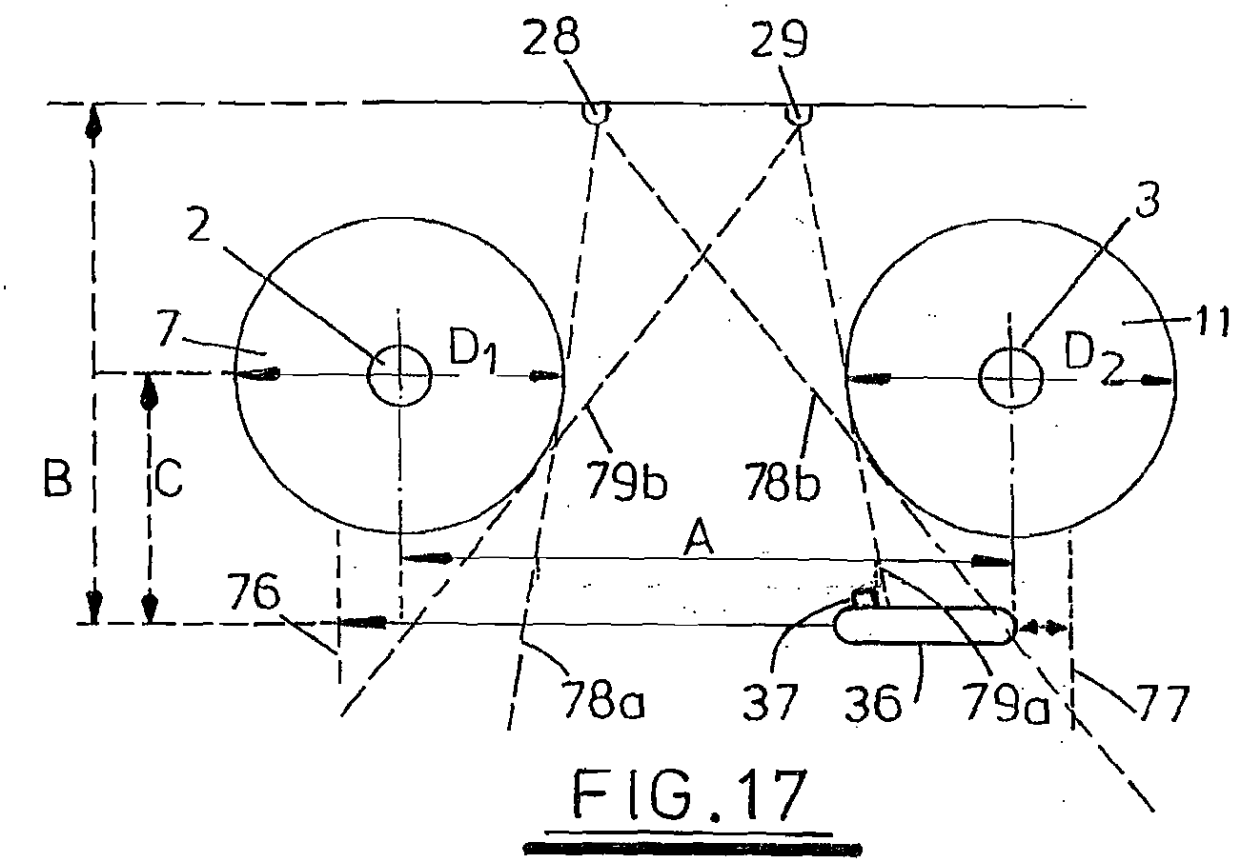



FIG.17

69. A detector 37 mounted on the printhead (itself on a carriage) is moved from right to left or left to right from within the shadow of the spool to the point where it is in the line of sight of an emitter (28, 29). The dimensions are then calculated by trigonometry. The specification continues by explaining that it is necessary also to gather information about changes in spool diameter over time:

> "Given knowledge of the spool diameters, the spools can be driven in push-pull mode so as to achieve high rates of acceleration and deceleration by appropriate control of the speeds of rotation of the two stepper motors. Tension in the ribbon between the two spools must however b[e] closely controlled to avoid the tension becoming too high (resulting in over tightening of the ribbon on the spools or even ribbon breakage) or the tension becoming too low (resulting in loss of positional control as a result of the ribbon becoming slack). To avoid this occurring, changes in spool diameters over time are monitored by reference to the stepper motors and tension in the ribbon is directly monitored by reference to the current drawn by the stepper motors."

70. This passage makes it tolerably clear that the measurement of spool diameters by means of the optical system is an initial measurement or calibration step. Indeed the Figure 17 process is later described as "an initial estimate" of the diameters. The final sentence of the passage quoted above refers to changes in spool diameters being

"monitored by reference to the stepper motors" and tension in the tape being "directly monitored by reference to the current drawn by the stepper motors". The impact of these latter passages was the subject of some debate, to which I will have to return.

71. Having obtained an initial value for the diameters of the spools from the optical system, the specification then describes a further step. The take up motor is used to pull the tape from the supply spool with the supply spool de-energised. The system counts the number of steps taken by the take up spool. The supply spool, being pulled along in this way, functions as a generator and produces a back-emf. Because the motor is a stepper motor, this back-emf will be in the form of a series of pulses. This enables the system to compare the number of steps taken by the take up motor with the number of pulses recorded from the supply motor, so as to arrive at a ratio of the two diameters. This again is in the nature of a calibration process, as opposed to a process carried out during printing, as the supply spool is de-energised, which would not be practical during operation.

72. The specification then describes a further optical scan of both take up and supply spools in order to determine eccentricities around the circumference. That information is then combined with the information about ratios of diameters from the motors to "give an accurate set of data related to spool diameters and shape". This creates the impression that the exercise is required to be a very accurate one.

73. The specification then explains the need to calibrate the motors if the current supplied to the motors is to be used for control of tension. It is fair to say that the calibration process is explained in somewhat broad terms. The motors are driven in zero-load conditions at a range of different speeds. The process is said to calculate a motor calibration factor, x for each step rate. A relationship is then expressed:

$$x = N/V$$

where x is the calibration factor for the motor at a given step rate

V is the average measured motor operation value at the given step rate

N is a constant normalisation or scaling factor.

74. This process is said to produce a series of values for x at each of the step rates.

75. Figure 18 illustrates the calculation of the values of a parameter V, called the motor operation value (not voltage) during calibration.

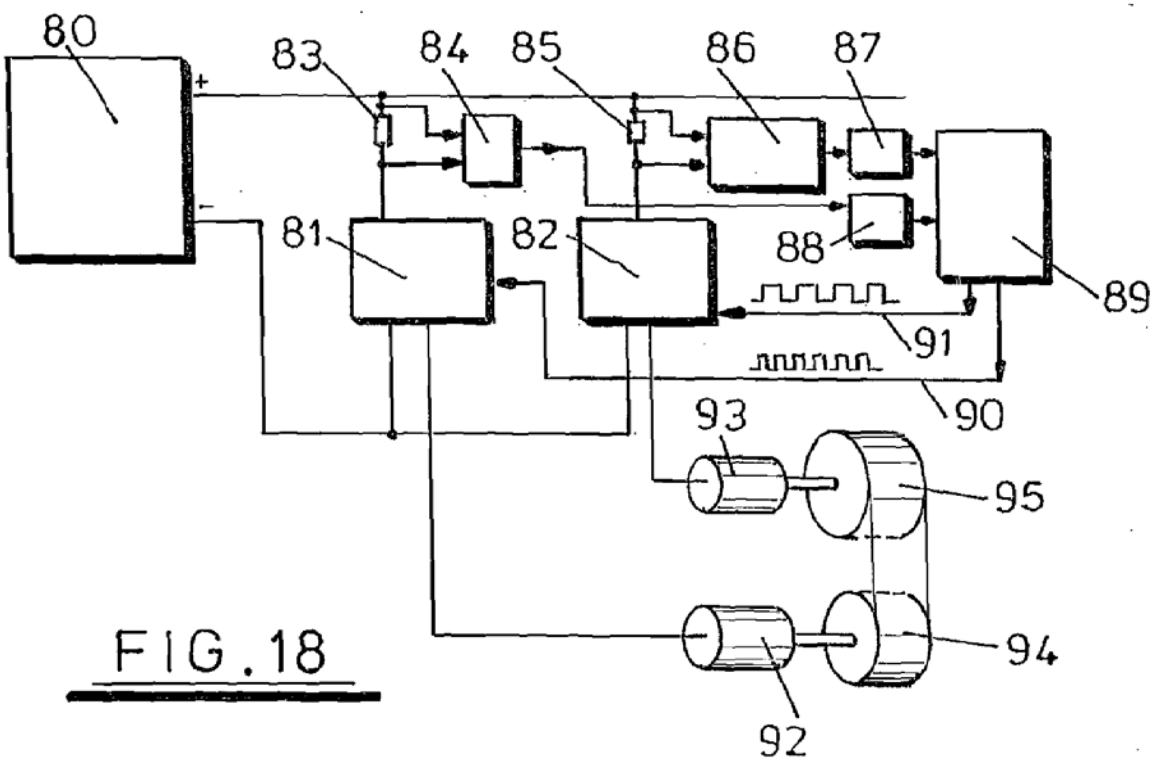



FIG. 18

76. 80 is a regulated power supply. 81 and 82 are first and second motor drive circuits. The current to these motor drives is delivered through series resistors 83 and 85. The potential developed across these resistors by the current supplied to the motor drive circuit is taken via devices 84 and 86, through analog to digital converters 87 and 88 to a controller 89 which delivers pulsed outputs (shown as 90 and 91) to the motor drives 81 and 82.

77. The above process yields (at the outputs of the ADCs 87 and 88) the values of x and V for each motor at each of the rate steps. Tension is then calculated by the following formulae:

$$V_1x_1 = (N + r_1tx_1)\ f(T) \qquad (1)$$

$$V_2x_2 = (N - r_2tx_2)\ f(T) \qquad (2)$$

Where:
$V_1$ is the output of ADC 88 given a selected constant step-rate ribbon feed
$V_2$ is the output of ADC 87 during that ribbon feed
$r_1$ is the radius of the spool 94
$r_2$ is the radius of the spool 95
$x_1$ is the calibration factor for motor 92 for the selected constant step rate
$x_2$ is the calibration factor for motor 93 for the step rate of motor 93
N is the scaling factor used during motor calibration
t is the ribbon tension
f(T) is a temperature-related function

$$t = N ((V_1/x_2) - (V_2/x_1))/(V_2r_1 + V_1r_2) \quad (3)$$

78. It will be seen that the temperature-related function f(T) is eliminated in formula 3. This is based on the expressed assertion that

> "temperature variations which will affect the measured values of $V_1$ and $V_2$ will generally affect both motors to the same extent"

79. This assertion gives rise to an issue of insufficiency.

80. It is common ground that formula (3) contains a fairly fundamental error, in that it does not take account of the changing angular velocity of the spools. This will result in an error as the spool diameter changes. Correctly expressed, the formula should be

$$t = N ((V_1/x_2) - (V_2/x_1))/(V_2r_1\omega_1 + V_1r_2\omega_2)$$

where $\omega_1$ and $\omega_2$ are the respective angular velocities of the spools.

81. There is an issue as to whether the skilled person would observe and correct this error, and whether it matters if he or she does not. It is common ground that if the error goes unnoticed, tension control will be compromised to some extent.

82. The specification explains that tension can be corrected by making a small step adjustment to either or both motors. The control algorithms (an example given is a PID algorithm) are said to calculate an amount of ribbon to be added or subtracted from the path between the spools. It does so when there is an error between the measured tension and a nominal demand tension. The process is described at page 22 line 24-23 line 8 in the following way:

> "If the derived value of t is too high (above a predetermined limit), then a small step adjustment can be made to either or both of the motors to add a short section of ribbon to the length of ribbon between the spools. If the derived value of t is too low (below a different predetermined limit), then a short section of ribbon can be removed from the length of ribbon between the spools. The control algorithms used to determine the correction amounts of ribbon added to or removed from the length of ribbon between the spools may be of conventional form, for example the algorithms known as proportional integral derivative control algorithms (PlD control). The algorithms make it possible to compare the measured tension t with predetermined upper and lower limits (the so-called deadband) and, if the measured tension is outside these limits, the difference between the measured tension t and a "nominal demand" tension which is set at a level between the upper and lower limits may be calculated, the result of that calculation being regarded as an error "signal". This error "signal" is then mathematically processed through the PID algorithms, which include a proportional gain constant, as well as integral and derivative factors. The mathematical processing results in a

> "correction" amount of ribbon that needs to be added to or removed from the ribbon path between the spools during the next ribbon feed. This addition or removal of ribbon maintains ribbon tension within acceptable limits."

83. A circuit for calculating the ratio of the diameters of the spools is then described by reference to Figure 19 (page 24 and following). As previously trailed, the take up spool pulls the tape off a de-energised supply spool, and the ratio of the steps taken by the two motors is calculated. This, again, is therefore a calibration process even though the specification later incorrectly states that it is appropriate during ribbon usage: see page 26 line 15.

84. The specification then includes a description of how ribbon tension is monitored using current supplied to the motor drives. This is done by sampling the voltage over resistors 83 and 85 in Figure 18 and preferably when the ribbon is advancing at constant speed. There is some explanation of the need to average the samples over a period of time, sampling frequency, averaging and filtering. There is a major dispute between the experts as to the adequacy of this explanation.

85. There is a further description (by reference to Figure 20) of an approach to monitoring the change in spool diameters using the area of the spools, working on the assumption that the combined area of the two spools will remain constant. There are some acknowledged errors in this description and the associated formulae on which nothing turns.

86. Finally I should note that the specification describes an alternative approach to deriving an approximation of ribbon tension is to use the difference in currents drawn by the two motors, as opposed to a ratio as in equation (3).

## The 375 Patent

87. The specification of 375 repeats most of the specification of 602. Much of the material in paragraphs [0022] to [0047] of 375 is however not in 602.

88. At [0040], the specification explains that printheads used in thermal transfer printing must be accurately positioned relative to a platen (which supports a substrate to be printed) if good quality print is to be produced and that an angular displacement of only a few degrees can radically affect print quality. It goes on to say that the traditional approach to dealing with the problem is to position a printhead on an appropriate support assembly in a nominally corrected position, run a test-print to check the quality, and then mechanically adjust the position of the printhead so as to optimise print quality. It is explained that this requires the installer to make very small mechanical adjustments using, for example, spacers, in a time-consuming fashion

89. The solution to the identified problem is to mount the printhead on a printhead support assembly which is displaceable relative to the housing in a direction parallel to the print ribbon path by action of a drive mechanism.

90. The method of operation and benefit of the disclosed apparatus is explained as being that an installer could initially position the printhead so that it would assume a nominal position which would be expected to produce good quality print. A test print

run would then be used to assess print quality. The printhead support is then displaced using the drive mechanism and a further print test is run. Adjustments in the position of the printhead are then made by the installer until the print quality is optimised. By using the drive mechanism to displace the printhead horizontally relative to the print roller, there is no need to make mechanical adjustments using, for example, spacers.

91. Figure 21 provides a more detailed diagram of the arrangement:

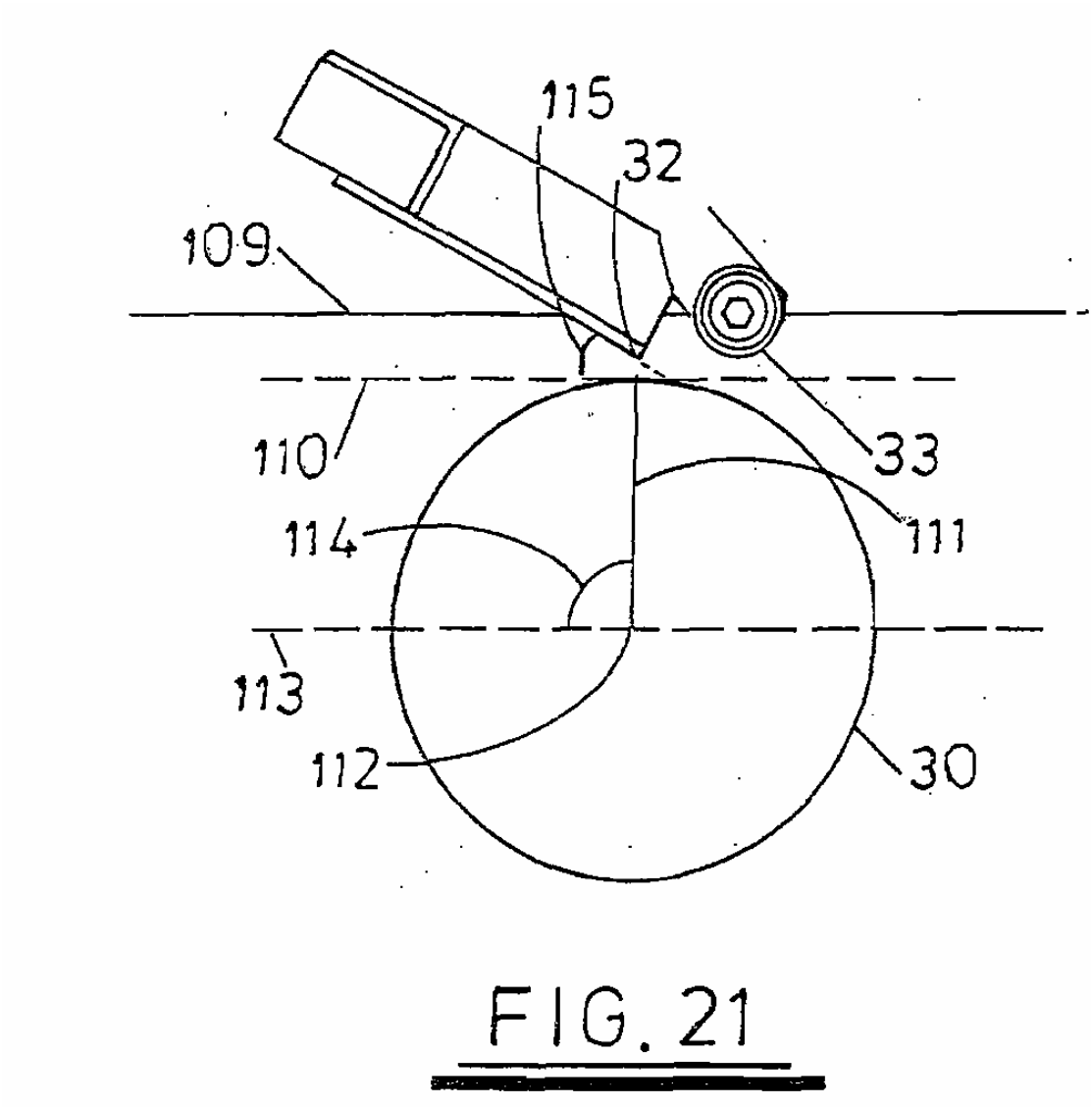



FIG. 21

92. The important angle is 115, between the printhead and the tangent to the print roller at the point of closest approach to the printhead edge (32). As the relative positions of the printhead and the roller move horizontally, the angle 114 at the centre of the roller between the horizontal and the print head will vary, and that there will be a corresponding change in the angle 115.

## The claims

93. 602 has apparatus and method claims, but Zipher does not assert that any method claim can survive if its corresponding apparatus claim falls. There are three independent apparatus claims 1-3 in 602, all of which Zipher contends are independently valid, along with claim 6 which is dependent thereon. Zipher reserves the right to contend that claim 4 is independently valid if claim 3 is invalid for added matter.

94. So far as 375 is concerned, claim 1 is the same as claim 1 of 602 as amended. Claim 3 is said to be independently valid but is acknowledged not to be infringed (power monitoring). Its validity is in issue. Only claim 33 of the remaining claims was said to be independently valid.

95. It is agreed that 582 and 345 do not need to be considered separately as their claims and disclosure are reproduced in 602 and 375.

96. I set out below the claims of 602 which are really in issue, with added lettering to aid reference. It is convenient to notice that features (a) to (d) are the same for each of claims 1-3:

| | **Claim 1.** |
|---|---|
| (a) | A tape drive comprising two stepper motors, |
| (b) | two tape spool supports on which spools of tape may be mounted, each spool being drivable by a respective one of said stepper motors, |
| (c) | and a controller for controlling the energisation of the motors such that the tape may be transported in at least one direction between spools mounted on the spool supports, |
| (d) | wherein the controller is operative to energise both motors to drive the spools of tape in the direction of tape transport |
| (e) | to monitor tension in a tape being transported between spools and to control the motors to maintain the monitored tension between predetermined limits. |
| | **Claim 2.** |
| (a) | A tape drive comprising two stepper motors, |
| (b) | two tape spool supports on which spools of tape may be mounted, each spool being drivable by a respective one of said stepper motors, |
| (c) | and a controller for controlling the energisation of the motors such that the tape may be transported in at least one direction between spools mounted on the spool supports, |
| (d) | wherein the controller is operative to energise both motors to drive the spools of tape in the direction of tape transport |
| (e) | and the controller is configured to implement a control algorithm to calculate a length of tape to be added or subtracted from a tape extending between the spools |

| | |
|---|---|
| | in order to maintain tension in the tape between predetermined limits and to control the motors to add or subtract the calculated length of tape to or from the tape extending between the spools. |
| | **Claim 3.** |
| (a) | A tape drive comprising two stepper motors, |
| (b) | two tape spool supports on which spools of tape may be mounted, each spool being drivable by a respective one of said stepper motors, |
| (c) | and a controller for controlling the energisation of the motors such that the tape may be transported in at least one direction between spools mounted on the spool supports, |
| (d) | wherein the controller is operative to energise both motors to drive the spools of tape in the direction of tape transport |
| (e) | And tension in the tape being transported is determined by control of the stepper motors |
| | **Claim 4** |
| (a) | A tape drive according to claim 3 |
| (b) | wherein the controller is operative to monitor tension in a tape being transported between spools mounted on the spool supports |
| (c) | and to control the motors to maintain the monitored tension between predetermined limits |
| | **Claim 6.** |
| | (A tape drive according to any preceding claim): incorporated in a thermal transfer printer. |

97. The relevant claims of 375 are the following

| | |
|---|---|
| | **Claim 3.** |
| | A tape drive according to claim 1 or 2 (n.b. claim 1 of '375 is the same as claim 1 of '602 as set out above and claim 2 adds the requirement that the controller be arranged to control the motors to transport tape in both directions), wherein |
| (a) | means are provided to monitor the power supplied to at least one of the motors (14, 15) and to calculate an estimate of tape tension from the monitored power. |
| | **Claim 33.** |
| | A printing apparatus incorporating a tape drive according to any one of claims 1 to 29, the printing apparatus comprising |
| (a) | A housing (1), |
| (b) | a printhead (4) mounted on a printhead support assembly which is displaceable relative to the housing in a direction parallel to a print ribbon path along which a |

| | |
|---|---|
| | ribbon (6) is driven by the tape drive, |
| (c) | a first drive mechanism for displacing the printhead support relative to the housing (1), |
| (d) | a roller (30) which in use supports a substrate (13) to be printed on the side of the ribbon path remote from the print head (4), |
| (e) | a second drive mechanism for displacing the printhead (4) relative to the printhead support assembly to a printing position in which a portion of the printhead bears against the roller (30) or any substrate or ribbon interposed between the printhead and roller, and |
| (f) | a controller for adjusting the first drive mechanism to adjust the angular position of the printhead (4) relative to the rotation axis of the roller (30). |

## The skilled addressee

98. The person skilled in the art is the legal construct which the law uses to ascertain the meaning of the language used in the patent as well as to test allegations of novelty, obviousness and insufficiency. He or she is a person with practical knowledge and experience of the field in which the invention is to be applied: *Catnic Components Ltd v Hill & Smith Ltd* [1982] RPC 183 at 242-243. In a case where the patent calls for a range of skills, the addressee is a team of people who between them have the requisite skills: *Minnesota Mining & Manufacturing Co v ATI Atlas Ltd* [2001] FSR 31 at [30].

99. Claims 1-3 of 602 and claims 1-29 of 375 are to tape drives generally. They are not restricted to thermal transfer printers, or indeed restricted to printers at all. It is only more subsidiary claims (claim 6 of 602 and claim 30 of 375) that are limited to thermal transfer printers.

100. It follows that, when considering the broader claims, the patents are addressed to people with experience of tape drives in fields other than thermal transfer printing.

101. Markem submitted that the addressee was a person with a degree or equivalent in electrical or electronic engineering. They submitted that there was no need for a specialist mechanical engineer given that courses in electrical and electronic engineering include modules in mechanical engineering. Further, the engineer would have access to someone able to write software. Markem drew a contrast with claim 33 of 375, which they submitted *did* require a mechanical engineer with experience of thermal transfer printers.

102. Zipher contends that the addressee was a team comprising a mechanical engineer and an electrical engineer.

103. I think that there is no doubt that the skilled team here must include a mechanical engineer with experience of designing and building tape drives as well as an electrical or electronic engineer to realise the necessary control systems together with a software engineer. This is what the teams at Markem (for the SmartDate 2) and at

Zipher (for the Zodiac) consisted of. It is what the patents in suit require in order to put the invention into effect.

## Construction

104. The correct approach to the construction of the claims of a patent specification is now well settled. The task for the court is to determine what the person skilled in the art would have understood the patentee to have been using the language of the claim to mean: see *Kirin Amgen v TKT* [2005] RPC 9 [30]-[35]. In that case the list of principles to be found in the judgment of Jacob LJ in *Technip France SA's Patent* [2004] RPC 46 was approved subject to minor modifications. Pumfrey J (as he was then) listed those modified principles in *Halliburton v Smith* [2006] RPC 2; [2005] EWHC 1623 at [68] to [69], and added some observations of his own. I apply those principles here.

*Construction: "controller is operative ... to monitor tension in a tape being transported"*

105. There are two issues here. Firstly, is the term limited to monitoring actual tension, or will some measure (and if so what sort of measure) of tension do? Secondly, does the monitoring have to happen while the tape is moving?

106. The first dispute is relevant to validity, because it is suggested that prior arrangements in which a dancer arm signals the approach of the point at which there will be too much or too little tape in the loop will "monitor tension".

107. It is clear from the specification that the quantity handled by the controller is not a *measurement* of absolute tension. However, what is attempted to be derived from the formulae is described as a "*measure of tension*" (see page $22_{20}$).

108. Markem submitted that the phrase was wide enough to cover any system which kept an eye on tension with a view to doing something about it if it went wrong. Zipher submitted that the phrase requires the monitoring of a variable which is in a known relationship to tension or representative of tension at a particular time. That follows, Zipher submitted, because the purpose of monitoring is to establish the movement of the tension from a norm at any time with a view to maintaining the monitored tension within predetermined limits.

109. I believe Zipher's submission is closer to being correct than Markem's, although I do not accept Zipher's submission in its entirety. Whilst the claim is not limited to monitoring absolute tension, it is I believe concerned with monitoring something which is indicative of tension. It is not, in my judgment, wide enough to encompass keeping an eye on something which simply has some bearing on what might happen to tension in the future if nothing is done about it. I agree with Mr Thorley QC when he says that however far the claim extends in terms of the relationship between the monitored value and the actual tension, it does not extend as far as monitoring something which is not tension at all. I think this is clear from the context of the words in claim 1, because claim 1 goes on to require that the *monitored tension* is maintained. This does not really work if the notion of tension monitoring is as loose a concept as that for which Markem contend. If what is monitored is not indicative of the tension in the tape, tension is not being monitored in the context of this

specification. In essence the claim is concerned with extracting a variable (it may be only a zero or a 1) which is in a known relationship to tension.

110. However I do not read the purpose of tension monitoring as confined to comparing the monitored value to a norm, although that is clearly one way in which the signal from the monitoring could be used. In my judgment the purpose of tension monitoring in this claim is broader: it is to obtain a monitored signal which can be used in some way to control the motors to maintain the tension.

111. The second area of dispute surrounds Markem's contention that this phrase means that the controller must be operative to monitor tension whilst the tape is moving. The issue goes to infringement because it is common ground that Markem's accused machines only measure tension when the tape is stationary.

112. Markem draw attention to the difference in wording with feature 1(c) which only refers to a tape which "may be transported". Markem rely on the fact that the description of the specific embodiment clearly contemplates measurement of tension whilst the tape is moving, and would not work while the tape is stationary, because it relies on the difference in work being performed by the two motors.

113. Zipher contends that the phrase merely identifies the tape or section of tape which is moved, and does not specify that the tape is moving at the moment that the tension is monitored. Zipher also draw attention to claim 3 which requires the "tension in the tape being transported" to be "determined". Given that tension needs to be determined both when the tape is moving and when it is stationary, Zipher submit that the phrase "being transported" cannot connote only a tape which is in motion.

114. The specification at page $25_{6\text{-}8}$ says that "preferably the current is detected only during periods in which the ribbon had been advanced at constant speed". This, in context, can only indicate a preference over detecting the current during periods of acceleration or deceleration (rather than a preference over not moving at all). As the embodiment under discussion will not function if the motors are not moving, it would not make sense to say that measurement whilst moving was merely "preferable". In the end, therefore, this passage does not help to resolve the issue of construction except to the extent that it emphasises the fact that in the specific embodiment the tape has to move.

115. In my judgment Markem's approach to this term is too literal. The invention is concerned with maintaining the tension in the tape generally, not just when it is in motion. So one would expect the same level of generality when it comes to monitoring the tape tension. The skilled person would expect the phrase "being transported" to cover the case where the tape is moving, but not to be limited to it. It would be wrong to construe the phrase in a more limited and literal way just because the specific embodiment relies on the movement of the motors for monitoring tension. The claim does not require the tape to be moving at the moment the tension in the tape is monitored.

*Construction: "to control the motors to maintain the monitored tension between predetermined limits"*

116. This feature arises in feature (e) of claim 1. There are similar but not identical features in claims 2 and 3 which I believe it is important to deal with comparatively. Claim 2 requires the motors to be controlled to add or subtract the calculated length of tape (to maintain tension between predetermined limits). Claim 3 requires the tension to be "determined" by control of the motors.

117. There are, again, two separate points which arise in relation to these features.

118. Markem contend, firstly, that these features require the controller to be operative to control both motors, not just one of them. They draw a contrast with the reference to "a respective one of said stepper motors" earlier in each claim. This issue goes to infringement, as Markem's machines deal out the adjustment with only one motor.

119. Zipher contends that so to construe the claims would be in conflict with page 22 lines 21-23 of the specification:

> *"then a small step adjustment can be made to <u>either or both</u> of the motors ….."*

120. Markem respond by pointing out that the specification then goes on to emphasise the advantage of sharing the adjustment between the two motors. Thus, they contend, the skilled reader would see when he comes to the claim that the patentee is deliberately using language to limit his invention to the case where the adjustment is shared between the motors.

121. I reject Markem's contentions on this issue. In my judgment, the language of the claims is apt to cover the case where all the adjustment is given to one of the motors as well as the case where it is shared. There is no requirement that the adjustment should always be shared. This conclusion applies to each of claims 1 to 3.

122. The second point which arises on this feature is as follows. Markem contended in their opening skeleton at paragraph 142 that these features require the tension to be maintained *solely* by the use of the stepper motors. They relied on the passage in the description which I have already referred to:

> "Tension in the tape being transported is determined by control of the drive motors **and therefore** is not dependent on any components which have to contact the tape between the take-up and supply spools" .

123. Markem developed this point in their final submissions as follows. In claim 3 the tension in the tape is "determined by" control of the motors. This, they submitted, meant that it was the motors (and nothing else) which determined the tension in the sense of both monitoring it and setting it. Reading claim 1 purposively and in context, the monitoring and maintaining requirements of claim 1 were to be read in the same sense as claim 3, so that it is the use of the motors and the motors alone which monitors the tension and maintains it within the limits.

124. Zipher contended in its oral opening that the claim was apt to cover the situation where the motors are *a* means of maintaining tension, even if they are not the *sole* means: see Day 1 pages 57-58. By the time of its closing written submissions at

paragraph 164 Zipher stated that it accepted the point made in paragraph 142 of Markem's opening skeleton, that the control of the motors alone must maintain the tension. Nevertheless it submits that this phrase does not exclude the presence of equipment to monitor tension between the spools.

125. The parties are divided as to whether the description at page 6, which speaks of the avoidance of intermediate components which contact the tape between the spools, is describing an advantage obtainable with the invention or one inevitably obtained by following the claims. For my part I do not think it is sufficiently clear for the skilled reader to take it as read that avoidance of intermediate components is an essential feature of all the independent claims. So the reader is reliant on the language of the claim to understand what is meant in each case.

126. I start with claim 3, which requires that the tension is "determined by control of the stepper motors". The word "determined" hints strongly at the negative proposition that the tension is not controlled by anything else: it is set by the motors. The passage on page 6 regards it as a consequence of the motor control *determining* tension that there are no intervening tension-controlling components ("and therefore").

127. By contrast I do not think that the requirement that control of the motors *determines* the tension would convey to the skilled person the additional idea that it is the use of the motors which monitors tension. It is true, as Mr Arnold submits, that the striking feature of the specific embodiment is that, in addition to driving the motors to set the tension in push-pull mode, the current supplied to the motors is used to monitor the tension. Whilst both concepts are essential, their functions are explained separately in the specification. In my judgment, the skilled reader would not understand the monitoring function to be encompassed by the phrase "tension … is determined by control of the stepper motors". I think the claim is entirely non-specific as to how (or indeed if) tension is monitored.

128. It follows, in my judgment, that claim 3 only excludes the presence of additional tension-controlling devices as opposed to monitoring devices. The motors are not required to monitor tension, only to control it. Tension monitoring is introduced into claim 3 by claim 4, without any limitation as to how or where it is done.

129. It is not easy to reach the same conclusion in relation to claim 1. The requirement that the motors are controlled *to maintain the monitored tension between predetermined limits* is different from the requirement that they are controlled *to determine* the tension in the tape. It does not seem to me that this phrase excludes the presence of other things which may be helping to maintain the tension in the tape. Of course if the motors cannot influence the tension in the tape, because tension is maintained wholly by other means, then the requirement is not satisfied.

130. Claim 2 is different again. The control required of the motors is only to add or subtract lengths of tape (the lengths having been calculated to be such as to maintain tension between predetermined limits). I am equally unable to read any negative restriction so as to exclude other tension controlling devices into this claim.

*Construction: Predetermined limits*

131. Feature (e) of claim 1 again requires that the controller is operative "to control the motors to maintain the monitored tension between predetermined limits". The phrase "predetermined limits" also occurs in feature (e) of claim 2.

132. Markem contend that, if the phrase is not to give rise to fatal ambiguity, it must be construed to mean "within acceptable limits: i.e. normal operating limits for the application concerned", and Zipher does not really disagree. I see no reason not to adopt this construction.

*Construction: control algorithm to calculate a length of tape*

133. This feature occurs in claim 2 of 602, at feature (e). Markem contend that the term "control algorithm" gives rise to issues of insufficiency, as it is unclear. I will deal with that issue under that heading. There is a further issue as to what is meant by "calculate a length of tape".

134. Markem say that the feature can be construed literally to mean that the system performs a calculation of the length of tape; or alternatively it can be construed so as to mean that the system ensures that sufficient tape is added or removed to adjust the tension. They prefer the literal construction, on which basis they say they do not infringe.

135. Zipher says that the algorithm must be such as to calculate a measure or quantity which represents the amount of tape which needs to be added or subtracted. That measure is then converted into motor steps which are to be applied to either or both motors.

136. I favour Zipher's construction. The expression clearly covers a system where there is a calculation in units of length of the amount of tape to be added or subtracted; but it is not limited to that. The claim will cover any control system which calculates a tension-controlling amount of tape.

*Construction - "Controller"*

137. This phrase arises in feature (f) of claim 33 of 375.

138. Markem contend that the expression *only* encompasses a basic form of control which allows the installation operator manually to displace the printhead on the carriage to carry out the adjustment process.

139. Zipher contends that it is a means which drives the printhead laterally, operated by the operator, and which controls the way in which the carriage moves such as to meet the needs of moving the printhead to make changes in the angle 115.

140. The real issue is whether the claim is limited to manual operation. I cannot so read it. I cannot see any reason why the skilled reader would treat other ways of controlling the position of the printhead as excluded by the word "controller".

*Construction "angular position"*

141. The controller has to adjust the angular position of the printhead relative to the rotation axis of the roller. Whilst the language of the claim is not really apt to say

this, it is clear that the angle in question would be understood from the specification as a whole to be the angle 115 in Figure 21.

## Zipher's application to amend 602

142. There is no dispute that the claims in 602 sought by Zipher by way of amendment and relied on for the purposes of infringement are broader than claim 5 of the application in the form it was in at the trial of the entitlement proceedings. Logically, the first question to consider is whether the present application to amend is in breach of any undertaking binding on Zipher. If so then it would follow that the amendments cannot be allowed. If the amendments are not allowed, there is no claim alleged to be infringed in the 602 patent which is not conceded to be invalid.

## The Undertaking Point

*Facts*

143. Claim 5 of the application as filed and published included the requirement that

> "means are provided to monitor the power supplied to at least one of the motors and to calculate an estimate of tape tension from the monitored power."

144. Claims 1 to 3 were very much wider. Claims 1-3 were similar to, but wider than, features (a) to (d) of the proposed amended claims set forth above. Claim 4 was effectively the monitoring and controlling feature of claim 1(e) in the amended claim.

145. Zipher's case before HHJ Fysh QC and the Court of Appeal was that Mr McNestry, its own employee, had invented the subject matter of claim 5 after he had left Markem. During the course of filing and prosecution of the claims, its patent attorneys had broadened out Mr McNestry's idea, and in the course of doing so had accidentally laid claim to subject matter which had been discussed at Markem.

146. In the course of closing speeches at the trial, HHJ Fysh expressed concern at the possibility that, if Zipher retained claims 1-4, Zipher would assert those claims against Markem. This led to the following set of exchanges between the judge and counsel for Zipher, Mr Adrian Speck:

> THE JUDGE: Yes, sorry, claim 1 -- then broadening up to claim 1 they are going to cover something he says that was invented at Markems.
>
> MR. SPECK: That is the problem and that is why we have made it quite [clear?] again and again that if my Lord thinks our claim is too broad we would be prepared to go back to the narrow ones.
>
> THE JUDGE: He will probably say that if I leave you with broad claim you will try and close him down on that bit.
>
> MR. SPECK: No, he will not.
>
> MR. SPECK: My Lord, I have made our position plain on that. If my Lord thinks we should go back to four or five then we will go back.

[THE JUDGE] There may be other procedural eventualities. However, we are leadenly clubbing it out.

MR. SPECK: No, we are not. I have made it absolutely plain. Our inventor thinks claim 5 is the crucial, the clever bit. We would be more than happy to drop down to claim 5 if my Lord thinks that the claim is too wide. The difficulty is that validity and so forth is not directly a matter for these proceedings but we can see the sense in my Lord taking a view on that and saying we are entitled to claim 5 in the subsidiary claims and we keep a patent as it stands on that. We have always made our position clear.

THE JUDGE: I can see they will turn around and shut you down. Then if I let you get on with the broad claims you will have a go at them.

MR. SPECK: No.

THE JUDGE: There is an undertaking coming.

MR. SPECK: I have already made that plain. What would we have a go at them with on the broad claims? There is no evidence they want to do Adkin, there is absolutely nothing that we can have a go at them on. What does my Lord have in mind because there is nothing?

THE JUDGE: In the way of a commercial product at the moment.

MR. SPECK: No. This is completely contrived. There is no suggestion that they want to do whatever it is they say is shown in Adkin. My Lord must appreciate that.

THE JUDGE: All right.

MR. SPECK: I am not standing here wanting to get away with claim 1 so that I can have a go at them. I am defending an application by Markem whereby they claim to be entitled to my patent and that claim. I would hardly be saying to my Lord that we would be perfectly happy with claim 5 if that was my aim. My Lord, appreciates ---- There is one thing that those behind me are very anxious that my Lord appreciates, and that is this point about the width of the ribbon drive claims. Again, I repeat, if my Lord thinks they are too wide and I can quite see how my Lord would say, that we would be perfectly happy to give an undertaking to my Lord, as I indicated in opening -- this is only an application so it is easily done on that one -- we could give an undertaking not to prosecute the wider claims. We can come back to either claim 4 or 5.

THE JUDGE: Why do you not do it any way, out of an abundance of caution?

MR. SPECK: I will just take some instructions.

147. Mr Speck took instructions overnight. On day 8 a sheet of paper was handed in which showed claim 5 incorporated into claims 1 and 4. Mr Speck returned to the topic in this way:

> MR. SPECK: My Lord will recall me asking about claims 1-4, the ribbon drive, yesterday.
>
> THE JUDGE: You have had an opportunity ----
>
> MR. SPECK: I have. I am in a position to accept my Lord's invitation out of an abundance of caution.
>
> THE JUDGE: It was a suggestion.
>
> MR. SPECK: My Lord's suggestion, that out of an abundance of caution we would undertake to my Lord not to prosecute a claim over and above claim 5 (which is actually claim 1) plus claim 4, plus claim 5; all the integers are put together. My learned friend complained that he wanted it written down on a piece of paper. We have done so, although it is straightforward ----
>
> …MR. SPECK: We have set it out on this piece of paper in the three sections, so one can see where the wording comes from. The top is claim 1, the middle bit is the wording from claim 5, obviously one takes out the words, "a tape drive according to claims, 1, 2 or 3" and we just have the "wherein". Likewise, on claim 5 "wherein" is the bottom part of this piece of paper. We will, out of an abundance of caution, give my Lord an undertaking. We are concerned on our side to repeat that it is rather concerning yesterday that my Lord thought these wider claims could be asserted against a commercial embodiment of Markem's. There is absolutely no evidence that they have -- for instance, that they are doing the Adkin machine, so ----
>
> 14 THE JUDGE: Yes.
>
> MR. SPECK: Perhaps, or that they even want to do that. That is not as we have perceived the evidence at the moment; contrary for our position ----
>
> THE JUDGE: Mr. Speck, that is fine. It is just that, being a judge, I see in every case hidden agendas, or rather I do not see them but I feel hidden agendas.
>
> MR. SPECK: It is something that my Lord said yesterday which made it look as though you thought that both of us were trying to assert these claims against each other after judgment.
>
> THE JUDGE: It is certainly true one way, or the possibility ---
>
> MR. SPECK: It certainly is, but we say not the other.

148. Further clarification of the nature of the undertaking was offered as follows:

> MR. SPECK: My friend has asked me to clarify the nature of the offer and there was another point which occurred to me when we were looking at the claims. Of course our offer to narrow the apparatus claim will be mirrored in the method claim which my Lord has just seen.
>
> THE JUDGE: Yes, the one tagged at the end.
>
> MR. SPECK: Yes, so that covers both. I just wanted to make that plain. The other point is that this is an unconditional offer made to you, my Lord, to the court; it is not subject to my friend accepting it. **That is what we will do to the claims should we succeed and we maintain our patent in our name. It is obviously subject to my friend's argument that it is not open to us to throw the swag in the river, as he puts it. Apart from that we will do it if we successfully maintain the patent in our name. It is not an offer to my friend to accept or reject in that way, it is an offer that we make to the court.** (emphasis supplied)
>
> THE JUDGE: If you are successful.
>
> MR. SPECK: Absolutely. My friend has asked me to clarify that. If the patent remains in our name we will narrow claim 1 to introduce ----
>
> THE JUDGE: I [had] rather understood that. I think we have to go on. I do not think there is any possibility of ----
>
> MR. SPECK: He is not going to accept it.
>
> THE JUDGE: No. Then do not let us waste time on it. I have your undertaking.

149. In his judgment [2004] RPC 10 at [134] HHJ Fysh QC recorded Zipher's position as follows:

> "In relation to claims 1-4, I am of the view that their subject matter had been devised by one or more of the named inventors at MTL. I say this for essentially the same reasons as I have given for '326. It was in respect of this application that during closing speeches, Mr Speck unconditionally offered to limit claim 1. His proposal was to combine existing claims 1, 4 and 5 ('the clever bit') so as to create a new claim 1 leaving claims 2 and 3 still subsidiary to it. The development did not attract Mr Watson but for reasons which will become apparent, it was, I believe, a realistic response to the evidence. "

150. It will be noted that HHJ Fysh QC said Mr Speck "unconditionally offered to limit claim 1". I believe that accurately records what the transcript shows. It is implicit that Zipher would only be able to limit claim 1 if they retained claims 1-4 in their name.

151. HHJ Fysh QC gave effect to his judgment that Claims 1-4 of the 602 application as it then stood belonged to Markem by ordering that the application be assigned to Markem with certain claims deleted and that Zipher file a divisional application directed to the deleted claims.

152. In the light of the learned Judge's finding that Markem owned claims 1-4, the undertaking was academic and it was accordingly not recorded in the Judge's order.

153. Zipher's skeleton argument on the appeal from HHJ Fysh's judgment included the following:

> "179. The learned Judge should have rejected Markem's claim to entitlement to those claims and accepted Zipher's offer to drop them from the application by amending down to claim 5.
>
> 214. Zipher's appeal should be allowed. Claims 1 to 4 of Ribbon Drive (602) are not derived from anything done at Markem. Zipher are willing to delete them and confine its claims to claim 5…."

154. During the hearing of the appeal Zipher stated through its counsel that it did not resile from its position below. Mr Thorley QC (who by then represented Zipher) said:

> "The question that arises of course is if you divine an inventive concept and then you find that certain claims have gone way beyond it, that may be a circumstance when you, the comptroller, say those claims must go. That is what I am coming down to. We made an offer down below that claims 1 to 4 should be deleted. That was our submission, and that is not something I resile from."

In this passage, the reference is to an *offer*, but later on Mr Thorley QC described it as an undertaking that was *given*:

> "The fact that we now accept, having gone through Datamax, that there may be no validity in claims 1 to 3, and we have accepted claim 4 can go as well because claim 5 is really what circumscribes what we want is neither here nor there, that undertaking was given below and it remains."

155. The Court of Appeal held that Markem were not entitled to any part of 602. One ground on which they so held was that a claim to entitlement must be based on breach of some private law right, a proposition on which the House of Lords subsequently took a different view: see *Yeda Research v Rhone Poulenc Rorer* [2007] UKHL 43. Markem contend that, whatever the legal basis, the eventuality upon which the undertaking offered to HHJ Fysh QC was to take effect had now arisen.

156. Following the judgment in the Court of Appeal there was a further hearing to decide the form of order. Markem sought the inclusion in the order of an undertaking somewhat wider than that which had been proffered to HHJ Fysh QC. The Court of Appeal declined to require Zipher to give this undertaking or require any undertaking to be recorded in its order. It did require that the order should record the concessions made by Mr Thorley about the validity of claims 1-3, and claim 4 on the basis of a particular construction of that claim. That is what the Court of Appeal's order ultimately recorded

157. In the course of the argument before the Court of Appeal, Jacob LJ said to Mr Watson QC who then appeared for Markem:

> "actually what we have held is that it [i.e. 602] is his [i.e. Zipher's] patent application, it is no business of yours and that is the end of it. The concession by Mr Thorley is really a concession by Mr Thorley and no more."

158. There had of course been more than a concession about validity. There had been an undertaking to the court below. The distinction is crucial here, where Zipher seeks to create claims wider than claim 5 but not as wide as the admittedly invalid ones.

*The rival submissions*

159. Markem summarise the position in this way:

> "…Zipher voluntarily, upon competent professional advice, after taking time for reflection and with a view to securing a tactical advantage in the entitlement proceedings, gave a binding undertaking to the Court to amend '602A down to Claim 5 from which it has never sought to be released and never has been released."

160. Zipher summarise their position in this way:

> ".. [n]o undertaking was ever given and accepted by the Court. There was just a proposal which was not accepted by HHJ Fysh QC as the appropriate way to go. Before the Court of Appeal the whole foundation for any such undertaking fell away by the decision on the main issue of the correct approach to entitlement and Zipher's complete victory on that issue. That is why no undertaking appears in any Order."

*Discussion*

161. There is obviously a difference between giving an undertaking and offering one. Every party who applies for an interim injunction impliedly *offers* a cross-undertaking in damages. He does not *give* it if the court declines to grant the injunction. It is then no longer material to the court's decision. If, on the other hand, an order for an injunction is to be made, the court accepts the offer. If the successful party were to make it plain that he refuses or is unable to give the cross undertaking, the court may – probably will - refuse to grant the injunction.

162. In other circumstances an undertaking is both offered and given at the same time. If counsel says to the court "You have my undertaking to do X within 7 days" that undertaking takes effect immediately. It means "This is what I will do". It bites unless it is discharged. It does not have to be recorded in an order, although it is preferable that it should. If a party does not comply with an undertaking it is the undertaking which is enforced, not the order: see *Hussain v Hussain* [1986] 1 Fam 134. Every practitioner knows that the giving of an undertaking to the court is a most serious step. It is only ever done on clear instructions.

163. I think the distinction which I have drawn is critical to deciding the present issue. Was Zipher making a proposal as to what it would be prepared to offer if the court decided in its favour, and which they could withdraw at any stage? Or was Zipher saying "This is what Zipher will do to the claims of the patent if it obtains them"?

164. I think it is clear that Zipher was doing the latter rather than the former. I explain my reasons below.

165. Some of the discussion on Day 7 of the trial made reference to a possible finding by the Judge that the claims were "too wide". This could have been the basis for a conditional undertaking which would have depended on the court coming to the conclusion that the claims were too wide. But on Day 8, when the matter was revisited, the undertaking was proffered without any such condition. Indeed it was said to be unconditional.

166. Thus when Mr Speck said "*This is what we will do should we succeed and maintain our patent in our name"* he was not qualifying it any further. Importantly he was not saying that this is what Zipher would do *if the court should consider it material* or *if the court wishes to accept it* or *should it be the High Court which awards us the patent but not if the Court of Appeal does the same thing.*

167. It is absolutely clear that what was being said was that Zipher would amend down to a claim no wider than claim 5.

168. Zipher attaches very great significance to the fact that the undertaking is not recorded in the court's order. I do not think it is at all surprising that it was not. The undertaking was only to bite if the court awarded claims 1-4 to Zipher, which it did not. It would have made little sense to record the undertaking in an order which awarded claims 1-4 to Markem. The way in which that was to be carried out was as I have described above. The absence from the order is in my judgment no support for the idea that the undertaking was not given. The place to look to see whether the undertaking was given is the transcript which records it being given, not the order which does not need to. Even if the court had awarded claims 1-4 to Zipher, the enforceability of the undertaking would not have depended on whether the undertaking was recorded in the order.

169. HHJ Fysh QC correctly recorded that "Mr Speck unconditionally offered to limit claim 1." His subsequent reference to it as a proposal is, I think, in connection with the fact that Markem did not accept it as a compromise of their claim to claims 1-4. But Mr Speck had made it clear that the undertaking was in no sense conditional on acceptance by Markem.

170. I think that what happened after the trial is irrelevant unless it amounted to discharging Zipher from its undertaking to HHJ Fysh QC. In my judgment, nothing that happened thereafter had that effect. Indeed, Mr Thorley based his oral argument at this trial on the proposition that no undertaking had been given to and accepted by HHJ Fysh QC (for which his principal support was its absence from the order) rather than on the proposition that an undertaking had been given and discharged.

171. Zipher's arguments on the substantive appeal to the Court of Appeal made it clear that it was not seeking to disturb the position from that which had pertained below: Indeed it sought to reinforce the impression that claim 5 was as far as they would and could go: "*That undertaking was given below and remains"*. Although Zipher resisted the incorporation of an undertaking into the order of the Court of Appeal, it never applied to be discharged from the one it had already given.

172. I do not think it makes any difference that the Court of Appeal decided the claim to entitlement on a different basis. As I have held, the undertaking was not conditional on the particular basis on which the court awarded the claims to Zipher. It was unconditional.

173. The fact that Markem sought to have an undertaking recorded in the Court of Appeal's order was relied on heavily by Mr Thorley. He asked, forensically, why Markem would seek such an undertaking if it already had the benefit of the undertaking from the court below. There are, I think, two answers. Firstly, it would be preferable for the undertaking, now that it had bitten, to be recorded in an order of the court. Secondly, the wording of the undertaking was slightly wider than that which had already been given to HHJ Fysh. It was not therefore inconsistent for Markem to ask to have an undertaking recorded.

174. In the result I would hold that Zipher is precluded by its unconditional undertaking to this court from making amendments to 602 which have as their result claims which are wider than claim 5 of the application.

175. The result is that the application to amend must fail as all the claims which result from the application are wider than claim 5 in the application as filed. The action for infringement of 602 must fail as well, as all the claims which are alleged to be infringed are wider than claim 5 of the application.

176. Markem ask for an injunction to enforce the undertaking. I will hear counsel in due course on whether such a remedy is necessary.

177. Nevertheless, in case the matter goes further, I must go on to make findings on all the further issues raised by the amendments, and by the action.

## Added Matter

*Law*

178. Section 76(3)(a) of the 1977 Act provides that an amendment is not permissible if it would result in the patent disclosing additional matter. What this involves was summarised by Jacob J (as he was then) in *Richardson Vicks' Patent* [1995] RPC 568 at 576:

> "I think the test of added matter is whether a skilled man would, upon looking at the amended specification, learn anything about the invention which he could not learn from the unamended specification"

179. Kitchin J's summary of the law in the following passage in his judgment in *European Central Bank v Document Security Systems Inc* [2007] EWHC 700 (Pat) was endorsed by the Court of Appeal in *Vector Corp v Glatt Air Techniques Ltd* [2007] EWCA Civ 805, [2008] RPC 10 at [7] and again in *European Central Bank v Document Security Systems Inc* [2008] EWCA Civ 192 at [12]:

> "96. The test for added matter was explained by Aldous J in *Bonzel v Intervention Ltd* [1991] RPC 553 at 574:
>
> 'The decision as to whether there was an extension of disclosure must be made on a comparison of the two documents read through the eyes of a skilled addressee. The task of the Court is threefold:
> (a) To ascertain through the eyes of the skilled addressee what is disclosed, both explicitly and implicitly in the application.
> (b) To do the same in respect of the patent as granted.
> (c) To compare the two disclosures and decide whether any subject matter relevant to the invention has been added whether by deletion or addition.
>
> The comparison is strict in the sense that subject matter will be added unless such matter is clearly and unambiguously disclosed in the application either explicitly or implicitly.'
>
> 97. A number of points emerge from this formulation which have a particular bearing on the present case and merit a little elaboration. First, it requires the court to construe both the original application and specification to determine what they disclose. For this purpose the claims form part of the disclosure (s.130(3) of the Act), though clearly not everything which falls within the scope of the claims is necessarily disclosed.
>
> 98. Second, it is the court which must carry out the exercise and it must do so through the eyes of the skilled addressee. Such a person will approach the documents with the benefit of the common general knowledge.
>
> 99. Third, the two disclosures must be compared to see whether any subject matter relevant to the invention has been added. This comparison is a strict one. Subject matter will be added unless it is clearly and unambiguously disclosed in the application as filed.
>
> 100. Fourth, it is appropriate to consider what has been disclosed both expressly and implicitly. Thus the addition of a reference to that which the skilled person would take for granted does not matter: *DSM NV's Patent* [2001] RPC 25 at [195]-[202]. On the other hand, it is to be emphasised that this is not an obviousness test. A patentee is not permitted to add matter by amendment which would have been obvious to the skilled person from the application.

> 101. Fifth, the issue is whether subject matter relevant to the invention has been added. In case G1/93, *Advanced Semiconductor Products*, the Enlarged Board of Appeal of the EPO stated (at paragraph [9] of its reasons) that the idea underlying Art. 123(2) is that that an applicant should not be allowed to improve his position by adding subject matter not disclosed in the application as filed, which would give him an unwarranted advantage and could be damaging to the legal security of third parties relying on the content of the original application. At paragraph [16] it explained that whether an added feature which limits the scope of protection is contrary to Art 123(2) must be determined from all the circumstances. If it provides a technical contribution to the subject matter of the claimed invention then it would give an unwarranted advantage to the patentee. If, on the other hand, the feature merely excludes protection for part of the subject matter of the claimed invention as covered by the application as filed, the adding of such a feature cannot reasonably be considered to give any unwarranted advantage to the applicant. Nor does it adversely affect the interests of third parties.
>
> 102. Sixth, it is important to avoid hindsight. Care must be taken to consider the disclosure of the application through the eyes of a skilled person who has not seen the amended specification and consequently does not know what he is looking for. This is particularly important where the subject matter is said to be implicitly disclosed in the original specification."

180. A particular way in which matter can be added is known as an "intermediate generalisation". In *Vector v Glatt* at [9] Jacob LJ described as "uncontroversial" the description of intermediate generalisation given by Pumfrey J in *Palmaz's European Patents* [1999] RPC 47 at 71 as follows:

> "If the specification discloses distinct sub-classes of the overall inventive concept, then it should be possible to amend down to one or other of those sub-classes, whether or not they are presented as inventively distinct in the specification before amendment. The difficulty comes when it is sought to take features which are only disclosed in a particular context and which are not disclosed as having any inventive significance and introduce them into the claim deprived of that context. This is a process sometimes called 'intermediate generalisation'."

181. The correct comparison is with the application as filed and not with the specification as granted: *Triumph Actuation Systems LLC v Aeroquip-Vickers Ltd* [2007] EWHC 1367 (Pat).

182. The objection of added matter arises in this case because new claims are being added.

*Added matter: "control algorithm"*

183. The first objection to claim 2 is that it discloses for the first time a generic control algorithm to maintain tension in the tape. It is said that the application as filed only discloses a PID control algorithm. As elaborated in argument, Markem contended

that the only disclosure was of control algorithms which would maintain the value "t" from the formula or the "difference measure" of current between predetermined limits. Accordingly there was nothing which disclosed an algorithm which maintains "tension itself" within predetermined limits as opposed to two indirect measures of tension.

184. It is not correct to say that the disclosure in the application as filed is limited to PID algorithms in the application as filed. The PID control algorithm is stated to be an example of a control algorithm see page $28_{9\text{-}12}$.

185. It is, however, correct to say that the control algorithms disclosed in the 602 as filed are only the specific ones mentioned, namely those which keep the parameter "t" or the difference value within predetermined limits. However, the value "t" in the formula is described in some places as "tension" (see page $27_{24}$) and others as a "measure of tension" (see page $27_{30}$).

186. The skilled person would also understand from the disclosure of the application that the object of maintaining the parameter within predetermined limits in the two cases was to maintain the "tension itself" within predetermined limits. The fact that this is so is stated expressly in relation to the specific embodiment at page $28_{20\text{-}21}$, but it did not need to say so. Accordingly, the generalised idea of a control algorithm which calculates a length of tape to maintain a parameter within predetermined limits and thereby to maintain tension is disclosed by the application as filed.

187. Turning to the proposed amended Claim 2, this describes a control algorithm which calculates a length of tape to maintain tension. I do not think there is anything new which is taught here about the invention which was not taught by the application.

188. Mr Arnold submitted that there was now a disclosure of something which literally calculated the length of tape to add. But, again, I do not think that there was anything new disclosed by claim 2.

189. I reject this ground of added matter.

*Added matter "no monitoring of tape tension"*

190. Markem contend that claim 2 introduces for the first time the control of tape tension without any requirement to monitor tape tension. They submit that this is an intermediate generalisation. They raise the same objection to new claim 3, where the controller determines the tension, but, as I construe it, does not require monitoring.

191. The application as filed at page 6 says the following:

> "Preferably the controller is arranged to control the motors to transport tape in both directions between the spools. The motors may both be stepper motors and the controller may be operative to measure tension in a tape being transported between spools mounted on the spool support and to control the motors to maintain the monitored tension between predetermined limits."

192. This passage, and indeed the rest of the specification make it clear that control of the motors to maintain tension, the monitored tension, is achieved by monitoring something that represents tension – in particular the power supplied to the motors or the difference in currents. Plainly, the application did not restrict itself to any particular means of monitoring tension, as claim 4 in the application (now feature (e) of the amended claim 1) shows. But the overall message is that monitoring is an integral part of tension control.

193. The passage relied on by Zipher to suggest that control of the motors to maintain tension is disclosed independently of monitoring tension is at page 6 lines 9-10 of the application:

> "Tension in the tape being transported is determined by control of the drive motors and therefore is not dependent upon any components which have to contact the tape between the take-up and supply spools."

194. This passage has however to be read in context. It does not begin to suggest that monitoring of tension can be dispensed with.

195. In my judgment both claims 2 and 3 represent impermissible intermediate generalisations. These claims are not allowable. Claim 4 does not suffer from the same defect because it requires the monitoring of tension.

*Added matter: control of tension*

196. Markem contend that the absence of a limitation in this claim to controlling tension between predetermined limits constitutes added matter. I can deal with this briefly in view of my earlier conclusions. Firstly, this is not really the pleaded objection. Secondly, I cannot see in the amended claim any disclosure of not controlling the tension within predetermined limits. Thirdly I think it is a permissible generalisation from what is disclosed.

**Amendment: Discretionary objections**

*Law*

197. For many years prior to the coming into force of the Patents Act 2004, courts and tribunals in this country have exercised a very wide discretion over whether to allow a party to amend the scope of the monopoly granted by a patent following its grant. In *SKF v Evans Medical* [1989] FSR 561, Aldous J (as he was then) described the discretion in the following terms (at p.569):

> "The discretion as to whether or not to allow amendment is a wide one and the cases illustrate some principles which are applicable to the present case. First, the onus to establish that amendment should be allowed is upon the patentee and full disclosure must be made of all relevant matters. If there is a failure to disclose all the relevant matters, amendment will be refused. Secondly, amendment will be allowed provided the amendments are permitted under the Act and no circumstances

> arise which would lead the court to refuse the amendment. Thirdly, it is in the public interest that amendment is sought promptly. Thus, in cases where a patentee delays for an unreasonable period before seeking amendment, it will not be allowed unless the patentee shows reasonable grounds for his delay. Such includes cases where a patentee believed that amendment was not necessary and had reasonable grounds for that belief. Fourthly, a patentee who seeks to obtain an unfair advantage from a patent, which he knows or should have known should be amended, will not be allowed to amend. Such a case is where a patentee threatens an infringer with his unamended patent after he knows or should have known of the need to amend. Fifthly, the court is concerned with the conduct of the patentee and not with the merit of the invention."

198. So the discretion travelled far and wide: it involved inquiry into the timeliness of the patentee's conduct, the patentee's state of mind about the need for amendment (involving his knowledge of the invalidating prior art and what he thought about it), the effect of the patent in its unamended state on third parties and so on. These could turn into elaborate and expensive issues to litigate. Sometimes the discretion was all that stood between the patentee and success.

199. The discretion existed because the Patents Acts historically gave the power to allow amendment in terms classically indicative of the existence of a discretion. Those statutes left it to the courts to work out how the discretion was to be exercised.

200. Following the United Kingdom's ratification of the European Patent Convention and the passing of the Patents Act 1977, it was doubted in a number of first instance cases whether the discretion was consistent with the Treaty and the Act, at least when there were concurrent proceedings before the court and in the EPO. The Court of Appeal, in *Kimberley Clark v Procter & Gamble* [2000] RPC 11 held that the Act had not introduced any change in the law.

201. Section 75(1) of the Patents Act 1977, provided:

> " 75.-(1) In any proceedings before the court or the comptroller in which the validity of a patent may be put in issue the court or, as the case may be, the comptroller **may**, subject to section 76 below, allow the proprietor of the patent to amend the specification of the patent in such manner, and subject to such terms as to advertising the proposed amendment and as to costs, expenses or otherwise, as the court or comptroller thinks fit." (emphasis added)

202. By section 2(5) of the Patents Act 2004, the legislature provided new guidance on how the discretion is to be exercised. This subsection provided for the insertion of a new subsection (5) into s.75 of the Patents Act 1977:

> "(5) In considering whether or not to allow an amendment proposed under this section, the court or the comptroller shall

> have regard to any relevant principles applicable under the European Patent Convention."

203. The subsection was brought into force on 13 December 2007 by Art. 2(d) of the *Patents Act 2004 (Commencement No. 4 and Transitional Provisions) Order 2007* (SI 2007 No.3396). There were no relevant transitional provisions, and so it is common ground that the new law must be applied here.

204. A similar amendment was made to section 27 of the Act (which contains the general power to allow amendment after grant outside proceedings where validity may be put in issue) by adding a new section 27(6) in the same terms as section 75(5).

205. Section 75, as it now stands, requires the court to "have regard to any relevant principles applicable under the European Patent Convention". Accordingly, one should turn to the Convention to see what principles are applied to considering whether or not to allow amendments.

206. There is very little by way of express guidance in the European Patent Convention. Amendments may be made both in the course of prosecuting the application and in the course of opposition proceedings. Article 123 in its original form provided:

> "(1) The conditions under which a European patent application or a European patent may be amended by proceedings before the European Patent Office are laid down in the Implementing Regulations. In any case, an applicant shall be allowed at least one opportunity of amending the description, claims and drawings of his own volition."

207. So there was one mandatory opportunity, followed by amendment under the conditions specified in the Rules. The first sentence has been amended to read:

> "(2) A European patent application or European patent may be amended in proceedings before the European Patent Office in accordance with the Implementing Regulations."

208. Rules 86(2) and (3) give effect to the right to amend once in the course of prosecution as follows:

> "(2) After receiving the European search report and before receipt of the first communication from the Examining Division, the applicant may, of his own volition, amend the description, claims and drawings,
>
> (3) After receipt of the first communication from the Examining Division the applicant may, of his own volition, amend once the description, claims and drawings provided that the amendment is filed at the same time as the reply to the communication. No further amendment may be made without the consent of the Examining Division."

209. Article 102(3) of the Convention refers in passing to "amendments made by the proprietor in the course of the opposition proceedings". The relevant rules are Rules 57 and 57A:

> "57(1) The Opposition Division shall communicate the opposition to the proprietor of the patent and shall invite him to file his observations and to file amendments, where appropriate, to the description, claims and drawings within a period to be fixed by the Opposition Division.
>
> 57A Without prejudice to Rule 87, the description, claims and drawings may be amended, provided that the amendments are occasioned by grounds for opposition specified in Article 100, even if the respective ground has not been invoked by the opponent."

210. It will be seen that Rule 57A restricts the discretion to amend to those amendments which are occasioned by grounds for opposition (including unpleaded ones). Until the introduction of that rule, the EPO only permitted amendments under Articles 102(3) and 123 which were responsive to a validity attack actually raised by an opponent.

211. The case law of the Boards of Appeal shows that appropriateness of the amendments to the proceedings, their necessity and procedural fairness are the main, perhaps only, factors considered relevant to the discretion to allow amendment in opposition proceedings. The EPO's publication, *Case Law of the Boards of Appeal* states at 570:

> "As already mentioned, the boards of appeal have derived in particular from R. 57(1) EPC the principle that the proprietor has no right to have amendments admitted at any stage of the proceedings. At the discretion of the opposition division or the board of appeal, amendments can be refused if they are neither appropriate nor necessary."

212. The EPC 2000 introduced a new procedure in Article 105a which enables a patentee to limit a granted European patent by an amendment of the claims outside the context of opposition proceedings and by a central application in the EPO. New Article 105(a) provides:

> "(1) At the request of the proprietor, the European patent may be revoked or be limited by an amendment of the claims. The request shall be filed with the European Patent Office in accordance with the Implementing Regulations. It shall not be deemed to have been filed until the limitation or revocation fee has been paid."

213. Article 105b now provides:

> "(1) The European Patent Office shall examine whether the requirements laid down in the Implementing Regulations for limiting or revoking the European patent have been met.
>
> (2) If the European Patent Office considers that the request for limitation or revocation of the European patent meets these requirements, it shall decide to limit or revoke the European patent in accordance with the Implementing Regulations. Otherwise, it shall reject the request."

214. Rule 95(2) provides

> "If a request for limitation is admissible, the Examining Division shall examine whether the amended claims constitute a limitation vis-à-vis the claims as granted or amended in opposition or limitation proceedings and comply with Article 84 [*requiring that the claims are clear and concise*] and Article 123, paragraphs 2 and 3 [*requiring that there is no added matter and the claims do not extend the scope of protection*]. If the request does not comply with these requirements, the Examining Division shall give the requester one opportunity to correct any deficiencies noted, and to amend the claims and, where appropriate, the description and drawings, within a period to be specified."

215. Rule 95(3) provides

> "If a request for limitation is allowable under paragraph 2, the Examining Division shall communicate this to the requester and invite him to pay the prescribed fee and to file a translation of the amended claims in the official languages of the European Patent Office other than the language of the proceedings, within a period of three months; Rule 82, paragraph 3, first sentence, shall apply mutatis mutandis. If the requester performs these acts in due time, the Examining Division shall limit the patent." [emphasis added]

216. Neither Article 105b nor the Implementing Regulations (rules 90-96) appear to give the EPO a discretion to reject a limitation request which complies with the formalities prescribed in rule 92 and with Articles 84 and 123(2) and (3).

217. The position under the EPC would therefore appear to be that:

i) in opposition proceedings, appropriateness of the amendments to the proceedings, their necessity and procedural fairness are the main, perhaps only, factors considered relevant to the discretion to allow amendment;

ii) in central amendment proceedings, compliance with the procedural requirements gives rise to a right to have the patent limited in accordance with the request.

218. If a proper amendment is now brought forward in opposition proceedings in good time and which is necessary and appropriate to meeting the opposition, it seems inescapable that it will be allowed. It would, it seems to me, be an odd result if an amendment which would be available as of right under the central amendment procedure was refused simply because the patent was under opposition. Such a result would only be justified if either (a) the amendments would have no effect on the opposition and could accordingly be made after its conclusion if the patent survives or (b) procedural fairness to the opponents meant that it could not be considered. I appreciate that (b) might result in a patent being revoked before it could be amended: but if it were not so, the patentee could derail the proceedings by claiming the right to amend at the last moment.

219. I think what I have derived so far can fairly be described as the principles on which in future, if not in the past, the power to allow amendment will be exercised in the EPO under the EPC. It follows that if I am to have regard to the principles applicable under the EPC, the discretion which I have to refuse amendments which comply with the Act has been limited. Considerations such as those formerly considered relevant to the discretion, such as the conduct of the patentee, are no longer relevant.

220. Mr Arnold submitted that the above is to go too far. First he draws attention to what the legislature has not done: change "may" to "shall" in the Patents Act 1977. I do not think he can get anything from that, except to say that it would have been a much shorter route to the objective than that I have arrived at. Secondly Mr Arnold asks, what if the application to amend was an abuse of right? I think the answer is that the party whose right is abused will be able to restrain the abuse, not through an appeal to the court's discretion, but by enforcing his right. Equally, where the application to amend would be an abuse of the process of the court, the court will not allow it to be made at all. That is not because the court is exercising a discretion to refuse amendments under the Act. It is because the court will always ensure that its procedure is not abused. In fact, that is what I have done here in relation to the undertaking to HHJ Fysh QC.

*The facts here*

221. Markem rely on a number of grounds as to why the discretion to amend should not be exercised in favour of Zipher which go beyond the undertaking to HHJ Fysh QC.

222. If I am wrong, and the court retains a discretion to refuse amendments on wider discretionary grounds, and I am also wrong that Zipher undertook not to make such an amendment application at all, then I would not have refused the amendments (or those amendments which do not add matter) on the additional discretionary grounds pleaded by Markem. I will deal with these fairly shortly.

223. Firstly Markem say that the court should not lend its assistance to an attempt by Zipher to claim monopolies which go far beyond what it claimed to have invented. Zipher's case throughout the entitlement proceedings was that the inventive concept which its employees had invented was represented by Claim 5 of the 602 application

and the Court of Appeal upheld Zipher's claim to entitlement on the basis of an inventive concept which is Claim 5 or even narrower.

224. There is nothing in this. If the claims are wider than that which is justified on the basis of Zipher's application, they will be invalid. If not, there is no reason (apart from the fact that Zipher undertook not to) why Zipher should not try to claim more broadly.

225. Secondly Markem say that Zipher not only admitted but also positively asserted to HHJ Fysh QC and the Court of Appeal that Claims 1-4 of the 602 application were invalid over the prior art. A party which has admitted and asserted that claims are invalid should not be permitted to make an amendment which preserves one of the claims admitted and asserted to be invalid and claims of equivalent or greater breadth. That would be to allow that party to abuse the procedure for amendment.

226. I reject this as well. I do not think there was ever a principle as wide as this. A party who knew the claims were invalid but pretended that they were not was treated unfavourably: but having second thoughts is different. Further, the claim which is retained is retained only if it bears a particular construction. The other claims which it seeks are not claims which Zipher has admitted to be invalid.

227. Finally, Zipher's Amended Statement of Reasons in support of the application to amend is said to be inadequate and unsatisfactory. I do not think there is anything in this.

## The prior art

### 602

228. It is convenient to deal first with the attacks on 602.

229. Markem rely on a number of citations against the novelty and obviousness of 602:

i) US Patent Specification No. 4 909 648 ("Datamax");

ii) The Adkin Memorandum;

iii) US Patent Specification No. 5 490 638 ("IBM");

iv) US Patent Specification No. 4 093 149 ("Shroff");

v) Japanese Unexamined Patent Application No. S-60 211 653 ("Ikenaga");

vi) US Patent Specification No. 5 649 672 ("Wolff").

230. With the exception of the Adkin Memorandum, there is no dispute that these documents were made available to the public before the priority date of 602. It is convenient to consider next the question of whether the Adkin Memorandum was made available to the public.

## Availability to the public

231. The Adkin Memorandum was a document which played an important part in the entitlement proceedings.

232. Section 2(2) of the 1977 Act provides:

> "The state of the art in the case of an invention shall be taken to comprise all matter (whether a product, a process, information about either, or anything else) which has at any time before the priority date of that invention been made available to the public (whether in the United Kingdom or elsewhere) by written or oral description, by use or in any other way."

233. Information is "made available to the public" if it is disclosed to a single person who is free in law and equity to use that information.

234. The pleading is important here. Paragraph 10 of Markem's pleading identifies the matter said to have been made available to the public as including:

> "A document [the Adkin Memorandum] which records the minutes of a meeting held on that day ("Adkin"). Said document was not published, but the Claimant has admitted and averred that the attendees of the meeting, being Phil Hart, Keith Buxton, Martin McNestry and Chris Adkin were free in law and equity to use the information contained in the said document after leaving their then employment."

235. The allegation is that the information in the document was made available to the public because Hart, Buxton, McNestry and Adkin were free to use it once they had left Markem.

236. It was common ground in the entitlement proceedings that the Adkin Memorandum was a document which was subject to obligations of confidentiality in the hands of Markem employees whilst they were employed by Markem. However, Markem contend and Zipher accepts that when that employment ceased, Markem employees were free to make use of the information contained in it. The dispute concerns whether a release from the obligation of confidence in these circumstances is sufficient to make the information in the document available to the public.

237. Zipher submits, firstly, that if such information is treated as available to the public it will mean that all information in a person's head is available to the public. Thus if a person has an idea in his head which he is free to use, he would be able to utilise that information in an attack against a patent.

238. I do not think that the proposition for which Markem contend has this consequence. The idea conceived by a single person and not communicated to anyone else is not made available to anyone: patents are not open to the attack by those who conceived the idea before the patentee but voluntarily kept the idea to themselves. The expression "made available to the public" involves more than a state of knowledge in one person's mind even if coupled with freedom to choose when to disclose it: it involves a handing over of (literally a transmission of) knowledge to the public. The question in this case is whether a release from confidence of material previously held

under confidence (by leaving employment or otherwise) is a sufficient handing over or transmission for this purpose.

239. Zipher also submits that Markem's approach is contrary to a number of decisions of the European Patent Office's Technical Board of Appeals.

240. In *BILFINGER/Sealing Screen* T842/91, [1999] EPOR 192, reliance was placed on an article published in a book after the priority date because the author had, before the priority date, given an express release for publication. There was also to be a consolidation seminar after the priority date. The Board held that the author's release

> "should be considered in its context solely as a clarification of the publisher's rights to publish the article….Any conclusion extending beyond this, that copies of the article may be distributed by the publisher before publication of the book (and before the consolidation seminar held after the priority date) without consulting the author cannot be deduced from this. Forwarding of the manuscript to the publisher does not itself therefore amount to prior publication"

241. Expressed in different words, what the Board in *Bilfinger* was holding is that, at the priority date, the publisher still held the article only for the purpose of publishing it in a book after the priority date. The publisher was not free to do anything else with it, so it was not available to the public. All this is entirely orthodox.

242. More relevantly, in *Acetals/NEW JAPAN CHEMICAL* T1081/01 (unreported, dated 27 September 2004), the opposition to the patent was entirely based on information which had been the subject of various agreements between the patentee and the opponent, but which had been expressly released from confidence before the priority date. There was no reliance on any further disclosure by the opponent.

243. The Board held that

> "5. What can be considered as part of the state of the art is laid down in Article 54(2) EPC as everything made available to the public by means of a written or oral description, by use or in any other way, before the date of filing of the European patent application. The case law (see Case Law of the Boards of Appeal of the European Patent Office, 4th edition 2001 Section I.C.1.6.6) accepts that information is "available to the public" if only a single member of the public is in a position to gain access to it and understand it, and if there is no obligation to maintain secrecy. However in every such case (see also T 932/96 of 16 June 1998 points 2.4.4.4 and 2.4.4.5, or T 11/99 of 10 October 2000 points 1.2.1 and 1.2.2) the information was made available to one or more persons who **at the time of the information being made available** could be described as a member or members of the public.
>
> 6. It is also part of the case law, as stated in decision T 300/86 of 28 August 1989, point 2.1, recently affirmed in this respect by decision T 50/02 of 29 June 2004, point 2.5.2, that for a document to be considered as being made available to the public **all the interested parties** must have an opportunity of gaining knowledge of the content of the document. These two strands of jurisprudence can only be

> reconciled on the basis that it is critical to show that the person(s) to whom the information was made available could **at the time of the information being made available** be treated as a member or members of the public, and thus representative of all interested persons.
>
> 7. If at the time of receipt of the information the recipient is in some special relationship to the donor of the information, then he cannot be treated as a member of the public, and the information cannot be regarded as published for the purpose of Article 54 EPC. Even if this special relationship should later cease, so that the recipient is now free to pass on the information, the mere cessation of this special relationship does not make the information available to anyone else." (original emphasis)

244. The Board's reasoning is that it is necessary to reconcile two notions. The first is the notion that a single disclosure to a person who is free in law and equity to use the information is enough to make that information available to the public. The second is the notion that for information to be available to the public it must be available to everyone. These two notions are reconciled by holding that the recipient who is free in law and equity to use the information is representative of the public at large. Someone who acquires information by virtue of a special relationship is not representative of the public at large.

245. It is easy to see from the Board's reasoning why the original disclosure does not count: the confidant is not representative of the public. It is less easy to see why the subsequent release does not make the information available: at the point of release the recipient is released from his special relationship, so is now a member of the public free in law and equity to use the information as he chooses. The Board's emphasis of the words "at the time of the information being made available" suggests that the decision must turn on the fact that at the point of release of the information no information changes hands.

246. The Board's reasoning raises the question of what would happen if a piece of information is disclosed by A to B with a restriction that it must be kept confidential for one hour. Is the legal consequence different from a disclosure without that restriction? One might think this was an odd result.

247. Zipher submits that even if the release of information previously held in confidence is capable of amounting to a "making available", it must at the very least be proved that at the point of release from confidentiality the recipient of the information still had it in his head. If not, then information would be treated as made available to the public when no one was in reality aware of it at the time when it was supposedly made available.

248. It is of course not normally relevant to assess what information a recipient of information *received* from a "making available" of information. The information in the most obscure public library is available to the public without any evidence that anyone has ever looked at it, let alone memorised its contents. But it is relevant to ask what information was *transmitted* (even if not received) by the making available. An employee may, technically, be free to make use of much information which he has forgotten. If it cannot be established that he was aware of it at the time he left his

employment, then there is no sense in which the information has been made available to the public.

249. So I would decide this aspect of the case on the narrow ground that, without proof that the ex-employees were aware of the information in the Adkin memorandum when they left their employment, it is not established that anything was made available to the public.

250. Mr Arnold invited me to say that *Acetals* was wrong. It is not necessary for me to do so to decide this case. A full consideration should await a case where it is established that something was made available by a release from confidence, such as the example mentioned in paragraph 246 above.

*Lack of novelty - law*

251. The law of novelty was reviewed by Lord Hoffmann in *Smithkline Beecham plc's (Paroxetine Methanesulfonate) Patent* [2005] UKHL 59, [2006] RPC 10. For present purposes, the law may be summarised in two propositions:

(1) There are two requirements for anticipation which it is important to keep separate, (a) disclosure and (b) enablement;

(2) So far as disclosure is concerned, the prior art must disclose subject-matter which, if performed, would necessarily result in an infringement of the patent;

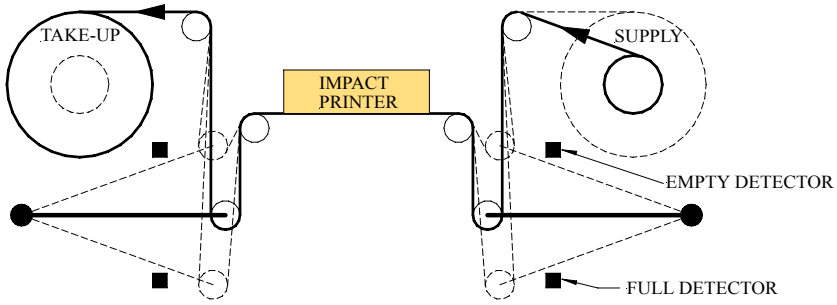
252. Something may be disclosed even if it is described as optional or less preferred. As Pumfrey J (as he was then) said in *Ranbaxy UK Ltd v Warner-Lambert Co* [2006] FSR 14 at [52]:

> "It is occasionally said that there cannot be clear and unmistakable directions to do something which is described as optional. I do not agree: to describe the thing as optional is to describe the thing. It is rather like the disclosure of something as adjustable: it necessarily also discloses something that is not adjustable - see *Gillette v Anglo-American* (1913) 30 RPC 465."

## Datamax

*Datamax disclosure*

253. Datamax describes a ticket printing machine of the type used for printing boarding passes at airports. The machine has a number of modular stations, such as a magnetic strip reader and an optical character reader. The section of interest to the present case is the so called bulk printing station. Mr Nelson's expert report produces a simplified version of the relevant parts as follows:




254. The impact printer is a series of dot matrix print heads. The tape passes from the supply spool to the take-up spool via the print heads over tension arms. These tension arms vary their position depending on the relative speeds of the two motors. The specification describes the drives for the spools as follows:

> "Each of the ribbon spools is also provided with a separate reversible motor, however, accurate positioning using the ribbon motors is not a problem and motors other than stepper motors are appropriate."

255. Each of the motors can be driven at two different speeds. So far as the supply spool is concerned, the lower speed is one at which the supply of tape to the tape path is always less than the take up spool will require. The higher speed is one which is always higher than the take-up spool can accept. The system toggles between these speeds for the supply spool under instructions from the detectors placed at the extremes of movement of the tension arms. The system is push-pull in the sense that both motors drive the tape in the direction of ribbon transport.

256. In operation, in the case where the take-up spool motor speed is supplying more tape than can be taken up, the feed tension arm will fall. If nothing were done, the tension arm would reach the bottom of its travel and the tape would eventually go slack. However, before the tension arm reaches the bottom of its travel it operates a switch which causes the feed motor to switch to its slow speed so that it then cannot supply sufficient tape to satisfy the take-up spool speed. This causes the tension arm to rise until it reaches a switch near the top of its travel whereupon the feed motor speed switches again and the whole process repeats.

257. The take-up spool also operates at two speeds: a normal take-up speed and a faster take-up speed when the take-up spool is relatively empty. Further, the system includes a way of detecting when the tape travel is nearly complete, by detecting the frequency of the movement of the tension arm. It uses this as a signal to reverse the tape.

258. One purpose of the tension arm is described by Datamax in this way:

> "The second purpose of the tension arm is to regulate and maintain a constant ribbon tension at all times during speed changes, reversals, etc."

259. Claim 1 of Datamax says that the printer has "ribbon tension control and sensing means". In context, I think this refers to the fact that the tension arms maintain a

constant ribbon tension, and the detector switches sense the points at which maximum and minimum lengths of ribbon are present in the system.

*Lack of novelty over Datamax*

260. The first question which arises is whether Datamax discloses a drive with stepper motors. In my judgment it does. Although it explains that stepper motors are not necessary to achieve the positional control required, there is a disclosure nevertheless: see the passage from *Ranbaxy v Warner Lambert* cited above. It will not always be the case that an unpreferred feature of this nature can be combined with other, preferred features: but I think it can here. The point is, however, academic as it is common ground that merely substituting stepper motors into Datamax would be a technically obvious step, even though it would not be justified on commercial grounds.

261. The second question is what Datamax discloses about the operation of the tension arms: are they gravity operated, or operated by constant or variable force springs? Mr Arnold invited me to approach the issue of novelty on the basis of an assumption that Datamax was disclosing gravity operated or constant force springs. I think that is a legitimate approach. It would certainly be wrong to assume that it is a variable force spring. Of the other two possibilities, nothing turns on whether it is one or the other.

262. The crucial issue is whether Datamax discloses feature (e) of claims 1, 2 and 3.

263. *Claim 1*: In my judgment Datamax does not disclose that the controller is operative to "monitor tension" as I have construed that term. The signal sent by the detectors in Datamax is not indicative of tension. The most that can be said about it is that it is an indicator that if the signal is ignored something will happen to tension. There is no monitoring of anything which is indicative of a rise or fall in tension in the tape. The tension in the tape in the steady state at the top of the travel of the arm is no different from that at the bottom.

264. Markem also advanced an argument that it was changes to tension in the tape (for example during acceleration and deceleration) which cause the tension arm to move. Thus movement of the tension arm was indicative of momentary changes in tension. This is technically correct. But there is no sense in which these momentary movements are monitored by the system in Datamax.

265. I think Datamax does "control the motors to maintain" the tension in tape "between predetermined limits". On the construction of the claims I have adopted, the motors are contributing to maintaining the tension, even though they are not determining it. The fact that the tension is kept more or less constant by the tension arm does not mean that the tension is not maintained between predetermined limits. But, if there is no monitoring of tension there can be no control of the motors to maintain the *monitored tension* between predetermined limits.

266. It follows that claim 1 is not anticipated by Datamax.

267. *Claim 2*: The critical feature here is whether Datamax discloses that the controller is configured to implement a control algorithm to calculate a length of tape to be added

or subtracted from a tape extending between the spools in order to maintain tension in the tape between predetermined limits and to control the motors to add or subtract the calculated length of tape to or from the tape extending between the spools.

268. The motors in Datamax are given instructions to adjust their speeds in response to signals from the detectors to allow the tension arm to move between its top and bottom positions. The motors are thus programmed and controlled alternately to add and subtract a fixed length of tape to or from the system. I can see no need in Datamax for any algorithm to calculate a length of tape to be added or subtracted. It must follow that this feature is not disclosed by Datamax.

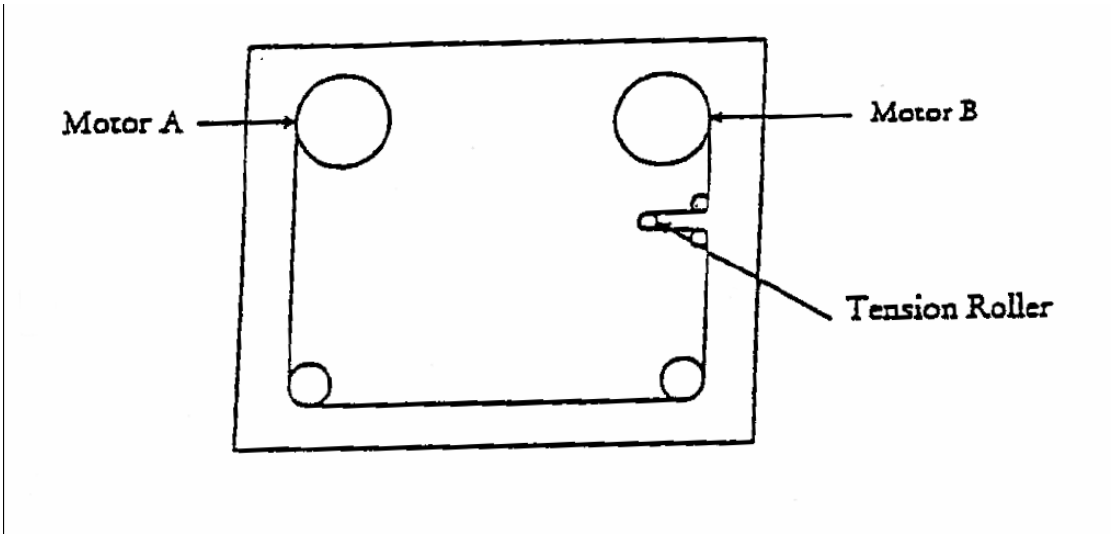
269. *Claim 3*: I can deal with this shortly. On the construction I have adopted for claim 3, the presence of the dancer arm means that there can be no anticipation. The tension in the tape being transported is not determined by control of the motors. Indeed the tension is determined by the weight of the tension arm and roller (or the force exerted by the constant force spring).

**Adkin**

*Adkin Disclosure*

270. I have held that the Adkin Memorandum was not a document made available to the public. However, as that finding involves, at least in part, an issue of law, I should express my view on the substance of the lack of novelty attack.

271. Markem's original SmartDate 2 Coder involved a shuttled printhead. The Adkin Memorandum is concerned with updating the Markem SmartDate 2 printer to make a shuttle-less printer. The design drawing could not be simpler:




272. The very short description states that the motors are synchronised for advance and rewind. Motor A would be the master and Motor B the slave. Driving the ribbon by this method would cause Motor A to discharge an amount of ribbon and Motor B would drive the same distance to collect the ribbon, relying on the tension roller to compensate for any inaccuracies. The requirement for initial calibration is noted as is

the fact that, as the number of cycles increases, the software would adjust the steps moved by each motor to compensate for ribbon size (by which is meant spool diameter). A list of advantages is given including:

1. No clutch required.

5. No shuttle mechanism.

7. Good ribbon tension control.

8. Good tension control will improve the ability to perform 'Slip'.

9. No loss of ribbon on calibration.

11. Faster ribbon break detection.

12 . The tension of the ribbon can be controlled or set.

13. Possible exclusion of the 'hall effect sensor' and rodgers roller.

*Lack of Novelty over Adkin*

273. It is common ground that Adkin discloses stepper motors in a bi-directional push-pull arrangement. As with Datamax, the question is whether it discloses feature (e) of any of claims 1-3.

274. Adkin would be seen by the skilled person as a system in which the tension is set by the tension roller or dancer arm. The motors are intended to be driven in such a way that the tension roller is kept within the limits of its movement. Feedback as to the position of the tension roller is used as an input to the motor control system, to assist in keeping the position of the arm within the limits of its movement. In that way the tension arm and the motors maintain constant tension.

275. Adkin is silent about whether the tension arm is gravity operated, or operated by a constant or variable force spring.

276. In his first report, Mr Taylor's evidence was that

> "Adkin … teaches that that the tension roller be of a moveable type and that its position in its travel is representative of tension such that it can be used to provide feedback to motor B to determine whether any "drive alterations" are necessary. Since both motors are stepper motors (see below), the only drive alteration that could be applied is a change in the number of steps that the motors move. This results in a length of tape being added to or subtracted from the tape extending between the spools. Since the drive alterations (number of steps) are dependent upon the position of the tension roller, the number of steps must be calculated from that position by the software (see below). In the absence of the position of the tension roller determining minor drive alterations to Motor B, then undoubtedly the tension roller would arrive at an end stop and

> therefore cease to function. Thus the motor drive alterations keep the tension within a desired range. Since the position of the tension roller indicates the tension in the ribbon, its position can be monitored both when the ribbon is moving as well as when it is stationary."

277. In his second report Mr Taylor sought to elaborate on this explanation in the case of a constant force spring:

> "… as soon as the tension roller moves, the tension in the ribbon will no longer be nearly constant, and the movement of the roller (for example, the rate of change of its position, or its acceleration/deceleration) will be a function of the tension in the ribbon."

278. *Claim 1*: I do not think that the disclosure in Adkin is of a system which monitors tension in the tape. Adkin only teaches the skilled reader to monitor the position of the tension roller. I read this as monitoring the position of the roller throughout its travel as opposed to at its limits (as in Datamax): nevertheless, the only teaching is to monitor its position, not the rate of change of its position or its acceleration or deceleration. The position of the tension roller is only an indication of the amount of tape in the system, not an indicator of tension.

279. *Claim 2*: Adkin does disclose feature (e) of this claim. By calculating (as it plainly must) the adjustments to the stepper motor necessary to keep the tension arm within its limits, the system is also calculating the adjustment necessary to maintain the tension. It follows that it must have a control algorithm falling within claim 2. The motors are then controlled to add or subtract that amount. If claim 2 were anticipated in this way then claim 6 as dependent on claim 2 would be anticipated as well.

280. *Claim 3*: Adkin does not disclose feature (e) of claim 3. The tension arm, not the motors, determines the tension in the tape.

281. It follows that if Adkin had been shown to be available to the public, it would deprive claim 2 of novelty.

*Obviousness – Law*

282. A patent will be invalid for lack of inventive step if the invention claimed in it was obvious to a person skilled in the art having regard to the state of the art at the priority date.

283. The familiar structured approach first articulated by the Court of Appeal in *Windsurfing v Tabur Marine* [1985] RPC 59 (CA) has recently been explained and restated in the judgment of Jacob LJ in *Pozzoli v BDMO SA*, [2007] EWCA Civ 588; [2007] FSR 37 at [23].

> "In the result I would restate the *Windsurfing* questions thus:
>
> (1) (a) Identify the notional "person skilled in the art"

> (b) Identify the relevant common general knowledge of that person;
>
> (2) Identify the inventive concept of the claim in question or if that cannot readily be done, construe it;
>
> (3) Identify what, if any, differences exist between the matter cited as forming part of the "state of the art" and the inventive concept of the claim or the claim as construed;
>
> (4) Viewed without any knowledge of the alleged invention as claimed, do those differences constitute steps which would have been obvious to the person skilled in the art or do they require any degree of invention?"

284. This approach assists the fact-finding tribunal, but is not a substitute for the statutory question: "is it obvious"? In applying it, as elsewhere, hindsight is impermissible. It has to be remembered that the skilled person is not in a position to perform his own *Pozzoli* analysis. It is particularly important to remember that the first three stages are merely those which the court needs to go through in order to equip itself with the tools to answer the statutory question, which is the fourth one. The first three steps involve knowledge of the invention, which must then be forgotten for the purposes of step 4. What one is seeking to establish is whether the claim extends to methods or objects which are, without knowledge of the invention and without inventive capacity, obvious.

285. I have identified the person skilled in the art and the relevant common general knowledge above. I have also dealt with the major issues of construction of the claims, which define the inventive concepts in issue. I bear in mind Mr Arnold's warning about using a précis of the claims, but it is nevertheless useful in approaching the issue of obviousness to have in mind the differences between the inventive concepts of claims 1 to 4 and 6 of 602.

286. In claim 1 the controller has to have three functions:

i) To energise both stepper motors in push/pull mode.

ii) To monitor tension in the tape.

iii) To control the motors to maintain the monitored tension within predetermined limits.

287. In claim 2 the controller again has to have three functions:

i) To energise both stepper motors in push/pull mode.

ii) To implement the control algorithm to calculate the length to maintain tension.

iii) To control the motors to add or subtract the length.

288. In claim 3 the controller has to have two functions:

i) To energise both stepper motors in push/pull mode.

ii) To control the motors to determine the tension in the tape.

289. Claim 4 adds into claim 3 functions b. and c. of claim 1 and claim 6 limits the tape drive to a thermal transfer printer.

**Obviousness over Datamax**

290. If I am wrong that Datamax discloses stepper motors, it is common ground that the use of stepper motors to implement Datamax would be technically obvious.

291. Claim 1 differs from Datamax additionally in that the latter does not monitor tension in the tape as I have construed that term. Claim 2 differs additionally in that Datamax does not calculate a length of tape to maintain tension: the length is a constant. Claim 3 differs additionally in that the motors do not determine the tension in the tape. For all three claims the difference is caused by the fact that in Datamax the tension is set by the conventional tension arm. This means that there is no need to monitor tension, no need to calculate lengths of tape and no need for the motors to determine the tension.

292. Do those differences constitute steps which would have been obvious? Markem's argument was that it would be obvious to implement Datamax with a variable rate spring, and that if the skilled person did so, the arrangement would fall within these claims.

293. As I have indicated above, it was accepted amongst the experts that the use in a tension arm of gravity, a constant rate spring or a variable rate spring was part of the common general knowledge at the priority date. Dr McMahon was cross examined about the use of a variable rate spring in Datamax:

> Q But would you agree with this, that each of gravity, a constant force spring, and a variable force spring, they would all be obvious choices for a skilled person wanting to build a tape drive of the kind described in Datamax?
>
> A. I am happy to accept that a tension arm with a zero rate spring, or something approaching a zero rate spring, would be a good solution. I think I would have slightly more qualms about a gravity system. Provided the machine sort of sits stably, that may well work too.
>
> Q. The skilled reader would appreciate that he could do it any of those three ways.
>
> A. With certain at the margin benefits and disadvantages, yes.

294. Later Dr McMahon said this:

> I think we earlier had a discussion about means of implementing these tension arms. If we were to use gravity, that would keep the tension sensibly constant. If we were to

> use zero rate spring, that is one whose force does not change with position, that would be very good at keeping a tension sensibly constant. We could compromise and use a regular spring which would have a finite rate and under those conditions there could be some change in running tension as the arm moves. The choice between those is really in the hands of the designer and what will be acceptable for the application.

295. In my judgment the incorporation of a variable rate spring into the tension arms in Datamax would be an obvious way of implementing it. Although it might not be the optimum or most preferred way, the evidence shows that these are all obvious alternatives. If that step were taken, the signal from the limit switches would indicate not only that the system required tape to be added or subtracted, but that the tension in the tape had risen or fallen through the action of the variable rate spring.

296. Zipher's real answer to this attack was to say that, if a variable rate spring was incorporated, Datamax would still not fall within claim 1. Although a signal from the limit switches was now associated with an increase or decrease in tension in the tape, the control system would not "care" that this was the case. The control system's only interest would be in the fact that the point had been reached at which the speed of the motors needed to be changed in order to supply more tape into the loop.

297. I do not think this is a valid answer to Markem's obviousness attack on claim 1. In my judgment, Datamax with a tension arm fulfils all the requirements of claim 1. The signal from the limit switches is now not merely a signal that more tape needs to be added or subtracted: it is a signal that the tension in the tape has risen or fallen. So the system now monitors tension as well as path length. That signal is used to control the motors to keep the tension arm from stepping outside its limits of movement, and therefore the *monitored* tension.

298. If Datamax with stepper motors and a variable spring were accused of infringement, in my judgment it would infringe. It would be no answer to say that the limit switches monitored path length as well as tension. It follows in my judgment that claim 1 lacks inventive step over Datamax.

299. The addition of a variable rate spring does not however have any impact on the validity of claims 2 and 3 over Datamax. Whilst one retains the tension arms, there is still no need for an algorithm to calculate any length of tape or for the motors to determine the tension.

300. Claim 6 adds to claim 1 the requirement that the tape drive is in a thermal transfer printer. Dr McMahon accepted that substituting a thermal transfer printer for the impact printer of Datamax would be "something that would be worth looking at as a possibility". Mr Nelson was not challenged on his evidence that if he would not regard Datamax as a good place to begin if he were charged with the design of a high speed and acceleration and high accuracy thermal transfer printer, or his evidence that to do so would require many changes to Datamax. I think Mr Nelson was setting too high a standard. Not all applications of thermal transfer printing require the exacting standards imposed by Mr Nelson in his analysis.

301. On the whole, I think it would be obvious to replace the printer in Datamax with a thermal transfer printer, whilst retaining the tension arm arrangement. It follows that claim 6 is invalid for obviousness over Datamax insofar as it is dependent on claim 1.

302. Claims 1 and 6 (but not 2 and 3) are invalid for obviousness over Datamax.

**Obviousness over Adkin**

303. For similar reasons to those which I gave in relation to Datamax, I consider that it would be obvious to implement Adkin with a variable rate spring. The effect would be that Adkin construed in this way would fall within claims 1 and 2 (and 6 when dependent on those claims) but not claim 3 (or 6 when dependent on claim 3).

**Obviousness over IBM**

304. This citation, published in 1996, is relied on for obviousness only. The invention relates to controlling the movement of tape between spools, particularly for controlling the tension of an ink ribbon in an impact printer.

305. The section entitled "Background to the Invention" explains that, in such ribbon feed systems, it is common to drive the spools by stepper motors and to use one of the motors to act as a drag motor. This drag motor generates an emf which is applied to a load resistance so as to produce a braking torque. In one such system so called "dynamic braking" is achieved by intermittently connecting a load across the motor windings. The load is varied by reference to "drag look-up tables".

306. In the IBM device the drive spool is maintained within 10% of a particular desired constant speed in the following way. As the drive spool pulls the tape from the supply spool, the supply spool motor generates a back emf pulse stream. The frequency of these pulses is fed to a velocity sense circuit and checked against a look up table, and sets the take up motor drive to the appropriate level.

307. The dynamic braking of the drag motor works by means of a variable current sink which is able to draw different levels of current from the windings of the supply spool motor, and therefore apply different levels of braking. The circuit employs a full wave rectifier across the windings and combines the signal from the two windings in order to produce a smoother signal and prevent cogging. The current level in the sink is set by the drag look up tables, using switching to bring into the drag circuit an appropriate resistance. The correct entry in the look up table is that determined by the velocity sense circuit. The values are empirically derived and may take account of different ribbon materials.

308. Zipher submits that there is an important difference between IBM and each of claims 1 to 3 is that there are no clear directions in IBM to drive the supply spool in the direction of tape transport. Markem submit that this is not a difference. If the difference exists it is to be found in integer (d):

> "wherein the controller is operative to energise both motors to drive the spools in the direction of tape transport"

309. Markem say the integer is satisfied if (i) both motors have current in them (ii) both spools are driven (somehow) in the direction of tape transport. It is not limited, they say, to the case where both motors are positively driving the spools.

310. I reject Markem's contention. The claims are limited to the case where both motors drive in the tape direction. That is the natural meaning of the language in the claims.

311. The evidence as to whether it was obvious to go from IBM to an arrangement in which the motors are both positively driven in the direction of tape transport can be summarised by setting out two passages from the cross examination of the experts. First Dr McMahon was cross examined about a modified circuit which drives the supply spool:

> Q. The skilled person will also immediately appreciate that as well as veering the drag that way, he could positively drive the supply route [spool] if that is what he wanted to do.
>
> A. I am not sure what we mean by the term "positively drive", but if we were to take a stepper motor and put it on the table and connect this drag circuit as configured and switch it on. Well, first of all, because the motor is not moving, there would be no current in the windings. My guess is that the motor would stay stationary.
>
> Q. You can drive the motor using the circuit on the lower half of the diagram, can you not?
>
> A. You mean the new circuit that has recently been conceived by Mr Arnold?
>
> Q. Yes.
>
> A. Well, I would hazard a guess that if we .. I mean, this is clearly not in the patent. This is a new idea, but, OK, let's go with it. If we were to connect this up and we were to put some current in the motor windings in this, shall we say, so-called positive driving mode, I hazard a guess that it would sit still. I don't believe that is the normal mode in which you drive stepper motors. A drive that sits still is not always a terribly useful drive.
>
> Q. The skilled person would appreciate that if he wanted to achieve that, all he had to do was to add the commutation to drive in the normal manner.
>
> A. If we were to move completely away from the concept of a drag motor to the normal mode of driving a stepper motor, then, yes, but we changed the circuit then from what is declared here to the normal motor. In order to do the commutation, you would have to have a whole lot of extra circuitry. Mr Arnold's

special circuit has no means that I can see of achieving commutation.

Q. It is a relatively trivial exercise in circuit design, is it not?

A. In the sense that you can go to many sources and look for stepper motor drives. It is a completely different circuit. It may be a well-known circuit, but it is quite different.

Q. You can get these kind of drives off the shelf, can't you?

A. Well, if by these types of drives we mean normal stepper motor drives, yes. If we mean drag circuits configured like this, I think it is unlikely. I have not done an exhaustive trawl, but I have never seen one in a catalogue.

312. Then, Mr Taylor:

Q. So basically what you are doing is causing a drag to be imparted on to the supply roll, the feed roll, so as to effect tension.

A. Yes. You are energising the feed roll in such a way as to achieve the desired tension.

Q. Can you tell my Lord, is there any teaching in IBM to your knowledge to positively drive the feed roll in the direction of movement of the tape?

A. No, there is no direct teaching.

Q. The moment you did that, you would have to abandon the apparent advantage of the IBM invention of having this intelligent drag circuit.

A. Yes. IBM is teaching using energization of the supply motor in a special way. The debate is whether that then teaches you to go that next step and use energization in a more proactive way.

Q. And if you did use it in a more proactive way, you would then lose the advantage of being able to use it as an intelligent drag circuit.

A. You would not be able to do it with this circuit shown here.

Q. There is no suggestion in IBM, is there, that its teaching would be of any assistance to somebody seeking to design the system for a thermal transfer printing machine?

A. I think it is teaching .... It is introducing the concept of using energization of the supply motor to create tension. As I

> said earlier, the debate is the step that gets from there into positively driving, if you like, to blowing current in rather than sucking current out.

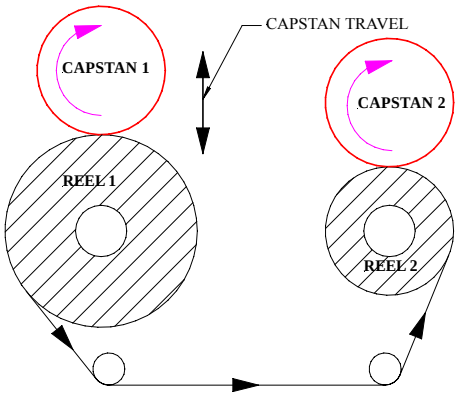
313. It is important also not to forget the evidence of Mr Nelson, who explained what would be involved by a re-design.

314. In my judgment the evidence as a whole does not establish that the step of driving both motors in the direction of tape transport was obvious in the light of IBM. The step would involve using the supply motor in a completely different way. Although, with hindsight, one can see that both the patent and IBM use the "concept" of energising the supply motor, I see no basis for supposing that the skilled person would make that link without knowledge of the patents. In the absence of such a connection, all that IBM discloses is a system where the supply motor is use in drag mode. Driving it positively in the direction of tape transport is the antithesis of this, and would not occur to the skilled team.

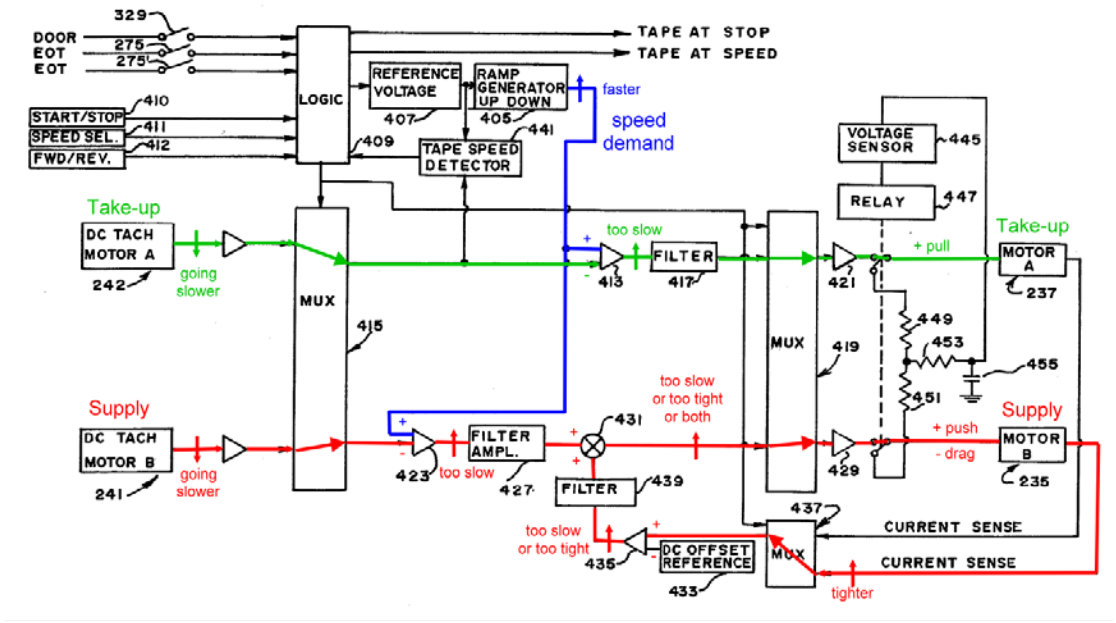
315. None of the claims lack inventive step over IBM.

**Shroff**

316. Shroff was published in November 1975. It describes a tape transport mechanism for a magnetic tape cartridge of the kind used in magnetic tape recorders. It uses two capstan motors. The two capstans are mounted in such a way that they always press against the periphery of the tape on each freewheeling spool. This arrangement causes the spools to rotate thereby transporting the tape at a tape speed which is independent of spool diameter. A simplified version of what is going on is this:




317. The control system of Shroff is illustrated in Figure 9. An annotated version taken from the first expert report of Mr Taylor looks like this:




318. Each capstan has a DC motor to drive it. Each DC motor is connected to a tachometer to measure its speed. There are three control loops in the figure. The first concerns DC motor A (237) and its tachometer (242). The desired linear speed for that motor (say it is the take-up motor) is fed from ramp generator (405) into the loop at differential amplifier (413). This produces a signal representative of the difference between the actual speed and the desired speed which determines whether the motor is to speed up or slow down.

319. The second loop is that which concerns DC motor B (235) and its tachometer (241). This loop is again fed by the same desired linear speed signal. So this loop would, but for the third loop about to be described, drive the supply motor at the same linear tape speed as the take-up motor.

320. The third loop is that which includes DC offset reference (433). This loop follows the line from the Motor B to the multiplexed current sensor (437) through amplifier (435) and filter (439) to summer (431) to apply a voltage adjustment to the input to the motor. It is this loop which generates the tension in the tape, by generating a difference in capstan speed. The current to the motor is sensed by the multiplexed current sensor 437 to produce a "holdback current signal".

321. Shroff explains that the difference in capstan speed can be generated in two ways: by applying a constant hold-back current to the supply motor, or by locking the supply motor to a reference signal which causes it to rotate at a slightly lower speed than the take-up motor.

322. Shroff points out that during acceleration and deceleration the supply reel error signal may exceed the constant hold back bias, and so during acceleration the system will act as a push-pull drive.

323. One difference between Shroff and each of claims 1-3 is that there is no teaching in Shroff to use a stepper motor. Thus in Figure 9 the drag torque (or torque to accelerate in push pull) applied to the supply spool is produced as it will be in a DC motor in proportion to applied current.

324. Markem's obviousness case was that it was obvious to substitute stepper motors into Shroff. Mr Taylor put it like this in his first report:

> "As I mentioned in paragraph 107, I believe that the skilled person would be more than familiar with trade-offs between the use of DC motors and stepper motors. I do not believe that the skilled person would regard it as inventive to replace the DC motors and tachometers used in Shroff with stepper motors. Both types of motor would enable the skilled person accurately to know the position and speed of the motors. Whilst the difficulties of measuring the tension related current in a stepper motor may be of concern to the skilled person, this is not a requirement of the claims of '602B (as amended), nor do I believe that the patents in suit provide adequate instructions on how to overcome these difficulties."

325. In cross examination:

> Q. Yes. Now, put yourself back into the year 2000. I would suggest that you would never consider using a stepper motor as an alternative to a DC motor in an embodiment which relied on control of torque in the way that is set out in figure 9.
>
> A. That is why I was having difficulty with your premise of using the word "torque" because you could apply equal logic to this diagram in the speed domain and then there would be a very natural transition in the year 2000 to stepper motors.
>
> Q. If my premise is correct and that the teaching is to employ using a holdback torque on a DC motor, then I would be correct, would I not, that you wouldn't consider using a stepper motor as an alternative to a DC motor in such an embodiment?
>
> A. With the proviso that I have difficulty that your characterisation excludes looking at this as a speed situation, I have to accept it.

326. The fact is that Figure 9 of Shroff does describe what is happening in terms of applying a constant hold-back current (and hence constant hold back torque) to the supply spool. Although this description does not apply when in push-pull, the teaching would not readily bring to mind the use of a stepper motor. Moreover even if the skilled person did think of a stepper motor he would have to consider how he was going to use the current to monitor tension. Mr Taylor's evidence was that this was being done with the DC motor arrangement in Figure 9 of Shroff. But his own evidence (directed to insufficiency) was that the skilled person would not readily see how this could be done using a stepper motor.

327. In his report Dr McMahon said:

> "Shroff does not disclose the use of stepper motors, but to use them in place of DC motors to turn the capstans at controlled

> speeds would be technically obvious, assuming the skilled addressee thought Shroff could be made to work at all."

328. Mr Arnold said that this meant that Dr McMahon thought that stepper motors were conceptually obvious. Dr McMahon had originally expressed grave doubts about whether Shroff could be made to work at all insofar as it taught imposing differential motor speeds. In cross examination he explained that he had appreciated that Figure 9 operated by applying a hold back torque, a proposition on which the experts were ultimately agreed. His cross examination went like this

> Q. At paragraph 1.17 you say: "Shroff does not disclose the use of stepper motors, but to use them in place of DC motors to turn the capstans would be technically obvious", and after the words "DC motors" I have added in "tachometers" because, as we have seen, Shroff does use DC motors with associated tachometers, does he not?
>
> A. Shroff does indeed use DC motors with tachometers. Shroff does not suggest stepper motors, but the idea of putting another type of motor in does not in itself require a lot of inventiveness.
>
> Q. That would be particularly so in push-pull mode?
>
> A. I think there are quite a few points hidden in there. I didn't really comment in my report on exactly how the stepper motors would be controlled, but if we take one of the embodiments of Shroff where he sets a fixed speed differential between the two capstans, then you could see how that could be done quite straightforwardly with stepper motors. If you wanted to use the drag mode, then that is not so straightforward.
>
> Q. That is precisely why I have said to you it would be very straightforward if you are going to operate it in push-pull mode.
>
> A. I think there is a sort of not direct linkage there, but having put stepper motors into the system, you could drive them both as stepper motors; in other words, contributing actively, **but that does rather beg the question of how you would control tension in such a system**.

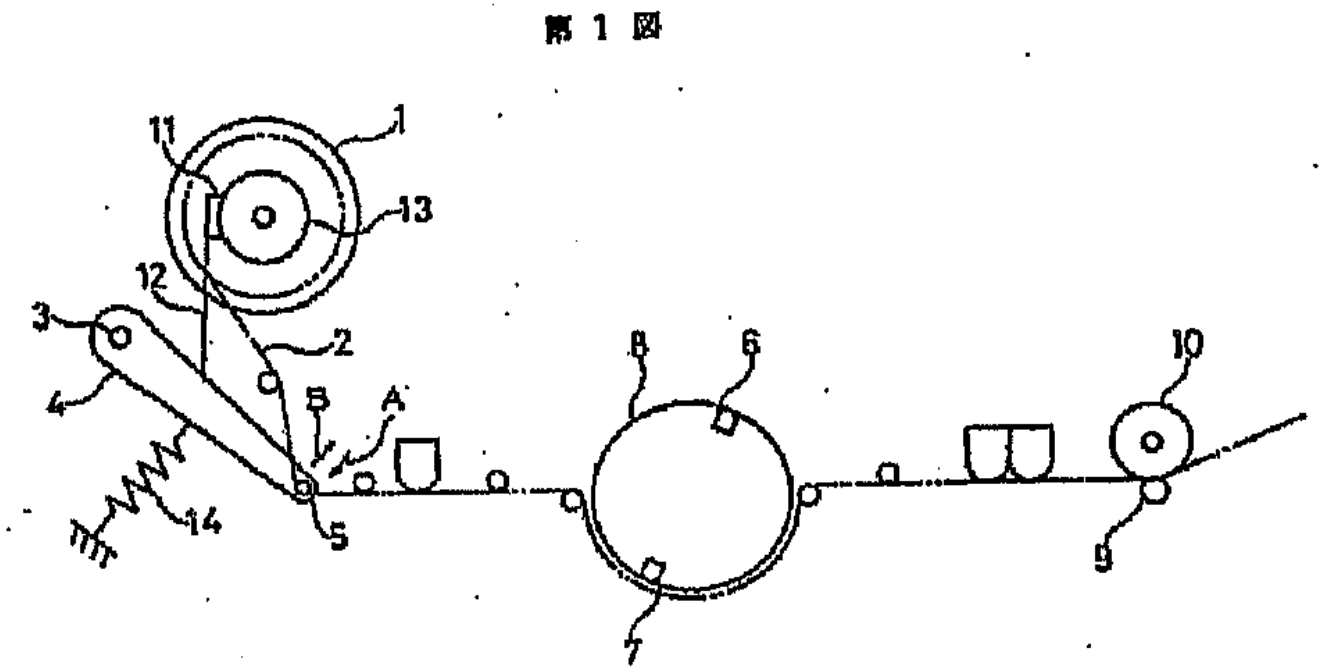
329. In my judgment, it would not have been obvious to substitute stepper motors for the DC motors in Shroff's Figure 9. The stepper motors would have to provide the drag torque so that the system could operate in both modes. The skilled person would not see readily how that could be done using stepper motors.

330. The claims are not obvious over Shroff.

**Ikenaga**

331. Ikenaga was published in 1985. It describes a tape drive system for a helical scan magnetic tape recorder.

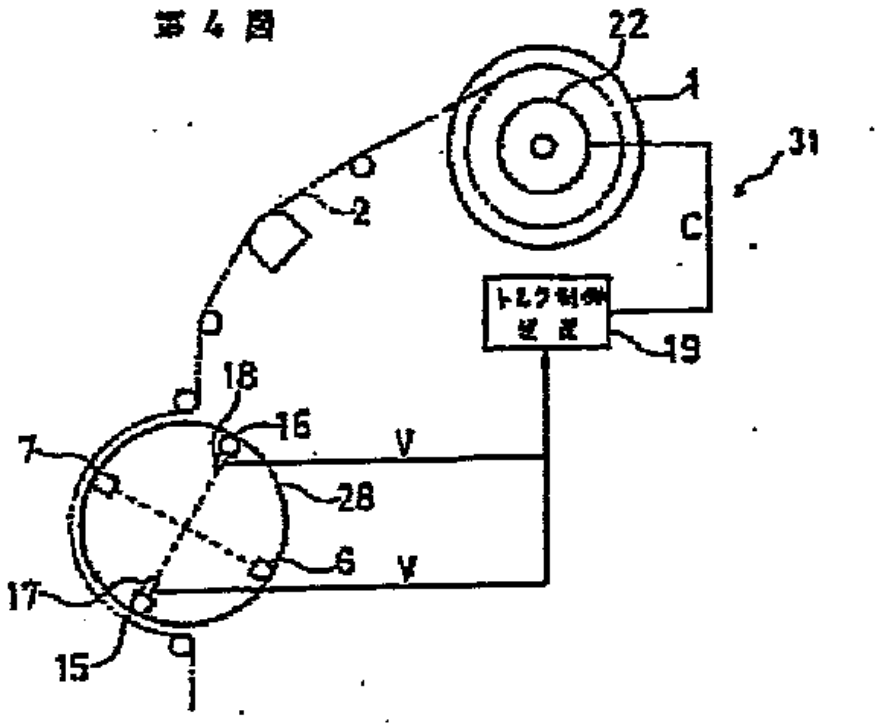
332. Ikenaga first explains the prior art. Figure 1 looks like this:




333. In Figure 1 the tape is driven by a capstan 9 and pinch roller 10 at a fixed speed, drawing the tape around a rotating magnetic cylinder 8 which carries rotating magnetic heads 6 and 7. A spring loaded tension arm 4 on the tape is connected to a felt pad 11 on the supply spool. When the tension in the tape increases, the tension arm moves so as to decrease the frictional force which the pad applies to the spool, and vice versa.

334. Ikenaga goes on to point out that the tension in the tape will be a function of the diameter of the tape left on the spool. This, together with other considerations led to a development of the Figure 2 arrangement, also prior art to Ikenaga, in which the position of the tension arm is monitored with a position sensor. Instead of the arm and felt pad, the supply reel now has a DC motor, and the back torque of the motor is controlled so that the position of the tension arm is fixed.

335. Ikenaga's actual invention seeks to do away with the tension arms of the two prior art devices. This is shown in Figure 4:




336. 15 and 16 are "dummy heads" which are designed to experience the same tape pressure as the real heads. Each dummy head has a piezo-electric sensor which outputs a signal in accordance with the contact pressure applied by means of the tension in the tape to the back-torque control device 19. The result is a closed loop control circuit which locks the tension at a fixed value.

337. Markem face the same problems with this citation as they do with Shroff, as a difference between Ikenaga and claims 1-3 of 602 is the absence of any teaching of using a stepper motor. Mr Arnold again got only this far with Dr McMahon:

> Q The skilled reader reading Ikenaga would also immediately appreciate that he could drive the spools using stepper motors, would he not?
>
> A. As I have said before, for any particular drive application you can look at different motors and for these sort of small drives you could look at a stepper motor. We go back to the usual issues of how we apply a braking torque with a stepper motor. The sort of stepping nature of the stepper motor might make it less attractive for this kind of application, because I understand that very steady tape speed is important in a VTR.
>
> Q. But of course if the application you have in mind is something a little less demanding than the VTR, that wouldn't be a problem.
>
> A. If there were no particular constraints or requirements for the smoothness of tape transport or rather those requirements are relatively relaxed, then we could consider a stepper motor

> on that basis, **but we are still back to the problem of implementing the braking torque**.
>
> Q You can put bundle B1 away

338. In my judgment the skilled team would not consider adapting Ikenaga so as to implement it with stepper motors, for much the same reasons as with Shroff.

339. The claims are not obvious over Ikenaga.

**Wolff**

340. Wolff was published in July 1997. It is entitled "Motor control of tape tension in a belt cartridge." The field of the invention is stated to be "belt-driven computer tape cartridges" and "ways of maintaining appropriate tension in the tape".

341. Figure 1 of Wolff is reproduced below:

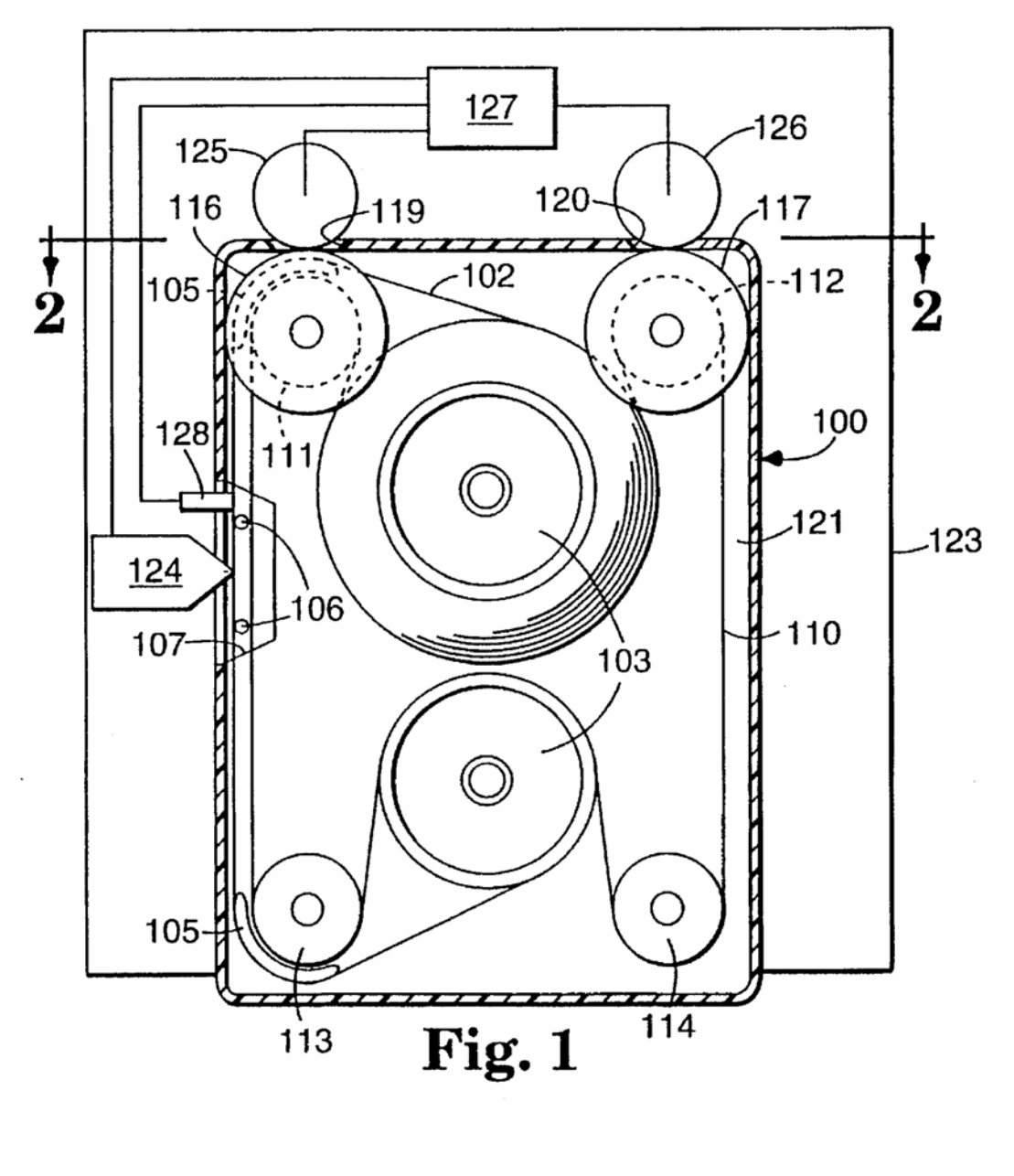
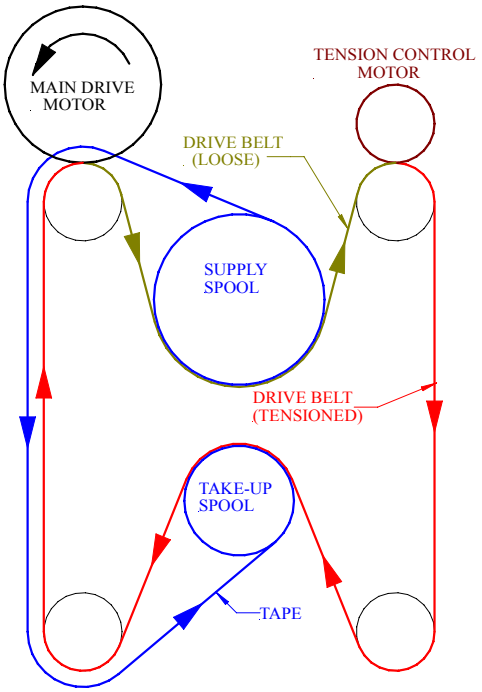



**Fig. 1**

342. The cartridge (100) has tapes wrapped on hubs (103). A belt (110) wraps around the tape on the hubs. The arrangement has a drive roller (111) and a tension control roller (112), driven from outside the cartridge by drive motor (125) and tension control motor (126) respectively, under the control of a control system (127).

343. The tape is read from and written to at a head (124). The drive has a tension sensor 128, which feeds a signal to the control system.

344. In Figure 1 it is quite difficult to distinguish the tape from the belt. A drawing taken from the evidence shows this more clearly for one direction of rotation:




345. The tension control motor develops suitable tension in the belt. In practice this means that the tension control motor is normally functioning as a generator. But at column 3 lines 61 onwards the following appears:

> "It also may be possible to operate the tension control motor 126 as a generator in one direction to increase tape tension and as a motor in the other to reduce tape tension, though controlling the system would be more complicated"

346. Wolff describes a number of possible control systems. The control system of Figure 7 does away with the tension control sensor, but instead relies on the difference in motor currents. Figure 7 is reproduced below:

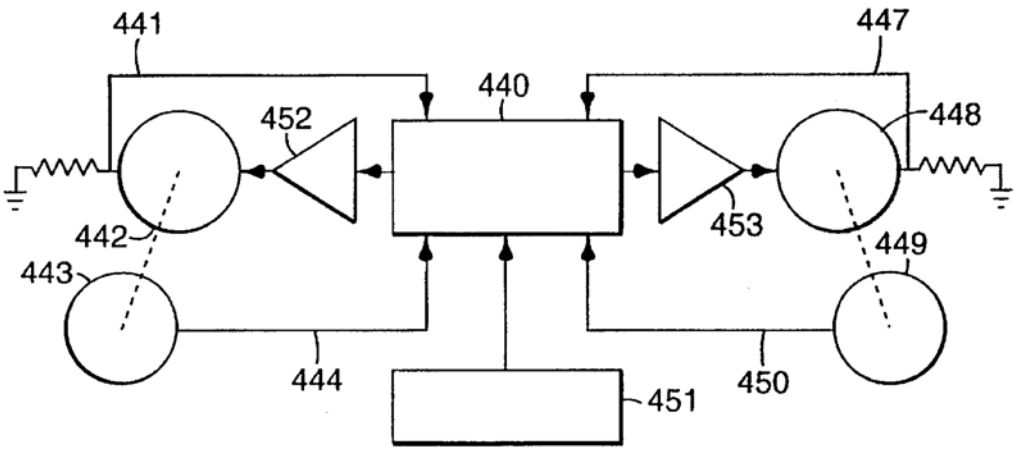



**Fig. 7**

347. The signal on line 441 and 447 are indicative of the current in motors. Tachometers 443 and 447 are indicative of the speed and direction of the motors. The processor 440 checks the currents, the motor speeds and directions and compares them with a lookup table. The processor determines the forces generated by the motors and the difference between them compared to a desired tape tension, and sends suitable adjustment signals to the motors accordingly.

348. Both parties agreed that the motors in Wolff would be DC motors. So again there is a difference from each of claims 1-3 of 602. Dr McMahon was of the view that it was not obvious to substitute stepper motors

> Q. So the skilled person reading that in the year 2000 would readily appreciate that rather than employing a DC motor with a tachometer to get direction and speed, if he has a stepper motor, he will have direction and speed directly?
>
> A. If the only things that you were trying to achieve were control and direction of speed, then that would be true, but I go back to my point again, that the key part of this is to sense the torque of the motors. That is not, as we know, at all straightforward with a stepper motor. The skilled person would not have been aware of the way of doing it with a stepper motor in 2000 and I think therefore would have shied away from it immediately because the DC motor is such an obvious choice for this application. A stepper motor is not an obvious choice.
>
> Q. That is all dependent on your theory that the skilled person simply does not know how to do with a stepper motor?
>
> A. It depends on my proposition that in 2000 sensing the torque exerted by a stepper motor from the currents in the stepper motor was something that was not well known.

349. Markem also argued that the skilled person would see in Wolff a method of controlling tension in the tape directly without the presence of the belt, as the belt was a potential obstacle to incorporating this system in a thermal transfer printer within claim 6. Mr Taylor's view was that the skilled person would see past the belt to such a system, because the belt is no more than a piece of material.

350. Dr McMahon thought that the belt was an important part of the disclosure of Wolff.

351. I agree with Zipher that the suggestion that the skilled person would see how to dispense with Wolff's belt is hindsight reasoning.

352. In the result the claims are not obvious over Wolff.

**Obviousness of claim 3 of 375**

353. Claim 3 of 375 has all the features of claim 1 of 602, and the additional feature that means are provided to monitor the power supplied to the motor and to calculate an estimate of tape tension from the monitored power. Claim 3 is attacked for

obviousness in the light of Shroff and Wolff. As I have dismissed the attack on claim 1 of 602 in the light of Shroff and Wolff, this attack must fail as well.

**Obviousness of claim 33 of 375 in the light of Markem**

354. Claim 33 is said to obvious in the light of UK Patent Specification No 2 302 523 in the name of Markem ("Markem").

355. Markem discloses a thermal transfer printer with a printhead capable of horizontal movement. The apparatus is said to be capable of three types of printing: (i) intermittent printing (ii) continuous printing where the substrate speed is slower than the maximum speed of the printhead and (iii) continuous printing where the substrate speed is faster than the maximum speed of the printhead.

356. Mr Taylor's evidence, given in relation to the same claim in 345, but unchallenged, was:

> "769. The Markem patent refers to the relative position between the platen and the print head being set manually. It also refers to a controller which is responsible for moving the print head when printing intermittently. I am therefore strongly of the view that there cannot be any invention involved in exploiting the existing capability of the print head to move under the control of a controller, to ensure that the print head is in the right place relative to the roller to achieve optimum print quality."

357. This is something of a broad brush to apply to the claimed invention. It assumes the presence of a roller when the Markem apparatus uses a special moving platen. Moreover the evidence is expressed in classic hindsight terms. It does not really explain why the skilled person reading Markem would realise that he could adapt a movement capability introduced for use during printing with a special platen for the different purpose of carrying out adjustment in relation to a conventional print roller for achieving optimum alignment.

358. Mr Nelson was cross examined on Markem. He accepted that the skilled reader would appreciate that he could use a conventional roller when carrying out low speed conventional printing. He also accepted that the skilled reader would appreciate that he could carry out desired movements of the printhead by giving it instructions from the control panel. His cross examination continued:

> Q. If one is changing the machine from intermittent printing to low speed continuous printing and one is using for the low speed continuous printing process the conventional roller, the required position of the print head is properly aligned with the centre of the roller, is it not?
>
> A. Yes. The designer will have set the angle of the print head if it is an edge head. He will have set the angle to be at the manufacturer's optimum recommendation when the tangent line

> drawn through the point of contact is horizontal or in the right relationship to the printer itself.
>
> Q. The only alternative to trying to put the print head into the right position from the outset would be to set it at some random position, carry out test prints and then have to relocate either the print head or the roller to ensure the necessary alignment.
>
> A. Yes. If you had got things in the wrong place or not the perfect optimum place, then some change would have to be made somewhere.
>
> Q. And clearly the easiest way to do it is going to be to move the print head.
>
> A. Yes, I can see that that is a nice way to do it.
>
> Q. It is the most straightforward way to do it, is it not?
>
> A. If you have got that facility available ----
>
> Q. Which one does in this machine, does one not?
>
> A. You have the tools within the machine to make it possible. Whether you have the interface so that the user may access that potential is not absolutely clear. But ----
>
> Q. It would be a straightforward matter to provide that in the user interface, would it not?
>
> A. Yes.

359. Mr Thorley attacked this as a stepwise approach to making the invention. The crucial step for Mr Arnold's purposes is to put a conventional roller into the Markem device. Whilst Mr Nelson accepted that this is something which could be done, it would be something which would lose the main advantage of the Markem device, namely its versatility. Far from there being a suggestion in Markem that one should change the platen configuration when changing the type of printing, the suggestion is the reverse. Choosing a conventional roller in place of the special platen arrangement is not, in my judgment an obvious step. Without that step the obviousness attack on this claim does not get off the ground.

360. Claim 33 of 375 is not obvious in the light of Markem.

## Insufficiency

361. A patent will be invalid if "the specification of the patent does not disclose the invention clearly enough and completely enough for it to be performed by a person skilled in the art": section 72(1)(c) of the Act.

362. Although insufficiency is a single objection to the validity of a patent, it may arise in a number of different ways. In every case, however, the purpose behind the objection

is to prevent a patentee laying claim to products or processes which the teaching of the patent does not enable in the relevant sense.

363. The first, or so-called classical insufficiency, is where following the express teaching of the patent does not enable the skilled addressee to perform the invention. This type of insufficiency requires an assessment by the court of the steps which it would be necessary for the skilled reader or team to take in following the teaching of the specification and in order to arrive within the claim. Plainly the steps should not include inventive ones. But a patent can also be insufficient if the steps can be characterised as prolonged research, enquiry or experiment.

364. What amounts to sufficient instruction depends on the facts in each case. In *Mentor Corporation v Hollister Inc* [1993] RPC 7 at 13, the Court of Appeal (Lloyd, Stuart-Smith, Scott LJJ) said they could find "no vestige of error" in a statement of Aldous J. in the same case in the following terms:

> "The section requires the skilled man to be able to perform the invention, but does not lay down the limits as to the time and energy that the skilled man must spend seeking to perform the invention before it is insufficient. Clearly there must be a limit. The subsection, by using the words, clearly enough and completely enough, contemplates that patent specifications need not set out every detail necessary for performance, but can leave the skilled man to use his skill to perform the invention. In so doing he must seek success. He should not be required to carry out any prolonged research, enquiry or experiment. He may need to carry out the ordinary methods of trial and error, which involve no inventive step and generally are necessary in applying the particular discovery to produce a practical result. In each case it is a question of fact, depending on the nature of the invention, as to whether the steps needed to perform the invention are ordinary steps of trial and error which a skilled man would realise would be necessary and normal in order to produce a practical result."

365. Two points need to be emphasised in this case. The first is that it is the claimed invention which must be enabled. If the skilled team would not be able to make something within the claim, insufficiency will be established. But what if the skilled team would be able to make something falling within the claim, but which is not as good as the patent promises? In my judgment that will not be insufficiency, although it may help in some cases (for the purposes of the separate objection of lack of inventive step) in showing that the technical advance made by the claim is less great than contended for by the description.

366. The second point, much pressed on me by Mr Thorley, is this. Although the skilled team for the purposes of insufficiency does not possess any greater skill than that for obviousness, the insufficiency team has the advantage that it will have the invention in view. The skilled team is trying to carry out the invention and achieve success, as the passage from Aldous J's judgment makes clear, not searching for a solution in ignorance of it.

367. The second, or so-called *Biogen* insufficiency (after the decision in the House of Lords in *Biogen v Medeva* [1997] RPC 1), is concerned with breadth of claim. An insufficiency attack on *Biogen* lines accepts that the teaching of the patent is adequate to bring the skilled reader within the claims, but asserts that the claims encompass products or processes which owe nothing to the teaching of the patent and which are not enabled.

368. It is important to see how far the *Biogen* principle goes. Enablement does not necessarily involve teaching how to make each member of a class. If it were not so, ingenious infringements could never be caught. If an element of the claim can be predicted to be of general application, the patentee is entitled to claim it in general terms:

> "… [I]f the patentee … has disclosed a beneficial property which is common to [a class of products] he will be entitled to a patent for all products of that class (assuming them to be new) even though he has not himself made more than one or two of them."

369. In *Kirin-Amgen Inc v Hoechst Marion Roussel* [2005] RPC 169, Lord Hoffmann explained the notion of a principle of general application in this way:

> "This [i.e. the passage cited above] gave rise to a good deal of argument about what amounted to a "principle of general application". In my opinion there is nothing difficult or mysterious about it. It simply means an element of the claim which is stated in general terms. Such a claim is sufficiently enabled if one can reasonably expect the invention to work with anything which falls within the general term. For example, in *Genentech I/Polypeptide expression (T 292/85)* [1989] OJ EPO 275, the patentee claimed in general terms a plasmid suitable for transforming a bacterial host which included an expression control sequence to enable the expression of exogenous DNA as a recoverable polypeptide. The patentee had obviously not tried the invention on every plasmid, every bacterial host or every sequence of exogenous DNA. But the Technical Board of Appeal found that the invention was fully enabled because it could reasonably be expected to work with any of them.
>
> This is an example of an invention of striking breadth and originality. But the notion of a "principle of general application" applies to any element of the claim, however humble, which is stated in general terms. A reference to a requirement of "connecting means" is enabled if the invention can reasonably be expected to work with any means of connection. The patentee does not have to have experimented with all of them. "

370. In *Generics v Lundbeck* [2008] EWCA Civ 311 the Court of Appeal (which included Lord Hoffmann sitting as a judge of that court) was concerned with a claim to a single chemical entity, an individual enantiomer which was one of two such enantiomers

known to exist in admixture in a known drug molecule. The patentee had been first to devise a way of isolating the individual enantiomer and had disclosed and enabled a way of making it in the patent. The trial judge had held that the claim was insufficient, in that, given that the enantiomer was known to exist (as part of a racemic mixture) and to be a desirable product to make, the patentee's technical contribution was to be seen as consisting only in the way of making it. The Court of Appeal held that approach to be wrong. The contribution to the art was the novel compound claimed: that was fully enabled because a way of making it had been taught. The critical distinction between *Biogen* and *Lundbeck* was that in *Biogen* the claim in the patent was to a class of products.

> "Thus, as a matter of construction, the House of Lords [in *Biogen*] interpreted the claim as being to a *class* of products which satisfied the specified conditions, one of which was that the molecule had been made by recombinant technology. That expression obviously includes a wide variety of possible processes. But the law of sufficiency, both in the United Kingdom and in the EPO, is that a class of products is enabled only if the skilled man can work the invention in respect of all members of the class. The specification might show that this has been empirically demonstrated or it might disclose a principle which can reasonably be expected to apply across the class: see T292/85 *Polypeptide expression/GENENTECH* [1989] OJ EPO 275; T409/91 *Fuel Oils/EXXON* [1994] OJ EPO 653; *Kirin-Amgen Inc v Hoechst Marion Roussel* [2005] RPC 169, 202. "

371. Jacob LJ expressed himself in different terms but to the same effect at [61]:

> "So, for example, if a man finds a particular way of making a new substance which is 10 times harder than diamond, he cannot just claim "a substance which is 10 times harder than diamond." He can claim his particular method and he can claim the actual new substance produced by his method, either by specifying its composition and structure or, if that cannot be done, by reference to the method (see *Kirin-Amgen* at [90-91]) but no more. The reason he cannot claim more is that he has not enabled more – he has claimed the entire class of products which have the known desirable properties yet he has only enabled one member of that class. Such a case is to be contrasted with the present where the desirable end is indeed fully enabled – that which makes it desirable forms no part of the claim limitation."

372. The same principle about the need to enable all members of the class is to be found in the *Case Law of the Boards of Appeal* at 175 as follows (emphasis in the original):

> … the disclosure of one way of performing an invention is only sufficient if it allows the invention to be performed **in the whole range claimed** rather than **only in some** members of the claimed class to be obtained (**T 409/91**, OJ 1994, 653; **T 435/01**, OJ 1995, 188; **T 172/99** and **T 1288/01**). This was considered a

> question of fact. Sufficiency of disclosure thus presupposes that the skilled person is able to obtain substantially all embodiments falling within the ambit of the claims. This was also the view taken by the board in decisions **T 19/90** (OJ 1990, 476), **T 242/92**, **T418/91**, **T 548/91**, **T 659/93**, **T 435/91** (OJ 1995, 188) and T 923/92 (OJ 1996, 564). More technical details and more than one example may be necessary in order to support claims of a broad scope (**T 612/92**, **T 694/92**, OJ 1997, 408; **T 187/93**).

373. Mr Thorley submitted that the decision of the Court of Appeal in *Generics v Lundbeck* had significantly restricted the *Biogen* principle. In my judgment it has not. It remains the law that where a class of products is claimed the class must be enabled in the relevant sense, not just one member.

374. The third type of insufficiency is that which arises through ambiguity. If the skilled person cannot tell whether he is working the invention or not, the specification is insufficient. It is not, however, enough to establish this type of insufficiency to show that there may be a puzzle at the edge of the claims. It will normally be necessary for the problem to permeate the whole claim. An example of an insufficiency of this type is the molecular weight test in *Kirin Amgen* at [121] which made it impossible to tell whether there was infringement or not.

375. It is convenient to deal with the numerous insufficiency attacks under the three headings of classical insufficiency, insufficiency through ambiguity and *Biogen.*

**The classical insufficiency objections**

376. The classical insufficiency objections raised in the Grounds of Invalidity to 602 (as granted) are as follows:

i) 602 purports to teach two methods of measuring ribbon tension with sufficient accuracy to control that tension, at pages 21-22 and pages.27-28 respectively. In fact neither method is suitable for monitoring ribbon tension in this way, because:

a) equations (1) to (3) are dimensionally incorrect and do not take account of the angular velocities of the motors;

b) the assumption that there is a single f(T) which applies to both motors is unjustified and materially incorrect.

ii) 602 purports to teach monitoring and control of ribbon tension utilising the radius of each of the two motor spools but in fact does not teach a method of determining the said radii during operational use of the printer.

iii) 602 fails to sufficiently teach a method of monitoring stepper motor power consumption, as it does not sufficiently describe implementation of any suitable low pass filter, sampling technique or other operation aimed at extracting a representative power signal from the noisy signal detected.

377. Markem raise two further objections against claim 2 of 602 as proposed to be amended:

i) Insufficient teaching of "control algorithm".

ii) Insufficient teaching of a method by which the length of tape extending between the spools may be altered in order to maintain tension between predetermined limits.

378. These insufficiencies also impact on the corresponding claims of other patents.

## Classical Insufficiency

379. Whilst it is convenient to deal with each pleaded insufficiency separately, Mr Arnold also relies on their cumulative effect, and indeed the cumulative effect of the pleaded insufficiencies with what he submitted were further inaccurate statements in the specification. Mr Taylor explained this point graphically in this way:

> Q. And you would know why it didn't work.
>
> A. I was thinking about this in the middle of the night after our conversation yesterday and I came up with an example. Forgive me if it appears to be folksy, but I would like to just give it anyway. My son came to me and just said, "I have just changed the spark plug in the lawnmower." The next time I go to try and start the lawnmower and it does not start, I would think that James has done something wrong and look at the spark plug and the connection to it. If instead my son came to me and said, "Actually, dad, I have just taken the entire lawnmower to pieces because I was interested in it and I put it back together again" and I then start it and it does not start, I don't have a clue what he has done wrong, and that is with a machine that you actually knew worked yesterday. Research and development was my business. That is what I did. You are presented with a machine that you actually don't know works because you have never built it before. It is not like the lawnmower. It just strikes me, and I am trying to be as fair and open as I can, that this patent is laying a minefield for the poor development engineer. It has got nothing to do whether you are mechanical engineer, an electrical engineer or a chemist. There are all these things that seem to be wrong and at each stage you would say, yes, you know that is wrong, and maybe you would if you could isolate that. What worries me is that you have got a machine there that is unstable. It is breaking or it is stalling. You don't know what is wrong. As I understood it, I am supposed to look at this as someone who is able to take this up and build it with minimal experimentation.

380. I think it is correct that a specification may present the skilled team with such a combination of defects that, whereas individually no single defect would have stopped the team from being able to perform the invention, in combination they may do. I think this proposition applies with particular force in this case, where adequate tension control depends on a number of factors: the validity of the tension equation,

the validity of cancelling the temperature function and the skilled person's ability to extract meaningful values of the work related current.

381. Nevertheless I consider the evidence in relation to each of the individual objections first.

*Measurement of power - 602*

382. I take this objection first. The only way taught in the patent for monitoring tension is by using the current to the motors. A critical aspect of the patent's teaching is therefore whether it is adequate to enable the skilled reader to obtain the relevant current. If the idea of using current to the motors as a way of monitoring tension is to work, there must be a way of obtaining the so-called "work-related" current. Mr Taylor's evidence in his report was that it would not be apparent to the skilled reader of 602 how to separate the work-related current from all the other factors affecting the current drawn by the stepper motors. Dr McMahon's evidence was that the choice of appropriate sampling filtering and averaging techniques would be well within the capacity of the skilled team.

383. It became clear during the cross examination of Dr McMahon that he accepted that there was no obvious way of obtaining the necessary current information from the current in the motor windings. However, it was in his view possible to obtain the information from the current supplied *to the motor drivers*.

384. The first question is therefore whether 602 contains an adequately clear teaching that it is the current supplied to the motor drivers which is the relevant current to analyse. Figure 18, as well as other passages, certainly teach this method. Other passages are, as Dr McMahon acknowledged, sloppily worded, something which he was "not entirely happy with". On the whole I think that there is sufficient in 602 to lead the reader to the conclusion that it is being suggested to him that it is preferable to measure the current to the motor drivers.

385. Mr Arnold submitted that the specification did not make it clear that measurement of the current to the drives was essential. It is, of course, not necessary for the specification to state expressly that this method is essential, although failure to do so may add to the overall burden on the skilled person who attempts to carry out the invention. In the present case, I do no think that the failure in 602 to point out more clearly where current is to be measured would add significantly to the burden on the skilled person. I will have to return to this latter point in connection with 375.

386. Mr Arnold points out that a number of assumptions underlie Dr McMahon's evidence that the skilled person would be able to obtain the necessary information from the current supplied to the motor drivers. He says these assumptions are nowhere taught in the patent, and are not assumptions would the skilled reader would necessarily make.

387. Firstly Dr McMahon accepted that he had assumed that the motor will be driven by a pulse-width-modulated, closed loop, constant current drive circuit. There is nothing in the teaching of 602 to indicate that this is what is required. On the contrary, Figure 19 shows a simple transistor, when, for a closed loop, constant current PWM circuit, more would be required.

388. Mr Arnold's principal complaint about this assumption was that it forced the decision to measure the current at the motor drivers: if the current in the motor windings is constant, it will do no good to attempt to find an indication of the tension from there. However, as I have concluded that there is adequate teaching in the patent to measure the current in the motor drivers, this aspect of Mr Arnold's complaint need not be considered further.

389. Secondly Dr McMahon assumed that the skilled person would appreciate that it is the DC component of the current which is required. He deduced this from the use of the word "average" in the patent's instruction to sample and "average" the current.

390. Here there is a direct conflict with the evidence of Mr Taylor, who concluded that what the skilled person was being told to measure was

> "one or more of the many AC components in the current waveform rather than in the so-called 'DC component' suggested by Dr McMahon".

391. Mr Taylor was cross examined on the basis that it was the DC component that one was trying to get at. His reaction was:

> A. You don't stand a chance of that Mr Thorley. This is the bit that I just cannot get my mind round. You don't stand a chance …. of getting a DC.

392. Mr Taylor accepted that Zipher had got this to work: but said "but it is interesting stuff".

393. My understanding of Mr Taylor's evidence is that he regarded the task of obtaining a DC component from the noisy wave form as so difficult that he thought the skilled reader would assume that something else was meant. Mr Thorley pressed him on this:

> Q…. That [i.e. DC] is the component that the patent is telling you to look for.
>
> A. Well is it? Where I have difficulty is that just averaging, if you have… if you are sampling something which has coherent information in it, where you take the samples is important and how you take the samples is important. If you take the samples in a certain way, then, yes, you can dig out of this the component that you are looking for. You are looking for the tension component in the signal. I accept that if you take some special precautions, you can achieve that.

394. It is clear from Mr Taylor's report and his cross-examination that he had thought very carefully about the problem of obtaining the required information. The Patent explains the sampling process in the following way:

> Preferably the motor currents are sampled over a period of time corresponding to for example the travel of the ribbon through a distance of at least 10mm at a constant velocity. For example the current could be sampled at regular intervals with the interval between successive samples corresponding to for example one quarter of a step of the motor. The samples are added together and the sum is divided by the number of samples taken. This gives an average current which is reasonably representative of the power being drawn by the associated stepper motor.

395. Mr Taylor calculated in a typical case this would give 7 pieces of information which he regarded as wholly inadequate. If one wanted more information as opposed simply to more samples, one would need to run the machine for longer at constant velocity and lose its agility.

396. Mr Thorley submits that Mr Taylor accepted that the patent taught that it was the DC component that one was looking for, and Mr Taylor's only problem was with carrying that out with an appropriate sampling method. I reject that submission. The patent only teaches the reader to sample, filter and average and to do so taking a few samples. Mr Taylor simply did not see how this could be done to obtain a DC component. He accepted that what one was after was a tension component, and that Zipher had shown in their Zodiac program that interesting and special sampling techniques make it possible to extract it. He was a very long way from accepting that the patent taught the skilled reader to go for the DC component or how to do so. His view that the skilled person would assume that it was to be extracted from one or other of the AC components was in my view maintained.

397. The details of Zipher's implementation of the sampling and averaging process in the Zodiac printer were quite different from the approach taught in the patent. For example the patent teaches taking a sample at intervals of a quarter of a step of the motor, whereas Zipher takes a sample only once (albeit using quarter stepping of the motor). These are quite different in terms of the information content per sample. Moreover the teaching of the patent suggests sampling synchronously with the motor steps, whereas Zipher has devised a method in which one motor is bound to be sampled asynchronously.

398. Mr Taylor's view was that even if one accepted that the DC component was to be obtained, the patent's teaching as to sampling would not be good enough. His answer below sums it up:

> Q. …There is obviously a conflict here between you and Dr. McMahon. Dr. McMahon suggested that he thought the degree of trial and error would be rather less than you do. Am I correct that you are dealing in your evidence purely on a matter of theory and that you are putting forward no evidence as to actual difficulties that occurred in practice?
>
> A. I am really disappointed now. I thought I had just spent the last half hour trying to explain in detail what the difficulties really were. There is a gap between Dr. McMahon and myself because I defy anybody to get DC out of seven pieces of

> information. You know, what I try to say in [paragraph 201 of his report] is that this is a much more complex issue than is suggested by the patent.

399. The impression I gained from Dr McMahon's evidence was that he did not feel constrained by the example in the patent.

> Q. So is it the four samples per step we are averaging or is it samples over a period of time, or what?
>
> A. I think at some level I accept that the wording of this section is less than ideal, but we must remember that the skilled person at least has some inkling of what we are trying to get out of this. We are trying to get an average value, therefore the more samples we take, the better value we will get for the average.

400. I did not in the end find Dr McMahon's evidence very convincing on the question of whether the skilled person would really be able to deduce from the terse summary in the patent what it was he was supposed to be trying to get or how he would get it. For example:

> MR. ARNOLD: Where in the patent does it tell you that the stepping related frequencies in this waveform are unwanted components?
>
> A. It does not explicitly say that. What it does tell you is that you want the average current and you know that the stepping related components are AC components and sort of by implication they are not the ones of interest. Also, I think the skilled addressee may well deduce that too.

401. Dr McMahon was not saying in that passage that Mr Taylor's view was untenable, only that the skilled person might be able to deduce that the stepping related components were unwanted. I think Dr McMahon is reading too much into the single word "average". I think Mr Arnold is right that once one has convinced oneself that what the patent is telling you to get is the DC component of the complex waveform, then the skilled person might be persuaded to depart from the teaching of the patent and its example so as to obtain enough information to arrive at that quantity. He points to the fact that in the course of cross examination Dr McMahon selected a sampling rate of 500 samples per second, and a low pass filter to accord with this sampling rate, all on the basis that he knows he is not interested in AC components at all.

402. This is an issue on which the court must prefer the evidence of one expert or the other, having done its best to consider and understand the underlying reasoning. On this issue I have no hesitation in preferring the evidence of Mr Taylor.

*No adequate teaching of how to monitor tension*

403. There is no dispute that the tension equations in 602 are incorrect in omitting any angular velocity term. This would not matter if the evidence supported a conclusion that the skilled team seeking to implement the teaching of the specification would

discover the error. The evidence does not support any such conclusion: in fact it supports the conclusion that the skilled team would not discover the error at all. Mr Taylor did not spot the error for some time, and even when he did he was not certain that he was right, as he thought the angular velocity might somehow have been allowed for in the other terms. Dr McMahon seemed to accept in his report that a skilled team of average skill would not spot the error initially. When he was specifically asked to check the equation he sought to derive it from first principles. He arrived at the corrected form and was satisfied he had thought it through adequately in a few hours. He said that he thought it would take the skilled team a day of effort if they had problems with the equation to spot and fix the problem. However, the skilled person would not have the benefit of someone asking him to check the equation – there is at least a hint there that something is wrong which the patent does not give. In fact the patent clearly asserts that the equation is right. In my judgment a team of appropriate skill would proceed on the assumption that the tension equations were correct. I do not believe that the team would realise that there was an error in the equation until long after it had expended undue effort.

404. The consequence of the use of the erroneous formula is that proper account would not be taken of the variation in spool diameter. Using the incorrect equations, the tension in the tape will vary with the spool diameter as the angular velocities change in order to maintain constant linear tape speed. The effect will not necessarily be as bad as it could be, because radius terms are used in the equation. But it will still be there. Variation of tension with diameter is, of course is one of things which the patentee describes as a "serious problem".

405. Zipher's answer to this complaint is to say that it does not matter for practical purposes, notwithstanding the patent's description of tension variation with diameter as a "serious problem". Zipher points to its own Zodiac printer which implemented equation (3) from 602 for over three years, during which the tension monitoring system worked. Mr Taylor accepted that this made it difficult to assert that the erroneous equation on its own prevented the skilled person from achieving adequate tension control in the sort of application with which Zipher was concerned.

406. Dr McMahon accepted that in an application where tension demands were high the erroneous equation would give rise to serious problems.

> Q. And, in particular, the tension of the tape will vary with the changing diameters of the spools?
>
> A. Exactly. The diameters will change as the thing runs from start to finish. It might be worth adding of course that we have to consider whether the changing tension actually matters. If we take some numbers, say, a nominal tension of two newtons and it varies between one and a half newtons and two and a half newtons but in fact the printer works perfectly well between one and three newtons, we may not lose any sleep over this. If we are trying to keep the tension to plus and minus 1%, then we would be in very big trouble.
>
> Q. It follows that someone who builds a tape drive in accordance with the patents and, in particular, in accordance with equation 3 may not get a tape drive which works in the sense of adequately controlling tension.

A. That is possible.

407. It seems to me that the evidence shows that the erroneous equation will produce errors in the tension control. These errors will be most severe as the spools approach empty (or full). Whether the tension error will lead to "very big trouble" will depend on the demands of the application.

*The temperature function*

408. The passage in the specification which gives rise to this objection is as follows:

> **Temperature variations which will affect the measured values $V_1$ and $V_2$ will generally affect both motors to the same extent. Therefore by dividing equation (1) by equation (2) the functions f(T) will cancel out. The equation can therefore be resolved to derive a measure of tension t as follows:**
>
> $$t = N((V_1/x_2) - (V_2/x_1))/(V_2r_1+V_1r_2) \quad (3)$$

409. The experts were not entirely agreed as to whether this passage was effectively telling the skilled reader that he could ignore temperature, or warning him that he should ensure that the temperatures of the two motors were as close as possible. In my judgment the passage would alert the reader to the existence of a temperature effect and to the need not to allow too great a variation in temperature between the motors. It would also teach him that, to the extent that there were inevitable variations in temperature, the equation is good enough for the specific embodiment taught.

410. The evidence established that unmatched motor temperatures were both likely to occur and likely to give rise to tension errors. For example in Zipher's development of the Zodiac, differences in operating temperatures of as much as $9^o$ C were common. These temperature variations meant that the current subtraction method (described later in the patent) would not work in a practical thermal printer, although it worked for some cycles on the bench in a "proof of principle" machine. I reject the suggestion that this amounts to a sufficiently workable prototype for the purposes of the law of insufficiency in this case. The error introduced by the ratio method (equation (3)) was less significant. The motors in the Zodiac were closely thermally coupled on the same aluminium baseplate, but this was a common feature on thermal transfer machines.

411. In the end Dr McMahon thought there would be a weak effect due to temperature, but accepted it would occur.

412. The consequence is that there will be a further error in tension control due to unmatched temperature variations between the motors. Although it made the tension difference method wholly unsatisfactory, it was not so severe that it prevented the tension ratio method working in the specific example of the invention represented by the Zodiac printer, provided some precautions were taken to minimise temperature differences.

*No method of obtaining operational spool diameters*

413. One of the things which the tension equation requires is the up-to-date value of the spool diameters, or at least an estimate of it. The patent contains extensive teaching on the calibration of the printer, indicating the importance attached to obtaining accurate values for the spool diameters. In contrast very little is said about how the up-to-date value of the spool diameters is obtained during operation of the printer. This is said to be done "by reference to the stepper motors" at page 18 lines 14-16.

414. It will be recalled that the patent describes three methods of ascertaining the spool diameters. The first two (optical and back-emf) are, on the evidence, only practical methods at the calibration stage, not in operational use. This is despite the express suggestion in the patent that the Figure 19 method is suitable "during ribbon usage". Mr Taylor's evidence was that the third method (the constant area calculation) required knowledge of the up-to-date ratio of the spool radii, which the patentee does not describe how to determine. His conclusion was that the patentee must be suggesting a form of dead reckoning, which he concluded would not be accurate enough for many purposes. Dead reckoning involves working from the knowledge of the distance the tape advances to calculate the increase and decrease in spool diameters, by adding or subtracting twice the thickness of the tape for each revolution.

415. Dr McMahon's evidence in his report was that the current value of the spool ratio could be obtained from the stepping rates of the motors, and this could be used with the initial calibration values in the constant area equation. His cross examination went like this:

> Q. Nor would that work, or at any rate work very well, because it is circular. All you are doing is obtaining information which you need to know in the first place to drive the motors in push-pull.
>
> A. Yes. This argument of circularity has been advanced, I think, in one of the reports. I find it a little puzzling that in order to keep the tape tension under control, you have to get the payout of the tape balancing the take-up. That in itself means that our stepping rates are correct. What is actually happening is that we have a current view of the diameters. If that is a bit out, i.e. we are, say, increasing the tension in the tape, we will add or subtract a little bit of tape. The action of that will put a few more steps in. We are told to split the number of steps between the motors, which will give us essentially an updated value of the real diameters. I don't accept that it is circular.
>
> Q. How do you get the update in the reel diameters from that process?
>
> A. Well, as I said, in order to keep the tension under control, we add or subtract steps. Well, step is an angular movement for this motor. We know the amount of tape shifted because we have a value of it from the current value of radius. We could use that to work out what is the correction.

> Q. What reel diameters are you going to use next time you [e]valuate tension in the tension equation?
>
> A. Well, I would suggest, and I am not sure this is explicitly taught, and I may be reading things across from what the actual printers do, with those caveats, we can work with the current value which we have which enable us to get tension. That current value will not be exactly right but it will be very nearly right. That will enable us get a value of tension. If that tension is off our nominal, then we will make a correction by adding some steps. That will enable us to say, "Well, actually, we should say we made 100 steps, we really should have made 101, and that is telling us the radius is out by one part in 100. We can use that corrected value for the next stage, run that, and then, if necessary, correct it again." It is not a circular argument; it is a sequential correction, as the tape drive runs.
>
> Q. What you say in your second report paragraph 3.8.1 -- I don't think you need look at it but if you want to I am happy – is that the bald statement in the patent that changes in spool diameters are monitored by reference to the stepper motors is not a reference to a feedback mechanism. By implication therefore, all one is left with is some method of dead reckoning based on pulses sent to the stepper motors. That is right, is it not?
>
> A. No, I don't think that is right. The stepper motors themselves are not able to distinguish between steps, what the source of the instruction for the steps are. They just know the number of steps. If the tension control system adds some more steps, the motor just takes those as ordinary steps.

416. Mr Arnold seized on Dr McMahon's speculation that he might be reading things into the patent description from his knowledge of the actual printers. It is certainly correct that the method he described was not explicitly taught in the patent. Further, Mr Taylor identified a number of ways in which the Zodiac printer had used more sophisticated algorithms.

417. Mr Thorley submitted that the effect of the evidence was that one determines the current ratio by looking back over a convenient window to see how many steps each motor had turned during the window. The count will include any steps added or subtracted by the tension correction. The ratio thus obtained can be used in the area calculation. This process would be derived from a reading of the patent.

418. In my judgment, whilst the patent could have been clearer, it is not insufficient on this point alone. The skilled reader would appreciate that he could get the current spool radius ratio from the stepping rates of the motors. The formula assumes that the current ratio is known, and the skilled person would understand that the current stepping ratio would yield the ratio of the diameters. He would understand this would involve looking at an appropriate window and obtaining the ratio of steps taken, and applying this ratio to the formula. This process would inevitably involve taking

account of corrected steps – the motors cannot differentiate the source of steps as Dr McMahon said.

419. It is unfortunate that the patent suggests that the Figure 19 approach would be suitable for determining spool radii during ribbon usage. To reject this teaching would however not involve much more than the application of common sense, and would lead the skilled reader fairly quickly to the suggested alternative of the constant area calculation. I think this comes into the category of correcting obvious errors, which the law of sufficiency allows for.

420. Markem also argued that variations in the tension in the take up-reel and distortions of the ribbon due to removal of ink and trauma during printing would undermine the constant area assumption and contribute to the overall inaccuracy. Although one feels it is improbable that the take up reel will match the supply spool in this respect, there was no evidence as to the magnitude of this effect or that it would be significant.

*Control algorithms*

421. Markem also say, supported by Mr Taylor, that the control algorithm specifically taught is a PID controller. The use of the derivative term in the PID controller will exacerbate the noise and lead the reader to think that the error signal was clean, which it would not be.

422. Dr McMahon's evidence was that programming and implementing algorithms of this type was routine. I would not be inclined to uphold this as an independent insufficiency. But the direction to use a derivative term does add something further to the difficulties of implementing the teaching as a whole. It was not established, as Zipher somewhat belatedly tried to do, that it was common general knowledge to work systematically through the P, I and D terms so that the skilled person would not use the D term unless it was helpful.

*Calculate a length of tape*

423. Markem also contend that there is insufficient teaching of a method by which the length of tape extending between the spools may be altered in order to maintain tension between predetermined limits.

424. Markem submit that the patent does not teach a control algorithm which literally calculates a length of tape. I have dealt with aspects of this point under added matter above. There is no evidence that the skilled reader who thought it worthwhile literally to generate a signal which represented the length would be unable to do so, if he were able to solve the other problems the patent presents him with.

**Conclusion on main insufficiency attacks on 602**

425. The test which I need to apply to all this evidence is whether the patent imposes an undue burden on the skilled reader to arrive at a workable prototype of the invention. Like many issues in patent law, this involves a value judgment. I have come to the conclusion that the patent does not sufficiently describe a method of monitoring or controlling tension.

426. Firstly, it is important to remember that the patent does not teach any general method at all. Sufficiency of this patent turns on the sufficiency of the specific embodiment.

427. Secondly, the specific embodiment uses current to monitor and control tension. That idea is undoubtedly a clever one, but one of the reasons it is clever is because the skilled person would not readily see, particularly in the case of a stepper motor, how to get at the relevant current. I have accepted evidence of that kind when rejecting Markem's allegations of obviousness. The teaching of the patent as to how to obtain the tension or work-related current is therefore important: does it make possible, for someone seeking success, that which would have been thought challenging or impractical before?

428. In my view the specification does not give an adequate description of how to obtain the work related current and therefore how to monitor and control tension with a stepper motor. Simply to direct the reader to sample, filter and average a noisy waveform a few times per cycle does not approach an adequate teaching. The skilled reader is left with very much the same puzzle as he would have had if the idea had crossed his mind independently.

429. This is not a matter of allowing for reasonable trial and error. I think it would take something approaching invention – certainly a research project - to fill the gaps left by the patent's teaching. The problem left behind by the patent is an interesting and difficult one.

430. I have borne in mind the evidence called by Zipher about the Zodiac printer. But on the critical question of whether the skilled person would understand what he would have to measure and how I think it is of more assistance to Markem than to Zipher.

431. I have reached that conclusion on the basis of my findings about the difficulty of obtaining the relevant current. But if I am wrong and the skilled team could without undue effort solve the problem of obtaining some, albeit imperfect, value for current, the other insufficiencies have a role to play as well. It is not as if the puzzles about what to measure and how to measure it were the only ones which the skilled person is facing in what is otherwise a perfectly described system. The system is one which is and will remain a somewhat one-legged one because of the error in the tension formula. Unless one is luckily operating within a generous tension range there will be failure on this ground alone, let alone with imperfect values of the tension related current. The system will have further errors introduced by temperature variations. Further burdens are potentially imposed by the suggestion to use the current difference method. Moreover there are other statements in the patent calculated to mislead rather than assist, such as the statement about motor sizing, which is liable to encourage the team to try motors which would introduce other errors. There is also the encouragement to use a derivative term which I have held unhelpful as well.

432. In my judgment the patent presents the skilled reader with such a combination of defects that it does not serve as a clear or complete description of how to perform the invention.

433. It follows that all the claims relied on are invalid for insufficiency.

*Measurement of power - 375*

434. 375 contains an express suggestion that measurement of the current to the motors is an alternative to the current to the drives. Mr Thorley invited me to say that if I found that the preferred method was adequately disclosed, it did not matter if the alternative method would not work. In my judgment, such a course would normally only be legitimate if the evidence established that the skilled reader would see without undue research, enquiry or experiment, that the suggestion was not one to be pursued.

435. Dr McMahon's evidence about that passage was

> "The reader may be rather puzzled as to why this alternative means is at least hinted at or flagged, but is not expanded further. Whether that can be taken as a suggestion that it is a way to go is debatable. Because it is not expanded further, you may feel it is not a pointer on that route"

436. In my judgment, the passage in 375 in question is an express suggestion that measurement of current to the motors will yield useful results. I have no reason to doubt Mr Taylor's evidence that consideration of this approach caused him much puzzlement over a substantial period of time. That is not acceptable.

437. It follows that 375 is, on this further ground, invalid for insufficiency.

**Insufficiency through ambiguity**

*Predetermined limits*

438. I have been able to construe the term "predetermined limits". It follows that the use of the term in the claims does not give rise to any insufficiency.

*Control algorithms*

439. Markem submit that it is unclear what "control algorithm" covers. I do not think there is any real difficulty here. The term is a general one. The control algorithm must generate a signal which is capable of being translated into motor steps.

**Biogen Insufficiency**

440. Zipher's primary submission is that the claims in issue here leave no room for *Biogen* insufficiencies, as they are product claims. For the reasons I have given above I do not feel able to accept that submission. I must consider each of the objections in turn.

*Stationary tension measurement*

441. Markem submit that if the claims on their proper construction cover measurement of tension when the tape is stationary, then they are insufficient because when the tape is stationary it is not possible to measure tension using motor power.

442. I have held that the claims are insufficient along classical lines. Had I not done so, I do not believe that I would have held at least the product claims insufficient on this ground. The question would have been whether, at the level of generality at which the invention is claimed, it was reasonable to predict that other methods of tension

monitoring would work. Markem, by asking whether a specific method would work "using motor power" poses the question at too specific a level for these claims.

*Tension control without measurement*

443. I have held that claims 2 and 3 of 602 which provide for tension control without monitoring/measurement are bad for added matter. I think added matter is the most relevant objection here.

*Tension device in the tape path*

444. Markem submit that, if and in so far as the claims are construed to cover apparatus in which tension is measured and/or controlled using components which do contact the tape between the two spools, the claims owe nothing to the teaching of the patents and are insufficient.

445. The absence of some kinds of tension device is an advantage achievable with the invention claimed. The fact that it is possible not to achieve all advantages with all the embodiments of the invention is not, as it seems to me, the basis for a good insufficiency attack.

*Measuring one motor*

446. Markem say that to the extent that Zipher contend that the claims extend to measuring tension using information from only a single motor, such a system would owe nothing to the patents' teaching.

447. I do not accept that a device which measured tension using information from only one motor would owe nothing to the patent. The claims are not specific as to where the information comes from.

*Constant voltage power supply*

448. Markem's complaint, as I understand it, is that to the extent that the claims cover anything other than a constant voltage power supply, they are insufficient.

449. The evidence was that to use anything other than a constant voltage power supply would be perverse. Claims cannot be rendered insufficient by the fact that a perverse implementation would give rise to difficulties.

*Tape drives*

450. The patent expressly suggests that the tape drives of the invention may have application outside the field of thermal transfer printers. The expression "tape drives" covers a wide range of fields including printers, audio tape recorders, video tape recorders and computer tape drives. Each of these fields is itself wide: audio, for example, includes everything from a tiny Dictaphone cartridge recorder to a 24-track studio-quality reel-to-reel editing machine; video, likewise, covers both linear and helical scan technologies and everything from home-quality camcorder tapes to large broadcast quality editing machines.

451. Markem submit that the techniques taught in the patents (particularly in terms of both measuring tension and controlling the motors), even if they might be made to work for a limited class of thermal transfer printers, are wholly unsuitable across the range which the patentee has chosen to claim.

452. I have held that the directions in the patent are insufficient even for a thermal transfer printer. In the light of that conclusion, it is not necessary for me to go on to consider whether it was a reasonable prediction from the teaching in relation to thermal transfer printers that the invention could be made to work across the entire field of tape drives, where the demands placed on tape drives would, on the evidence, be greater.

*Thermal transfer printers*

453. Markem also contend that the claims which are limited to thermal transfer printers are too broad. In particular they rely on the fact that Zipher's Zodiac printer did not work satisfactorily with a shorter ribbon.

454. I do not think it was established that the claims are too broad in this respect.

## Infringement

## The alleged infringing machines

455. It is convenient first to describe some of the features of the alleged infringing machines.

*SmartDate 5 EV*

456. The SmartDate 5 comes in two model variants: shuttled and unshuttled. The shuttled version cannot infringe claim 33 of 375 because it has a fixed printhead. Otherwise it is common ground that there is no distinction between shuttled and unshuttled for the purposes of infringement. The following diagram shows the layout of the SmartDate 5 ribbon cassette:

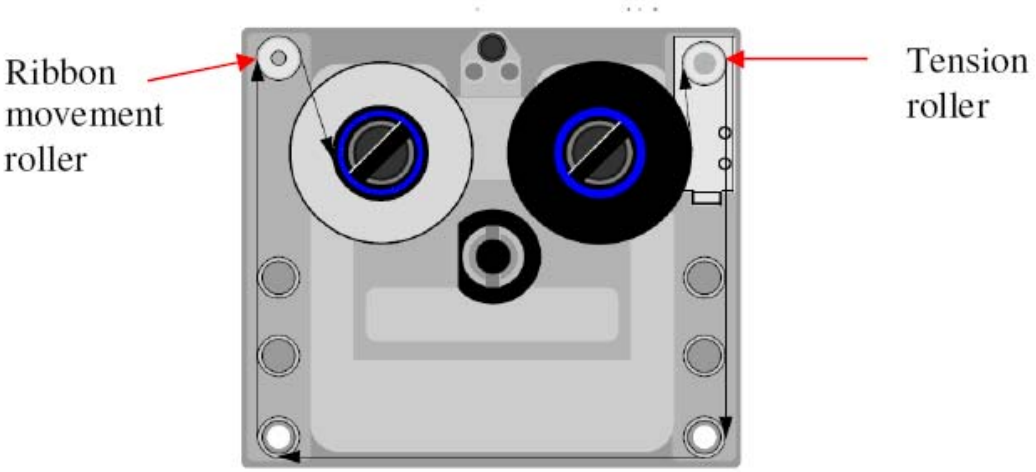



**Figure 28**
**SmartDate 5**

457. The tension roller is mounted on a linear slide. In use one end of the linear slide is held in contact with a piezo-resistive sensor. Samples are only taken from the piezo-resistive sensor when the tape is stationary.

458. A proportional-integral (PI) algorithm is used to derive an adjustment which strives to bring the tension back to a set point. There is a deadband to stabilise the loop, outside which the controller effects a correction. Markem accept that the EV carries out a calculation which translates the desired tension calculation into a number of motor steps using the ratio between ribbon distance and motor steps. It does not literally calculate a length of tape. The correction is applied to one of the motors.

459. Markem contend that the SmartDate 5 EV does not infringe for a number of reasons:

i) Markem contend that the controller is not operative to monitor tension in a tape being transported between spools mounted on the spool supports (claim 1(e)). This is the point of construction which I have resolved against Markem above.

ii) Markem contend that the controller is not operative to control the motors to maintain the monitored tension between predetermined limits (claim 1(e)). These issues are disposed of by the construction which I have adopted. The correction does not have to be applied to both motors. Further, as I have construed the term "predetermined limits", the controller must be operative to keep the tension within acceptable limits. This is what the controller does in this apparatus.

iii) Markem contend that the controller is not configured to implement a control algorithm to calculate a length of tape to be added or subtracted ... in order to maintain tension within predetermined limits (claim 2(e)). This argument depends on taking a literal view of what the calculation requires, which I have rejected.

iv) Markem contend that the controller is not configured to control the motors to add or subtract the calculated length of tape (claim 2(e)). This, again, depends on a construction of the claims which I have rejected.

v) Markem contend that tension in the tape being transported is not determined by control of the stepper motors (claim 3(e)). As I have construed that term there must not be any components in the path of the tape which control as opposed to merely monitor tension. The tension roller in the EV is there to monitor tension: the tension is determined (as I have construed that term) by the control of the stepper motors.

460. Markem also contend that it is not established that claim 33 of 375 is infringed by the unshuttled version of the SmartDate 5. In his expert report Dr McMahon explained why it seemed to him that the apparatus did enable the printhead to be adjusted for optimum print position in the manner claimed in claim 33 of 375, but he had not been given access to the software to confirm this. In cross examination, he said that he could not say *for sure* without seeing the code.

461. Markem have adduced no positive evidence on the point. The question is therefore whether Dr McMahon's evidence is sufficient to make it more likely than not that the claimed feature is present. In my judgment it is. The absence of absolute confirmation from the code is beside the point.

462. Markem have two further construction-based points on why claim 33 of 375 is not infringed. These are based on what is meant by "controller" and the relevant angle. On the construction I have adopted, these points do not assist Markem.

*SmartDate 5 LV*

463. There is no mechanical difference between the SmartDate EV and LV. The differences are:

i) There is no deadband.

ii) The controller does not use the ribbon step ratio: it uses a fixed ratio to convert the correction to motor steps.

464. The effect of these changes is that under some conditions the controller will add more tape (and under others it will not add as much) as it would have done if it had used the current value of the ribbon step ratio.

465. In my judgment these changes do not avoid infringement. The controller is still calculating an adjustment measure which is then translated (albeit with less accuracy than before) into motor steps. The end result of maintaining the tension within acceptable limits is still achieved.

*Series 18*

466. The arrangement of the Series 18, which is a lower cost version of the SmartDate 5, is below:

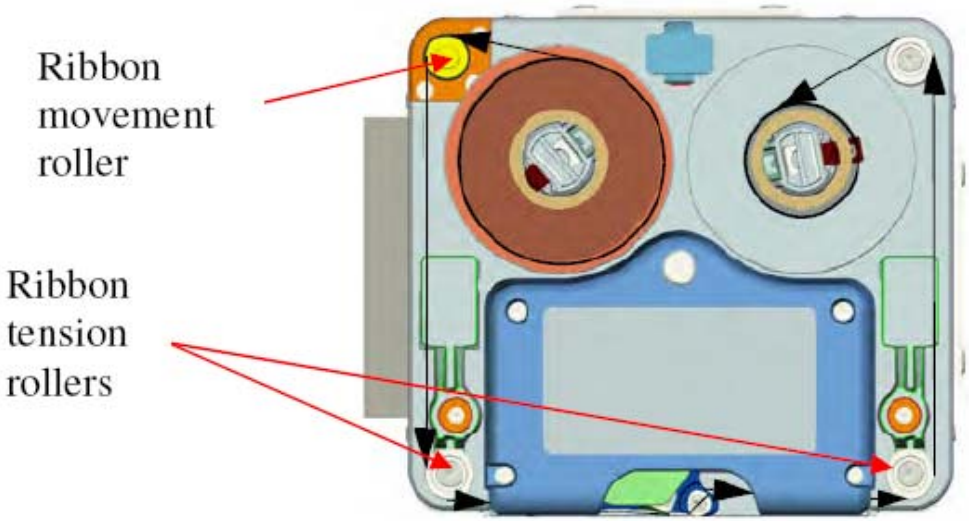



**Figure 32**

467. The Series 18 printers have two spring-loaded, pivoting, tension roller arms which move according to the tension in the ribbon. As the tension in the ribbon changes, a magnet in the end of the arm sends a signal which causes a correction to be applied to one of the motors. The movement of these arms counteracts small errors in tension.

468. The Series 18 is not alleged to infringe claim 3. I consider that concession rightly made, as the motors do not wholly determine the tension in the tape. So far as claims 1 and 2 are concerned the position is the same as for the SmartDate 5.

**Conclusion**

469. My principal conclusions are:

i) Zipher is precluded by its undertaking to HHJ Fysh QC from pursuing Markem in respect of the claims of 602 which it wishes to assert.

ii) If Zipher had not been precluded from pursuing the application, I would not have refused the application to amend on discretionary grounds.

iii) 602 is invalid for insufficiency and remains so even if amended.

iv) The Adkin Memorandum was not made available to the public.

v) Amended claim 1 and 6 of 602 would additionally be invalid (for lack of inventive step over Datamax).

vi) The amendment to Claims 2 and 3 of 602 would add matter.

vii) If they had been valid and if I had allowed the amendment, claims 1-4 and 6 of 602 would be infringed by the SmartDate 5 EV and LV, and the Series 18 would have infringed claims 1, 2 and 6.

viii) 375 is invalid for insufficiency.

ix) If 375 had been valid, claim 33 would have been infringed by the unshuttled SmartDate 5 EV and LV.