



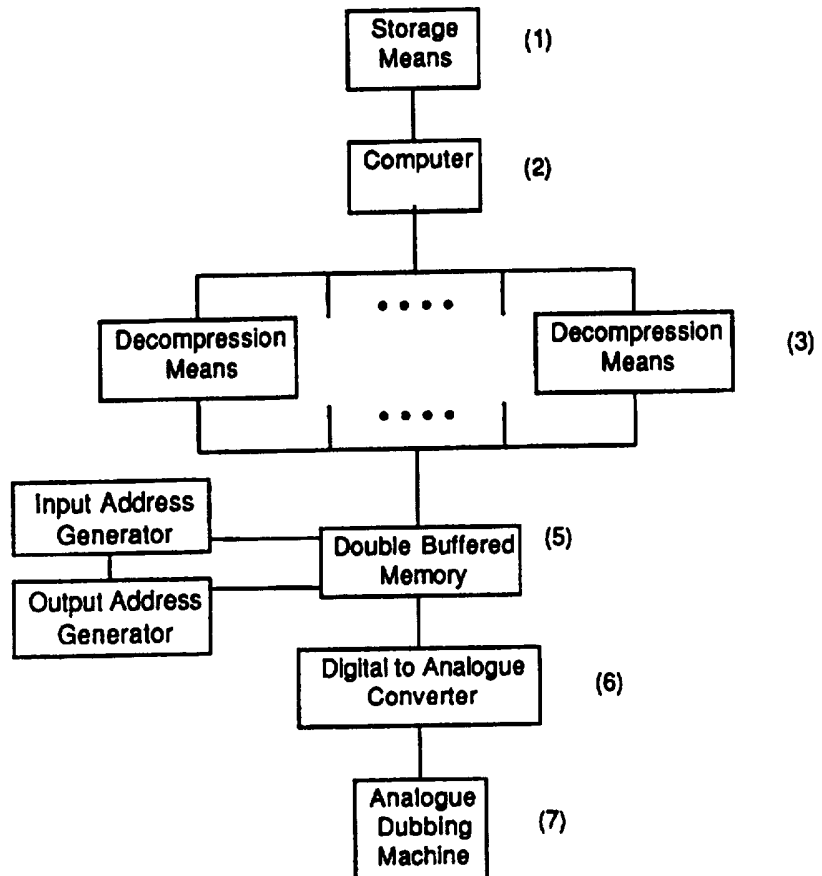
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : G11B 20/02, 20/10</p>	<p>A1</p>	<p>(11) International Publication Number: WO 96/18191 (43) International Publication Date: 13 June 1996 (13.06.96)</p>
<p>(21) International Application Number: PCT/AU95/00822 (22) International Filing Date: 5 December 1995 (05.12.95) (30) Priority Data: PM 9875 5 December 1994 (05.12.94) AU (71) Applicant (for all designated States except US): SOUTHERN BROADCASTING SYSTEMS PTY. LTD. [AU/AU]; 72 Kings Park Road, Western Perth, W.A. 6005 (AU). (72) Inventor; and (75) Inventor/Applicant (for US only): O'SULLIVAN, Daniel, Shane [AU/AU]; 4 Yorston Place, Hamilton Hill, W.A. 6163 (AU). (74) Agent: WATERMARK; Durack Centre, 4th floor, 263 Adelaide Terrace, Perth, W.A. 6000 (AU).</p>		<p>(81) Designated States: AL, AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, LS, MW, SD, SZ, UG). Published <i>With international search report.</i></p>

(54) Title: HIGH SPEED DUBBING OF COMPRESSED DIGITAL AUDIO

(57) Abstract

High speed dubbing of compressed digital audio into analog storage (1) by dividing the compressed digital audio signal into a plurality of portions, interleaving the portions to respective decompression means (3) which separately decompress in parallel each portion, then recombining the portions and converting into analog form for transfer to analog storage (1). The decompression means (3) may run at greater than normal speed to allow the sound artefact at the join between the portions to be removed, also use of common or redundant data across a join is shown. High speed dubbing of an analog signal into compressed digital data storage by converting the analog signal to digital form, dividing the digital data into a plurality of portions which are separately compressed through respective compression means in parallel, recombining and transferring to digital storage. A memory (5) can be used to interleave and deinterleave the portions, this may be double buffered.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgystan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CS	Czechoslovakia	LV	Larvia	TG	Togo
CZ	Czech Republic	MC	Monaco	TJ	Tajikistan
DE	Germany	MD	Republic of Moldova	TT	Trinidad and Tobago
DK	Denmark	MG	Madagascar	UA	Ukraine
ES	Spain	ML	Mali	US	United States of America
FI	Finland	MN	Mongolia	UZ	Uzbekistan
FR	France			VN	Viet Nam
GA	Gabon				

HIGH SPEED DUBBING OF COMPRESSED DIGITAL AUDIO

Field of Invention

This invention relates generally to recording technology, and in particular to dubbing of digitally recorded audio onto analogue tapes at high speeds.

5 In particular, the present invention is applicable for the dubbing of recordings of court transcriptions and music quality stereo recordings.

Background Art

The advent of digital technology has allowed for audio to be digitally recorded, providing substantial advantages in costs, storage requirements and
10 quality. However, even though digital technology is available there is still a large demand for analogue copies of the digital recordings.

It is desirable in many court systems, particularly in the United States of America, to be able to obtain copies of the audio court transcripts on analogue tape, usually within 24 hours. To this end the present Applicants have disclosed
15 an invention which allows transcripts to be readily accessible in International Patent Application No. PCT/AU94/00765, details of which are incorporated herein by reference.

However, the applicants prior invention stores the audio as compressed digital data, such that in order to listen to the transcript a person could not utilise
20 standard analogue tape players unless an analogue copy of the transcript was made.

It is desirable in at least Court environments to be able to provide copies of the court transcriptions within a working day, and to also preferably take advantage of digital technology, as disclosed in the Applicants above noted
25 application.

The problem of dubbing digital recordings onto analogue tapes at speed ratios greater than 1:1 is not limited to court transcription systems. For example the music industry, still has substantial sales in standard analogue cassette tapes. Because of the advantages associated with digital technology, such as
30 superior sound, most recordings are digitally recorded. In order to mass produce audio cassettes from such recordings it is usual for a master analogue tape to be produced from the digital recording at a speed ratio of 1:1, and for

further tapes to then be produced from that master tape using standard analogue dubbing hardware.

The ability to copy an analogue tape at high speed directly from a digital master recording would significantly decrease the amount of noise and quality degradation that is presently introduced when copying from a digital recording to an analogue master tape and then high speed copying the analogue master tape.

While digitally recorded audio has advantages over analogue recorded audio, analogue audio has always been easier to duplicate because of the ability to use high speed dubbing. In a digital system this has been difficult to achieve as the usual practice when storing audio in a digital format is to compress the data (preferably without any loss in quality) in order to minimise the storage requirements. The digital audio therefore has first to be decompressed before dubbing can be done.

Up to now decompression at speed ratios greater than one to an industry acceptable standard has been difficult to achieve.

One solution to the problem would be to use digital signal processors with the ability to process data at multiple speeds. Whilst such a solution is possible it presents serious disadvantages. Such digital signal processors are by themselves expensive, and in cases where more than one channel is involved this cost is magnified, as a separate digital signal processor would be required for each channel. Additionally, in order for the digital signal processor to operate effectively, other high speed chips, such as memory and communication chips, would be required. Again adding to the cost. Further large outlays would also be required in order to create and program algorithms to operate the digital signal processor. Hence the use of such digital signal processors is currently not a viable solution.

Objects of the Invention

There is therefore a need for a relatively inexpensive digital dubbing system able to handle common speed ratios and match the speed of existing tape decks, without compromising the quality of the audio. An object of the present invention is to alleviate some of the disadvantages of the prior art.

Summary of Invention

In order to address the problems noted above the present invention provides in one aspect a method and/or apparatus of high speed dubbing of a compressed digital audio signal onto an analogue storage means including
5 dividing the compressed signal into a plurality of portions and separately decompressing each portion through a respective decompression means in parallel.

However, this dividing and interleaving presents further problems in that a sound artefact is created at the join points of the recombined audio signal.
10 Therefore another aspect of the present invention relates to solving the problem created by the sound artefacts resulting from the interleaving necessary for parallel processing.

This aspect is predicated on the principle of replacing the sound artefact otherwise created by decompression with an overlapping, enlarged or extended
15 portion of signal.

In this regard the present invention provides in yet a further aspect a method for high speed dubbing of a compressed digital audio signal onto an analogue storage means, including the steps of:

20 dividing the compressed digital audio signal into a plurality of portions,
each portion having an overlap,
interleaving the portions to respective decompression means,
separately decompressing each portion thereof in parallel,
recombining the portions wherein the overlap provides for correction of a
sound artefact.

25 One alternative used to remove the sound artefact is to provide additional decompression components, such that the additional unit(s) will process data immediately before and after the join point. The data thus provided by the additional unit(s) will then be used to replace those beginning portions which contain the sound artefact.

30 Another alternative useful in removing the sound artefact is to run the decompression unit at greater than normal speed. By running at this increased speed it is then possible to overlap the portions, such that each decompression

unit will also decompress the first bytes of the next portion. The overlap between portions is used to eliminate the sound artefact which occurs at the beginning of the decompression of a discontinuous portion of digital audio at the portion boundary. The sound that is distorted at the beginning of the portion will
5 be faithfully decompressed in the overlap on a different decompression digital signal processor. This is then used to replace the first bytes of the next portion thus removing the sound artefact.

This invention provides in another aspect a method for high speed dubbing of a compressed digital audio signal onto an analogue storage means,
10 including the steps of:

dividing the compressed digital audio signal into a plurality of portions,
interleaving the portions to respective decompression means,
separately decompressing each portion thereof in parallel,
recombining the portions,
15 converting combined portions of decompressed digital audio into analogue data, and
transferring the analogue data onto an analogue storage means.

The compressed digital audio signal is preferably first retrieved from a digital storage means. The interleaving of the portions may include the step of
20 the decompression means receiving the portions sequentially, and the memory means may also be used to recombine the portions by first reading in the portions from each decompression means and then outputting each portion in order to deinterleave the signal

The sound artefact may be removed by additionally decompressing data
25 immediately before and after each join between adjacent portions. Alternatively the sound artefact may be removed by first dividing the compressed digital audio into a plurality of portions such that a part of each portion is also contained in a part of an adjacent portion. Preferably an adjacent portion contains common data such that data immediately at the end of each portion is
30 also contained at the beginning of a next adjacent portion. Ideally the common data contained in two adjacent portions should be sufficient to enable the sound artefact to be completely removed between those two portions. The

decompression means and memory means can then be operated at a greater than normal speed to enable each portion together with the common data to be processed in the time it would normally take to process each portion had there been no common data.

5 In yet another aspect this invention provides a high speed dubber for dubbing of a compressed digital audio signal onto an analogue storage means, the dubber including:

a control means adapted to divide the compressed digital audio signal into a plurality of portions, interleave and then transfer the portions,

10 a plurality of decompression means each adapted to receive interleaved portions from the control means and decompress the portions in parallel,

a memory means adapted to receive decompressed portions from the decompression means and then effectively deinterleave the portions,

15 a conversion means adapted to convert decompressed digital audio into analogue data,

a writing means adapted to transfer the analogue data onto an analogue storage means.

The control means preferably receives the compressed digital audio signal from a digital storage means. Ideally the control means can be a
20 computer adapted to retrieve the compressed digital audio signal, divide the signal into a plurality of portions and interleave the portions by transferring each portion in turn to a separate decompression means. The deinterleaving may be achieved by using a double buffered memory, each side of which alternates between reading in the decompressed data and reading out the decompressed
25 data in a deinterleaved order.

To remove the sound artefact a first clock means may be adapted to operate the decompression means at a greater than normal speed to enable each portion to also contain a part of an adjacent portion without substantially affecting the throughput of the decompression means. Preferably an input
30 address generator and an output address generator are also connected between the double buffered memory and the first clock means so that the memory means can run at a speed equal to that of the decompression means.

A second clock means may also preferably be provided to operate the conversion means at its normal operating speed.

In a further aspect of this invention it has been discovered that a need exists to be able to dubb existing analogue tapes into digital storage. In such
5 circumstances the present invention can be utilised effectively in a reverse manner. That is the analogue tape is played at 8 or 16 times speed, digitised and compressed into digital storage. Multiple digital signal processors can again be used in parallel with extra speed clocking margin to suppress the audio artefacts at the boundaries between each portion of audio handled by
10 each digital signal processor.

In order to address this need the present invention provides in another aspect a method and/or apparatus for high speed dubbing of an analogue signal into a compressed digital data storage means including converting the analogue signal into digital data, dividing the digital data into a plurality of
15 portions and separately compressing each portion through respective compression means in parallel.

In yet another aspect the present invention provides a method for high speed dubbing of an analogue signal into a compressed digital data storage means, including the steps of:

- 20 converting the analogue signal into digital data,
 dividing the digital data into a plurality of portions,
 interleaving the portions to respective compression means,
 separately compressing each portion thereof in parallel,
 recombining the portions,
- 25 transferring compressed digital data into a digital data storage means.

In yet a further aspect the present invention provides a high speed dubber for dubbing of an analogue signal into a digital data storage means, the dubber including:

- 30 a reading means adapted to transfer the analogue signal to a conversion means,
- the conversion means adapted to convert the analogue signal into digital data,

a memory means adapted to receive the digital data from the conversion means and then effectively divide the digital data into a plurality of portions,

a plurality of compression means each adapted to receive respective interleaved portions from the memory means and compress the interleaved
5 portions in parallel, and

a control means adapted to recombine the interleaved portions into compressed digital data.

Brief Description of Drawings

The invention will be more fully understood from the following
10 descriptions of examples of the dubber system and as illustrated in the accompanying drawings. It is however to be appreciated that the present invention is not limited to the described examples.

Figure 1 is a procedural flow diagram outlining the major steps in the invention.

15 Figure 2 is a similar procedural flow diagram outlining the major steps in the invention including suppression of the sound artefact.

Figure 3 shows the invention of Figure 2 in reverse to allow analogue audio to be dubbed at high speed into digital storage.

Referring now to Figure 1, if we consider that multitrack compressed
20 digital audio has been stored on a computer or in some other storage means (1) easily accessible via the computer (2), then in a preferred arrangement the means employed is to break the multitrack compressed digital audio into multisecond portions, interleave this data and transmit this time interleaved at multiplied speed to 8 or 16 times the usual number of digital decompression
25 components (3), each decompressing a 1/8 or 1/16 portion of the digital audio in parallel and writing 8 or 16 decompressed digital audio streams per track to a double buffered memory (5). It will be appreciated that while most commercial tape dubbers run at 8 or 16 times speed, other ratios are equally applicable.

After a small time delay to allow sufficient amount of decompressed
30 digital audio to be accumulated in the buffer memory (5) it is read out in a different order in series as 8 or 16 times speed multitrack decompressed digital audio, which is passed to high speed digital to analogue converter

components (6), one per track, which can function at this speed.

This results in multitrack analogue audio at 8 or 16 times speed, which is what would be obtained from the master unit of an industry standard master/slave 8 or 16 times speed analogue cassette tape dubbing (duplication) machine. This is passed to the slave unit (7) and a cassette can be dubbed with it.

The apparatus according to the present invention provides a means of playing back compressed digitally recorded multitrack audio at 8 or 16 times normal playback speed in order to record it on analogue cassette tape at this high speed using the slave unit of an industry standard master/slave 8 or 16 times speed analogue cassette tape dubbing (duplication) machine (7), with the high speed digital playback unit (2,3,4,5,6) replacing the analogue cassette master unit.

The digital unit includes multiple digital signal processors (3) connected in parallel, each decompressing a portion of the digital audio, such that the digital audio is converted to analogue audio at a rate comparable to that of the cassette unit.

Referring now to Figure 2, the present invention allows for the dubbing of digital audio onto analogue cassettes by dividing the digital signal into a plurality of discrete portions and interleaving the portions, each of which are then processed in parallel before being recombined. The parallel processing thus enables the digital audio to be converted into a suitable format so as to enable existing analogue dubbing hardware to be utilised.

As part of the decompression operation the decompression algorithm maintains a series of rolling coefficients to assist in the processing of the data. These coefficients are updated every sample and effectively track the immediate past. Where standard processing of digital data is performed, such that byte two follows byte one, the value of this coefficient is not an issue as the coefficient correctly reflects the previous value. However, the applicants system differs in that it splits the digital data into discrete portions and interleaves those portions such that byte two does not necessarily follow byte one.

Such a system leads to the creation of sound artefacts, whereby a slight

discontinuity in the sound is found at the join points between the sections of audio that are decompressed by different components in parallel. This is caused by the fact that each decompression component is decompressing discontinuous multisecond portions of audio and they maintain certain rolling
5 coefficients which have the wrong values for a moment immediately after the join point. Even though the coefficients are self adapting such that they converge to the correct value, the incorrect value, even though momentary has the effect of creating a sound artefact which varies from inaudible to a slight click or pop, depending on the variance of the coefficient from the correct value.

10 Attempts to filter or mute the resultant sound artefact usually resulted in the production of a less acceptable noise or an equally unacceptable period of silence.

However, as the spoken language has a large proportion of breaks or silences, for some applications which deal predominantly with voice recordings,
15 the creation of sound artefacts may be acceptable, as a large proportion of the artefacts tend to occur during breaks in the speech. In these circumstances, in order to minimise the effect of the sound artefact the memory buffer size is maximised for long time portions, so as to produce the longest time between occurrences of the sound artefact.

20 However, in most circumstances where a continuous audio output is desired, such as the applicant's court transcription system and the music industry, any sound artefact is not acceptable. Therefore, the present invention will preferably remove the resultant sound artefacts, by overlapping the sound at the join points such that the beginning of each decompressed portion, which
25 contains the sound artefact, will be replaced by the end of the previous portion overlapping it.

Further with regard to Figure 2, again compressed digital audio has been filed on some storage means (8) easily accessible via the computer (9). The computer (9) which utilises double buffering reads in a block of data which is
30 then divided into portions and interleaved into the computers memory ready for outputting to the multiple decompression means (10).

The multiple decompression means (10) are run at greater than normal

speed, so as to allow overlapping of the audio at the joins caused by the interleaving, in order to suppress the sound artefact. This speed increase can be achieved by incorporating a first clocked state machine (16) that adjusts the clock (18) input to the multiple decompression means (10). The clocking pulse
5 from the first state machine (16) is also used to synchronise the address generators (14,15) linked to the buffered memory (11).

The digital compressed interleaved audio is transmitted from the computer (9) to eight or 16 times the usual number of digital signal processors (10), each decompressing a 1/8 or 1/16 portion of the digital audio and writing
10 the decompressed audio to the double buffered memory (11). The sound artefact however is not written to memory (11) and is simply discarded. The address generators (14,15) which are also run at a speed equal to the multiple decompression means (10) effectively deinterleave the audio in the buffer memory (11). The memory (11) is required to run at a speed comparable to that
15 of the multiple decompression means (10) as the non write cycle which discards the sound artefact still takes time.

After a small time delay to allow sufficient amount of decompressed digital audio to be accumulated in the buffer memory (11) it is read out in a different order in series as 8 or 16 times speed multitrack decompressed digital
20 audio, which is passed to high speed digital to analogue converters components (12), one per track, which can function at this speed.

The digital to analogue converters (12) are running at their normal speed, being connected to a second clocked state machine (17). In order, to operate effectively and match the speed of the data from the memory (11), the digital to
25 analogue converters (12), can be configured to function with each clock cycle corresponding to the removed sound artefact suppressed.

This results in multitrack analogue audio at 8 or 16 times speed, which is what would be obtained from the master unit of an industry standard master/slave 8 or 16 times speed analogue cassette tape dubbing (duplication)
30 machine. This is passed to the slave unit (13) and a cassette can be dubbed with it.

In a preferred example for 4 track dubbing at a speed ratio of 8 without

removing the sound artefact, a computer accesses the compressed digital audio stored in files. 64 seconds of this compressed digital audio for each of four tracks is then read into the computer at eight times the normal speed, that is in eight seconds. This 64 seconds of compressed digital audio is then split into
5 eight sequential portions of eight seconds for each of the four tracks and interleaved into memory as 32 channels. The interleaving is such that the first byte of each channel is processed first, then the second bytes and so on. That is the interleaving results in the reordering of the bytes such that byte one for channels one to 32 is followed by byte two of channels one to 32 and so forth.
10 This is then written to 32 single channel decompression digital signal processors. Decompressed audio is then stored in one half of a buffer memory. Every eight seconds this process is repeated alternating which half of the buffer memory is written to. Simultaneously the other half of the buffer memory (which was written to in the previous eight seconds), is read out in deinterleaved order
15 such that it is once again in four channel order. This results in four track decompressed digital audio which is then passed through four high speed digital to analogue converters, finally giving analogue audio compatible with the input of an eight times speed analogue stereo cassette recorder commonly used for high speed cassette dubbing or duplication.

20 In an alternative example for four track dubbing at a speed ratio of 16 and also suppressing the sound artefact, the computer reads in 16 seconds of compressed digital audio for each of four tracks at 16 times the normal speed, that is in one second. The compressed digital audio is then split into 16 sequential portions of $5/4$ seconds for each of four channels with a $1/4$ second
25 overlap and interleaved into memory as 64 channels. The interleaved audio will then be written to 16 quad channel decompression digital signal processors running at $5/4$ times normal speed. This increase in speed is achieved by having the clock input to the decompression means coming from a state machine which effectively divides the system clock running at 20MHz by four,
30 thus providing the decompression means with a clock rate of 5MHz and not the usual rate of 4MHz. This slight increase in clock rate is however within the tested margins for the components. The decompressed audio is then

alternatively written to one half of the buffer memory. At this time the first 1/4 second of each portion which contains the sound artefact is discarded. The extra 1/4 second overlap between portions is used to eliminate the sound artefact. This is repeated every one second. Simultaneously the other half of the
5 buffer memory (which was written to in the previous one second), is read out in deinterleaved order such that it is once again in four track order. This results in four track decompressed digital audio which is then passed through four high speed digital to analogue converters. The digital to analogue converters are connected to another state machine which suppresses every fifth 5MHz clock
10 cycle, thereby allowing the digital to analogue converters to run at their normal rating of 4MHz. The digital to analogue converters must run at an average of 4MHz but can function with a 5MHz clock with each fifth 5MHz clock cycle suppressed, thus matching the speed of the buffer memory. The result is to produce analogue audio compatible with the input of a 16 times speed
15 analogue stereo cassette recorder commonly used for high speed cassette dubbing or duplication.

The present invention provides a system that is significantly cheaper than what is currently available without sacrificing quality. However, it will be appreciated that further cost savings can be made by decreasing the size of the
20 buffer memory. This can be achieved by minimising the size of each portion and therefore the size of the buffer memory required, such that each portion is only a fraction of a second.

Referring now to Figure 3, if it is also desired to dubb at high speed into digital storage, audio is first played at 16 times speed from a high speed tape
25 deck (19), then digitised at 16 times speed by one high speed analogue to digital converter (20) per track into one half of a buffer memory. Simultaneously the other half of the buffer memory is read out in interleave order in multiple overlapping portions which are distributed to multiple digital signal processors (21) in parallel, each of which compresses a portion. A slightly higher than
30 usual clock speed is used to allow a portion plus overlap to be compressed in the time usually allowed for the compression of an unoverlapped portion. These interleave and overlapped portions of compressed digital audio are then read

from the digital signal processors into a computer memory, discarding the overlaps in the process. They are then deinterleaved in memory by the computer and then stored in files in the same form as if the analogue audio had been straightforwardly digitised and compressed at normal speed.

- 5 It is to be understood that where this specification has referred to the term "MHz", this term is to be given its standard digital telecommunications industrial meaning such that 1MHz is equivalent to 1.024MHz.

The above improvements enable the high speed dubbing of digital audio onto analogue cassettes using existing technology. Standard digital signal
10 processors are used to convert the digital audio into analogue audio which is then passed to existing industry standard high speed dubbing tape decks. The use of standard digital signal processors may require more componentry than specialised digital signal processors. However the end result will be a system that is relatively cheaper and able to match market requirements, and in another
15 aspect substantially suppressing the sound artefacts created by the interleaving process.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of high speed dubbing of a compressed digital audio signal onto an analogue storage means including dividing said compressed signal into a plurality of portions and separately decompressing each said portion through a respective decompression means in parallel.
2. A method for high speed dubbing of a compressed digital audio signal onto an analogue storage means, including the steps of:
 - dividing said compressed digital audio signal into a plurality of portions,
 - interleaving said portions to respective decompression means,
 - separately decompressing each portion thereof in parallel,
 - recombining said portions,
 - converting combined portions of decompressed digital audio into analogue data, and
 - transferring said analogue data onto an analogue storage means.
3. A method as claimed in any one of the preceding claims wherein the compressed digital audio signal is first retrieved from a digital storage means.
4. A method as claimed in claim 2 or 3 wherein the interleaving of said portions includes the step of the decompression means receiving said portions sequentially.
5. A method as claimed in any one of the preceding claims wherein a memory means is used to recombine the portions by first reading in the portions from each decompression means and then outputting each portion in order to deinterleave the signal.
6. A method as claimed in any one of the preceding claims including additionally decompressing data immediately before and after each join between adjacent portions.

7. A method as claimed in any one of claims 1 to 5 wherein the compressed digital audio is divided into a plurality of said portions such that a part of each said portion is also contained in a part of an adjacent portion.
8. A method as claimed in claim 7 wherein each adjacent portion contains common data such that data immediately at the end of each portion is also contained at the beginning of a next adjacent portion.
9. A method as claimed in claim 8 wherein the common data contained in two said adjacent portions is sufficient to remove a sound artefact between those two portions.
10. A method as claimed in one of claims 7 to 9 including operating the decompression means and memory means at a greater than normal speed to enable each portion together with the common data to be processed in the time it would normally take to process each portion alone.
11. A high speed dubber for dubbing of a compressed digital audio signal onto an analogue storage means, said dubber including:
a control means adapted to divide the compressed digital audio signal into a plurality of portions, interleave and then transfer said portions,
a plurality of decompression means each adapted to receive interleaved portions from said control means and decompress said portions in parallel,
a memory means adapted to receive decompressed portions from said decompression means and then effectively deinterleave said portions,
a conversion means adapted to convert decompressed digital audio into analogue data, and
a writing means adapted to transfer said analogue data onto an analogue storage means.
12. A high speed dubber as claimed in claim 11 wherein the control means

receives the compressed digital audio signal from a digital storage means.

13. A high speed dubber as claimed in any one of claims 11 or 12 wherein said control means is a computer adapted to retrieve said compressed digital audio signal, divide said signal into a plurality of portions and interleave said portions by transferring each portion in turn to a separate decompression means.

14. A high speed dubber as claimed in any one of claims 11 to 13 wherein a first clock means is adapted to operate said decompression means at a greater than normal speed to enable each said portion to also contain a part of an adjacent portion without substantially affecting throughput of said decompression means.

15. A high speed dubber as claimed in any one of claims 11 to 14 wherein said memory means is double buffered, each side of which alternates between reading in said decompressed data and reading out said decompressed data in a deinterleaved order.

16. A high speed dubber as claimed in claim 15 wherein an input address generator means and an output address generator means are connected between said double buffered memory and said first clock means such that the memory means is run at a speed equal to that of said decompression means.

17. A high speed dubber as claimed in any one of claims 11 to 16 wherein a second clock means is provided to operate said conversion means at its normal operating speed.

18. A method of high speed dubbing of an analogue signal into a compressed digital data storage means including converting said analogue signal into digital data, dividing said digital data into a plurality of portions and separately compressing each said portion through respective compression

means in parallel.

19. A method for high speed dubbing of an analogue signal into a compressed digital data storage means, including the steps of:

converting said analogue signal into digital data,
dividing said digital data into a plurality of portions,
interleaving said portions to respective compression means,
separately compressing each portion thereof in parallel,
recombining said portions,
transferring compressed digital data into a digital data storage means.

20. A method as claimed in claim 18 or 19 wherein the analogue signal is first retrieved from a high speed tape deck.

21. A method as claimed in claim 19 or 20 wherein the interleaving of said portions includes the step of the compression means receiving said portions sequentially.

22. A method as claimed in any one of claims 18 to 21 wherein a memory means is used to divide said digital data into said portions for interleaving to said compression means.

23. A method as claimed in any one of claims 18 to 22 including additionally compressing data immediately before and after each join between adjacent portions.

24. A method as claimed in any one of claims 18 to 22 wherein said digital data is divided into a plurality of said portions such that a part of each said portion is also contained in a part of an adjacent portion.

25. A method as claimed in claim 24 wherein each adjacent portion contains common data such that data immediately at the end of each portion is also

contained at the beginning of a next adjacent portion.

26. A method as claimed in claim 25 wherein the common data contained in two said adjacent portions is sufficient to remove a sound artefact between those two portions.

27. A method as claimed in one of claims 24 to 26 including operating the compression means and memory means at a greater than normal speed to enable each portion together with the common data to be processed in the time it would normally take to process each portion alone.

28. A high speed dubber for dubbing of an analogue signal into a digital data storage means, said dubber including:

a reading means adapted to transfer said analogue signal to a conversion means,

said conversion means adapted to convert said analogue signal into digital data,

a memory means adapted to receive said digital data from said conversion means and then effectively divide said digital data into a plurality of portions,

a plurality of compression means each adapted to receive respective interleaved portions from said memory means and compress said interleaved portions in parallel, and

a control means adapted to recombine said interleaved portions into compressed digital data.

29. A high speed dubber as claimed in claim 28 wherein the control means transfers the compressed digital data to a digital storage means.

30. A high speed dubber as claimed in claim 28 or 29 wherein a second clock means is adapted to operate said compression means at a greater than normal speed to enable each said portion to also contain a part of an adjacent

portion without substantially affecting throughput of said compression means.

31. A high speed dubber as claimed in any one of claims 28 to 30 wherein said memory means is double buffered, each side of which alternates between reading in digital data from said conversion means and reading out interleaved digital data to respective compression means.

32. A high speed dubber as claimed in claim 31 wherein an input address generator means and an output address generator means are connected between said double buffered memory and said second clock means such that the memory means is run at a speed equal to that of said compression means.

33. A high speed dubber as claimed in any one of claims 28 to 32 wherein a first clock means is provided to operate said conversion means at its normal operating speed.

34. A method for high speed dubbing of a compressed digital audio signal onto an analogue storage means, including the steps of:

dividing said compressed digital audio signal into a plurality of portions,
each portion having an overlap,

interleaving said portions to respective decompression means,

separately decompressing each portion thereof in parallel,

recombining said portions wherein the overlap provides for correction of a sound artefact.

35. A method and/or apparatus substantially as herein before described with reference to the accompanying drawings.

36. A apparatus substantially as herein before described with reference to the accompanying drawings.

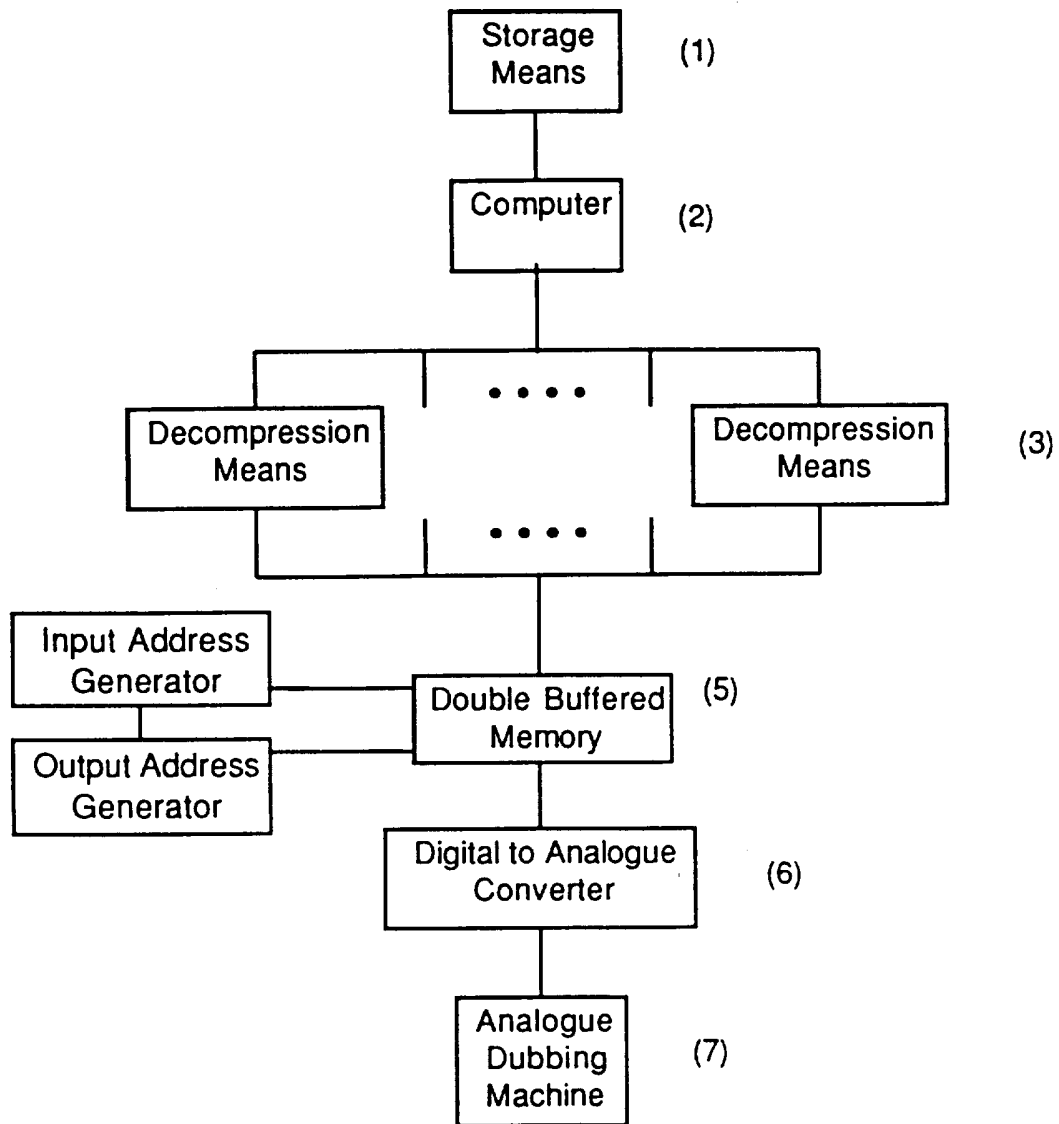


Figure 1

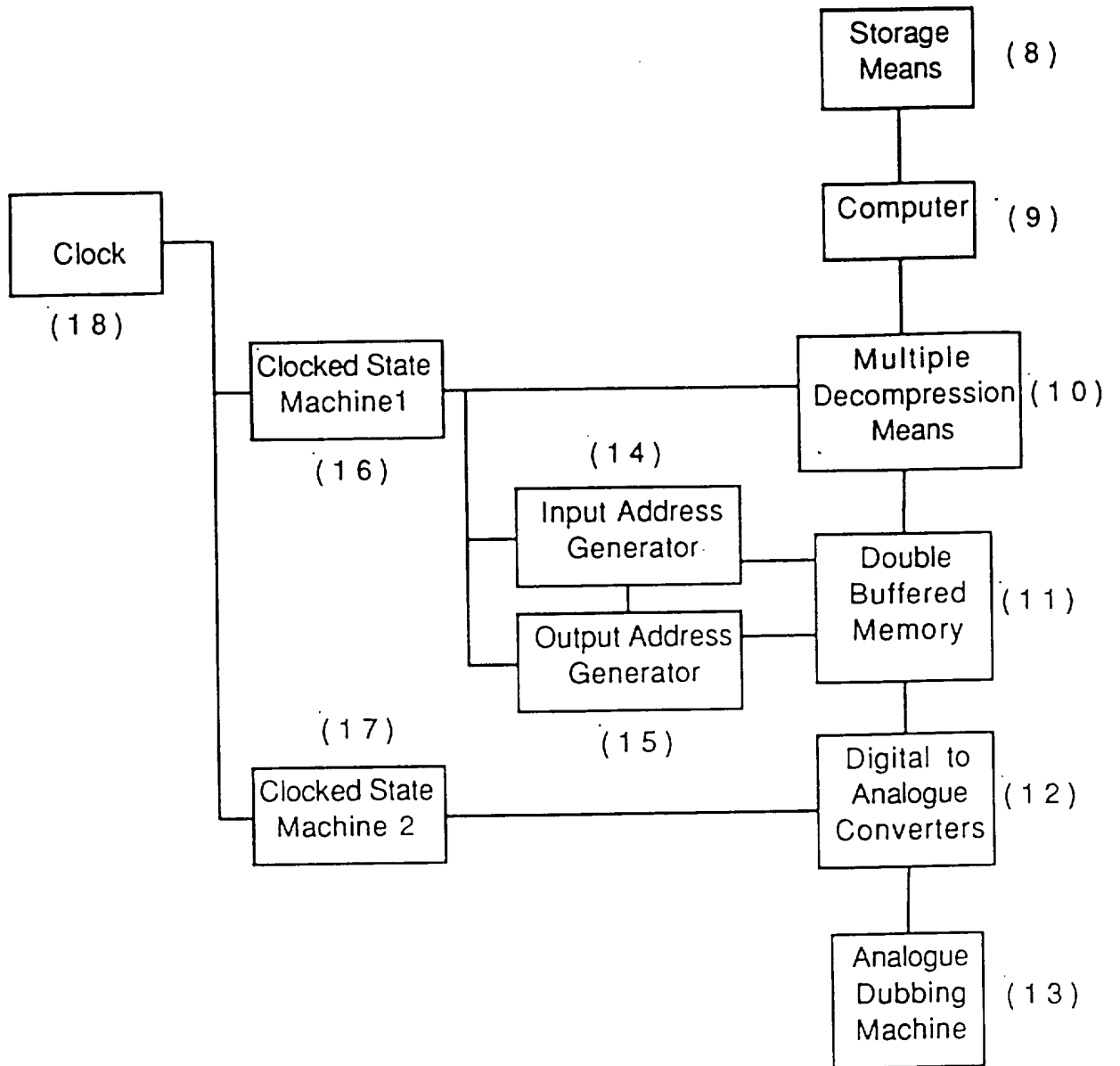


Figure 2

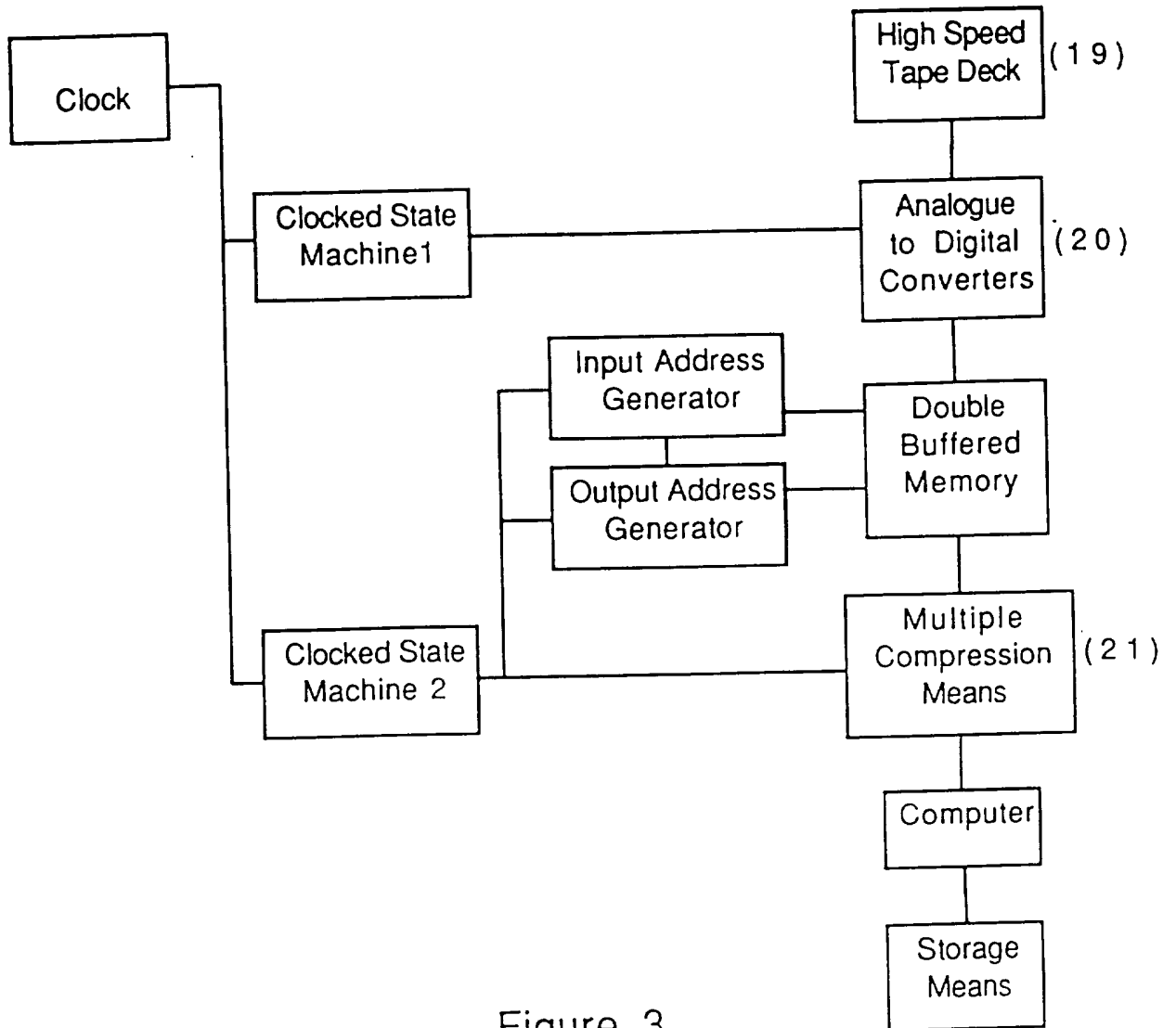


Figure 3

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 95/00822

A. CLASSIFICATION OF SUBJECT MATTER					
Int Cl ⁶ : G11B 20/02, 20/10					
According to International Patent Classification (IPC) or to both national classification and IPC					
B. FIELDS SEARCHED					
Minimum documentation searched (classification system followed by classification symbols) IPC : G11B <u>20/02</u> G11B 20/04 G11B <u>20/10</u> G11B 27/022 G11B 27/024 G11B 27/028 G11B 27/031 G11B 27/032 G11B 27/034 G11B 5/027 G11B 5/09					
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched AU : IPC as above					
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) WPAT, JOPAL					
C. DOCUMENTS CONSIDERED TO BE RELEVANT					
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.			
X	US 5167034 A (MACLEAN, Jr et al) 24 November 1992 column 1 lines 57-68, column 2 lines 1-2, 33-42, column 3 lines 25-37	1-4, 18-21			
X	EP 596398 A2 (SONY CORPORATION) 11 May 1994 column 2 lines 3-7, column 2 lines 17-29	18-21			
A	US 4858217 A (FUJIE et al) 15 August 1989 column 2 lines 29-34, 56-64, column 4 lines 16-22, column 6 lines 44-51				
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex					
<p>* Special categories of cited documents:</p> <table style="width:100%; border:none;"> <tr> <td style="width:45%; vertical-align: top;"> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </td> <td style="width:5%; vertical-align: top;"> <p>"T"</p> <p>"X"</p> <p>"Y"</p> <p>"&"</p> </td> <td style="width:50%; vertical-align: top;"> <p>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>document member of the same patent family</p> </td> </tr> </table>			<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T"</p> <p>"X"</p> <p>"Y"</p> <p>"&"</p>	<p>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>document member of the same patent family</p>
<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T"</p> <p>"X"</p> <p>"Y"</p> <p>"&"</p>	<p>later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>document member of the same patent family</p>			
Date of the actual completion of the international search 22 February 1996		Date of mailing of the international search report 8th March 1996			
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929		Authorized officer R. STOPFORD Telephone No.: (06) 283 2177			

INTERNATIONAL SEARCH REPORTInternational Application No.
PCT/AU 95/00822**C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4541089 A (WATANABE) 10 September 1985 column 1 lines 57-68, column 2 lines 1-9	

INTERNATIONAL SEARCH REPORT

International Application No.

Information on patent family members

PCT/AU 95/00822

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	5167034	NONE					
EP	596398	CA	2109015	JP	6153151		
US	4858217	EP	268454	JP	63127469		
US	4541089	CA	1204504	EP	87886	JP	58141483
END OF ANNEX							