Description

The invention relates to production of duplicates of video and other information recorded in slanted tracks for playback with standardised equipment at standard speed.

Fifty years ago, a major radio communication company decided as a matter of corporate policy to enter the then still very experimental television field. From the start, this necessitated an intensive search for suitable transmission frequencies, since a major stumbling block in the way of television was the very high bandwidth required for the transmission of acceptable video signals. Very high radio frequency transmission through transmitting antennae generally was seen as the only practical approach to large-scale video broadcast. The ensuing struggle for suitable television transmission channels lead to an unfortunate jockeying for television channel frequency allocations, to the detriment of the then nascent field of frequency modulation (FM) radio broadcasting, which at least in the United States wound up with frequency allocations that are less than ideal to its wide-band transmission purpose.

As a result of the quasi-optical nature of very high and ultra-high radio frequency signals (VHF and UHF), there always remained geographical areas that could not effectively be covered by video broadcasting. In consequence, community television antenna systems (CATV) arose, which received "off the air" television broadcasts with community antennae for distribution through local coaxial cable networks. A combination of increased demands and aggressive marketing brought about widespread cable television systems even in areas where "off the air" television reception would be acceptable. Such Cable TV systems can provide more and better motion picture entertainment than "off the air" television stations. However, the price Cable TV operators have to charge therefor is considerable and increasing. In addition, Cable TV is plagued by increasing operating, service and personnel problems, and deteriorating customer relations.

Part of the problem stems from the advent of satellite retransmission systems which beam television programs from outer space, making increasing inroads into profitable marketing areas of Cable TV. Fortunately for Cable TV, television systems from outer space satellites still require sizable parabolic antennae which, in some communities, are restricted in location and number by local building codes, while being banned altogether in others.

However, there are serious questions to what extent Cable TV can survive as a major communication tool, as satellite television systems become more sophisticated and develop smaller antenna technology.

Even then, better ways will be needed for transmitting video information or programs from producer to viewers. In the case of video entertainment, production and distribution of prerecorded media for playback by individual viewers has become very popular to the extent of converting video record duplication technology into a recognized mode of transmitting video information from producer to viewers, in parallel to traditional television program broadcasting, conventional Cable TV, and state-of-the-art satellite television broadcasting. In short, what started out as an adjunct to home video recording is maturing into a video transmission channel of its own, from performer and producer to millions of viewers.

However, while prerecorded video has been assuming an identity as a video transmitting mode of its own, attainment of its full potential as a distinct video transmission channel has been impeded by a bottleneck that was thought to be endemic to its technology.

Good insight into the problem has been provided by Yuma Shiraishi, in "History of Home Videotape Recorder Development," SMPTE Journal, December, 1985, pp. 1257-63. As can be seen from that article, the history of video recording in general can be characterized as a struggle with a recording medium and technology whose band-width practically corresponds to the bandwidths of the video signal to be recorded. As is typical in such struggles, everything was purchased at a price.

For instance, the first video tape recorder (VTR) mentioned in that article required ten separate channels for recording video signals longitudinally on multiple tracks. Required tape speed was 100 inches or 2.54 meters per second. The second VTR mentioned reduced the number of required channels to three, but increased tape speed to 360 inches or 9.144 meters per second. Of course, such high tape speeds were just plain useless.

The break toward a lasting solution came with transverse scan and slant track recording and playback coupled with appropriate modulation of the video signal for recording purposes. Tape speed was reduced very drastically by recording and playback in transverse or slanted tracks with rotating recording heads. While this eventually put video tape recording and playback into the hands of individuals in their homes, the new technique engendered other problems. A good background in this respect was given in Soviet Author's Certificate 287 127, by V. F. Zaychenko, issued January 14, 1971 for copying tape recordings with oblique or slanted tracks.

In particular, as that Soviet certificate points out known methods for copying slant track recordings use two ordinary recorders with rotating heads which read out the signal tracks in succession. That Soviet certificate, which obviously refers to a slant track recording apparatus in series with a slant track playback apparatus, points out that the main disadvantage of that method is low copying speed.

The solution proposed by that Soviet certificate is that, in order to increase the tape speed by a whole number of times with respect to the recording speed of the initial signals, the number of simultaneously read-out tracks by the reproducing and recording apparatus is increased by the same whole number of times. By way of example, this Soviet certificate mentions a simultaneous scanning of three slanted tracks of a master tape, together with a simultaneous recording of three slanted tracks of a copy tape, for a three-times increase in speed of the master and recording tapes. This might be a fine approach to the problem, if it worked in practice.

However, a good idea of the problem may be gained from U. S. Patent 4,558,376, by J. Heitmann, issued December 10, 1985, for method and system of reproduction of magnetically recorded video signals at speeds differing from recording speed. As Heitmann points out, the scanning tracks of reproduction heads do not coincide with the recorded tracks in this kind of situation. Of course, in the Soviet proposal, this would not only affect the playback from the master tape at the copying station, but also the playback of each copy tape at the end user, such as at video home recorders operated as playback apparatus for the copy tapes. The solution which Heitmann proposes includes the provision of a further magnetic head positioned so that signals which are not scanned by one head are, effectively, scanned by another head, whereby, by use of a programmed memory, the signal can be stored in proper sequence for reproduction as essentially complete video signal, for read out in accordance with a desired scanning standard, in analog or digital signal form. More specifically, Heitmann temporarily stores reproduced signals which are of a quality sufficient for reproduction, reads out these temporarily stored signals subsequently at a predetermined television scanning standard, and controls the relative axial position of at least two axially adjustable transducer heads on the head wheel with respect to each other as a function of the relationship between recorded speeds and reproduction speeds to place a maximum number of transducer heads in scanning transducing position over the previously recorded tracks.

While that may be a fine solution for special circumstances, one obviously cannot expect owners and users of standard video tape recorders and playback apparatus to replace their equipment by still more costly machines, just in order to play back duplicated video tapes. To put it differently, tapes copied according to the Soviet proposal simply would have no market among present or potential viewers of video programs. Even if some solution could be found, the Soviet proposal still would be practically limited to copying between like tape and recording formats, which is very unrealistic, considering that a high-quality first generation copy usable in home VCRs typically requires working from a broadcast or studio quality master having a radically different format.

A subsequent proposal disclosed in U. S. Patent 4,108,365, by Robert M. Hughes, issued August 22, 1978, for coin-operated recording machine, deals with the dubbing of selected audio and/or video recordings stored in the apparatus onto magnetic tape cartridges inserted by customers. Even though that proposal shows a video duplication system in two of its figures, it does not appear to reveal any workable equipment for duplicating video faster than in real time. In other words, the main disadvantage mentioned in the Soviet certificate still has not been remedied. Accordingly, a customer would have to stand around for at least an hour for each one-hour video program he or she wants copied for home video playback.

Yet, the subsequent German Published Patent Application 29 07 987, by Michael P. Oversberg, published 11 September 1980, for cassette tape systems, still proposes no remedy, even though it discloses the duplication of video recordings from one cassette to another.

U. S. Patent 4,393,415, by Robert N. Hurst, issued July 12, 1983, for a time changing system for video tape recording, proposes resynchronization of reproduced signals to a standard speed by repeating or deleting frames when successive frames are substantially identical. Frame averaging can be used in addition or as an alternative. Provision for real time is made to minimize human error. This is another very complicated approach to a persistent problem.

U.S. Patent 4,410,917, by Ronald M. Newdoll et al, issued October 18, 1983 for method of and apparatus for recording information from a master medium onto a slave medium employing digital techniques. Recorded analog information reproduced from a master medium is digitized and stored in a digital storage device, from where it is recovered and reconverted into analog information for recording onto slave media. While information is entered into the digital storage device at the same rate as it was recorded on the master medium, information is recovered from the digital storage device at the faster rate and is also recorded on the slave media at a faster rate than it was recorded on the master medium. However, any time saving thus realized with respect to the rerecording of information on a slave medium is purchased at the heavy price of digital framing buffers and their operating paraphernalia.

U.S. Patent 4,496,997, by Tadashi Ohtsuki, issued January 29, 1985, also proposes copying of video information from one recording medium to another. However, that proposal is more concerned with generating code signals and recording cue data, than with improved video signal copying as such.

Japanese Patent Publication 57-3229, by Kenichi Sawazaki, published January 8, 1982 in the name

of Tokyo Shibaura Denki K.K., proposed a copying and recording system manifestly unsuitable for copying slant-track recordings. Rather, linear heads were shifted by one track pitch for every lap of the recording medium in an effort to shorten duplicating time in proportion to the number of heads. No copies reproducible by standard VCRs or similar standard playback machines could be produced in this manner.

Japanese Patent Publication 57-185779, by Masao Tomita, filed on 11 May 1981 and published on 16 November 1982, having as applicant Matsushita Denki Sangyo K.K., proposed increasing the speed of duplication by increasing the speed of rotation of the playback and the recording heads by a multiple of the standardised speed and by increasing the speed of the playback and recording tapes by the same multiple. This publication claimed to achieve the increased speed without requiring any increase in the number of playback or recording heads and also claimed to achieve high performance duplication by copying the video signal directly without intermediate demodulation and remodulation. However, the intended application of this method is limited to home VTR-VTR copying and the publication stated that demand for copying on a commercial scale would be met by the method of contact duplicating.

Japanese Patent Publication 57-203232, having the same inventor and applicant as the above discussed JP 57-185779, filed on 5 June 1981 and published on 13 December 1982, also describes a method suitable for home copying. This method involves increasing the duplication speed by increasing the number of playback and recording heads and ignores the method disclosed earlier in JP 57-185779.

A third patent application by Matsushita Denki Sangyo K.K., publication number 58-139339, filed 12 February 1982 and published 18 August 1983, again relates to a method suitable for home VTR-VTR copying similar to that disclosed in JP 57-203232. Both of the later Matsushita applications recognize that the approaches disclosed therein not only increase the complexity but also increase the frequency of the video signals making them more difficult to handle, resulting in the need to vary the head azimuth angle such as with piezoelectric head mounting devices or to alternate the head azimuth angle between successive rotating heads and to change the relative tilt of the head drum. The resulting copies would not be commercially saleable for playback with standard equipment.

Japanese Patent Publication 58-143410, by Kenji Nakano, published August 26, 1983 in the name of Sony K.K., proposed a type of copying method for video tapes having an inherent lip sync problem between resulting video and audio presentations. In an effort to correct errors that such a problem would engender, clock frequency at the time of copying is increased by three times normal clock frequency, whereby error correction and adjustment and encoding rate are tripled. While such a procedure is said to prevent degradation of audio accompaniments, it cannot achieve complete lip sync.

As apparent from a writeup by John Streets et al, entitled "Development of an Ultra Wide Band Video Tape Recorder," IBC Proc. 1982, Brighton, in order to record at higher band width or to record two video signals multiplexed together, head-to-tape velocity and linear tape speed were doubled and the servo and tape control circuits modified to accommodate these changes by modification of the tachometer sense circuits. The resulting records were, of course, not suitable for playback with standard VTRs or VCRs.

Japanese Patent Publications 55-105828 and 55-105829, by Y. Makino, of Tokyo Shibaura Denki K.K., published August 13, 1980, reassert that, contrary to audio tapes, video tapes cannot be duplicated satisfactorily, if the tape feed or video head revolution speed is raised to twice the standard speed or more. Against this background, these Japanese patent publications propose multiplying the number of playback and rerecording heads as well. However, such multiplication, in turn, required the scanner cylinder diameter to be either larger than standard, such as for the Beta format, or smaller than standard, such as for the VHS standard. As is apparent from numerous equations in these Japanese patent publications, geometrical parameter relationships became rather complex and the resulting machines became incapable of slant track recording or reproduction at standard speed.

The same applies to the systems disclosed in Japanese Patent Publications 54-25717, by T. Kobayashi, of Sony Corporation, published February 26, 1979 and Japanese Patent Publication 56-7242, by K. Takahashi, also of Sony Corporation, published January 24, 1981, and also employing numerous equations for determining geometrical parameter relationships needed under that approach.

These state-of-the-duplicating-art publications also show that when the breakthrough to higher duplicating speeds finally came, the multiple-times-standard playbacks and rerecording heads were retained. In other words, the prejudice against higher-than-standard playback and recording speed found a variant in a prejudice against the standard number of heads, which prejudice, as shown above, was engendered by the prejudice against higher duplication speeds.

As a result of such perpetuated prejudice, the more advanced prior art still insisted on using multiple heads (multiples of the standard number of heads for the standard format duplicated) with all the attendant problems of non-standard scanner cylinder diameter, modified scanner cylinder tilt angle and/or continuous scanner head tracking control, each of which introduces problems of its own.

Attempts at rendering equipment alternatively suitable for high-speed and standard speed operation by making the scanner cylinder tilt angle switchable between two values, as in the above mentioned Matsushita Japanese Patent Publication 58-139339 by Masao Tomita, shed further light on the complexities engendered by the above mentioned prior art prejudice.

Reference is made herein to standard formats, standard speeds, standard scanner cylinder diameter and so on. 'Standard' in this sense refers to the common parameters generally in use today, such as VHS, Beta and B-helical scan formats and may be determined from the tapes themselves. Typically a 'standard' tape for general use defines the 'standard' parameters. For example, to reproduce a 'standard' tape in real time the skilled worker will readily appreciate that a scanning cylinder of specific diameter (d) provided with a specific number (x) of video reading heads rotating at a specific speed (s) with a specific scanning angle of (α) is required. These parameters are defined geometrically by the tape itself. These parameters also define the relative velocity (v) existing between the video reading (or recording) heads and the tape for 'real time' replay (or recording).

It is a general object of this invention to overcome the above mentioned disadvantages and to meet the needs of a public equipped and increasingly equipping itself with standardised apparatus capable of reproducing video information from a standard record, and to meet this need by economising video information duplication and improving the quality of copies of video information relative to copies resulting from prior-art processes which attempted to copy at increased speeds.

According to an aspect of the invention, there is provided an apparatus for producing on destination recording tapes recordings of information derived from a master recording medium seriatim in the form of electric signals which are simultaneously re-recorded with a number of recording devices seriatim in series of tracks at a predetermined angle for a predetermined format on the destination recording tapes, without deliberate omission of information tracks, for ultimate playback at real time from said predetermined format comprising a series of tracks slanted at said predetermined angle relative to a direction of movement of the destination recording tape, with a predetermined number of playback heads rotating at a predetermined angular velocity, with said predetermined angular velocity, angle and number of playback heads being standardised for that predetermined format, the apparatus being

characterised in that there are means for modulating said electric signals, prior to recording on each recording device, to the modulation format required for the predetermined format of the destination recording tapes, said recording devices comprising for each of said destination recording tapes recording heads equal in number to said standardised number of playback heads in order that the successive tracks will be recorded at each recording device one after the other, and in that said apparatus includes driving means having control means for controlled rotation of these recording heads at an angular velocity which is a multiple n of said standardised angular velocity, and a transport means for producing said standard track angle for said predetermined format while moving each recording tape relative to the rotating number of recording heads at a speed corresponding to said multiple, whereby duplication of information recordings is achieved at each tape at a rate which is a multiple of real-time production without multiplication of recording heads beyond said standard number and without change in diameter of a trajectory of rotation of the recording heads for any of the tapes and without changing the angle between the plane of movement of said tape and the plane of rotation of said heads.

According to a second aspect of the invention, there is provided a method of producing on destination recording tapes recordings of information derived from a master recording medium seriatim in the form of electric signals which are simultaneously re-recorded with a number of recording devices seriatim in series of tracks at a predetermined angle for a predetermined format on the destination recording tapes, without deliberate omission of information tracks, for ultimate playback at real time from said predetermined format, comprising a series of tracks slanted at said predetermined angle relative to a direction of movement of the destination recording tape, with a predetermined number of playback heads rotating at a predetermined angular velocity, with said predetermined angular velocity, angle and number of playback heads being standardised for that predetermined format, the method being characterised in that said method comprises modulating the electric signals, prior to recording on each recording device, to the modulation format for the predetermined format of the destination recording tapes and utilizing recording devices comprising for each of said destination recording tapes recording heads equal in number to said standardised number of playback heads, recording successive tracks at each recording device one after the other, rotating these recording heads, controlling the rotation of these recording heads at an angular velocity which is a multiple n of said standardised angular velocity, and moving each recording tape relative to the rotating number of recording heads at a speed corresponding to said multiple, so as to produce said standardised track angle, thus duplicating information recording at each tape at a rate which is a multiple of real-time production without multiplication of recording heads beyond said

standardised number and without change in diameter of a trajectory of rotation of the recording heads for any of the tapes and without changing the angle between the plane of movement of said tape and the plane of rotation of said heads.

Where the information has been provided on a first recording medium at standard speed with the aid of first synchronization signals having standard synchronization frequencies, an embodiment of the invention provides second synchronisation signals having increased frequencies on the order of a multiple of the standard synchronization frequencies, and processes with such second synchronization signals the above mentioned electric signals reproduced at increased speed.

The subject invention resides also in records of information fixed in tangible media produced by methods according to the subject invention as articles of manufacture for replay of the thus recorded information by several end users at different times, but at standard speed.

The subject invention and its various objects and aspects will become more readily apparent from the following detailed description of preferred embodiments thereof, illustrated by way of example in the accompanying drawings, in which like reference numerals designate like or functioning equivalent parts, and in which:

Fig. 1 is a block diagram and a diagrammatic view of video information production, reproduction and signal processing, according to preferred embodiments of the subject invention;

Fig. 2 is a block diagram and diagrammatic view of apparatus for simultaneously rerecording video information reproduced and processed according to Fig. 1;

Fig. 3 is a block diagram of equipment for replay of the rerecorded video information by several viewers at different times from several recording media at standard speed;

Fig. 4 is a schematic showing how Figs. 1, 2, and 3 should be combined in series to show the video information transmission systems from producer to viewers according to the illustrated preferred embodiments of the subject invention; and

Fig. 5 is a block diagram of a master playback control and rerecording system according to a further preferred embodiment of the invention.

Figs. 1 to 3, when arranged in the manner shown in Fig. 4, illustrate a system for transmitting video information from producer to viewers, according to preferred embodiments of the subject invention.

While "video" basically refers to seeing, and "audio" generally refers to hearing, the subject disclosure does not intend a strict dichotomy along this line, as far as the expression "video" in compound form is concerned. For instance, the expression "video information" as herein employed is intended to be broad enough to include audio accompaniment of video signals or programs. Indeed, even silent motion pictures of yesteryear are, and even then were, generally replayed with a sound accompaniment. Today, video information, features and programs for education and entertainment would hardly be saleable, if they were distributed without a synchronous sound accompaniment of the displayed action.

Accordingly, Fig. 1 shows a studio and video recording production facility in which a performer or entertainer 12 creates viewable action and audible sound 13 by playing a xylophone, marimba or other musical instrument 14. A video or motion picture camera 15 takes the action either on film or in the form of a video signal. One or more microphones, symbolically shown at 16, generate electric signals containing the sound accompaniment.

The outputs of camera 15 and microphone facility 16 are applied to video/audio processing equipment 17. For instance, film exposed in a motion picture camera may be developed or video signals produced by a video camera may be recorded for further processing. The audio accompaniment may be recorded on the same medium as the video action, or may in fact be recorded separately for subsequent unification with the video portion. Cue signal provision and editing apparatus of the type mentioned in the above-mentioned Ohtsuki patent may be employed at that point, as may other conventional motion picture and video recording techniques and facilities. The result of such efforts typically is applied to a video tape recorder 18 which produces a video program or information record 19. In other words, the reference numeral 10 in effect represents the production facility or producer of what is referred to herein as the video information provided on a first recording medium 21 recorded at a standard speed and in a standard format in a series of tracks 22 slanted to a direction of movement 23 of the first recording medium. In other words, the video tape recorder 18 is a conventional recorder or otherwise records the video information at a standard speed in a standard format, such as the slant track format shown in Fig. 1. In this respect, the video tape recorder could be a conventional transverse scan recorder or a slant track recorder producing video recordings in a standard format generally recognized in the industry as such.

As already indicated above, "video information", "video recording" and expressions of like import are terms of art typically implying the presence of a sound accompaniment. Indeed, the video recording 19 includes conventional audio tracks, in addition to synchronization and control signal tracks, one of which is shown at 25.

According to conventional practice, the audio accompaniment is recorded longitudinally, while the video signal is recorded in slanted tracks. However, this need not necessarily be the case, since the audio

accompaniment could be recorded along with the video signal or otherwise in the area of the video signal recording, such as according to a technique described, for instance, by Shiraishi on the last page of his above mentioned SMPTE article.

Also, while video tape recording, duplication and playback have been emphasized herein, it should be understood that the video information, including the video signal and audio accompaniment, could be recorded or present on other media, such as video disks, for instance.

As shown by dotted outline 28 in Fig. 1, the produced master tape or other video recording 19 is applied to a reproducing facility or playback apparatus 31. That reproducing facility and the rerecording facility 32 shown in Fig. 2 may be viewed as the video duplication facility according to the illustrated preferred embodiment of the subject invention.

It is a special advantage of the subject invention that basically conventional playback and recording equipment may be employed at 31 and 32 in conjunction with the processes and features of the subject invention. This is not a step backward from the more complicated prior proposals described above, but is a rather sophisticated approach that builds the new on selected items of the old, thereby arriving at combinations which work quite well, where more complicated approaches have failed in toto or for practical purposes.

Also, it will be seen that the subject invention is capable of producing complete video recordings, where recent endeavours of large corporations in the field produced copies by deliberately omitting information content or degrading information quality.

Dotted lines 28 in Fig. 1 thus signify the flow of essentially undegraded video information from studio and producer 10 to the copying or duplication facility 31, 32 in the form of high-quality video records or tapes to be duplicated.

In principle, the same kind of machine may be used at 18 and at 31, with the machine at 18 operating as a recorder and the machine at 31 as a reproducing or playback facility. However, the subject invention is not limited to the use of the same kind of machine at 18 and at 31, as long as the playback machine at 31 can handle the kind and format of the video information recorded at 18.

If the recording medium 21 is a magnetic recording tape, then such first recording medium typically will arrive at the reproduction facility 31 on a tape reel such as the first tape reel 34 symbolically indicated in Fig. 1 together with its servo system. Conventional tape reel servo systems may be employed for this purpose, and Fig. 1 thus only indicates the first and second tape reels and their servos symbolically at 34 and 35.

The video tape 21 is supplied from the first tape reel 34 to a scanner assembly 36 which is equipped with two tilted auxiliary rollers 37 and 38 for an oblique guidance of the tape at an acute angle to the plane of a rotary headwheel, shown in dotted outline at 39. As is well known in that art, the wrap angle of the tape 21 around the scanner drum depends on the number of active video heads on the headwheel 39. In this case, the wrap angle is somewhat greater than 180°, such as 190° omega wrap, at an appropriate tilt angle, such as 14.4° relative to the headwheel plane.

For increased clarity, the video playback heads 41 and 42, actually located diagramatically opposite of each other on the headwheel 39, are shown in Fig. 1 above the scanner assembly 36 along a phantom line 43. The scanner assembly also includes rotary transformers 45 and 46, normally located in the scanner drum, for applying the played-back video signal to a playback preamplifier or amplifier 47. A tape drive spindle or capstan 48, which may be assisted by a pinch roller (not shown), advances the tape from the scanner assembly via an audio head assembly 49 to the second tape reel 35, which winds the tape 19 thereon.

The practice of the subject invention is not limited to the use of any particular makes or models of equipment. However, use of a head drum assembly having a drum or headwheel diameter of about 2 inches or 50 mm is resently preferred, as suited to the increased head rotation and tape speeds according to the subject invention.

In this respect, the best mode presently contemplated for carrying out the subject invention employs a video tape recorder, Type BCN 41/51 A manufactured and sold by the Fernseh Department of Robert Bosch GmbH, the West German Assignee of the above mentioned Heitmann Patent 4,558,376.

Within the scope of the subject invention, the playback machine 31 may, for instance, be of a type in which video and its audio accompaniment are recorded in the same tracks or in the area of these slanted tracks 22, for instance, as mentioned on the last page of the above mentioned SMPTE article by Shiraishi, and as more fully described in connection with the rerecording equipment 32 shown in Fig. 2.

The playback machine 31 reproduces the video information from the series of tracks 22 on the first recording medium 21 in the form of electric signals seriatim at increased speed on the order of a multiple of the standard speed at which the video information was recorded at 18 by or for the producer. Strictly speaking, while the expression "video information" is sufficiently broad herein to cover also audio accompaniments, such audio accompaniments are, of course, not played back from the slanted tracks 22, unless they have been recorded therein as mentioned above. In the embodiment shown by way of example in Fig. 1, the audio accompaniments are played back from longitudinal tracks 24 by the audio head assembly 49. Since there is generally no prob-

lem in reproducing and rerecording audio at increased speeds, that phase of the operation, while useful when audio accompaniments are present, is not emphasized herein.

A motor 51 rotates the headwheel 39 in the scanner drum assembly 36. In principle, a scanner assembly with rotary head drum could be employed. However, in the embodiment illustrated in Fig. 1, both head drum parts are stationary, and a projecting pin 52 is provided to prevent the tape from falling off the scanner drum during threading of the tape.

The scanner motor 51 is energized and controlled by a scanner amplifier and servo 53, which is in a servo loop 54 including a scanner tachometer 55 and a divider 56.

Similarly, the tape advance capstan 48 is driven by a motor 58 which is energized by a capstan drive amplifier and servo 59. A capstan tachometer 61 and divider 62 are part of a velocity loop 63 including the servo 59. A phase loop 65 for the capstan servo 59 includes a control signal playback head 66 and a divider 67. The control signal playback head 66 is seen on the drum of the scanner 36 at the top margin of the slanted tape 21 for playback of control signals therefrom. These control signals in effect correspond to the type of sprocket holes used with motion picture film and assure the correct phase position of the rotating playback heads 41 and 42. Of course, if such control signals are recorded in the lower control track 25 in a given situation, then the head 66 would be located at the lower margin of the advancing tape.

The servo 53 for the scanner motor 51 may also have a phase loop 60 in addition to the servo loop 54. Such a phase loop may utilize off-the-tape synchronizing signals which a line 68 connected to the demodulator 77 applies to a divider 69 having the purpose and function of dividers 56, 62 and 67.

It may be noted at this point that the dividers 56, 62 and 67 diminish a rate of their input signals by a divisor corresponding to the multiple of the standard speed at which the video information is reproduced and simultaneously rerecorded. By way of example, if it is, for instance, desired to double the speed of the duplication process, the divider 56 would divide the output signal of the scan tachometer by a factor of 2, and would apply such correspondingly diminished output signal to the scan amplifier and servo 53. Accordingly, if the headwheel 39 would not rotate at the desired velocity of twice the standard velocity at which the video information was recorded at 18, the scan amplifier and servo 53 would not receive scan tachometer signals of a sufficient rate. Accordingly, the scan amplifier and servo 53 would cause the scanner drive motor 51 to speed up accordingly. In other words, the servo loop 54 would constantly try to make up for the pulse rate division or diminution at 56, until the scanner wheel 39 has caught up with the desired higher rotation of twice standard speed.

Similarly, the tape velocity loop 63 would try to make up for the diminution inflicted on the capstan tachometer signal by the divider 62, while the phase lock loop 65 would try to make up for the diminution of "sprocket hole signals" brought about by the divider 67. In consequence, the tape drive motor 58 would cause the tape 19 to catch up with the desired double velocity thereof. In this manner, the illustrated preferred embodiment avoids the major drawback of the above mentioned Soviet proposal, while at the same time avoiding Heitmann's complex tracking angle servo system with its axially adjustable transducer heads.

Of course, for proper operation, the servos 53 and 59 need appropriate synchronization signals. In this respect, these servos could be redesigned to operate at twice standard synchronization frequency. However, such a redesign would be rather costly and time consuming in practice.

A generally better approach is to operate the servos at standard synchronization frequency, f. In that respect, the conventional local oscillator supplying the standard synchronization frequency, f, could be employed. This, indeed, would be the obvious way of solving the problem.

However, the illustrated preferred embodiment of the invention avoids that obvious way in the interest of a superior solution.

In particular, the illustrated preferred embodiment provides second synchronization signals having frequencies, nf, increased by the selected multiple relative to the standard synchronization frequencies. In this respect, the standard synchronization frequencies refer to the synchronization frequencies used at 18 in Fig. 1. In other words, the producer at 10 recorded the video information on the first recording medium 21 at a standard speed and in a standard format with the aid of first synchronization signals having standard synchronization frequencies, f. The illustrated preferred embodiment then provides a local oscillator 71 for providing second synchronization signals having frequencies, nf, increased relative to the standard synchronization frequencies, f, by the above mentioned multiple of the reproduction and rerecording speed relative to the standard speed at which the recording was made at 18.

For instance, if the speed of the duplication process is doubled, then the factor, n, shown in the drawings is equal to two. Of course, the desired multiple need not be an integer, and the duplication process may be increased by a factor of more than two, within the scope of the subject invention.

A divider 72, similar to the dividers 56, 62 and 67, is employed for diminishing the output of the local oscillator 71 to the standard frequency, f, for driving the scan and capstan servos, including those shown at 53 and 59 in Fig. 1. On the other hand, the undiminished oscillator frequency, nf, is still employed in the

processsing of the video signal between reproduction and rerecording. In this manner, the illustrated preferred embodiment of the invention not only avoids the ambiguities that would be introduced by synchronization frequency multiplication, but at the same time provides the optimum synchronization frequency for each purpose, namely f for the scan and capstan servos of the reproduction and rerecording equipment, and nf for the best possible signal processing between reproduction and rerecording. At the same time, the dividers 56, 62, as well as their counterparts in the rerecording equipment 32, avoid the kind of phase ambiguity that afflict frequency multiplication.

The video signal handling and processing equipment 74 shown in Fig. 1 may be composed of essentially conventional components. For instance, the playback amplifier 47 may apply the reproduced video information in the form of electric signals to a head switching device 75 which applies the amplified output of the rotating playback heads 41 and 42 to the type of playback equalizer 76 present in such circuits.

The equalizer, in turn, applies its output to a demodulator 77. The kind of chroma control 78 present in such circuits for chroma correction in the case of color video signals, is located in a feed-back loop 80 extending from the demodulator 77 to the playback equalizer 76.

The output of the demodulator 77 is applied to a dropout and velocity error compensation 81 which applies its output to a time base corrector which, in a manner conventional per se, applies its time base correction control signal via lead 83 to the compensation 81. The time base corrector 82 applies its time base corrected output signal to a color stabilizing amplifier 85 which also receives conventional color dropout compensator or Color DOC and velocity error compensation signals via a line 86 from the drop out and velocity error compensation 81.

Synchronization signals of increased frequency nf are applied via lines 88 to the head switching device 75, demodulator 77, compensation 81, time base corrector 82, and color stabilizing amplifier 84 to synchronize their operation and thereby the processing of the video information between reproduction and rerecording.

For increased clarity, Figs. 1 and 2 show identical terminals 91, 92, 93 and 94 for processed video signals, audio signals, higher synchronization frequency signals nf and lower synchronization frequency signals f, respectively. In other words, the output of the reproduction system 31, as well as its synchronization signals, are applied to the input of the rerecording system 32, including several video tape recorders, three of which are seen at 96, 97 and 98 in Fig. 2.

The rerecording system 32 or recorders 96, 97, etc., simultaneously rerecord the reproduced video information from the electric signals received through a video input 100 and audio input 101 seriatim in a standard format with a series of tracks 102 on several second recording media 103, 104, 105, etc., at the increased speed, for replay of the rerecorded video information by several viewers at different times from the several recording media at standard speed, as more fully explained below in connection with Fig. 3.

In accordance with standard practice, the re-recorded video tapes 103, 104, 105, etc., also could include longitudinal audio recording tracks of the type shown at 24 in Fig. 1. However, as explained above and as described by way of example on the last page of the above mentioned SMPTE article by Shiraishi, audio accompaniment can be recorded directly in with the video signal. For instance, the audio signal may be frequency-modulated and recorded mixed with the video carrier using an appropriate frequency spectrum allocation. According to a further method, frequency-modulated audio signals are recorded by independent audio heads, and the video signal is recorded over it using separate video heads. Accordingly, the flipped-over portion 107 shown in Fig. 2 for the tape 103 does not show any audio channels, even though such could be provided, if desired. A control signal track 108 is, however, shown along the slanted video tracks.

The control signal could alternatively be frequency multiplexed and recorded mixed with the audio and video signals using an appropriate frequency allocation.

The video input 100 in Fig. 2 may comprise a recording preamplifier, signal processor, or simply a terminal connected to a luminance signal recording processor 109 and to a chromanance signal recording processor 110. Similarly, the audio input 101 may comprise a recording preamplifier, signal processor, or simply a terminal connected, for instance, to frequency modulators 112 and 113 in two audio stereo channels. Of course, in such a case the audio signal would preferably be recorded in separate stereo channels at 24 in Fig. 1 as well.

In principle, apparatus shown in Fig. 1 at 31 for reproduction could also be used at 96 to 98 for rerecording. However, such is not a requirement of the subject invention, and reproduced video information can be rerecorded on any desired format with a variety of recorders that can operate at the desired multiple of standard speed.

By way of example, the currently contemplated best mode of carrying out the invention or its preferred embodiments employs at 96, etc., video cassette recorders of the Type AG-6300, Panasonic, VHS format.

Except for the frequency dividers 115 and 116, the components shown in Fig. 2 may be of the type supplied with such commercial recorders.

The outputs of the luminance and chromanance signal recording processors 109 and 110 are applied

to a recording amplifier 118 for recording on the tape 103 by a pair of rotating video recording heads 121 and 122. Any requisite remodulation of the video information and related signals may be done at 109, 110 or at 100 jointly for all recorders 96, 97 and 98.

Similarly, after frequency modulation, the stereophonic audio channels are applied to a conventional type of combiner and recording amplifier 123 which supplies the audio information to a pair of rotating audio recording heads 125 and 126. Again, rotary transformers preferably are used for conveying the video and audio signals to their respective recording heads. While suitable rotating transformers have been shown in Fig. 1 at 45 and 46, such rotating transformers have only symbolically been indicated at 131 to 135 in Fig. 2. The rotary head-wheel has been shown at 136 in Fig. 2, and it should be understood that such headwheel is part of a scanner assembly 138 in which the tape proceeds at a helical slant through an omega wrap, such as shown at the scanner 36 in Fig. 1. If desired, what has been called herein a headwheel 136 may in fact be a rotating cylinder on which the recording heads are mounted.

The scanner 138 is driven by a scanner motor 141 which is energized by a scanner drive amplifier and servo control 142. A tachometer signal is derived from the scanner by a scanner tachometer 143 which applies tachometer pulses to the divider 115 in a scanner servo amplifier loop 145. As in the case of the scanner servo loop 54 described above with respect to Fig. 1, the frequency divider 115 causes the scanner servo control and drive 141 and 142 to catch up with the desired speed, which is n times standard speed.

The same principle applies to the tape drive effected by a tape drive capstan 146 driven by a motor 147. The capstan motor 147 is energized by a capstan drive amplifier and servo 148 connected into a servo loop 149 including also a capstan tachometer 151 and the frequency divider 116. As in the case of the servo loop 63 disclosed above in connection with Fig. 1, the frequency divider 116 causes the capstan and thereby the tape advance to catch up with the desired speed, which is the selected multiple of the standard speed.

The increased frequency, nf, produced, for instance, by the oscillator 71 shown in Fig. 1, is also used via leads 154 and 155 to control the operation of the luminance and chrominance signal processors, as well as head switching functions shown, for simplicity, as incorporated in the video and audio recording amplifiers 118 and 123. Conversely, the divided-down frequency, f, produced, for instance by frequency division at 72 in Fig. 1, is employed also in Fig. 2 to control the scanner and capstan drive servos 142 and 148.

On the other hand, the increased synchronization frequency, nf, is employed according to the preferred embodiment shown in Fig. 2 for generating the control track signal. In particular, a control signal recording head 161 records the control signal in the track 108 of the tape during the record mode, so as to enable the recorded pattern of slant tracks 102 to be traced during subsequent playback. The control signal generator 162 may derive information from the scanner servo 142 and may drive the reference signal recording head 161 in a conventional manner, except that the reference signal recorded in the track 108 is derived from the higher frequency synchronization signal, nf, rather than from the lower frequency, f.

The video recordings thus produced are suitable for playback by conventional equipment at standard speed. In principle, the several recording apparatus 96, 97, and 98 may be identical or alternatively may be different, as required for given tasks. In Fig. 2, the video recorders 96 to 98 are shown as connected in parallel with respect to the video, audio, increased synchronization frequency and standard synchronization frequency inputs.

Figs. 2 and 3 show the recorded tape 103 applied to a standard video tape or cassette playback machine 165 in the home or at another location 166 of a first viewer. This illustrates the flow of video information from the duplication facility to the equipment of individual viewers. However, in practice, there typically will be at least one intermediate step in such video information flow. For instance, the recorder 96 in the duplication facility typically will have tape supply and takeup reels and reel servos, such as those symbolically shown in Fig. 1 at 34 and 35 for the playback machine 31. On the other hand, if the information is rerecorded on such media as video disks, there will be no tape reels. The upper portion of Figs. 2 and 3 showing the medium 103 as running from duplication facility to individual viewer thus illustrates a general case. However, there practically will be some packaging involved in the video information channel between duplicator and distributor of duplicated video recordings.

For instance, Fig. 3 shows a cassette loader 169 which, in practice, may well belong to the duplicating facility shown in Fig. 2, or which may be a separate or spaced operation. Cassette loading apparatus have been described in U.S. Patent 4,512,527, by George D. Rehklau et al, issued April 23, 1985 and referring to further information in that area.

Duplicated tapes, including the rerecorded tape 104, may thus be loaded into video cassettes 171, for sale to, and replay by individual viewers in standard video cassette recorders with playback facility. In principle, a video cassette playback apparatus would be sufficient for that purpose, but most viewers likely will prefer having a video cassette apparatus capable of recording as well. Accordinly, Fig. 3 broadly shows a standard video cassette recorder 172, for replay of the rerecorded video information at a viewer's loca-

tion or home 174. For viewers having video tape recorders 175 using tape reels without cassettes, a tape loader 176 may be employed for loading duplicated tapes, such as the tape 105 on reels for supply to consumers, as indicated by dotted lines 178 in Fig. 3.

The video information channel from producer to viewers thus includes branches reaching into individual homes or to several viewer locations 166, 174 and 179. The subject invention liberates such communication channels from a bottleneck which heretofor impeded achievement of their full potential.

It certainly is significant in this respect that others who have tried to remedy that bottleneck have in effect degraded the information, as shown above, and thus have degraded, rather than augmented any transmission channel that could have been provided by intensive video information duplication.

As shown in Fig. 3, the rerecorded video information is replayed by several viewers, symbolized by different viewer locations 166, 174 and 179. The rerecorded video information is thus replayed at different times from the several recording media 103, 104, 105, etc. at standard speed. In this manner, the subject invention avoids the serious impairment of the communication channel that would result from any requirement that viewers purchase non-standard equipment for viewing the duplicated video information.

Conventional video monitors or television sets 181, 182 and 183 may be employed for viewing the video action, including the entertainer 12 playing the instrument 14. Dual loudspeaker systems 185 and 186 may, for instance, be employed for reproducing the sound accompaniment 13 stereophonically. Monaural reproduction is, of course, also possible, such as via a loudspeaker 187.

Looking again at the area 10 of Fig. 1, video information is recorded on the first recording medium 21 at the standard speed and in the standard format with the aid of first synchronization signals having standard synchronization frequencies, f. The duplication facility according to the preferred embodiment of the subject invention illustrated in Figs. 1 et seq. then provides, such as with an oscillator 71, second synchronization signals having frequencies, nf, increased by a multiple relative to the standard synchronization frequencies. That multiple is the factor n by which the speed of the duplication process is increased over the standard speed at which the video recording 19 was made at 10. Alternatively, the multiple may be the factor by which the frequency nf is higher than the standard frequency f, and the increased speed of the reproduction and simultaneous rerecording processes then corresponds to such increased synchronization frequencies, nf.

In either case, the electric signals reproduced by the playback process in the duplication facility, such as at 31, are processed with the second synchronization signals having the increased frequencies nf, such as shown at 74 and 88 in Fig. 1, and also at 109 and 110 in Fig. 2. The rerecording of the video information reproduced at 31 is then effected from the processed electric signals, such as shown at 118, 121, and 122 in Fig. 2.

Also within the scope of the currently discussed aspect of the invention, or of the illustrated preferred embodiment, there are derived, from the second synchronization signals having the increased frequencies nf, third synchronization signals having the standard frequencies f, as shown, for instance, at 72 in Fig. 1. According to this aspect of the invention or of the illustrated preferred embodiment, reproduction and rerecording of the video information are then synchronized with the third synchronization signals, such as shown at 53, 59, 97, 98, 142 and 148 in Figs. 1 and 2.

In particular, the illustrated preferred embodiment provides servo systems 53, 59, 142 and 148 for synchronizing the reproduction and rerecording at 31 and 96, and effect synchronization of such reproduction and rerecording with the servo systems in response to the third synchronization signals having standard frequency f, even though multiple synchronization frequencies nf are generated and otherwise employed in the reproduction and rerecording process.

Where rotary components are employed for effecting the reproduction and rerecording, such as with the rotating components 41, 42, 48, 121, 122, and 146, tachometer signals are generated in response to operation of such rotary components, such as in the manner shown at 55, 61, 143, and 151 in Figs. 1 and 2.

According to the illustrated preferred embodiment, a rate of these tachometer signals is diminished by a divisor corresponding to the above mentioned multiple. In practice, this may be accomplished by dividing tachometer output frequencies by the above mentioned factor of n, as shown by way of example at 56, 62, 115 and 116 in Figs. 1 and 2, and also at 67 in Fig. 1 for the synchronization signals in the phase lock loop 65.

Where servo systems are provided for synchronizing reproduction and rerecording, the illustrated preferred embodiment effects such synchronization of the reproduction and rerecording processes with such servo systems 54, 63, 65, 145, and 149 in response to the tachometer signals at the diminished rate, by n, and in response to the third synchronization signals of standard frequencies f. In this respect, and also with respect to the increased frequency, the symbol f is intended to cover all vertical, horizontal and other required synchronization frequencies of signals employed in the synchronization of the reproduction and rerecording processes.

Where the first recording medium is a first tape, such as shown at 21 in Fig. 1, having the video information 19 stored therein, and the second recording media comprise second tapes 103, 104 and 105 for receiving the duplicated video information, the reproduction of video information includes moving the first tape 21 and moving reproducing means, such as the rotary playback heads 41 and 42, relative to that moving first tape for reproducing the video information in the form of electric signals, as shown at 31 in Fig. 1.

The rerecording of reproduced video information then includes moving the second tapes 103, 104 and 105 and moving recording means, such as rotary recording heads 121 and 122, relative to the moving second tapes for simultaneously rerecording the reproduced video information from the electric signals derived at 91 onto the second tapes.

In cases of the latter kind, the illustrated preferred embodiment of the invention records the video information on the first tape 21 at the standard speed and in the standard format with the aid of first synchronization signals having standard synchronization frequencies, as mentioned above with respect to the video tape recorder 18 at 10. This aspect of the illustrated preferred embodiment provides second synchronization signals, such as shown at 71 in Fig. 1, having frequencies increased by the multiple n relative to the standard synchronization frequencies f. Electric signals containing video information reproduced by the moving reproducing means, such as the rotating heads 41 and 42, are then processed with the second synchronization signals, nf, while third synchronization signals having standard frequencies f are derived from such second synchronization signals having the increased frequencies nf.

The reproduced video information is rerecorded from the electric signals processed, such as at 91 with moving recording means, such as rotating heads 121 and 122,on the moving second tapes 103, 104 and 105. If the video information includes a sound accompaniment, such audio may also be recorded by moving recording means, such as the audio heads 125 and 126 shown in Fig. 2, or by stationary audio heads.

The third signals, f, are then employed for synchronizing movement of the reproducing means 41 and 42 relative to the moving first tape 21 and the movement of the recording means 121 and 122, with or without audio heads 125 and 126, relative to the moving second tapes 103, 104 and 105.

Fig. 5 shows a system 200 according to the preferred embodiment of the subject invention for processing the reproduced electric signals jointly for the rerecording processes on the several second recording media 103, 104, 105, etc.

According to Fig. 5, a master playback system 201 is followed by a rerecording control 202. That master playback system includes a reproducing facility, such as the playback apparatus 31 shown in Fig. 1, from which information from the series of slanted tracks 22 on the first recording medium 19 is reproduced in the form of electric signals seriatim at the increased speed, n. As in Fig. 1, the playback apparatus 31 typically is equipped with time base correction and related video signal handling and processing equipment 74 for supplying a line 204 with stable audio-accompanied synchronized video signals corresponding to the information recorded on the master tape 19.

Typically, the master playback system 201 includes at least one further playback apparatus 231, equipped with signal correction circuitry 274, for supplying a further line 205 with stable audio-accompanied synchronized electric signals corresponding to information recorded on a further master tape 219. That further master tape may correspond to the master tape shown in Fig. 1 and may also include video or other information recorded at standard speed and in a standard format in a series of tracks slanted relative to a direction of movement of that master tape 219.

If desired, the second playback apparatus 231 and its signal handling and processing circuitry 274 may correspond or even be identical to the playback apparatus 31 and circuitry 74, 80 shown in Fig. 1 and explained above. If desired, the apparatus 231 with circuitry 274 may be provided for reproducing information from a master tape 219 on which information was recorded in a format different from that used in recording the information on the first master tape 19. In practice, this may also apply to the recording, reproduction and rerecording of any audio accompaniment or information, with one audio system being, for instance, used for the master tape 19 and playback apparatus 31, and another audio/video system being used for the second master tape 219 and playback apparatus 231. Reference may in this respect be had to the above mentioned SMPTE article by Shiraishi, and it is, of course, understood that any playback apparatus will be provided with such equipment as required to reproduce also the particular audio accompaniment. Further information on the advanced technique of HD sound dubbing may, for instance, be obtained from the above mentioned National/Panasonic Training Manual No. VRD-8510-232.

The lines 204 and 205 apply the played-back sound-accompanied synchronized video signals to a matrix switcher and signal router 206 which handles and directs the various played-back video, audio, synchronization control and system control signals. For instance, in the case of video signals with stereophonic sound accompaniments, the matrix switcher 206 applies the video signal, V, the left channel audio signal, Lt, and the right channel audio signal, Rt, to a line 208 which, in turn, applies the signals as shown in Fig. 5.

In particular, the video signal is applied to a video modulator 209 which modulates the video signal for rerecording purposes. By way of example, the video modulator 209 supplies the matrix switcher 206 with a frequency modulated luninance signal via a line 211 and with an amplitude, phase or frequency modulated chrominance signal via a line 212.

Line 208 applies the left channel audio signal, Lt, and the right channel audio signal, Rt, separately to a dbx encoder 213 and an audio limiter 214, which may be of conventional types for dynamic range compression.

The encoder 213 may be part of the above mentioned HD sound dubbing system providing stereophonic HIFI sound. That system may also include a dual-channel audio modulator 216 which, in turn, may include the frequency modulators 112 and 113 shown in Fig. 2 and described above for the two stereophonic audio channels. As in the case of the component 123 shown in Fig. 2, the frequency modulated left and right audio channels are applied to a combiner or adder 217 which applies the combined stereophonic audio signals via line 218 to the matrix switcher 206 for subsequent depth or frequency multiplex video and audio recording.

The line 208 also applies the left and right channel stereophonic audio signals via audio limiter 214 to an audio modulator 221 rendering the audio signals suitable for distribution to multiple longitudinal rerecording systems. Standard compression of dynamic range for recording purposes may be provided by a Dolby encoder 222, while a tone generation adder 223 inserts a signal identifying the particular tape or the particular tape section.

In this respect, synchronization control signals serve to preserve the necessary coherence of the rerecording system, to produce standard recordings at 103, 104, 105, etc. System control signals are inserted to identify the particular tape or particular tape section and are used for quality control, editing and separating a tape with multiple copies of programs into separate cassettes or reels.

The second modulated left channel and right channel audio signals are also applied to the adder 217 for supply via line 218 to the matrix switcher 206 and subsequent recording thereof.

The system 200 also includes a master synchronization signal generator 226 for synchronizing the playback apparatus as indicated by a line 227 and for synchronizing also the rerecording processes via a servo lock generator 228. In practice, that synchronization equipment may include the nf oscillator 71 and the frequency divider, ÷ n, 72 shown in Fig. 1, operating on the scan and capstan servo controls shown in Figs. 1 and 2. In addition to supplying the lower synchronization signals f to the playback apparatus 31 and 231 via line 227, the master synchronization generator 226 or its local oscillator 71, also supplies via a line 229 the higher synchronization frequencies nf for the signal handling and processing circuits 74 and 274. That principle also applies to the rerecording process, in that a line 230 in Fig. 5 supplies the higher frequency synchronization signals nf to the rerecording process, while a line 232 supplies servo lock synchronization signals at the lower rate f for the rerecording servo lock control.

Such servo control signals drive a servo lock distribution amplifier 234 which, in turn, drives servo circuits 235 for the video recorders 96, 97, 98, etc. Reference may in this respect be had to Fig. 2, including the scanner and capstan servo controls 145 and 149 thereof.

The line 231 supplies the higher synchronization frequencies nf to a control signal generator 162 which, as in Fig. 2, provides recording of the control signal in the track 108 or mixed with the tracks 102 of each slave tape via the recording head 161 or heads 121 etc.

The rerecording control 202 includes a block control 237 which, for instance, controls the on-off condition of each machine in a particular block. That block control 237 acts on a machine control 238 for the playback machines 31 and 231 in the master playback system 201, and on a machine control 239 in the rerecording system 241. That machine control 239 may be both remote and local, responding also to an indication when any slave tape has become stuck or is otherwise not advancing or recording properly. To this end, a motion detector 243 generates a signal which is supplied via the tape drive control 244 to the machine control 239 when an intended tape motion is not taking place. The machine control 239, in turn, controls the tape run accordingly via that tape drive control 244.

The machine control 239 and block control 237 may also respond to other trouble related signals such as servo unlock or rerecord signal level errors, signaling various alarms and indicators. Dependent on the magnitude of the error, maintenance or complete stopping of the rerecording process may be required.

The matrix switch 206 applies the played-back luminance signal to a luminance distribution amplifier 246 and the chrominance signal to a chrominance distribution amplifier 247. These distribution amplifiers, in turn, drive a luminance record driver 248 and a chrominance record driver 249 in each rerecording machine 96, 97, 98 etc. In practice, luminance and chrominance signal recording may, of course, be combined for each slave tape 103, 104, 105 etc. as shown, for instance, at 118, 121, and 122 in Fig. 2 for one of the rerecording machines.

The matrix switcher 206 applies the audio information to an audio demodulator 250 which demodulates the left channel and right channel audio signals to baseband for standard linear recording in a well

known manner. The audio signals may be recorded via distribution amplifier 251 and linear audio recorder 258 in longitudinal tracks 24 along an edge of any slave tape. The standard circuit for that purpose may also include the customary bias and erase frequency generators 252, and may apply the erase frequency to an erase head 253, for erasing each slave tape before information is recorded thereon.

The modulated audio information is also applied via a low-pass filter 254 to an audio HIFI distribution amplifier 255. The low-pass filter 254 eliminates undesired modulated signal components occurring above 5 MHz provided for longitudinal recording after demodulation thereof.

In this respect, longitudinal recording may be effected by linear audio recording equipment 258 which includes an audio head assembly similar to the assembly 49 shown in Fig. 1. On the other hand, the audio HIFI distribution amplifier 255 drives an audio HIFI record driver 259 in each rerecording machine in which deep layer or frequency multiplex audio signal recording is practiced. As already mentioned in connection with Fig. 2, rotating audio heads 125 and 126 may be employed for that purpose in conjunction with the rotating video heads 121 and 122. Reference may also be had in this respect to the above mentioned SMPTE article and National/Panasonic Training Manual.

The components shown for the rerecording system 241 in Fig. 5 may be duplicated for as many rerecording machines 96, 97, 98, etc., as desired. Accordingly, output signals of the luminance, chrominance, audio and servo lock distribution amplifiers, and of the block control 237 are shown as being applied to loops in the rerecording system 241. However, as indicated by the multiple outputs of the distribution amplifiers in the rerecording control 202, the various distribution amplifier output signals alternatively may be applied in parallel to the different rerecording machines 96, 97, 98, etc. Conventional resistive matrices may be employed for that purpose at the distribution amplifiers.

Economies of scale and other considerations and realities in systems of the subject kind require quality control at every step to remove defective recordings at the earliest possible point and to otherwise exclude any defective tape or cassette as much as humanly possible. In systems according to the subject invention, such quality control can be largely automated.

By way of example, Fig. 5 shows a signal monitor 262 which receives inputs from the servo lock distribution amplifier 234, luminance distribution amplifier 246, chominance distribution amplifier 247 and audio distribution amplifiers 251 and 255 indicating whether such components are operating properly either of themselves or in conjunction with other components. The signal monitor 262 accordingly applies an output signal to the block control 237 for the performance of its above mentioned functions. A similar signal monitor (not shown) may be provided in the system 241 for monitoring the components 162, 235, 248, 249, 252, 253, 258 and 259 therein and for controlling the machine control 239 or even the block control 237 accordingly.

The subject invention may also be employed in conjunction with the apparatus and methods disclosed in United States Patent 3,592,977, by James U. Lemke, issued July 13, 1971 for Mirror-Image Magnetic Information Recording Methods, and herewith incorporated by reference herein.

By way of example, the mirror-image type of recording disclosed in that Lemke patent may be employed for rerecording the information reproduced by a master playback machine such as the playback machine at 31 in Fig. 1 hereof. For instance, a Lemke type mirror-image recorder may be used as rerecorder at 98 in Fig. 2. In that case, at least the video information would be recorded on the copy tape 105 in slant tracks representing a mirror image of the tracks which the standard VTR or VCR 175 is able to handle. Accordingly, what has been labeled in Fig. 3 as TAPE LOADER 176 would then actually be or include a tape-to-tape contact copier which produces for the VTR 175 or for any VCR 165 or 172 a right-reading copy, as distinguished from a mirror-image copy.

Anhysteretic, thermal or other static or dynamic processes for making a right-reading copy tape from a mirror-image master or submaster tape are also shown and described in the latter incorporated Lemke patent or have otherwise become well known over the years.

In practice, thousands of copy tapes could be made from a single mirror-image master 105 rerecorded at 98. Such copy tapes could be made at high speeds exceeding the speed of the recording or rerecording process by many times. The resulting right-reading copy tapes would then be suitable for playback with standard VTRs or VCRs 165, 172, 175, etc., at a large number of viewers. Of course, while the broad aspect of the invention includes use of a Lemke-type mirror-image rerecording machine, the practice of the invention is not dependent on such a use. However, pursuant to the principles of the subject invention, any Lemke-type or other mirror-image rerecording machine is run at the higher speed and controlled with the standard and higher synchronization frequencies as disclosed with the aid of Fig. 2 or otherwise within the scope of the invention. While the copying of video information has been emphasized herein, it should be understood that the utility of the invention is not so limited. In this respect, producers have started to put audio information and entertainment in slant tracks on tape for playback with slant-track machines, as if it were video. Very high quality sound recordings can be realized that way and

produced in great numbers through duplication according to the subject invention.

Whenever video and/or audio copying speed is doubled, the capacity of the duplication plant is doubled as well. In more general terms, increase of the duplication speed by a factor of n correspondingly decreases the volume required for a duplication plant in which each playback machine serves dozens of rerecorders. The subject invention thus not only multiplies plant output, but at the same time increases the relative quality of the resulting product. It is that proliferation of high-quality copies which gives the whole process the status of a comparable video or other communication channel of its own, since it also decreases price per copy.

When price per tape decreases with increasing quality, the now prevalent tape piracy is effectively discouraged if not successively stopped. This, in turn, encourages producers to release more and more first-class features to the prerecorded tape market.

At the same time, lower prices render expansions into the literary field feasible, whereby high-quality audio visual "books on tape" become affordable for wide segments of the population and for the educational field as well.

Similarly, education and entertainment in the form of games on tape become feasible and affordable through the subject type of rapid high-volume duplication.

Computer programs, music or other data recorded in slant tracks can also be duplicated at high volume and widely proliferated by the subject invention.

Claims

1. Apparatus for producing on destination recording tapes (103-105) recordings of information derived from a master recording medium (21) seriatim in the form of electric signals which are simultaneously re-recorded with a number of recording devices (96, 97, 98) seriatim in series of tracks at a predetermined angle for a predetermined format on the destination recording tapes (103-105), without deliberate omission of information tracks, for ultimate playback at real time from said predetermined format comprising a series of tracks (102) slanted at said predetermined angle relative to a direction of movement of the destination recording tape (103-105), with a predetermined number of playback heads (165, 172) rotating at a predetermined angular velocity, with said predetermined angular velocity, angle and number of playback heads (165, 172) being standardised for that predetermined format, the apparatus being

characterised in that there are means (109, 110, 209) for modulating said electrical signals, prior to recording on each recording device, to the modulation format required for the predetermined format of the destination recording tapes, said recording devices (96, 97, 98) comprising for each of said destination recording tapes (103-105) recording heads (121, 122) equal in number to said standardised number of playback heads (165, 172) in order that the successive tracks will be recorded at each recording device one after the other, and in that said apparatus includes driving means (141) having control means (142) for controlled rotation of these recording heads (121, 122) at an angular velocity which is a multiple n of said standardised angular velocity, and a transport means (146-149) for producing said standard track angle for said predetermined format while moving each recording tape (103-105) relative to the rotating number of recording heads (121, 122) at a speed corresponding to said multiple, whereby duplication of information recordings is achieved at each tape at a rate which is a multiple of real-time production without multiplication of recording heads beyond said standard number and without change in diameter of a trajectory of rotation of the recording heads for any of the tapes and without changing the angle between the plane of movement of said tape and the plane of rotation of said heads.

2. Apparatus as claimed in claim 1, including a cassette loader (169) for loading said recording tapes or media (103-105) into video cassettes (171).

3. Apparatus as claimed in claim 1 or 2, including an oscillator (71) for providing first synchronization signals having frequencies (nf) increased by said multiple relative to second synchronization frequencies (f) which are standard for the recording concerned, and signal processing means (74) for processing the electric signals prior to rerecording thereof with said first synchronization signals having said increased frequencies (nf).

4. Apparatus as claimed in claim 3, including means (72) connected to said oscillator (71) for deriving from said first synchronization signals having said increased frequencies (nf), third synchronization signals having said standard frequencies (f), and means (142, 148) for synchronizing said driving means (141) and said transport means (146-149) with said third synchronization signals.

5. Apparatus as claimed in claim 4, wherein the synchronizing means comprise servo means (116, 148, 151) for synchronizing said apparatus,

produced in great numbers through duplication according to the subject invention.

Whenever video and/or audio copying speed is doubled, the capacity of the duplication plant is doubled as well. In more general terms, increase of the duplication speed by a factor of n correspondingly decreases the volume required for a duplication plant in which each playback machine serves dozens of rerecorders. The subject invention thus not only multiplies plant output, but at the same time increases the relative quality of the resulting product. It is that proliferation of high-quality copies which gives the whole process the status of a comparable video or other communication channel of its own, since it also decreases price per copy.

When price per tape decreases with increasing quality, the now prevalent tape piracy is effectively discouraged if not successively stopped. This, in turn, encourages producers to release more and more first-class features to the prerecorded tape market.

At the same time, lower prices render expansions into the literary field feasible, whereby high-quality audio visual "books on tape" become affordable for wide segments of the population and for the educational field as well.

Similarly, education and entertainment in the form of games on tape become feasible and affordable through the subject type of rapid high-volume duplication.

Computer programs, music or other data recorded in slant tracks can also be duplicated at high volume and widely proliferated by the subject invention.

Claims

1. Apparatus for producing on destination recording tapes (103-105) recordings of information derived from a master recording medium (21) seriatim in the form of electric signals which are simultaneously re-recorded with a number of recording devices (96, 97, 98) seriatim in series of tracks at a predetermined angle for a predetermined format on the destination recording tapes (103-105), without deliberate omission of information tracks, for ultimate playback at real time from said predetermined format comprising a series of tracks (102) slanted at said predetermined angle relative to a direction of movement of the destination recording tape (103-105), with a predetermined number of playback heads (165, 172) rotating at a predetermined angular velocity, with said predetermined angular velocity, angle and number of playback heads (165, 172) being standardised for that predetermined format, the apparatus being

characterised in that there are means (109, 110, 209) for modulating said electrical signals, prior to recording on each recording device, to the modulation format required for the predetermined format of the destination recording tapes, said recording devices (96, 97, 98) comprising for each of said destination recording tapes (103-105) recording heads (121, 122) equal in number to said standardised number of playback heads (165, 172) in order that the successive tracks will be recorded at each recording device one after the other, and in that said apparatus includes driving means (141) having control means (142) for controlled rotation of these recording heads (121, 122) at an angular velocity which is a multiple n of said standardised angular velocity, and a transport means (146-149) for producing said standard track angle for said predetermined format while moving each recording tape (103-105) relative to the rotating number of recording heads (121, 122) at a speed corresponding to said multiple, whereby duplication of information recordings is achieved at each tape at a rate which is a multiple of real-time production without multiplication of recording heads beyond said standard number and without change in diameter of a trajectory of rotation of the recording heads for any of the tapes and without changing the angle between the plane of movement of said tape and the plane of rotation of said heads.

2. Apparatus as claimed in claim 1, including a cassette loader (169) for loading said recording tapes or media (103-105) into video cassettes (171).

3. Apparatus as claimed in claim 1 or 2, including an oscillator (71) for providing first synchronization signals having frequencies (nf) increased by said multiple relative to second synchronization frequencies (f) which are standard for the recording concerned, and signal processing means (74) for processing the electric signals prior to rerecording thereof with said first synchronization signals having said increased frequencies (nf).

4. Apparatus as claimed in claim 3, including means (72) connected to said oscillator (71) for deriving from said first synchronization signals having said increased frequencies (nf), third synchronization signals having said standard frequencies (f), and means (142, 148) for synchronizing said driving means (141) and said transport means (146-149) with said third synchronization signals.

5. Apparatus as claimed in claim 4, wherein the synchronizing means comprise servo means (116, 148, 151) for synchronizing said apparatus,

* C L M S *

and means (94) connected to the servo means for effecting synchronization of the driving means (141) and said transport means (146) in response to said third synchronization signals.

6. Apparatus as claimed in any one of the preceding claims, wherein the number of recording heads is two.

7. A method of producing on destination recording tapes (103-105) recordings of information derived from a master recording medium (21) seriatim in the form of electric signals which are simultaneously re-recorded with a number of recording devices (96, 97, 98) seriatim in series of tracks at a predetermined angle for a predetermined format, on the destination recording tapes (103-105), without deliberate omission of information tracks, for ultimate playback at real time from said predetermined format comprising a series of tracks (102) slanted at said predetermined angle relative to a direction of movement of the destination recording tape (103-105), with a predetermined number of playback heads (165, 172) rotating at a predetermined angular velocity, with said predetermined angular velocity, angle and number of playback heads (165, 172) being standardised for that predetermined format,

characterised in that said method comprises modulating (109, 110, 209) said electrical signals, prior to recording on each recording device, to the modulation format required for the predetermined format of the destination recording tapes and utilizing recording devices comprising for each of said destination recording tapes (103-105) recording heads (121, 122) equal in number to said standardised number of playback heads, recording successive tracks at each recording device one after the other, rotating these recording heads (121, 122), controlling the rotation of these recording heads (121, 122) at an angular velocity which is a multiple n of said standardised angular velocity, and moving each recording tape (103-105) relative to the rotating number of recording heads (121, 122) at a speed corresponding to said multiple, so as to produce said standardised track angle, thus duplicating information recording at each tape at a rate which is a multiple of real-time production without multiplication of recording heads beyond said standardised number and without change in diameter of a trajectory of rotation of the recording heads for any of the tapes and without changing the angle between the plane of movement of said tape and the plane of rotation of said heads.

8. A method as claimed in claim 7, and comprising loading said tapes or media (103-105) into video cassettes (171).

9. A method as claimed in claim 7 or 8, and including the steps of providing first synchronization signals having a frequencies (nf) increased by said multiple relative to second synchronization frequencies (f) which is standard for the recording format concerned, and of processing said electric signals with said first synchronization signals having said increased frequencies (nf), prior to application thereof to said recording heads.

10. A method as claimed in claim 7, 8 or 9 and including the steps of deriving from said first synchronization signals having said increased frequencies (nf) third synchronization signals having said standard frequencies (f), and synchronizing said recording or duplication with said third synchronization signals.

11. A method as claimed in any one of claims 7 to 10, wherein said recording devices each have two recording heads.

Patentansprüche

1. Vorrichtung zum Herstellen von Informations-Aufzeichnungen auf Aufnahmebändern (103-105), ab einem Original-Aufnahme-Medium (21), wobei die Information seriell in der Form elektrischer Signale kommen und gleichzeitig wieder mit einer Anzahl von Aufnahme-Vorrichtungen (96, 97, 98) und dabei nacheinander in Reihen von Spuren unter einem vorbestimmten Winkel nach einem vorgegebenen Format auf den Aufnahmebändern (103-105) aufgezeichnet werden, ohne bestimmte Informationsspuren wegzulassen, beim sofortigen Echtzeit-Wiederabspielen dieses vorgegebenen Formats einer Reihe von unter vorgegebenem Winkel zur Laufrichtung des Aufnahmebandes (103-105) schräg angelegten Spuren (102) in Echtheit, mit einer vorgegebenen Anzahl von Abspielköpfen (165, 172), welche sich mit einer vorgegebenen Winkelgeschwindigkeit drehen, wobei die vorgegebene Winkelgeschwindigkeit, der Winkel und die Anzahl der Abspielköpfe für ein vorgegebenes Format genormt sind, wobei die Vorrichtung dadurch gekennzeichnet ist, dass Mittel (109,110,209) vorgesehen sind, um die genannten elektrischen Signale vor dem Aufnehmen auf jedem Ausnahmegerät zu dem für das vorbestimmte Format der Aufnahmebänder benötigte Modulationsformat zu modulieren, wobei die genannten Aufnahme-Vorrichtungen (96, 97, 98) für jedes der genannten Aufnahmebänder (103-105) eine gleiche

*. C L M S *

Anzahl von Aufnahmeköpfen (121, 122) und von Abspielköpfen (165, 172) aufweist, sodass aufeinanderfolgende Spuren mit jeder Aufnahme-Vorrichtung aufeinanderfolgend aufgenommen werden, und dass dieser Apparat Antriebssystem (141) aufweist, die Regel- und Steuermittel (142) für das geregelte Drehen der Aufnahmeköpfe (121, 122) mit einem n-fachen der genormten Winkelgeschwindigkeit aufweist, und dass Transportmittel (146-149) vorhanden sind, welche den genormten Winkel der Spur einhalten, wenn das Aufnahmeband (103-105) an den rotierenden Aufnahmeköpfen (121, 122) mit der n-fachen Normgeschwindigkeit vorbeigeführt wird und dabei das Vervielfachen der Informationsaufzeichnung auf jedes Band mit einer Geschwindigkeit erfolgt, die einem Vielfachen der Geschwindigkeit bei Echtzeit entspricht, ohne dass die Zahl der Aufnahmeköpfe über die Norm-Anzahl erhöht werden muss und ohne dass der Durchmesser der Rotationskurve der Aufnahmeköpfe für irgend eines der Bänder, oder der Winkel zwischen der Bewegungsrichtung des Bandes und der Rotaionsebene der Köpfe geändert werden muss.

2. Vorrichtung nach Anspruch 1, mit einem Kassettenlader (169) für das Laden der Aufnahmebänder oder Medien (103-105) in Videokassetten (171).

3. Vorrichtung nach Anspruch 1 oder 2, mit einem Oszillator (71) zum Erzeugen von ersten Synchronisationssignalen mit einer Frequenz (nf) die dem Vielfach der zweiten Synchronisationsfrequenz (f) entspricht, die der Norm für die entsprechende Aufnahme entspricht und weiter mit Mitteln (74) zum Verarbeiten der elektrischen vor deren Wiederaufnahme mit Synchronisationssignale, welche die erhöhten Frequenzen (nf) aufweisen.

4. Vorrichtung nach Anspruch 3, mit Mitteln (72) Erzeugen von dritten Synchronisationssignalen der genormten Frequenz (f), welche mit Hilfe der ersten Synchronisationssignale der Frequenz (nf) erzeugt werden und die mit dem Oszillator (71) verbunden sind und mit Mitteln (142, 148) zum Synchronisieren der Antriebssystem (141) und der Transportmittel (146) mit den dritten Synchronisationssignalen.

5. Vorrichtung nach Anspruch 4, bei welcher die Synchronisations-Mittel Servomittel (116, 148, 151) zum Synchronisieren der genannten Vorrichtung umfassen und mit Mitteln (94) die mit den Servomitteln zum Durchführen der Synchronisation der Antriebssystem (141) und der Transportmittel (146) in Funktion der dritten Synchronisationssignale verbunden sind.

6. Vorrichtung nach einem der vorhergehenden Ansprüche mit zwei Aufnahmeköpfen.

7. Verfahren zum Herstellen von Informations-Aufzeichnungen auf Aufnahmebändern (103-105), ab einem Original-Aufnahme-Medium (21) wobei die Information seriell in der Form elektrischer Signale kommen und gleichzeitig wieder mit einer Anzahl von Aufnahme-Vorrichtungen (96, 97, 98) und dabei nacheinander in Reihen von Spuren unter einem vorbestimmten Winkel nach einem vorgegebenen Format auf den Aufnahmebändern (103-105) aufgezeichnet werden, ohne bestimmte Informationsspuren wegzulassen, beim sofortigen Echtzeit-Wiederabspielen dieses vorgegebenen Formats einer Reihe von unter vorgegebenem Winkel zur Laufrichtung des Aufnahmebandes (103-105) schräg angelegten Spuren (102) in Echtheit, mit einer vorgegebenen Anzahl von Abspielköpfen (165, 172), welche sich mit einer vorgegebenen Winkelgeschwindigkeit drehen, wobei die vorgegebene Winkelgeschwindigkeit, der Winkel und die Anzahl der Abspielköpfe für ein vorgegebenes Format genormt sind, wobei das Verfahren dadurch gekennzeichnet ist, dass es ein Modulieren (109,110,209) der genannten elektrischen Signale vor dem Aufnehmen auf jedem Aufnahmegerät zu dem für das vorbestimmte Format der Aufnahmebänder benötigte Modulationsformat umfasst, wobei Aufnahme-Vorrichtungen verwendet werden die für jedes der genannten Aufnahmebänder (103-105) eine gleiche Anzahl von Aufnahmeköpfen (121, 122) und eine genormte Anzahl von Abspielköpfen aufweist, sodass aufeinanderfolgende Spuren mit jeder Aufnahmevorrichtung aufeinanderfolgend aufgenommen werden, und dass die Aufnahmeköpfe (121, 122) mit einer n-fachen der genormten Winkelgeschwindigkeit gedreht werden, und dass jedes Aufnahmeband (103-105) an den rotierenden Aufnahmeköpfen (121, 122) mit der n-fachen Normgeschwindigkeit vorbeigeführt wird, um den genormten Spurwinkel zu erzeugen und dabei die Informationsaufzeichnung auf jedes Band mit einer Geschwindigkeit erfolgt, die einem Vielfachen der Gwschwindigkeit bei Echtzeit entspricht, ohne dass die Zahl der Aufnahmeköpfe über die Norm-Anzahl hinaus erhöht werden muss und ohne dass der Durchmesser der Rotationskurve der Aufnahmeköpfe für irgend eines der Bänder, oder der Winkel zwischen der Bewegungsrichtung des Bandes und der Rotaionsebene der Köpfe geändert werden muss.

* C L M S *

8. Verfahren nach Anspruch 7, bei welchem Aufnahmebänder oder -Medien (103-105) in Videokassetten (171) eingebracht werden.

9. Verfahren nach Anspruch 7 oder 8, bei welchem erste Synchronisationssignalen einer Frequenz (nf) die dem Vielfach der zweiten Synchronisationsfrequenz (f), die der Norm für die entsprechende Aufnahme entspricht, erzeugt werden und dem Weiterverarbeiten dieser ersten elektrischen Signale der erhöhten Frequenzen (nf) vor dem Zuführen der Signale zu den Aufnahmeköpfen.

10. Verfahren nach Anspruch 7, 8 oder 9 bei welchem von den ersten Synchronisationssignalen der erhöhten Frequenz (nf) dritte Synchronisationssignale der genormten Frequenz (f) abgeleitet werden und bei welchem die Aufnahme oder Kopie mit den dritten Synchronisationssignalen synchronisiert werden.

11. Verfahren nach einem der vorhergehenden Ansprüche 7 bis 10 bei welchem die Aufnahmevorrichtungen je zwei Aufnahmeköpfen aufweisen.

Revendications

1. Appareil pour produire des enregistrements sur des rubans d'enregistrement récepteurs (103-105) à partir d'une information dérivée d'un milieu d'enregistrement maître (21) sous la forme d'une succession de signaux électriques qui sont réenregistrés simultanément avec un certain nombre de dispositifs d'enregistrement (96, 97, 98) dans une série de pistes à un angle prédéterminé pour un format prédéterminé sur les rubans d'enregistrement récepteurs (103-105), sans omission délibérée de pistes d'information, pour un play-back final en temps réel dudit format prédéterminé comprenant une série de pistes inclinées (102) avec ledit angle prédéterminé par rapport à une direction de déplacement du ruban d'enregistrement récepteur (103-105), avec un nombre prédéterminé de têtes de play-back (165, 172) tournant à une vitesse angulaire prédéterminée, ladite vitesse angulaire, ledit angle et ledit nombre de têtes de play-back prédéterminés (165, 172) étant standardisés pour ce format prédéterminé, l'appareil étant

caractérisé en ce que des moyens (109, 110, 209) sont prévus pour moduler lesdits signaux électriques avant l'enregistrement sur chaque dispositif d'enregistrement, au format de modulation requis pour le format prédéterminé des rubans d'enregistrement récepteurs, lesdits dispositifs d'enregistrement (96, 97, 98) comprenant pour chacun desdits rubans d'enregistrement récepteurs (103-105), un nombre de têtes d'enregistrement (121, 122) égal audit nombre standardisé de têtes de play-back (165, 172), afin que les pistes successives soient enregistrées à chaque dispositif d'enregistrement l'une après l'autre, et en ce que ledit appareil comprend des moyens d'entraînement (141) ayant des moyens de commande (142) pour contrôler la rotation de ces têtes d'enregistrement (121, 122) à une vitesse angulaire qui est un multiple n de ladite vitesse angulaire standardisée et un moyen de transport (146-149) pour produire ledit angle de piste standard pour ledit format prédéterminé, tout en déplaçant chaque ruban d'enregistrement (103-105) par rapport aux têtes rotatives d'enregistrement (121, 122) à une vitesse correspondant audit multiple, ce qui permet de réaliser la copie de l'information enregistrée sur chaque ruban à une vitesse qui est un multiple de la production en temps réel, sans multiplier les têtes d'enregistrement au-delà dudit nombre standard, sans changer le diamètre d'une trajectoire de rotation des têtes d'enregistrement pour un quelconque des rubans et sans changer l'angle entre le plan de mouvement dudit ruban et le plan de rotation desdites têtes.

2. Appareil selon la revendication 1, comprenant un chargeur de cassettes (169) pour charger lesdits rubans ou milieux d'enregistrement (103-105) dans des cassettes vidéo (171).

3. Appareil selon la revendication 1 ou 2, comprenant un oscillateur (71) pour fournir de premiers signaux de synchronisation ayant des fréquences augmentées (nf) par ledit multiple par rapport aux dites secondes fréquences de synchronisation (f) qui sont standard pour l'enregistrement concerné et des moyens de traitement des signaux (74) pour traiter les signaux électriques avant leur réenregistrement avec lesdits premiers signaux de synchronisation ayant lesdites fréquences augmentées (nf).

4. Appareil selon la revendication 3, comprenant des moyens (72) connectés avec ledit oscillateur (71) pour dériver desdits premiers signaux de synchronisation ayant lesdites fréquences augmentées (nf), de troisièmes signaux de synchronisation ayant lesdites fréquences standard (f) et des moyens (142, 148) pour synchroniser ledit moyen d'entraînement (141) avec lesdits moyens de transport (146-149) avec lesdits troisièmes signaux de synchronisation.

5. Appareil selon la revendication 4, où le moyen de synchronisation comprend des moyens de

* C L M S *

commande (116, 148, 151) pour synchroniser ledit appareil, et des moyens (94) connectés aux dits moyens de commande pour réaliser la synchronisation du moyen d'entraînement (141) et dudit moyen de transport (146) en réponse aux dits troisièmes signaux de synchronisation.

6. Appareil selon l'une quelconque des revendications précédentes, où le nombre de têtes d'enregistrement est égal à deux.

7. Méthode pour produire des rubans des enregistrements sur des rubans récepteurs (103-105) à partir d'une information dérivée d'un milieu d'enregistrement maître (21) sous la forme d'une succession de signaux électriques qui sont réenregistrés simultanément avec un certain nombre de dispositifs d'enregistrement (96, 97, 98) dans une série de pistes à un angle prédéterminé pour un format prédéterminé sur les rubans d'enregistrement récepteurs (103-105), sans omission délibérée de pistes d'information, pour un play-back final en temps réel dudit format prédéterminé comprenant une série de pistes inclinées (102) avec ledit angle prédéterminé par rapport à une direction de déplacement du ruban d'enregistrement récepteur (103-105), avec un nombre prédéterminé de têtes de play-back (165, 172) tournant à une vitesse angulaire prédéterminée, ladite vitesse angulaire, ledit angle et ledit nombre de têtes de play-back (165, 172) prédéterminés étant standardisés pour ce format prédéterminé,

caractérisée en ce que ladite méthode comprend de moduler (109, 110, 209) lesdits signaux électriques avant l'enregistrement sur chaque dispositif d'enregistrement, au format de modulation requis pour le format prédéterminé des rubans d'enregistrement récepteurs et d'utiliser des dispositifs d'enregistrement comprenant pour chacun desdits rubans d'enregistrement récepteurs (103-105), un nombre de têtes d'enregistrement (121, 122) égal audit nombre standardisé de têtes de play-back, d'enregistrer les pistes successives à chaque dispositif d'enregistrement l'une après l'autre, de tourner ces têtes d'enregistrement (121, 122), de contrôler la rotation de ces têtes d'enregistrement (121, 122) à une vitesse angulaire qui est un multiple n de ladite vitesse angulaire standardisée et de déplacer chaque ruban d'enregistrement (103-105) par rapport aux têtes d'enregistrement rotatives (121, 122) à une vitesse correspondant audit multiple, de manière à produire ledit angle standardisé de piste, copiant ainsi l'information sur chaque ruban à une vitesse qui est un multiple de la production en temps réel sans multiplier les têtes d'enregistrement au-delà dudit nombre standardisé, sans changer le diamètre d'une trajectoire de rotation des têtes d'enregistrement pour un quelconque des rubans et sans changer l'angle entre le plan du mouvement dudit ruban et le plan de rotation des dites têtes.

8. Méthode selon la revendication 7, comprenant de charger lesdits rubans ou milieux (103, 105) dans des cassettes vidéo (171).

9. Méthode selon la revendication 7 ou 8, comprenant les étapes consistant à fournir des premiers signaux de synchronisation ayant une fréquence (nf) augmentée par ledit multiple par rapport aux secondes fréquences de synchronisation (f) qui sont standard pour le format d'enregistrement concerné et à traiter lesdits signaux électriques avec lesdits premiers signaux de synchronisation ayant lesdites fréquences augmentées (nf) avant leur application auxdites têtes d'enregistrement.

10. Méthode selon la revendication 7, 8 ou 9, comprenant les étapes consistant à dériver à partir desdits premiers signaux de synchronisation ayant lesdites fréquences augmentées (nf), des troisièmes signaux de synchronisation ayant lesdites fréquences standard (f) et à synchroniser ledit enregistrement ou ladite reproduction avec lesdits troisièmes signaux de synchronisation.

11. Méthode selon l'une quelconque des revendications 7 à 10, où lesdits dispositifs d'enregistrement ont chacun deux têtes d'enregistrement.

* C L M S *