

The invention relates to a method for track following in magnetic tape units according to the preamble of claim 1 and to a magnetic tape unit according to the preamble of claim 5.

If a magnetic head leaves a track during the reading and gets more or less into an adjacent track, cross-talk from the adjacent track occurs or wrong signals are read. In particular during the recording of digital signals the correct reading of the signals is then made more difficult or impossible.

From EP-A 117 753 there is known for automatic track following during the reading, i.e. during play-back, the recording of identifying signals in one or more track sections. The latter are formed in a distinguishable manner in mutually adjacent tracks so that by processing of the identifying signals a control variable may be obtained. This control variable indicates by what amount and in what direction the magnetic head deviates from its intended track. It is exploited to return the head again onto its intended track by means of an additional control of the head drum or the tape feed.

In the case of the recently developed R-DAT system, a system for digital sound recording on magnetic tape, the tracks lie next to one another without a gap, and the gap of the magnetic heads is greater than the track width, so that with a head in middle position on a track the adjacent tracks are in each case also partly covered by the head. Interference with the useful signals in the form of cross-talk from the adjacent tracks is prevented due to the fact that the working gaps of the two heads are inclined in opposite directions to one another. For the identifying signals the cross-talk from the adjacent tracks is exploited for the track following, as will be explained by means of Fig. 1.

Fig. 1 shows three adjacent oblique tracks 1, 2 and 3 on a tape 4, an identifying signal A, B, C of identical length being recorded in each track so that the identifying signals in the three tracks are staggered relative to one another, but adjoin one another. If now the magnetic head 5 scans the centre track 2 in correct middle position, the identifying signals A and B produce from the adjacent tracks 1 and 3 small amplitudes a and b of equal magnitude, and the identifying signal C from the centre track 2 produces the greater amplitude c. With differing track position in the direction of track 1 the amplitude b rises, and with differing track position in the direction of track 3 the amplitude a rises. Independently of the scanning of the useful signals the identifying signals supply in the case of such differences a control variable which is inputted as an actual value into a phase regulator that restores the correct track position by adjustment of the drive shaft for the tape feed.

Successive oblique tracks are written on alternately by the two heads of the head wheel. Accurate track following therefore presupposes that the amplifiers connected in series with the heads supply signals with equal amplitude when the track position is correct. In practice, however, the head amplifier outputs

fluctuate, so that with constant track deviation a different control variable is obtained for the track following and the track optimum cannot be attained.

In order to correct this drawback, there is known, during the manufacture of the unit in the factory by means of a measurement cassette on which the identifying signals are recorded with equal levels in all the tracks, the setting of the two channels to the same value by potentiometers. This is on the one hand cumbersome and on the other necessitates high expenditure on the processing electronics.

It has moreover been found in practice that a whole number of factors can distort the works setting initially made. Thus ageing of the setting means, wear of the heads, fouling of the heads and asymmetry during the recording are not allowed for. This results in defective control signals for the gap, which lead to imperfect reproduction of the useful signals and necessitate resetting of the unit in the workshop or in the factory.

The aim of the invention is to create a method of the kind mentioned in the preamble, with which the supply of correct track following signals can be achieved in a simple manner and with small outlay without involving the manufacturer or a workshop.

The set aim is achieved according to the invention by the subject of claim 1. A magnetic tape unit according to the invention is contained in claim 5.

The correction value may be adjusted and set initially in the works. It is also possible, however, for the user to be able to undertake and also repeat the correction himself whenever necessary, either with a measuring cassette or with the use of existing played-on cassettes.

A unit for carrying out the method contains means which switch on the measuring phase before the start of the useful signal play-back, said means preferably being associated with the function selector switch.

It is moreover possible to provide the function selector switch with a special switch position for the switching on of the measuring method. In that case a measuring cassette may for example be inserted beforehand. The switching on of the measuring method may however also take place each time play-back mode is switched on. The user then has no possibility of intervening, but the switching on of the measuring method takes place automatically, so that it is always ensured that at the amplifier output the amplitudes of the identifying signals of the two heads are identical.

The invention will be explained in detail below by means of the drawing. There are shown there:

Fig. 1a the already previously explained layout of the identifying signals,

- Fig. 1b the associated amplitudes during the scanning of the identifying signals,
- Fig. 2 a signal diagram explaining the correction method according to the invention, and
- Fig. 3 a block diagram of a unit for carrying out the method according to the invention.

In the signal diagram of Fig. 2 there are denoted by w the amplitudes of the identifying signal sequences which are measured with different tape feed phases z , it being assumed that the first measurement starts at -120° and then continues at -60° , at 0° , at $+60^\circ$ and at $+120^\circ$ etc.. The amplitudes a , b , c correspond to the first identifying signal sequence in Fig. 1b, which is scanned by the first magnetic head 5, while the amplitudes b , c , d correspond to the second identifying signal sequence, which is scanned by the second head 5', the amplitude b now corresponding to the middle track and the two amplitudes c and d (Fig. 1a) to the adjacent tracks. X represents here the head switching signal which activates the two heads at the correct time in each case. Amplitude measurements are made in a similar way for the following tape feed phases z , the further clocking of which is ensured by output pulses y . T_1 is the time in which the cross-talk component a of the identifying signal A is measured by the first magnetic head. This value is stored. T_2 is the time in which the cross-talk component b of the identifying signal B is measured by the first magnetic head. This value is likewise stored. T_3 is the time in which the first magnetic head measures the identifying signal C in the centre track. This value also is stored.

In a similar way the second head subsequently measures the amplitudes T_1' , T_2' and T_3' , which are likewise stored.

As the sequences w show, the amplitudes which the two heads measure are unequal at the output of the associated amplifiers. This means - as mentioned in the preamble - that a wrong track following signal is fed to the tape feed system.

The invention now prevents this by the fact that the amplitude difference which is found is used to correct the control variable for the track following. There are several possibilities for this. One consists in selecting from each identifying signal sequence the amplitudes T_3 and T_3' of the identifying signals scanned by the two magnetic heads in the respective centre track, forming from the selected amplitudes the quotient Q and storing it, and then loading with the quotient Q each further identifying signal measured by the head which has supplied the lower or higher amplitude.

Moreover, the measurement and the amplitude comparison of the identifying signals scanned in the centre track may take place a plurality of times and the mean value of the quotients Q be formed in each case, so that after a few measurement cycles a very accurate quotient is obtained.

In a further development the difference of the amplitudes T_1 and T_2 of the identifying signals scanned by the one head in the adjacent tracks and the difference of the amplitudes T_1' and T_2' of the identifying signals scanned by the other head in the adjacent tracks and loaded with the quotient Q may be obtained and from the differences the mean value be obtained as a corrected control variable. The result is a quantity whose amount indicates the deviation from the track middle, and whose sign determines the direction of the correction.

The measurement described in the preamble may take place in a test phase with inserted measurement cassette, but it is also possible to carry out the measurement during the playing back of any cassette and to repeat it after changing the cassette. This may take place automatically when play-back mode is switched on. It is of advantage moreover if defectively recorded cassettes are also played back in the track middle. Because of the measurement, however, a certain time elapses before the engagement in position takes place and the signal play-back can start.

It is also possible, however, instead of the amplitudes T_3 and T_3' of each identifying signal sequence to utilise the amplitudes T_1 , T_2 and T_1' , T_2' of the identifying signals scanned by the two magnetic heads in the adjacent tracks, to form from the utilized amplitudes of each head the quotients M , N , and to form from the quotients as a corrected control variable the mean value, which then represents the track middle deviation. In this case also each cassette is played back in the track middle.

The block diagram of Fig. 3 shows in highly simplified form the layout of the circuit for the carrying out of the measurement and correction method according to the invention in a magnetic tape unit. There are fed to the input 6 of the processing circuit 7 the identifying signals for the processing which are obtained by scanning of the magnetic tape, the processing circuit 7 also receiving the head switching signals which are supplied by a head drum servo circuit 21. The signals from the output 8 of the processing circuit 7 are fed to an A/D converter 9, which is part of a microcomputer 10 indicated by the broken lines. The A/D converter 9 controls a phase regulator 11 whose output is the actual value of the track position information, which is fed to a D/A converter 12 that controls the motor 14 for the tape feed via an output amplifier 13. A frequency generator 15 connected to the motor 14 supplies via an amplifier 16 an actual signal to a speed controller 17, which in accordance with the intended value predetermined for it by a circuit 18 activates the D/A converter 12. The circuit 18, which also transmits an intended value to the phase regulator 11, is connected to the operating element of the magnetic tape unit and initiates e.g. on selection of the function mode "play-back" the measuring procedure, so that there are inputted into the microcomputer the scanning pulses for the further clocking of the tape feed phase and appropriate intended values are fed from the circuit 18 to the phase regulator 11 and to the speed regulator 17. From the amplitudes measured during the various tape feed phases and compared by the microcomputer, that is to say the amplitudes of the identifying

signals at the head amplifier outputs, a control variable determined by the microcomputer is then - as described above - passed into a storage means 20 fed by a battery 19, said storage means 20, on completion of the measurement procedure, supplying constantly to the phase controller 11 during the subsequently beginning play-back mode an information item which ensures a correct gap position.

The invention is not limited to use in units for digital sound recording and play-back, but can also be used in a similar fashion with video recorders.

Claims

1. Method for track following in magnetic tape units, in which at least two magnetic heads (5, 5') arranged on a rotating wheel record and read useful and identifying signals in tracks (1, 2, 3) running obliquely to the longitudinal axis of the magnetic tape (4), where the identifying signals recorded in sections (A, B, C, D) of equal length of mutually adjacent tracks, said sections however being staggered relative to one another in track longitudinal direction, generate during the reading operation in accordance with the amplitudes scanned from adjacent tracks a control variable for the tape feed system, by means of which the required middle position of the magnetic heads relative to the tracks is produced, characterised in that the tape feed means are prior to the reading operation for the useful signals controlled step-wise so that the magnetic heads sweep the entire track width once or a plurality of times, that in so doing there are measured, in each case in predetermined relevant rotational positions of the magnetic heads and hence scanning positions along the tracks, the amplitudes (a, b, c) of the identifying signals, which are read in respective successive tracks by different magnetic heads, that out of the amplitude sequence of each magnetic head the amplitude of the respective middle track is selected and the selected amplitudes are compared with one another and, in the event of an amplitude difference being found, correction values are obtained and stored, with which during the subsequent reading operation for the useful signals the control variable obtained for the track middle following is corrected.
2. Method according to claim 1, characterised in that a comparison of the selected amplitudes is carried out in such a way that from the amplitudes the quotient is formed and then stored, and that each further identifying signal measured by the magnetic head which has supplied the lower or higher amplitude is then loaded with the quotient.

signals at the head amplifier outputs, a control variable determined by the microcomputer is then - as described above - passed into a storage means 20 fed by a battery 19, said storage means 20, on completion of the measurement procedure, supplying constantly to the phase controller 11 during the subsequently beginning play-back mode an information item which ensures a correct gap position.

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Claims

1. Method for track following in magnetic tape units, in which at least two magnetic heads (5, 5') arranged on a rotating wheel record and read useful and identifying signals in tracks (1, 2, 3) running obliquely to the longitudinal axis of the magnetic tape (4), where the identifying signals recorded in sections (A, B, C, D) of equal length of mutually adjacent tracks, said sections however being staggered relative to one another in track longitudinal direction, generate during the reading operation in accordance with the amplitudes scanned from adjacent tracks a control variable for the tape feed system, by means of which the required middle position of the magnetic heads relative to the tracks is produced, characterised in that the tape feed means are prior to the reading operation for the useful signals controlled step-wise so that the magnetic heads sweep the entire track width once or a plurality of times, that in so doing there are measured, in each case in predetermined relevant rotational positions of the magnetic heads and hence scanning positions along the tracks, the amplitudes (a, b, c) of the identifying signals, which are read in respective successive tracks by different magnetic heads, that out of the amplitude sequence of each magnetic head the amplitude of the respective middle track is selected and the selected amplitudes are compared with one another and, in the event of an amplitude difference being found, correction values are obtained and stored, with which during the subsequent reading operation for the useful signals the control variable obtained for the track middle following is corrected.
2. Method according to claim 1, characterised in that a comparison of the selected amplitudes is carried out in such a way that from the amplitudes the quotient is formed and then stored, and that each further identifying signal measured by the magnetic head which has supplied the lower or higher amplitude is then loaded with the quotient.



3. Method according to claim 2, characterised in that the measurement and the amplitude comparison of the identifying signals scanned in the central track takes place a plurality of times and the mean value of the quotients is obtained in each case.
4. Method according to claim 3, characterised in that the difference of the amplitudes of the identifying signals scanned by the one head in the adjacent tracks and the difference of the amplitudes of the identifying signals scanned by the other head in the adjacent tracks and loaded with the quotient is obtained and that from the differences the mean value is obtained as corrected control variable.
5. Magnetic tape unit with at least two magnetic heads (5, 5') arranged on a rotating wheel, which record and read useful and identifying signals in tracks (1, 2, 3) running obliquely to the longitudinal axis of the magnetic tape (4), and with a tape feed system which produces the required centre position of the magnetic heads relative to the tracks, where the identifying signals recorded in sections (A, B, C, D) of equal length of mutually adjacent tracks, said sections however being staggered relative to one another in track longitudinal direction, generate during the reading operation in accordance with the amplitudes scanned from adjacent tracks a control variable for the tape feed system, characterised in that means are provided which prior to the reading operation switch on for a predetermined time a measurement phase in which the tape feed means are controlled step-wise so that the magnetic heads sweep the entire track width once or a plurality of times, that in so doing there are measured, in each case in predetermined relevant rotational positions of the magnetic heads and hence scanning positions along the tracks, the amplitudes (a, b, c) of the identifying signals, which are read in respective successive tracks by different magnetic heads, that out of the amplitude sequence of each magnetic head the amplitude of the respective middle track is selected and the selected amplitudes are compared with one another and, in the event of an amplitude difference being found, correction values are obtained and stored, with which during the subsequent reading operation for the useful signals the control variable obtained for the track middle following is corrected.
6. Unit according to claim 5, characterised in that the means are associated with the function selector switch (18).
7. Unit according to claim 6, characterised in that there is associated with the function selector switch (18) a special switch position for the switching on of the measuring phase.



8. Unit according to claim 6, characterised in that the switching on of the measuring phase takes place automatically each time play-back is switched on.
9. Unit according to any one of claims 5 to 8, characterised in that the means (18) for the switching on and execution of the measuring phase consist of a microcomputer (10).
10. Unit according to claim 9, characterised in that the microcomputer (10) contains a battery-operated storage means (20) for the correction value.

