There is known in the case of commercial video recorders based on the helical scanning method the use for head drum and magnetic tape drives of automatic motor controls which produce reference position conditions of video heads and magnetic tape which are optimum for the interaction of the two drives.

Said precision controls, also called servo controls, are determined by reference signals, which serve as a common source for the interlinking of the various control arrangements.

An important reference source is the vertical sync signal emitted by the transmitter. It serves both during the recording and during the play-back (read by separate head) as a reference to which all further auxiliary sync signals produced in the recorder have to be tuned.

In the VHS standard it is laid down, for example, that the magnetic tape must wrap around a head drum with two magnetic heads by slightly more than 180^0. A field is recorded in a track in the 180^0 wrap around region by each magnetic head which is in engagement with the magnetic tape. Further lines are recorded in a region extending beyond 180^0 by some 3^0, so that an overlapping zone of two adjacent tracks is obtained during the recording of some six lines. The position of said overlapping zone is fixed in its mean correlation at 6.5 ± 1.5 lines before the arrival of a vertical sync pulse. It is also the so-called switching position for the switching over of the magnetic heads during play-back. For the switching on and off of the magnetic heads in said switching position there are attached e.g. at the periphery of the head drum in a fixed correlation one or more small magnets, which generate in one or more stationary coils at the start of each magnetic track pulses from which the head switching is derived. Since both the arrangement of the magnets and also the position of the generator coils are subject to tolerances, mechanical adjustment e.g. of the coils is required in order to achieve the required correlation of the head switching pulse with the vertical pulse. Optical generators are also known for the generation of head switching pulses, which have to be adjusted just like the electromechanical generators. It is possible to replace mechanical adjustment by settable electric circuits, e.g. by variation of the run time of one-shot multivibrators.

A further reference source for the reference position correlation between video head and magnetic tape in play-back mode is provided, in addition to the useful signal, by sync signals recorded on the magnetic tape. Thus according to the VHS standard, for example, there is recorded on a longitudinal track with a stationary separate monitor head, which may also be combined with an audio head, a pulse train synchronised with the vertical sync pulses of the video signal. The monitor head comprises mechanical setting devices, with which the head may be displaced parallel to the tape edge for setting of the sync pulse position during alignment operations in the factory or during a service. Such a setting is necessary in order to ensure the mutual compatibility of individual recorders and hence also of the tapes accommodated. The criterion for the setting is the

optimum track position correlation of the magnetic heads with previously recorded magnetic tracks. During a setting operation there is used in place of the latter during play-back of a reference tape the maximum FM amplitude of the FM-modulated signal recorded. Existing track position actuators (tracking actuators) are at the same time fixed in a predetermined desired position. It is essential for exactness of the setting that the generator for the head switching pulses has been adjusted beforehand. Thus the servo circuit for the magnetic tape drive during play-back, whose phase control results from a comparison of the converted vertical pulses recorded on the monitor track with the head switching pulses, is adjusted to the head drum rotations.

The setting operations for the head switching pulse generator and for the monitor head in the factory or during a service require, because of the high degree of accuracy required, considerable outlay on measuring equipment and call for skilled operating personnel. Experience also shows that these setting operations are characterised by a certain unsureness in the setting.

The aim of the invention is to simplify the setting operations so that an optimum setting can be achieved with small outlay on measuring equipment.

This aim is achieved by the invention described in claim 1. Advantageous developments are described in the dependent claims.

There is known from DE-A-2 211 704 a tape driving device in which, by means of stored correction signals which are correlated with various angular positions of the tape drive shaft and are scannable in synchrony with rotation of the latter, differences between the actual value of the tape speed and the actual value of the tape driving speed are offset by addition of the correction signals to the deviation signals. The obtaining of the correction signals (in a setting operation during recording and play-back of a signal of stable frequency) and their correlation take place by means of a pulse generator connected to the tape drive shaft. Said method disclosed there makes it possible, however, simply to improve the synchronism between recording speed and play-back speed in the case of a video recorder.

There is known from DE-B2-2 339 406 a recording and play-back unit for video signals, in which a new recording is able to follow an existing recording free from interference. To this end the servo system for the tape drive is first of all prepared for the new recording by synchronizing it with the vertical sync pulses of the new recording, there being derived from said vertical sync pulses and from the sync pulses of the existing recording which are scanned with the stationary monitoring head signals, which are stored. Said signals, which are passed during the new recording to a first control input of the tape drive servo system, moreover serve as the desired signal for the latter, while the tacho signals produced with a tacho-generator of the tape drive, which are passed to a second control input of the tape drive servo system, form the actual signal. The

generation and storage of correction signals for a time correction of the head switching pulses and the sync pulses scanned with the monitoring head, on the basis of a wrong setting of head switching pulse generator and monitor head, is likewise not provided for there.

The invention consists in principle in no longer modifying an actual mechanical state resulting from the mounting of monitor head and pulse generator. Signals are thereby emitted or received whose time sequence does not conform to the times laid down by the respective system standard, so that such a unit would not be compatible with other units. In a service position, which is obtained by switches or bridges during a setting operation, the respective timing error of the pulse position is compared with a reference source and in an evaluation circuit stored as a correction signal in a non-volatile store. After cancellation of the service position the respective stored correction signal is added to the non-set signals as a correction value.

Two settings are essential for such an alignment operation, one of which settings is already obtained automatically without any special setting operation during the mounting of the unit, namely by the laying down of a particular bolted-on position for the head switching pulse generator. The head switching pulses generated by the pulse generator must in fact be generated earlier than 6.5 lines in time before the arrival of the vertical pulses from the video signal in order to achieve a correction by delaying of the pulses emitted.

The other setting operation takes place with the aid of a tracking controller provided in video recorders, with which the signal derived by the monitor head out of the vertical sync signal must be set so that optimum track scanning takes place during play-back, i.e. a maximum emitted FM-amplitude of a recorded signal is obtained as an indicator. The invention will be explained in detail by way of example from the figures.

Fig. 1 shows in a block circuit diagram a possibility for the electrical correction of wrongly set pulse generators during a service,
Fig. 2 in a time correlation the correction of pulses of a wrongly set head switching pulse generator,
Fig. 3 in a time correlation the correction of pulses of a wrongly set monitor head during play-back and
Fig. 4 in a time correlation the correction of pulses which are fed during recording to a wrongly set monitor head.

Fig. 1 shows in a block circuit diagram a possibility for the electrical connection of wrongly set pulse generators during a service.

The service setting takes place during the play-back of a reference tape which has been recorded exactly according to standard. Particular connections are required for the settings, which are made by the switches S1, S2 and S3. For the first

setting in the setting sequence the switch S1 is closed, switches S2 and S3 are opened.

In the pulse generator 1 pulses are generated by the rotation of a head drum (not shown), which serve as a reference on the one hand for the synchronisation of the servo controls and on the other for the switching over of the magnetic heads arranged in the head drum. It is laid down e.g. according to the VHS standard that the head switching, i.e. the emission of a pulse during play-back, must take place 6.5 lines before the arrival of a vertical sync pulse recovered from the recorded FM with a tolerance of ± 1.5 lines. For the determination of the wrong setting of the non-settable pulse generator 1 the vertical sync pulses recovered from the FM of the played-back reference tape are passed to the input A of a comparison circuit 5 and compared with one another in respect of their phase position with the head switching signals supplied from the pulse generator 1 and converted in the converter 12. From the difference determined there is derived a correction signal 3, which is deposited in the storage means 7 with the switch S1 in closed position for said service setting. Accurate scanning by the magnetic heads of each of the previously recorded magnetic tracks is essential for the determination of the correction signal 3. This is achieved by setting of the tracking actuator 9 to optimum FM yield of the recorded video signal.

After the correction signal 3 has been deposited in the non-volatile storage means 7, the switch S1 is opened and the setting operation for correcting the point in time of the head switching is completed. All the head switching signals generated by the pulse generator 1 are now, by means of the correction signals 3 deposited in the storage means 7, outputted in the phase actuator 11 delayed in time by the wrong amount of the mechanical pre-setting. Storage and delaying may take place in analog or else in digital form. The delayed head switching signals from the phase actuator 11 are made available for the head switching at the output B. In addition they serve for the generation of the phase error voltage for the servo controls of the magnetic tape drive during play-back. Said branch is formed by the converter 13, in which the rectangular-shaped signal is converted into a trapezoidal signal, and by the sample-and-hold circuit 14, at whose output D a phase error voltage is emitted.

For the correction of the pulses emitted by the non-adjusted monitor head 2 the switch S3 must be closed, while switches S1 and S2 are opened. The phase actuator 10 is set to zero, e.g. on a reset input (not shown). With the tracking actuator 9 optimum track scanning, i.e. maximum FM, is set once again during play-back of the reference tape, in order to ensure that the servo systems function in the correct correlation. The pulse-type monitor signal scanned by the monitor head 2 is converted in the converter 17 into a pulse train into so-called tracking-vertical-pulses which are fed to the input C of the sample-and-hold circuit 14 for the phase control of the magnetic tape drive.

In the comparison circuit 6 the incoming tracking-vertical-pulses are compared as to phase with the already corrected head switching signals supplied by the phase actuator 11. If the phase position of the leading edges of the two trains is different, a correction signal 4 is generated which is stored in the non-volatile storage means 8. The setting operation for the correction of the monitor head signals, i.e. of the tracking-vertical-pulses, is thereby completed. Switch S3 is opened and switch S2, which was opened only for the service setting, is closed. Simultaneously with the closing of switch S2 the tracking actuator 9, which may be set manually or else may be constructed as an electronically controlled control device, is set to zero. By means of the correction signal 4 stored in the storage means 8 there takes place with the aid of the phase actuator 10 with the switch S2 in the closed position the tracking compensation of the pulses supplied at the wrong time by the monitor head 2. An individual tracking setting may be made with the tracking controller 9 during the play-back of recordings made on outside recorders.

Said wrong setting also has to be compensated for at the recording stage if the monitor head is not set mechanically, in order to ensure the mutual compatibility of individual recorders. In order to achieve this, the correction signal 4 stored in the storage means 8 is also allowed for during the generation of the monitor pulse signal train derived from the vertical sync pulses coming from the transmitter. The vertical sync signal obtained at input E is converted in the converter 16 into a rectangular-shaped pulse train whose emission in time to the monitor head 2 takes place by means of the phase actuator 15 as a function of the correction signal 4 stored in the storage means 8.

The settings described above have been described with reference to a block circuit diagram as an exemplifying embodiment with known structural elements. It is also possible, however, to carry out the sequences described in a setting routine with the aid of a microcomputer or microprocessor and to integrate a large proportion of the structural elements in such a computer or processor. It is moreover possible to automate the setting operation still further by means of a sequential generator, if e.g. the tracking setting by tracking actuators is automatically set to an optimum by evaluation of the maximum FM and if several comparative measurements are carried out by progressive measurement with a storage means in strictly predetermined steps.

Fig. 2 shows in a time correlation the correction of emitted pulses of a wrongly set head switching pulse generator.

2a shows vertical sync pulses which have been recovered during play-back of a used reference tape from the video signal recorded in FM.

2b shows pulses generated by the rotation of the head drum in the pulse generator 1, which because of poor adjustment of the pulse generator are generated arbitrarily, but at least 6.5 lines

before the arrival of a vertical sync pulse. Tn is the time for a rotation of the head drum, Tn-1 the time for the rotation n-1.

2c shows the head switching signal converted out of the pulses of the pulse generator 1 without time correction.

2d shows the correction signal Tk, which is produced from a comparison of the head switching signal as per 2c with the vertical sync pulses as per 2a in the comparison circuit 5. The rear trailing edge of Tk lies 6.6 lines in front of the vertical sync pulses.

2e shows the head switching signal according to 2c, which is displaced in time in the phase setting device 11 with the correction signal Tk shown in 2d in such a way that the edges of the corrected head switching signal appear exactly 6.5 lines before the arrival of a vertical sync pulse.

Fig. 3 shows in a time correlation the correction of emitted pulses of a wrongly set monitor head 2 during play-back of a used reference tape.

3a shows the head switching signal corrected according to Fig. 2 at an input of the comparison circuit 6.

3b shows the desired position, settable with tracking actuators 9, of the sync pulses at the input C of the sample-and-hold circuit 14 6.5 lines after the edge of the head switching signal.

3c shows an arbitrary actual position of emitted sync pulses due to wrong mechanical setting of the monitor head 2 at a second input of the comparison circuit 6.

3d shows the correction signal Tk1 determined between 3a and 3c, which is stored in storage means 6 and serves for the setting of the phase actuator 10 during play-back, so that the pulses applied at input C of the sample-and-hold circuit 14 correspond to the desired position according to Fig. 3b.

Fig. 4 shows in a time correlation the correction of a pulse train which is fed during recording to a wrongly set monitor head 2.

Fig. 4a shows the vertical sync signal supplied by the transmitter at input E.

Fig. 4b shows the desired position of the recording signal for a mechanically optimally set monitor head. The time T1 is assigned to the magnetic head 1 and the time T2 to the magnetic head 2.

4c shows the corrected recording signal for the synchronising head for the correction value Tk1 determined according to Fig. 3d and stored in storage means 8.

* C L M S *

Claims

1. Video recorder with a rotating head drum partly wrapped around with a magnetic tape and bearing magnetic heads, with a pulse generator (1) generating signals due to the rotation of the head drum and a monitor head (2) recording or reproducing a sync signal, in which in a service setting operation signal differences in time, caused by wrong mechanical setting, in particular positioning differences of pulse generator (1) and/or monitor head (2) compared with the values prescribed by the particular system, are evaluated in a comparison circuit (5, 6), stored as correction signals (3, 4) in a non-volatile storage means (7, 8) and after completion of the setting operation added during recording and play-back as correction signals (3, 4) to the signals supplied by the pulse generator (1) and/ or supplied or to be supplied by the monitor head (2) for the time correction of the latter.

2. Video recorder according to claim 1, characterised in that the service setting operation takes place during play-back of a reference tape.

3. Video recorder according to claim 1 or claim 2, characterised in that in the course of the service setting operation there takes place first of all a correction of the signals of the pulse generator (1) generating signals.

4. Video recorder according to any one of claims 1 - 3, characterised in that the service setting operation is carried out in a microprocessor or microcomputer.

5. Video recorder according to claim 4, characterised in that the microprocessor or microcomputer is also used in the servo and sequence controls.

6. Video recorder according to claim 4 or claim 5, characterised in that the microprocessor or microcomputer is in the service setting operation brought by a pulse or a statically acting signal into a setting routine.

7. Video recorder according to any one of claims 4 to 6, characterised in that the service setting operation is controllable by a sequential generator.