

System for detecting marks ^{ings.} 

The invention relates to a system for detecting marks which each comprise at least one marking signal of a given frequency and which together with information signals corresponding to information are recorded on a magnetic tape which extends between a supply reel hub and a take-up reel hub and which during recording is driven only *via* the take-up reel hub, which is then driven with a constant rotational speed, which marking signals identify specific items of the information, the system comprising a supply mandril and a take-up mandril for driving the supply reel hub and the take-up reel hub, at least one magnetic head for reproducing the recorded signals, and a frequency-comparison device for comparing the instantaneous frequency of the signals reproduced by means of the magnetic head and applied to the frequency-comparison device with a reference frequency, which device when a given relational condition is satisfied supplies a signal indicating the presence of a mark.

Such a system is known from a commercially available dictation apparatus for magnetic tapes accommodated in cassettes. This apparatus enables speech signals dictated by a user to be recorded on a magnetic tape. In addition, the user has the possibility of recording marks on the magnetic tape to identify specific parts of the dictations, for example the end of a dictation or a part of a dictation where a correction of the dictation or an insert in the dictation is required. A mark for identifying the end of a dictation then consists of a substantially sinusoidal marking signal having a frequency of 40 Hz, which is recorded on the magnetic tape at the end of the dictation after the speech signals in the same track. A mark which characterizes a part of a dictation to be corrected consists of the substantially sinusoidal marking signal having a frequency of 40 Hz and a further substantially sinusoidal marking signal having a frequency of 1500 Hz, which signals are both recorded on the magnetic tape at the location of the part of the dictation to be corrected, instead of the speech signals in the same track. In order to enable these marks and hence the parts of the dictation marked thereby to be detected the known apparatus comprises the system defined in the opening paragraph for detecting the marks recorded on the magnetic tape, the mere presence of

a mark being detected by detecting the recorded marking signal having a frequency of 40 Hz contained in all the marks.

During the recording of the dictations and the marks in the known apparatus the magnetic tape is driven only *via* the take-up reel hub, which is then driven
5 by the take-up mandril with a constant first speed. For the detection of the marks the magnetic tape is also driven *via* the take-up reel hub only, but now the take-up mandril drives this reel hub with a constant second speed, which is twenty times as high as the first speed. As a result of this, the speed with which the magnetic tape is driven during detection is twenty times as high as that during recording, enabling the recorded marks
10 to be detected rapidly. During the detection of the marks this twenty-fold speed results in a frequency conversion of the recorded marking signals, so that the marking signals reproduced by magnetic heads during detection have a frequency which is twenty times as high. Since both during the recording and during the detection of marks the magnetic tape is driven *via* the take-up hub, which in each case is driven with a constant speed,
15 this frequency conversion remains the same over the entire length of the magnetic tape. This means that regardless of the location where it has been recorded on the magnetic tape, for example, the recorded marking signal of a frequency of 40 Hz present in all the marks is always reproduced as a frequency-converted marking signal having a frequency of 800 HZ upon detection. In the prior-art system the mere presence of a
20 mark is detected by detecting the occurrence of the frequency-converted reproduced marking signal having a frequency of 800 Hz, for which purpose the known system comprises a frequency comparison device in the form of a filter circuit having a fixed mid frequency of 800 Hz, which constitutes the reference frequency with which the instantaneous frequency of the signals, comprising the speech signals and the marking
25 signals reproduced by means of the magnetic head, is compared and which, if the frequencies are equal, *i.e.* if a frequencyconverted marking signal having a frequency of 800 Hz is reproduced by means of the magnetic head, produces an output signal which indicates the presence of a mark and which is employed to control a device for stopping the tape drive. If the frequency conversion varies over the entire length of the magnetic
30 tape, which is the case if during detection of the marks the take-up hub is not driven with a constant speed but with a varying speed or if the supply hub is driven with a constant or variable speed, the marks cannot be detected with the prior-art system comprising a frequency comparison device in the form of a filter circuit having a fixed

mid frequency, because in the case of a varying frequency conversion the frequency of the reproduced frequency-converted marking signal changes but the mid frequency of the filter circuit, which forms the reference frequency, remains the same.

US-A-4,377,826 describes a magnetic-tape apparatus which in the
5 recording mode drives the magnetic tape with a constant tape speed and can record marking signals of a given frequency. To enable the marking signal frequency to be detected also during the speed search mode the marking signals reproduced in the speed search mode are compared with the output signal of a tachometer coupled to the supply reel. However, the marking signals and the output signals of the tachometer are then not
10 subjected to the same frequency change independently of the drive mode and the spool diameter.

It is an object of the invention to eliminate the above restriction and to provide a system of the type defined in the opening paragraph which by simple means enables the marks to be detected also in the case of a varying frequency conversion of
15 the recorded marking signals. To this end the invention is characterised in that a tachometer is coupled to the take-up mandril to supply a tacho-signal having a frequency proportional to the rotational speed of the take-up mandril, and in that the tacho-signal is applied to the frequency-comparison device, in which the frequency of the tacho-signal forms the reference frequency and which compares the instantaneous frequency of
20 the tacho-signal with the instantaneous frequency of the signals reproduced by means of the magnetic head. In this way it is achieved that during the detection of the marks the instantaneous frequency of the signals reproduced by means of the magnetic head is compared with a reference frequency which corresponds to the instantaneous speed of the take-up hub and which is subjected to the same frequency change as the frequency
25 of the recorded marking signals regardless of how the magnetic tape is driven, so that the frequency conversion has no effect on the comparison between the two frequencies. This results in a mark detection which is independent of the frequency conversion, so that during the detection of the marks the magnetic tape can be driven in any desired way, *i.e.* for example also by driving the supply hub with a constant or variable speed
30 or by driving the take-up hub with a constant or a variable speed.

In a system in accordance with the invention the frequency comparison device may comprise, for example, two frequency/voltage converters, the tacho-signal being applied to one of said converters and the signals reproduced by the magnetic head

being applied to the other converter, which converters supply output voltages which correspond the frequencies of the signals applied to them and which are processed in a voltage comparator circuit in order to detect the presence of a mark. However, it is found to be advantageous if the frequency comparison device is formed by means of a
5 microprocessor which for comparing the instantaneous frequency of the tacho-signal with the instantaneous frequency of the signals reproduced by means of the magnetic head determines the instantaneous period of the tacho-signal and the instantaneous period of the signals reproduced by means of the magnetic head and subsequently compares the determined periods in conformity with a given relational condition for said
10 two periods and, if said relational condition is satisfied, supplies a signal indicating the presence of a mark. This results in a very simple and cheap construction, which suitably also employs a microprocessor provided for carrying out a plurality of other functions for realising the frequency-comparison device.

The microprocessor may compare the instantaneous period of the tacho-
15 signal and the instantaneous period of the signals reproduced by means of the magnetic head directly with each other. However, it is found to be very advantageous if the microprocessor computes a tolerance window having a lower period-limit and an upper period-limit from the detected period of the tacho-signal, and the given relational condition is defined in such a way that the detected instantaneous period of the signals
20 reproduced by means of the magnetic head should be situated between said two period limits. Such a system has the advantage that it is immune to tolerances of the tacho-generator and tolerances in the frequency of the reproduced marking signals.

In this respect it is also found to be advantageous if the microprocessor only supplies the signal indicating the presence of a mark if the relational condition for
25 the two periods has been satisfied recurrently. Such a system has the advantage that it is immune to momentary spurious signals which appear in the reproduction signal path of the magnetic head and which have a frequency within the frequency range of the reproduced marking signals.

Two embodiments of the invention will now be described in more detail,
30 by way of non-limitative examples, with reference to the accompanying drawings. Fig. 1 shows diagrammatically a dictation apparatus for recording dictations and marks comprising a single marking signal of predetermined frequency on a magnetic tape in a cassette. Fig. 2 shows diagrammatically a magnetic tape on which dictations and marks

have been recorded by means of an apparatus as shown in Fig. 1. Fig. 3 shows diagrammatically the signal waveform of the marking signal, which forms a mark, as recorded on the magnetic tape, shown in Figure 2. Fig. 4 shows diagrammatically a dictation apparatus comprising a system in accordance with the invention, for the
5 detection of marks recorded by means of the apparatus shown in Fig. 1, and a microprocessor. Fig. 5 is a flow chart of a program carried out in the microprocessor of the apparatus shown in Fig. 4 in order to detect the marks. Fig. 6 shows diagrammatically a magnetic tape on which dictations and three different marks have been recorded by means of an apparatus, now shown, of a construction similar to the
10 apparatus shown in Fig. 1. Fig. 7 shows diagrammatically the signal composition of the three different marks recorded on the magnetic tape shown in Fig. 6. Fig. 8 shows a dictation apparatus comprising another system in accordance with the invention, for detecting three different marks as illustrated in Fig. 7, and a microprocessor. Fig. 9 is a flow chart of a program carried out in a microprocessor of the apparatus of Fig. 8 in
15 order to detect the marks.

Fig. 1 shows diagrammatically a part of dictation apparatus 1, which is constructed for example as a hand-held pocket dictation machine, for use in conjunction with a magnetic tape 3 accommodated in a cassette 2 which can be loaded into the apparatus, the magnetic tape extending between a supply reel hub 4 and a take-up reel
20 hub 5 in the cassette. In Fig. 1 the cassette 2 is shown diagrammatically in dash-dot lines. The dictation apparatus 1 enables speech signals corresponding to dictations to be recorded on the magnetic tape 3. The dictation apparatus 1 enables marks identifying specific points of the dictations, *i.e.* the dictation ends, to be recorded on the magnetic tape 3 together with the speech signals marks.

25 In order to drive the supply hub 4 and the take-up hub 5 the apparatus 1 comprises a supply mandril 6 and a take-up mandril 7, which are each locked in rotation to a friction wheel 8 and 9, respectively. For driving the friction wheels 8 and 9 there is provided a motor 10, which is energized by means of a control circuit 11, which can also define the direction of rotation and the speed of the motor 10. Such
30 control circuits are known from prior-art dictation machines and are therefore not described in detail because their construction is not relevant to the present invention. By means of a belt 12 the motor 10 drives an idler wheel 15, which is rotatably supported on a pivotable support 13 by means of a spindle 14. The spindle 14 also constitutes a

drive shaft for the two friction wheels 8 and 9 with whose circumference the drive shaft 14 is selectively engageable by pivoting the support 13, in order to obtain a non-positive drive.

The apparatus 1 further has a built-in microphone 16 to which a
5 recording-signal-processing circuit 18 is connected *via* a normally closed switch 17, the output of said circuit being connected to a magnetic head 19 by means of which the speech signals corresponding to the dictations can be recorded on the magnetic tape 3 in a "recording" mode. To start the "recording" mode the apparatus 1 comprises a key 20 upon whose actuation, as is shown diagrammatically in broken lines, a switch 21 for
10 activating the control circuit 11 for the motor 10 and a further switch 22 for driving the recording signal processing circuit 18 are closed and the support 13 with the drive shaft 14 is moved towards the friction wheel 9. When the switch 21 is closed the control circuit 11 is actuated in such a way that by means of the belt 12, the idler wheel 15 and the drive shaft 14, the motor 10 drives the friction wheel 9 and hence the take-up
15 mandril 5 with a predetermined constant first speed in the direction indicated by an arrow 23 in Fig. 1. When the switch 22 is closed the recording signal processing circuit 18 is activated to process the speech signals received from the microphone 16 *via* the switch 17 and to apply said signals to the magnetic head 19 in order to record them on the magnetic tape 3, which is driven *via* the take-up mandril 7, causing the magnetic
20 tape 3 to be moved past the magnetic head 19 in the direction indicated by the arrow 24 and past a magnetic erase head 25, which is in principle constituted by a permanent magnet and which is arranged upstream of the magnetic head 19 in the transport direction of the magnetic tape.

The apparatus 1 further comprises an oscillator 26 which serves to
25 generate a sinusoidal marking signal S_1 having a predetermined frequency f_1 of 40 Hz. Upon actuation of a marking button 27 a switch 28 is closed, so that the oscillator 26 is turned on for a given time interval T_1 of, for example, 600 ms, which oscillator 26 supplies a marking signal S_1 to the magnetic head 19, which subsequently records this signal on the magnetic tape 3 as a mark M_1 . Upon actuation of the marking button 27
30 the switch 17 is opened to ensure that no speech signal is recorded at the location of the magnetic tape 3 where a mark M_1 is to be recorded.

Fig. 2 shows diagrammatically a part of a magnetic tape 3 on which two dictations are recorded in a track 29, the ends of the dictations each being identified by

means of a mark M_1 . Each of these marks M_1 comprises the sinusoidal marking signal S_1 having a frequency f_1 of 40 Hz and a period T_1 of 600 ms, as is indicated in Fig. 3. In the present case each marking signal S_1 consequently comprises twenty-four (24) periods. Here, the marks M_1 are recorded in the same track as the speech signals. As is
5 customary in such dictation apparatuses, the recorded speech signals are situated in a frequency range between approximately 200 Hz and 6 kHz, so that the frequency of the 40 Hz marking signal S_1 is situated distinctly outside the frequency range of the recorded speech signals. It is to be noted that the marks M_1 need not be recorded in the same track as the speech signals but may also be recorded in a separate track.

10 Fig. 4 shows diagrammatically a part of a transcription dictation apparatus 30, which is constructed, for example, as a desk-top dictation machine and which serves for reproducing speech signals recorded on the magnetic tape 3, so that these signals can be transcribed. The apparatus 30 comprises a system 31 in accordance with the invention for detecting marks recorded on the magnetic tape 3 by means of an apparatus
15 as shown in Fig. 1. The system 31 for detecting the marks will be described in detail hereinafter.

Similarly to the apparatus shown in Fig. 1 the apparatus 30 comprises a supply mandril 6 and a take-up mandril 7, which are each locked in rotation to a friction wheel 8 and 9, respectively. Likewise, there is provided a motor 10, which is
20 energized by means of a control circuit 11 and which drives an idler wheel 15 by means of a belt 12, which idler wheel is rotatably mounted on a pivotable support 13 by means of a shaft 14, the shaft 14 constituting a drive shaft for driving the two friction wheels 8 and 9. For reproducing the speech signals and the marking signals in a "reproduction" mode, which signals in the present case are recorded in the same track on the magnetic
25 tape 3, there is provided a magnetic head 19. The apparatus 30 comprises a key 32 for starting the "reproduction" mode. Upon actuation of the key 32, as is indicated diagrammatically in broken lines in Fig. 4, a switch 33 for activating the control circuit 11 is closed and the support 13 carrying the drive shaft 14 is moved towards the friction wheel 9. When the switch 33 is closed the control circuit 11 for the motor 10 is
30 activated to energise the motor 10 in such a way that, via the belt 12, the idler wheel 15 and the capstan 14, this motor drives the friction wheel 9 and hence the take-up mandril 7 in the direction indicated by the arrow 23 in Fig. 4 with the same predetermined constant first speed as during recording of the speech signals and marking signals.

Thus, in the "reproduction" mode the magnetic tape 3 is also driven only *via* the take-up mandril 7, which is then driven with the constant first speed, and the take-up reel hub 5, causing the magnetic tape 3 to be moved past the magnetic head 19 in the direction indicated by the arrow 24. The signals scanned by means of the magnetic head 19 are applied to a reproduction signal processing circuit 34, which drives a loudspeaker 35 for the acoustic reproduction of the recorded dictations.

As stated above, the apparatus 30 comprises a system 31 for detecting marks M_1 recorded on the magnetic tape 3 to enable these marks, and hence the dictation end thus marked, to be located simply and rapidly. In order to start a "detection" mode the apparatus 30 comprises a key 36. When the key 36 is actuated, as is indicated diagrammatically by broken lines in Fig. 4, a switch 37 and a switch 38 are closed and the support 13 carrying the drive shaft 14 is moved towards the friction wheel 8. As a result of the closure of the switch 37 the control circuit 11 for the motor 10 is activated to energize the motor 10 in such a way that this motor drives the friction wheel 8 *via* the belt 12, the idler wheel 15, the drive shaft 14 and hence the supply mandril 6 in the indicated direction with a given constant second speed, which is twenty times as high as the first speed with which the take-up mandril 7 is driven during recording and reproduction. In this way the magnetic tape 3 is driven only *via* the supply mandril 6 and the supply hub 4 during the detection of marks, so that during mark detection the magnetic tape 3 is moved past the magnetic head 19 in a direction opposite to that during recording of the marks, *i.e.* opposite to the direction indicated by the arrow 24, the speed of the magnetic tape 3 during the detection of the marks being higher than during recording because the speed of the supply mandril 6 is twenty times as high. The speed of the magnetic tape 3 during the detection of the marks increases as the tape-roll diameter on the supply hub 4 increases, whereas during the recording of the marks the speed of the magnetic tape increases as the tape-roll diameter on the take-up hub 5 increases. The fact that the speed of the magnetic tape during the detection of the marks is higher than the speed during the recording of the marks results in a frequency change of the recorded marking signals during detection, the oppositely directed increase in speed of the magnetic tape during detection of the marks in comparison with the speed increase during the recording of the marks, causing said frequency change to vary over the entire length of the magnetic tape. For example, on account of the varying frequency change the marking signals S_1 of a frequency of 40

Hz which are recorded on the magnetic tape will be reproduced as frequency-converted marking signals in a frequency range of 300 Hz to 2000 Hz during detection. It is to be noted that for the detection of the marks the magnetic tape 3 can also be driven *via* the take-up mandril 7, which is then for example also driven with a speed which is twenty
5 times as high as during recording. This also gives rise to a frequency change of the reproduced marking signals, but this change remains constant over the entire length of the magnetic tape.

As already stated, the switch 38 is closed upon actuation of the key 36. As a result of this the signals reproduced from the magnetic tape 3 by means of the
10 magnetic head 19, in the present case speech signals and marking signals, are applied to an amplifier stage 40. The output signals of the amplifier stage 40 are applied to a pulse shaper 41, which supplies pulse-shaped output signals, which are applied to an input 43 of a frequency-comparison device 42. In the present case the frequency-comparison device 42 is advantageously constructed by means of a microprocessor which performs
15 several functions in the apparatus, which functions will not be described because they are not relevant to the present invention. Here, the microprocessor 42 serves as a frequency-comparison device for comparing the instantaneous frequency of the frequency-converted signals, reproduced by the magnetic head 19 and applied to the input 43 as pulse-shaped signals, with a reference frequency, the microprocessor 42
20 supplying a signal indicating the presence of a mark to its output 44 when a given relational condition is satisfied. This signal on the output 44, for example, turns on a light-emitting diode 45 for a given time interval so that the detection of a mark is indicated optically. However, the signal on the output 44 may also be indicated acoustically or may be applied to the control circuit 11 for the motor 10, the control
25 circuit 11 switching off the power supply to the motor 10 when said signal appears, so that the motor 10 stops and the transport of the magnetic tape 3 stops when a mark is detected.

The system 31 for detecting the marks M_1 also comprises a tachometer 46 coupled to the take-up mandril 7. The tachometer 46 comprises a toothed disc 47,
30 which in an advantageous manner is directly locked in rotation to the take-up mandril 7. However, as is indicated by a dash-dot line in Fig. 1, the disc 47 may also be coupled to the take-up mandril 7 *via* a transmission 48, for example a belt. The teeth of the toothed disc 47 cooperate with a symbolically shown photoelectric sensor 49 of the

tachometer 46. As the disc 47 is driven, its teeth periodically interrupt a light beam in the sensor 49, so that it supplies a periodic tacho-signal whose frequency is proportional to the speed of the take-up mandril 6 and, hence, of the take-up reel hub 5. The tachometer 46 is constructed in such a way that if the motor 10 drives the take-up
5 mandril 7 with the given first speed, as is the case during recording, the tachometer supplies a tacho-signal of a given frequency f_G , which is in a predetermined ratio to the frequency f_1 of 40 HZ of the marking signal S_1 . Thus, the equation $f_G = k.f_1$ is satisfied, where k is a specific factor. In practice, the frequency f_G may be, for example, 20 Hz, so that the factor k is then 0.5 because the frequency f_1 of the marking
10 signal S_1 is 40 Hz. Instead of a photoelectric tachometer it is possible to employ a tachometer which operates capacitively, inductively or in any other way.

Since the tachometer 46 is coupled to the take-up mandril 7, which is driven with the constant first speed by the motor 10 during recording of the marks M_1 , the frequency of the tacho-signal generated by means of the tachometer 46 will be
15 subjected to the same frequency change as that to which the signal reproduced by the magnetic head 19, *i.e.* the marking signals S_1 , are subjected when the supply mandril 6 is driven by the motor 10, as is the case during the detection of the marks M_1 in the present apparatus 30. Consequently, if during detection the frequency-converted signals reproduced by the magnetic head 19 are compared in frequency with the frequency-
20 converted tacho-signals from the tachometer 46, the similar frequency changes to which both frequency-converted signals are subjected will have no effect on the frequency comparison. The frequency comparison between these two frequency-converted signals is therefore independent of the frequency conversion to which said signals have been subjected. On the basis of the recognition of this fact, the tacho-signal, in the form of a
25 pulse-shaped signal, is applied from the tachometer 46, which is coupled to the take-up mandril 7, *via* an amplifier 50 and a pulse shaper 51, to a further input 52 of the microprocessor 42 forming the frequency-comparison device. In the microprocessor 42 the instantaneous frequency of the frequency-converted tachosignal now forms the reference frequency and the microprocessor 42 compares this reference frequency with
30 the instantaneous frequency of the signals reproduced by means of the magnetic head 17, *i.e.* the frequency-converted speech signals and the frequency-converted marking signals, whose frequency is always situated outside the frequency range of the frequency-converted speech signals.

A program carried out by the microprocessor 42 to detect the marks in the "detection" mode will now be described with reference to Fig. 5. The start of the "detection" mode is reported to the microprocessor 42 when the key 36 for starting the "detection" mode is actuated, as is indicated in broken lines in Fig. 4.

5 After the start of the "detection" mode the program is started in a block 53. In the next block 54 an internal timer Z_Z is set to zero. In the next block 55 a period counter Z_p is set to zero. After this, in block 56, the instantaneous length T_2 of one period of the pulse-shaped frequency-converted speech signal, supplied to the input 52 of the microprocessor 42 by the tachometer 46, is determined and is stored in a
10 register R_1 . Subsequently, in a block 57, a tolerance window having an upper period limit T_3 and a lower period limit T_4 is computed from the detected instantaneous period T_2 of the frequency-converted speech signal. The upper period limit T_3 is then computed, for example, in accordance with the equation $T_3 = k \cdot T_2 \cdot 1.1$ and the lower period T_4 is computed, for example, in accordance with the equation $T_4 = k \cdot T_2 \cdot 0.9$,
15 the upper period limit T_3 being stored in a register R_2 and the lower limit T_4 in a register R_3 . The factor k is dictated by the frequency ratio $f_G : f_1$, as described above. Subsequently, in block 58 the instantaneous length T_5 of a period of the frequency-converted signals reproduced by the magnetic head 19 and applied to the input 43 of the microprocessor 42 is determined and is stored in a register R_4 .

20 After this, in block 59, the two instantaneous periods T_2 and T_5 thus determined are compared in conformity with a relational condition for the two periods. This predetermined relational condition is defined in the microprocessor 42 in such a way that the detected instantaneous period T_5 of the signals reproduced by means of the magnetic head 19 should be situated between the two period limits T_3 and T_4 computed
25 from the detected instantaneous period T_2 of the tacho-signal. Consequently, the relational condition $k \cdot T_2 \cdot 0.9 < T_5 < k \cdot T_2 \cdot 1.1$ should be satisfied in the present case. The tolerance window ensures a detection which is immune to tolerances of the tachometer and of the frequency tolerances of the reproduced frequencyconverted marking signals. If said relational condition is not satisfied, *i.e.* if the magnetic head 19
30 reproduces a speech signal having a period which differs from the period of the marking signal, or if this magnetic head does not reproduce any signal or only noise signals, this program sequence is terminated in block 60.

However, if in block 59 the relational condition is satisfied, *i.e.* when for the first time a period of a frequency-converted reproduced marking signal S_1 is detected, it is ascertained in block 61 whether the count of the period counter Z_p is zero. If it is zero the internal timer Z_z is started in block 62 and is subsequently

5 incremented automatically as the time elapses. After the block 62 the program continues in block 63, which is also the case if in block 61 it is found that the count of the period counter Z_p is not zero. This means that the timer Z_z will be started only if the count of the period counter Z_p is zero, *i.e.* after a period of a frequency-converted reproduced marking signal S_1 has been detected for the first time. In the block 63 the period

10 counter Z_p is incremented. The period counter Z_p thus counts how many times the detected instantaneous periods T_2 and T_5 satisfy the relational condition verified in block 59, or in other words how many periods of a frequency-converted reproduced marking signal S_1 have been detected. In the next block 64 it is ascertained whether the count of the period counter Z_p is greater than a given value n . In the present case the

15 value n is selected to be, for example, $n = 20$. This means that the relational condition should be satisfied for at least twenty (20) periods of the twenty-four (24) recorded periods of a marking signal S_1 . In this way the detection process becomes immune to momentary spurious signals which appear on the input 43 of the microprocessor 42 and whose frequency is situated within the frequency range of the frequency-converted

20 reproduced marking signals, which spurious signals can therefore simulate a mark. As long as the value n is not greater than twenty (20), it is checked in the block 65 whether the count of the timer Z_z has at least a value corresponding to the greatest possible length of a frequency-converted reproduced marking signal S_1 . If this is not the case, the program proceeds in block 56 and may continue up to block 64.

25 If it is found in block 64 that the count of the period counter Z_p is greater than the predetermined value n , which means that the relational condition verified in block 59 has been satisfied at least twenty times, *i.e.* at least twenty periods of a frequency-converted reproduced marking signal S_1 have been detected, the program is continued in block 66. In block 66 the microprocessor 42 produces a signal indicating

30 the presence of a mark M_1 on the output 44 for a given time T_6 , which signal causes the light-emitting diode 45 to be turned on for said time interval T_6 to give the user an indication that a mark M_1 has been detected. In block 66 the microprocessor 42 can also internally store a digital identification value for a mark together with a digital

position value, corresponding to the count of a length-of-tape counter upon detection of the mark, at a specific storage location, the identification value together with the position value indicating the presence of a mark on the magnetic tape at the location specified by the count of the length-of-tape counter. Subsequently, the program is
5 terminated in block 67.

If it is found in block 65 that the count of the timer Z_Z has already reached a value corresponding at least to the maximal length of a frequency-converted reproduced marking signal S_1 , although it has been found previously in block 64 that the relational condition verified in block 59 has not been satisfied frequently enough, no
10 mark is present and the program is discontinued in block 68.

Fig. 6 shows a magnetic tape 3, on which three dictations and three different symbolically represented marks M_1 , M_2 and M_3 have been recorded in a track 29. Each mark M_1 identifies the end of a dictation to be transcribed without priority. Each mark M_2 identifies a part of a dictation to be corrected during transcription. Each
15 mark M_3 identifies the end of a dictation to be transcribed with priority.

As is shown diagrammatically in Fig. 7, each mark M_1 , as is also apparent from Fig. 3, only comprises a first sinusoidal marking signal S_1 having a frequency f_1 of 40 Hz and a period T_1 of 600 ms. Each mark M_1 comprises the first sinusoidal marking signal S_1 having a frequency f_1 of 40 Hz and a period T_1 of 600 ms
20 and a second sinusoidal marking signal S_2 having a frequency f_2 of 1500 Hz and a period T_1 of 600 ms. Each mark M_3 is made up of the first sinusoidal marking signal S_1 having a frequency f_1 of 40 Hz and a period T_1 of 600 ms and the second sinusoidal marking signal S_2 having a frequency f_2 of 1500 Hz and a period $T_1/2$ of 300 ms.

Fig. 8 shows an apparatus 69 comprising a system 70 for detecting the
25 three above marks M_1 , M_2 and M_3 . In the apparatus 69 the pulse shaper 41 connected to the output of the amplifier stage 40 is constructed as a Schmitt-trigger having an upper limit frequency of approximately 2.5 kHz, so that only the frequency-converted reproduced marking signals, which correspond to the recorded marking signals S_1 having a frequency of 40 Hz and whose frequencies are always below 2.5 kHz, are
30 applied to the input 43 of the microprocessor 42. Moreover, a high-pass filter 71 is connected to the output of the amplifier stage 40, which filter has a lower cut-off frequency of approximately 10 kHz, so that this high-pass filter rejects the frequency-converted reproduced marking signals corresponding to the recorded marking signals S_1

and having a frequency of 40 Hz, but transmits all the other frequency-converted reproduced signals, *i.e.* also the frequency-converted reproduced marking signals corresponding to the recorded marking signals S_2 having a frequency of 1500 Hz. An amplitude detector 72 constructed as a rectifier is connected to the high-pass filter 71 and is followed by a threshold switch 72, whose output is connected to a further input 74 of the microprocessor 42.

A program sequence carried out in the microprocessor 42 of the apparatus 69 shown in Fig. 8 in the "detection" mode will be described hereinafter with reference to Fig. 9. After the start of the "detection" mode, which is reported to the microprocessor when the key 36 is actuated, the program sequence given in Fig. 9 is started in block 75. In the next block 76 an internal timer Z_Z is set to zero. In the next block 77 the period counter Z_p is set to zero. In the subsequent block 78 a further counter Z_S is set to zero. In the next block 79 a further period counter Z_F is set to zero. In the following block 80, in the same way as in the block 56 in Fig. 5, the instantaneous length T_2 of a period of the pulse-shaped frequency-converted tacho-signal supplied by the tachometer 46 to the input 52 of the microprocessor 42 is determined and is stored in a register R_1 . Subsequently, in block 81, in the same way as in block 57 in Fig. 5, a tolerance window having an upper period-limit T_3 and a lower period-limit T_4 is computed from the detected instantaneous period T_2 of the frequency-converted tacho-signal, the upper period-limit T_3 being stored in a register R_2 and the lower period-limit T_4 being stored in a register R_3 . Subsequently, in block 82, in the same way as in block 58 in Fig. 5, the instantaneous length T_5 of a period of the frequency-converted signals, reproduced by means of the magnetic head and applied to the input 43 of the microprocessor 42, is determined and is stored in a register R_4 . After this, in block 83, in the same way as in block 59 in Fig. 5, the detected instantaneous periods T_2 and T_5 are compared with each other in accordance with the relational condition $k \cdot T_2 \cdot 0.9 < T_5 < k \cdot T_2 \cdot 1.1$.

If the relational condition verified in block 83 is satisfied, *i.e.* if for the first time a period of a frequency-converted reproduced marking signal S_1 is detected, it is checked in block 84 whether the count of the period counter Z_p is zero. If this is the case, the internal timer Z_Z is started in block 85, which is subsequently incremented automatically in accordance with the elapsed time. After the block 85 the program is continued in block 86, which is also the case if it is found in block 84 that the count of

the period counter Z_p is not zero. This means that the timer Z_z is started only if the count in the period counter Z_p is zero, *i.e.* only after a period of a frequency-converted reproduced marking signal S_1 is detected for the first time. In this way the period counter Z_p counts how many periods of a frequency-converted reproduced marking signal S_1 are detected. In the next block 87 it is checked whether a signal appears on the input 74 of the microprocessor 42. This means that it is checked whether also a frequency-converted reproduced marking signal S_2 appears during the occurrence of a period of the frequency-converted reproduced marking signal S_1 . If this is the case, the further counter Z_s is subsequently incremented in the block 88. This means that the counter Z_s detects the number of periods of the frequency-converted reproduced marking signal S_1 during which also a frequency-converted reproduced marking signal S_2 appears. After the block 88 the program proceeds in the block 89, which is also the case if the test in the block 87 is negative, *i.e.* if no signal appears on the input 74 of the microprocessor 42. In block 89 it is checked whether the count of the period counter Z_p is greater than a given value n , the value n again being selected to be $n = 20$, in the same way as in block 64 in Fig. 5. As long as the value n is not greater than twenty (20) it is checked in block 90, in the same way as in block 65 in Fig. 5, whether the count of the timer Z_z has at least a value which corresponds to the maximal length of a frequency-converted reproduced marking signal S_1 . If this is the case, although previously in block 89 it has been found that the relational condition verified in block 83 has not yet been satisfied frequently enough, no mark is present and the program is discontinued in block 91. However, if the test in block 90 is negative the program is continued in block 80 and is repeated, starting in block 80.

If in block 89 the count of the period counter Z_p is found to be greater than $n = 20$ it is subsequently checked in block 92 whether the count of the further counter Z_s is smaller than 4, *i.e.* whether a frequency-converted reproduced marking signal S_2 has appeared during less than four, in particular zero, periods of the frequency-converted reproduced marking signal S_1 . If this is the case a mark M_1 is present and in block 93 the microprocessor 42 produces a signal indicating the presence of a mark M_1 on its output 94 for a predetermined time interval T_6 , which signal for example causes a light-emitting diode connected to the output 94 to light up. After the block 93 this program sequence is terminated in block 91.

- If the check carried out in block 92 appears to be negative it is ascertained in block 95 whether the count of the further counter Z_3 is smaller than the value 16, *i.e.* whether also a frequency-converted reproduced marking signal S_2 has appeared on the input 74 of the microprocessor 42 during at least four and at the most fifteen
- 5 periods of the frequency-converted reproduced marking signal S_1 . If this is the case, a mark M_3 is present and in block 96 the microprocessor 42 produces on its output 97 a signal indicating the presence of a mark M_3 for a predetermined time interval T_6 , which signal for example causes a light-emitting diode connected to the output 97 to light up. After the block 96 the program sequence is discontinued in block 91.
- 10 If the check in block 95 appears to be negative, *i.e.* the count of the further counter Z_3 is at least 16 or greater, *i.e.* whether also a frequency-converted reproduced marking signal S_2 has appeared on the input 74 of the microprocessor 42 during at least sixteen periods of the frequency-converted reproduced marking signal S_1 , a mark M_2 is present and in block 98 the microprocessor 42 produces on its output 99 a
- 15 signal indicating the presence of a mark M_2 for a predetermined time interval T_6 , which signal for example causes a light-emitting diode connected to the output 99 to light up. After the block 98 the program sequence is discontinued in block 91.
- If in block 83 it is found that the relational condition
- $$k \cdot T_2 \cdot 0.9 < T_5 < k \cdot T_2 \cdot 1.1$$
- 20 and T_5 , the program proceeds with block 100. In block 100 it is ascertained whether the count of the period counter Z_p is zero. If this is the case, *i.e.* if the count of the period counter Z_p is zero, which means that prior to this no period of a frequency-converted reproduced marking signal S_1 has been detected, the program is discontinued in block 91. However, if the count of the period counter Z_p is not zero, *i.e.* if previously at
- 25 least one period of a frequency-converted reproduced marking signal S_1 has been detected, the program is continued in block 101. In block 101 the further period counter Z_F is incremented. This means that the further period counter Z_F counts how many times the relational condition verified in block 83 is not satisfied for the two instantaneous periods T_2 and T_5 if this condition has already been satisfied at least once
- 30 before. After this, in block 102, it is ascertained whether the count of the period counter Z_F is greater than a predetermined value m . The value m is, for example, selected to be $m=4$. If this is not the case, the program proceeds with block 80. Thus, during the detection of a mark the relational condition may not have been satisfied four

times as a result of spurious signals and nevertheless the detection process for this mark will be continued. However, if the count of the further period counter Z_F is greater than the value m it may be assumed that no mark is present and the program sequence is discontinued in block 91.

- 5 Both in the embodiment of the system shown in Fig. 4 and in the embodiment of the system shown in Fig. 8 the occurrence of a mark M_1 , M_2 or M_3 is, in principle, detected by frequency comparison of the instantaneous frequency of the frequency-converted marking signal, corresponding to the recorded marking signal S_1 having a frequency of 40 Hz, with the instantaneous frequency of the frequency-
- 10 converted tacho-signal supplied by the tachometer 46, which frequency comparison has the advantage that it is independent of the frequency conversion because both the marking signals and the tacho-signal are subjected to the same frequency conversion. This has the advantage that during the detection of the marks the magnetic tape may be driven in any desired manner, *i.e.* both by driving the supply hub and by driving the
- 15 take-up hub. In order to identify the marks which differ from one another by the length of the marking signal S_2 having a frequency of 1500 HZ, the embodiment of the system shown in Fig. 8 detects the actual appearance and the length of time of the frequency-converted reproduced marking signal corresponding to the recorded marking signal S_2 having a frequency of 1500 Hz in relation to the length of the frequency-converted
- 20 reproduced marking signal corresponding to the recorded marking signal S_1 having a frequency of 40 HZ. Detection of the appearance of a frequency-converted reproduced marking signal S_2 is then effected by means of an amplitude detector constituted by a rectified stage. Obviously, the occurrence of a frequency-converted reproduced marking signal S_2 can also be detected, in the same way as for the frequency-converted
- 25 reproduced marking signal S_1 , by frequency comparison between the instantaneous frequency of the frequency-converted reproduced marking signal S_2 and the instantaneous frequency of the frequency-converted tacho-signal supplied by the tachometer.

CLAIMS:

1. A system for detecting marks (M) which each comprise the recording of at least one marking signal of a given frequency and which together with information signals corresponding to information are recorded on a magnetic tape (3) which extends between a first reel hub (4) and a second reel hub (5) and which during recording is
5 driven only *via* the second reel hub (5) which is then driven as a take-up reel hub with a constant rotational speed, which marking signals identify specific items of the information, the system comprising a first mandril (6) and a second mandril (7) for driving the first reel hub (6) and the second reel hub (7), at least one magnetic head (19) for reproducing the recorded signals and a frequency-comparison device (42) for
10 comparing the instantaneous frequency of the signals reproduced by means of the magnetic head (19) and applied to the frequency-comparison device (42) with a reference frequency, which device when a given relational condition is satisfied supplies a signal indicating the presence of a mark (M), characterised in that a tachometer (46) is coupled to the second mandril (7) to supply a tacho-signal having a frequency
15 proportional to the rotational speed of the second mandril (5), and in that the tacho-signal is applied to the frequency-comparison device (42), in which the frequency of the tacho-signal forms the reference frequency and which compares the instantaneous frequency of the tacho-signal with the instantaneous frequency of the signals reproduced by means of the magnetic head (19).
- 20 2. A system as claimed in Claim 1, characterised in that the frequency comparison device (42) is formed by means of a microprocessor which for comparing the instantaneous frequency of the tacho-signal with the instantaneous frequency of the signals reproduced by means of the magnetic head (19) determines the instantaneous period of the tacho-signal and the instantaneous period of the signals reproduced by
25 means of the magnetic head (19) and subsequently compares the determined periods in conformity with a given relational condition for said two periods and, if said relational condition is satisfied, supplies a signal indicating the presence of a mark.



3. A system as claimed in Claim 2, characterised in that the microprocessor computes a tolerance window having a lower period-limit and an upper period-limit from the detected period of the tacho-signal, and in that the given relational condition is defined in the microprocessor in such a way that the detected instantaneous period of
- 5 the signals reproduced by means of the magnetic head (19) should be situated between said two period limits.
4. A system as claimed in Claim 2 or 3, characterised in that the microprocessor only supplies the signal indicating the presence of a mark if the relational condition for the two periods has been satisfied recurrently.