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(54) MAGNETIC TAPE APPARATUS

(71) We, LICENTIA PATENT - VERWALTUNGS - GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, a company organised under the laws of Germany, of Theodore-Stern Kai 1, 6 Frankfurt/Main 70, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to magnetic tape apparatus.

In magnetic tape apparatus having non-enclosed spools, the direction of movement and speed of movement of the magnetic tape that have been set can be ascertained from the movement of the spools. This can be done, however, only if the spools are in the field of view of the operator, which is not the case, for example, with a remotely controlled apparatus.

In contrast, in the case of cassette magnetic tape apparatus, the spools are covered by the casing of the cassette, As is known, the spools of conventional compact-cassettes are driven by pins that engage with the spools. The movement of the pins can be followed by the operator if he observes the cassette from above. It is, however, too laborious for the operator to ascertain, from the movement of the pins, the direction of movement of the magnetic tape located in the apparatus, since he must determine how the magnetic tape is located in the cassette. Frequently the cassette is also located in a reception compartment closed by a cover, so that the pins of the apparatus cannot be seen at all.

The invention is based on the problem of providing auxiliary means for permitting improved perception of the set mode of movement of the magnetic tape in a magnetic tape apparatus.

According to the invention there is provided magnetic tape apparatus, including an arrangement for indicating the direction and speed of tape movement, said arrangement including an indicating device made up of a plurality of serially arranged light emitting devices, the devices being so controlled, by means of a control device, that the impression of a moving light spot or light strip is created wherein the control device includes a clock-pulse controlled, electronic ring circuit which selectively energises said light emitting devices, and a clock pulse generator for generating the clock pulses, the ring circuit and the generator being coupled via switchable means to the operating control of the apparatus so that said controls govern, on the one hand, the direction of operation of said ring circuit, depending upon the direction of tape movement and, on the other hand, the frequency of the clock pulses generated by the generator, depending upon the speed of tape movement; the frequency having one value for slow tape movement and another, higher, value for fast tape movement.

The invention leads, particularly in the case of cassette apparatus, to simplification of the operation and servicing of the apparatus. The light elements of the indicating device, provided in accordance with the invention, are so energised that the direction of movement of the magnetic tape can clearly be read from the sequence by which the adjoining light elements are lit or extinguished. The period during which the light elements are energised is, for example, capable of being changed between two fixed values, in such manner that the speed of movement of the magnetic tape can be read from the indicating device as well as the said direction of movement.

It has been found that the control sequence specified in Claim 2 is particularly effective in the control of the light elements. The invention may, however, be performed by means of other types of control, e.g. in such manner that the light elements are switched on and off one after another before the next light element is switched on and off in the same manner.

The invention may also be employed with advantage with a remotely controlled magnetic tape apparatus, for indicating the movement

of the tape at the place where the operation is effected.

In order that the invention may be clearly understood and readily carried into effect, one embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:—

Figure 1 shows a block circuit diagram of the essential parts of a magnetic tape apparatus having the features of one example of the invention,

Figure 2 shows a ring circuit for controlling the light elements provided in the case of one example of the invention,

Figure 3 shows a practical example of the whole of the indicating device in accordance with one example of the invention, and

Figure 4 shows a switchable beat oscillator which is suitable for controlling the ring circuit in accordance with Figure 1.

Figure 1 shows a magnetic tape apparatus having features in accordance with one example of the invention. The drive mechanism 1 of the apparatus is controlled by means of operating buttons 2. There is provided a periodically operating control circuit 4 which serves to control four light elements 8. The control circuit 4 is switched with the aid of a source 7 of clock pulses. The light elements 8 serve as an indicating device for indicating the set direction and speed of movement of the magnetic tape and for this purpose are controlled in the manner of a moving light. The direction of this indicator, like a moving light, is selected in accordance with the direction of movement of the magnetic tape via a change-over input 5 of the control circuit 4 by means of switches, not shown in detail, which are coupled to the operating buttons 2. This connection between the operating buttons 2 and the control circuit 4 is indicated by the line 3. In order that the speed of the indicator, like a moving light, may be matched to the speed of movement of the tape, the source 7 is likewise changed over between two fixed frequencies via an input 6, by means of the said switches.

Although four light elements 8 are shown, any convenient member can be used, although it is preferable to use at least three such elements.

It is also possible to switch the control circuit 4 by means of a control signal which is derived from a part moved by the magnetic tape, e.g. the driving disc of the tape counting mechanism. The control circuit 4 may also be replaced by a programme control disc which is driven in the same sense as the magnetic tape.

Figure 2 shows a clock pulse controlled ring circuit, illustrated as an example of a control circuit for the said light elements 8.

The ring circuit is formed by a shift register made up of four J—K flip-flops 11 to 14. The clock inputs of all the flip-flops are brought together and connected to a terminal 23 which is located at the output of a free running oscillator serving as source of clock pulses. With each clock pulse, the logical state at the input J or K is taken into the flip-flop and appears at the output Q or $\overline{Q}$. As is usual with shift registers, it is the non-inverted output Q that is connected to the non-inverted input J of the next flip-flop and the inverted output $\overline{Q}$ that is connected to the inverted input K of the next flip-flop. There is an exception only in the connections between the final flip-flop 14 and the input of the first flip-flop 11. Here the connections are crossed over, so that the logical state at the output of the final flip-flop 14 is, at each clock pulse, transmitted inverted to the first flip-flop 11. The shift register so far described is well known as a "Johnson counter". The shift register has the following function table:

Clock pulse No.	Logical state at the output Q in the case of flip-flop No.:			
	1	2	3	4
0	0	0	0	0
1	1	0	0	0
2	1	1	0	0
3	1	1	1	0
4	1	1	1	1
5	0	1	1	1
6	0	0	1	1
7	0	0	0	1
8	0	0	0	0 (like clock pulse 0)
9	1	0	0	0 (like clock pulse 1)

and so on.

To the Q outputs of the flip-flop 11 to 14 are connected light elements 15, 17, 19 and 21, (constituting the elements 8 referred to previously) via resistors 16, 18, 20 and 22 respectively. Advantageously, the light elements can comprise light emitting diodes (LED)

which can be mounted adjacent one another without spacing. The light elements light up when the logical state unity occurs at the output of the associated flip-flop. The light elements are arranged adjacent one another in the sequence shown, as an indicating device for a magnetic tape apparatus. As can be seen from the above function table of the shift register described, the light elements are switched at a fixed clock pulse frequency, one after another from left to right with constant time separations, and after they have all been switched on they are switched off again one after another in the same sequence. This operation repeats periodically.

Such control of light elements in sequence by means of a ring circuit is known in itself in electronic apparatus for the creation of light effects, e.g. for advertising purposes. A corresponding circuit is described in the periodical "Elektor", November 1974, page 52.

In the case of the invention, the operator of the magnetic tape apparatus is to ascertain the movement of the magnetic tape from the indicating device. Therefore the shift register is made reversible as regards its direction of shift and the oscillator generating the clock pulses controlling the shift register as regards its frequency. In the following the reversal of the direction of shift will first be described.

The flip-flops of the shift register have, respectively, data inputs A, B, C and D, which permit a parallel insertion of logical states into the shift register, which in itself otherwise operates serially. There is further provided a control input M ("mode" input) by means of which it can selectively be arranged whether, upon a clock pulse, a logical state at the serial input J or K or a logical state at the data input shall be taken into the flip-flop. With a logical state zero at the control input M the logical state at the data input has no effect on the flip-flop, and the shift register operates from left to right in the manner described. In contrast, the inputs J and K are closed, and the data inputs A to D are effective, when the control input M assumes the logical state unity.

The non-inverted outputs Q of the individual flip-flops are connected to the respective data inputs of the preceding flip-flop, with, as is necessary with a shift register connected as a Johnson counter, an inverter 26 located between the output ofthe flip-flop 11 and the data input D of the flip-flop 14. If the inverted output $\overline{Q}$ of the flip-flop 11 is accessible, it is also possible not to provide an inverter but instead to connect the inverted output $\overline{Q}$ of the flip-flop 11 directly to the input D of the flip-flop 14. By means of the said connection it is also possible to switch the shift register in the opposite direction to that described, viz. from right to left. The following function table then results:

Clock pulse No.	Logical state at the output Q in the case of flip-flop No.			
0	0	0	0	0
1	0	0	0	1
2	0	0	1	1
3	0	1	1	1
4	1	1	1	1
5	1	1	1	0
6	1	1	0	0
7	1	0	0	0
8	0	0	0	0 (like clock pulse 0)
9	0	0	0	1 (like clock pulse 1)

and so on.

The possibility described of reversing the shift direction by reversal of the logical state at the control inputs M is indicated by a switch 24.

The flip-flops have resetting inputs R. In Figure 2 the resetting inputs R of the flip-flops are connected to an electronic switch 27. If the resetting inputs are switched to the logical state unity, then the outputs Q are held in the zero states independently of which signals are on the inputs.

In order that the shift register may operate in the manner given in the function tables it is necessary for the flip-flops to assume definite output states. This may be effected e.g. upon switching on of the apparatus in that the resetting inputs R are switched to the logical state unity, upon the application of the supply voltage, momentarily by means of an auxiliary circuit, not illustrated. The outputs Q are thereby brought to the state zero corresponding to the first line of the tables.

For the part of the circuit illustrated in Figure 2 framed by broken lines 25, a known integrated circuit may be used, e.g. CD 4035 of RCA which is described in the book "COS/MOS Integrierte Digital-Schaltungen,

RCA Applications berichte 1973". In this integrated circuit the data and control inputs described are correspondently present.

In Figure 3 is shown how the ring circuit (34 in Figure 3) described with reference to Figure 2 can be controlled by the operating buttons of a magnetic tape apparatus. There are provided switches S1, S2, S3 and S4 which are coupled to the operating buttons. In the following table the second column shows which switches are closed for the individual functions of the magnetic tape apparatus.

Running function of the magnetic tape	Switches closed	9	Logical State R	M	Direction of movement of indicator	Clock pulse frequency
Fast forward	No switches	0	0	1	to right	14 Hz
Fast backward	S1	0	0	0	to left	14 Hz
Slow forward	S4	1	0	1	to right	4 Hz
Stop	S2	(0	1	1)	blank*	(14 Hz)*
Pause	S3+S4	(1	1	1)	blank*	(4 Hz)*

* values without meaning, since indicator blank.

By means of a combining circuit controlled by the switches S1 to S4 and consisting of the gates 29 to 32, the control input M and the resetting input R of the ring circuit 34 and a control input 9 of an oscillator 33 generating the clock pulses are provided with voltage levels which correspond to the logical states that are shown in the third to fifth columns of the table. Via resistors 28 the inputs of the gates 29, 30 and 32, in which the switches S1 to S4 are located, are provided with logical voltage levels that are opposite to the logical voltage levels created by the switches.

In this way the indicating device always has the direction of running given in the sixth column, and the ring circuit 34 is switched at a clock pulse frequency as given in the final column. As can be seen from the table, the direction of running of the indicating device always corresponds to the set direction of movement of the magnetic tape. The clock pulse frequency, and with it the running speed, is matched to the running speed of the magnetic tape.

The two different values given in the table for the clock pulse frequency, namely 4 Hz and 14 Hz, were found empirically to be particularly suitable for a given arrangement of the light elements 8. These values may be varied according to the number of light elements and their spacings within the arrangement.

As oscillator 33 for generating the clock pulses there may be used with particular advantage an oscillator as illustrated in Figure 4. The frequency of this oscillator can be varied in a particularly simple manner. The oscillator is made up of two series inverters 36 and 37. The output of the first inverter 36 is coupled via a resistor 39 to the input of the same inverter 36. The output 44 of the second inverter 37 is, in the case of a known circuit (COS/MOS Integrierte Digital-Schaltungen, RCA Applications berichte 1973, page 353), connected to a terminal 43 of a capacitor 40 (lead 45 shown by a broken line). The other terminal of the capacitor 40 is coupled to the input of the first inverter 36. For stabilising the frequency of the oscillator, a further resistor 38 may be inserted in front of the input of the first inverter 36.

Normally the frequency of an oscillator is altered by reversing the elements that determine the frequency. In the case of the circuit illustrated in Figure 4, in contrast, the alteration of frequency is effected in a different, particularly advantageous manner. The terminal 43 of the capacitor 40 is not connected directly to the output 44 of the inverter 37 as in the said known circuit, but is on the mid-point 46 of a voltage divider formed from resistors 41 and 42. The terminal of the resistor 41 remote from the mid-point 46 is connected to the output of the inverter 37, so that the terminal 43 of the condenser 40 is connected via this resistor to the output of the inverter 37. The terminal of the other resistor 42 remote from the mid-point 46 represents the control input 9 of the oscillator.

By means of the inverter 32 shown in Figure 3, the function of which is shown in Figure 4 by a commutator framed by broken lines, there is applied to this control input 9, via a diode 47, a fixed voltage potential related to the logical state zero or the logical state unity, according to the position of the switch S4. In this way the reverse charging conditions of the condenser 40 are varied between two different settings. The duration of the period of the oscillotor and therewith its frequency can be influenced in this manner.

The circuit described is also advantageous for other uses than the above. It represents generally a very simple solution for the in-

fluencing of the frequency of an oscillator constructed in the manner described.

WHAT WE CLAIM IS:—

1. Magnetic tape apparatus, including an arrangement for indicating the direction and speed of tape movement, said arrangement including an indicating device made up of a plurality of serially arranged light emitting devices, the devices being so controlled, by means of a control device, that the impression of a moving light spot or light strip is created wherein the control device includes a clock-pulse controlled, electronic ring circuit which selectively energises said light emitting devices and a clock pulse generator for generating the block pulses, the ring circuit and the generator being coupled via switchable means to the operating controls of the apparatus so that said controls govern, on the one hand, the direction of operation of said ring circuit, depending upon the direction of tape movement, and on the other hand, the frequency of the clock pulses generated by the generator, depending upon the speed of tape movement; the frequency having one value for slow tape movement and another, higher, value for fast tape movement.

2. Magnetic tape apparatus according to Claim 1, wherein the light emitting devices are successively energised, by the ring circuit, during a period in a sequence whtich is indicative of the direction of movement of the tape, and wherein, after the devices have all been energised, they are de-energised successively in the same sequence.

3. Magnetic tape apparatus according to either of Claims 1 and 2 wherein the ring circuit is formed by a shift register connected up as a Johnson counter, the light emitting devices each being controlled by a respective stage of the shift register, and the individual stages of the shift register have, additionally to the usual series inputs (J, K), data inputs for a parallel input and control inputs for controlling the transfer of the logical states of the data inputs into the shift register instead of the logical states at the series inputs, the outputs of the second to final stages are connected to the respective data input of the preceding stage, the inverter output of the first stage is connected to the data input of the final stage and the control inputs of all the stages are connected together and are coupled to operating controls of the apparatus for controlling the direction of shift of the shift register.

4. Magnetic tape opparatus according to claim 3, including an oscillator having first and second inverters, there being located in series, between the input and the output of the second inverter, a resistor and a capacitor, the junction of the resistor and the capacitor being coupled to the input of the first inverter, either directly or via a further resistor, and wherein a voltage divider is provided, one side of which can be connected to the output of the second inverter and the other side of which can be connected selectively, via a diode and by means of an electronic switch, to the potentials related to the logical states, and to the mid-point of which is connected the terminal of the capacitor remote from the output of the second inverter.

5. Magnetic tape apparatus substantially as herein described with reference to the accompanying drawings.

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