

- ## [54] TRANSDUCER POSITIONING MECHANISM

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- [58] **Field of Search** 340/174.1 B

[56] **References Cited**

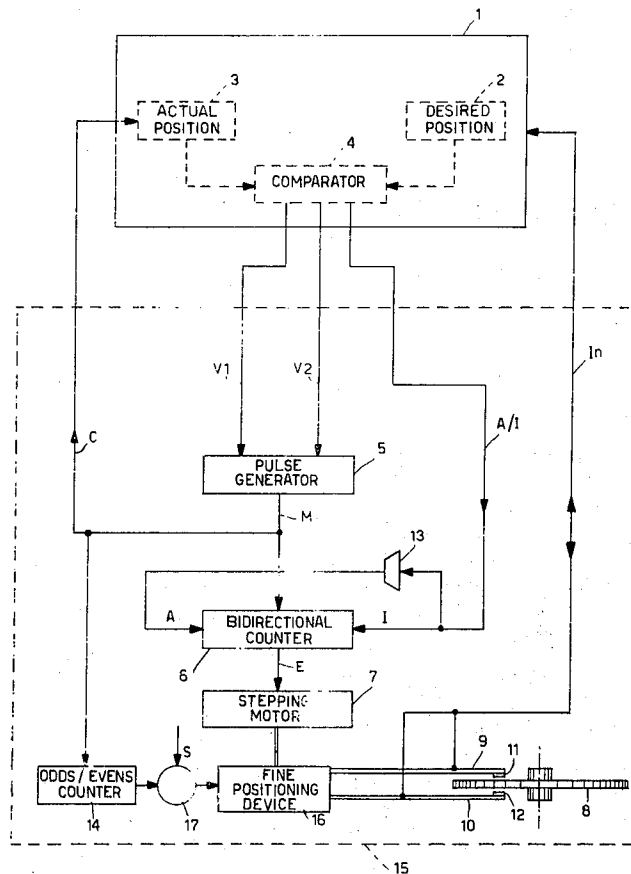
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[57] **ABSTRACT**

In a magnetic disc store system, transducers are positioned over tracks on the discs by a stepping motor controlled by a central unit which sends signals over three channels commanding first and second pulse frequencies to be emitted from a pulse generator, which frequencies are applied to a bidirectional counter. The counter controls the motor and the pulses are fed back to the central unit and are there counted to indicate actual transducer position. When the transducers reach the selected position, fine positioning is effected by a push rod which engages a wedge between teeth of a rack attached to the transducers. There is further disclosed an improved mechanism for interchanging disc cartridges with automatic opening and closing of the shutter through which the transducers are introduced and positioned.

4 Claims, 9 Drawing Figures



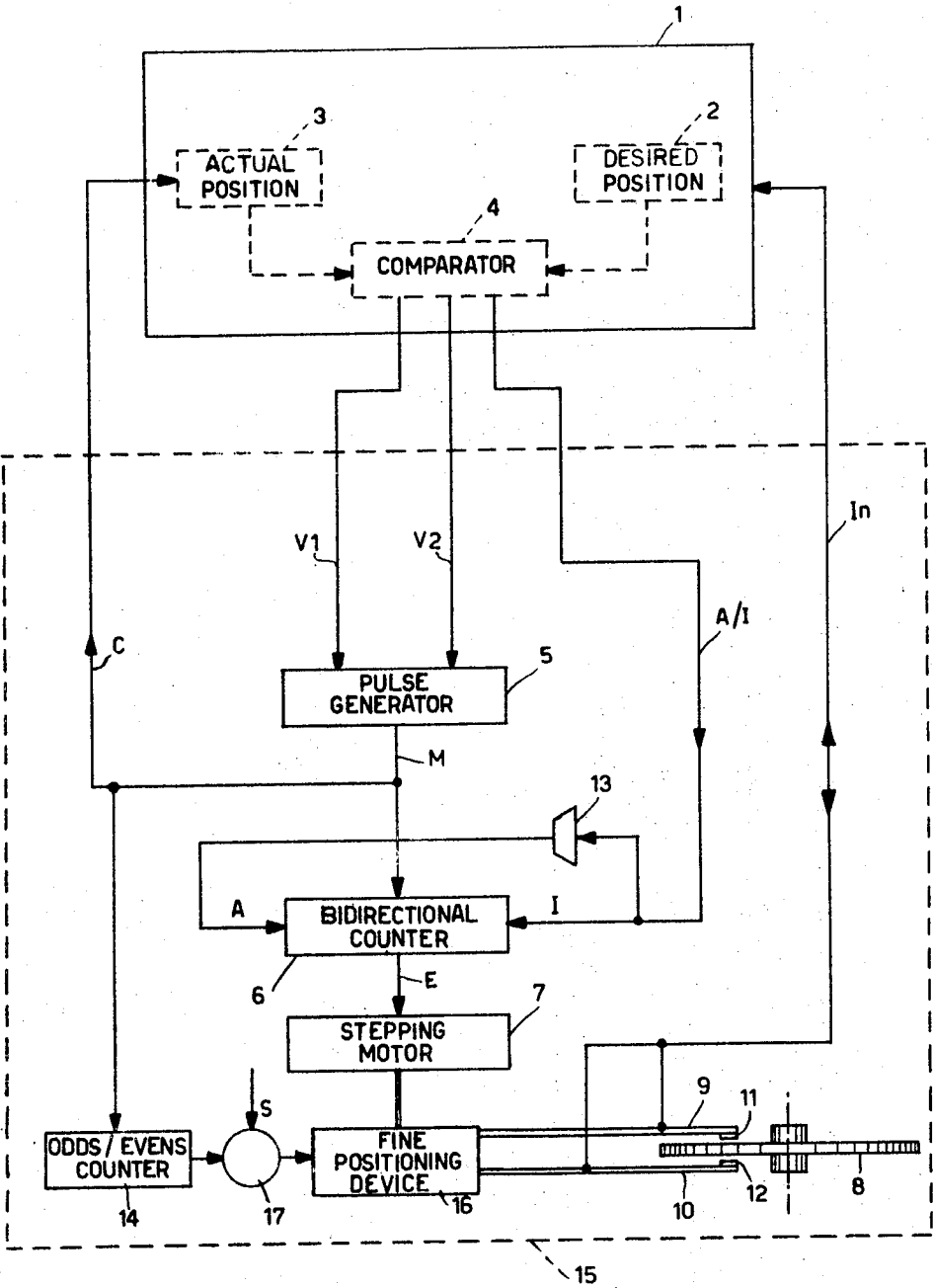
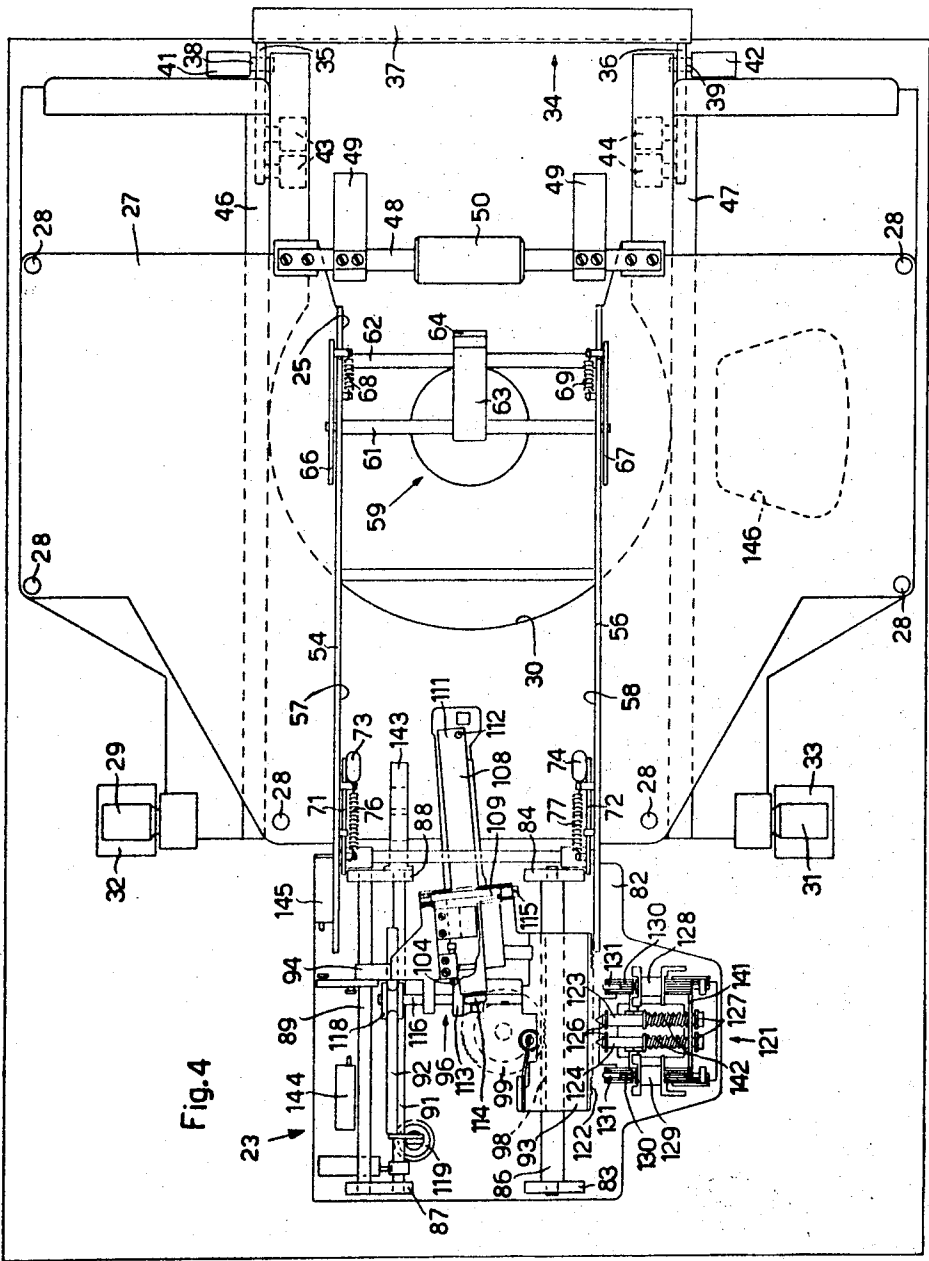


Fig. 1



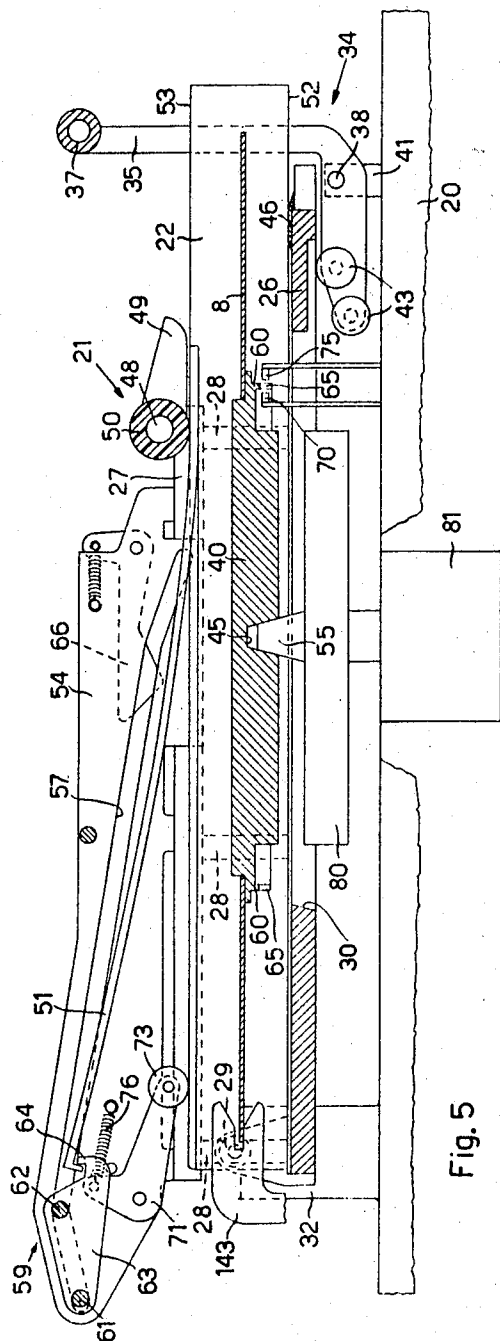


Fig. 5

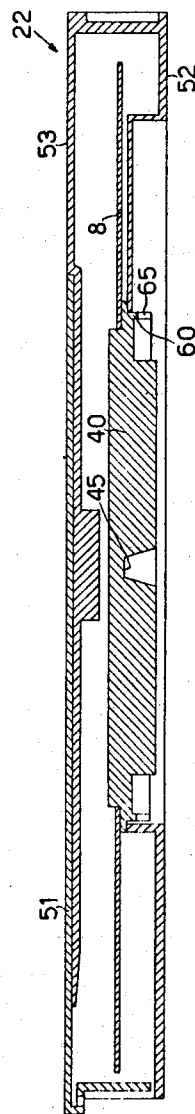
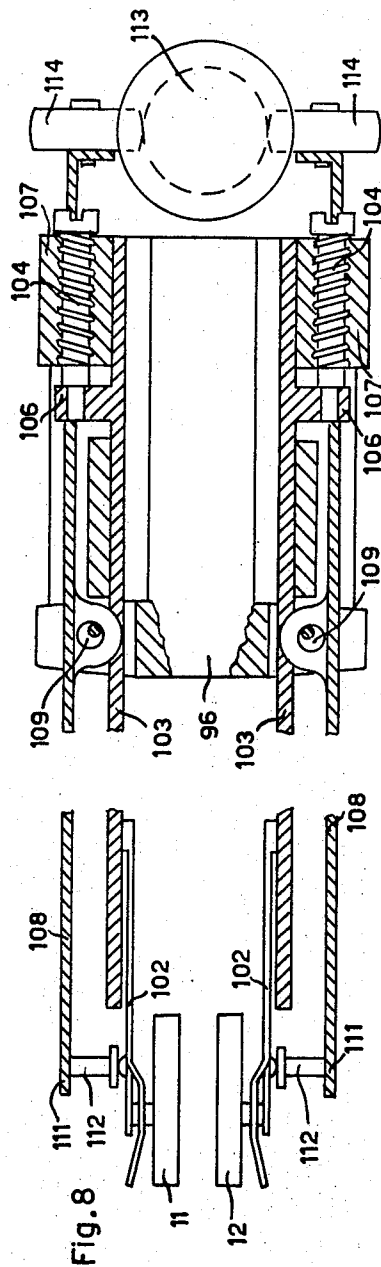
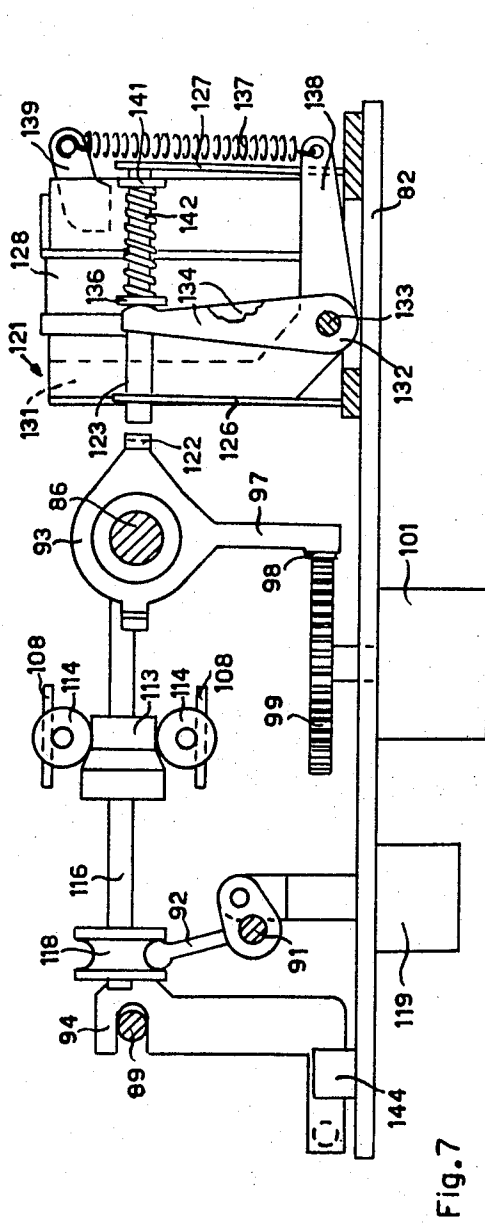


Fig. 6



TRANSDUCER POSITIONING MECHANISM

BACKGROUND OF THE INVENTION

The present invention relates to a system for connecting a central processing unit to a peripheral magnetic disc store and more particularly to a positioning system for bringing a read/write transducer over a selected recording track of a disc.

Owing to the capacity of modern electronic processors of large and medium sizes for processing large masses of information, they necessitate the availability of large mass stores outside the processor, in which the data or instructions are easily to be found in use. In other words, the need arises for types of external stores the capacity of which can be increased at will and in which searching and reading are rapid. These requirements are adequately met by magnetic disc storage units, each of which includes a single-disc cartridge or a cylindrical package of vertically stacked discs, the cartridge or package being normally of interchangeable type.

In magnetic discs, the information is recorded in serial digital form on each face of a disc along a plurality of concentric circular tracks laid down in the circular band between the outer edge of the disc and a given central circular area. The tracks may be subdivided into sectors, so that it is possible to select even a single segment of track as a storage area for recording or reading. One or more transducer elements may be selectively positioned over a given portion of the recording surface to carry out a reading or writing operation.

Rapid reading of the information sought is tied up with the means permitting rapid positioning of the magnetic transducer on the track of the disc which contains this information. Once the transducer has reached the desired track, the codes recorded on the said track will allow the identification and the reading of a given sector.

Normally, read/write transducers are mounted facing one another on a pair of arms movable in a radial direction with respect to the disc and disposed in the form of a fork so as to operate on both faces of the disc. Each transducer must be accurately positioned both in a normal direction with respect to the surface of the disc and in a radial direction with respect to the axis of the disc. The disc is caused to rotate at high speed (for example of the order of 4,000 r.p.m.) so that there is created a thin layer of air which accompanies the surfaces of the disc during the movement and on which glides the head containing the transducer, which is thus kept at a very small distance from the face of the disc. The form, type of mounting and possibility of adjustment of the head therefore constitute so many critical points for the use of these types of store, inasmuch as contact between the transducer and the magnetized surface of the disc may cause damage both to the disc and to the transducer.

The positioning of the transducers is generally carried out by means of systems of electromechanical type. It is obvious that the closer the tracks are brought to one another and the smaller the tolerance in the radial distance between two tracks (with a consequent greater amount of information recordable on the surface of the disc), the greater are the problems that arise as regards the positioning mechanism, which must not only achieve a low time of access to the information sought, but must also effect precise positioning of the

transducer over a predetermined track. That is, the positioning mechanism requires tolerances not greater than those of the recording disc, otherwise the electro-mechanical tolerances of the positioning mechanism would have repercussions on the storage capacity of the disc.

When a given item of information is required in a peripheral store unit having interchangeable discs, the disc containing the information is selected and is inserted in the unit itself, which will then receive from the computer the indication of the track in which the information sought is located. The peripheral unit must therefore be able to execute the order from the computer by positioning the magnetic transducers over the track addressed and thereafter be able to perform the function of reading or writing (or possibly of erasure) which the processor transmits to it.

Peripheral disc units are known which employ rather complex control systems and relatively costly positioning mechanisms, these control systems and positioning mechanisms being therefore unsuitable for small, low-priced peripheral units, which require a particularly simplified internal structure and, therefore, simplicity of connection with the central processor and must allow reliable operation without sacrificing too much to access time.

More particularly, the known connecting systems use a peripheral unit which receives the address of the selected track in binary coded form from the central processor, for example in parallel on eight channels. The address of the selected track is deposited in a staticizing register of the peripheral unit and compared by means of a comparator with the address of the track on which the transducer is at that moment. The difference is utilized to command the movement of the positioning motor until the track addressed is reached. These systems therefore require a high number of command channels on which the central processor sends the address of the selected track; moreover, the peripheral unit must contain all the logical measuring and comparison elements for processing signals for the positioning of the transducers.

SUMMARY OF THE INVENTION

These drawbacks are obviated, thus achieving the pre-established objects for low-cost peripheral disc units, in a system comprising one or more read/write transducers positioned radially over a selected recording track by a stepping motor controlled by a bidirectional counter which indicates the position and the direction in which the said transducers are to be shifted, the counter being fed by a pulse generator. In the present invention, the central unit is prearranged to send on three separate channel signals respectively denoting first and second speeds and the direction of the shifting, the first-speed and second-speed signal being adapted to control the frequency of the pulse generator. The direction signal controls the counting direction of the counter. The central unit receives on a return line the pulses supplied by the pulse generator and counts these pulses for the purpose of obtaining an actual indication of the current position of the transducers. The central unit compares the said actual indication with the nominal indication of the selected track, i.e. the indication of the track to which the transducer has to move, to generate separate binary logical level signals denoting the first or second speed and the direction, respec-

tively, on the said three channels on the basis of the amount and sign of the difference between the said actual and nominal indications.

Therefore, a first object of the invention is to simplify the peripheral unit and its connection with the central processor in such manner that the commands coming from the latter may be carried back on a few channels.

Another object of the invention is to control the transient originating from the passage from one speed of shifting or movement of the transducers to another speed.

A third object of the invention is to obtain a very precise control of the position of the transducer with respect to the selected track by means of a fine positioning device which is actuated at the end of the execution of the track selection command by the step-by-step motor.

A fourth object of the invention is to obtain improvements in the command of this fine positioning device.

A fifth object of the invention is to have a method of loading and regulating the transducers which allows easy adjustment of the positioning system.

A further object of the invention is to facilitate the insertion and withdrawal of the single-disc container into and from the peripheral unit.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the system according to the invention for connecting a central processing unit to a peripheral disc store;

FIG. 2a illustrates an embodiment of the pulse generator included in the diagram of FIG. 1;

FIG. 2b is a diagram illustrating the course in time of a number of signals present in the generator of FIG. 2a;

FIG. 3 is a diagram illustrating the course in time of a number of signals present in the system according to the invention;

FIG. 4 is a plan view of the peripheral disc unit according to the invention;

FIG. 5 is a side view, partly in section, of a first detail of FIG. 4;

FIG. 6 is a section of a single-disc cartridge employed in the peripheral unit of FIG. 4;

FIG. 7 is a transverse view, partly in section, of a second detail of FIG. 4;

FIG. 8 is a side view, partly in section, of a third detail of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the system for connecting a central processing unit, in particular a computer 1, to a peripheral unit 15 containing a magnetic-disc store is substantially constituted by three command channels extending from the computer to the peripheral unit and a return channel from the peripheral unit to the computer.

The three command channels transmit the first-speed signals V1, the second-speed signals V2 and the direction of movement signals A/I, respectively. The return channel C feeds back to the computer the stepping pulses which command the positioning of the read/write transducers. The peripheral unit 15 comprises a

pulse generator 5 which feeds a bidirectional counter 6; the output of this counter commands a first positioning device constituted by a step-by-step motor 7 adapted to position a system of transducers 11 and 12 with respect to a recording support consisting of a magnetic disc 8. Each of the transducers 11 and 12 is adapted to execute a reading or writing operation on a face of the disc and is suitably supported by arm 9 or 10. The shifting of the arms is controllable by the stepping motor 7. The stepping motor 7 is bidirectional and therefore can effect the positioning in both radial directions; it is, of course, possible to employ two separate motors, one for forward movement and one for backward positioning.

The peripheral unit according to the invention is also provided with a second positioning device 16 of fine type which is controlled by another counter 14 and is activated when the motor 7 has completed the coarse positioning.

The various circuits for reading and writing and for executing auxiliary functions (such as, for example, the selection of the transducer, the indication of the availability of the peripheral unit, the signalling of an erroneous search for the track, etc.) are not described, inasmuch as they are not related to the present invention; the signals at the interface of the computer and peripheral unit are represented by the line In, which line indicates a plurality of transmitting and receiving channels.

The computer 1 is a general purpose processor set up in such manner as to effect the connection with the peripheral unit 15 in the manner hereinbefore indicated through three outgoing channels (V1, V2, A/I) and one return channel (C). Only those elements of the computer which develop a function connected with the command for positioning at a selected track are illustrated, that is two registers 2 and 3, the desired-position and actual-position registers, respectively, and a comparator 4; the register 3 is arranged to function as a counter.

The problem preliminary to reading or writing in a magnetic disc store is represented by the positioning of the transducers 11 and 12 from the position in which they are located at the instant of initiation of a new search phase to the position in which the addressed track is located.

The search cycle may start after the peripheral unit has supplied the computer with the available machine signal and commences with the introduction of the address of the selected track into the desired position register 2. Register 3 contains the current (actual) address of the track over which the transducers are located. The two addresses are compared in the comparator 4, which gives an indication of the difference between the registers; the comparator sends a signal on either the channel for the first speed V1 or the second speed V2 according to whether the error resulting from the comparison is smaller than or greater than a predetermined quantity. Comparators of this type are, of course, entirely conventional and, besides being commercially available, are found in all digital computing machines.

The comparator 4 sends a forward or backward shifting level A/I which indicates the direction of error.

The channels for low speed V1 and high speed V2 activate the pulse generator 5 (which is of conventional construction) and it begins to send stepping clock pulses with a frequency which depends on the speed

channel which effects the activation (for example 200 c/s for V1 and 500 c/s for V2).

The stepping clock pulses M are applied directly to the bidirectional counter 6 which commands the stepping motor 7. The bidirectional counter 6 totals algebraically the pulses which it receives; the direction of counting depends on the presence of the forward or backward signal (transmitted on the channel A/I) which enables either the input A (through the inverter 13) or the input I. The output E of counter 6 controls stepping motor 7. The advance commands E that the stepping motor receives from the counter 6 are in the form of decoded binaries of the numeric content of the counter itself and are used to energize the position windings concerned. The E commands have the same frequency and correspond to the stepping clock pulses M produced by the pulse generator 5, as is illustrated in the diagram of FIG. 3.

Each stepping clock pulse commands an advance equal to the radial pitch or step of the tracks of the disc and therefore the total of the stepping clock pulses generated in a certain interval of time represents the number of tracks traversed. Since the stepping clock pulse M are also sent through the channel C to the actual position indicator 3 in computer 1, this indicator varies its numeric content by one unit for each pulse received so as to represent the address of the actual position of the transducers. As long as the speed signals V1 and V2 remain, the generator 5 remains activated and the indicator 3 continues to advance, so that the difference found by the comparator 4 decreases progressively with each pulse received by register 3. The high speed signal V2 is disenabled first and the fine difference signal V1 is disenabled thereafter when the difference between the counters 2 and 3 reaches the value 0, that is, when the selected track has been reached. At this instant, the comparator disenables both channels V1, V2, and pulse generator 5 stops, causing counter 6 to cease stepping the motor 7 (see the pulse diagram of FIG. 3).

In FIG. 3, the series of the last five command pulses for the advance of the transducer carriage carry an indication of the distance in track pitches from the selected track at the instant corresponding to each of the said pulses. In the same diagram, there is moreover assumed the simultaneous initial presence of the signals V1 and V2, as will be explained hereinafter, and the change-over (cancellation) of the machine-available signal in synchronism with the appearance of the low-speed signal V1.

For the purpose of improving the positioning of the transducers over the addressed track and ensuring a predetermined precision, the peripheral unit according to the invention employs the fine positioning device 16 of electromechanical type, which can come into action only after the generation of the stepping clock pulses M has been turned off. The fine positioning device 16, which will be described in more detail hereinafter, consists of a rack parallel to and fast with the transducer carrying arms; the rack can be engaged and arrested in the adjusted position with respect to each of the tracks of the disc by means of a push rod actuated by an electromagnet. More particularly, if the rack has symmetrical saw teeth and its pitch is twice the radial track pitch and the fine positioning device is equipped with two push rods disposed in fixed radial positions and separated by a distance equal to an odd number of track pitches and movable selectively in a direction

perpendicular to the rack, it is possible to control the positioning of the successive odd or even tracks with the precision ensured by the push rod and rack coupling.

The selective actuation of the said push rods is controlled by a bistable element 14 which acts as an odds and evens counter for the number of tracks traversed or crossed under the command of the stepping pulses M. When the generation of these pulses stops, the counter 14 has stored in it the odd or even position of the track reached. After the M pulses stop, the machine produces a pulse S which opens gate 17 allowing the odd or even indication of device 14 to be communicated to positioning device 16. Depending on the contents of counter 14, the odd or even push rod of device 16 is activated. This operation will be described in detail hereinafter.

It is obvious that in the positioning system described the number of commands required by the peripheral unit is reduced to a minimum and that more speed commands are available; moreover the electronics associated with the positioning of the selected track are exceedingly simplified inasmuch as the capacities of the central computer are exploited. This peripheral disc unit is therefore simple and of low cost, without the complexity of circuits and the connecting interface normally present in similar servo-systems and without sacrificing speed or precision in the positioning.

The positioning devices of read/write transducers for disc stores are generally provided with a circuit which signals when the transducers are on the reference track (normally the outermost of the disc) called "track 0" and with another circuit which detects an erroneous search or positioning, understood as an overstepping of the number of tracks possible (for example 202) towards the central part of the disc. When the condition of erroneous search is produced, the computer, by methods entirely similar to those hereinbefore described for a generic track, causes a positioning, at low speed and with a direction of movement towards the outside of the disc, of the track 0.

For the purpose of facilitating the finding of the reference track (track 0) and the maximum distance track (track 202) and in order to prevent damage to the machine due to command errors, the initial and final parts of the travel of the transducers carriage are controlled by end-of-travel microswitches. The activation of the said microswitches takes place, for example, six tracks before the end of the travel and causes the exclusion of the high-speed command V2 if still present. The approach to the end-of-travel track then takes place at low speed under the control of an auxiliary end-of-travel counter which, activated by the said microswitches and fed with the stepping clock pulses, signals the reaching of the first and last tracks when by counting six pulses it reaches a well-defined configuration.

There will now be described, with reference to FIGS. 2a and 2b, a particular embodiment of the pulse generator 5 which, according to a further characteristic of the invention, enables the passage from the low to the high speed and vice versa to be effected with controlled acceleration and deceleration.

We have seen that in the case in which the difference obtained in the comparator 4 between the desired position and the actual position gives a result less than or equal to a predetermined value (for example 4) the channel enabled is the channel for the first speed V1,

which sets the pulse generator 5 in operation at the lower frequency (for example 200 c/s).

In the case in which the difference obtained from the comparator 4 is greater than the predetermined value, both speed channels V1 and V2 are enabled and the pulse generator 5 is obliged to pass over to operation at the higher frequency (for example 500 c/s). During the passage from one frequency to the other, there is a transient which it is necessary to control. To this end, it is possible to use a control circuit with a fixed time constant which comes into operation every time the second-speed signal V2 is switched over. This control of the transient is also necessary during the final positioning phase, since on the reaching of that distance from the selected track which is equal to the predetermined value (for example 4, which defines the change-over point from slow to fast) and after which only the first speed remains enabled the second speed is switched off, with the consequent passage from the greater frequency to the smaller one. The deceleration transient must involve a time less than that necessary for covering the number of tracks intervening before the selected goal is reached.

FIG. 2a shows a single-junction sawtooth oscillator constituted by the single-junction transistor T (biased with voltage V_a), the resistor R1 and the capacitor C1. In addition, this oscillator has a delay circuit represented by the group C2, R2, R3. The signals V1 and V2 control the short circuit of the capacitors C1 and C2, respectively.

In the phase of arrest (low speed absent), the switch V1 is closed and short-circuits C1, thus preventing the oscillations of the circuit and keeping the output U at voltage O.

In the low-speed phase, the switch V1 is open, so that C1 is charged with a time constant equal to $C1R1$. The oscillations of the sawtooth oscillator, represented in FIG. 2b by means of the voltage V_b on the capacitor C1, are triggered. Pulses in correspondence with each cycle of the oscillator are present at the output U.

To change to high speed, it is necessary for the switch V1 to be open; the change takes place by means of the opening of the switch V2. In this case, the voltage at the point A which was about O begins to rise with a law determined by the time constant $C2R2$. As long as the voltage at A is lower than that at C1, R2 does not intervene to charge C1; when this value is exceeded, C1 is charged with a new time constant represented by $(R1 \cdot R2 / (R1 + R2)) C1$. In the meantime, C2 is charged until it reaches the maximum voltage at which C1 can arrive in the course of the cycle of oscillations and from this instant the diode D2 excludes it from the oscillator circuit. The effect produced by the gradual passage of the oscillator circuit from the initial time constant $C1R1$ to the final one $(R1 \cdot R2 / (R1 + R2)) C1$ is illustrated in FIG. 2b by means of the voltage diagram V_b : there is a gradual reduction of the period of the oscillator and therefore an increase in the frequency of the pulses at the output U.

To pass from high to low speed, it is necessary to close the switch V2. In consequence of the discharge of C2 through R3 and when the voltage at C2 decreases, the proportion of current which is required from the branch $R3V2$ to the resistor R2 increases. This resistor therefore no longer contributes to the charging of C1, so that an effect reciprocal to that which was obtained in acceleration is achieved.

CARTRIDGE INSERTION AND WITHDRAWAL DEVICE

The embodiment of the invention described here relates to a peripheral store unit having interchangeable discs and more precisely to the so-called single-disc type of store contained in a cartridge of standard type.

Referring to FIGS. 4 and 5, the peripheral unit comprises a base 20 (FIG. 5) on top of which there is arranged an insertion and withdrawal device 21 for a disc cartridge 22 and a positioning device 23 (FIG. 4) for a pair of transducers 11 and 12 (FIG. 8) adapted to read and write on a selected recording track of the disc 8 contained in the cartridge.

Each of these disc cartridges 22 (FIG. 6) is provided with a shutter or door 51 openable to allow the introduction and positioning of the transducers 11 and 12 with respect to the disc 8 contained therein and is moreover provided with a pair of locating surfaces 52 and 53 adapted to couple up with corresponding guides 46 and 47 included in the insertion and withdrawal device 21. Moreover, in these cartridges, the disc 8 is mounted concentrically on a hub 40 having a conical cavity 45 adapted to engage a like-wise conical tip 55 of a spindle 80 of electromagnetic type supplied by a motor 81 positioned below the base 20.

The hub 40, which also acts as a flywheel, is provided at the bottom with a ring 60 in which there is formed a series of notches 65 adapted to co-operate with a photoelectric assembly constituted by a lamp 70 and a phototransistor 75 for the control of the speed and the signalling of the angular position of the disc.

The insertion and withdrawal device 21 for the disc cartridge 22 comprises a supporting platform 26 (FIG. 5) parallel to which, supported by the posts 28, there is arranged a plate 27 provided in its central portion with a recess 25 (FIG. 4) in which it is adapted to accommodate the shutter 51 of the cartridge 22.

The platform 26 has a circular hole 30 in its central portion which is adapted to permit the spindle 80 to engage the hub 40 of the cartridge.

The supporting platform 26 is pivoted by means of two pins 29 and 31 (FIG. 4) on two first blocks 32 and 33, respectively, of the base 20 and is inclinable with respect to the normal working position (shown in FIG. 5) by means of a manually operated arm 34. This arm 34 is constituted by two L-shaped levers 36 and 36 (FIG. 4) interconnected by a handle 37 and pivoted by means of two pins 38 and 39, respectively, on two second blocks 41 and 42, respectively, of the base 20. Each of the levers 35 and 36 is provided with two rollers 43 and 44, respectively, adapted to cooperate with the bottom part of the supporting platform 26. Two guides 46 and 47 are arranged on the top of this platform 26, while on a rod 48 disposed on the plate 27 transversely of the recess or opening 25 there is arranged a pair of vertical references 49 and a rubber-cover roller 50 adapted to exert a resilient pressure on the upper surface 53.

At the edges of the opening 25, in the upper part of the plate 27 (FIG. 5) and at right angles thereto, there are arranged two side pieces 54 and 56 which are parallel to one another and in which there are formed two slots 57 and 58 (FIG. 4), respectively, adapted to produce a compulsory path for a movable carriage 59 constituted by two shafts 61 and 62 slidable in the said slots

and between which there is arranged a central body 63 provided with a hook 64 at one end.

In the inoperative position, the movable carriage 59 (FIG. 4) is accommodated with its two shafts 61 and 62 in the lower end of the slots 57 and 58, where, pivoted on the side pieces 54 and 56, there are arranged two stops 66 and 67 adapted to hold the carriage 59 in this position through the action of two springs 68 and 69 when the cartridge 22 is withdrawn.

When the cartridge 22 is fully inserted into the device 21, the carriage 59 is accommodated with its shafts 61 and 62 in the upper end of the slots 57 and 58 (FIG. 5), where it remains in stable equilibrium since these slots have a sharp downward reversal of direction.

Below the upper end of the slots 57 and 58 and pivoted on the side pieces 54 and 56 there are arranged two levers 71 and 72 bearing at one end two rollers 73 and 74 adapted, through the action of two springs 76 and 77 to press against the locating or reference surface 53 of the cartridge 22 and to co-operate with the references 49 for the vertical centring of the cartridge.

A stop fork 143 receiving the disc cartridge 22 effects an approximate centring of the disc 8 in the radial direction.

MECHANISM FOR POSITIONING AND ADJUSTING THE TRANSDUCERS

The positioning device 23 for the pair of transducers 11 and 12 (FIG. 8) comprises a base plate 82 (FIG. 4) on which there are mounted two first posts 83 and 84 adapted to support a first guide shaft 86 and two second posts 87 and 88 adapted to support a second guide shaft 89, and a pin 91 of a command bar 92.

Slidable on the cylindrical guides 86 and 89 are two bushes 93 and 94 of a carriage 96 movable in a radial direction with respect to the disc 8. One bush 93 carries an arm or flange 97 to which there is fixedly connected a rack 98 meshing with a toothed wheel 99 driven by a step-by-step motor 101 arranged below the base 20.

Each transducer 11, 12 (FIG. 8) is supported by the resilient end 102 of an arm 103 mounted on the carriage 96 (FIGS. 8 and 4) and movable manually with respect to this carriage in a direction parallel and radial with respect to the surface of the disc by means of an adjusting screw 104 connected to a lug 106 of the same arm 103 and in engagement with a screw nut 107 of the carriage 96, in such manner as to effect a centering of the transducer with respect to the tracks of the disc 8.

The approach of each transducer to the surface of the disc, once the predetermined working conditions have been achieved, is produced by a loading member constituted by a lever 108 pivoted on the carriage 96 by means of an eccentric pin 109 and provided at one end 111 with a pin 112 adapted to transfer to the resilient end 102, as a bending load, an action applied at the other end of the lever 108 by means of a cam 113 co-operating with a small roller 114 fixed to the lever 108.

The eccentricity of the pin 109 is adjustable manually by means of a screw 115 (FIG. 4) which, by rotation thereof, enables the axis of the lever 108 to be shifted to adjust the distance of the transducer with respect to the surface of the disc.

The cam 113 is mounted on a shaft 116 with its axis extending transversely of the movement of the carriage 96 and is movable axially between two predetermined positions under the command of the command bar 92

(see also FIG. 7) co-operating with a collar 118. The command to the bar 92 is given by an electromagnet 119 arranged below the base 20. Through the medium of the toothed wheel 99 and the rack 98, the step-by-step motor 101 executes a first approximate positioning of the transducers 11 and 12 in a radial direction with respect to the disc 8. A more precise positioning is effected by a second positioning device 121 constituted by a rack 122 fast with the bush 93 of the carriage 96 and adapted to co-operate with two stop push rods 123 and 124 which are parallel to one another and have one end wedge-shaped for penetration into one of the sawtooth spaces of the rack 122.

The push rods 123 and 124 are each supported by two transverse leaf springs 126 and 127 fixed at the bottom to the base plate 82 and are controlled by two electromagnets 128 and 129, respectively. The push rods 123, 124 cause the rack 122 to be moved by the action of a rod being inserted into the sawtooth with the sawtooth gap not being precisely aligned with the rod tip. The insertion of the rod tip will, of course, cause the rack to move so that the gap will be aligned with the tip.

Each of the armatures 130 of the electromagnets 128 and 129 is fast with the arm 131 of a lever 132 pivoted on a shaft 133 and having one of its arms 134 adapted to co-operate with a collar 136 of each of the push rods 123 and 124. A spring 137 stretched between an arm 138 of the lever 132 and a lug 139 fast with the electromagnets 128 and 129, respectively, is adapted to keep each armature 130 spaced from the corresponding electromagnet 128, 129, respectively, when it is not energized.

Between the collar 136 and a fixed stop 141, concentrically with each of the push rods 123 and 124, respectively, there is arranged a compression spring 142. More particularly, the spring 137 is adapted to exert a resilient load greater than that of the spring 142.

In the condition in which the machine is switched off and unloaded, the handle 37 (FIGS. 4, 5) can be lowered and the arm 34 then holds the supporting platform 26 inclined upwardly in a position suitable for the introduction of a cartridge. In this position, moreover, the movable carriage 59 is accommodated with its shafts 61 and 62 (FIG. 5) at the lower end of the slots 57 and 58 and has the hook 64 prearranged for engaging the shutter 51 of a cartridge 22.

Moreover, the two transducers 11 and 12 are at the end of their travel and spaced from one another so as not to interfere with the insertion and withdrawal device 21.

A cartridge 22 is then introduced into the device 21 by causing it to slide with the locating surface 52 on the guides 46 and 47. The cartridge 22 is guided at the top by the references 49 and the resilient roller 50 (FIGS. 5, 4). Once the shutter 51 has been gripped by the hook 64, pushing the cartridge 22 by hand to insert it, the movable carriage 59 — the stops 66 and 67 having been raised — is brought towards the upper end of the slots 57 and 58, thus raising the shutter 51.

When the cartridge 22 has been fully inserted, the handle 37 is raised, bringing the supporting platform 26 parallel to the base 20 and thus enabling the electromagnetic spindle to engage the disc hub 40, centring it by means of the conical tip 55. The spindle 80 also exerts an upward thrust on the cartridge which is opposed resiliently by the rubber-covered roller 50 and by the

rollers 73 and 74 mounted on resiliently acting levers. Moreover, by lowering the cartridge, the ring 60 is interposed between the source of light 70 and the phototransistor 75.

The disc 8 contained in the cartridge 22 is thus prearranged for correct reading and/or recording thereof. The transducers 11 and 12 can approach the surfaces of the disc 8 only after the latter has been set in rapid rotation by the spindle; since the distance between the transducer and the disc depends on the balance between the aerodynamic force acting on the transducer invested by the cushion of air carried along by the moving disc and the resilient load imposed by the lever 108, until the speed of rotation of the disc and, therefore, the bearing action of the air has reached a predetermined value, the transducers 11 and 12 are kept spaced from the surfaces of the disc 8. If it is assumed that this value is reached within a predetermined interval starting from the switching on the motor, at the end of this interval there is generated a signal enabling the approach of the transducers 11 and 12 to the surfaces of the disc 8. This signal energizes the electromagnet 119 (FIGS. 4, 7) which, causing the command bar 92 to turn clockwise, shifts the shaft 116 to the right and causes the rollers 114 to co-operate with the larger-diameter cylindrical part of the cam 113. Consequently, the lever 108 produces the approach of the respective transducer to the surface of the disc.

Any possible track centring operations or adjustments of the distance from the disc can be effected by acting on the devices hereinbefore described for adjusting the transducer.

The operations which are required for effecting the positioning, both approximate and fine, of the transducers over an addressed track have been described in the section on the electronic controls. FIG. 4 also illustrates the end-of-travel microswitches 144 and 145.

The mechanical simplicity of the positioning devices is obvious from the foregoing description, this mechanical simplicity, by reducing the number of mechanical components required by the known systems, achieving reliable positioning operations and eliminating plays and tolerances which have a direct repercussion on the storage capacity of the disc. Moreover, the masses in movement for the fine positioning by means of the rack and push rod coupling have also been considerably reduced due to the new type of command mechanism for the push rods which separates the release of the armature 130 (restored by the spring 137) from the advance of the push rod carried out thereafter by the spring 142, thus avoiding the disadvantage of heavy blows of the push rod against the rack and of repeated rebounds.

The peripheral disc unit is also provided with a system for the forced circulation of air and the cleaning thereof. More particularly, the air circulates in a close circuit and is introduced by a fan into the cartridge, which has a cover openable towards the interior in its lower face. In correspondence with this cover, the platform 26 has an opening 146 in coincidence with which an air filter is arranged in the base 20.

What we claim is:

1. In a system for positioning a transducer over a selected recording track of a peripheral magnetic disc store, the combination including:

means for storing the desired position of the transducer and means for storing the actual position of the transducer;

means for comparing the actual and desired positions, said comparing means being connected to said actual and desired position storing means and producing a fast and slow positioning signals depending on the magnitude of the difference between the desired and actual positions and further producing a direction signal;

pulse generator means, responsive to said slow and fast signals, for producing pulses of relatively low or high frequencies, an output of said pulse generator being connected to said actual position storing means;

a bi-directional counter, connected to an output of the pulse generator, for counting the pulse produced, the direction of counting being controlled by said direction signal;

a stepping motor, connected to an output of the bi-directional counter for positioning said transducer; an odd-even counter means, connected to the output of the pulse generator for recording whether the number of pulses produced by said generator is odd or even;

a fine positioning device, responsive to said odd-even counter, for positioning said transducer.

2. The system according to claim 1, wherein said fine positioning device includes a rack fast with said transducer, at least two stop latches having a fixed position with respect to the direction of movement of said transducer and movable in a transverse direction to engage with said rack, the pitch of said rack being equivalent to an even multiple of the radial distance between two recording tracks while the pitch between said two latches is equivalent to an odd multiple of the radial distance between two recording tracks, said latches being selectively activated by said odd-even counter means.

3. The system according to claim 1, wherein said pulse generator comprises a transistor connected across a bias voltage in parallel with a first and a second branch, said first branch including a resistor R1 and a capacitor C1 while said second branch includes a resistor R2 and a capacitor C2, C1 being connected in parallel with switch V1 and C2 being connected in parallel with switch V2 and resistor R3, R3 and V2 being in series, the points between R1-C1 and R2-C2 being connected, the opening of V1 causing low frequency oscillations, the opening of both V1 and V2 causing high frequency oscillations.

4. Mechanism for positioning the transducers of a disc store, comprising a coarse positioning device to control the shifting of said transducers in a radial direction with respect to said discs, and a fine positioning device to control in a fine manner the positioning of said transducers over a selected track, said second positioning device functioning as a locating device and being constituted by a rack fast with said transducers, at least one stop push rod having a wedge-shaped end fixed position with respect to the direction of shifting of said transducers and an electromagnet for moving said rod in a transverse direction to engage said wedge-shaped end thereof with that space of said rack which is brought into correspondence therewith by said coarse positioning device, two transverse leaf springs supporting each push rod, a lever fast with the armature of said electromagnet and opposing a first spring to control said push rod, said armature in the condition of energization of the electromagnet being maintained in a first

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position by overcoming the action of the second spring which tends to retain it in a second position corresponding to the de-energization of the electromagnet, said second spring being adapted to exert a resilient load greater than that of said first spring, so that when the command of said fine position device effects the de-

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energization of said electromagnet said second spring, by shifting said armature towards the second position, releases said rod from the control of said lever and permits said first spring to act on the mass only of said rod and cause it to engage with said rack.

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