This invention relates to parametron circuits and more particularly to the selection of a single driver parametron among a plurality thereof.

In many computing systems, a means must be provided to store information used in the computing process. It is common practice at the present time to store binary bits of information in magnetic cores which may be magnetized in either of two directions to represent the binary values. The particular magnetization of the respective cores may be obtained by the dual-frequency system wherein a first signal is used together with one or the other of another pair of signals, each of which pair is a second harmonic of the first signal but which pair of signals are 180 degrees out of phase with each other. By applying such first and one of the other signals in appropriate phase relative to each other, to conductors extending through the cores, a resultant magnetization of the cores in either of two directions can be achieved. The respective signals of appropriate frequency and phase may be effectively obtained by parametrons in which a pump or excitation signal is applied to vary a circuit parameter at a certain frequency and from which circuit an output signal of one half this frequency is obtained.

The two signals to be applied to magnetize a core in each case may be derived from two parametrons, one supplying the first signal to a conductor passing through cores in one line of a matrix and the other parametron supplying the second signal to a conductor passing through cores in a column or line orthogonal to the first. Thus, the common core at the intersection of the lines receives the effect of both signals. For a simple, inexpensive and reliable computing machine, a simple, inexpensive and effective means of selecting the appropriate parametrons is required.

Accordingly, it is a principal object of this invention to achieve the selection of one parametron among a plurality, by simple, effective and reliable means.

In accordance with this invention, an additional selector winding is provided on each core in a plurality of parametrons. The ends of these selector windings may be selectively short circuited by suitable switch means. In the case of a parametron having two cores, the switches for shorting the selector windings are coupled to operate in unison. Any selector winding having its ends short circuited is effective in response to high frequency magnetic excitation of the core produced by a pump source, to induce a magneticizing force in the core tending to produce a flux in the core, equal in magnitude and opposite in direction to that tending to be produced by the pump source. Thus, the high frequency fields cancel and no such fields exist in the core and no parametron output can be obtained. Accordingly, by maintaining selector windings, open in one parametron and short circuiting the others, the one parametron is selected and an output is obtained therefrom.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawings.

FIGURE 1 illustrates a portion of a memory system of a computing machine incorporating the parametron selection feature of the invention, and

FIGURE 2 illustrates waveforms of signals produced in the circuit of FIGURE 1. Referring now to FIGURE 1 of the drawings for a detailed description of the invention, 10 represents generally a magnetizable core plane serving as the memory apparatus of a computing machine. The memory apparatus 10 includes a large plurality of magnetizable cores 12 arranged in a rectangular matrix and having conductors such as shown at 14 and 16 extending through rows of the cores and conductors such as shown at 18 and 20 extending through columns of the cores. Clearly, the column conductors are orthogonal to the row conductors. As in the usual core plane, the individual cores are magnetizable in either of two directions to represent the respective binary values, zero and one. Thus, the direction of magnetization of a core represents an information bit and its position in the plane represents its order.

For magnetizing an individual core, a predetermined current through the wires in that core is required and necessarily, the currents must be of appropriate frequency and phase relationship. Each row of cores is excited by a parametron and each column is excited by a different parametron.

A parametron for exciting conductor 14 is shown generally at 22 and a second parametron for exciting conductor 16 is shown generally at 24. Parametron 22 is identical in construction to parametron 22 and the same reference numerals identify similar elements but it is not described in detail. The parametron 22 includes a pair of magnetizable cores 26 and 28. For establishing a direct magnetic bias in cores 26 and 28, a pair of windings 30 and 32 are wound on these respective cores and are serially connected with a source of direct current, not shown. For minimizing the effects of alternating or pulsating currents, a choke coil 34 is interposed in this line.

The same direct biasing current may be used for magnetic bias of cores in other parametrons by suitable connections shown.

For establishing a resonant, frequency determining output circuit 37 for parametron 22, a winding 36 on core 26 and a winding 38 on core 28 are connected in series with each other and with a capacitor 40 and row conductor 14 in a closed loop. The inductance of windings 36 and 38 and the capacitance of capacitor 40 essentially determine the resonant frequency of this tank type circuit.

A high frequency generator 42 of a frequency F serves as a pump source for parametron 22 with all other parametrons exciting row conductors and is effective to energize a winding 44 on core 26 and a winding 46 on core 28, connected in series with each other and with the generator 42. The windings 36 and 38 are connected in such a manner that potentials of frequency F induced therein are in polarity opposition and thus, no currents of this frequency appear in the resonant circuit 37.

In accordance with known principles, the excitation of windings 44 and 46 at frequency F by generator 42 is effective to produce an output potential in the resonant circuit 37 of a frequency F/2 if the circuit is resonant at this frequency. Also in the absence of any other influence, the output potential may be in either one of two phases differing by 180 degrees. Accordingly, for establishing a desired phase of oscillation in circuit 37, a seed signal of the desired phase is introduced before the oscillations in the resonant circuit begin. For introducing the seed signal, a magnetizable core 48 is provided and a line connection of circuit 37 extends through this core. A single turn conductor 50 is looped through the core and from a source, not shown, a predetermined signal having the phase desired may be applied to the loop 50.
By induction from loop 50, the seed signal potential is introduced into circuit 37. Similar provision is made for establishing the phase of oscillation of the other row parametrons.

The column conductors such as 18 and 20 are excitable by corresponding parametrons such as 56 and 58 which are similar to parametrons 22 and 24 with the exception that the resonant circuit involved is resonant at a frequency equal to F/4 and no provision is made for introducing a seed signal. Thus, the pump frequency for these parametrons is necessarily of a frequency F/2 and may be derived from generator 42. The generator signal is halved in frequency by a frequency divider circuit 52 and appropriately shifted in phase by a phase shifter circuit 54.

Referring now to FIGURE 2 of the drawings, 60 represents the waveform of potentials produced by column parametrons such as 56 and 58, and 62 and 64 represent waveforms of opposite phase produced as the output of row parametrons such as 22. The waveform 60 is sinusoidal and waves 62 and 64 are cosine waves of opposite phase. The superposition of potentials as represented by waveforms 60 and 62 results in a potential of waveform 66 and the superposition of potentials represented by waveforms 60 and 64 results in a potential of waveform 68. Thus, by applying to respective row and column conductors alternating through a single pair of conductors magnetically coupled to each core comprising different parametron circuits for exciting different conductors, each parametron including a pair of magnetizable cores and means for establishing an alternating magnetic field in each core, a winding coupled to each parametron core, a switch means in electrical circuit with each said winding, and means for simultaneously operating both of said switch means in selected said parametrons to connect the ends of each said winding in a low impedance circuit individual to each of said windings to render ineffective the alternating magnetic field of both of said cores.

However, in the case of parametrons having shorted windings, in accordance with Lenz' well known law, the short circuited windings tend to produce a magnetic flux on which they are wound, a magnetic flux substantially equal in magnitude and opposite in direction to the flux tending to be produced by the magnetomotive force of the applied high frequency currents in windings such as 44 and 46. Accordingly, parametrons with such shorted windings are unresponsive to the high frequency excitation and no output potential in output circuit windings and only the row conductor corresponding to the selected parametron is excited.

The selective operation of switches may be accomplished in virtually any known manner. Typically, the mechanical linkages such as 78, may be coupled to star wheels such as shown at 80 passing over a tape which is programmed by holes therein. Upon coincidence with a tape hole, the star wheels and linkage actuate the switches.

It is to be understood that although the several parametrons shown and described herein utilize two magnetizable cores, the invention is equally applicable to parametrons each employing a single core of the binocular type. In this event a selector winding would be wound on the core and means for shorting its ends would be provided.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A parametron selection circuit for a memory system having a matrix of magnetizable cores and a pair of conductors magnetically coupled to each core comprising different parametron circuits for exciting different conductors, each parametron including a pair of magnetizable cores and means for establishing an alternating magnetic field in each core, a winding coupled to each parametron core, a switch means in electrical circuit with each said winding, and means for simultaneously operating both of said switch means in selected said parametrons to connect the ends of each said winding in a low impedance circuit individual to each of said windings to render ineffective the alternating magnetic field of both of said cores.

2. A parametron selection circuit for a memory system having a matrix of magnetizable memory cores and a conductor magnetically coupled to all cores in a single row and a conductor magnetically coupled to all cores in a single column so that a pair of conductors is associated with each core comprising a different parametron circuit for exciting each row conductor and each column conductor, each parametron including a pair of magnetizable cores, means for establish a high frequency magnetic field in each of said parametron cores, a winding on each parametron core, a switch means in electrical circuit with each said winding, and means for simultaneously operating said switch means in selected said parametrons to connect the ends of each said winding in a short circuit individual to each of said windings so that the shorting of windings in all but one parametron capable of exciting a row conductor and all but one parametron capable of exciting a column conductor is effective to magnetize a memory core coupled to the row and column conductors corresponding to parametrons having unshorted windings.

3. A method of exciting a plurality of magnetizable cores and a plurality of parametrons, each parametron having a plurality of independent flux conducting paths, a pair of windings on each said flux conducting paths and an output circuit magnetically coupled on all said flux conducting paths, a switch means in electrical circuit with one of said pair of windings, means for simulta-
simultaneously operating all of said switch means in selected of said parametrons to connect the ends of each of said one winding in electrical circuit with a switch in a short circuit so that excitation of the other of said pair of windings of any parametron by alternating current is effective 5 to induce potentials in output circuits coupled to flux conducting paths having unshorted windings and to induce potentials in shorted windings producing currents establishing magnetic flux countering the magnetic flux produced by said alternating currents and producing no potential in output circuits coupled thereto.

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