

June 2, 1964

C. F. AULT ET AL
BARRIER GRID STORAGE TUBE INFORMATION
STORAGE AND READOUT SYSTEM
Filed Oct. 11, 1960

3,135,923

FIG. 1

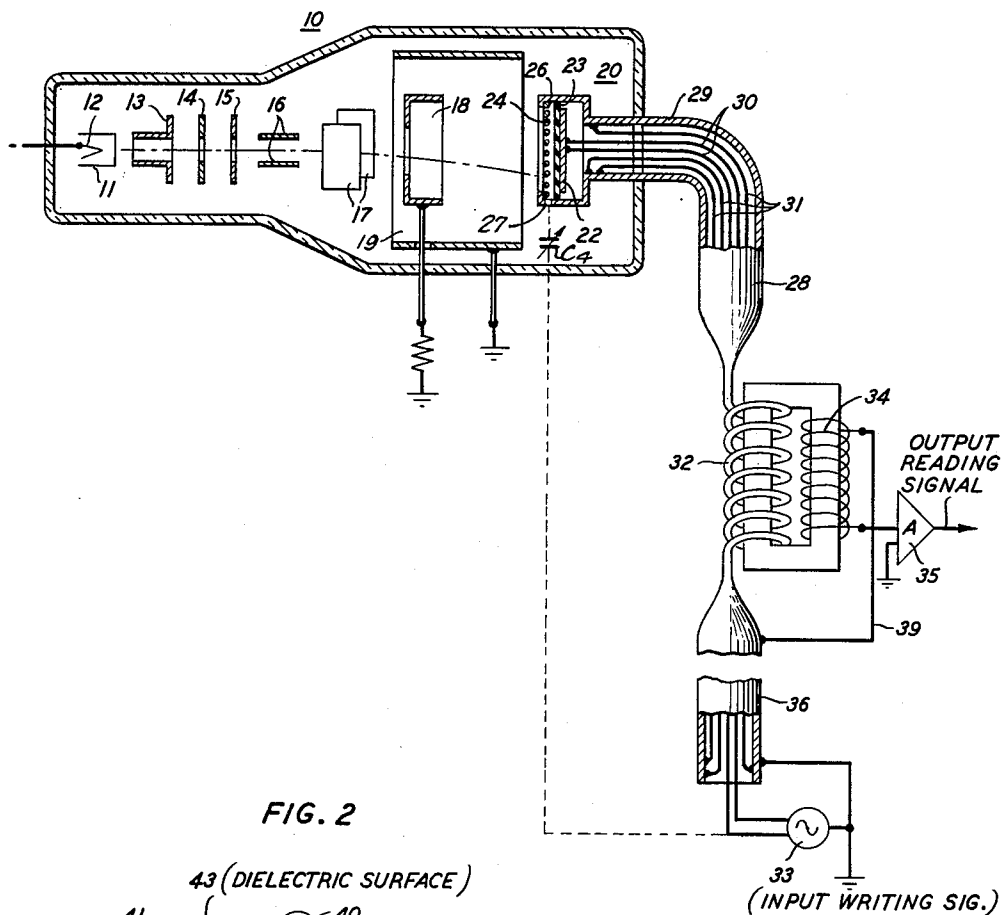
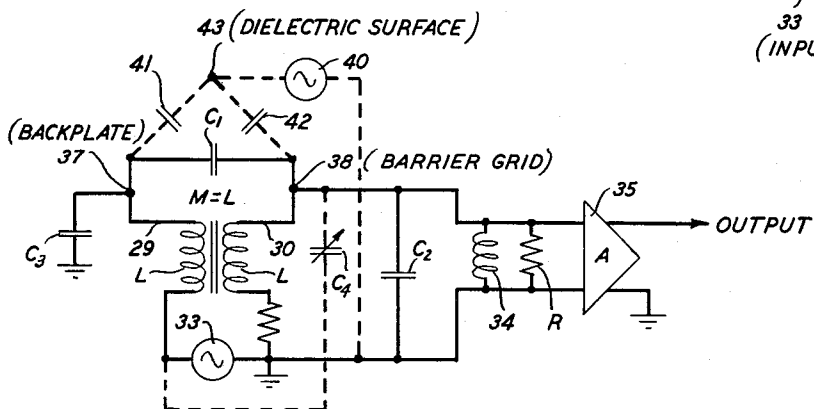


FIG. 2



INVENTORS: C. F. AULT
R. M. GENKE
BY R. C. Winter
ATTORNEY

1

3,135,923

BARRIER GRID STORAGE TUBE INFORMATION STORAGE AND READOUT SYSTEM

Cyrus F. Ault, Clifton, and Richard M. Genke, Boonton, N.J., assignors to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York
Filed Oct. 11, 1960, Ser. No. 61,969
16 Claims. (Cl. 328—124)

This invention relates to information storage and retrieval devices and more particularly to the reading and writing of information in such devices.

One type of fast access, temporary storage memory device that has been employed in information storage and retrieval systems utilizes electron discharge devices of the beam storage type, and particularly of the type known as the barrier grid storage tube. Such tubes are well known in the art, being described for example in an article "Digital Barrier Grid Storage Tubes," by M. E. Hines, M. Chrunev and J. A. McCarthy, Bell System Technical Journal, volume 34, pages 1241-1264, November 1955, and in R. W. Sears Patent 2,675,499, April 13, 1954.

In a barrier grid storage tube a target such as a dielectric sheet has a conductive electrode or backplate secured to one face thereof, and an electron gun projects a concentrated electron stream against the other face of the dielectric through a barrier grid which is positioned immediately adjacent the other face of the dielectric. In the operation of such a tube the electron beam advantageously is deflected in two coordinate directions; for example, it may be rapidly swept in one coordinate and selectively deflected in the opposite coordinate, or it may be turned on and deflected to a discrete area of the dielectric surface if completely random access is desired.

The operation of the device involves basically two cycles; one Store or Write and the other Remove or Read. During the writing cycle the potential or charge present at discrete areas of the dielectric surface impinged by the electron beam is varied by changing the potential at the backplate in accordance with an input signal, the variation in charge being dependent on the signal present at the time the beam impinges on the discrete area. During the reading cycle the charges upon these areas are removed by action of the electron beam. Reading is accomplished by bombarding discrete areas of the dielectric surface with the electron beam while the backplate is held at the reading potential and by thereafter observing the behavior of high energy, secondary electrons emitted from the dielectric surface.

The flow of electron current may be detected in several ways including variations in current received at a collector electrode. However, a preferred readout method, called target reading, senses the net current flow to or from the target assembly itself. By reading the stored information directly at the target structure; that is, by reading the signal caused by the secondary electrons leaving the target instead of those arriving at the collector, problems inherent in collector reading, including collector efficiency and variations in fractional amounts of secondary electrons collected, are obviated.

It is also desirable to apply the writing signal directly to the target assembly, but in considering obtaining the reading signal from the target assembly directly, it is evident that the writing signal and reading signal, which may differ by six orders of magnitude, utilize a common path. Thus an amplifier connected to the target assembly for the purpose of amplifying reading signals must be protected against the considerably larger writing signals sharing the common target input and output circuitry.

A solution to this problem, and consequently the pro-

2

vision of a practical target reading system, is disclosed in M. E. Hines Patent 2,844,722, July 22, 1958. Briefly, this scheme utilizes a coiled coaxial line to provide the charging current to the target and to provide a return path therefor. The inner and outer conductors in the coiled portion of the coaxial line correspond to the primary and secondary windings of a transformer. With the writing current applied to the inner conductor and the outer conductor grounded, primary and secondary currents are equal, and since the mutual coupling between the windings is established near unity, there will be virtually no voltage developed across either winding. The readout current, however, flows in the same direction through both the outer and inner conductors of the coaxial line and thus will develop a signal across its inductance. The readout signal then may be taken directly from the barrier grid or from a winding inductively coupled to the coiled portion of the coaxial line.

Several problems arise in the use of such a target reading circuit, particularly in applications calling for extreme sensitivity and high speed operation. One principal source of difficulty is encountered due to leakage capacitance between the backplate and ground through the barrier grid. The barrier grid is an imperfect electrostatic shield, and as a result some of the primary backplate drive current received at the target through the inner conductor of the coaxial line leaks through the barrier grid and fails to return to ground on the outer conductor. This causes an unbalance of the drive signal between the inner and outer conductors of the coaxial line, and a measure of interference in the output circuit is the ultimate result.

Another source of interference which is primarily of significance with regard to the recovery time of the readout circuit preparatory to a subsequent cycle of operation is the presence of a transient condition in the coaxial line. Specifically, if a large current pulse is applied to a shorted coaxial line, a transient voltage signal other than that due to resistance will be developed across the length of the outer conductor, which transient is independent of the inductance of the outer conductor. Such a transient tends to reduce the effectiveness of a highly sensitive readout system.

It is an object of this invention to provide an improved information storage and retrieval system.

It is another object of this invention to improve the operation of beam storage tubes and particularly to improve the provision and detection of output signals read from the tube.

It is a further object of this invention to overcome interference in target reading circuitry of beam storage tubes.

These and other objects of this invention are attained in one specific embodiment thereof wherein the writing signal is applied directly to the backplate portion of the target assembly via a first plurality of inner conductors of a coaxial line and directly to the barrier grid via a capacitive coupling. The reading signal is taken directly from the target assembly as a whole through the outer conductor and a second plurality of inner conductors attached to the outer conductor of the coaxial line. The charging and return currents flowing in the inner and outer conductors, respectively, effectively cancel each other out in the coiled portion and induce no voltage across this inductance.

The unbalance which would otherwise exist between these two currents, due to the leakage capacitance from backplate to ground through the barrier grid, is compensated by the capacitance coupling a small amount of the backplate drive signal directly to the barrier grid. In effect this reinserts a component of current equal to the backplate to ground leakage current and balances the

system. A conventional coaxial line having a braided outer conductor would produce a similar unbalance due to leakage capacitance through the braid to ground. Such leakage is overcome, in accordance with this specific illustrative embodiment, by the employment of a solid outer conductor, preferably of silver tubing.

Despite the type of outer conductor employed, however, a transient phenomenon is noted which may seriously affect the recovery time of a target reading coil. It may be due to the diffusion properties of an imperfect transmission line and, as indicated, is evidenced by a transient voltage signal developing across the length of the outer conductor. It has an amplitude which depends upon current magnitude and the length of the line, while its duration is purely a function of the cross-sectional geometry of the coaxial line.

This transient condition is overcome, in accordance with our invention, by the employment of the first plurality of inner conductors to carry the backplate drive signal, and the second plurality of inner conductors, connected to the ends of the outer conductor, to carry some of the return current from barrier grid to ground thereby reducing the amplitude and duration of the transient.

If any of the transient succeeds in passing through the coaxial line, it will be coupled to the output circuit through a readout winding employed in this specific embodiment of the invention. The voltage developed across a length of tubing, comprising the outer shell of the coaxial line, due to the diffusion of current from the inside of the tubing to the outside is independent of the portion of the coaxial line in which it is developed; that is, its magnitude is not varied by its development in the coil which constitutes the primary of the transformer coupling energy to the secondary winding rather than in some other length not part of the coil. Thus in accordance with this invention, by adding a length of coaxial line between the coiled portion and ground which corresponds in length to the coiled portion, a voltage due to diffusion equivalent to that developed in the coiled portion is generated, but because this portion is not wound on the magnetic core, essentially none of the desired readout signal is lost therein. Advantageously, however, the diffusion voltage developed in the extra length of coaxial line is available for compensation purposes, and when coupled to the secondary winding in the proper polarity, it greatly reduces the effect of the transient voltage on the circuit recovery time.

A further refinement in accordance with our invention employs an additional conductor connecting the common side of the readout winding to a point on the extended portion of the coaxial line where the transient has equal amplitude but opposite polarity. This effectively cancels any remaining transient and permits rapid recovery from the writing signal.

It is a feature of this invention that the leakage capacitance between the backplate of a beam storage tube and ground be compensated by coupling a portion of the input signal directly to the grid in the target assembly. More specifically, it is a feature of this invention that a compensating capacitor be connected between the grid and the input signal source.

It is another feature of this invention that a coaxial line having a coiled portion across which the reading signal is detected, be connected to the target assembly of a beam storage tube, the coaxial line having an outer conductor and a plurality of inner conductors.

It is a further feature of this invention that the outer conductor of the coaxial line be connected to the grid of the target assembly, that a first plurality of the inner conductors be connected to the backplate and that the remainder of the inner conductors be connected to opposite ends of the outer conductor.

It is a still further feature of this invention that a readout winding coupled to the coiled portion of the coaxial line be connected to a point on the outer conductor of

the coaxial line in a noninductive portion intermediate the coiled portion and ground.

It is a feature of one specific embodiment of this invention that the coaxial line comprises a hollow metallic tube having a plurality of wires positioned therein, some of which transmit the input signal from the source to the backplate and others of which carry a portion of the input signal returning from the grid of the target assembly.

A complete understanding of this invention and of these and various other features thereof may be gained from consideration of the following detailed description and the accompanying drawing, in which:

FIG. 1 is a diagrammatic representation of one specific illustrative embodiment of this invention; and

FIG. 2 is a simplified circuit schematic for the reading and writing circuits of the embodiment of FIG. 1.

Referring now to the drawing, FIG. 1 depicts an illustrative embodiment of this invention utilizing a barrier grid storage tube 10. As known in the art, the tube 10 may advantageously comprise within an evacuated envelope, such as glass, an electron gun including a cathode 11, heater 12, and accelerating and focusing electrodes 13, 14, and 15, defining an electron lens, deflection plates 16 and 17, a collector electrode 18, a shield 19, and a target assembly 20. The target assembly 20 includes a backplate 22, a dielectric sheet 23, and a barrier grid 24, positioned directly in front of the dielectric sheet 23. In accordance with an aspect of this invention, the backplate 22 and dielectric sheet 23 are enclosed within a shielding member 26 to which the barrier grid is attached.

In storage tubes of this kind, information is stored by an electrostatic charge on a discrete zone or area of the surface of the dielectric sheet 23. To place such a negative charge on the surface, the electron beam is turned on while the backplate is temporarily raised to a positive potential. This temporarily raises the potential of the front face of the dielectric sheet through capacitive action. The electron beam then charges this surface with negative electrons sufficiently to drop its potential to that of the barrier grid which is the equilibrium potential. During the charging operation, the secondary emission electrons from the dielectric sheet return to it and cannot escape. Thus when the beam is removed and the backplate potential returned to normal, the charge remains on the particular discrete area, thus maintaining it at a negative potential.

In this embodiment of the invention the circuit which applies the positive writing potential to the backplate during the storage operation just described comprises a coaxial line 28 having its outer conductor 29 connected to the shield member 26 and thus to the barrier grid 24, a first plurality of inner conductors 30 connected to the backplate 22 and a second plurality of inner conductors 31 connected to opposite ends of the outer conductor 29. The coaxial line 28 has a portion 32 wound as an inductor with the inner conductors 30 having the same inductance at this portion as the return current conductors comprising outer conductor 29 and the inner conductors 31. The mutual inductance between the charging and return conductors equals the self inductance of either group.

A source 33 of input writing signals is connected between the outer conductor 29 and the plurality of inner conductors 30 of the coaxial line 28. When a writing signal is applied by the source 33, current flows along the inner conductors 30 to the backplate and returns via the outer conductor 29 and the inner conductors 31.

The coiled portion of the coaxial line acts as a non-inductive winding, and ideally, in the absence of beam current, no voltage should appear between the barrier grid 24 and ground. In practice, backplate drive interference is encountered which tends to produce unbalance in the charging and return conductors of the coaxial line and thus a finite output signal during the writing operation.

One principal source of such unbalance is leakage capacitance between the backplate 22 and ground through the barrier grid 24 upon application of an input signal to the backplate 22. The barrier grid 24 being an imperfect electrostatic shield, permits some of the primary backplate drive current received over the inner conductors 30 of the coaxial line 28 to leak through the barrier grid 24 and fail to return to ground via the outer conductor 29 and inner conductors 31. For this reason in accordance with this invention, a small amount of the input signal is coupled directly to the barrier grid 24, serving to compensate for the leakage therethrough. This coupling is illustrated in FIG. 2 as compensating capacitance C_4 . The order of magnitude of the compensating capacitance C_4 is very small so that such compensation may be accomplished in accordance with this specific illustrative embodiment of the invention by exposing a slug 27 of FIG. 1 in contact with the barrier grid 24 through the surrounding shield 26 and air-coupling the backplate drive signal to the cap of the tube 10. The effect of adding this variable compensating capacitance is similarly illustrated in FIG. 1 by the dotted lines from the source of input writing signals 33 to the slug 27 abutting the barrier grid 24 through the shield 26. The compensating capacitance C_4 thus provides a path for a small portion of the input signal to be coupled directly to the barrier grid as mentioned above.

In one application of this specific illustrative embodiment of the invention, an output signal due to backplate interference was found to be approximately the same amplitude as the readout signal in the presence of the compensating capacitance C_4 and the recovery time was approximately .5 microsecond excluding the fall time of the backplate drive signal. Absent the compensating capacitance C_4 , the interference was twenty to thirty times the amplitude of the readout signal and the recovery time was of the order of 2 to 3 microseconds.

Interference in the target reading circuitry is also due to a transient phenomenon in the coaxial line 28; specifically, a large current pulse applied to a shorted coaxial line produces a transient voltage signal across the length of the outer conductor 29. Again in the application according to the specific illustrative embodiment of this invention, a one-half ampere pulse applied through an 18 inch length of coaxial line resulted in a transient signal of approximately 40 microvolt amplitude and 2 microsecond duration. In ordinary transmission line applications such a transient condition may prove negligible in its over-all effect, but the rapid recovery required in barrier grid tube operation between writing and reading cycles renders such a transient condition a critical factor. The particular readout system coupled to the coiled portion 32 of the coaxial line 28 is sufficiently sensitive to distinguish with high reliability signal separations of 30 microvolts. The 40 microvolt variation due to the transient signal thus would decrease this sensitivity more than 100 percent. We have found, in accordance with this invention, that causing some of the return current from the barrier grid to ground to be carried by a plurality of inner conductors 31 effectively reduces both the amplitude and duration of the transient.

The output signal advantageously is received in the amplifier 35 coupled by a winding 34 to the coiled portion 32 of the coaxial line 28, whereby transformer coupling is attained with an increase in signal strength over direct coupling to the barrier grid, as utilized in some instances. The output winding 34 in turn is connected to noninductive portion 36 of the coaxial line. This portion 36 of the coaxial line is made noninductive so that the readout signal will not be developed thereacross, but any of the low frequency transient voltage which is otherwise coupled to the output circuit will be compensated by the transient voltage developed therein. This is accomplished by connecting the common side of the wind-

ing 34 via conductor 39 to a point on the noninductive portion 36 where the transient voltage has equal amplitude but opposite polarity. Such a connection serves to cancel the remainder of the transient voltage otherwise coupled to the output circuit and permits rapid recovery from the backplate drive signal. In the specific illustrative embodiment, the length of the noninductive portion 36 of the coaxial line is approximately equal to the length of coaxial line in the coil 32.

A schematic diagram of the reading and writing circuits of the embodiment of FIG. 1 is shown in FIG. 2. In this schematic diagram the return conductors comprising outer conductor 29 plus the inner conductors 31 in the coiled portion have a combined inductance L . Similarly, the charging conductors comprising inner conductors 30 have an inductance L in the coiled portion which also displays a mutual inductance M equal to L . The inner conductors 30 connect one inductance to the backplate, which is represented by the point 37, and outer conductor 29 plus inner conductors 31 connect the other inductance to the barrier grid, which is represented by the point 38.

Capacitance C_1 , which is the barrier grid to backplate capacitance, is connected between points 37 and 38. C_2 is the barrier grid to ground capacitance which is relatively large, and C_3 is the backplate to ground leakage capacitance which is compensated by the capacitance C_4 coupling the backplate drive signal directly to the barrier grid 38. Advantageously, capacitance C_4 is made variable to permit adjustments necessary to accommodate different barrier grid tubes. Connected between the two inductors is the writing signal source 33.

The output amplifier 35 is connected to the readout coil 34, which in turn is closely coupled to the coiled portion 32 of the coaxial line 28. The output circuit is represented in FIG. 2 by an equivalent parallel RLC circuit, where the inductance is that of the outer conductor of the coaxial line 28, the resistance R is an equivalent damping element, and the capacitance is composed of the barrier grid to ground capacity, the distributed capacity of the output coil 34, and the loading capacity of the output amplifier.

During the charging of the capacitor C_1 , current flows from the source 33 through the input inductor L to the capacitor C_1 , and then all of the current except for that leaking to ground through capacitance C_3 returns to the source 33 through the output inductor L . A small portion of the input current from the source 33 is coupled directly to the barrier grid 24 via capacitor C_4 to compensate for the current loss through the leakage capacitance C_3 .

When the beam returns to the charged spot on the dielectric sheet to read out the information stored at that spot, the charge on the dielectric sheet is removed and current flows to ground through both the charging and return conductors of the coaxial line. It can be considered, therefore, that there is a current generator 40 connected to a point 43 representing the dielectric sheet surface which is connected by a first capacitance 41, representing the dielectric sheet surface to backplate capacitance, to the backplate and by a second capacitance 42, representing the dielectric sheet surface to barrier grid capacitance, to the barrier grid. The reading signal source is thus an assumed source of current that is actually the difference between the primary and secondary electron currents at the dielectric sheet surface. As this source and its current path are not actually present, but only assumed, the source has been indicated as connected in the circuit by dotted lines. The current from this source is minute in comparison to the backplate drive current, such that the reading operation in order to be successful cannot commence until the backplate writing signal has disappeared completely.

The transient voltage condition encountered in the outer

conductor 29 of the coaxial line 28 militates against the early conduct of the subsequent reading cycle. Utilizing plural inner conductors in the coaxial line 28 effectively reduces the amplitude and duration of these transient voltages such that rapid recovery from the writing cycle is achieved, and the early conduct of the subsequent reading cycle is permitted. This rapid recovery is further enhanced by the inclusion in the readout circuit of the noninductive portion of the coaxial line to shunt any remaining transient voltage to ground.

In the specific application according to the illustrative embodiment of this invention the coaxial line has an outer conductor of silver tubing and five inner conductors, two of which are connected to the backplate to provide the charging current, and the remaining three of which are connected to the ends of the outer conductor so as to conduct a portion of the return current. The coiled portion comprises an 8 turn coaxial winding and a 20 turn readout winding.

It is to be understood that the above-described arrangements are illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An electrostatic memory device comprising a backplate, a dielectric target mounted on said backplate, a grid positioned in front of said dielectric target, electron gun means for projecting a beam of electrons through said grid and against said dielectric target, and means including said electron gun means for applying signals to said backplate to store information on said dielectric target and for receiving output information from said dielectric target, said last-mentioned means comprising a coaxial line having its outer conductor connected to said grid and inner conducting means connected to said backplate, a source of input signals connected between said outer conductor and said inner conducting means, distinct capacitance means between said grid and said source of input signals for coupling a portion of the input signal directly to said grid to overcome the effects of parasitic capacitance present between said signal applying means and ground, and means coupled to said coaxial line for receiving output signal voltages developed thereacross.

2. An electron discharge device having a target assembly comprising a backplate, dielectric target means in contact with said backplate and a grid positioned in front of said dielectric means, electron gun means for projecting a stream of electrons against said dielectric means, means for storing information in said target assembly and for receiving information from said target assembly including a source of input signals, a coaxial line connected between said target assembly and said source of input signals and an output circuit coupled to said coaxial line, and means for overcoming interference due to leakage capacitance between said target assembly and ground comprising capacitance means coupled directly between said input signal source and said target assembly.

3. An electron discharge device in accordance with claim 2 wherein said coaxial line comprises an outer conductor connected to said grid, a first plurality of inner conductors connected to said backplate and a second plurality of inner conductors connected to opposite ends of said outer conductor, said input signal source being connected between said outer conductor and said first plurality of inner conductors.

4. A circuit for retrieving information from the target assembly of an information storage system in which the target assembly comprises a backplate, a storage element contiguous to the backplate and a grid in the path of electrons from an electron source to the storage element, said circuit comprising a coaxial line having its outer conductor connected to said grid, a first plurality of inner conductors connected to said backplate and a second plurality of inner conductors connected to opposite ends of

said outer conductor, a source of input signals connected between said outer conductor and said first plurality of inner conductors, and means coupled to said coaxial line for receiving output signal voltages developed thereacross.

5. A circuit for retrieving information from the target assembly of an information storage device in which the target assembly comprises a backplate, a storage element abutting the backplate and a grid, said circuit comprising first conducting means connected to said grid, second conducting means connected to said backplate and a signal source connected between said first and second conducting means, said first conducting means including a plurality of distinct conductors for reducing interference due to transient voltages developed in said conducting means, and output means inductively coupled to said conducting means for receiving output signals developed therein.

6. A circuit in accordance with claim 5 wherein said second conducting means comprises a plurality of individual conductors.

7. A circuit in accordance with claim 6 wherein said first conducting means comprises the outer conductor and a first plurality of inner conductors of a coaxial line, said second conducting means comprises a second plurality of inner conductors of the coaxial line, and said output means comprises a coil coupled to a coiled portion of the coaxial line.

8. A circuit in accordance with claim 7 and further comprising capacitance means coupled directly between said input signal source and said grid.

9. In an information storage and retrieval system, a target assembly, means for directing an electron beam toward said target assembly, means for applying an input signal to said target assembly during operation of said electron beam directing means comprising a coaxial line connected between an input signal source and said target assembly, and means for receiving output signal voltages developed thereacross, said last-mentioned means comprising an output coil inductively coupled to a coiled portion of said coaxial line and means connecting said output coil to a point on the outer conductor of said coaxial line.

10. In an information storage and retrieval system, the combination in accordance with claim 9 wherein said coaxial line is noninductive between the coiled portion and ground, said connecting means being connected to said coaxial line at a point in said noninductive portion such that transient voltage developed in said coaxial line is cancelled.

11. In an information storage and retrieval system, the combination in accordance with claim 9 wherein said coaxial line comprises an outer conductor, a plurality of inner conductors connected between said input signal source and said target assembly and another plurality of inner conductors connected only to said outer conductor.

12. In an information storage and retrieval system, the combination according to claim 9 and further comprising capacitance means between said target assembly and said input signal source to balance the leakage capacitance between said target assembly and ground.

13. An electron discharge device comprising a target assembly, means for storing information as an electrical charge on said target assembly and retrieving information therefrom including a source of electrical energy, a circuit from said source to said target assembly comprising a coaxial line having its outer conductor connected to one side of said target assembly, a plurality of inner conductors connected to the opposite side of said target assembly, said source of electrical energy being connected between the outer conductor and the first plurality of inner conductors, a second plurality of inner conductors connected to opposite ends of the outer conductor, capacitance means coupled between said electrical energy source and said target assembly, and an output circuit comprising a winding coupled to a coiled portion of said coaxial line and

a distinct connection between said winding and a point on a noninductive portion of said coaxial line.

14. In a signal storage and readout system comprising a signal receiving element, an input signal source and a coaxial line for coupling signals from said source to said signal receiving element and an output winding coupling signals from said coaxial line, capacitance means coupled between said source and said signal receiving element to balance leakage capacitance from the signal receiving element to ground, and means for overcoming transient voltages developed across the outer conductor of said coaxial line upon application of input signals from said source comprising plural inner conductors a number of which are connected at both ends to the outer conductor of said coaxial line and an additional conductor connected between a noninductive portion of said coaxial line and said output winding.

15. An electron discharge device having a target assembly comprising a backplate, dielectric target means in contact with said backplate and a grid positioned in front of said dielectric means, electron gun means for projecting a stream of electrons against said dielectric means, means for storing information in said target assembly and for receiving information from said target assembly including a source of input signals, a coaxial line connected between said target assembly and said source of input signals, an output circuit comprising a winding coupled to a coiled portion of said coaxial line and means connected between said winding and the outer conductor of said coaxial line between the coiled portion and ground, and means for overcoming interference due to

leakage capacitance between said target assembly and ground comprising capacitance means coupled between said input signal source and said target assembly.

16. A circuit for retrieving information from the target assembly of an information storage device in which the target assembly comprises a backplate, a storage element abutting the backplate and a grid, said circuit comprising first conducting means connected to said grid, second conducting means connected to said backplate and a signal source connected between said first and second conducting means, said first conducting means including a plurality of distinct conductors for reducing interference due to transient voltages developed in said conducting means, said second conducting means including a plurality of individual conductors, and output means inductively coupled to said conducting means for receiving output signals developed therein, wherein said first conducting means comprises the outer conductor and a first plurality of inner conductors of a coaxial line, said plurality of individual conductors in said second conducting means comprises a second plurality of inner conductors of the coaxial line, and said output means comprises a coil coupled to a coiled portion of the coaxial line, capacitance means coupled directly between said input signal source and said grid, and means connecting said coil to a point on the outer conductor of said coaxial line.

References Cited in the file of this patent

UNITED STATES PATENTS

2,844,722	Hines	July 22, 1958
3,054,926	Graham	Sept. 18, 1962