United States Patent

[11] **3,564,154**

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Division of Ser. No. 832,848, Aug. 10, 1959, Patent No. 3,133,150 and division of Ser. No. 281,939, Apr. 11, 1952, Patent No. 2,900,443
[45] Patented **Feb. 16, 1971**
[73] Assignee **Iit Research Institute**
Chicago, Ill.

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[54] **CATHODE RAY TUBE MAGNETIC REPRODUCER FOR VIDEO**
23 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** **179/100.2,** 178/6.6, 313/73, 313/89
[51] **Int. Cl.** **G11b 5/32;** H04n 1/24; H01j 31/04
[50] **Field of Search** ..... 178/6.6 (A); 179/100.2 (CRT); 346/74 (CRT)

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Primary Examiner—J. Russell Goudeau
Attorney—Hill, Sherman, Meroni, Gross & Simpson

ABSTRACT: An electron beam head for reproducing magnetically recorded video signals wherein magnetic fields from the record medium are channeled to the interior of the envelope to deflect the primary electrons transversely to the scanning direction of the beam. In one embodiment, the sensing electrodes are at opposite sides of the magnetic field region at an end wall of the envelope, while in another embodiment the primary electron beam passes through the openings in a grid of magnetic wires so as to interact with the magnetic fields therebetween, electrostatic deflecting means serving to deflect the electron beam through a substantial angle as it leaves the grid so as to impinge on sensing electrodes remote from the grid. In a third embodiment, secondary electrons are conducted into a branch tube extending from the main envelope and a single electrode senses the degree of deflection of the secondary electrons by the magnetic fields permeating the secondary emission region.

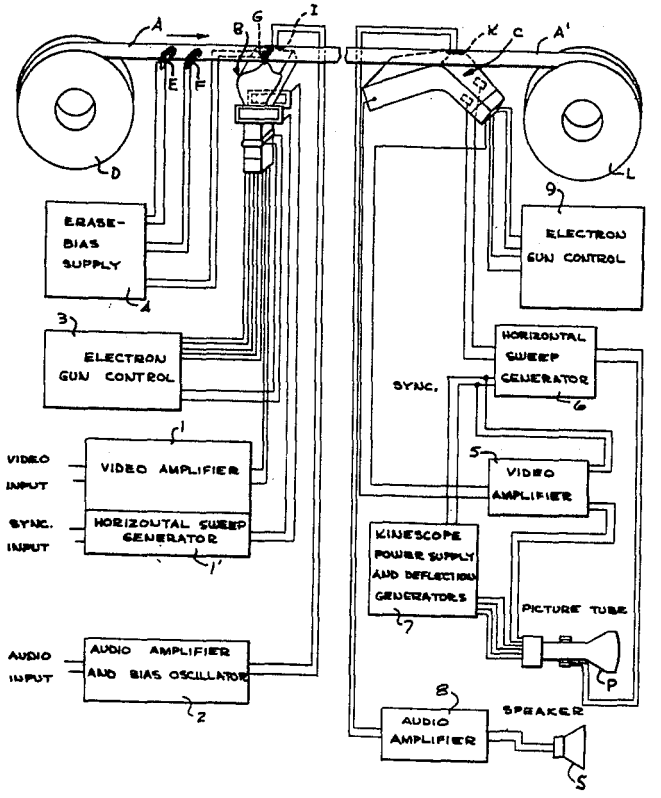

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Fig. 1

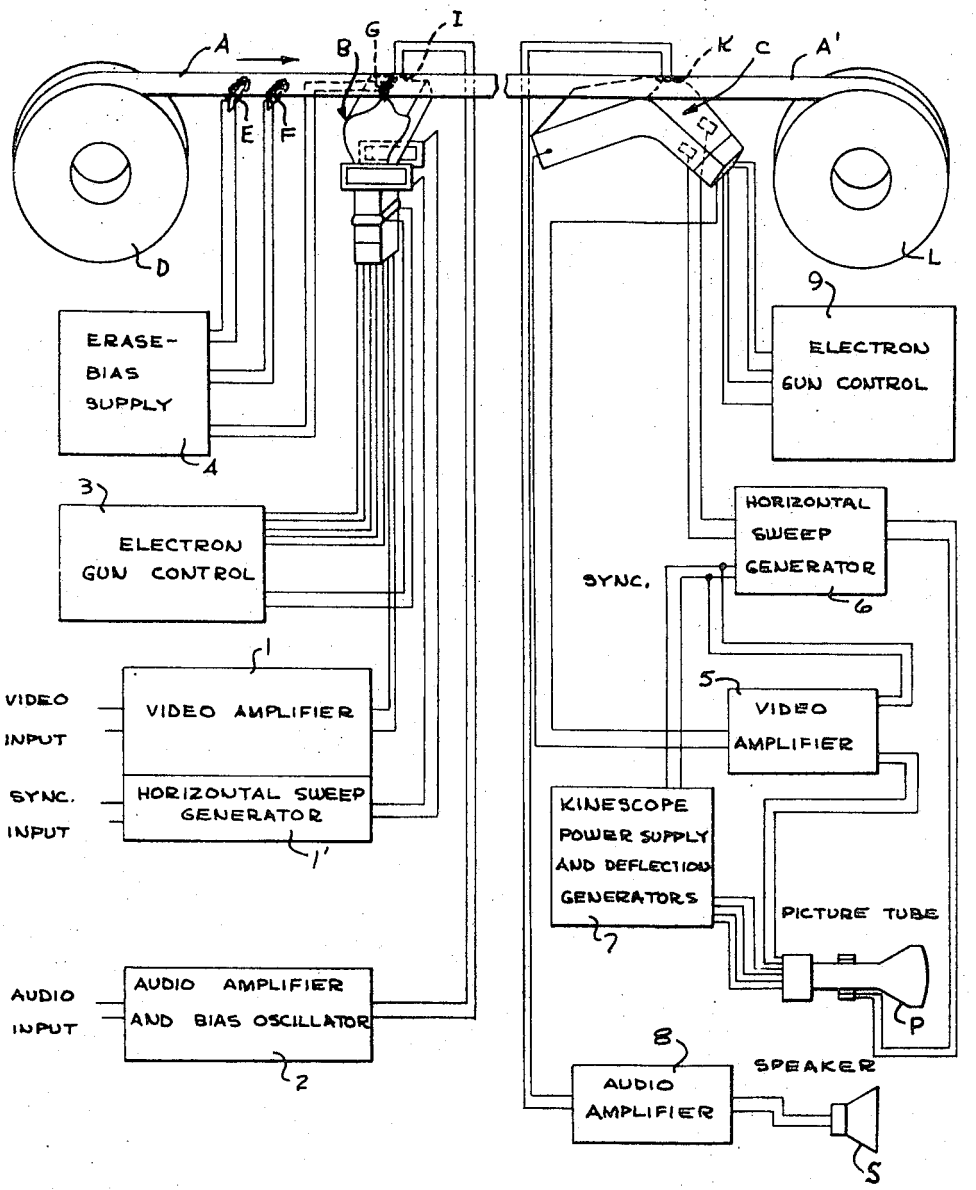

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Fig. 2

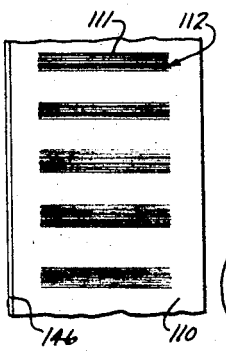

Fig. 3

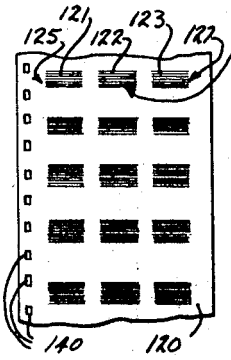

Fig. 4

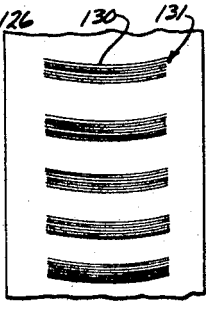

Fig. 5

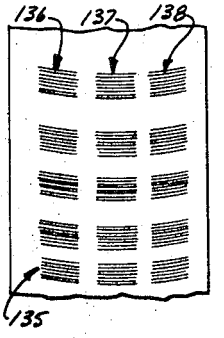

Fig. 12

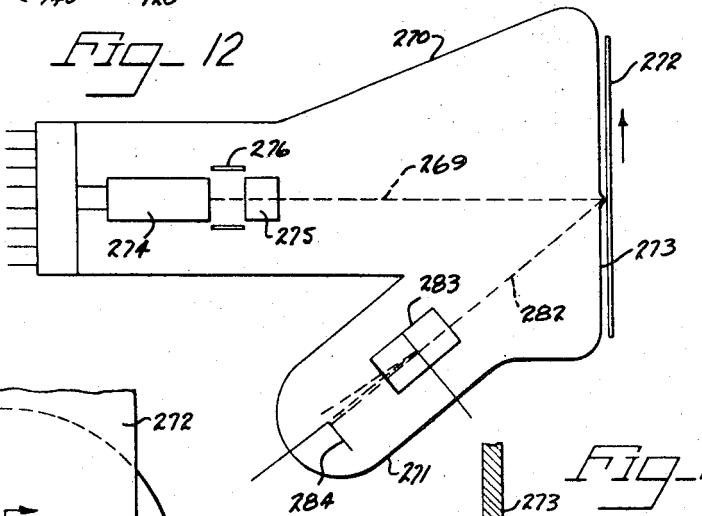

Fig. 13

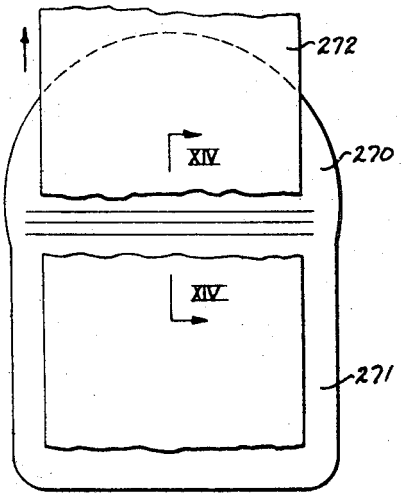

Fig. 14

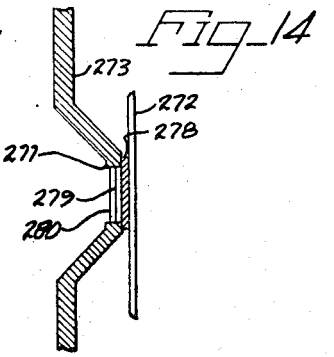

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Fig. 6

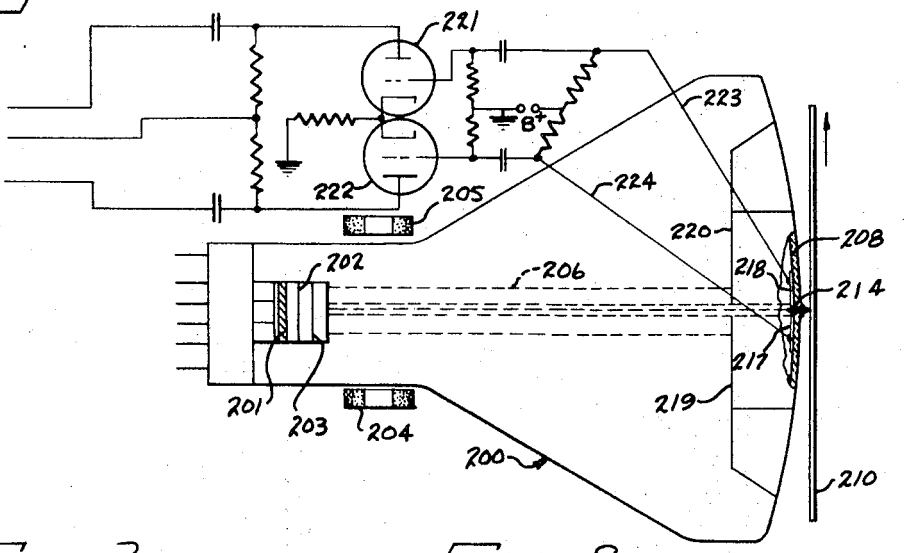

Fig. 7

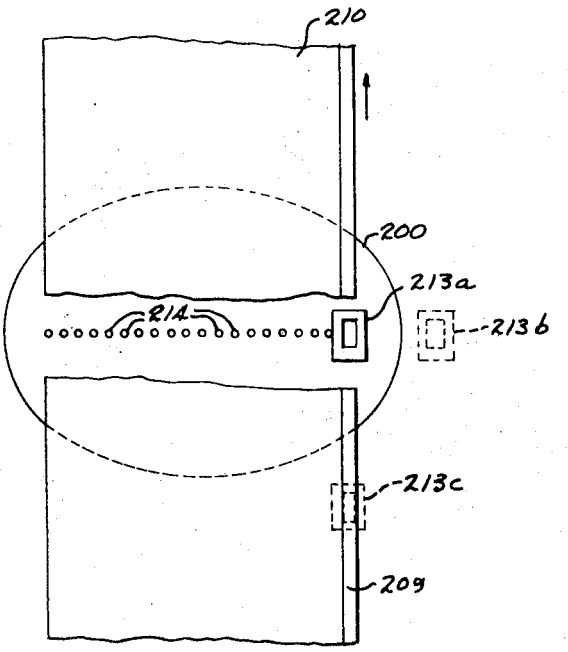

Fig. 8

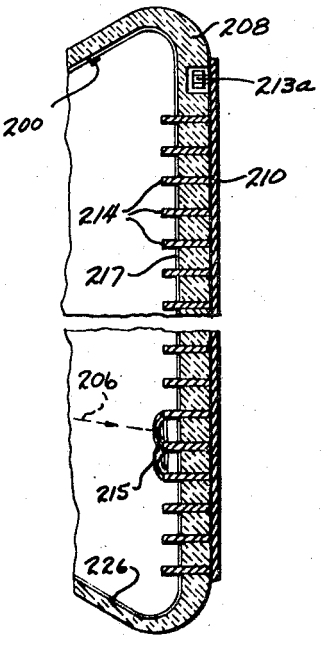

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Fig. 9

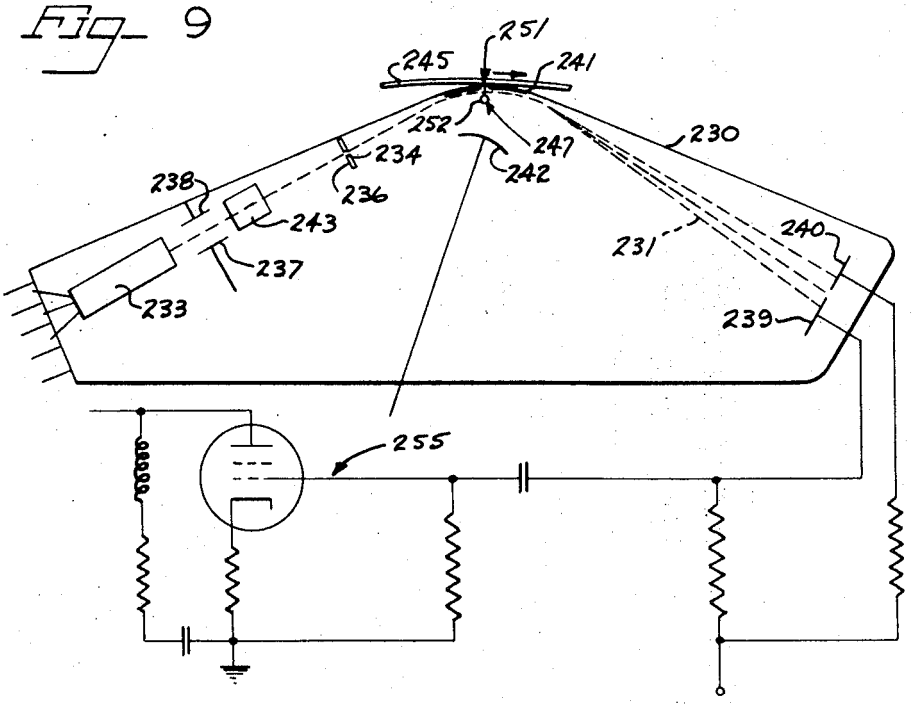


Fig. 11

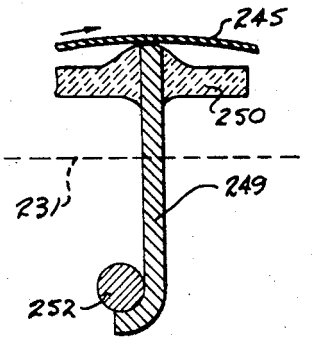
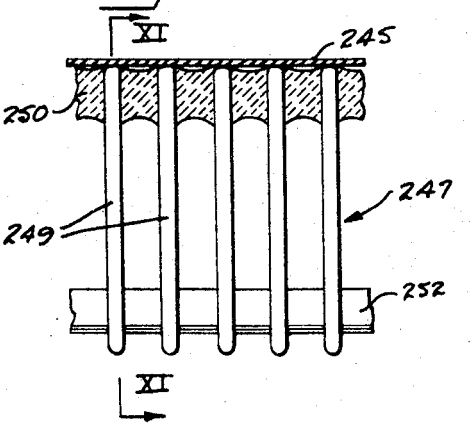


Fig. 10



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CATHODE RAY TUBE MAGNETIC REPRODUCER FOR VIDEO

The present application is a division of my earlier application Ser. No. 832,848 filed Aug. 10, 1959, now U.S. Pat. No. 3,133,150 issued May 12, 1965, which in turn is a division of my application Ser. No. 281,939 filed Apr. 11, 1952, now U.S. Pat. No. 2,900,443 issued Aug. 18, 1959.

This invention relates to the reproduction of magnetically recorded signals and particularly to the reproduction of video signals generated by moving visual images.

One of the principal features and objects of the present invention is the provision of a method and means for reproducing a recorded video signal such as a television signal.

Another object of the present invention is to provide a novel method and means for translating a magnetic signal into an electrical signal.

A further object of the present invention is to provide a novel magnetic reproducer head and a novel magnetized record for reproduction by said head.

Other objects and features which we believe to be characteristic of our invention are set forth with particularly in the appended claims. Our invention itself, however, both as to its organization, manner of construction, and method of operation, together with further advantages and objects thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic showing of a video recording system and a video reproducing system as they might be employed in recording and monitoring a video signal, and embodying the novel teachings and principals of the present invention;

FIG. 2 is a fragmentary diagrammatic plan view of a portion of a lengthy magnetizable medium magnetized in accordance with the novel teachings and principles of the present invention;

FIG. 3 is a fragmentary diagrammatic showing of a lengthy magnetizable medium magnetized in a second manner;

FIG. 4 is a fragmentary diagrammatic plan view of a lengthy magnetizable medium magnetized in a third manner;

FIG. 5 is a fragmentary diagrammatic plan view of a lengthy magnetizable medium magnetized in a fourth manner;

FIG. 6 is a diagrammatic side view of an electromagnetic reproducer head embodying the novel teachings and principles of the present invention, and indicating an electric circuit for detecting the video signal produced by the head;

FIG. 7 is an end elevational view of the reproducer head of FIG. 6 looking from the right in FIG. 6 and with a portion of the lengthy magnetizable medium broken away;

FIG. 8 is a fragmentary horizontal sectional view of a reproducer head of FIG. 6;

FIG. 9 is a diagrammatic elevational view of a further form of electromagnetic reproducer head embodying the novel teachings and principles of the present invention;

FIG. 10 is a fragmentary front elevational view of the magnetic grid wire assembly of the head of FIG. 9;

FIG. 11 is a fragmentary cross-sectional view taken substantially along the line IX–IX of FIG. 10;

FIG. 12 is a diagrammatic side elevational view of a still further form of electromagnetic reproducer head embodying the novel teachings and principles of the present invention;

FIG. 13 is an end elevational view of the reproducer head of FIG. 12 looking from the right in FIG. 12 and with a portion of the lengthy magnetizable medium broken away; and

FIG. 14 is a fragmentary enlarged vertical sectional view taken substantially along the lines XIV–XIV in FIG. 13.

In FIG. 1 is illustrated the complete overall system of the present invention as it might be employed for example in recording a television program and contemporaneously reproducing the recording for purposes for monitoring. In such a case, the tape portions A,A′ passing respectively over a recording head B and reproducer head C could be part of the same tape. In any event, the tape portion A represents an elongated magnetizable medium which may be delivered at a substantially uniform rate from a supply reel D and may first travel over an erase head E, then possibly a polarizing head F, and thereafter may travel over bias head G and the video electromagnetic recording head B and preferably an audio electromagnetic recording head I. The tape portion A′ has a video signal and preferably an audio signal recorded thereon and is passed over the video electromagnetic reproducer or playback head C and an audio electromagnetic reproducer head K and is then wound on a takeup reel L at a substantially uniform rate. The video reproducer head C is shown in detail in FIGS. 9, 10 and 11, and will be specifically described hereinafter. The polarizing head F might be used in conjunction with a DC erase head E to depolarize the tape prior to recording thereon. The bias head G would likewise be used to aid in depolarizing the tape. If a high frequency erase head were used, the bias head would produce a high frequency bias field and the polarizing head F would not be used. The bias field could be produced by the recording head B as will hereinafter be described.

As indicated in FIG. 1, the video signal to be recorded may be supplied to the video amplifier 1, for example from a television receiver, or from television program lines, and the horizontal sweep generator 1′ may receive a synchronizing signal from the same source. The audio input may be supplied from the discriminator stage of a receiver or from audio lines to the audio amplifier 2 for the audio recording head I. A bias oscillator 2 may supply the bias field to the head I instead of using a separate bias head. The electron gun control 3 is represented as supplying the recording tube filament, plate, and beam supply voltages as well as control voltages for focus, positioning, intensity and the like, while erase bias supply 4 furnishes erasing, polarizing and bias voltages.

In the playback system, the video signal detected by reproducer head C is delivered to the video amplifier 5 and the amplified signal controls a conventional television picture tube P, for example. The video amplifier may be provided with a conventional DC restorer circuit if desired. The output from the video amplifier 5 may be used to synchronize the horizontal sweep generator 6 for the reproducer head C and the deflection generators of the kinescope supply 7 for the picture tube P, or in some cases, as for example if the video signal is being transmitted, a master sync. generator can be used to synchronize the sweep generator 6 and deflection generators of the picture tube. The audio signal on the tape A′ is detected by the audio reproducer head K and transmitted through audio amplifier 8 to the speaker S. The electron gun supply 9 is indicated as furnishing filament, plate and beam supply voltages for the playback tube C as well as control voltages for focus, positioning and the like.

The manner in which magnetization is impressed on a tape 110 by the head B of FIG. 1 is indicated diagrammatically in FIG. 2. Each horizontal sweep of a scanning beam in the head B produces a transverse line 111 of magnetization on the tape. This line 111 corresponds to a line of the video signal. If the video signal comprises a moving visual image which is transmitted by scanning the image a number of times a second, a magnetic reproduction of that image will appear on the tape 110, though the image might be elongated laterally or longitudinally, and each complete scanning or frame of the moving image will have a magnetic counterpart in a frame 112 on the lengthy magnetizable medium 110. In fact, if magnetic particles were dusted on the film an actual image corresponding to the image of the video signal would appear at each frame. The advantage of recording the video signal line for line and frame for frame in this manner is that in reproduction, the tape need not be scanned exactly line for line, but may be scanned between lines, or even longitudinally instead of transversely, that is the magnetic image need not be scanned in reproduction in the identical way in which it was recorded.

In order to facilitate scanning of the recorded magnetic image, it is desirable to have adjacent lines of the magnetic image overlap. Such overlapping can be accomplished, for example, by utilizing a transducer lamination in the head B of

the thickness of 0.001 inch with the tape travelling at the rate of 15 inches per second.

With double interlaced scanning, two "frames" make each picture, but the above cited advantages still hold, though not as perfectly as with a series of complete pictures. Where it is practical to do so, it is preferred to record complete rather than interlaced pictures. A record having complete pictures can be converted to the interlaced type, by offset heads, for example.

FIG. 3 illustrates a lengthy magnetizable medium **120** wherein three lines of a video signal **121**, **122** and **123**, for example, are located generally in the same transverse row across the tape. For the same size tape, this reduces the speed of scanning by a factor of three. Such a magnetic recording would be produced with the recording head of Fig. **1**, if the beam were moved across the target at one-third the scanning speed of the video signal being recorded. Each frame on the tape would then comprise three transversely aligned frame portions **125**, **126** and **127**. In this case, while each frame portion could be scanned separately to reproduce an image, such an image would not be satisfactory, since only one-third of the lines originally scanned are included in the image. A record of this type has the advantage of reduced scanning rate, by a factor depending on the number of columns. A slower scanning rate is important when the system contains mechanical elements, or where inductive reactances, transmit time, etc. are problems.

In FIG. **4** is shown a record member similar to FIG. **2** in having a single line of video signal across the width of the tape, but in which each magnetic line **130** on the tape is curved, as would be produced by the head B of FIG. **1** if the transducer device were curved along its longitudinal axis. The frames **131** are spaced serially along the tape as in FIG. **2**. An arc shaped path gives a longer line for a given tape width. This type of pattern is also an advantage when used with certain mechanical scanners.

In FIG. **5** each frame **135** comprises frame portions **136**, **137** and **138** in an arcuate pattern across the tape.

Any one of the tapes illustrated in FIGS. **2** to **5** may be perforated at one edge as indicated at **140** in FIG. **3** for synchronizing the speed of the tape with the video signal, or a synchronizing control may be actuated by pickup from the magnetic frame pattern recorded on the tape; the control signals being amplified and used to correct for phase errors of the tape with respect to the pickup head. An audio sound track may run along an edge of the tapes as indicated in FIG. **2** at **146**.

In FIGS. **6**, **7** and **8** is illustrated in electromagnetic reproducer head according to the present invention. The head comprises a cathode ray tube **200** provided with an electrode assembly including an electron emitter **201** and accelerating and focusing electrodes such as **202** and **203** producing an electron beam **206** having considerable vertical extent as indicated in FIG. **6**. Such a beam will be termed a wide beam, wide referring to the vertical extent of the beam in the orientation of the tube illustrated. Horizontal deflection coils **204** and **205** are illustrated for sweeping the electron beam **206** back and forth across the tube end wall **208**. A magnetic tape **210** having a video signal recorded on the magnetizable coating thereof is moved across the exterior of the end wall. The tape may also have an audio signal indicated at **209** recorded at one edge thereof for reproduction by a conventional head. A similar sound track is indicated at **146** in FIG. **2**. As indicated in FIGS. **7** and **8**, the head is preferably disposed within the tube end wall **208** as indicated in solid outline at **213***a*, or it may be located to one side at **213***b*. It may also be located in advance of the head at **213***c*. With the audio head in line with the video head as shown in **213***a* or **213***b*, a record tape is made which can readily be edited because picture and sound correspond.

The magnetic signal recorded on the tape is utilized to deflect the wide electron beam **206**. To this end a large number of high permeability wires **214** are embedded in the end wall **208** of the tube. These wires are indicated diagrammatically only in FIGS. **6** and **8**. There may be, for example, 500 of them in a 2-inch tube wall, and they may be made of **4750** alloy, which has the same coefficient of expansion as glass and thus makes possible a good seal. As the tape passes the exterior ends of the wires, magnetic fields are set up through the wires which may extend as indicated at **215** in FIG. **8**. It will be observed that the fields extend generally in a horizontal plane between adjacent wires and generally at right angles to the beam. Thus the beam will be deflected either upwardly or downwardly depending on the polarity of the fields. Collector plates **217** and **218** are located above and below the wires to collect the deflected electrons. The baffle plates **219** and **220** accurately control the width of the electron beam reaching the region of the collector plates regardless of small variations that usually occur in cathode ray tubes, and the magnetic fields **215** alter the proportion of the electrons traveling to each of the collector plates **217** and **218**.

As indicated in FIG. **6**, the output from collector plates **217** and **218** may be delivered to the grids of a pair of tubes **221** and **222** of the push-pull amplifier by means of conductors **223** and **224**. The video output from the push-pull amplifier may be delivered to a video amplifier for further amplification. The elements at the face of the tube, and coatings on the sides of the tube indicated at **226** in FIG. **8**, are charged positive with respect to the electron gun, for focusing and acceleration. A low voltage beam is preferred because it allows greater sensitivity to deflection by the magnetic elements. Only one of the collector elements **219** or **220** may be used with a single ended video amplifier.

In FIGS. **9**, **10** and **11** is illustrated a second embodiment of the electromagnetic reproducer head of the present invention. This head comprises a tube **230** providing a curved path for an electron beam **231**. The beam is generated by an electron gun **233** and may be directed through an elongated slit **234** in a baffle plate **236** by means of vertical positioning plates **237** and **238** or by other suitable means. The beam is illustrated as being deflected downwardly to the target plates **239**, **240** by means of electrostatic deflecting plates **241**, **242**, however magnetic deflection means could be used advantageously. The horizontal sweep plates **243** cause the beam to cyclically travel across the length of the target plates **239**, **240** which act similarly to target plates **217** and **218** in FIG. **6**. The reproducer head of FIG. **9** differs from that of FIG. **6** in that the magnetic field of the record medium **245** is applied to the beam at a point remote from the target plates so that the effect of the field on the beam is amplified; that is, greater displacement of the beam at the target plates is obtained for a given applied magnetic field.

The magnetic field of the tape **245** is applied to the beam by means of a magnetic grid **247** extending across the path of the beam **231**. As shown in FIGS. **10** and **11**, this grid comprises a plurality of vertically extending members **249** of high permeability material which protrude through the tube wall **250** at the elbow **251** therein, FIG. **9**. The wires are sealed in the tube wall at the top and may project above the tube wall slightly as indicated in FIGS. **10** and **11** to receive the tape thereacross. The wires may be connected by a metallic nonmagnetic support bar **252** at their lower ends and electrical connection may be made to the support bar **252** to maintain it at a desired potential relative to the beam. As indicated in FIG. **11**, the beam passes between adjacent magnetic grid wires **249** and is deflected downwardly to a greater or lesser extent depending on the strength of the magnetic field between the pair of grid wires **249** through which the beam is momentarily passing. The beam may tend to spread somewhat as the target plates are approached, the proportion of the electrons reaching each plate depending on the signal on the tape **245**. It will be apparent that one target plate could be utilized which would receive varying amounts of electrons depending on the magnetic signal on the tape. A single ended output amplifier **255** may receive the signal from the target plates.

In FIGS. 12, 13 and 14, a further form of electromagnetic reproducer head according to the present invention is illustrated. The head comprises a cathode ray tube 270 having a branch tube 271 for collecting secondary emission electrons. The tape 272 having a magnetizable portion with a video signal recorded thereon is passed across the end of the tube in a manner similar to that in recording. An electron gun 274 supplies a stream of electrons 269 which is swept back and forth across the end wall of the tube by means of horizontal deflectors 275. Vertical adjustment of the beam is afforded by vertical deflectors 276 which may be used to initially adjust the beam vertically to impinge upon a slit or window 277, shown greatly enlarged in FIG. 14, in the end wall 273 of the tube. Baffle plates and a wide beam may be used to keep the beam accurately on the slit surface, or alternatively automatic control of the deflection voltages may be used. The slit is preferably closed by means of an elongated horizontally extending strip 278 of nonmagnetic conductive material, such as beryllium copper having base layer 279 of silver oxide and a coating 280 of caesium deposited thereon. Since beryllium alone is a good secondary emitter, the other materials are not necessary in all cases. The slit is preferably very narrow in order to give good resolution and the strip 278 very thin.

The reproduction is accomplished by moving the magnetized tape 272 across the exterior surface of the strip 278 so that the magnetic field of successive transverse portions of the magnetized tape extends into the interior of the tube to influence the secondary stream of electrons 282 emitted progressively across the coating 280 of the strip 278 as the scanning beam 269 sweeps across the strip. An accelerating and focusing electrode 283 directs the stream 282 to the video output collector 284, the electrode 283 preferably being shaped to give a linear gradient along the length of the collector 284 corresponding to the gradient established along the length of the strip 278 by the magnetized tape. Video collector 284 may also be made to operate like elements 217 and 218 in FIG. 6, but on the secondary instead of primary electron stream. Instead of the target 284, an electron multiplier may be provided to give an amplified video output. Thus the unmodulated scanning beam 269 regulates the timing of the horizontal scanning stream 282 and the magnetized tape 272 operates to modulate the stream in accordance with the video signal recorded on the tape. The target plate 284 may operate on a principle analogous to the plates 239 and 240 in FIG. 9 and a single ended amplifier such as there shown may be utilized to amplify the output from the plate 284.

The present application is a division of my earlier application Ser. No. 832,848 filed Aug. 10, 1959 which in turn was a division of Ser. No. 281,939 filed Apr. 11, 1952, now U.S. Pat. No. 2,900,443 issued Aug. 18, 1959.

It will be understood that modifications and variations may be effected without departing from the scope of the novel concepts of the present invention.

I claim:

1. An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a stream of said primary electrons from said source to said target, means for sweeping said stream of primary electrons across the length of said elongated target, and means for channeling the magnetic fields of a lengthy magnetized medium traveling in close proximity to said target for interaction between the magnetized medium and said stream of primary electrons, said target having means for collecting substantially exclusively said stream of primary electrons after interaction thereof with said magnetized medium to generate an electric output signal in accordance with said interaction.

2. An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a beam of primary electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of primary electrons, and means for electrically detecting the effect of said medium on said beam of primary electrons, said target including a plurality of high permeability wires spaced along the length of said target, and said detecting means being adjacent said wires and collecting substantially exclusively said beam of primary electrons after interaction thereof with the magnetic fields defined by said wires.

3. An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a beam of said primary electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of primary electrons, and means for electrically detecting the effect of said medium on said beam of primary electrons, said electrically detecting means including collector plates on either side of said target, and in the path of the beam of primary electrons for collecting substantially exclusively said primary electrons.

4. An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a beam of said primary electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of primary electrons, and means for electrically detecting the effect of said medium on said beam of primary electrons, said target including a plurality of high permeability wires spaced along the length of said target, and said electrically detecting means including collector plates on either side of said target for collecting substantially exclusively said primary electrons to electrically reproduce the magnetized medium.

5. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a beam of electrons from said source and cyclically sweeping across the length of said target, means for moving a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of electrons, and means for electrically detecting the effect of said medium on said beam, said electrically detecting means including collector plates on either side of said target, and said beam of electrons being of such width to impinge on said collector plates as well as said target.

6. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a beam of electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of electrons, and means for electrically detecting the effect of said medium on said beam, said electrically detecting means including collector plates on either side of said target, and said beam of electrons being of such width to impinge on said collector plates as well as said target, and baffle plates limiting the width of said beam reaching said collector plates.

7. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a beam of electrons from said source and cyclically sweeping across the length of said target, means for moving a lengthy magnetized medium in close proximity to said target for interaction between the magnetic fields of said medium and said beam of electrons, and means for electrically detecting the effect of said medium on said beam, said electrically detecting means including collector plates on either side of said target, and said beam of electrons being of such width to impinge on said collector plates as well as said target, said target including a plurality of high permeability wires spaced along the length of said target.

8. An electromagnetic reproducing head comprising a source of electrons, a target having secondary electron emission properties, means for establishing a beam of electrons

from said source to said target, means for establishing a stream of secondary electrons emitted from said target, and means for accommodating a lengthy magnetized medium in close proximity to said target for interaction between the magnetized medium and said streams of electrons, characterized in that the establishing means for establishing said stream of secondary electrons directs said stream of secondary electrons exclusively to one side of the beam of electrons from said source to said target, and an evacuated branch tube extending from the target generally rearwardly at an acute angle relative to the beam of electrons and having an electrode therein for collecting said secondary electrons to electrically reproduce the magnetized medium.

9. An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a beam of said primary electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in proximity to said beam of primary electrons for interaction between the magnetic fields of said medium and said beam of primary electrons, and means for electrically detecting substantially exclusively the effect of said medium on said beam of primary electrons to electrically reproduce the magnetized medium.

10 An electromagnetic reproducing head comprising a source of primary electrons, an elongated target, means for establishing a beam of said primary electrons from said source and cyclically sweeping across the length of said target, means for accommodating a lengthy magnetized medium in proximity to said beam of primary electrons for interaction between the magnetic field of said medium and said beam of primary electrons, means for electrically detecting the effect of said medium on said beam of primary electrons, and means for channeling said magnetic fields of said medium for interaction with said beam of primary electrons including a grid of high permeability members extending across the path of said beam of primary electrons, said electrically detecting means being on the opposite side of the grid from said source and collecting substantially exclusively said primary electrons and providing an output signal in accordance with the interaction of the magnetic fields of said medium with said beam of primary electrons.

11. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a wide beam of electrons, of greater width than thickness, from said source and cyclically sweeping across the length of said target, means for channeling the magnetic fields on a lengthy magnetized medium for interaction between the magnetic fields of said medium and said beam of electrons, and means for electrically detecting the effect of said magnetic fields on said beam, said establishing means comprising baffle plates extending parallel to the target at each side thereof with the beam impinging on both of said baffle plates, and the portion of the beam flowing between the baffle plates having said greater width thereof determined by the spacing of said baffle plates.

12. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a beam of electrons from said source and cyclically sweeping across the length of said target to define an incident beam path, means for channeling the magnetic fields on a lengthy magnetized medium for interaction between the magnetic fields of said medium and said beam of electrons at a region of interaction, and means for electrically detecting the effect of said magnetic fields on said beam, said establishing means comprising electron beam intercepting means adjacent said target and upstream thereof intercepting a portion of the beam to maintain the width of the beam reaching said target substantially constant regardless of small variations in the path of the beam as it flows from said source toward said target, and said detecting means being on the side of said intercepting means away from said source and receiving predominantly said beam of electronics as it travels along said incident beam path after traversing said region of interaction.

13. An electromagnetic reproducing head comprising a source of electrons, an elongated target, means for establishing a beam of electrons from said source and cyclically sweeping across the length of said target, means for channeling the magnetic field on a lengthy magnetized medium for interaction between the magnetic fields of said medium and said beam for electrons, and means for electrically detecting the effect of said magnetic fields on said beam, said channeling means comprising a grid of high permeability members with each member extending generally parallel to each other and lying in a common plane and across the path of said beam with the beam sweeping in a plane generally at right angles to said common plane of said members, said detecting means being on the side of said grid remote of said source and directly collecting said beam of electrons from said source and thereby producing an electrical output signal in accordance with the magnetization of said medium.

14. The method of reproducing an electrical signal recorded magnetically on a lengthy magnetizable medium, which comprises establishing a stream of primary electrons cyclically scanning an elongated region, and passing said lengthy magnetizable medium adjacent said elongated region to alter said scanning stream of primary electrons in accordance with the magnetic record thereon, and collecting said primary electrons substantially exclusively to generate an electrical output signal in accordance with the signal recorded on the magnetizable medium.

15. A transducer mechanism comprising an elongated transducer device having a plurality of magnetic circuits each with at least two nonmagnetic gaps, means for accommodating an elongated magnetizable medium across one of said gaps of each magnetic circuit, electronic stepping switch means utilizing primary electrons exclusively for sequentially linking with the other of said gaps of each magnetic circuit, and electric circuit means for conducting a video signal operatively connected with said electronic stepping switch means for sequential linking with the other of said gaps of said transducer device, said magnetizable medium having a video signal recorded thereon for linking said one gap of each magnetic circuit and for producing a corresponding magnetic field in said other of said gaps of each magnetic circuit, whereby said electric circuit means is energized with the video signal recorded on said magnetizable medium.

16. An electromagnetic reproducing head comprising means for establishing a stream of primary electrons, means for cyclically deflection said stream of primary electrons to establish an elongated scanning region, means for channeling the magnetic fields on a lengthy magnetized medium for interaction with said stream of primary electrons in said scanning region, and means for detecting the effect of said magnetic fields on said stream of primary electrons substantially exclusively by collecting substantially only said primary electrons to produce an electrical output signal in accordance with the magnetization of said medium.

17. An apparatus for converting magnetic configurations to electrical signals which comprises an envelope, means within said envelope for producing a primary electron beam, a target means sealed into a predetermined area of said envelope and positioned substantially transverse to said primary beam, said target means having a face, a magnetic condition space pattern record, said record being positioned so that its magnetic fields permeate said target means and establish a space pattern of magnetic fields on said face, means for subjecting consecutive areas of said space pattern of magnetic fields to said primary beam whereby the electrons of said primary beam alter their paths in dependence on the magnetic condition of said space pattern of fields, collecting means adapted for deriving signals substantially exclusively from said electrons of said primary beam representative of said space pattern of magnetic fields; and means for utilizing said signals.

18. *In combination, a system comprising:*

a. a magnetized elongated magnetic tape record medium having an active exterior surface and having a record

track of substantial length and width exhibiting a residual magnetization in a predetermined general direction in accordance with a recorded image, the residual magnetization of said record track in accordance with said recorded image producing external magnetic fields at said active exterior surface of said tape record medium varying in amplitude along the length of said record track and varying in amplitude along the width of said record track in accordance with said recorded image,

b. moving means for continuously moving said tape record medium at substantially a constant speed along a record medium path including a record medium path region of limited longitudinal extent where said active exterior surface of said tape record medium conforms substantially to a record medium path region plane over the entire transverse extent of said record track,

c. an evacuated envelope having an evacuated interior and having record medium coupling means for receiving said active exterior surface of said tape record medium in sliding contact therewith, said record medium coupling means transmitting the external magnetic fields of an incremental portion of the length of the record track to the interior of said evacuated envelope, said incremental portion of the length of the record track representing a line segment of said recorded image, and the magnetic fields from said line segment where they are of substantially maximum strength within the interior of the envelope lying predominantly in a magnetic field region and in a transverse plane disposed substantially at right angles to said record medium path region plane and disposed transversely to the direction of movement of said record medium along said record medium path,

d. means comprising a source of primary electrons within said envelope for supplying primary electrons and for directing said primary electrons toward and through said magnetic field region with the primary electrons traveling generally at right angles to the magnetic fields where they are of substantially maximum strength within the interior of the envelope as the primary electrons traverse said magnetic field region so that the respective primary electrons are deflected in accordance with the magnitude of said magnetic fields at the respective points of traverse of said magnetic field region by the respective primary electrons,

e. means comprising an electrically conductive surface at the interior of said envelope adjacent said magnetic field region which surface is maintained at an electric potential to repel said primary electrons for tending to reverse the component of electron velocity which lies substantially parallel to said transverse plane and substantially perpendicular to said record medium path region plane so that the primary electrons move along respective incident electron paths with said velocity component thereof which is substantially parallel to said transverse plane being directed toward said magnetic field region, and move along respective departing electron paths with said velocity component thereof which is substantially parallel to said transverse plane being directed away from said magnetic field region,

f. cyclically operating deflection means for causing the primary electrons produced at successive instants of time in each cycle thereof to scan respective points along said magnetic field region and thereby to produce a sequential scanning of the incremental portion of the length of said record track at said path region in said cycle, the duration of each cycle of said deflection means being sufficiently short in relation to said speed of said record medium so that successive line segments of the recorded image signal are scanned by said primary electrons during operation of said system,

g. collecting means in said envelope disposed for collecting said primary electrons after travel thereof through said magnetic field region and providing an electrical output which is a function of the deflection of said primary electrons by the magnetic fields of the record medium at said magnetic field region, and said collecting means in operation of said system providing a time varying electric signal comprising a series of signal lines corresponding to successive line segments of said recorded image on said magnetic tape record medium, and

h. said magnetic field region being relatively close to that portion of the exterior of said envelope which is occupied by the incremental length of the record track being scanned at a given instant of time, in comparison to one-half of each of the cross-sectional dimensions of said envelope, and said magnetic coupling means extending from said incremental length to said magnetic field region and being of corresponding relatively small dimension with respect to the direction substantially parallel to said transverse plane and substantially perpendicular to said record medium path region plane in comparison to one-half of each of the cross-sectional dimensions of said envelope.

19. An apparatus for converting magnetic configurations to electrical signals which comprises:

a. an envelope,

b. a target comprising a conductive element having a face thereof within said envelope,

c. means within said envelope for producing an electron beam,

d. Means for focusing, directing and accelerating said beam from said beam producing means to said target,

e. means for establishing a pattern of magnetic fields in proximity of said face,

f. means for subjecting said beam to consecutive areas of said pattern of magnetic fields so as to cause the electrons of said beam to alter their paths in dependence on the magnetic condition of said pattern of fields,

g. means for controlling the potential of said target, and

h. a circuit connected to said target for extracting electrical signals derived by said target from said beam in representation of said pattern of magnetic fields.

20. An apparatus for converting magnetic configurations to electrical signals which comprises:

a. an envelope,

b. means within said envelope for producing an electron beam,

c. a target,

d. means for focusing and directing said beam from said beam producing means to said target,

e. means for positioning said beam relative to said target,

f. said target comprising means sealed into a predetermined area of said envelope having exterior surface means exterior to said envelope and having interior surface means within said envelope,

g. means for disposing a magnetic space pattern record at the exterior surface means of said target in a manner to permeate said means sealed into said predetermined area of said envelope and establish a space pattern of magnetic fields on the interior surface means thereof,

h. means for subjecting consecutive areas of said space pattern to said beam to alter their paths in dependence on the magnetic condition of said space pattern, and

i. said target comprising means for deriving signals from said beam representative of said space pattern of magnetic fields.

21. An apparatus for converting magnetic configurations to electrical signals which comprises:

a. an envelope,

b. means within said envelope for producing an electron beam,

c. a target,

d. means for focusing and directing said beam from said beam producing means to said target,

e. means for positioning said beam relative to said target,

f. said target comprising means sealed into a predetermined area of said envelope and having exterior surface means

at the exterior of said envelope and having interior surface means at the interior of said envelope,

g. means for disposing a magnetic space pattern record at the exterior surface means of said target in a manner to permeate said means sealed into said predetermined area of said envelope and establish a space pattern of magnetic fields on the interior surface means thereof,

h. said focusing and directing means including means for accelerating said beam to the region of said space pattern of magnetic fields,

i. means for subjecting consecutive areas of said space pattern of magnetic fields to said beam so as to cause the electrons of said beam to alter their paths in dependence on the magnetic condition of said space pattern of fields,

j. means for providing a low voltage beam in the proximity of said interior surface means of said target, and

k. said target comprising means for deriving electrical signals from said beam representative of said space pattern of magnetic fields.

22. An apparatus for converting magnetic configurations to electrical signals comprising:

a. an envelope having a substantially zero electrical conductivity,

b. said envelope having an end wall,

c. a target means,

d. said target means comprising a conductive layer on the interior face of said end wall,

e. means for disposing a magnetic condition space pattern record at the exterior of said end wall in a manner to permeate and establish a space pattern of magnetic fields on said target means,

f. means within said envelope for producing an electron beam,

g. means for focusing and directing said beam from said

beam producing means to said target means,

h. means for subjecting consecutive areas of said space pattern of magnetic fields to said beam so as to cause the electrons of said beam to alter their paths in dependence on the magnetic condition of said space pattern of fields, and

i. said target means comprising means for deriving signals from said beam in representation of said space pattern of magnetic fields.

23. An apparatus for converting magnetic configurations to electrical signals which comprises:

a. an envelope,

b. a target means comprising a conductive element having a face thereof within said envelope,

c. means within said envelope for producing an electron beam,

d. means for focusing and directing said beam from said beam producing means to said target means,

e. means for establishing a pattern of magnetic fields in a region of said face,

f. means for subjecting said beam to said pattern of magnetic fields so as to cause the electrons of said beam to alter their paths in dependence on the magnetic condition of said pattern of fields,

g. said face being at a potential to reject said beam in a manner to prevent, substantially, said beam from landing on said face,

h. an electrode positioned away from said face and at a potential to attract said beam in a generally reverse direction, and

i. means for extracting electrical signals from said beam in representation of said pattern of magnetic fields.